DREXEL UNIVERSITY
College of
Computing & Informatics

CATALOG
2020-2021

UNDERGRADUATE

catalog.drexel.edu

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College of Computing & Informatics

From our position on the leading edge of information and technology, Drexel University's College of Computing & Informatics (CCI) instills the knowledge and skills necessary for our students to lead and innovate across industries in a rapidly evolving technological landscape.

Building on Drexel University's exceptional foundation of entrepreneurship and cooperative education, we provide unparalleled professional experiences and on-the-job training that is vital to preparing today's students for tomorrow's world. At CCI, our unique structure bringing computing and informatics together under one roof in a dynamic, collaborative college allows us to spot trends before they emerge, to solve problems before they occur, and to build a better tomorrow starting today.

The College contributes to theory and practice along dimensions that include technical, human, organizational, policy, and societal considerations. This broad perspective positions the College to address the complex, multi-disciplinary problems that are increasingly common as society becomes more dependent on information technology.

The College's academic programs provide broad and deep coverage of computing and informatics. For more information about the College, please visit the College's website (https://drexel.edu/cci/).

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About the College

The College of Computing & Informatics (https://drexel.edu/cci/) (CCI) offers a number of undergraduate degrees in computer science, computing and security technology, data science, information systems, and software engineering. The degree programs are open to freshmen and transfers from other departments at Drexel and other universities. Students have access to the computing facilities available to all Drexel students.

The College educates professionals through its interdisciplinary programs to meet a wide range of needs in the computing and informatics fields to benefit all sectors of society.

Transfer admission for traditional undergraduate programs occurs in the fall term only due to the sequence of required courses. Internal transfer students can be admitted at any term. Admission to the BS in Computing and Security Technology is offered on a rolling basis. Please contact an undergraduate advisor (https://drexel.edu/cci/current-students/undergraduate/advising/) for more information.

Cooperative Education

Cooperative education emphasizes career management through experiential learning as an integral part of the education process. The co-op is based on employment in practical, major-related positions consistent with the interests, abilities, and aptitudes of the students.

For more general information on Drexel University's co-op opportunities, visit the Drexel Steinbright Career Development Center (http://www.drexel.edu/scdc/).

Computer Science

Major: Computer Science
Degree Awarded: Bachelor of Science in Computer Science (BSCS) or Bachelor of Arts in Computer Science (BACS)
Calendar Type: Quarter
Total Credit Hours: 186.5
Co-op Options: Three Co-op (Five years); One Co-op (Four years)
Classification of Instructional Programs (CIP) code: 11.0701
Standard Occupational Classification (SOC) code: 11-3021; 15-1111; 15-1131; 15-1132; 11-1199

About the Program

The College of Computing & Informatics' Bachelor of Science/Arts in Computer Science offers extensive exposure and hands-on practice in the core areas of the field, including programming paradigms and languages, algorithms, systems, networking, and software engineering. Students also select upper level tracks in areas such as artificial intelligence, security, graphics and vision, and human-computer interaction. The program's flexibility allows students to easily sample from areas in which they would like to apply their computing knowledge. This hands-on curriculum combined with co-op provides real-world experience that culminates in a full-year software project.

The programs of study in computer science are designed with the flexibility to prepare students for careers in a rapidly changing profession and to allow strong preparation for graduate education in the field. In addition to the courses in the major, the Bachelor of Science program emphasizes foundation courses in the sciences and in applied mathematics, leading to careers involving applications in science and engineering. The Bachelor of Arts degree emphasizes foundation courses in the humanities and the social sciences, leading to careers involving applications in those areas.

Core courses in all programs include programming and data structures, programming language concepts, computer systems architecture, and software methodology and engineering. Students also choose two other tracks from a list of possible specializations. Please contact your advisor

(https://drexel.edu/cci/current-students/undergraduate/advising/) at the College of Computing & Informatics for a current list of computer science track and elective courses.

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- Computer Security (p. 12)
- Game Programming and Development (p. 14)

Additional Information

For more information about this program, please visit the BS/BA in Computer Science web page (https://drexel.edu/cci/academics/undergraduate-programs/bsba-computer-science/) on the College of Computing & Informatics' website.

Degree Requirements (BS)

The Bachelor of Science (BS) in Computer Science program emphasizes foundation courses in the sciences and in applied mathematics, leading to careers involving applications in science and engineering.

Computer Science Requirements		
CS 164	Introduction to Computer Science	3.0
CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
CS 277	Algorithms and Analysis	3.0
CS 281	Systems Architecture	4.0
CS 283	Systems Programming	3.0
CS 360	Programming Language Concepts	3.0
SE 181	Introduction to Software Engineering and Development	3.0
SE 310	Software Architecture I	3.0
Computer Science track courses (see below)		18.0
Computer Science electives (see below)		6.0
Computing & Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CI 491 [WI]	Senior Project I	3.0
CI 492 [WI]	Senior Project II	3.0
CI 493 [WI]	Senior Project III	3.0
Mathematics Requirements		
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 123	Calculus III	4.0
MATH 200	Multivariate Calculus	4.0
MATH 201	Linear Algebra	4.0
MATH 221	Discrete Mathematics	3.0
MATH 311	Probability and Statistics I	4.0
Science Requirements		**19.0**
Select one of the following lab science sequences:		
BIO 131	Cells and Biomolecules	
& BIO 134	and Cells and Biomolecules Lab	
& BIO 132	and Genetics and Evolution	
& BIO 135	and Genetics and Evolution Lab	
& BIO 133	and Physiology and Ecology	
& BIO 136	and Anatomy and Ecology Lab	
Or		
CHEM 101	General Chemistry I	
& CHEM 102	and General Chemistry II	
& CHEM 103	and General Chemistry III	
Or		
PHYS 101	Fundamentals of Physics I	
& PHYS 102	and Fundamentals of Physics II	
& PHYS 201	and Fundamentals of Physics III	
Additional science electives to have total 19 credits (see below)		
Arts & Humanities Requirements		
COM 230	Techniques of Speaking	3.0
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
PHIL 311	Ethics and Information Technology	3.0
Writing & Communication electives (see below)		6.0
Arts & Humanities, Business, or Social Studies electives (see below) *		18.0
University Requirements		
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development	1.0
Free electives		**21.5**
Total Credits		**186.5**

* At least 3.0 credit must be taken from a Business category course (see below) and at least 3.0 credits must be from a Social Studies category course (see below)

Program Electives

Independent study courses and special topics courses must be approved by the department prior to enrollment to satisfy a program elective requirement.

- **Computer Science electives**: any CS course numbered 300 or higher
- **Science electives**: any CHEM (except CHEM 111, CHEM 112, CHEM 113, CHEM 114, CHEM 151), BIO (except BIO 161, BIO 162, BIO 163; can take only one of BIO 100, BIO 107; can take only one of BIO 101, BIO 109), PHYS (except PHYS 050, PHYS 100,PHYS 103, PHYS 104, PHYS 105, PHYS 106 [WI] , PHYS 121, PHYS 122, PHYS 151, PHYS 160, PHYS 305, PHYS 324,PHYS 405; cannot take both PHYS 131 & PHYS 181), ENVS, ENSS, PHEV
- **Writing & Communications electives**: any WRIT, COM, ENGL courses officially certified as Writing Intensive (http://drexel.edu/engphil/about/DrexelWritingCenter/wiCourses/course_list/) (WI), SCRP 270 [WI] and SCRP 275
- **Business electives**: any ACCT, BLAW, BUSN, ECON, ENTP, FIN, HRMT, INTB, MGMT, MIS, MKTG, OPM, OPR, ORGB, STAT, TAX
- **Social Studies electives**: any AFAS, ANTH, GST, HIST, JUDA, PSCI, PSY, SOC, WGST
- **Arts & Humanities electives**: any ARCH, ARTH, CMGT, CJS, COM, CULA, DANC, EDEX, EDUC, ENGL (except ENGL 101, ENGL 102, ENGL 103, ENGL 105, ENGL 111, ENGL 112, ENGL 113), ESTM, FASH, FMST, FMVD, GST, INTR, LING, MUSC, PHIL, PHTO, THTR, VSCM, VSST, WRIT, Foreign Language courses (http://www.drexel.edu/culturecomm/academics/undergraduate/modernlang/

languages/) as defined by the College of Arts and Sciences, and GMAP 260, ANIM 140, ANIM 141, ANIM 211, ANIM 212

Computer Science Tracks

Students must complete two of the following Computer Science tracks for a total of 18.0 credits. The tracks may overlap by one course. Students should check with the College for any additional Special Topics courses being offered that may be appropriate for one of the tracks. The student may propose a Student Defined Track with departmental approval.

Algorithms and Data Structures		
CS 440	Theory of Computation	3.0
CS 457	Data Structures and Algorithms I	3.0
CS 458	Data Structures and Algorithms II	3.0
Artificial Intelligence		
Select three of the following:		9.0
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 385	Evolutionary Computing	
CS 387	Game AI Development	
CS 481	Advanced Artificial Intelligence	
Computer and Network Security		
Select three of the following:		9.0
CS 303	Algorithmic Number Theory and Cryptography	
CS 377	Software Security	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
Computer Architecture		
Select three of the following:		9.0
CS 352	Processor Architecture & Analysis	
CS 476	High Performance Computing	
ECEC 356	Embedded Systems	
ECEC 413	Introduction to Parallel Computer Architecture	
Computer Graphics and Vision		
Select three of the following:		9.0
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
Computing Systems		
Select three of following:		9.0
CS 314	Computing in the Small	
CS 352	Processor Architecture & Analysis	
CS 361	Concurrent Programming	
CS 365	System Administration	
CS 370	Operating Systems	
CS 375	Web and Mobile App Development	
CS 441	Compiler Workshop I	
CS 461	Database Systems	
CS 472	Computer Networks: Theory, Applications and Programming	
Game Development and Design		
Select three of the following:		9.0
CS 341	Serious Game Development	
or CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 387	Game AI Development	
CS 445	Topics in Computer Gaming	
GMAP 377	Game Development: Workshop I	
GMAP 378	Game Development: Workshop II	
Graphics and Interaction		
Select three of the following:		9.0
CS 338	Graphical User Interfaces	
CS 341	Serious Game Development	
or CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 387	Game AI Development	
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
CS 445	Topics in Computer Gaming	
GMAP 377	Game Development: Workshop I	
GMAP 378	Game Development: Workshop II	
INFO 310	Human-Centered Design Process & Methods	
Human-Computer Interaction		
Select three of the following:		9.0
CS 338	Graphical User Interfaces	
CS 345	Computer Game Design and Development	
CS 432	Interactive Computer Graphics	
INFO 310	Human-Centered Design Process & Methods	
Intelligent Systems		
Select three courses from the following:		9.0
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 385	Evolutionary Computing	
CS 387	Game AI Development	
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
CS 481	Advanced Artificial Intelligence	
Numeric and Symbolic Computation		
Select three of the following:		9.0
CS 300	Applied Symbolic Computation	
CS 303	Algorithmic Number Theory and Cryptography	
MATH 300	Numerical Analysis I	
MATH 301	Numerical Analysis II	
MATH 305	Introduction to Optimization Theory	
Programming Languages		
CS 440	Theory of Computation	3.0
CS 441	Compiler Workshop I	3.0
CS 442	Compiler Workshop II	3.0
Software and Security		
Select three of the following:		9.0
CS 303	Algorithmic Number Theory and Cryptography	
CS 377	Software Security	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
SE 311	Software Architecture II	
SE 320	Software Verification and Validation	
SE 410	Software Evolution	
Software Engineering		
SE 311	Software Architecture II	3.0
SE 320	Software Verification and Validation	3.0
SE 410	Software Evolution	3.0
Systems and High-Performance Computing		
Select three of the following:		9.0
CS 314	Computing in the Small	
CS 352	Processor Architecture & Analysis	
CS 361	Concurrent Programming	
CS 365	System Administration	
CS 370	Operating Systems	
CS 375	Web and Mobile App Development	
CS 440	Theory of Computation	

CS 441	Compiler Workshop I	
CS 442	Compiler Workshop II	
CS 461	Database Systems	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 476	High Performance Computing	
ECEC 356	Embedded Systems	
ECEC 413	Introduction to Parallel Computer Architecture	
Theory and Computation		
Select three of the following:		9.0
CS 300	Applied Symbolic Computation	
CS 303	Algorithmic Number Theory and Cryptography	
CS 440	Theory of Computation	
CS 441	Compiler Workshop I	
CS 442	Compiler Workshop II	
CS 457	Data Structures and Algorithms I	
CS 458	Data Structures and Algorithms II	
MATH 300	Numerical Analysis I	
MATH 301	Numerical Analysis II	
MATH 305	Introduction to Optimization Theory	

Writing-Intensive Course Requirements

In order to graduate, all students must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/writing-intensive-courses/) at the University Writing Program (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/). (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/drexel-writing-center/) Students scheduling their courses can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

Degree Requirements (BA)

The Bachelor of Arts (BA) in Computer Science program emphasizes foundation courses in the humanities and the social sciences, leading to careers involving applications in those areas.

Computer Science Requirements		
CS 164	Introduction to Computer Science	3.0
CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
CS 277	Algorithms and Analysis	3.0
CS 281	Systems Architecture	4.0
CS 283	Systems Programming	3.0
CS 360	Programming Language Concepts	3.0
SE 181	Introduction to Software Engineering and Development	3.0
SE 310	Software Architecture I	3.0
Computer Science track courses (see below)		18.0
Computer Science electives (see below)		6.0
Computing & Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CI 491 [WI]	Senior Project I	3.0
CI 492 [WI]	Senior Project II	3.0
CI 493 [WI]	Senior Project III	3.0
Mathematics Requirements		
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 123	Calculus III	4.0
MATH 200	Multivariate Calculus	4.0
MATH 201	Linear Algebra	4.0
MATH 221	Discrete Mathematics	3.0
MATH 311	Probability and Statistics I	4.0
Science Requirements		**18.0**
Select one of the following lab science sequences plus science electives from below:		
BIO 131 & BIO 134 & BIO 132 & BIO 135 & BIO 133 & BIO 136	Cells and Biomolecules and Cells and Biomolecules Lab and Genetics and Evolution and Genetics and Evolution Lab and Physiology and Ecology and Anatomy and Ecology Lab	
CHEM 101 & CHEM 102 & CHEM 103	General Chemistry I and General Chemistry II and General Chemistry III	
PHYS 101 & PHYS 102 & PHYS 201	Fundamentals of Physics I and Fundamentals of Physics II and Fundamentals of Physics III	
Arts & Humanities Requirements		
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
PHIL 311	Ethics and Information Technology	3.0
COM 230	Techniques of Speaking	3.0
Arts Humanities, Business, or Social Studies electives (see below)		6.0
Disciplinary Minor		**24.0**
University Requirements		
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development *	1.0
Free electives		**16.5**
Total Credits		**186.5**

* Co-op cycles may vary. Students are assigned a co-op cycle (fall/winter, spring/summer, summer-only) based on their co-op program (4-year, 5-year) and major.
COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Program Electives

Independent study courses and special topics courses must be approved by the department prior to enrollment to satisfy a program elective requirement.

- **Computer Science electives**: any CS course numbered 300 or higher
- **Science electives**: any CHEM (except CHEM 111, CHEM 112, CHEM 113, CHEM 114, CHEM 151), BIO (except BIO 161, BIO 162, BIO 163; can take only one of BIO 100, BIO 107; can take only one of BIO 101, BIO 109). PHYS (except PHYS 050, PHYS 100, PHYS 103, PHYS 104, PHYS 105, PHYS 106 [WI] , PHYS 121, PHYS 122,PHYS 151, PHYS 160, PHYS 305, PHYS 324, PHYS 405; cannot take both PHYS 131 & PHYS 181); ENVS, ENSS, PHEV
- **Social Studies electives**: any AFAS, ANTH, GST, HIST, JUDA, PSCI, PSY, SOC, WGST
- **Arts & Humanities electives**: any ARCH, ARTH, CMGT, CJS, COM, CULA, DANC, EDEX, EDUC, ENGL (except ENGL 101, ENGL 102, ENGL 103, ENGL 111,ENGL 112,ENGL 113), ESTM, FASH, FMST, FMVD, GST, INTR, LING, MUSC, PHIL, PHTO, THTR, VSCM, VSST, WRIT, Foreign Language courses (http://www.drexel.edu/culturecomm/academics/undergraduate/modernlang/languages/) as defined by the College of Arts and Sciences, and GMAP 260, ANIM 140, ANIM 141, ANIM 211, ANIM 212
- **Business electives:** any ACCT, BLAW, BUSN, ECON, ENTP, FIN, HRMT, INTB, MGMT, MIS, MKTG, OPM, OPR, ORGB, STAT, TAX

Computer Science Tracks

Students must complete two of the following Computer Science tracks for a total of 18.0 credits. The tracks may overlap by one course. Students should check with the College for any additional Special Topics courses being offered that may be appropriate for one of the tracks. The student may propose a Student Defined Track with departmental approval.

Algorithms and Data Structures		
CS 440	Theory of Computation	3.0
CS 457	Data Structures and Algorithms I	3.0
CS 458	Data Structures and Algorithms II	3.0
Artificial Intelligence		
Select three of the following:		9.0
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 385	Evolutionary Computing	
CS 387	Game AI Development	
CS 481	Advanced Artificial Intelligence	
Computer and Network Security		
Select three of the following:		9.0
CS 303	Algorithmic Number Theory and Cryptography	
CS 377	Software Security	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
Computer Architecture		
Select three of the following:		9.0
CS 352	Processor Architecture & Analysis	
CS 476	High Performance Computing	
ECEC 356	Embedded Systems	
ECEC 413	Introduction to Parallel Computer Architecture	
Computer Graphics and Vision		
Select three of the following:		9.0
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
Computing Systems		
Select three of the following:		9.0
CS 314	Computing in the Small	
CS 352	Processor Architecture & Analysis	
CS 361	Concurrent Programming	
CS 365	System Administration	
CS 370	Operating Systems	
CS 375	Web and Mobile App Development	
CS 441	Compiler Workshop I	
CS 461	Database Systems	
CS 472	Computer Networks: Theory, Applications and Programming	
Game Development and Design		
Select three of the following:		9.0
CS 341	Serious Game Development	
or CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 387	Game AI Development	
CS 445	Topics in Computer Gaming	
GMAP 377	Game Development: Workshop I	
GMAP 378	Game Development: Workshop II	
Graphics and Interaction		
Select three of the following:		9.0
CS 338	Graphical User Interfaces	
CS 341	Serious Game Development	
or CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 387	Game AI Development	
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
CS 445	Topics in Computer Gaming	
GMAP 377	Game Development: Workshop I	
GMAP 378	Game Development: Workshop II	
INFO 310	Human-Centered Design Process & Methods	
Human-Computer Interaction		
Select three of the following:		9.0
CS 338	Graphical User Interfaces	
CS 345	Computer Game Design and Development	
CS 432	Interactive Computer Graphics	
INFO 310	Human-Centered Design Process & Methods	
or PSY 337	Human-Computer Interaction	
Intelligent Systems		
Select three of the following:		9.0
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 385	Evolutionary Computing	
CS 387	Game AI Development	
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
CS 481	Advanced Artificial Intelligence	
Numeric and Symbolic Computation		
Select three of the following:		9.0
CS 300	Applied Symbolic Computation	
CS 303	Algorithmic Number Theory and Cryptography	
MATH 300	Numerical Analysis I	
MATH 301	Numerical Analysis II	
MATH 305	Introduction to Optimization Theory	

Programming Languages		
CS 440	Theory of Computation	3.0
CS 441	Compiler Workshop I	3.0
CS 442	Compiler Workshop II	3.0
Software and Security		
Select three of the following:		9.0
CS 303	Algorithmic Number Theory and Cryptography	
CS 377	Software Security	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
SE 311	Software Architecture II	
SE 320	Software Verification and Validation	
SE 410	Software Evolution	
Software Engineering		
SE 311	Software Architecture II	3.0
SE 320	Software Verification and Validation	3.0
SE 410	Software Evolution	3.0
Systems and High-Performance Computing		
Select three of the following:		9.0
CS 314	Computing in the Small	
CS 352	Processor Architecture & Analysis	
CS 361	Concurrent Programming	
CS 365	System Administration	
CS 370	Operating Systems	
CS 375	Web and Mobile App Development	
CS 440	Theory of Computation	
CS 441	Compiler Workshop I	
CS 442	Compiler Workshop II	
CS 461	Database Systems	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 476	High Performance Computing	
ECEC 356	Embedded Systems	
ECEC 413	Introduction to Parallel Computer Architecture	
Theory and Computation		
Select three of the following		9.0
CS 300	Applied Symbolic Computation	
CS 303	Algorithmic Number Theory and Cryptography	
CS 440	Theory of Computation	
CS 441	Compiler Workshop I	
CS 442	Compiler Workshop II	
CS 457	Data Structures and Algorithms I	
CS 458	Data Structures and Algorithms II	
MATH 300	Numerical Analysis I	
MATH 301	Numerical Analysis II	
MATH 305	Introduction to Optimization Theory	

Writing-Intensive Course Requirements

In order to graduate, all students must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/writing-intensive-courses/) at the University Writing Program (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/). (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/drexel-writing-center/) Students scheduling their courses can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

Sample Plan of Study (BS)

BS COMPUTER SCIENCE

5-Year Spring Summer Coop Cycle *

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
MATH 121	4.0	COOP 101**	1.0	ENGL 103 or 113	3.0		
ENGL 101 or 111	3.0	CS 171 or 175	3.0	MATH 123	4.0		
UNIV CI101	1.0	ENGL 102 or 112	3.0	UNIV CI101	1.0		
Science Lab	4.5	MATH 122	4.0	Science Lab	4.5		
		Science Lab	4.5				
	17.5		**18.5**		**17.5**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 270	3.0	MATH 200	4.0				
MATH 201	4.0	MATH 221	3.0				
SE 181	3.0	Science Elective	3.0				
Social Studies Elective	3.0	Free Elective	3.0				
	16		**16**		**0**		**0**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COM 230	3.0	CS 283	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 277	3.0	CS 360	3.0				
CS 281	4.0	Science Elective	3.0				
SE 310	3.0	Writing & Communication Elective	3.0				
Free Elective	3.0	Free Elective	3.0				
	16		**15**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
MATH 311	4.0	Arts & Humanities	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 311	3.0	Business Elective	4.0				
Computer Science Electives	6.0	Computer Science Elective	3.0				
Arts & Humanities Elective	3.0	Science Electitve	3.0				

		Free Elective	3.0				
	16		**16**		**0**		**0**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
Arts & Humanities Elective	3.0	Arts & Humanities Elective	3.0	Computer Science Elective	3.0
Computer Science Electives	6.0	Computer Science Electives	6.0	Writing & Communication Elective	3.0
Free Elective	2.0			Free Elective	3.0
	14		**12**		**12**

Total Credits 186.5

4-Year Spring Summer Coop Cycle*

First Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0
MATH 121	4.0	CS 171 or 175	3.0	ENGL 103 or 113	3.0
ENGL 101 or 111	3.0	ENGL 102 or 112	3.0	MATH 123	4.0
UNIV CI101	1.0	MATH 122	4.0	UNIV CI101	1.0
Science Lab	4.5	Science Lab	4.5	Science Lab	4.5
	17.5		**17.5**		**17.5**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	COM 230	3.0	CS 283	3.0
CS 270	3.0	COOP 101**	1.0	CS 277	3.0	CS 360	3.0
MATH 201	4.0	MATH 200	4.0	CS 281	4.0	Science Elective	3.0
SE 181	3.0	MATH 221	3.0	SE 310	3.0	Writing & Communication Elective	3.0
Social Studies Elective	3.0	Science Elective	3.0	Free Elective	3.0	Free Elective	3.0
		Free Elective	2.0				
	16		**16**		**16**		**15**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
MATH 311	4.0	Arts & Humanities Elective	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 311	3.0	Business Elective	4.0				
Computer Science Electives	6.0	Computer Science Elective	3.0				
Arts & Humanities Elective	3.0	Science Elective	3.0				
		Free Elective	3.0				
	16		**16**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
Arts & Humanities Elective	3.0	Arts & Humanities Elective	3.0	Computer Science Elective	3.0
Computer Science Electives	6.0	Computer Science Electives	6.0	Writing & Communications Elective	3.0
Free Elective	3.0			Free Elective	3.0
	15		**12**		**12**

Total Credits 186.5

* Co-op cycles may vary. Students are assigned a co-op cycle (fall/winter, spring/summer, summer only) based on their co-op program (5-year or 4-year) and major.

** *COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.*

Sample Plan of Study (BA)

4 year, one co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
ENGL 101 or 111	3.0	COOP 101*	1.0	ENGL 103 or 113	3.0		
MATH 121	4.0	CS 171 or 175	3.0	MATH 123	4.0		
UNIV C101	1.0	ENGL 102 or 112	3.0	UNIV C101	1.0		
Science lab	4.5	MATH 122	4.0	Science lab	4.5		
		Science lab	4.5				
	17.5		**18.5**		**17.5**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	COM 230	3.0	CS 283	3.0
CS 270	3.0	MATH 221	3.0	CS 277	3.0	CS 360	3.0
MATH 201	4.0	Disciplinary Minor elective	3.0	CS 281	4.0	MATH 200	4.0
SE 181	3.0	Free elective	3.0	SE 310	3.0	Arts & Humaniries, Business, and Social Studies elective	3.0
Disciplinary Minor elective	3.0	Science elective	4.5	Disciplinary Minor elective	3.0	Disciplinary Minor elective	3.0
	16		**16.5**		**16**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
MATH 311	4.0	Arts & Humanities, Business, and Social Studies elective	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 311	3.0	Computer Science elective	3.0				

Computer Science electives	6.0	Disciplinary Minor electives	6.0				
Disciplinary Minor elective	3.0	Free elective	3.0				
	16		**15**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
Computer Science electives	6.0	Computer Science electives	6.0	Computer Science elective	3.0
Disciplinary Minor elective	3.0	Free elective	3.0	Free electives	6.0
Free elective	1.5				
	13.5		**12**		**12**

Total Credits 186.5

* Co-op cycles may vary. Students are assigned a co-op cycle (fall/winter, spring/summer, summer-only) based on their co-op program (4-year, 5-year) and major.
COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

5 year, 3 co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
ENGL 101	3.0	COOP 101*	1.0	ENGL 103 or 113	3.0		
MATH 121	4.0	CS 171 or 175	3.0	MATH 123	4.0		
UNIV C101	1.0	ENGL 102 or 112	3.0	UNIV C101	1.0		
Science lab	4.5	MATH 122	4.0	Science lab	4.5		
		Science lab	4.5				
	17.5		**18.5**		**17.5**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 270	3.0	MATH 221	3.0				
MATH 201	4.0	Disciplinary Minor elective	3.0				
Disciplinary Minor elective	3.0	Free elective	3.0				
SE 181	3.0	Science elective	4.5				
	16		**16.5**		**0**		**0**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COM 230	3.0	CS 283	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 277	3.0	CS 360	3.0				
CS 281	4.0	MATH 200	4.0				
SE 310	3.0	Arts & Humaniries, Business, and Social Studies elective	3.0				
Disciplinary Minor elective	3.0	Disciplinary Minor elective	3.0				
	16		**16**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
MATH 311	4.0	Arts & Humanities, Business, and Social Studies elective	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 311	3.0	Computer Science elective	3.0				
Computer Science electives	6.0	Disciplinary Minor electives	6.0				
Disciplinary Minor elective	3.0	Free elective	3.0				
	16		**15**		**0**		**0**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
Computer Science electives	6.0	Computer Science electives	6.0	Computer Science elective	3.0
Disciplinary Minor elective	3.0	Free elective	3.0	Free electives	6.0
Free elective	1.5				
	13.5		**12**		**12**

Total Credits 186.5

* Co-op cycles may vary. Students are assigned a co-op cycle (fall/winter, spring/summer, summer-only) based on their co-op program (4-year, 5-year) and major.
COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Co-op/Career Opportunities

Co-Op Options

Two co-op options are available for this program:

- 5-year/3 co-op
- 4-year/1 co-op

Career Opportunities

The demand for computing skills is tremendous and growing, with highly paid jobs. Most professionals in the field focus on the design and development of software and software-based applications. Typical jobs include software engineer, programmer, web designer, multimedia or software developer, systems analyst or consultant, manager of technical staff, client-server architect, network designer, and database specialist. Most positions require at least a bachelor’s degree. Relevant work

experience, such as that provided by co-operative education, is also very important, as cited by the Occupational Outlook Handbook (http://www.bls.gov/ooh/) published by the US Bureau of Labor Statistics.

Job titles of recent computer science graduates include:

- Web Developer
- Software Systems Engineer
- Software Developer
- Network Engineer
- Application Analyst

Visit the Drexel Steinbright Career Development Center (http://www.drexel.edu/scdc/) page for more detailed information on co-op and post-graduate opportunities.

3675 Market Street

In March 2019, the College of Computing & Informatics relocated to 3675 Market (https://drexel.edu/cci/about/our-facilities/). For the first time in the College's history, all CCI faculty, students and professional staff are housed under one roof. Occupying two floors in the brand new uCity Square building, CCI's new home offers state-of-the-art technology in our classrooms, labs, meeting areas and collaboration spaces. 3675 Market offers Class A laboratory, office, coworking, and convening spaces. In fall 2019, the College will open a third floor which will include additional offices, classrooms, a research lab, a maker space, and a ground-breaking DXC Technology Innovation Lab. Located at the intersection of Market Street and 37th Street, 3675 Market will act as a physical nexus, bridging academic campuses and medical centers to the east and south, the commercial corridors along Market Street and Chestnut Street, and the residential communities to the north and west.

The uCity Square building offers:

- Speculative lab/office space
- World-class facilities operated by CIC (https://cic.us/philadelphia/)
- Café/restaurant on-site
- Quorum, a two-story, 15K SF convening space and conference center
- Adjacent to future public square
- Access to Science Center’s nationally renowned business acceleration and technology commercialization programs

Drexel University Libraries

Drexel University Libraries (http://www.library.drexel.edu/) is a learning enterprise, advancing the University’s academic mission through serving as educators, supporting education and research, collaborating with researchers, and fostering intentional learning outside of the classroom. Drexel University Libraries engages with Drexel communities through three physical locations, including W. W. Hagerty Library, Queen Lane Library, and the Library Learning Terrace, as well as a vibrant online presence which sees, on average, over 8,000 visits per day. In the W.W. Hagerty Library location, College of Computing & Informatics students have access to private study rooms and nearly half a million books, periodicals, DVDs, videos and University Archives. All fields of inquiry are covered, including: library and information science, computer science, software engineering, health informatics, information systems, and computing technology. Resources are available online at library.drexel.edu (http://www.library.drexel.edu/) or in-person at W. W. Hagerty Library (http://www.library.drexel.edu/locations/).

The Libraries also make available laptop and desktop PC and Mac computers, printers and scanners, spaces for quiet work or group projects and designated 24/7 spaces. Librarians and library staff—including a liaison librarian for computing and informatics—are available for individual research consultations and to answer questions about materials or services.

CCI Commons

Located on the 10th floor of 3675 Market Street, the CCI Commons is an open lab and collaborative work environment for students. It features desktop computers, a wireless/laptop area, free black and white printing, and more collaborative space for its students. Students have access to 3675 Market's fully equipped conference room with 42” displays and videoconferencing capabilities. The CCI Commons provides technical support to students, faculty, and professional staff. In addition, the staff provides audio-visual support for all presentation classrooms within 3675 Market. Use of the CCI Commons is reserved for all students taking CCI courses.

The computers for general use are Microsoft Windows and Macintosh OSX machines with appropriate applications which include the Microsoft Office suite, various database management systems, modeling tools, and statistical analysis software. Library related resources may be accessed at the CCI Commons and through the W.W. Hagerty Library. The College is a member of the Rational SEED Program which provides cutting-edge software development and project management software for usage in the CCI Commons and CCI classrooms. The College is also a member of the Microsoft Academic Alliance known also as “DreamSpark” that allows students free access to a wide array of Microsoft software titles and operating systems.

The CCI Commons, student labs, and classrooms have access to networked databases, print and file resources within the College, and the Internet via the University’s network. Email accounts, Internet and BannerWeb access are available through the Office of Information Resources and Technology.

CCI Learning Center

The CCI Learning Center (CCILC), located in 3675 Market Street's CCI Commons student computer lab, provides consulting and other learning resources for students taking computer science classes. The CCILC is staffed by graduate and undergraduate computer science students from the College of Computing & Informatics.

The CCILC and CCI Commons serve as a central hub for small group work, student meetings, and TA assistance.

Research Laboratories

The College houses multiple research labs, led by CCI faculty, in 3675 Market Street including: the Drexel Health and Risk Communication Lab, Interactive Systems for Healthcare, Socio-Technical Studies Group, Intelligent Information & Knowledge Computing Research Lab, Evidence-based Decision Making Lab, Applied Symbolic Computation Laboratory (ASYM), High Performance Computing Laboratory (SPIRAL), Drexel Research on Play (RePlay) Laboratory, Software Engineering Research Group (SERG), Social Computing Research Group, Vision and Cognition Laboratory (VisCog) and the Vision and Graphics Laboratory. For more information on these laboratories, please visit the College’s research web page (http://cci.drexel.edu/research.aspx).

Evaluations

The College of Computing & Informatics works continually to improve its degree programs. As part of this effort, the Computer Science degree is evaluated relative to the following Objectives and Outcomes.

Computer Science Program Educational Objectives

Drexel Computer Science alumni will:

a. be valued employees in a wide variety of occupations in industry, government and academia, in particular as computer scientists and software engineers;

b. succeed in graduate and professional studies, such as engineering, science, law, medicine and business;

c. pursue life-long learning and professional development to remain current in an ever changing technological world;

d. provide leadership in their profession, in their communities, and society;

e. function as responsible members of society with an awareness of the social and ethical ramifications of their work.

Computer Science Student Outcomes (for Bachelor of Science and Bachelor of Arts)

The Drexel Computer Science program enables students to attain, by the time of graduation:

a. An ability to apply knowledge of computing and mathematics appropriate to the discipline
b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
c. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
d. An ability to function effectively on teams to accomplish a common goal
e. An understanding of professional, ethical, legal, security and social issues and responsibilities
f. An ability to communicate effectively with a range of audiences
g. An ability to analyze the local and global impact of computing on individuals, organizations, and society
h. Recognition of the need for and an ability to engage in continuing professional development
i. An ability to use current techniques, skills, and tools necessary for computing practice
j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
k. An ability to apply design and development principles in the construction of software systems of varying complexity.

Computer Science Faculty

David Augenblick, MS *(University of Pennsylvania)*. Associate Teaching Professor. Introductory and object-oriented programming, data structures and database systems, computer application project management, application of computer programming principles and solutions to engineering problems.

Mark Boady, PhD *(Drexel University)*. Assistant Teaching Professor. Computer Algebra, complex symbolic calculations, automation of computation problems

David E. Breen, PhD *(Rensselaer Polytechnic Institute) Associate Department Head for Graduate Affairs, Computer Science*. Professor. Computer-aided design, biomedical image informatics, geometric modeling and self-organization algorithms.

Matthew Burlick, PhD *(Stevens Institute of Technology)*. Associate Teaching Professor. Image processing, machine learning, real-time video tracking, object detection and classification, statistics/probability, and acoustics

Yuanfang Cai, PhD *(University of Virginia)*. Professor. Formal software design modeling and analysis, software economics, software evolution and modularity.

Preetha Chatterjee, PhD *(University of Delaware)*. Assistant Professor. Software engineering, data mining, natural language processing, and machine learning

Vasilis Gkatzelis, PhD *(New York University)*. Assistant Professor. Algorithmic mechanism design, multiagent resource allocation, approximation algorithms .

Colin Gordon, PhD *(University of Washington)*. Associate Professor. Software reliability, program behavior, concurrent and systems-level code, formal assurance, programming models, distributed computing, even testing

Shahin Jabbari Assistant Professor. Algorithmic fairness, game theory, and artificial intelligence for social good.

Jeremy R. Johnson, PhD *(Ohio State University) Department Head, Computer Science*. Professor. Computer algebra; parallel computations; algebraic algorithms; scientific computing.

Constantine Katsinis, PhD *(University of Rhode Island)*. Teaching Professor. High-performance computer networks, parallel computer architectures with sustained teraflops performance, computer security, image processing.

Ehasn B. Khosroshahi, PhD *(Drexel University)*. Assistant Teaching Professor. Computational cognitive modeling, artificial intelligence, machine learning and data analysis.

Edward Kim, PhD *(Lehigh University)*. Associate Professor. Computer Vision, Sparse Coding, Neuromorphic Computing, Medical Image Processing, Computer Graphics, Artificial Intelligence, Game Development

Galen Long, MS *(Drexel University)*. Assistant Teaching Professor.

Geoffrey Mainland, PhD *(Harvard University)*. Associate Professor. High-level programming languages and runtime support for non-general purpose computation.

Spiros Mancoridis, PhD *(University of Toronto) The Auerbach Berger Chair in Cybersecurity Distinguished Professor of Computer Science*. Professor. Software engineering; software security; code analysis; evolutionary computation.

Adelaida Alban Medlock, MS *(Drexel University) Associate Department Head for Undergraduate Affairs, Computer Science*. Teaching Professor. Introductory programming; computer science education.

Krzysztof Nowak, PhD *(Washington University)*. Associate Teaching Professor. Fourier analysis, partial differential equations, image processing, wavelets, asymptotic distribution of eigenvalues, numerical methods and algorithms, computer science education.

Santiago Ontañón, PhD *(University of Barcelona)*. Associate Professor. Game AI, computer games, artificial intelligence, machine learning, case-based reasoning

Yusuf Osmanlioglu, PhD *(Drexel University)*. Assistant Teaching Professor. Graph theory and algorithms, brain network analysis, optimization, computer vision, natural language processing

Tammy Pirmann, Ed D *(Gwynedd Mercy University)*. Teaching Professor. Introductory programming, object-oriented programming, game design, mobile computing, computer science education, computer science educator pipeline

Jeffrey L. Popyack, PhD *(University of Virginia)*. Professor. Operations research, stochastic optimization, computational methods of Markov decision processes; artificial intelligence, computer science education.

Emmanouil Pountourakis, PhD *(Northwestern University)*. Assistant Professor. Algorithmic game theory, algorithmic mechanism design, algorithmic aspects of behavioral economics, game theory and learning, computational and game theoretic aspects of energy grids

Jeffrey Salvage, MS *(Drexel University)*. Teaching Professor. Object-oriented programming, multi-agent systems, software engineering, database theory, introductory programming, data structures.

Dario Salvucci, PhD *(Carnegie Mellon University)*. Professor. Human computer interaction, cognitive science, machine learning, applications for driving.

Kurt Schmidt, MS *(Drexel University)*. Associate Teaching Professor. Data structures, math foundations for computer science, programming tools, programming languages.

Ali Shokoufandeh, PhD *(Rutgers University) Senior Associate Dean for Academic Affairs and Operations*. Professor. Theory of algorithms, graph theory, combinational optimization, computer vision.

Brian Stuart, PhD *(Purdue University)*. Associate Teaching Professor. Machine learning, networking, robotics, image processing, simulation, interpreters, data storage, operating systems, computer science, data communications, distributed/operating systems, accelerated computer programming, computer graphics.

Boris Valerstein, MS *(Pennsylvania State University)*. Assistant Teaching Professor.

Dimitra Vista Teaching Professor. Database systems

Filippos Vokolos, PhD *(Polytechnic University)*. Associate Teaching Professor. System architecture, principles of software design and construction, verification and validation methods for the development of large software systems, foundations of software engineering, software verification & validation, software design, programming languages, dependable software systems.

Kaidi Xu, PhD *(Northeastern University)*. Assistant Professor. AI security, explainable artificial intelligence, optimization.

Emeritus Faculty

Bruce W. Char, PhD *(University of California-Berkeley)*. Professor Emeritus. Symbolic mathematical computation, algorithms and systems for computer algebra, problem-solving environments parallel and distributed computation.

Valerie Ann Yonker, PhD *(Drexel University)*. Associate Teaching Professor Emerita. Human service information systems, systems analysis and design, measurement in software evaluation, knowledge engineering.

Computer Science

Computer Security Concentration

The Computer Science concentration in Computer Security is designed to supply graduates with the skills needed to prepare them for a wide range of opportunities. It gives students the ability to design and implement computing security and privacy processes, software, and systems. Students use mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of such systems.

Computer security specialists are needed who can work within cyberspace to help secure, defend against, respond to, and in some instances, even initiate preemptive attacks. These individuals must have detailed knowledge of the systems they protect, an understanding of the cyber-environment and physical environment in which they operate, and an understanding of the ethical expectations and legal surroundings of their field.

Additional Information

For more information about this concentration, visit the College of Computing & Informatics (https://drexel.edu/cci/academics/undergraduate-programs/bsba-computer-science/) website.

Degree Requirements - Computer Security Concentration

Students in the Computer Security concentration should follow the below concentration requirements in addition to the core degree requirements for the BS in Computer Science program (p. 3). For any questions regarding your plan of study, please contact your undergraduate advisor (https://drexel.edu/cci/current-students/undergraduate/advising/).

Program Requirements

The concentration in Computer Security follows the requirements of the B.S. in Computer Science (p. 3) except as noted below.

Computer Science Requirements		**67.0**
The following courses must be taken as the 6 CS track courses and the CS electives:		
CS 303	Algorithmic Number Theory and Cryptography	
CS 361	Concurrent Programming	
CS 370	Operating Systems	
CS 377	Software Security	
CS 467	Security and Human Behavior	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
INFO 310	Human-Centered Design Process & Methods	
Computing & Informatics Requirements		**15.0**

Mathematics Requirements	**27.0**
Science Requirements	**19.0**
Arts & Humanities Requirements	**36.0**
The following course must be taken as the Social Studies elective:	
PSY 101 General Psychology I	
The following course must be taken as the Business elective:	
ECON 201 Principles of Microeconomics	
University Requirements	**3.0**
Free Electives	**19.5**
Total Credits	**186.5**

Sample Plan of Study - Computer Security Concentration

5-Year Spring Summer Coop Cycle: Computer Security Concentration*

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
MATH 121	4.0	CS 171 or 175	3.0	ENGL 103 or 113	3.0		
ENGL 101 or 111	3.0	COOP 101*[1]	1.0	MATH 123	4.0		
UNIV CI101	1.0	ENGL 102 or 112	3.0	UNIV CI101	1.0		
Science Lab	4.5	MATH 122	4.0	Science Lab	4.5		
		Science Lab	4.5				
	17.5		**18.5**		**17.5**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 270	3.0	ECON 201	4.0				
PSY 101	3.0	MATH 221	3.0				
MATH 200	4.0	Free Elective	5.0				
SE 181	3.0						
	16		**15**		**0**		**0**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COM 230	3.0	CS 283	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 277	3.0	CS 360	3.0				
CS 281	4.0	Free Elective	6.0				
MATH 201	4.0	Science Elective	4.0				
SE 310	3.0						
	17		**16**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 303	3.0	CS 370	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 361	3.0	Arts and Humanities Elective	3.0				
INFO 310	3.0	Writing and Communications Elective	3.0				
MATH 311	4.0	Free Elective	3.0				
PHIL 311	3.0						
	16		**12**		**0**		**0**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
CS 467	3.0	CS 475	3.0	CS 377	3.0
CS 472	3.0	Arts and Humanities Elective	3.0	Science Elective	3.0
Writing and Communica Elective	3.0	Free Elective	4.0	Arts and Humanities Elective	3.0
Arts and Humanities Elective	3.0				
	15		**13**		**12**

Total Credits 185.5

4-Year Spring Summer Coop Cycle: Computer Security Concentration*

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
MATH 121	4.0	COOP 101**	1.0	ENGL 103 or 113	3.0		
ENGL 101 or 111	3.0	CS 171 or 175	3.0	MATH 123	4.0		
UNIV CI101	1.0	ENGL 102 or 112	3.0	UNIV CI101	1.0		
Science Lab	4.5	MATH 122	4.0	Science Lab	4.5		
		Science Lab	4.5				
	17.5		**18.5**		**17.5**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	COM 230	3.0	CS 283	3.0
CS 270	3.0	ECON 201	4.0	CS 277	3.0	CS 360	3.0
PSY 101	3.0	MATH 221	3.0	CS 281	4.0	Free Elective	6.0
MATH 200	4.0	Free Elective	6.0	MATH 201	4.0	Science Elective	4.0
SE 181	3.0			SE 310	3.0		
	16		**16**		**17**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 303	3.0	CS 370	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 361	3.0	Arts and Humanities Elective	3.0				
INFO 310	3.0	Writing and Communications Elective	3.0				
MATH 311	4.0	Free Elective	3.0				
PHIL 311	3.0						
	16		**12**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0

CS 467	3.0	CS 475	3.0	CS 377	3.0
CS 472	3.0	Arts and Humanities Elective	3.0	Arts and Humanities Elective	3.0
Writing and Communica Elective	3.0	Free Elective	4.0	Science Elective	3.0
Arts and Humanities Elective	3.0				
	15		**13**		**12**

Total Credits 186.5

* Co-op cycles may vary. Students are assigned a co-op cycle (fall/winter, spring/summer, summer only) based on their co-op programs (5-year or 4-year) and major.

** COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Computer Science

Game Programming and Development Concentration

The concentration in Game Programming and Development provides conceptual understanding of game design and practical experience in the design and the development of games. The courses in this concentration include fundamentals of game design and development, large-scale game development, and special topics in educational and experimental game design.

Additional Information

For more information about this concentration, visit the College of Computing & Informatics (https://drexel.edu/cci/academics/undergraduate-programs/bsba-computer-science/) website.

Degree Requirements - Game Programming and Development Concentration

Students in the Game Programming and Development concentration should follow the below concentration requirements in addition to the core degree requirements for the BS in Computer Science (p. 3).

The Game Programming and Development concentration follows the requirements of the BS in Computer Science (p. 3) except as noted below. For any questions regarding your plan of study, please contact your undergraduate advisor (https://drexel.edu/cci/current-students/undergraduate/advising/).

Program Requirements

Computer Science Requirements	**64.0**
Select three of the following courses to fulfill the Game Development and Design track:	
CS 341 Serious Game Development	
or CS 342 Experimental Game Development	
CS 345 Computer Game Design and Development	
CS 387 Game AI Development	
CS 445 Topics in Computer Gaming	
Computing & Informatics Requirements	**15.0**
Mathematics Requirements	**27.0**
Science Requirements	**19.0**
The sequence below must be taken as the lab science sequence:	
PHYS 101 Fundamentals of Physics I	
& PHYS 102 and Fundamentals of Physics II	
& PHYS 201 and Fundamentals of Physics III	
Arts & Humanities Requirements	**36.0**
The following course must be taken as the Social Studies elective:	
PSY 101 General Psychology I	
The following courses must be taken as Arts & Humanities electives:	
ANIM 140 Computer Graphics Imagery I	
ANIM 211 Animation I	
GMAP 260 Overview of Computer Gaming	
VSST 110 Introductory Drawing	
University Requirements	**4.0**
Free Electives	**21.5**
The following courses must be taken as a free elective:	
GMAP 377 Game Development: Workshop I	
GMAP 378 Game Development: Workshop II	
Total Credits	**186.5**

Sample Plan of Study (BS) - Game Programming and Development Concentration

5 YR Spring Summer Coop Cycle : Game Programming & Development Concentration*

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172	3.0		
ENGL 101 or 111	3.0	COOP 101**	1.0	ENGL 103	3.0		
MATH 121	4.0	CS 171	3.0	MATH 123	4.0		
PHYS 101	4.0	ENGL 102 or 112	3.0	PHYS 201	4.0		
UNIV CI101	1.0	MATH 122	4.0	UNIV CI101	1.0		
		PHYS 102	4.0				
	17		**18**		**17**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	ANIM 140	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 270	3.0	CS 260	3.0				
GMAP 260	3.0	PSY 101	3.0				
MATH 201	4.0	Free Elective	6.0				
SE 181	3.0						
	16		**15**		**0**		**0**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 277	3.0	COM 230	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 281	4.0	CS 283	3.0				
SE 310	3.0	CS 360	3.0				
VSST 110	3.0	Writing and Communications Elective	3.0				
GMPD Concentration Course	3.0	Arts and Humanities Elective	3.0				
	16		**15**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
ANIM 211	3.0	GMAP 378	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
GMAP 377	3.0	MATH 311	4.0				
MATH 200	4.0	Business Elective	4.0				
MATH 221	3.0	Free Elective	3.0				
PHIL 311	3.0						
	16		**14**		**0**		**0**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
GMPD Concentration Course	3.0	GMPD Concentration Course	3.0	Computer Science elective	3.0
Computer Science Elective	6.0	Computer Science elective	6.0	Writing & Communications Elective	3.0
Science Elective	3.0	Science elective	4.0	Free Elective	2.5
	15		**16**		**11.5**

Total Credits 186.5

4-Year Spring Summer Coop Cycle: Game Programming and Development Concentration*

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172	3.0		
ENGL 101 or 111	3.0	COOP 101**	1.0	ENGL 103 or 113	3.0		
MATH 121	4.0	CS 171	3.0	MATH 123	4.0		
PHYS 101	4.0	ENGL 102 or 112	3.0	PHYS 201	4.0		
UNIV CI101	1.0	MATH 122	4.0	UNIV CI101	1.0		
		PHYS 102	4.0				
	17		**18**		**17**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	ANIM 140	3.0	CS 277	3.0	COM 230	3.0
CS 270	3.0	CS 260	3.0	CS 281	4.0	CS 283	3.0
GMAP 260	3.0	PSY 101	3.0	SE 310	3.0	CS 360	3.0
MATH 201	4.0	Free Elective	5.0	VSST 110	3.0	Writing and Communications Elective	3.0
SE 181	3.0			GMPD Concentration Course	3.0	Arts and Humanities Elective	3.0
	16		**14**		**16**		**15**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
ANIM 211	3.0	GMAP 378	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
GMAP 377	3.0	MATH 311	4.0				
MATH 200	4.0	Business Elective	4.0				
MATH 221	3.0	Free Elective	3.0				
PHIL 311	3.0						
	16		**14**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
GMPD Concentration Course	3.0	GMPD Concentration Course	3.0	Computer Science Elective	3.0
Computer Science Elective	6.0	Computer Science Elective	6.0	Writing and Communications Elective	3.0
Science Elective	3.0	Science Elective	4.0	Free Elective	3.5
	15		**16**		**12.5**

Total Credits 186.5

* Co-op cycles may vary. Students are assigned a co-op cycle (fall/winter, spring/summer, summer only) based on their co-op program (5-year or 4-year) and major.

** COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Computing and Security Technology

Major: Computing and Security Technology
Degree Awarded: Bachelor of Science in Computing & Security Technology (BSCST)
Calendar Type: Quarter
Total Credit Hours: 188.0
Co-op Options: Three Co-op (Five years); One Co-op (Four years)
Classification of Instructional Programs (CIP) Code: 11.1003
Standard Occupational Classification (SOC) Code: 15-1122

Note: The on-campus CST major (Full Time only) admits new and transfer students Fall Quarter. The online CST major (Part Time only) admits transfer students Fall and Spring Quarters.

About the Program

The College of Computing & Informatics' Bachelor of Science in Computing & Security Technology (BSCST) prepares students for work related to securing and managing large-scale computing infrastructure. Students gain experience with core information technology (IT) areas including servers, databases, networks, the Web, information security and cybersecurity technologies. The program emphasizes practical education and fundamental concepts that are supplemented by laboratory experience.

Core courses provide students with practical knowledge and skills related to managing servers, network administration, database administration, and cybersecurity fundamentals. Students take advanced electives and a concentration in either Computing Technology or Computing Security. The advanced courses include topics such as mobile applications, wireless networks, risk assessment, intrusion detection, security audits, computer forensics, ethical hacking, cloud security, disaster recovery and continuity of business.

The degrees in Computing & Security Technology, Data Science (p. 23), and Information Systems (p. 29) share a common first year. This allows students to easily switch among the degrees early in their studies. In addition, some of the electives in each degree are accessible

to students in the other two majors; this provides a deeper and broader set of advanced topics for students in all three majors.

The BS in Computing & Security Technology is offered as a full-time, on-campus bachelor's degree program or as an online, part-time degree completion program for students who have completed approximately two years of college work.

For more information about this program, please visit the BS in Computing & Security Technology web page (https://drexel.edu/cci/academics/undergraduate-programs/bs-computing-security/) on the College of Computing & Informatics' website.

Degree Requirements

Students completing this major must select either a concentration in computing technology or a concentration in computing security.

Computing & Security Technology Core Requirements		
CT 140	Network Administration I	3.0
CT 200	Server I	3.0
CT 201	Information Technology Security I	3.0
CT 210	Open Server I	3.0
CT 301	Information Technology Security II	3.0
CT 310	Open Server II	3.0
CT 320	Server II	3.0
CT 330	Network Administration II	3.0
Students completing this major must select either a concentration in Computing Technology or a concentration in Computing Security. see below		21.0
Information Science Requirements		
INFO 101	Introduction to Computing and Security Technology	3.0
INFO 102	Introduction to Information Systems	3.0
INFO 103	Introduction to Data Science	3.0
INFO 200	Systems Analysis I	3.0
INFO 210	Database Management Systems	3.0
INFO 215	Social Aspects of Information Systems	3.0
INFO 310	Human-Centered Design Process & Methods	3.0
INFO 324 [WI]	Team Process and Product	3.0
INFO 355	Systems Analysis II	3.0
INFO 365	Database Administration I	3.0
INFO 420	Software Project Management	3.0
Programming Requirements		**9.0**
Choose one of the following sequences		
INFO 151 & CS 171 & CS 172	Web Systems and Services I and Computer Programming I and Computer Programming II	
INFO 151 & INFO 152 & INFO 153	Web Systems and Services I and Web Systems and Services II and Applied Data Management	
Computing & Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CT 491 [WI]	Senior Project I	3.0
CT 496 [WI]	Senior Project II	3.0
CCI elective *		6.0
Mathematics Requirements		
Choose Mathematics Sequence		8.0
If a Math seqence of less than 8 credits is taken, additional 2 credits added to free electives		
MATH 171 & MATH 172	Introduction to Analysis A and Introduction to Analysis B	
MATH 101 & MATH 102	Introduction to Analysis I and Introduction to Analysis II	
MATH 121 & MATH 122	Calculus I and Calculus II	
MATH 180	Discrete Computational Structures	4.0
STAT 201	Introduction to Business Statistics	4.0
Natural Science Requirements **		**8.0**
Liberal Studies Requirements		
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
COM 230	Techniques of Speaking	3.0
Liberal Studies Electives ***		12.0
University Requirements		
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development	1.0
Free Electives		**31.0**
Total Credits		**188.0**

* One course must be a CCI 300 level or higher course.

** Students select any non-required courses from the following: ANAT, BIO, CHEM, ENVS, FDSC, NFS, PHEV, PHYS, HSCI, GEO, ENSS.

*** Students select any non-required courses from the following: ANTH, COM, ENGL, HIST, PHIL, PSCI, PSY, SOC, WRIT, ECON, ENTP, ARTH, FMST, MUSC, TVST, VSST

Please note: If a Computing & Security Technology student pursues a Business Administration Minor, MIS classes do not count towards the Business Administration Minor for Computing & Security Technology students. Students must choose another option to fulfill the Business Administration Minor requirements.

Concentration in Computing Technology

Computing Technology Concentration Requirements		
CT 335	Mobile Applications	3.0
CT 353	Virtual Environments and Cloud Security	3.0
CT 355	Wireless Network Security Technology	3.0
CT 415	Disaster Recovery and Continuity Planning	3.0
INFO 366	Database Administration II	3.0
Computing Technology Electives		
Select two of the following:		6.0
CT 362	Network Auditing Tools	
CT 393	Information Technology Security Risk Assessment	
CT 412	Information Technology Security Policies	
INFO 215	Social Aspects of Information Systems	
INFO 315	Advanced Database Management Systems	
Total Credits		**21.0**

Concentration in Computing Security

Computing Security Concentration Requirements		
CT 212	Computer Forensics I: Fundamentals	3.0
CT 312	Access Control and Intrusion Detection Technology	3.0
CT 400	Network Security	3.0
CT 412	Information Technology Security Policies	3.0

CT 432	Information Technology Security Systems Audits	3.0
Computing Security Electives		
Select two of the following:		6.0
CT 250	IT Security Awareness	
CT 382	Applied Cryptography	
CT 393	Information Technology Security Risk Assessment	
CT 414	Ethical Hacking and Penetration Testing	
CT 415	Disaster Recovery and Continuity Planning	
Total Credits		**21.0**

Concentrations: Sample Plans of Study

Computing Technology Concentration

4-Year, 1 co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	ENGL 103 or 113	3.0		
INFO 101	3.0	ENGL 102 or 112	3.0	INFO 103	3.0		
INFO 151	3.0	INFO 102	3.0	INFO 153 or CS 172	3.0		
MATH 171	3.0	INFO 152 or CS 171	3.0	MATH 180	4.0		
UNIV CI101	1.0	MATH 172	3.0	UNIV CI101	1.0		
	15		**15**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP 101*	1.0	CT 310	3.0	CT 200	3.0	CT 301	3.0
CT 140	3.0	CT 330	3.0	CT 201	3.0	CT 320	3.0
CT 210	3.0	INFO 210	3.0	CT 212	3.0	INFO 355	3.0
INFO 200	3.0	STAT 201	4.0	Liberal Studies Elective	3.0	Free Elective	3.0
INFO 215	3.0	Free Elective	3.0	Science Elective I	4.0	Science Elective II	4.0
Free Elective	3.0						
	16		**16**		**16**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		COM 230	3.0	CT 412	3.0
				CT 312	3.0	INFO 324	3.0
				INFO 310	3.0	INFO 420	3.0
				INFO 365	3.0	Computing Security Elective	3.0
				Liberal Studies Elective	3.0	Free Elective	3.0
				Free Elective	3.0		
	0		**0**		**18**		**15**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CT 400	3.0	CT 432	3.0	CT 496	3.0
CCI Elective	3.0	CT 491	3.0	CCI Elective	3.0
Computing Security Elective	3.0	Free Electives	9.0	Free Elective	6.0
Free Elective	3.0			Liberal Studies Elective	3.0
Liberal Studies Elective	3.0				
	15		**15**		**15**

Total Credits 188

* COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

5-Year, 3 co-ops

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	ENGL 103 or 113	3.0		
INFO 101	3.0	COOP 101*	1.0	INFO 103	3.0		
INFO 151	3.0	ENGL 102 or 112	3.0	INFO 153 or CS 172	3.0		
MATH 171	3.0	INFO 102	3.0	MATH 180	4.0		
UNIV CI101	1.0	INFO 152 or CS 171	3.0	UNIV CI101	1.0		
		MATH 172	3.0				
	15		**16**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		CT 140	3.0	CT 310	3.0
				CT 210	3.0	CT 330	3.0
				INFO 200	3.0	INFO 210	3.0
				INFO 215	3.0	STAT 201	4.0
				Free Elective	3.0	Free Elective	3.0
	0		**0**		**15**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		CT 200	3.0	CT 301	3.0
				CT 201	3.0	CT 320	3.0
				CT 212	3.0	INFO 355	3.0
				Liberal Studies Elective	3.0	Free Elective	3.0
				Science Elective I	4.0	Science Elective II	4.0
	0		**0**		**16**		**16**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		COM 230	3.0	CT 412	3.0
				CT 312	3.0	INFO 324	3.0
				INFO 310	3.0	INFO 420	3.0
				INFO 365	3.0	Computing Security Elective	3.0
				Liberal Studies Elective	3.0	Free Elective	3.0
				Free Elective	3.0		
	0		**0**		**18**		**15**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CT 400	3.0	CT 432	3.0	CT 496	3.0
CCI Elective	3.0	CT 491	3.0	CCI Elective	3.0
Computing Security Elective	3.0	Free Electives	9.0	Free Electives	6.0
Free Elective	3.0			Liberal Studies Elective	3.0
Liberal Studies Elective	3.0				
	15		**15**		**15**

Total Credits 188

* COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Computing Security Concentration

4-Year, 1 co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	ENGL 103 or 113	3.0		
INFO 101	3.0	CS 171	3.0	INFO 103	3.0		
INFO 151	3.0	ENGL 102 or 112	3.0	INFO 153 or CS 172	3.0		
MATH 171	3.0	INFO 102	3.0	MATH 180	4.0		
UNIV CI101	1.0	MATH 172	3.0	UNIV CI101	1.0		
	15		**15**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP 101*	1.0	CT 301	3.0	CT 200	3.0	CT 310	3.0
CT 140	3.0	CT 330	3.0	CT 210	3.0	CT 320	3.0
CT 201	3.0	INFO 210	3.0	CT 335	3.0	INFO 355	3.0
INFO 200	3.0	STAT 201	4.0	Liberal Studies Elective	3.0	Free Elective	3.0
INFO 215	3.0	Free Elective	3.0	Science Elective I	4.0	Science Elective II	4.0
Free Elective	3.0						
	16		**16**		**16**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		COM 230	3.0	INFO 324	3.0
				INFO 310	3.0	INFO 366	3.0
				INFO 365	3.0	INFO 420	3.0
				Computing Technology Elective	3.0	Free Electives	6.0
				Liberal Studies Elective	3.0		
				Free Elective	3.0		
	0		**0**		**18**		**15**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CT 355	3.0	CT 362	3.0	CT 415	3.0
CCI Elective	3.0	CT 491	3.0	CT 496	3.0
Liberal Studies Elective	3.0	Computing Technology Elective	3.0	Free Electives	6.0
Free Electives	6.0	Free Electives	6.0	Liberal Studies Elective	3.0
	15		**15**		**15**

Total Credits 188

* COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

5-Year, 1 co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	ENGL 103 or 113	3.0		
INFO 101	3.0	COOP 101*	1.0	INFO 103	3.0		
INFO 151	3.0	ENGL 102 or 112	3.0	INFO 153 or CS 172	3.0		
MATH 171	3.0	INFO 102	3.0	MATH 180	4.0		
UNIV CI101	1.0	INFO 152 or CS 171	3.0	UNIV CI101	1.0		
		MATH 172	3.0				
	15		**16**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		CT 140	3.0	CT 301	3.0
				CT 201	3.0	CT 330	3.0
				INFO 200	3.0	INFO 210	3.0
				INFO 215	3.0	STAT 201	4.0
				Free Elective	3.0	Free Elective	3.0
	0		**0**		**15**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		CT 200	3.0	CT 310	3.0
				CT 210	3.0	CT 320	3.0
				CT 335	3.0	INFO 355	3.0
				Liberal Studies Elective	3.0	Free elective	3.0
				Science Elective I	4.0	Science Elective II	4.0
	0		**0**		**16**		**16**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		COM 230	3.0	INFO 324	3.0
				INFO 310	3.0	INFO 366	3.0
				INFO 365	3.0	INFO 420	3.0
				Computing Technology Elective	3.0	Free Electives	6.0

				Liberal Studies Elective	3.0	
				Free Elective	3.0	
	0		0		18	15

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits	
CT 355	3.0	CT 362	3.0	CT 415	3.0	
CCI Elective	6.0	CT 491	3.0	CT 496	3.0	
Liberal Studies Elective	3.0	Computing Technology Elective	3.0	Free Elective	6.0	
Free Elective	3.0	Free Electives	6.0	Liberal Studies Elective	3.0	
	15		15		15	

Total Credits 188

* COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Co-Op/Career Opportunities

Co-Op Options

Two co-op options are available for this program:

- 5-year/3 co-op
- 4-year/1 co-op

Co-op is not available for online students.

Career Opportunities

Graduates of the Computing and Security Technology program who complete a concentration in Computing Technology can pursue careers as information technologists and advanced technicians in a wide range of industries. Information technologists are capable of performing multiple IT tasks and accessing various information resources. The program gives students a unique set of applied skills that allow them to fill a number of roles as part of the information systems team. Graduates with a concentration in Computing Security pursue careers as advanced technicians who operate and administer the security tools, technologists who create and install security solutions, and leaders who define the security policies.

Job titles of recent computing and security technology graduates include:

- Security Administrator
- Chief Information Security Officer
- IT Audit Manager
- Project Manager
- Lead Systems Engineer
- Network Engineer
- Server Engineer

Visit the Drexel Steinbright Career Development Center (http://www.drexel.edu/scdc/) page for more information on career opportunities.

Facilities

3675 Market Street

In March 2019, the College of Computing & Informatics relocated to 3675 Market (https://drexel.edu/cci/about/our-facilities/). For the first time in the College's history, all CCI faculty, students and professional staff are housed under one roof. Occupying two floors in the brand new uCity Square building, CCI's new home offers state-of-the-art technology in our classrooms, labs, meeting areas and collaboration spaces. 3675 Market offers Class A laboratory, office, coworking, and convening spaces. In fall 2019, the College will open a third floor which will include additional offices, classrooms, a research lab, a maker space, and a ground-breaking DXC Technology Innovation Lab. Located at the intersection of Market Street and 37th Street, 3675 Market will act as a physical nexus, bridging academic campuses and medical centers to the east and south, the commercial corridors along Market Street and Chestnut Street, and the residential communities to the north and west.

The uCity Square building offers:

- Speculative lab/office space
- World-class facilities operated by CIC (https://cic.us/philadelphia/)
- Café/restaurant on-site
- Quorum, a two-story, 15K SF convening space and conference center
- Adjacent to future public square
- Access to Science Center’s nationally renowned business acceleration and technology commercialization programs

Drexel University Libraries

Drexel University Libraries (http://www.library.drexel.edu/) is a learning enterprise, advancing the University’s academic mission through serving as educators, supporting education and research, collaborating with researchers, and fostering intentional learning outside of the classroom. Drexel University Libraries engages with Drexel communities through three physical locations, including W. W. Hagerty Library, Queen Lane Library, and the Library Learning Terrace, as well as a vibrant online presence which sees, on average, over 8,000 visits per day. In the W.W. Hagerty Library location, College of Computing & Informatics students have access to private study rooms and nearly half a million books, periodicals, DVDs, videos and University Archives. All fields of inquiry are covered, including: library and information science, computer science, software engineering, health informatics, information systems, and computing technology. Resources are available online at library.drexel.edu (http://www.library.drexel.edu/) or in-person at W. W. Hagerty Library (http://www.library.drexel.edu/locations/).

The Libraries also make available laptop and desktop PC and Mac computers, printers and scanners, spaces for quiet work or group projects and designated 24/7 spaces. Librarians and library staff—including a liaison librarian for computing and informatics—are available for individual research consultations and to answer questions about materials or services.

CCI Commons

Located on the 10th floor of 3675 Market Street, the CCI Commons is an open lab and collaborative work environment for students. It features desktop computers, a wireless/laptop area, free black and white printing, and more collaborative space for its students. Students have access to 3675 Market’s fully equipped conference room with 42” displays and videoconferencing capabilities. The CCI Commons provides technical

support to students, faculty, and professional staff. In addition, the staff provides audio-visual support for all presentation classrooms within 3675 Market. Use of the CCI Commons is reserved for all students taking CCI courses.

The computers for general use are Microsoft Windows and Macintosh OSX machines with appropriate applications which include the Microsoft Office suite, various database management systems, modeling tools, and statistical analysis software. Library related resources may be accessed at the CCI Commons and through the W.W. Hagerty Library. The College is a member of the Rational SEED Program which provides cutting-edge software development and project management software for usage in the CCI Commons and CCI classrooms. The College is also a member of the Microsoft Academic Alliance known also as “DreamSpark” that allows students free access to a wide array of Microsoft software titles and operating systems.

The CCI Commons, student labs, and classrooms have access to networked databases, print and file resources within the College, and the Internet via the University’s network. Email accounts, Internet and BannerWeb access are available through the Office of Information Resources and Technology.

CCI Learning Center

The CCI Learning Center (CCILC), located in 3675 Market Street's CCI Commons student computer lab, provides consulting and other learning resources for students taking computer science classes. The CCILC is staffed by graduate and undergraduate computer science students from the College of Computing & Informatics.

The CCILC and CCI Commons serve as a central hub for small group work, student meetings, and TA assistance.

Research Laboratories

The College houses multiple research labs, led by CCI faculty, in 3675 Market Street including: the Drexel Health and Risk Communication Lab, Interactive Systems for Healthcare, Socio-Technical Studies Group, Intelligent Information & Knowledge Computing Research Lab, Evidence-based Decision Making Lab, Applied Symbolic Computation Laboratory (ASYM), High Performance Computing Laboratory (SPIRAL), Drexel Research on Play (RePlay) Laboratory, Software Engineering Research Group (SERG), Social Computing Research Group, Vision and Cognition Laboratory (VisCog) and the Vision and Graphics Laboratory. For more information on these laboratories, please visit the College’s research web page (http://cci.drexel.edu/research.aspx).

Evaluations

The College of Computing & Informatics works continually to improve its degree programs. As part of this effort, the Computing & Security Technology degree is evaluated relative to the following Objectives and Outcomes.

BS Computing & Security Technology Program Educational Objectives

Within three to five years of graduating, alumni of the program are expected to achieve one or more of the
following milestones:

- Be valued contributors to private or public organizations as demonstrated by promotions, increased responsibility, or other professional recognition
- Contribute to professional knowledge as demonstrated by published papers, technical reports, patents, or conference presentations
- Succeed in continuing professional development as demonstrated by completion of graduate studies or professional certifications
- Display commitment and leadership within the profession and community as demonstrated by contributions towards society's greater good and prosperity

BS Computing & Security Technology Program Student Outcomes

The program enables students to attain, by the time of graduation:

- An ability to apply knowledge of computing and mathematics appropriate to the program’s student outcomes and to the discipline
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
- An ability to function effectively on teams to accomplish a common goal
- An understanding of professional, ethical, legal, security and social issues and responsibilities
- An ability to communicate effectively with a range of audiences
- An ability to analyze the local and global impact of computing on individuals, organizations, and society
- Recognition of the need for and an ability to engage in continuing professional development
- An ability to use current techniques, skills, and tools necessary for computing practice

Computing & Informatics Faculty

Denise E. Agosto, PhD *(Rutgers, The State University of New Jersey)*. Professor. Youth information behaviors, public libraries, multicultural issues in youth library services, and qualitative research methods.

Yuan An, PhD *(University of Toronto, Canada) Director of International Programs*. Associate Professor. Conceptual modeling, schema and ontology mapping, information integration, knowledge representation, requirements engineering, healthcare information systems, semantic web.

David Augenblick, MS *(University of Pennsylvania)*. Associate Teaching Professor. Introductory and object-oriented programming, data structures and database systems, computer application project management, application of computer programming principles and solutions to engineering problems.

Ellen Bass, PhD *(Georgia Institute of Technology) Joint Appointment with the College of Nursing and Health Professions*. Professor. Characterizing human judgement and decision making, modeling human judgement when supported by information automation, computational models of human-human and human-automation coordination.

Mark Boady, PhD *(Drexel University)*. Assistant Teaching Professor. Computer Algebra, complex symbolic calculations, automation of computation problems

David E. Breen, PhD *(Rensselaer Polytechnic Institute) Associate Department Head for Graduate Affairs, Computer Science*. Professor. Computer-aided design, biomedical image informatics, geometric modeling and self-organization algorithms.

Matthew Burlick, PhD *(Stevens Institute of Technology)*. Associate Teaching Professor. Image processing, machine learning, real-time video tracking, object detection and classification, statistics/probability, and acoustics

Yuanfang Cai, PhD *(University of Virginia)*. Professor. Formal software design modeling and analysis, software economics, software evolution and modularity.

Andrew Calhoun, MS *(American Military University)*. Social engineering, ethical hacking, information assurance, business continuity & disaster recovery planning, Computer forensics, and Computer security

Christopher Carroll, MS *(Drexel University) BSCST Program Director*. Associate Teaching Professor. Information technology within healthcare companies, computer networking and design, IT infrastructure, server technology, information security, virtualization and cloud computing.

Preetha Chatterjee, PhD *(University of Delaware)*. Assistant Professor. Software engineering, data mining, natural language processing, and machine learning

Chaomei Chen, PhD *(University of Liverpool)*. Professor. Information visualization, visual analytics, knowledge domain visualization, network analysis and modeling, scientific discovery, science mapping, scientometrics, citation analysis, human-computer interaction.

Michael Chu, MSE *(University of Pennsylvania)*. Associate Teaching Professor. System, server, computer networking and design; IT infrastructure; information technology management and security; Web system programming; database and mobile application development.

Andrea Forte, PhD *(Georgia Institute of Technology) PhD Program Director, and MS in Information Program Director*. Associate Professor. Social computing, human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, information literacy.

Susan Gasson, PhD *(University of Warwick)*. Associate Professor. The co-design of business and IT-systems, distributed cognition & knowledge management in boundary-spanning groups, human-centered design, social informatics, online learning communities, grounded theory.

Vasilis Gkatzelis, PhD *(New York University)*. Assistant Professor. Algorithmic mechanism design, multiagent resource allocation, approximation algorithms .

Colin Gordon, PhD *(University of Washington)*. Associate Professor. Software reliability, program behavior, concurrent and systems-level code, formal assurance, programming models, distributed computing, even testing

Tim Gorichanaz, PhD *(Drexel University)*. Assistant Teaching Professor. Human information behavior, human-centered computing, neo-documentation studies, and information ethics.

Jane Greenberg, PhD *(University of Pittsburgh) Alice B. Kroeger Professor*. Metadata, ontological engineering, data science, knowledge organization, information retrieval

Peter Grillo, PhD *(Temple University) Associate Department Head for Undergraduate Affairs, Information Science*. Teaching Professor. Software economics, Project management, Strategic applications of technology within organizations.

Thomas Heverin, PhD *(Drexel University)*. Associate Teaching Professor. Computer security, ethical hacking, computer forensics, network forensics, cloud security and cybersecurity.

Gregory W. Hislop, PhD *(Drexel University)*. Professor. Information technology for teaching and learning, online education, structure and organization of the information disciplines, computing education research, software evaluation and characterization.

Xiaohua Tony Hu, PhD *(University of Regina, Canada)*. Professor. Data mining, text mining, Web searching and mining, information retrieval, bioinformatics and healthcare informatics.

Jina Huh-Yoo, PhD *(University of Michigan at Ann Arbor)*. Assistant Professor. Human-computer interaction, humancentered design, Health informatics, mobile and wireless health, social computing.

Shahin Jabbari Assistant Professor. Algorithmic fairness, game theory, and artificial intelligence for social good.

Jeremy R. Johnson, PhD *(Ohio State University) Department Head, Computer Science*. Professor. Computer algebra; parallel computations; algebraic algorithms; scientific computing.

Constantine Katsinis, PhD *(University of Rhode Island)*. Teaching Professor. High-performance computer networks, parallel computer architectures with sustained teraflops performance, computer security, image processing.

Weimao Ke, PhD *(University of North Carolina at Chapel Hill)*. Associate Professor. Information retrieval (IR), distributed systems, intelligent filtering/recommendation, information visualization, network science, complex systems, machine learning, text/data mining, multi-agent systems, the notion of information.

Mat Kelly, PhD *(Old Dominion University)*. Assistant Professor. Information retrieval, Web archives, metadata, digital humanities, archival privacy

Ehasn B. Khosroshahi, PhD *(Drexel University)*. Assistant Teaching Professor. Computational cognitive modeling, artificial intelligence, machine learning and data analysis.

Edward Kim, PhD *(Lehigh University)*. Associate Professor. Computer Vision, Sparse Coding, Neuromorphic Computing, Medical Image Processing, Computer Graphics, Artificial Intelligence, Game Development

Xia Lin, PhD *(University of Maryland at College Park) Department Head, Information Science*. Professor. Digital libraries, information visualization, visual interface design, knowledge mapping, human-computer interaction, information retrieval, information architecture, informetrices, information-seeking behaviors in digital environments.

Galen Long, MS *(Drexel University)*. Assistant Teaching Professor.

Chris MacLellan, PhD *(Carnegie Mellon University)*. Assistant Professor. Artificial intelligence, data science, machine learning, human-computer interaction, cognitive modeling,

Geoffrey Mainland, PhD *(Harvard University)*. Associate Professor. High-level programming languages and runtime support for non-general purpose computation.

Spiros Mancoridis, PhD *(University of Toronto) The Auerbach Berger Chair in Cybersecurity Distinguished Professor of Computer Science*.

Professor. Software engineering; software security; code analysis; evolutionary computation.

Adelaida Alban Medlock, MS *(Drexel University) Associate Department Head for Undergraduate Affairs, Computer Science*. Teaching Professor. Introductory programming; computer science education.

Danuta A. Nitecki, PhD *(University of Maryland at College Park) Dean of Libraries*. Professor. Library metrics and use in management, library as place, and academic library service models.

Krzysztof Nowak, PhD *(Washington University)*. Associate Teaching Professor. Fourier analysis, partial differential equations, image processing, wavelets, asymptotic distribution of eigenvalues, numerical methods and algorithms, computer science education.

Santiago Ontañón, PhD *(University of Barcelona)*. Associate Professor. Game AI, computer games, artificial intelligence, machine learning, case-based reasoning

Yusuf Osmanlioglu, PhD *(Drexel University)*. Assistant Teaching Professor. Graph theory and algorithms, brain network analysis, optimization, computer vision, natural language processing.

Jung-ran Park, PhD *(University of Hawaii at Manoa)*. Associate Professor. Knowledge organization and representation, metadata, computer-mediated communication, cross-cultural communication, multilingual information access.

Tammy Pirmann, Ed D *(Gwynedd Mercy University)*. Teaching Professor. Introductory programming, object-oriented programming, game design, mobile computing, computer science education, computer science educator pipeline

Alex Poole, PhD *(University of North Carolina)*. Assistant Professor. Digital curation, archives and records management, digital humanities, and diversity, inclusivity, and equity.

Jeffrey L. Popyack, PhD *(University of Virginia)*. Professor. Operations research, stochastic optimization, computational methods of Markov decision processes; artificial intelligence, computer science education.

Emmanouil Pountourakis, PhD *(Northwestern University)*. Assistant Professor. Algorithmic game theory, algorithmic mechanism design, algorithmic aspects of behavioral economics, game theory and learning, computational and game theoretic aspects of energy grids

Michelle L. Rogers, PhD *(University of Wisconsin-Madison)*. Associate Professor. Human-computer interaction, healthcare informatics, human factors engineering, socio-technical systems, health services research, patient safety.

Jeffrey Salvage, MS *(Drexel University)*. Teaching Professor. Object-oriented programming, multi-agent systems, software engineering, database theory, introductory programming, data structures.

Dario Salvucci, PhD *(Carnegie Mellon University)*. Professor. Human computer interaction, cognitive science, machine learning, applications for driving.

Aleksandra Sarcevic, PhD *(Rutgers University)*. Associate Professor. Computer-supported cooperative work, human-computer interaction, and healthcare informatics.

Kurt Schmidt, MS *(Drexel University)*. Associate Teaching Professor. Data structures, math foundations for computer science, programming tools, programming languages.

Bhupesh Shetty, PhD *(University of Iowa)*. Assistant Teaching Professor. Process pattern mining, data mining, operations management, sports analytics, information systems, and machine learning applications.

Ali Shokoufandeh, PhD *(Rutgers University) Senior Associate Dean for Academic Affairs and Operations*. Professor. Theory of algorithms, graph theory, combinational optimization, computer vision.

Il-Yeol Song, PhD *(Louisiana State University)*. Professor. Conceptual modeling, ontology and patterns, data warehouse and OLAP, object-oriented analysis and design with UML, medical and bioinformatics data modeling & integration,.

Bo Song, PhD *(Drexel University)*. Assistant Teaching Professor. Database management, Data mining, bioinformatics, big data analytics, and knowledge discovery.

Brian Stuart, PhD *(Purdue University)*. Associate Teaching Professor. Machine learning, networking, robotics, image processing, simulation, interpreters, data storage, operating systems, computer science, data communications, distributed/operating systems, accelerated computer programming, computer graphics.

Milad Toutounchian, PhD *(Simon Fraser University)*. Assistant Teaching Professor. Data Science, Applied Machine Learning and Deep Learning.

Boris Valerstein, MS *(Pennsylvania State University)*. Assistant Teaching Professor.

Dimitra Vista Teaching Professor. Database systems

Filippos Vokolos, PhD *(Polytechnic University)*. Associate Teaching Professor. System architecture, principles of software design and construction, verification and validation methods for the development of large software systems, foundations of software engineering, software verification & validation, software design, programming languages, dependable software systems.

Lei Wang, PhD *(Drexel University)*. Assistant Teaching Professor. Biomedical data science, machine learning, deep learning, neuroimaging processing & analytics, natural language processing, simulation modeling.

Rosina Weber, PhD *(Federal University of Santa Catarina)*. Associate Professor. Case-based reasoning, explainable artificial intelligence, machine learning, textual analytics, natural language understanding, language models, recommender systems, technological aspects of knowledge management, project management, and requirements engineering.

Jake Williams, PhD *(University of Vermont)*. Assistant Professor. Data science, scientific programming, computational social science, computational linguistics and natural language processing, mathematics, machine learning, algorithms, and scalability.

Kaidi Xu, PhD *(Northeastern University)*. Assistant Professor. AI security, explainable artificial intelligence, optimization.

Erija Yan, PhD *(Indiana University Bloomington)*. Associate Professor. Network Science, information analysis and retrieval, scholarly communication methods and applications.

Christopher C. Yang, PhD *(University of Arizona, Tucson)*. Professor. Web search and mining, security informatics, knowledge management, social media analytics, cross-lingual information retrieval, text summarization, multimedia retrieval, information visualization, information sharing and privacy, artificial intelligence, digital library, and electronic commerce.

Emeritus Faculty

Michael E. Atwood, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, organizational memory.

Bruce W. Char, PhD *(University of California-Berkeley)*. Professor Emeritus. Symbolic mathematical computation, algorithms and systems for computer algebra, problem-solving environments parallel and distributed computation.

Thomas A. Childers, PhD *(Rutgers University)*. Professor Emeritus. Measurement, evaluation, and planning of information and library services, the effectiveness of information organizations.

David E. Fenske, PhD *(University of Wisconsin-Madison)*. Dean Emeritus and Professor. Digital libraries, informatics, knowledge management and information technologies.

John B. Hall, PhD *(Florida State University)*. Professor Emeritus. Academic library service, library administration, organization of materials.

Katherine W. McCain, PhD *(Drexel University)*. Professor Emeritus. Scholarly communication, information production and use in the research process, development and structure of scientific specialties, diffusion of innovation, bibliometrics, evaluation of information retrieval systems.

Carol Hansen Montgomery, PhD *(Drexel University) Dean of Libraries Emeritus*. Research Professor. Selection and use of electronic collections, evaluation of library and information systems, digital libraries, economics of libraries and digital collections.

Delia Neuman, PhD *(The Ohio State University)*. Professor Emerita. Learning in information-rich environments, instructional systems design, the use of media for learning, and school library media.

Gerry Stahl, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, theory of collaboration.

Howard D. White, PhD *(University of California at Berkeley)*. Professor Emeritus. Literature information systems, bibliometrics, research methods, collection development, online searching.

Susan Wiedenbeck, PhD *(University of Pittsburgh)*. Professor Emeritus. Human-computer interaction, end-user programming/end-user development, empirical studies of programmers, interface design and evaluation.

Data Science

Major: Data Science
Degree Awarded: Bachelor of Science in Data Science (BSDS)
Calendar Type: Quarter
Total Credit Hours: 187.0
Co-op Options: Three Co-op (Five years); One Co-op (Four years)
Classification of Instructional Programs (CIP) code: 11.0401; 11.0501; 11.0802
Standard Occupational Classification (SOC) code: *15-1121; 15-1141*

About the Program

The Bachelor of Science in Data Science (BSDS) prepares students to meet the challenges presented by the explosive growth of very large scale and complex data sources. The availability of data from sources such as business activities, social media and scientific instruments constantly creates new problems requiring data-driven solutions and opportunities and problems for innovation. BS in Data Science students develop the knowledge and skill to address these opportunities for the benefit of individuals and organizations. Students in the degree complete a minor, typically in business or the sciences, to provide knowledge and skill in a specific subject area to which data science techniques can be applied.

Data Science students learn to:

- Define domain specific and context-relevant data analytics questions and hypotheses for individuals and organizations.
- Select relevant data sources and transform data suitable for solving data analytics problems.
- Identify appropriate techniques and tools for acquiring, retrieving, analyzing, and making use of the data.
- Apply data analytics techniques and skills to build analytical and predictive models for answering data science questions.
- Create visualizations and communicate data analytics results to stakeholders and decision makers.
- Assess the necessary skills arising from the interdisciplinary nature of data science as a combination of hacking skills, analytical techniques, and domain knowledge.

The degrees in Computing and Security Technology (p. 15), Data Science, and Information Systems (p. 29) share a common first year. This allows students to easily switch among the degrees early in their studies. In addition, some of the electives in each degree are accessible to students in the other two majors; this provides a deeper and broader set of advanced topics for students in all three majors.

Additional Information

For more information about this program, please visit the BS in Data Science web page (https://drexel.edu/cci/academics/undergraduate-programs/bs-datascience/) on the College of Computing & Informatics' website.

Degree Requirements

Data Science Requirements		
INFO 101	Introduction to Computing and Security Technology	3.0
INFO 102	Introduction to Information Systems	3.0
INFO 103	Introduction to Data Science	3.0
INFO 200	Systems Analysis I	3.0
INFO 202	Data Curation	3.0
INFO 210	Database Management Systems	3.0
or CS 461	Database Systems	
INFO 212	Data Science Programming I	3.0
INFO 213	Data Science Programming II	3.0
INFO 215	Social Aspects of Information Systems	3.0
INFO 250	Information Visualization	3.0
INFO 300	Information Retrieval Systems	3.0
INFO 323	Cloud Computing and Big Data	3.0
INFO 332	Exploratory Data Analytics	3.0
INFO 371	Data Mining Applications	3.0

INFO 432	Advanced Data Analytics	3.0
INFO 440	Social Media Data Analysis	3.0
INFO 442	Data Science Projects	3.0
CCI Electives		**6.0**
Select 2 CCI courses that are at 200 or above level and not otherwise required		
Data Science Electives		**6.0**
Select 2 of the following courses:		
CS 375	Web and Mobile App Development	
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
INFO 315	Advanced Database Management Systems	
INFO 350	Visual Analytics	
INFO 355	Systems Analysis II	
INFO 420	Software Project Management	
Computing and Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CI 491 [WI]	Senior Project I	3.0
CI 492 [WI]	Senior Project II	3.0
CI 493 [WI]	Senior Project III	3.0
Introductory Programming		
INFO 151	Web Systems and Services I	3.0
CS 171	Computer Programming I	3.0
CS 172	Computer Programming II	3.0
Mathematics Requirements		
Select one of the following sequences:		12.0
MATH 101 & MATH 102 & MATH 180	Introduction to Analysis I and Introduction to Analysis II and Discrete Computational Structures	
MATH 121 & MATH 122 & MATH 180	Calculus I and Calculus II and Discrete Computational Structures	
Statistics Requirements		
STAT 201	Introduction to Business Statistics	4.0
STAT 202	Business Statistics II	4.0
Natural Science Requirements		
Science electives: Select from ANAT, BIO, CHEM, ENVS, FDSC, NFS, PHEV, PHYS. Courses from other departments may be considered with advisor approval.		8.0
Behavioral and Social Science Requirements		
PSY 101	General Psychology I	3.0
PSY 330	Cognitive Psychology	3.0
Arts and Humanities Requirements		
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
COM 230	Techniques of Speaking	3.0
or COM 310	Technical Communication	
University and College Requirements		
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development **	1.0
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
Minor Requirements *		**24.0**
Choose a minor in a data science application area including business and natural science		
Free Electives		**26.0**
Total Credits		**187.0**

* Students should consult their academic advisor regarding a minor that requires more than 24.0 credits. *Please note:* If a Business Administration Minor is selected, MIS classes do not count towards the Business Administration Minor for Data Science students. Students must choose another option to fulfill the Business Administration Minor requirements.

** COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Writing-Intensive Course Requirements

In order to graduate, all students must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/writing-intensive-courses/) at the University Writing Program (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/). (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/drexel-writing-center/) Students scheduling their courses can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

Sample Plan of Study

5 year, 3 co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	CS 172	3.0		
INFO 101	3.0	COOP 101*	1.0	ENGL 103 or 113	3.0		
INFO 151	3.0	CS 171	3.0	INFO 103	3.0		
MATH 101 or 121	4.0	ENGL 102 or 112	3.0	MATH 180	4.0		
UNIV CI101	1.0	INFO 102	3.0	UNIV CI101	1.0		
		MATH 102 or 122	4.0				
	16		**17**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		INFO 200	3.0	INFO 213	3.0
				INFO 202	3.0	INFO 215	3.0
				INFO 210 or CS 461	3.0	INFO 250	3.0
				INFO 212	3.0	PSY 101	3.0
				STAT 201	4.0	STAT 202	4.0
	0		**0**		**16**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		COM 230 or 310	3.0	INFO 332	3.0
				INFO 300	3.0	PSY 330	3.0
				INFO 323	3.0	Data Science Elective	3.0
				INFO 371	3.0	Free Elective	3.0
				Science Elective	4.0	Science Elective	4.0
	0		**0**		**16**		**16**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		INFO 432	3.0	INFO 442	3.0
				INFO 440	3.0	Free Elective	3.0
				Data Science Elective	3.0	Minor Electives	6.0
				Minor Elective	3.0	CCI Elective	3.0
				Free Elective	3.0		
	0		**0**		**15**		**15**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
Free Electives	5.0	CCI Elective	3.0	Free Electives	6.0
Minor Electives	6.0	Free Electives	6.0	Minor Electives	6.0
		Minor Elective	3.0		
	14		**15**		**15**

Total Credits 187

* COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

4 year, one co-op

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	CS 172	3.0		
INFO 101	3.0	CS 171	3.0	ENGL 103 or 113	3.0		
INFO 151	3.0	ENGL 102 or 112	3.0	INFO 103	3.0		
MATH 101 or 121	4.0	INFO 102	3.0	MATH 180	4.0		
UNIV CI101	1.0	MATH 102 or 122	4.0	UNIV CI101	1.0		
	16		**16**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP 101*	1.0	INFO 213	3.0	COM 230 or 310	3.0	INFO 332	3.0
INFO 200	3.0	INFO 215	3.0	INFO 300	3.0	PSY 330	3.0
INFO 202	3.0	INFO 250	3.0	INFO 323	3.0	Data Science Elective	3.0
INFO 210 or CS 461	3.0	PSY 101	3.0	INFO 371	3.0	Free Elective	3.0
INFO 212	3.0	STAT 202	4.0	Science Elective	4.0	Science Elective	4.0
STAT 201	4.0						
	17		**16**		**16**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		INFO 432	3.0	INFO 442	3.0
				INFO 440	3.0	CCI Elective	3.0
				Data Science elective	3.0	Free Elective	3.0
				Minor Elective	3.0	Minor Elective	6.0
				Free Elective	3.0		
	0		**0**		**15**		**15**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
Free Electives	5.0	CCI Elective	3.0	Free Electives	6.0
Minor Electives	6.0	Free Electives	6.0	Minor Electives	6.0
		Minor Electives	3.0		
	14		**15**		**15**

Total Credits 187

* COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Co-op/Career Opportunities

Co-Op Options

Two co-op options are available for this program:

- 5-year/3 co-op
- 4-year/1 co-op

Career Opportunities

The new data science major provides valuable skills that can be transported to a number of job settings. The demand for graduates with data science knowledge is strong, and employers often want evidence of additional communication and problem-solving skills that can be applicable to specific disciplines. Data science program graduates could potentially serve as key members of organizational data science teams able to create novel information products, with an emphasis on solving problems that can only be addressed using large and disparate data sources. The program is also an excellent preparation for graduate study in data science.

Sample job titles for data science graduates include:

- Data Scientist
- Business Intelligence Officer

- Information Architect
- Usability Analyst

Visit the Drexel Steinbright Career Development Center (http://www.drexel.edu/scdc/) page for more detailed information on co-op and post-graduate opportunities.

3675 Market Street

In March 2019, the College of Computing & Informatics relocated to 3675 Market (https://drexel.edu/cci/about/our-facilities/). For the first time in the College's history, all CCI faculty, students and professional staff are housed under one roof. Occupying two floors in the brand new uCity Square building, CCI's new home offers state-of-the-art technology in our classrooms, labs, meeting areas and collaboration spaces. 3675 Market offers Class A laboratory, office, coworking, and convening spaces. In fall 2019, the College will open a third floor which will include additional offices, classrooms, a research lab, a maker space, and a ground-breaking DXC Technology Innovation Lab. Located at the intersection of Market Street and 37th Street, 3675 Market will act as a physical nexus, bridging academic campuses and medical centers to the east and south, the commercial corridors along Market Street and Chestnut Street, and the residential communities to the north and west.

The uCity Square building offers:

- Speculative lab/office space
- World-class facilities operated by CIC (https://cic.us/philadelphia/)
- Café/restaurant on-site
- Quorum, a two-story, 15K SF convening space and conference center
- Adjacent to future public square
- Access to Science Center’s nationally renowned business acceleration and technology commercialization programs

Drexel University Libraries

Drexel University Libraries (http://www.library.drexel.edu/) is a learning enterprise, advancing the University’s academic mission through serving as educators, supporting education and research, collaborating with researchers, and fostering intentional learning outside of the classroom. Drexel University Libraries engages with Drexel communities through three physical locations, including W. W. Hagerty Library, Queen Lane Library, and the Library Learning Terrace, as well as a vibrant online presence which sees, on average, over 8,000 visits per day. In the W.W. Hagerty Library location, College of Computing & Informatics students have access to private study rooms and nearly half a million books, periodicals, DVDs, videos and University Archives. All fields of inquiry are covered, including: library and information science, computer science, software engineering, health informatics, information systems, and computing technology. Resources are available online at library.drexel.edu (http://www.library.drexel.edu/) or in-person at W. W. Hagerty Library (http://www.library.drexel.edu/locations/).

The Libraries also make available laptop and desktop PC and Mac computers, printers and scanners, spaces for quiet work or group projects and designated 24/7 spaces. Librarians and library staff—including a liaison librarian for computing and informatics—are available for individual research consultations and to answer questions about materials or services.

CCI Commons

Located on the 10th floor of 3675 Market Street, the CCI Commons is an open lab and collaborative work environment for students. It features desktop computers, a wireless/laptop area, free black and white printing, and more collaborative space for its students. Students have access to 3675 Market's fully equipped conference room with 42” displays and videoconferencing capabilities. The CCI Commons provides technical support to students, faculty, and professional staff. In addition, the staff provides audio-visual support for all presentation classrooms within 3675 Market. Use of the CCI Commons is reserved for all students taking CCI courses.

The computers for general use are Microsoft Windows and Macintosh OSX machines with appropriate applications which include the Microsoft Office suite, various database management systems, modeling tools, and statistical analysis software. Library related resources may be accessed at the CCI Commons and through the W.W. Hagerty Library. The College is a member of the Rational SEED Program which provides cutting-edge software development and project management software for usage in the CCI Commons and CCI classrooms. The College is also a member of the Microsoft Academic Alliance known also as “DreamSpark” that allows students free access to a wide array of Microsoft software titles and operating systems.

The CCI Commons, student labs, and classrooms have access to networked databases, print and file resources within the College, and the Internet via the University’s network. Email accounts, Internet and BannerWeb access are available through the Office of Information Resources and Technology.

CCI Learning Center

The CCI Learning Center (CCILC), located in 3675 Market Street's CCI Commons student computer lab, provides consulting and other learning resources for students taking computer science classes. The CCILC is staffed by graduate and undergraduate computer science students from the College of Computing & Informatics.

The CCILC and CCI Commons serve as a central hub for small group work, student meetings, and TA assistance.

Research Laboratories

The College houses multiple research labs, led by CCI faculty, in 3675 Market Street including: the Drexel Health and Risk Communication Lab, Interactive Systems for Healthcare, Socio-Technical Studies Group, Intelligent Information & Knowledge Computing Research Lab, Evidence-based Decision Making Lab, Applied Symbolic Computation Laboratory (ASYM), High Performance Computing Laboratory (SPIRAL), Drexel Research on Play (RePlay) Laboratory, Software Engineering Research Group (SERG), Social Computing Research Group, Vision and Cognition Laboratory (VisCog) and the Vision and Graphics Laboratory. For more information on these laboratories, please visit the College’s research web page (http://cci.drexel.edu/research.aspx).

Evaluations

The College of Computing & Informatics works continually to improve its degree programs. As part of this effort, the Data Science degree is evaluated relative to the following Objectives and Outcomes.

BS Data Science Program Educational Objectives

Within three to five years of graduation, alumni of the program are expected to achieve one or more of the following milestones:

- Be valued contributors to private or public organizations as demonstrated by promotions, increased responsibility, or other professional recognition
- Contribute to professional knowledge as demonstrated by published papers, technical reports, patents, or conference presentations
- Succeed in continuing professional development as demonstrated by completion of graduate studies or professional certifications
- Display commitment and leadership within the professional and community as demonstrated by contributions towards society's greater good and prosperity.

BS Data Science Program Student Outcomes

The program enables students to attain, by the time of graduation

- An ability to apply knowledge of computing and mathematics appropriate to the discipline
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
- An ability to function effectively on teams to accomplish a common goal
- An understanding of professional, ethical, legal, security and social issues
- An ability to communicate effectively with a range of audiences
- An ability to analyze the local and global impact of computing on individuals, organizations, and society
- Recognition of the need for and an ability to engage in continuing professional development
- An ability to use current techniques, skills, and tools necessary for computing practice

Information Science Faculty

Denise E. Agosto, PhD *(Rutgers, The State University of New Jersey)*. Professor. Youth information behaviors, public libraries, multicultural issues in youth library services, and qualitative research methods.

Yuan An, PhD *(University of Toronto, Canada) Director of International Programs*. Associate Professor. Conceptual modeling, schema and ontology mapping, information integration, knowledge representation, requirements engineering, healthcare information systems, semantic web.

Ellen Bass, PhD *(Georgia Institute of Technology) Joint Appointment with the College of Nursing and Health Professions*. Professor. Characterizing human judgement and decision making, modeling human judgement when supported by information automation, computational models of human-human and human-automation coordination.

Andrew Calhoun, MS *(American Military University)*. Social engineering, ethical hacking, information assurance, business continuity & disaster recovery planning, Computer forensics, and Computer security

Christopher Carroll, MS *(Drexel University) BSCST Program Director*. Associate Teaching Professor. Information technology within healthcare companies, computer networking and design, IT infrastructure, server technology, information security, virtualization and cloud computing.

Chaomei Chen, PhD *(University of Liverpool)*. Professor. Information visualization, visual analytics, knowledge domain visualization, network analysis and modeling, scientific discovery, science mapping, scientometrics, citation analysis, human-computer interaction.

Michael Chu, MSE *(University of Pennsylvania)*. Associate Teaching Professor. System, server, computer networking and design; IT infrastructure; information technology management and security; Web system programming; database and mobile application development.

Andrea Forte, PhD *(Georgia Institute of Technology) PhD Program Director, and MS in Information Program Director*. Associate Professor. Social computing, human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, information literacy.

Susan Gasson, PhD *(University of Warwick)*. Associate Professor. The co-design of business and IT-systems, distributed cognition & knowledge management in boundary-spanning groups, human-centered design, social informatics, online learning communities, grounded theory.

Tim Gorichanaz, PhD *(Drexel University)*. Assistant Teaching Professor. Human information behavior, human-centered computing, neo-documentation studies, and information ethics.

Jane Greenberg, PhD *(University of Pittsburgh) Alice B. Kroeger Professor*. Metadata, ontological engineering, data science, knowledge organization, information retrieval

Peter Grillo, PhD *(Temple University) Associate Department Head for Undergraduate Affairs, Information Science*. Teaching Professor. Software economics, Project management, Strategic applications of technology within organizations.

Thomas Heverin, PhD *(Drexel University)*. Associate Teaching Professor. Computer security, ethical hacking, computer forensics, network forensics, cloud security and cybersecurity.

Gregory W. Hislop, PhD *(Drexel University)*. Professor. Information technology for teaching and learning, online education, structure and organization of the information disciplines, computing education research, software evaluation and characterization.

Xiaohua Tony Hu, PhD *(University of Regina, Canada)*. Professor. Data mining, text mining, Web searching and mining, information retrieval, bioinformatics and healthcare informatics.

Jina Huh-Yoo, PhD *(University of Michigan at Ann Arbor)*. Assistant Professor. Human-computer interaction, humancentered design, Health informatics, mobile and wireless health, social computing.

Weimao Ke, PhD *(University of North Carolina at Chapel Hill)*. Associate Professor. Information retrieval (IR), distributed systems, intelligent filtering/recommendation, information visualization, network science, complex systems, machine learning, text/data mining, multi-agent systems, the notion of information.

Mat Kelly, PhD *(Old Dominion University)*. Assistant Professor. Information retrieval, Web archives, metadata, digital humanities, archival privacy

Ehasn B. Khosroshahi, PhD *(Drexel University)*. Assistant Teaching Professor. Computational cognitive modeling, artificial intelligence, machine learning and data analysis.

Xia Lin, PhD *(University of Maryland at College Park) Department Head, Information Science*. Professor. Digital libraries, information visualization, visual interface design, knowledge mapping, human-computer interaction, information retrieval, information architecture, informetrices, information-seeking behaviors in digital environments.

Chris MacLellan, PhD *(Carnegie Mellon University)*. Assistant Professor. Artificial intelligence, data science, machine learning, human-computer interaction, cognitive modeling,

Danuta A. Nitecki, PhD *(University of Maryland at College Park) Dean of Libraries*. Professor. Library metrics and use in management, library as place, and academic library service models.

Jung-ran Park, PhD *(University of Hawaii at Manoa)*. Associate Professor. Knowledge organization and representation, metadata, computer-mediated communication, cross-cultural communication, multilingual information access.

Alex Poole, PhD *(University of North Carolina)*. Assistant Professor. Digital curation, archives and records management, digital humanities, and diversity, inclusivity, and equity.

Michelle L. Rogers, PhD *(University of Wisconsin-Madison)*. Associate Professor. Human-computer interaction, healthcare informatics, human factors engineering, socio-technical systems, health services research, patient safety.

Aleksandra Sarcevic, PhD *(Rutgers University)*. Associate Professor. Computer-supported cooperative work, human-computer interaction, and healthcare informatics.

Bhupesh Shetty, PhD *(University of Iowa)*. Assistant Teaching Professor. Process pattern mining, data mining, operations management, sports analytics, information systems, and machine learning applications.

Il-Yeol Song, PhD *(Louisiana State University)*. Professor. Conceptual modeling, ontology and patterns, data warehouse and OLAP, object-oriented analysis and design with UML, medical and bioinformatics data modeling & integration,.

Bo Song, PhD *(Drexel University)*. Assistant Teaching Professor. Database management, Data mining, bioinformatics, big data analytics, and knowledge discovery.

Milad Toutounchian, PhD *(Simon Fraser University)*. Assistant Teaching Professor. Data Science, Applied Machine Learning and Deep Learning.

Lei Wang, PhD *(Drexel University)*. Assistant Teaching Professor. Biomedical data science, machine learning, deep learning, neuroimaging processing & analytics, natural language processing, simulation modeling.

Rosina Weber, PhD *(Federal University of Santa Catarina)*. Associate Professor. Case-based reasoning, explainable artificial intelligence, machine learning, textual analytics, natural language understanding, language models, recommender systems, technological aspects of knowledge management, project management, and requirements engineering.

Jake Williams, PhD *(University of Vermont)*. Assistant Professor. Data science, scientific programming, computational social science, computational linguistics and natural language processing, mathematics, machine learning, algorithms, and scalability.

Erija Yan, PhD *(Indiana University Bloomington)*. Associate Professor. Network Science, information analysis and retrieval, scholarly communication methods and applications.

Christopher C. Yang, PhD *(University of Arizona, Tucson)*. Professor. Web search and mining, security informatics, knowledge management, social media analytics, cross-lingual information retrieval, text summarization, multimedia retrieval, information visualization, information sharing and privacy, artificial intelligence, digital library, and electronic commerce.

Emeritus Faculty

Michael E. Atwood, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, organizational memory.

Thomas A. Childers, PhD *(Rutgers University)*. Professor Emeritus. Measurement, evaluation, and planning of information and library services, the effectiveness of information organizations.

David E. Fenske, PhD *(University of Wisconsin-Madison)*. Dean Emeritus and Professor. Digital libraries, informatics, knowledge management and information technologies.

Linda Marion, PhD *(Drexel University)*. Teaching Professor Emerita. Formal and informal communication, bibliometric studies of scholarly communication, diffusion of information, information use in the social sciences, academic and public libraries, information science education.

Katherine W. McCain, PhD *(Drexel University)*. Professor Emeritus. Scholarly communication, information production and use in the research process, development and structure of scientific specialties, diffusion of innovation, bibliometrics, evaluation of information retrieval systems.

Carol Hansen Montgomery, PhD *(Drexel University) Dean of Libraries Emeritus*. Research Professor. Selection and use of electronic collections, evaluation of library and information systems, digital libraries, economics of libraries and digital collections.

Delia Neuman, PhD *(The Ohio State University)*. Professor Emerita. Learning in information-rich environments, instructional systems design, the use of media for learning, and school library media.

Gerry Stahl, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, theory of collaboration.

Howard D. White, PhD *(University of California at Berkeley)*. Professor Emeritus. Literature information systems, bibliometrics, research methods, collection development, online searching.

Susan Wiedenbeck, PhD *(University of Pittsburgh)*. Professor Emeritus. Human-computer interaction, end-user programming/end-user development, empirical studies of programmers, interface design and evaluation.

Valerie Ann Yonker, PhD *(Drexel University)*. Associate Teaching Professor Emerita. Human service information systems, systems analysis and design, measurement in software evaluation, knowledge engineering.

Information Systems

Major: Information Systems
Degree Awarded: Bachelor of Science Degree in Information Systems (BS)
Calendar Type: Quarter
Total Credit Hours: 187.0
Co-op Options: Three Co-op (Five years); One Co-op (Four years)
Classification of Instructional Programs (CIP) code: 11.0401
Standard Occupational Classification (SOC) code: 11-3021

About the Program

The College of Computing & Informatics' Bachelor of Science in Information Systems (BSIS) prepares students to apply information technology for the benefit of individuals and organizations. Students develop the skills and knowledge to design, develop, and manage leading-edge information systems. Since many Information Systems students choose careers in business organizations, a minor in business is built into the degree requirements.

The Information Systems curriculum prepares students for a wide range of information technology applications. Students learn how to determine client needs, design appropriate solutions, specify data architectures, and improve the usability of systems.

The core courses in the program address topics including fundamentals of programming, systems analysis and design, database management systems, networking, security and privacy, and social aspects of information systems. These courses provide a foundation for more advanced courses in technical areas of interest to each student. The technical courses are supplemented by courses in business, behavioral sciences, natural sciences, mathematics, and the humanities to provide balance and useful supplemental materials for information systems careers.

The BSIS has four (4) core competencies students will have mastered upon graduation. The core competencies are supported by three (3) courses in each area.

- Requirements and Design

1. INFO 200 *Systems Analysis I*
2. INFO 324 [WI] *Team Process and Product*
3. INFO 355 *System Analysis II*

- Database and Information Management

1. INFO 210 *Database Management Systems*
2. INFO 315 *Advanced Database Management Systems*
3. INFO 371 *Data Mining Applications*

- User Experience

1. INFO 150 *Introduction to Ubiquitous Computing*
2. INFO 310 *Human-Centered Design Process & Methods*
3. INFO 405 *Social and Collaborative Computing*

- Security and Assurance

1. CT 201 *Information Technology Security I*
2. CT 250 *IT Security Awareness*
3. INFO 375 *Introduction to Information Systems Assurance*

The degrees in Computing and Security Technology (p. 15), Data Science (p. 23), and Information Systems share a common first year. This allows students to easily switch among the degrees early in their studies. In addition, some of the electives in each degree are accessible to students in the other two majors, and this provides a deeper and broader set of advanced topics for students in all three majors.

Additional Information

For more information about this program, please visit the BS in Information Systems web page (https://drexel.edu/cci/academics/undergraduate-programs/bs-information-systems/) on the College of Computing & Informatics website.

Degree Requirements

Information Systems Requirements		
CT 140	Network Administration I	3.0
CT 201	Information Technology Security I	3.0
CT 250	IT Security Awareness	3.0
INFO 101	Introduction to Computing and Security Technology	3.0
INFO 102	Introduction to Information Systems	3.0
INFO 103	Introduction to Data Science	3.0
INFO 150	Introduction to Ubiquitous Computing	3.0
INFO 200	Systems Analysis I	3.0
INFO 210	Database Management Systems	3.0
INFO 215	Social Aspects of Information Systems	3.0
INFO 310	Human-Centered Design Process & Methods	3.0
INFO 315	Advanced Database Management Systems	3.0
INFO 324 [WI]	Team Process and Product	3.0
INFO 355	Systems Analysis II	3.0
INFO 371	Data Mining Applications	3.0
INFO 375	Introduction to Information Systems Assurance	3.0
INFO 405	Social and Collaborative Computing	3.0
INFO 420	Software Project Management	3.0
INFO/CT Electives [*]		12.0
Programming Requirements		**9.0**
Choose one of the following sequences		
INFO 151 & CS 171 & CS 172	Web Systems and Services I and Computer Programming I and Computer Programming II	
INFO 151 & INFO 152 & INFO 153	Web Systems and Services I and Web Systems and Services II and Applied Data Management	
Computing and Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CI 491 [WI]	Senior Project I	3.0
CI 492 [WI]	Senior Project II	3.0
CI 493 [WI]	Senior Project III	3.0
Business or IS Environment Minor Requirements (See Minor Requirements below)		**24.0**
Mathematics Requirements		
Choose 1 of the following sequences:		8.0
If sequence less than 8 credit, add additional 2 credits to free electives		
MATH 171 & MATH 172	Introduction to Analysis A and Introduction to Analysis B	
MATH 101 & MATH 102	Introduction to Analysis I and Introduction to Analysis II	
MATH 121 & MATH 122	Calculus I and Calculus II	
MATH 180	Discrete Computational Structures	4.0
STAT 201	Introduction to Business Statistics	4.0

Natural Science Requirements		
Select 8.0 credits from any non-required courses from the following: ANAT, BIO, CHEM, ENVS, FDSC, NFS, PHEV, PHYS, HSCI, GEO, ENSS		8.0
Liberal Studies Requirements		
COM 230	Techniques of Speaking	3.0
or COM 310	Technical Communication	
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
Select and non-required courses from ANTH, COM, ENGL, HIST, PHIL, PSCI, PSY, SOC, WRIT, ECON, ENTP, ARTH, FMST, MUSC, TVST, VSST		6.0
University and College Requirements		
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development	1.0
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
Free Electives		**27.0**
Total Credits		**187.0**

* Any non-required INFO or CT course

MInor Requirements:

Students must complete the requirements for a minor in an information systems application area. The following minors are approved for this requirement:

- College of Business minors – Note: the MIS minor cannot be used for this requirement due to its considerable overlap with the IS major
- Close School of Entrepreneurship minors
- School of Public Health minors
- Other minors in IS application areas may be taken for this requirement with prior approval of an advisor

Writing-Intensive Course Requirements

In order to graduate, all students must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/writing-intensive-courses/) at the University Writing Program (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/). (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/drexel-writing-center/) Students scheduling their courses can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

Sample Plan of Study

5 YR UG Co-op Concentration

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	ENGL 103 or 113	3.0		
INFO 101	3.0	COOP 101*	1.0	INFO 103	3.0		
INFO 151	3.0	ENGL 102 or 112	3.0	INFO 153 or CS 172	3.0		
MATH 171	3.0	INFO 102	3.0	MATH 180	4.0		
UNIV CI101	1.0	INFO 152 or CS 171	3.0	UNIV CI101	1.0		
		MATH 172	3.0				
	15		**16**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		COM 230 or 310	3.0	INFO 210	3.0
				CT 201	3.0	STAT 201	4.0
				INFO 150	3.0	INFO Elective	3.0
				INFO 200	3.0	Liberal Studies Elective	3.0
				INFO 215	3.0	Free Elective	3.0
	0		**0**		**15**		**16**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		INFO 315	3.0	CT 140	3.0
				INFO 324	3.0	CT 250	3.0
				INFO 371	3.0	INFO 310	3.0
				INFO 375	3.0	Liberal Studies Elective	3.0
				Minor Elective	4.0	Minor Elective	4.0
	0		**0**		**16**		**16**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COOP EXPERIENCE		COOP EXPERIENCE		INFO 355	3.0	INFO 420	3.0
				Science Sequence Course 1*	4.0	Science Sequence Course 2*	4.0
				Minor Elective	4.0	Minor Electives	8.0
				Free Elective	6.0		
	0		**0**		**17**		**15**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
INFO 405	3.0	INFO Elective	3.0	Free Electives	12.0
INFO Electives	6.0	Free Electives	8.0		
Minor Elective	4.0				
	16		**14**		**15**

Total Credits 187

4 YR UG Co-op Concentration

First Year							
Fall	**Credits**	**Winter**	**Credits**	**Spring**	**Credits**	**Summer**	**Credits**
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	CIVC 101	1.0	ENGL 103 or 113	3.0		
INFO 101	3.0	COOP 101*	1.0	INFO 103	3.0		
INFO 151	3.0	ENGL 102 or 112	3.0	INFO 153 or CS 172	3.0		
MATH 171	3.0	INFO 102	3.0	MATH 180	4.0		
UNIV CI101	1.0	INFO 152 or CS 171	3.0	UNIV CI101	1.0		
		MATH 172	3.0				
	15		**16**		**16**		**0**
Second Year							
Fall	**Credits**	**Winter**	**Credits**	**Spring**	**Credits**	**Summer**	**Credits**
COM 230 or 310	3.0	INFO 210	3.0	INFO 315	3.0	CT 140	3.0
CT 201	3.0	STAT 201	4.0	INFO 324	3.0	CT 250	3.0
INFO 150	3.0	INFO Elective	3.0	INFO 371	3.0	INFO 310	3.0
INFO 200	3.0	Liberal Studies Elective	3.0	INFO 375	3.0	Liberal Studies Elective	3.0
INFO 215	3.0	Free Elective	3.0	Minor Elective	4.0	Minor Elective	4.0
	15		**16**		**16**		**16**
Third Year							
Fall	**Credits**	**Winter**	**Credits**	**Spring**	**Credits**	**Summer**	**Credits**
COOP EXPERIENCE		COOP EXPERIENCE		INFO 355	3.0	INFO 420	3.0
				Science Sequence Course 1*	4.0	Science Sequence Course 2*	4.0
				Minor Elective	4.0	Minor Electives	8.0
				Free Elective	6.0		
	0		**0**		**17**		**15**
Fourth Year							
Fall	**Credits**	**Winter**	**Credits**	**Spring**	**Credits**		
CI 491	3.0	CI 492	3.0	CI 493	3.0		
INFO 405	3.0	INFO Elective	3.0	Free Electives	12.0		
INFO Electives	6.0	Free Electives	8.0				
Minor Elective	4.0						
	16		**14**		**15**		

Total Credits 187

* See degree requirements (p. 29).
COOP 101 registration is determined by the co-op cycle assigned and may be scheduled in a different term. Select students may be eligible to take COOP 001 in place of COOP 101.

Co-op/Career Opportunities

Co-Op Options

Two co-op options are available for this program:

- 5-year/3 co-op
- 4-year/1 co-op

The following list is a sample of recent co-op job titles and employers:

- *Applications Architect,* Aetna
- *e-Communications Intern,* Airgas
- *PC Network Support,* Aramark
- *Information Systems Intern,* Campbell's Soup
- *Distributed WAN Support Co-op,* Cigna
- *Network Services,* GlaxoSmithKline
- *Programmer/Analyst*, Independence Blue Cross
- *Information Management Co-op,* Johnson & Johnson
- *Database Developer,* Princeton Plasma Physics
- *Website Developer,* QVC
- *Shared Services Co-op,* Wyeth

Career Opportunities

The demand for information systems professionals is strong. Graduates find careers in a number of areas, including designing information systems, leading project teams, planning, developing, and marketing information systems. Most information systems students enter the professional world right after graduation, but some continue their studies in advanced information technology programs.

Job titles of recent information systems graduates include:

- Security Analyst
- Network Systems Analyst
- Database Administrator
- Data Communications Analyst
- Systems Administrator
- Systems Engineer

Visit the Drexel Steinbright Career Development Center (http://www.drexel.edu/scdc/) page for more detailed information on co-op and post-graduate opportunities.

3675 Market Street

In March 2019, the College of Computing & Informatics relocated to 3675 Market (https://drexel.edu/cci/about/our-facilities/). For the first time in the College's history, all CCI faculty, students and professional staff are housed under one roof. Occupying two floors in the brand new uCity Square building, CCI's new home offers state-of-the-art technology in our classrooms, labs, meeting areas and collaboration spaces. 3675 Market offers Class A laboratory, office, coworking, and convening spaces. In fall 2019, the College will open a third floor which will include additional offices, classrooms, a research lab, a maker space, and a ground-breaking DXC Technology Innovation Lab. Located at the intersection of Market Street and 37th Street, 3675 Market will act as a physical nexus, bridging academic campuses and medical centers to the east and south, the commercial corridors along Market Street and Chestnut Street, and the residential communities to the north and west.

The uCity Square building offers:

- Speculative lab/office space
- World-class facilities operated by CIC (https://cic.us/philadelphia/)
- Café/restaurant on-site
- Quorum, a two-story, 15K SF convening space and conference center
- Adjacent to future public square

- Access to Science Center's nationally renowned business acceleration and technology commercialization programs

Drexel University Libraries

Drexel University Libraries (http://www.library.drexel.edu/) is a learning enterprise, advancing the University's academic mission through serving as educators, supporting education and research, collaborating with researchers, and fostering intentional learning outside of the classroom. Drexel University Libraries engages with Drexel communities through three physical locations, including W. W. Hagerty Library, Queen Lane Library, and the Library Learning Terrace, as well as a vibrant online presence which sees, on average, over 8,000 visits per day. In the W.W. Hagerty Library location, College of Computing & Informatics students have access to private study rooms and nearly half a million books, periodicals, DVDs, videos and University Archives. All fields of inquiry are covered, including: library and information science, computer science, software engineering, health informatics, information systems, and computing technology. Resources are available online at library.drexel.edu (http://www.library.drexel.edu/) or in-person at W. W. Hagerty Library (http://www.library.drexel.edu/locations/).

The Libraries also make available laptop and desktop PC and Mac computers, printers and scanners, spaces for quiet work or group projects and designated 24/7 spaces. Librarians and library staff—including a liaison librarian for computing and informatics—are available for individual research consultations and to answer questions about materials or services.

CCI Commons

Located on the 10th floor of 3675 Market Street, the CCI Commons is an open lab and collaborative work environment for students. It features desktop computers, a wireless/laptop area, free black and white printing, and more collaborative space for its students. Students have access to 3675 Market's fully equipped conference room with 42" displays and videoconferencing capabilities. The CCI Commons provides technical support to students, faculty, and professional staff. In addition, the staff provides audio-visual support for all presentation classrooms within 3675 Market. Use of the CCI Commons is reserved for all students taking CCI courses.

The computers for general use are Microsoft Windows and Macintosh OSX machines with appropriate applications which include the Microsoft Office suite, various database management systems, modeling tools, and statistical analysis software. Library related resources may be accessed at the CCI Commons and through the W.W. Hagerty Library. The College is a member of the Rational SEED Program which provides cutting-edge software development and project management software for usage in the CCI Commons and CCI classrooms. The College is also a member of the Microsoft Academic Alliance known also as "DreamSpark" that allows students free access to a wide array of Microsoft software titles and operating systems.

The CCI Commons, student labs, and classrooms have access to networked databases, print and file resources within the College, and the Internet via the University's network. Email accounts, Internet and BannerWeb access are available through the Office of Information Resources and Technology.

CCI Learning Center

The CCI Learning Center (CCILC), located in 3675 Market Street's CCI Commons student computer lab, provides consulting and other learning resources for students taking computer science classes. The CCILC is staffed by graduate and undergraduate computer science students from the College of Computing & Informatics.

The CCILC and CCI Commons serve as a central hub for small group work, student meetings, and TA assistance.

Research Laboratories

The College houses multiple research labs, led by CCI faculty, in 3675 Market Street including: the Drexel Health and Risk Communication Lab, Interactive Systems for Healthcare, Socio-Technical Studies Group, Intelligent Information & Knowledge Computing Research Lab, Evidence-based Decision Making Lab, Applied Symbolic Computation Laboratory (ASYM), High Performance Computing Laboratory (SPIRAL), Drexel Research on Play (RePlay) Laboratory, Software Engineering Research Group (SERG), Social Computing Research Group, Vision and Cognition Laboratory (VisCog) and the Vision and Graphics Laboratory. For more information on these laboratories, please visit the College's research web page (http://cci.drexel.edu/research.aspx).

Evaluations

The College of Computing & Informatics works continually to improve its degree programs. As part of this effort, the Information Systems degree is evaluated relative to the following Objectives and Outcomes.

BS in Information Systems Program Educational Objectives

Within three to five years of graduating, alumni of the program are expected to achieve one or more of the following milestones:

- Be valued contributors to private or public organizations as demonstrated by promotions, increased responsibility, or other professional recognition
- Contribute to professional knowledge as demonstrated by published papers, technical reports, patents, or conference presentations
- Succeed in continuing professional development as demonstrated by completion of graduate studies or professional certifications
- Demonstrate commitment and leadership within their profession and community as demonstrated by professional and community activity or contributions towards society's greater good and prosperity

BS in Information Systems Student Outcomes

The program enables students to attain, by the time of graduation:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
- An ability to function effectively on teams to accomplish a common goal
- An understanding of professional, ethical, legal, security and social issues
- An ability to communicate effectively with a range of audiences
- An ability to analyze the local and global impact of computing on individuals, organizations, and society
- Recognition of the need for and an ability to engage in continuing professional development

- An ability to use current techniques, skills, and tools necessary for computing practice.
- An understanding of processes that support the delivery and management of information systems within a specific application environment

The BSIS is accredited by the Computing Accreditation Commission (CAC) of ABET, http://www.abet.org.

To view the latest BS in Information Systems program enrollment numbers, please click here (https://drexel.edu/cci/academics/undergraduate-programs/facts/).

Computing & Informatics Faculty

Denise E. Agosto, PhD *(Rutgers, The State University of New Jersey)*. Professor. Youth information behaviors, public libraries, multicultural issues in youth library services, and qualitative research methods.

Yuan An, PhD *(University of Toronto, Canada) Director of International Programs*. Associate Professor. Conceptual modeling, schema and ontology mapping, information integration, knowledge representation, requirements engineering, healthcare information systems, semantic web.

David Augenblick, MS *(University of Pennsylvania)*. Associate Teaching Professor. Introductory and object-oriented programming, data structures and database systems, computer application project management, application of computer programming principles and solutions to engineering problems.

Ellen Bass, PhD *(Georgia Institute of Technology) Joint Appointment with the College of Nursing and Health Professions*. Professor. Characterizing human judgement and decision making, modeling human judgement when supported by information automation, computational models of human-human and human-automation coordination.

Mark Boady, PhD *(Drexel University)*. Assistant Teaching Professor. Computer Algebra, complex symbolic calculations, automation of computation problems

David E. Breen, PhD *(Rensselaer Polytechnic Institute) Associate Department Head for Graduate Affairs, Computer Science*. Professor. Computer-aided design, biomedical image informatics, geometric modeling and self-organization algorithms.

Matthew Burlick, PhD *(Stevens Institute of Technology)*. Associate Teaching Professor. Image processing, machine learning, real-time video tracking, object detection and classification, statistics/probability, and acoustics

Yuanfang Cai, PhD *(University of Virginia)*. Professor. Formal software design modeling and analysis, software economics, software evolution and modularity.

Andrew Calhoun, MS *(American Military University)*. Social engineering, ethical hacking, information assurance, business continuity & disaster recovery planning, Computer forensics, and Computer security

Christopher Carroll, MS *(Drexel University) BSCST Program Director*. Associate Teaching Professor. Information technology within healthcare companies, computer networking and design, IT infrastructure, server technology, information security, virtualization and cloud computing.

Preetha Chatterjee, PhD *(University of Delaware)*. Assistant Professor. Software engineering, data mining, natural language processing, and machine learning

Chaomei Chen, PhD *(University of Liverpool)*. Professor. Information visualization, visual analytics, knowledge domain visualization, network analysis and modeling, scientific discovery, science mapping, scientometrics, citation analysis, human-computer interaction.

Michael Chu, MSE *(University of Pennsylvania)*. Associate Teaching Professor. System, server, computer networking and design; IT infrastructure; information technology management and security; Web system programming; database and mobile application development.

Andrea Forte, PhD *(Georgia Institute of Technology) PhD Program Director, and MS in Information Program Director*. Associate Professor. Social computing, human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, information literacy.

Susan Gasson, PhD *(University of Warwick)*. Associate Professor. The co-design of business and IT-systems, distributed cognition & knowledge management in boundary-spanning groups, human-centered design, social informatics, online learning communities, grounded theory.

Vasilis Gkatzelis, PhD *(New York University)*. Assistant Professor. Algorithmic mechanism design, multiagent resource allocation, approximation algorithms .

Colin Gordon, PhD *(University of Washington)*. Associate Professor. Software reliability, program behavior, concurrent and systems-level code, formal assurance, programming models, distributed computing, even testing

Tim Gorichanaz, PhD *(Drexel University)*. Assistant Teaching Professor. Human information behavior, human-centered computing, neo-documentation studies, and information ethics.

Jane Greenberg, PhD *(University of Pittsburgh) Alice B. Kroeger Professor*. Metadata, ontological engineering, data science, knowledge organization, information retrieval

Peter Grillo, PhD *(Temple University) Associate Department Head for Undergraduate Affairs, Information Science*. Teaching Professor. Software economics, Project management, Strategic applications of technology within organizations.

Thomas Heverin, PhD *(Drexel University)*. Associate Teaching Professor. Computer security, ethical hacking, computer forensics, network forensics, cloud security and cybersecurity.

Gregory W. Hislop, PhD *(Drexel University)*. Professor. Information technology for teaching and learning, online education, structure and organization of the information disciplines, computing education research, software evaluation and characterization.

Xiaohua Tony Hu, PhD *(University of Regina, Canada)*. Professor. Data mining, text mining, Web searching and mining, information retrieval, bioinformatics and healthcare informatics.

Jina Huh-Yoo, PhD *(University of Michigan at Ann Arbor)*. Assistant Professor. Human-computer interaction, humancentered design, Health informatics, mobile and wireless health, social computing.

Shahin Jabbari Assistant Professor. Algorithmic fairness, game theory, and artificial intelligence for social good.

Jeremy R. Johnson, PhD *(Ohio State University) Department Head, Computer Science*. Professor. Computer algebra; parallel computations; algebraic algorithms; scientific computing.

Constantine Katsinis, PhD *(University of Rhode Island)*. Teaching Professor. High-performance computer networks, parallel computer architectures with sustained teraflops performance, computer security, image processing.

Weimao Ke, PhD *(University of North Carolina at Chapel Hill)*. Associate Professor. Information retrieval (IR), distributed systems, intelligent filtering/recommendation, information visualization, network science, complex systems, machine learning, text/data mining, multi-agent systems, the notion of information.

Mat Kelly, PhD *(Old Dominion University)*. Assistant Professor. Information retrieval, Web archives, metadata, digital humanities, archival privacy

Ehasn B. Khosroshahi, PhD *(Drexel University)*. Assistant Teaching Professor. Computational cognitive modeling, artificial intelligence, machine learning and data analysis.

Edward Kim, PhD *(Lehigh University)*. Associate Professor. Computer Vision, Sparse Coding, Neuromorphic Computing, Medical Image Processing, Computer Graphics, Artificial Intelligence, Game Development

Xia Lin, PhD *(University of Maryland at College Park) Department Head, Information Science*. Professor. Digital libraries, information visualization, visual interface design, knowledge mapping, human-computer interaction, information retrieval, information architecture, informetrices, information-seeking behaviors in digital environments.

Galen Long, MS *(Drexel University)*. Assistant Teaching Professor.

Chris MacLellan, PhD *(Carnegie Mellon University)*. Assistant Professor. Artificial intelligence, data science, machine learning, human-computer interaction, cognitive modeling,

Geoffrey Mainland, PhD *(Harvard University)*. Associate Professor. High-level programming languages and runtime support for non-general purpose computation.

Spiros Mancoridis, PhD *(University of Toronto) The Auerbach Berger Chair in Cybersecurity Distinguished Professor of Computer Science*. Professor. Software engineering; software security; code analysis; evolutionary computation.

Adelaida Alban Medlock, MS *(Drexel University) Associate Department Head for Undergraduate Affairs, Computer Science*. Teaching Professor. Introductory programming; computer science education.

Danuta A. Nitecki, PhD *(University of Maryland at College Park) Dean of Libraries*. Professor. Library metrics and use in management, library as place, and academic library service models.

Krzysztof Nowak, PhD *(Washington University)*. Associate Teaching Professor. Fourier analysis, partial differential equations, image processing, wavelets, asymptotic distribution of eigenvalues, numerical methods and algorithms, computer science education.

Santiago Ontañón, PhD *(University of Barcelona)*. Associate Professor. Game AI, computer games, artificial intelligence, machine learning, case-based reasoning

Yusuf Osmanlioglu, PhD *(Drexel University)*. Assistant Teaching Professor. Graph theory and algorithms, brain network analysis, optimization, computer vision, natural language processing.

Jung-ran Park, PhD *(University of Hawaii at Manoa)*. Associate Professor. Knowledge organization and representation, metadata, computer-mediated communication, cross-cultural communication, multilingual information access.

Tammy Pirmann, Ed D *(Gwynedd Mercy University)*. Teaching Professor. Introductory programming, object-oriented programming, game design, mobile computing, computer science education, computer science educator pipeline

Alex Poole, PhD *(University of North Carolina)*. Assistant Professor. Digital curation, archives and records management, digital humanities, and diversity, inclusivity, and equity.

Jeffrey L. Popyack, PhD *(University of Virginia)*. Professor. Operations research, stochastic optimization, computational methods of Markov decision processes; artificial intelligence, computer science education.

Emmanouil Pountourakis, PhD *(Northwestern University)*. Assistant Professor. Algorithmic game theory, algorithmic mechanism design, algorithmic aspects of behavioral economics, game theory and learning, computational and game theoretic aspects of energy grids

Michelle L. Rogers, PhD *(University of Wisconsin-Madison)*. Associate Professor. Human-computer interaction, healthcare informatics, human factors engineering, socio-technical systems, health services research, patient safety.

Jeffrey Salvage, MS *(Drexel University)*. Teaching Professor. Object-oriented programming, multi-agent systems, software engineering, database theory, introductory programming, data structures.

Dario Salvucci, PhD *(Carnegie Mellon University)*. Professor. Human computer interaction, cognitive science, machine learning, applications for driving.

Aleksandra Sarcevic, PhD *(Rutgers University)*. Associate Professor. Computer-supported cooperative work, human-computer interaction, and healthcare informatics.

Kurt Schmidt, MS *(Drexel University)*. Associate Teaching Professor. Data structures, math foundations for computer science, programming tools, programming languages.

Bhupesh Shetty, PhD *(University of Iowa)*. Assistant Teaching Professor. Process pattern mining, data mining, operations management, sports analytics, information systems, and machine learning applications.

Ali Shokoufandeh, PhD *(Rutgers University) Senior Associate Dean for Academic Affairs and Operations*. Professor. Theory of algorithms, graph theory, combinational optimization, computer vision.

Il-Yeol Song, PhD *(Louisiana State University)*. Professor. Conceptual modeling, ontology and patterns, data warehouse and OLAP, object-oriented analysis and design with UML, medical and bioinformatics data modeling & integration,.

Bo Song, PhD *(Drexel University)*. Assistant Teaching Professor. Database management, Data mining, bioinformatics, big data analytics, and knowledge discovery.

Brian Stuart, PhD *(Purdue University)*. Associate Teaching Professor. Machine learning, networking, robotics, image processing, simulation, interpreters, data storage, operating systems, computer science, data communications, distributed/operating systems, accelerated computer programming, computer graphics.

Milad Toutounchian, PhD *(Simon Fraser University)*. Assistant Teaching Professor. Data Science, Applied Machine Learning and Deep Learning.

Boris Valerstein, MS *(Pennsylvania State University)*. Assistant Teaching Professor.

Dimitra Vista Teaching Professor. Database systems

Filippos Vokolos, PhD *(Polytechnic University)*. Associate Teaching Professor. System architecture, principles of software design and construction, verification and validation methods for the development of large software systems, foundations of software engineering, software verification & validation, software design, programming languages, dependable software systems.

Lei Wang, PhD *(Drexel University)*. Assistant Teaching Professor. Biomedical data science, machine learning, deep learning, neuroimaging processing & analytics, natural language processing, simulation modeling.

Rosina Weber, PhD *(Federal University of Santa Catarina)*. Associate Professor. Case-based reasoning, explainable artificial intelligence, machine learning, textual analytics, natural language understanding, language models, recommender systems, technological aspects of knowledge management, project management, and requirements engineering.

Jake Williams, PhD *(University of Vermont)*. Assistant Professor. Data science, scientific programming, computational social science, computational linguistics and natural language processing, mathematics, machine learning, algorithms, and scalability.

Kaidi Xu, PhD *(Northeastern University)*. Assistant Professor. AI security, explainable artificial intelligence, optimization.

Erija Yan, PhD *(Indiana University Bloomington)*. Associate Professor. Network Science, information analysis and retrieval, scholarly communication methods and applications.

Christopher C. Yang, PhD *(University of Arizona, Tucson)*. Professor. Web search and mining, security informatics, knowledge management, social media analytics, cross-lingual information retrieval, text summarization, multimedia retrieval, information visualization, information sharing and privacy, artificial intelligence, digital library, and electronic commerce.

Emeritus Faculty

Michael E. Atwood, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, organizational memory.

Bruce W. Char, PhD *(University of California-Berkeley)*. Professor Emeritus. Symbolic mathematical computation, algorithms and systems for computer algebra, problem-solving environments parallel and distributed computation.

Thomas A. Childers, PhD *(Rutgers University)*. Professor Emeritus. Measurement, evaluation, and planning of information and library services, the effectiveness of information organizations.

David E. Fenske, PhD *(University of Wisconsin-Madison)*. Dean Emeritus and Professor. Digital libraries, informatics, knowledge management and information technologies.

John B. Hall, PhD *(Florida State University)*. Professor Emeritus. Academic library service, library administration, organization of materials.

Katherine W. McCain, PhD *(Drexel University)*. Professor Emeritus. Scholarly communication, information production and use in the research process, development and structure of scientific specialties, diffusion of innovation, bibliometrics, evaluation of information retrieval systems.

Carol Hansen Montgomery, PhD *(Drexel University) Dean of Libraries Emeritus*. Research Professor. Selection and use of electronic collections, evaluation of library and information systems, digital libraries, economics of libraries and digital collections.

Delia Neuman, PhD *(The Ohio State University)*. Professor Emerita. Learning in information-rich environments, instructional systems design, the use of media for learning, and school library media.

Gerry Stahl, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, theory of collaboration.

Howard D. White, PhD *(University of California at Berkeley)*. Professor Emeritus. Literature information systems, bibliometrics, research methods, collection development, online searching.

Susan Wiedenbeck, PhD *(University of Pittsburgh)*. Professor Emeritus. Human-computer interaction, end-user programming/end-user development, empirical studies of programmers, interface design and evaluation.

Software Engineering

Major: Software Engineering
Degree Awarded: Bachelor of Science in Software Engineering (BSSE)
Calendar Type: Quarter
Total Credit Hours: 186.5
Co-op Options: Three Co-op (Five years); One Co-op (Four years)
Classification of Instructional Program (CIP) code: 14.0903
Standard Occupational Classification (SOC) code: *15-1132; 15-1133*

About the Program

The College of Computing & Informatics' Bachelor of Science in Software Engineering (BSSE) prepares students to design and build software systems. Software is essential to the functioning of modern society but high quality software is very challenging to create. Software engineering focuses on the knowledge and skills to meet that challenge and create high quality software on schedule within budget.

The Software Engineering curriculum addresses a full range of software activities including gathering client requirements, designing and constructing software solutions, testing software, and modifying and extending existing systems. The curriculum also recognizes that most software is developed by teams, and students develop skills in project management and team operation. Graduates are well-prepared to

function as software engineering team members and also move toward software engineering management.

The core courses address programming and use of software development tools, specification and design, software architecture, verification and validation, software evolution, and team projects. These courses are supplemented with courses drawn from computer science and Informatics that provide theoretical background and application knowledge. The full curriculum prepares BSSE students to apply processes, methods, and tools to the problem of building and maintaining software with a defined level of quality, at a predictable cost, on a predictable schedule.

Additional Information

For more information about this program, please visit the BS in Software Engineering web page (https://drexel.edu/cci/academics/undergraduate-programs/bs-software-engineering/) on the College of Computing & Informatics' website.

Degree Requirements

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Software Engineering Requirements		
CS 164	Introduction to Computer Science	3.0
CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
SE 210	Software Specification and Design I	3.0
SE 181	Introduction to Software Engineering and Development	3.0
SE 211	Software Specification and Design II	3.0
SE 310	Software Architecture I	3.0
SE 311	Software Architecture II	3.0
SE 320	Software Verification and Validation	3.0
SE 410	Software Evolution	3.0
Computer Science Requirements		
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
CS 281	Systems Architecture	4.0
CS 283	Systems Programming	3.0
CS 472	Computer Networks: Theory, Applications and Programming	3.0
Information Systems Requirements		
INFO 210	Database Management Systems	3.0
INFO 310	Human-Centered Design Process & Methods	3.0
INFO 420	Software Project Management	3.0
Computing & Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CI 491 [WI]	Senior Project I	3.0
CI 492 [WI]	Senior Project II	3.0
CI 493 [WI]	Senior Project III	3.0
Computing & Informatics Electives (see below)		**18.0**
Mathematics Requirements		
CS 270	Mathematical Foundations of Computer Science	3.0
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 123	Calculus III	4.0
MATH 221	Discrete Mathematics	3.0
STAT 201	Introduction to Business Statistics	4.0
STAT 202	Business Statistics II	4.0
Science Requirements		**18.0**
Select one of the following lab science sequences:		
BIO 131	Cells and Biomolecules	
& BIO 134	and Cells and Biomolecules Lab	
& BIO 132	and Genetics and Evolution	
& BIO 135	and Genetics and Evolution Lab	
& BIO 133	and Physiology and Ecology	
& BIO 136	and Anatomy and Ecology Lab	
CHEM 101	General Chemistry I	
& CHEM 102	and General Chemistry II	
& CHEM 103	and General Chemistry III	
PHYS 101	Fundamentals of Physics I	
& PHYS 102	and Fundamentals of Physics II	
& PHYS 201	and Fundamentals of Physics III	
Additional Science electives to reach 18 credits (see below)		
Arts & Humanities Requirements		
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
PHIL 105	Critical Reasoning	3.0
PHIL 311	Ethics and Information Technology	3.0
COM 230	Techniques of Speaking	3.0
COM 310 [WI]	Technical Communication	3.0
PSY 101	General Psychology I	3.0
PSY 330	Cognitive Psychology	3.0
Select two of the following:		8.0
ACCT 110	Accounting for Professionals	
ECON 201	Principles of Microeconomics	
ECON 202	Principles of Macroeconomics	
Arts & Humanities, Business, or Social Studies elective (see below)		3.0
University Requirements		
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development	1.0
Free Electives		**12.5**
Total Credits		**186.5**

Program Electives

Independent study courses and special topics courses must be approved by the department prior to enrollment to satisfy a program elective requirement.

- **Computing & Informatics electives**: any non-required CS, INFO, SE course numbered 300 or higher; a well as CT 210, CT 200, CT 320, CT 330
- **Science electives**: any CHEM (except CHEM 111, CHEM 112, CHEM 113, CHEM 114, CHEM 151), BIO (except BIO 161, BIO 162, BIO 163; can take only one of BIO 100, BIO 107; can take only one of BIO 101, BIO 109), PHYS (except PHYS 050, PHYS 100,PHYS 103, PHYS 104, PHYS 105, PHYS 106 [WI] , PHYS 121, PHYS 122, PHYS 151, PHYS 160, PHYS 305, PHYS 324, PHYS 405; cannot take both PHYS 131 and PHYS 181), ENVS, ENSS, PHEV.
- **Business electives**: any ACCT, BLAW, BUSN, ECON, ENTP, FIN, HRMT, INTB, MGMT, MIS, MKTG, OPM, OPR, ORGB, STAT, TAX
- **Social Studies electives**: any AFAS, ANTH, HIST, GST, JUDA, PSCI, PSY, SOC (except SOC 364, SOC 365), WGST
- **Arts & Humanities electives**: any ARCH, ARTH, CMGT, CJS, COM, CULA, DANC, EDEX, EDUC, ENGL (except ENGL 101,ENGL 102, ENGL 103, ENGL 105), ESTM, FASH, FMST, FMVD, GST, INTR,

LING, MUSC, PHIL, PHTO, THTR, VSCM, VSST, WRIT, Foreign Language courses (http://www.drexel.edu/culturecomm/academics/undergraduate/modernlang/languages/) as defined by the College of Arts and Sciences, and GMAP 260, ANIM 140, ANIM 141, ANIM 211, ANIM 212

Writing-Intensive Course Requirements

In order to graduate, all students must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/writing-intensive-courses/) at the University Writing Program (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/). (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/drexel-writing-center/) Students scheduling their courses can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

Sample Plan of Study

5 YR UG Co-op Concentration

5-Year Spring Summer Coop Cycle

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
ENGL 101 or 111	3.0	COOP 101	1.0	ENGL 103 or 113	3.0		
MATH 121	4.0	CS 171 or 175	3.0	MATH 123	4.0		
UNIV CI101	1.0	ENGL 102 or 112	3.0	UNIV CI101	1.0		
Science Lab	4.0	MATH 122	4.0	Science Lab	4.0		
		Science Lab	4.0				
	17		**18**		**17**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COM 230	3.0	CS 260	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 265	3.0	INFO 210	3.0				
CS 270	3.0	MATH 221	3.0				
SE 181	3.0	SE 211	3.0				
SE 210	3.0	Science Elective	3.0				
	15		**15**		**0**		**0**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COM 310	3.0	CS 283	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
CS 281	4.0	SE 311	3.0				
PSY 101	3.0	STAT 202	4.0				
SE 310	3.0	Science Elective	3.0				
STAT 201	4.0	Free Elective	3.0				
	17		**16**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
INFO 420	3.0	INFO 310	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 105	3.0	PHIL 311	3.0				
SE 320	3.0	SE 410	3.0				
Computing & Informatics Elective	3.0	Computing & Informatics Elective	3.0				
Free Elective	3.0	Free Elective	3.0				
	15		**15**		**0**		**0**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
CI 491	3.0	CI 492	3.0	CI 493	3.0
CS 472	3.0	PSY 330	3.0	Computing & Informatics Elective	3.0
ACCT 110, ECON 201, or ECON 202	4.0	ACCT 110, ECON 201, or ECON 202	4.0	Arts & Humanities Elective	3.0
Computing & Informatics Elective	3.0	Computing & Informatics Elective	6.0	Free Elective	3.5
	13		**16**		**12.5**

Total Credits 186.5

4-Year Spring Summer Coop Cycle

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
ENGL 101 or 111	3.0	CS 171 or 175	3.0	ENGL 103 or 113	3.0		
MATH 121	4.0	ENGL 102 or 112	3.0	MATH 123	4.0		
UNIV CI101	1.0	MATH 122	4.0	UNIV CI101	1.0		
Science Lab	4.0	Science Lab	4.0	Science Lab	4.0		
	17		**17**		**17**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
COM 230	3.0	COOP 101	1.0	COM 310	3.0	CS 283	3.0
CS 265	3.0	CS 260	3.0	CS 281	4.0	SE 311	3.0
CS 270	3.0	INFO 210	3.0	PSY 101	3.0	STAT 202	4.0
SE 181	3.0	MATH 221	3.0	SE 310	3.0	Science Elective	3.0
SE 210	3.0	SE 211	3.0	STAT 201	4.0	Free Elective	3.0

		Science Elective	3.0				
	15		**16**		**17**		**16**
Third Year							
Fall	**Credits**	**Winter**	**Credits**	**Spring**	**Credits**	**Summer**	**Credits**
INFO 420	3.0	INFO 310	3.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 105	3.0	PHIL 311	3.0				
SE 320	3.0	SE 410	3.0				
Computing & Informatics Elective	3.0	Computing & Informatics Elective	3.0				
Free Elective	3.0	Free Elective	3.0				
	15		**15**		**0**		**0**
Fourth Year							
Fall	**Credits**	**Winter**	**Credits**	**Spring**	**Credits**		
CI 491	3.0	CI 492	3.0	CI 493	3.0		
CS 472	3.0	PSY 330	3.0	Computing & Informatics Elective	3.0		
ACCT 110, ECON 201, or ECON 202	4.0	ACCT 110, ECON 201, or ECON 202	4.0	Arts & Humanities Elective	3.0		
Computing & Informatics Elective	3.0	Computing & Informatics Electives	6.0	Free Elective	3.5		
	13		**16**		**12.5**		

Total Credits 186.5

Co-op/Career Opportunities

Co-Op Options

Two co-op options are available for this program:

- 5-year/3 co-op
- 4-year/1 co-op

Career Opportunities

The demand for software engineering professionals is quite strong. Graduates can expect career opportunities in software design and development in a variety of application areas. Software engineering graduates are particularly well suited to work as members or leaders of software project teams. They have knowledge and skills to help them develop quality software within schedule and cost constraints.

According to the U.S. Bureau of Labor Statistics' Occupational Outlook Handbook (http://www.bls.gov/ooh/), software developer is among the fastest growing U.S. careers requiring at least a bachelor's degree, with an estimated 284,100 new jobs by 2028. Although they have jobs in most industries, many software developers work in computer systems design and related services firms or software publishers. The field's rapid growth is mainly due to the increase in demand for computer software, especially in healthcare.

Most software engineering students enter the professional world right after graduation, but some continue their studies in advanced software engineering programs.

Job titles of recent software engineering graduates include:

- Software Engineer
- Software Architect
- Software System Project Manager
- Software Project Team Leader

Visit the Drexel Steinbright Career Development Center (http://www.drexel.edu/scdc/) page for more detailed information on co-op and post-graduate opportunities.

3675 Market Street

In March 2019, the College of Computing & Informatics relocated to 3675 Market (https://drexel.edu/cci/about/our-facilities/). For the first time in the College's history, all CCI faculty, students and professional staff are housed under one roof. Occupying two floors in the brand new uCity Square building, CCI's new home offers state-of-the-art technology in our classrooms, labs, meeting areas and collaboration spaces. 3675 Market offers Class A laboratory, office, coworking, and convening spaces. In fall 2019, the College will open a third floor which will include additional offices, classrooms, a research lab, a maker space, and a ground-breaking DXC Technology Innovation Lab. Located at the intersection of Market Street and 37th Street, 3675 Market will act as a physical nexus, bridging academic campuses and medical centers to the east and south, the commercial corridors along Market Street and Chestnut Street, and the residential communities to the north and west.

The uCity Square building offers:

- Speculative lab/office space
- World-class facilities operated by CIC (https://cic.us/philadelphia/)
- Café/restaurant on-site
- Quorum, a two-story, 15K SF convening space and conference center
- Adjacent to future public square
- Access to Science Center’s nationally renowned business acceleration and technology commercialization programs

Drexel University Libraries

Drexel University Libraries (http://www.library.drexel.edu/) is a learning enterprise, advancing the University’s academic mission through serving as educators, supporting education and research, collaborating with researchers, and fostering intentional learning outside of the classroom. Drexel University Libraries engages with Drexel communities through three physical locations, including W. W. Hagerty Library, Queen Lane Library, and the Library Learning Terrace, as well as a vibrant online presence which sees, on average, over 8,000 visits per day. In the W.W. Hagerty Library location, College of Computing & Informatics students have access to private study rooms and nearly half a million books, periodicals, DVDs, videos and University Archives. All fields of inquiry are covered, including: library and information science, computer science, software engineering, health informatics, information systems, and computing technology. Resources are available online at library.drexel.edu (http://www.library.drexel.edu/) or in-person at W. W. Hagerty Library (http://www.library.drexel.edu/locations/).

The Libraries also make available laptop and desktop PC and Mac computers, printers and scanners, spaces for quiet work or group projects and designated 24/7 spaces. Librarians and library staff—including a liaison librarian for computing and informatics—are available for individual research consultations and to answer questions about materials or services.

CCI Commons

Located on the 10th floor of 3675 Market Street, the CCI Commons is an open lab and collaborative work environment for students. It features desktop computers, a wireless/laptop area, free black and white printing, and more collaborative space for its students. Students have access to 3675 Market's fully equipped conference room with 42” displays and videoconferencing capabilities. The CCI Commons provides technical support to students, faculty, and professional staff. In addition, the staff provides audio-visual support for all presentation classrooms within 3675 Market. Use of the CCI Commons is reserved for all students taking CCI courses.

The computers for general use are Microsoft Windows and Macintosh OSX machines with appropriate applications which include the Microsoft Office suite, various database management systems, modeling tools, and statistical analysis software. Library related resources may be accessed at the CCI Commons and through the W.W. Hagerty Library. The College is a member of the Rational SEED Program which provides cutting-edge software development and project management software for usage in the CCI Commons and CCI classrooms. The College is also a member of the Microsoft Academic Alliance known also as “DreamSpark” that allows students free access to a wide array of Microsoft software titles and operating systems.

The CCI Commons, student labs, and classrooms have access to networked databases, print and file resources within the College, and the Internet via the University’s network. Email accounts, Internet and BannerWeb access are available through the Office of Information Resources and Technology.

CCI Learning Center

The CCI Learning Center (CCILC), located in 3675 Market Street's CCI Commons student computer lab, provides consulting and other learning resources for students taking computer science classes. The CCILC is staffed by graduate and undergraduate computer science students from the College of Computing & Informatics.

The CCILC and CCI Commons serve as a central hub for small group work, student meetings, and TA assistance.

Research Laboratories

The College houses multiple research labs, led by CCI faculty, in 3675 Market Street including: the Drexel Health and Risk Communication Lab, Interactive Systems for Healthcare, Socio-Technical Studies Group, Intelligent Information & Knowledge Computing Research Lab, Evidence-based Decision Making Lab, Applied Symbolic Computation Laboratory (ASYM), High Performance Computing Laboratory (SPIRAL), Drexel Research on Play (RePlay) Laboratory, Software Engineering Research Group (SERG), Social Computing Research Group, Vision and Cognition Laboratory (VisCog) and the Vision and Graphics Laboratory. For more information on these laboratories, please visit the College’s research web page (http://cci.drexel.edu/research.aspx).

Evaluations

The College of Computing & Informatics works continually to improve its degree programs. As part of this effort, the software engineering degree is evaluated relative to the following Objectives and Outcomes.

Program Educational Objectives

Within three to five years of graduating, alumni of the program are expected to achieve one or more of the following milestones:

- Graduates of the program obtain employment as software developers, where their software and communication skills eventually propel them toward technical and administrative leadership positions in industry and government.
- Graduates of the program demonstrate an ability to continue to learn throughout their career and to keep pace with changing technology as appropriate to their positions.
- Graduates of the program specialize and enhance their software engineering knowledge by enrolling and completing technical graduate courses and other technical education to position them to advance software engineering practice as senior technical staff members or managers.
- Graduates of the program specialize and enhance their software engineering knowledge by enrolling and graduating from MSc and PhD degree programs to position them to contribute to the intellectual foundations of the discipline of software engineering as researchers in industrial and government laboratories as well as in academia.
- Graduates of the program advance toward becoming leaders in disciplines other than software engineering by enrolling and graduating from graduate-level degree programs in complimentary disciplines such as law and business, where the BSSE serves as an educational foundation.
- Graduates of the program will demonstrate an awareness of their professional and social responsibility as software engineers by participation in professional activities and application of their knowledge for the good of society.

Software Engineering Student Outcomes

The program enables students to attain by the time of graduation:

- An ability to apply knowledge of mathematics, science and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
- An ability to function on multidisciplinary teams
- An ability to identify, formulate and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Computing & Informatics Faculty

Denise E. Agosto, PhD *(Rutgers, The State University of New Jersey)*. Professor. Youth information behaviors, public libraries, multicultural issues in youth library services, and qualitative research methods.

Yuan An, PhD *(University of Toronto, Canada) Director of International Programs*. Associate Professor. Conceptual modeling, schema and ontology mapping, information integration, knowledge representation, requirements engineering, healthcare information systems, semantic web.

David Augenblick, MS *(University of Pennsylvania)*. Associate Teaching Professor. Introductory and object-oriented programming, data structures and database systems, computer application project management, application of computer programming principles and solutions to engineering problems.

Ellen Bass, PhD *(Georgia Institute of Technology) Joint Appointment with the College of Nursing and Health Professions*. Professor. Characterizing human judgement and decision making, modeling human judgement when supported by information automation, computational models of human-human and human-automation coordination.

Mark Boady, PhD *(Drexel University)*. Assistant Teaching Professor. Computer Algebra, complex symbolic calculations, automation of computation problems

David E. Breen, PhD *(Rensselaer Polytechnic Institute) Associate Department Head for Graduate Affairs, Computer Science*. Professor. Computer-aided design, biomedical image informatics, geometric modeling and self-organization algorithms.

Matthew Burlick, PhD *(Stevens Institute of Technology)*. Associate Teaching Professor. Image processing, machine learning, real-time video tracking, object detection and classification, statistics/probability, and acoustics

Yuanfang Cai, PhD *(University of Virginia)*. Professor. Formal software design modeling and analysis, software economics, software evolution and modularity.

Andrew Calhoun, MS *(American Military University)*. Social engineering, ethical hacking, information assurance, business continuity & disaster recovery planning, Computer forensics, and Computer security

Christopher Carroll, MS *(Drexel University) BSCST Program Director*. Associate Teaching Professor. Information technology within healthcare companies, computer networking and design, IT infrastructure, server technology, information security, virtualization and cloud computing.

Preetha Chatterjee, PhD *(University of Delaware)*. Assistant Professor. Software engineering, data mining, natural language processing, and machine learning

Chaomei Chen, PhD *(University of Liverpool)*. Professor. Information visualization, visual analytics, knowledge domain visualization, network analysis and modeling, scientific discovery, science mapping, scientometrics, citation analysis, human-computer interaction.

Michael Chu, MSE *(University of Pennsylvania)*. Associate Teaching Professor. System, server, computer networking and design; IT infrastructure; information technology management and security; Web system programming; database and mobile application development.

Andrea Forte, PhD *(Georgia Institute of Technology) PhD Program Director, and MS in Information Program Director*. Associate Professor. Social computing, human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, information literacy.

Susan Gasson, PhD *(University of Warwick)*. Associate Professor. The co-design of business and IT-systems, distributed cognition & knowledge management in boundary-spanning groups, human-centered design, social informatics, online learning communities, grounded theory.

Vasilis Gkatzelis, PhD *(New York University)*. Assistant Professor. Algorithmic mechanism design, multiagent resource allocation, approximation algorithms .

Colin Gordon, PhD *(University of Washington)*. Associate Professor. Software reliability, program behavior, concurrent and systems-level code, formal assurance, programming models, distributed computing, even testing

Tim Gorichanaz, PhD *(Drexel University)*. Assistant Teaching Professor. Human information behavior, human-centered computing, neo-documentation studies, and information ethics.

Jane Greenberg, PhD *(University of Pittsburgh) Alice B. Kroeger Professor*. Metadata, ontological engineering, data science, knowledge organization, information retrieval

Peter Grillo, PhD *(Temple University) Associate Department Head for Undergraduate Affairs, Information Science*. Teaching Professor. Software economics, Project management, Strategic applications of technology within organizations.

Thomas Heverin, PhD *(Drexel University)*. Associate Teaching Professor. Computer security, ethical hacking, computer forensics, network forensics, cloud security and cybersecurity.

Gregory W. Hislop, PhD *(Drexel University)*. Professor. Information technology for teaching and learning, online education, structure and organization of the information disciplines, computing education research, software evaluation and characterization.

Xiaohua Tony Hu, PhD *(University of Regina, Canada)*. Professor. Data mining, text mining, Web searching and mining, information retrieval, bioinformatics and healthcare informatics.

Jina Huh-Yoo, PhD *(University of Michigan at Ann Arbor)*. Assistant Professor. Human-computer interaction, humancentered design, Health informatics, mobile and wireless health, social computing.

Shahin Jabbari Assistant Professor. Algorithmic fairness, game theory, and artificial intelligence for social good.

Jeremy R. Johnson, PhD *(Ohio State University) Department Head, Computer Science*. Professor. Computer algebra; parallel computations; algebraic algorithms; scientific computing.

Constantine Katsinis, PhD *(University of Rhode Island)*. Teaching Professor. High-performance computer networks, parallel computer architectures with sustained teraflops performance, computer security, image processing.

Weimao Ke, PhD *(University of North Carolina at Chapel Hill)*. Associate Professor. Information retrieval (IR), distributed systems, intelligent filtering/recommendation, information visualization, network science, complex systems, machine learning, text/data mining, multi-agent systems, the notion of information.

Mat Kelly, PhD *(Old Dominion University)*. Assistant Professor. Information retrieval, Web archives, metadata, digital humanities, archival privacy

Ehasn B. Khosroshahi, PhD *(Drexel University)*. Assistant Teaching Professor. Computational cognitive modeling, artificial intelligence, machine learning and data analysis.

Edward Kim, PhD *(Lehigh University)*. Associate Professor. Computer Vision, Sparse Coding, Neuromorphic Computing, Medical Image Processing, Computer Graphics, Artificial Intelligence, Game Development

Xia Lin, PhD *(University of Maryland at College Park) Department Head, Information Science*. Professor. Digital libraries, information visualization, visual interface design, knowledge mapping, human-computer interaction, information retrieval, information architecture, informetrices, information-seeking behaviors in digital environments.

Galen Long, MS *(Drexel University)*. Assistant Teaching Professor.

Chris MacLellan, PhD *(Carnegie Mellon University)*. Assistant Professor. Artificial intelligence, data science, machine learning, human-computer interaction, cognitive modeling,

Geoffrey Mainland, PhD *(Harvard University)*. Associate Professor. High-level programming languages and runtime support for non-general purpose computation.

Spiros Mancoridis, PhD *(University of Toronto) The Auerbach Berger Chair in Cybersecurity Distinguished Professor of Computer Science*. Professor. Software engineering; software security; code analysis; evolutionary computation.

Adelaida Alban Medlock, MS *(Drexel University) Associate Department Head for Undergraduate Affairs, Computer Science*. Teaching Professor. Introductory programming; computer science education.

Danuta A. Nitecki, PhD *(University of Maryland at College Park) Dean of Libraries*. Professor. Library metrics and use in management, library as place, and academic library service models.

Krzysztof Nowak, PhD *(Washington University)*. Associate Teaching Professor. Fourier analysis, partial differential equations, image processing, wavelets, asymptotic distribution of eigenvalues, numerical methods and algorithms, computer science education.

Santiago Ontañón, PhD *(University of Barcelona)*. Associate Professor. Game AI, computer games, artificial intelligence, machine learning, case-based reasoning

Yusuf Osmanlioglu, PhD *(Drexel University)*. Assistant Teaching Professor. Graph theory and algorithms, brain network analysis, optimization, computer vision, natural language processing.

Jung-ran Park, PhD *(University of Hawaii at Manoa)*. Associate Professor. Knowledge organization and representation, metadata, computer-mediated communication, cross-cultural communication, multilingual information access.

Tammy Pirmann, Ed D *(Gwynedd Mercy University)*. Teaching Professor. Introductory programming, object-oriented programming, game design, mobile computing, computer science education, computer science educator pipeline

Alex Poole, PhD *(University of North Carolina)*. Assistant Professor. Digital curation, archives and records management, digital humanities, and diversity, inclusivity, and equity.

Jeffrey L. Popyack, PhD *(University of Virginia)*. Professor. Operations research, stochastic optimization, computational methods of Markov decision processes; artificial intelligence, computer science education.

Emmanouil Pountourakis, PhD *(Northwestern University)*. Assistant Professor. Algorithmic game theory, algorithmic mechanism design, algorithmic aspects of behavioral economics, game theory and learning, computational and game theoretic aspects of energy grids

Michelle L. Rogers, PhD *(University of Wisconsin-Madison)*. Associate Professor. Human-computer interaction, healthcare informatics, human factors engineering, socio-technical systems, health services research, patient safety.

Jeffrey Salvage, MS *(Drexel University)*. Teaching Professor. Object-oriented programming, multi-agent systems, software engineering, database theory, introductory programming, data structures.

Dario Salvucci, PhD *(Carnegie Mellon University)*. Professor. Human computer interaction, cognitive science, machine learning, applications for driving.

Aleksandra Sarcevic, PhD *(Rutgers University)*. Associate Professor. Computer-supported cooperative work, human-computer interaction, and healthcare informatics.

Kurt Schmidt, MS *(Drexel University)*. Associate Teaching Professor. Data structures, math foundations for computer science, programming tools, programming languages.

Bhupesh Shetty, PhD *(University of Iowa)*. Assistant Teaching Professor. Process pattern mining, data mining, operations management, sports analytics, information systems, and machine learning applications.

Ali Shokoufandeh, PhD *(Rutgers University) Senior Associate Dean for Academic Affairs and Operations*. Professor. Theory of algorithms, graph theory, combinational optimization, computer vision.

Il-Yeol Song, PhD *(Louisiana State University)*. Professor. Conceptual modeling, ontology and patterns, data warehouse and OLAP, object-oriented analysis and design with UML, medical and bioinformatics data modeling & integration,.

Bo Song, PhD *(Drexel University)*. Assistant Teaching Professor. Database management, Data mining, bioinformatics, big data analytics, and knowledge discovery.

Brian Stuart, PhD *(Purdue University)*. Associate Teaching Professor. Machine learning, networking, robotics, image processing, simulation, interpreters, data storage, operating systems, computer science, data communications, distributed/operating systems, accelerated computer programming, computer graphics.

Milad Toutounchian, PhD *(Simon Fraser University)*. Assistant Teaching Professor. Data Science, Applied Machine Learning and Deep Learning.

Boris Valerstein, MS *(Pennsylvania State University)*. Assistant Teaching Professor.

Dimitra Vista Teaching Professor. Database systems

Filippos Vokolos, PhD *(Polytechnic University)*. Associate Teaching Professor. System architecture, principles of software design and construction, verification and validation methods for the development of large software systems, foundations of software engineering, software

verification & validation, software design, programming languages, dependable software systems.

Lei Wang, PhD *(Drexel University)*. Assistant Teaching Professor. Biomedical data science, machine learning, deep learning, neuroimaging processing & analytics, natural language processing, simulation modeling.

Rosina Weber, PhD *(Federal University of Santa Catarina)*. Associate Professor. Case-based reasoning, explainable artificial intelligence, machine learning, textual analytics, natural language understanding, language models, recommender systems, technological aspects of knowledge management, project management, and requirements engineering.

Jake Williams, PhD *(University of Vermont)*. Assistant Professor. Data science, scientific programming, computational social science, computational linguistics and natural language processing, mathematics, machine learning, algorithms, and scalability.

Kaidi Xu, PhD *(Northeastern University)*. Assistant Professor. AI security, explainable artificial intelligence, optimization.

Erija Yan, PhD *(Indiana University Bloomington)*. Associate Professor. Network Science, information analysis and retrieval, scholarly communication methods and applications.

Christopher C. Yang, PhD *(University of Arizona, Tucson)*. Professor. Web search and mining, security informatics, knowledge management, social media analytics, cross-lingual information retrieval, text summarization, multimedia retrieval, information visualization, information sharing and privacy, artificial intelligence, digital library, and electronic commerce.

Emeritus Faculty

Michael E. Atwood, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, organizational memory.

Bruce W. Char, PhD *(University of California-Berkeley)*. Professor Emeritus. Symbolic mathematical computation, algorithms and systems for computer algebra, problem-solving environments parallel and distributed computation.

Thomas A. Childers, PhD *(Rutgers University)*. Professor Emeritus. Measurement, evaluation, and planning of information and library services, the effectiveness of information organizations.

David E. Fenske, PhD *(University of Wisconsin-Madison)*. Dean Emeritus and Professor. Digital libraries, informatics, knowledge management and information technologies.

John B. Hall, PhD *(Florida State University)*. Professor Emeritus. Academic library service, library administration, organization of materials.

Katherine W. McCain, PhD *(Drexel University)*. Professor Emeritus. Scholarly communication, information production and use in the research process, development and structure of scientific specialties, diffusion of innovation, bibliometrics, evaluation of information retrieval systems.

Carol Hansen Montgomery, PhD *(Drexel University) Dean of Libraries Emeritus*. Research Professor. Selection and use of electronic collections, evaluation of library and information systems, digital libraries, economics of libraries and digital collections.

Delia Neuman, PhD *(The Ohio State University)*. Professor Emerita. Learning in information-rich environments, instructional systems design, the use of media for learning, and school library media.

Gerry Stahl, PhD *(University of Colorado)*. Professor Emeritus. Human-computer interaction, computer-supported cooperative work, computer-supported collaborative learning, theory of collaboration.

Howard D. White, PhD *(University of California at Berkeley)*. Professor Emeritus. Literature information systems, bibliometrics, research methods, collection development, online searching.

Susan Wiedenbeck, PhD *(University of Pittsburgh)*. Professor Emeritus. Human-computer interaction, end-user programming/end-user development, empirical studies of programmers, interface design and evaluation.

Computer and Informatics Undeclared

About the Program

The Computer & Informatics Undeclared program allows students to explore academic options within the College of Computing & Informatics before declaring a major and while staying on track during their first year.

The Computer & Informatics Undeclared program is not a major; however, all the courses in the first year are required in some form in the various majors in the College of Computing & Informatics. This selection of courses will “follow” the student to an eventual chosen major in the college. With the help of an advisor, students can select courses based on their interests and goals. No later than the end of spring term in the first academic year, students are required to select an appropriate major (Computer Science, Computing and Security Technology, Data Science, Information Systems, Software Engineering) which will lead to a bachelor's degree.

Students will complete co-ops in accordance with the requirements for the major that they choose.

Admission Requirements

There are no specific requirements for admission into the undeclared option beyond those that are required for any student applying to majors in the College of Computing & Informatics at Drexel University.

Program Requirements

University Requirements		
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
MATH courses according to placement		12.0
UNIV CI101	The Drexel Experience	2.0
COOP 101	Career Management and Professional Development	1.0
CIVC 101	Introduction to Civic Engagement	1.0
College Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0

Based on area of interest select appropriate options in consultation with an advisor	
CS/INFO Programming courses	9.0
Exploration of major options	9.0
Major Credits	**86.0**
Electives	**51.5**
Total Credits	**186.5**

Sample Plan of Study

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
ENGL 101 or 111	3.0	ENGL 102 or 112	3.0	ENGL 103 or 113	3.0		
UNIV CI101	1.0	CIVC 101	1.0	UNIV CI101	1.0		
MATH*	4.0	COOP 101	1.0	MATH*	4.0		
Programming**	3.0	MATH*	4.0	Programming**	3.0		
Major credits***	3.0	Programmin	3.0	Major credits***	3.0		
		Major credits***	3.0				
	16		**17**		**16**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
Major credits	9.0	Major credits	9.0	Major credits	9.0	VACATION	
Electives	6.0	Electives	6.0	Electives	6.0		
	15		**15**		**15**		**0**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
Major credits	9.0	Major credits	9.0	Major credits	10.0	VACATION	
Electives	6.0	Electives	6.0	Electives	5.0		
	15		**15**		**15**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits
Major credits	10.0	Major credits	10.0	Major credits	10.0
Electives	6.0	Electives	6.0	Electives	5.5
	16		**16**		**15.5**

Total Credits 186.5

* MATH courses according to placement

** Programming courses according to area of interest

*** Major credits according to area of interest

Computer Science BS / Computer Science MS

Major: Computer Science
Degree Awarded: Bachelor of Science (BS) and Master of Science (MS)
Calendar Type: Quarter
Total Credit Hours: 225.5
Co-op Options: One Co-op (Five years)
Classification of Instructional Programs (CIP) code: *11.0701*
Standard Occupational Classification (SOC) code: 11-3021

About the Program

The College of Computing & Informatics offers an accelerated degree program designed to allow students to complete both a bachelor's degree and a graduate degree along with cooperative educational experience in fewer years than would be typical if pursuing the degrees separately.

Admission Requirements

The guidelines for applying to the Computer Science Bachelor's/Master's (BS/MS) Accelerated Degree Program are as follows:

- University regulations require application after the completion of 90.0 credits but before the completion of 120.0 credits.
- Applicants must have an overall cumulative Grade Point Average of 3.5 or higher.
- Letters of recommendation from two Computer Science faculty are required.
- Students must submit a plan of study. Consult your advisor and course schedules for guidance.
- Applicants must have completed the following courses with a minimum GPA of 3.50

Degree Requirements

The courses below should be taken at Drexel. Seek guidance from your advisor regarding additional coursework if any courses below have been taken outside of Drexel.

CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0
CS 281	Systems Architecture	4.0
MATH 221	Discrete Mathematics	3.0

Requirements

The requirements of the Computer Science BS/MS program follow the requirements of both the BS in Computer Science (http://catalog.drexel.edu/undergraduate/collegeofcomputingandinformatics/computerscience/#requirementsbstext) and the MS in Computer Science (http://catalog.drexel.edu/graduate/collegeofcomputingandinformatics/computerscience/#degreerequirementsmstext). Students must complete all the requirements of the BS in Computer Science (http://catalog.drexel.edu/undergraduate/collegeofcomputingandinformatics/computerscience/#requirementsbstext) except that they may replace 6 credits of free electives (still maintaining the 180.0 credit minimum for the BS degree) with graduate coursework. In addition, students must complete 45.0 credits of graduate courses to satisfy the requirements of the MS in Computer Science (http://catalog.drexel.edu/graduate/collegeofcomputingandinformatics/computerscience/#degreerequirementsmstext). Please refer to the linked program pages for the details of these requirements.

Undergraduate Degree Requirements

Computer Science Requirements		
CS 164	Introduction to Computer Science	3.0
CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
CS 270	Mathematical Foundations of Computer Science	3.0

CS 277	Algorithms and Analysis	3.0
CS 281	Systems Architecture	4.0
CS 283	Systems Programming	3.0
CS 360	Programming Language Concepts	3.0
SE 181	Introduction to Software Engineering and Development	3.0
SE 310	Software Architecture I	3.0
Computer Science track courses (see below)		**18.0**
Computer Science electives (see below)		**6.0**
Computing & Informatics Requirements		
CI 101	Computing and Informatics Design I	2.0
CI 102	Computing and Informatics Design II	2.0
CI 103	Computing and Informatics Design III	2.0
CI 491 [WI]	Senior Project I	3.0
CI 492 [WI]	Senior Project II	3.0
CI 493 [WI]	Senior Project III	3.0
Mathematics Requirements		
MATH 121	Calculus I	4.0
MATH 122	Calculus II	4.0
MATH 123	Calculus III	4.0
MATH 200	Multivariate Calculus	4.0
MATH 201	Linear Algebra	4.0
MATH 221	Discrete Mathematics	3.0
MATH 311	Probability and Statistics I	4.0
Science Requirements		**19.0**
Select one of the following lab science sequences:		
BIO 131 & BIO 134 & BIO 132 & BIO 135 & BIO 133 & BIO 136	Cells and Biomolecules and Cells and Biomolecules Lab and Genetics and Evolution and Genetics and Evolution Lab and Physiology and Ecology and Anatomy and Ecology Lab	
CHEM 101 & CHEM 102 & CHEM 103	General Chemistry I and General Chemistry II and General Chemistry III	
PHYS 101 & PHYS 102 & PHYS 201	Fundamentals of Physics I and Fundamentals of Physics II and Fundamentals of Physics III	
Science electives (see below)		
Arts & Humanities Requirements		
COM 230	Techniques of Speaking	3.0
ENGL 101	Composition and Rhetoric I: Inquiry and Exploratory Research	3.0
or ENGL 111	English Composition I	
ENGL 102	Composition and Rhetoric II: Advanced Research and Evidence-Based Writing	3.0
or ENGL 112	English Composition II	
ENGL 103	Composition and Rhetoric III: Themes and Genres	3.0
or ENGL 113	English Composition III	
PHIL 311	Ethics and Information Technology	3.0
Writing & Communications electives (see below)		**6.0**
Arts & Humanities, Business, or Social Studies electives (see below) *		**18.0**
Universtiy Requirements		
CIVC 101	Introduction to Civic Engagement	1.0
COOP 101	Career Management and Professional Development	1.0
UNIV CI101	The Drexel Experience	2.0
or CI 120	CCI Transfer Student Seminar	
Free electives		**15.5**
Graduate Degree Requirements		
Core Requirements		
Students must take 1 course from each pair		
CS 500	Fundamentals of Databases	3.0
or CS 510	Introduction to Artificial Intelligence	
CS 521	Data Structures and Algorithms I	3.0
or CS 525	Theory of Computation	
CS 530	Developing User Interfaces	3.0
or CS 540	High Performance Computing	
CS 536	Computer Graphics	3.0
or CS 583	Introduction to Computer Vision	
CS 543	Operating Systems	3.0
or CS 544	Computer Networks	
CS 550	Programming Languages	3.0
or SE 575	Software Design	
Major Electives		**15.0**
Student must take an additional 5 CS-related courses from the following categories		
From the courses listed below, excluding any courses taken to fulfill a core requirement and spanning at least 2 categories		
Theory		
CS 521	Data Structures and Algorithms I (Core Candidate)	
CS 522	Data Structures and Algorithms II	
CS 525	Theory of Computation (Core Candidate)	
CS 618	Algorithmic Game Theory	
CS 618	Algorithmic Game Theory	
CS 621	Approximation Algorithms	
CS 623	Computational Geometry	
Intelligent Systems		
CS 500	Fundamentals of Databases (Core Candidate)	
CS 510	Introduction to Artificial Intelligence (Core Candidate)	
CS 511	Robot Laboratory	
CS 610	Advanced Artificial Intelligence	
CS 611	Game Artificial Intelligence	
CS 612	Knowledge-based Agents	
CS 613	Machine Learning	
CS 615	Deep Learning	
CS 660	Data Analysis at Scale	
CS 661	Responsible Data Analysis	
Programming Systems		
CS 550	Programming Languages (Core Candidate)	
CS 650	Program Generation and Optimization	
CS 675	Reverse Software Engineering	
CS 676	Parallel Programming	
SE 575	Software Design (Core Candidate)	
SE 576	Software Reliability and Testing	
SE 577	Software Architecture	
SE 578	Security Engineering	
Computer Systems		
CS 543	Operating Systems (Core Candidate)	
CS 544	Computer Networks (Core Candidate)	
CS 643	Advanced Operating Systems	
CS 645	Network Security	
CS 647	Distributed Systems Software	
Vision and Graphics		
CS 536	Computer Graphics (Core Candidate)	
CS 537	Interactive Computer Graphics	
CS 558	Game Engine Programming	
CS 583	Introduction to Computer Vision (Core Candidate)	
CS 634	Advanced Computer Vision	
CS 636	Advanced Computer Graphics	
Applications		
CS 530	Developing User Interfaces (Core Candidate)	
CS 540	High Performance Computing (Core Candidate)	
CS 567	Applied Symbolic Computation	
CS 590	Privacy	
CS 630	Cognitive Systems	
CS 668	Computer Algebra I	
CS 669	Computer Algebra II	
From MSSE Core Courses		
SE 575	Software Design	

SE 576	Software Reliability and Testing	
SE 627	Requirements Engineering and Management	
SE 638	Software Project Management	
From the following MSDS Core Courses		
DSCI 511	Data Acquisition and Pre-Processing	
DSCI 521	Data Analysis and Interpretation	
Additional Graduate-Level Courses		**12.0**
Four (4) additional graduate level courses are required, which could be:		
Up to 6 credits for the thesis option		
Up to 2 CS Independent Studies		
Additional appropriate graduate level Computer Science, Software Engineering, Data Science or Artificial Intelligence courses, consulting with your advisor		
Total Credits		**225.5**

* At least 3.0 credits must be taken from a Business category course (see below) and at least 3.0 credits must be taken from a Social Studies category (see below)

When completing undergraduate CS electives and graduate CS courses, students should take care to avoid equivalent courses at both the undergraduate and graduate levels. Please consult with your advisor for courses that should not be taken at both the undergraduate and graduate level.

Program Electives

Independent Study courses and Special Topics courses must be approved by the department prior to enrollment to satisfy a program elective requirement.

- **Computer Science electives**: any CS course numbered 300 or higher
- **Science electives**: any CHEM (except CHEM 111, CHEM 112, CHEM 113, CHEM 114, CHEM 151), BIO (except BIO 161, BIO 162, BIO 163; can take only one of BIO 100 or BIO 107; can take only one of BIO 101 or BIO 109), PHYS (except PHYS 050, PHYS 100, PHYS 103, PHYS 104, PHYS 105, PHYS 106 [WI] , PHYS 122, PHYS 151, PHYS 160, PHYS 305, PHYS 324, PHYS 405; cannot take both PHYS 131 & PHYS 181), ENVS, ENSS, PHEV
- **Writing & Communications electives**: any WRIT, COM, ENGL courses officially certified as Writing Intensive (WI), SCRP 270 [WI] , and SCRP 275 [WI]
- **Business electives**: any ACCT, BLAW, BUSN, ECON, ENTP, FIN, HRMT, INTB, MGMT, MIS, MKTG, OPM, OPR, ORGB, STAT, TAX
- **Social Studies electives**: any AFAS, ANTH, GST, HIST, JWST, PSCI, PSY, SOC, WGST
- **Arts & Humanities electives**: any ARCH, ARTH, CMGT, CJS, COM, CULA, DANC, EDEX, EDUC, ENGL (except ENGL 101, ENGL 102, ENGL 103, ENGL 105, ENGL 111, ENGL 112, ENGL 113), ESTM, FASH, FMST, FMVD, GST, INTR, LING, MUSC, PHIL, PHTO, THTR, VSCM, VSST, WRIT, Foreign Language courses (http://www.drexel.edu/culturecomm/academics/undergraduate/modernlang/languages/) as defined by the College of Arts and Sciences, and GMAP 260, ANIM 140, ANIM 141, ANIM 211, ANIM 212

Computer Science Tracks

Students must complete two of the following Computer Science tracks for a total of 18.0 credits. The tracks may overlap by one course. Students should check with the College for any additional Special Topics courses being offered that may be appropriate for one of the tracks. The student may propose a Student Defined Track with departmental approval.

Algorithms and Data Structures		
CS 440	Theory of Computation	3.0
CS 457	Data Structures and Algorithms I	3.0
CS 458	Data Structures and Algorithms II	3.0
Artificial Intelligence		
Select three of the following:		9.0
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 385	Evolutionary Computing	
CS 387	Game AI Development	
CS 481	Advanced Artificial Intelligence	
Computer and Network Security		
Select three of the following:		9.0
CS 303	Algorithmic Number Theory and Cryptography	
CS 377	Software Security	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
Computer Architecture		
Select three of the following:		9.0
CS 352	Processor Architecture & Analysis	
CS 476	High Performance Computing	
ECEC 356	Embedded Systems	
ECEC 413	Introduction to Parallel Computer Architecture	
Computer Graphics and Vision		
Select three of the following:		9.0
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
Computing Systems		
Select three of the following:		9.0
CS 314	Computing in the Small	
CS 352	Processor Architecture & Analysis	
CS 361	Concurrent Programming	
CS 365	System Administration	
CS 370	Operating Systems	
CS 375	Web and Mobile App Development	
CS 441	Compiler Workshop I	
CS 461	Database Systems	
CS 472	Computer Networks: Theory, Applications and Programming	
Game Development and Design		
Select three of the following:		9.0
CS 341	Serious Game Development	
or CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 387	Game AI Development	
CS 445	Topics in Computer Gaming	
GMAP 377	Game Development: Workshop I	
GMAP 378	Game Development: Workshop II	
Graphics and Interaction		
Select three of the following:		9.0
CS 338	Graphical User Interfaces	
CS 341	Serious Game Development	
or CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 387	Game AI Development	
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
CS 445	Topics in Computer Gaming	
GMAP 377	Game Development: Workshop I	

GMAP 378	Game Development: Workshop II	
INFO 310	Human-Centered Design Process & Methods	
Human-Computer Interaction		
Select three of the following:		9.0
CS 338	Graphical User Interfaces	
CS 345	Computer Game Design and Development	
CS 432	Interactive Computer Graphics	
INFO 310	Human-Centered Design Process & Methods	
Intelligent Systems		
Select three of the following:		9.0
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 385	Evolutionary Computing	
CS 387	Game AI Development	
CS 430	Computer Graphics	
CS 431	Advanced Rendering Techniques	
CS 432	Interactive Computer Graphics	
CS 435	Computational Photography	
CS 481	Advanced Artificial Intelligence	
Numeric and Symbolic Computation		
Select three of the following:		9.0
CS 300	Applied Symbolic Computation	
CS 303	Algorithmic Number Theory and Cryptography	
MATH 300	Numerical Analysis I	
MATH 301	Numerical Analysis II	
MATH 305	Introduction to Optimization Theory	
Programming Languages		
CS 440	Theory of Computation	3.0
CS 441	Compiler Workshop I	3.0
CS 442	Compiler Workshop II	3.0
Software and Security		
Select three of the following:		9.0
CS 303	Algorithmic Number Theory and Cryptography	
CS 377	Software Security	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 475	Computer and Network Security	
SE 311	Software Architecture II	
SE 320	Software Verification and Validation	
SE 410	Software Evolution	
Software Engineering		
SE 311	Software Architecture II	3.0
SE 320	Software Verification and Validation	3.0
SE 410	Software Evolution	3.0
Systems and High-Performance Computing		
Select three of the following:		9.0
CS 314	Computing in the Small	
CS 352	Processor Architecture & Analysis	
CS 361	Concurrent Programming	
CS 365	System Administration	
CS 370	Operating Systems	
CS 375	Web and Mobile App Development	
CS 440	Theory of Computation	
CS 441	Compiler Workshop I	
CS 442	Compiler Workshop II	
CS 461	Database Systems	
CS 472	Computer Networks: Theory, Applications and Programming	
CS 476	High Performance Computing	
ECEC 356	Embedded Systems	
ECEC 413	Introduction to Parallel Computer Architecture	
Theory and Computation		
Select three of the following:		9.0
CS 300	Applied Symbolic Computation	
CS 303	Algorithmic Number Theory and Cryptography	
CS 440	Theory of Computation	
CS 441	Compiler Workshop I	
CS 442	Compiler Workshop II	
CS 457	Data Structures and Algorithms I	
CS 458	Data Structures and Algorithms II	
MATH 300	Numerical Analysis I	
MATH 301	Numerical Analysis II	
MATH 305	Introduction to Optimization Theory	

Writing-Intensive Course Requirements

In order to graduate, all students must pass three writing-intensive courses after their freshman year. Two writing-intensive courses must be in a student's major. The third can be in any discipline. Students are advised to take one writing-intensive class each year, beginning with the sophomore year, and to avoid “clustering” these courses near the end of their matriculation. Transfer students need to meet with an academic advisor to review the number of writing-intensive courses required to graduate.

A "WI" next to a course in this catalog may indicate that this course can fulfill a writing-intensive requirement. For the most up-to-date list of writing-intensive courses being offered, students should check the Writing Intensive Course List (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/writing-intensive-courses/) at the University Writing Program (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/). (http://drexel.edu/coas/academics/departments-centers/english-philosophy/university-writing-program/drexel-writing-center/) Students scheduling their courses can also conduct a search for courses with the attribute "WI" to bring up a list of all writing-intensive courses available that term.

Sample Plan of Study

First Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CI 101	2.0	CI 102	2.0	CI 103	2.0	VACATION	
CS 164	3.0	CIVC 101	1.0	CS 172 or 176	3.0		
MATH 121	4.0	COOP 101*	1.0	ENGL 103 or 113	3.0		
ENGL 101 or 111	3.0	CS 171 or 175	3.0	MATH 123	4.0		
UNIV CI101	1.0	ENGL 102 or 112	3.0	UNIV CI101	1.0		
(UG) Lab Science course	4.5	MATH 122	4.0	(UG) Lab Science course	4.5		
		(UG) Lab Science course	4.5				
	17.5		**18.5**		**17.5**		**0**

Second Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 265	3.0	CS 260	3.0	CS 277	3.0	CS 283	3.0
CS 270	3.0	MATH 200	4.0	CS 281	4.0	CS 360	3.0
MATH 201	4.0	MATH 221	3.0	COM 230	3.0	(UG) Writing & Communications elective	3.0
SE 181	3.0	(UG) Science elective	3.0	SE 310	3.0	(UG) Arts & Humanities electives	5.0

(UG) Social Studies elective	4.0	(UG) Writing & Communications elective	3.0	(UG) Science elective	3.0		
	17		**16**		**16**		**14**

Third Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
MATH 311	4.0	(UG) Arts & Humanities elective	4.0	COOP EXPERIENCE		COOP EXPERIENCE	
PHIL 311	3.0	(UG) Computer Science electives	12.0				
(UG) Computer Science electives	9.0						
	16		**16**		**0**		**0**

Fourth Year

Fall	Credits	Winter	Credits	Spring	Credits	Summer	Credits
CS 491	3.0	CI 492	3.0	CI 493	3.0	(GR) MS Core courses	6.0
(UG) Business elective	4.0	(UG) Free electives	7.0	(UG) Free elective	3.0	(GR) MS Major elective	3.0
(UG) Science elective	3.0	(UG) Free elective / (GR) MS Core course	3.0	(UG) Computer Science	3.0		
(UG) Free elective / (GR) MS Core Course	3.0			(UG) Arts & Humanities elective	3.0		
				Student awarded BS Degree			
				Classified as Graduate status			
	13		**13**		**12**		**9**

Fifth Year

Fall	Credits	Winter	Credits	Spring	Credits
(GR) MS Core course	3.0	(GR) MS Core course	3.0	(GR) MS Major elective	3.0
(GR) MS Major electives	6.0	(GR) MS Major elective	3.0	(GR) MS electives	6.0
(GR) MS Elective	3.0	(GR) MS elective	3.0		
	12		**9**		**9**

Total Credits 225.5

Minor in Computer Science

About the Minor

The Computer Science minor provides students with a breadth of knowledge in areas that form the foundation of computer science. The student adds some depth by selecting courses from a list of advanced computer science courses.

Program Requirements

The Computer Science minor is available to all University students in good standing, with the exception of Computer Science majors.

Prerequisites

One of the following Mathematics sequences must be completed before entering the program:

- MATH 101 and MATH 102
- MATH 121 and MATH 122

Requirements

CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
Additional CS courses numbered 200 or higher.		12.0
Total Credits		**24.0**

Note: No more than 9.0 credits from a student's major may be used to fulfill the minor requirements. Students who, because of this rule, require additional credits to reach 24.0 total credits may select additional Advanced Electives as needed.

Additional Information

For more information about this program, please visit the College of Computing & Informatics (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/)website.

Minor in Computing Technology

About the Minor

The demand for individuals with technology skills is increasing and essential in today's internet-dominated society. Almost every field nowadays relies on technology. People in all fields may become responsible for building or using computer networks and increasingly more complex websites and intranets. The minor in Computing Technology combines basic courses in computing technology required to help organizations build infrastructure solutions.

Any student in any major can benefit from a minor in Computing Technology. Graduates with such background knowledge are prepared to actively participate in the application of technology within the major area of study.

The minor is available to all University students in good standing with the exception of students majoring in Computing and Security Technology.

Program Requirements

CS 171	Computer Programming I	3.0
or INFO 151	Web Systems and Services I	
CT 140	Network Administration I	3.0
CT 200	Server I	3.0
CT 201	Information Technology Security I	3.0
CT 210	Open Server I	3.0
INFO 101	Introduction to Computing and Security Technology	3.0
INFO 210	Database Management Systems	3.0

Computer Technology Elective, select 1 of the following		3.0
CT 310	Open Server II	
CT 320	Server II	
CT 330	Network Administration II	
INFO 365	Database Administration I	
Total Credits		**24.0**

Additional Information

For more information, please visit the College of Computing & Informatics website (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/).

Minor in Data Science

About the Minor

Data Science provides a foundation for problem-solving in a data-driven society. The minor in Data Science combines basic courses in statistics, information and technology, and social contexts to address problems that require large and disparate datasets.

Any student in any major can benefit from a minor in data science. Graduates with such background knowledge are prepared to actively participate in the application of data science within their major area of study.

The minor is available to all University students in good standing with the exception of students majoring in Data Science.

Program Requirements

CS 171	Computer Programming I	3.0
CS 172	Computer Programming II	3.0
INFO 103	Introduction to Data Science	3.0
INFO 371	Data Mining Applications	3.0
STAT 201	Introduction to Business Statistics	4.0
STAT 202	Business Statistics II	4.0
Select 2 of the following:		6.0
CS 375	Web and Mobile App Development	
CS 380	Artificial Intelligence	
CS 383	Machine Learning	
CS 461	Database Systems	
or INFO 210	Database Management Systems	
INFO 202	Data Curation	
INFO 212	Data Science Programming I	
INFO 213	Data Science Programming II	
INFO 250	Information Visualization	
INFO 323	Cloud Computing and Big Data	
INFO 332	Exploratory Data Analytics	
INFO 350	Visual Analytics	
INFO 432	Advanced Data Analytics	
INFO 440	Social Media Data Analysis	
Total Credits		**26.0**

Additional Information

For more information about this program, please visit the College of Computing & Informatics website (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/).

Minor in Human Computer Interaction

About the Minor

The minor in Human Computer Interaction provides a course of study for students who would like to improve the integration of computing in the lives of individuals and to use computing to enable collaboration within groups. The minor combines courses in human computer interaction, ubiquitous computing, graphical interface design, and social computing.

The minor is available to all University students in good standing with the exception of students already majoring in Information Systems, Computing and Security Technology, or Data Science.

Program Requirements

CS 171	Computer Programming I	3.0
or INFO 151	Web Systems and Services I	
INFO 102	Introduction to Information Systems	3.0
INFO 215	Social Aspects of Information Systems	3.0
INFO 310	Human-Centered Design Process & Methods	3.0
INFO 405	Social and Collaborative Computing	3.0
HCI Electives **		
Select 3 of the following:		9.0
CS 338	Graphical User Interfaces	
CS 341	Serious Game Development	
CS 342	Experimental Game Development	
CS 345	Computer Game Design and Development	
CS 375	Web and Mobile App Development	
CS 380	Artificial Intelligence	
CS 467	Security and Human Behavior	
INFO 101	Introduction to Computing and Security Technology	
INFO 103	Introduction to Data Science	
INFO 110	Introduction to Human-Computer Interaction	
INFO 150	Introduction to Ubiquitous Computing	
INFO 250	Information Visualization	
INFO 350	Visual Analytics	
INFO 405	Social and Collaborative Computing	
INFO 440	Social Media Data Analysis	
Total Credits		**24.0**

* CCI majors: Replace INFO 110 with an additional HCI elective.

** HCI Elective Recommendations:
For non-CCI majors: INFO 101 INFO 103 INFO 150 INFO 250
For CS majors: CS 338 CS 341 CS 342 CS 345 CS 380 CS 375

* An additional 9.0 credits or more are to be chosen from other course offerings in HCI pertinent to the student's overall program of study. Guidance in selecting these electives will be provided by staff and faculty of the College of Computing & Informatics.

Additional Information

For more information, please visit the College of Computing & Informatics website (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/).

Minor in Information Systems

About the Minor

Drexel's undergraduate Information Systems minor combines basic courses in areas including human-computer interaction, systems analysis, database management systems, and computer networking technology. The Information Systems minor is available to all University students in good standing with the exception of students already majoring in Computing and Security Technology or Data Science.

Program Requirements

Required Courses		
CT 140	Network Administration I	3.0
INFO 101	Introduction to Computing and Security Technology	3.0
INFO 102	Introduction to Information Systems	3.0
INFO 103	Introduction to Data Science	3.0
INFO 200	Systems Analysis I	3.0
INFO 210	Database Management Systems	3.0
INFO 310	Human-Centered Design Process & Methods	3.0
One information system elective *		3.0
Total Credits		**24.0**

* An additional 3 credits or more are to be chosen from other course offerings in information systems pertinent to the student's overall program of study. Guidance in selecting these electives will be provided by staff and faculty of the College of Computing and Informatics.

Additional Information

For more information, please visit the College of Computing & Informatics website (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/).

Minor in Security Technology

About the Minor

The demand for individuals with security related skills is increasing and essential in today's internet-dominated society. Computer and information systems managers are becoming more involved with the security of data, responsible for sophisticated and more efficient computer networks, and increasingly more complex websites and intranets. The minor in Security Technology combines basic courses in security and technology required to help organizations keep their computer systems secure.

Any student in any major can benefit from a minor in Security Technology. Graduates with such background knowledge are prepared to actively participate in the application of security technology within the major area of study.

The minor is available to all University students in good standing with the exception of students majoring in Computing and Security Technology.

Program Requirements

CT 140	Network Administration I	3.0
CT 201	Information Technology Security I	3.0
CT 210	Open Server I	3.0
CT 301	Information Technology Security II	3.0
CT 312	Access Control and Intrusion Detection Technology	3.0
CT 412	Information Technology Security Policies	3.0
INFO 101	Introduction to Computing and Security Technology	3.0
Security Technology Elective, Select 1 of the following:		3.0
CT 315	Security Management Practice	
CT 362	Network Auditing Tools	
CT 393	Information Technology Security Risk Assessment	
CT 415	Disaster Recovery and Continuity Planning	
Total Credits		**24.0**

Additional Information

For more information, please visit the College of Computing & Informatics website (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/).

Minor in Software Engineering

About the Minor

The Software Engineering minor is available to all University students in good standing with the exception of Software Engineering majors.

Prerequisites

One of the following mathematics sequences must be completed before entering the program:

- MATH 101 and MATH 102
- MATH 121 and MATH 122

Program Requirements

CS 171	Computer Programming I	3.0
or CS 175	Advanced Computer Programming I	
CS 172	Computer Programming II	3.0
or CS 176	Advanced Computer Programming II	
CS 260	Data Structures	3.0
CS 265	Advanced Programming Tools and Techniques	3.0
SE 210	Software Specification and Design I	3.0
SE 310	Software Architecture I	3.0
SE 320	Software Verification and Validation	3.0
Select one of the following:		3.0
SE 211	Software Specification and Design II	
SE 311	Software Architecture II	
SE 410	Software Evolution	
Total Credits		**24.0**

Note: No more than 9.0 credits from a student's major may be used to fulfill the minor requirements. Students who, because of this rule, require additional credits to reach 24.0 total credits may select from the following courses as needed:

INFO 210	Database Management Systems	3.0
INFO 310	Human-Centered Design Process & Methods	3.0
INFO 355	Systems Analysis II	3.0
INFO 420	Software Project Management	3.0

Additional Information

For more information, please visit the College of Computing & Informatics (https://drexel.edu/cci/academics/undergraduate-programs/undergraduate-minors/) website.

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