COMPUTER SCIENCE, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN DATA SCIENCE

The Bachelor of Science in Computer Science is built on a rigorous, highly concentrated, accredited curriculum of computer science courses, and includes concentrations in cybersecurity, data science and software engineering. The program provides a strong foundation in the discipline and includes advanced study in several important areas of computer science.

The degree requires a minimum of 120 credit hours and includes undergraduate requirements, general education requirements and computer science major requirements.

Student learning outcomes

Upon completing this program, students will know and know how to do the following:

Computer science core outcomes

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions

2. Design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline

3. Communicate effectively in a variety of professional contexts

4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles

5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline

6. Apply computer science theory and software development fundamentals to produce computing-based solutions

Data science concentration-specific outcome

1. Apply data science and artificial intelligence algorithms to meet specific data and/or model requirements and produce practical solution to a data analysis or data processing problem

Special requirements

The B.S. in Computer Science with a concentration in data science requires a minimum of 120 credits. Students must receive a minimum grade of C in all computer science courses in order to graduate.

Based on the results of the Computer Science Placement Test, students may be required to take CMSC 254, which then can count toward the degree requirements as an elective.

Degree requirements for Computer Science, Bachelor of Science (B.S.) with a concentration in data science

Course	Title	Hours
General education (http://bulletin.vcu.edu/undergraduate/undergraduate-study/general-education-curriculum/)		
Select 30 credits of general education courses in consultation with an adviser.		30
Major requirements		
• Major core requirements		
CMSC 235	Computing and Data Ethics	3
CMSC 254	Introduction to Problem-solving	4
CMSC 255	Introduction to Object-oriented Programming	4
CMSC 256	Introduction to Data Structures	4
CMSC 257	Computer Systems	4
CMSC 302	Introduction to Discrete Structures	3
CMSC 303	Introduction to the Theory of Computation	3
CMSC 304	Programming Languages	3
CMSC 311	Computer Organization	3
CMSC 312	Introduction to Operating Systems	3
CMSC 355	Fundamentals of Software Engineering	3
CMSC 401	Algorithm Analysis with Advanced Data Structures	3
CMSC 408	Databases	3
CMSC 440	Data Communication and Networking	3
CMSC 441 & CMSC 451	Senior Design Studio I (Laboratory/Project Time) and Senior Project I	3
CMSC 442 & CMSC 452	Senior Design Studio II (Laboratory/Project Time) and Senior Project II	3
• Concentration requirements (choose three from the following)		9
CMSC 435	Introduction to Data Science	3
CMSC 436	Artificial Intelligence	3
CMSC 437	Introduction to Natural Language Processing	3
CMSC 438	Machine Learning	3
Ancillary requirements		
ECON 205	The Economics of Product Development and Markets (satisfies general education BOK for social/behavioral science and AOI for global perspectives)	3
ENGR 395	Professional Development	1
MATH 200	Calculus with Analytic Geometry I (satisfies general education quantitative foundations)	4
MATH 201	Calculus with Analytic Geometry II	4
STAT 212	Concepts of Statistics	3
Humanities electives (from list below)		6
MATH courses (300- to 400-level)		3
Natural science option: Select from BIOL, CHEM or PHYS course with a lab (3-5 credits satisfy general education BOK for natural science and AOI for scientific and logical reasoning) [1]		4-5
Open electives		

Select any course.		9-10
Total Hours		**120**

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Select one of the following options:

- Option A: CHEM 101 and CHEZ 101
- Option B: PHYS 207
- Option C: BIOL 151 and BIOZ 151

The minimum number of credit hours required for this degree is 120.

Approved humanities electives

Course	Title	Hours
Select six credits from the following programs or subject areas:		6
African-American studies		
American studies		
Anthropology		
School of the Arts		
English		
Foreign language		
History		
Philosophy		
Psychology		
Religious studies		
Social work		
Sociology		
Urban studies		

Some courses in other programs (including most honors modules and other courses that focus on human behavior, communication and/or social interaction) may be counted toward this requirement with departmental approval.

What follows is a sample plan that meets the prescribed requirements within a four-year course of study at VCU. Please contact your adviser before beginning course work toward a degree.

Freshman year

Fall semester		Hours
CMSC 235	Computing and Data Ethics	3
CMSC 254	Introduction to Problem-solving	4
UNIV 111 Play course video for Focused Inquiry I	Focused Inquiry I (satisfies general education UNIV foundations)	3
General education course		3
Humanities elective (from list)		3
	Term Hours:	**16**

Spring semester

CMSC 255	Introduction to Object-oriented Programming	4

ECON 205	The Economics of Product Development and Markets (satisfies general education BOK for social/behavioral science and AOI for global perspectives)	3
MATH 200	Calculus with Analytic Geometry I (satisfies general education quantitative foundations)	4
UNIV 112 Play course video for Focused Inquiry II	Focused Inquiry II (satisfies general education UNIV foundations)	3
	Term Hours:	**14**

Sophomore year

Fall semester

CMSC 256	Introduction to Data Structures	4
CMSC 302	Introduction to Discrete Structures	3
MATH 201	Calculus with Analytic Geometry II	4
UNIV 200	Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations)	3
	Term Hours:	**14**

Spring semester

CMSC 304	Programming Languages	3
CMSC 311	Computer Organization	3
ENGR 395	Professional Development	1
STAT 212	Concepts of Statistics	3
General education course		3
Humanities elective (from list)		3
	Term Hours:	**16**

Junior year

Fall semester

CMSC 257	Computer Systems	4
CMSC 303	Introduction to the Theory of Computation	3
CMSC 355	Fundamentals of Software Engineering	3
Natural science option (3-5 credits satisfy general education BOK for natural science and AOI for scientific and logical reasoning)(select one):		3-5
CHEM 101 & CHEZ 101	General Chemistry I and General Chemistry Laboratory I	4
PHYS 207	University Physics I	5
BIOL 151 & BIOZ 151	Introduction to Biological Sciences I and Introduction to Biological Science Laboratory I	4
General education course		3
	Term Hours:	**17-18**

Spring semester

CMSC 401	Algorithm Analysis with Advanced Data Structures	3
CMSC 408	Databases	3
CMSC 440	Data Communication and Networking	3
MATH course (300- to 400-level)		3
General education course (select BOK for humanities/fine arts)		3
	Term Hours:	**15**

Senior year
Fall semester

CMSC 441	Senior Design Studio I (Laboratory/Project Time)	2
CMSC 451	Senior Project I (capstone)	1
Concentration requirements (select two):		6
CMSC 435	Introduction to Data Science	3
CMSC 436	Artificial Intelligence	3
CMSC 438	Machine Learning	3
Open electives		6
	Term Hours:	**15**

Spring semester

CMSC 312	Introduction to Operating Systems	3
CMSC 437	Introduction to Natural Language Processing	3
CMSC 442	Senior Design Studio II (Laboratory/Project Time)	2
CMSC 452	Senior Project II (capstone)	1
Open electives		3-4
	Term Hours:	**13**
	Total Hours:	**120-121**

The minimum number of credit hours required for this degree is 120.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows qualified students to earn both the B.S. and M.S. in Computer Science in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to six hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 144 credits rather than the 150 credits necessary if the two degrees are pursued separately.

The program is designed to develop skills and educate computer science students to be major contributors in the computing industry. The graduate program in computer science provides state-of-the-art education through the use of didactic courses to those students who wish to further their knowledge and careers within the computing industry. The program emphasizes continuing self-development and broadening of the knowledge of individuals currently engaged in science, technology and engineering-related fields. It also prepares persons who have completed undergraduate majors in these fields for entry into a career in the numerous areas that use computing technology. Both the theoretical and applied aspects of computer science are emphasized in this program.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to this accelerated program include completion of 30 undergraduate credit hours including six computer science courses CMSC 255, CMSC 256, CMSC 257, CMSC 302, CMSC 303 and CMSC 311; an overall GPA of 3.0; and a GPA of 3.4 in the six courses identified above. Successful applicants would enter the program in the fall semester of their senior year.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "**Satisfactory academic progress**" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate computer science adviser and the faculty adviser to the graduate program.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to the graduate program requires a separate step that occurs through a formal application to the master's program, which is submitted through Graduate Admissions no later than a semester prior to graduation with the baccalaureate degree, that is, before the end of the fall semester of the senior year. In order to continue pursuing the master's degree after the baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin. Three reference letters (including one from the computer science undergraduate program director and at least one more from a computer science faculty member) must accompany the application. Students who do not meet the minimum GPA requirements may submit GRE scores to receive further consideration.

Degree requirements

The Bachelor of Science in Computer Science degree will be awarded upon completion of a minimum of 120 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits may be taken prior to completion of the baccalaureate degree. At most, six of these graduate credits will substitute for open elective credits for the undergraduate degree. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements.

The graduate computer science courses that may be taken as an undergraduate, once a student is admitted to the program, are:

Course	Title	Hours
Maximum for shared credits is 12.		
CMSC 501	Advanced Algorithms	3
CMSC 502	Parallel Algorithms	3
CMSC 510	Regularization Methods for Machine Learning	3
CMSC 516	Advanced Natural Language Processing	3
CMSC 525	Introduction to Software Analysis, Testing and Verification	3
CMSC 591	Topics in Computer Science	3

Recommended course sequence/plan of study for students pursuing a thesis master's

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior year prior to admission to the accelerated program in the senior year.

Course	Title	Hours
Junior year		
Fall semester		
CMSC 257	Computer Systems	4
CMSC 303	Introduction to the Theory of Computation	3
CMSC 355	Fundamentals of Software Engineering	3
Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)		4-5
Select one of the following:		
BIOL 151 & BIOZ 151	Introduction to Biological Sciences I and Introduction to Biological Science Laboratory I	
CHEM 101 & CHEZ 101	General Chemistry I and General Chemistry Laboratory I	
PHYS 207	University Physics I	
General education course		3
Contact undergraduate and graduate program directors		
Term Hours:		17-18
Spring semester		
CMSC 401	Algorithm Analysis with Advanced Data Structures	3
CMSC 408	Databases	3
CMSC 440	Data Communication and Networking	3
MATH upper-level (300 to 400)		3
General education course (select BOK for humanities/fine arts)		3
Secure approval from undergraduate program director		
Apply to the M.S. program		
Term Hours:		15
Senior year		
Fall semester		
CMSC 441	Senior Design Studio I (Laboratory/Project Time)	2
CMSC 451	Senior Project I	1
CMSC 501	Advanced Algorithms	3
CMSC 516	Advanced Natural Language Processing	3
Open electives		6
Term Hours:		15
Spring semester		
CMSC 312	Introduction to Operating Systems	3
CMSC 442	Senior Design Studio II (Laboratory/Project Time)	2
CMSC 452	Senior Project II	1
CMSC 525	Introduction to Software Analysis, Testing and Verification (counts toward B.S. and M.S.)	3
CMSC 5XX (Select fourth shared graduate course from list above.)		3
Choose the M.S. thesis adviser		
Term Hours:		12
Fifth year		
Fall semester		
CMSC 697	Directed Research	3
M.S. foundational area courses (theory and systems) [1]		6
Term Hours:		9
Spring semester		
CMSC 697	Directed Research	6
M.S. foundational area course (applied) [1]		3
Term Hours:		9

[1]

See the Graduate Bulletin for the list of theory, systems and applied foundational area courses.

Recommended course sequence/plan of study for students pursuing a non-thesis master's

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior year prior to admission to the accelerated program in the senior year.

Course	Title	Hours
Junior year		
Fall semester		
CMSC 257	Computer Systems	4
CMSC 303	Introduction to the Theory of Computation	3
CMSC 355	Fundamentals of Software Engineering	3
Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)		4-5
Select one of the following:		
BIOL 151 & BIOZ 151	Introduction to Biological Sciences I and Introduction to Biological Science Laboratory I	
CHEM 101 & CHEZ 101	General Chemistry I and General Chemistry Laboratory I	
PHYS 207	University Physics I	
General education course		3
Contact undergraduate and graduate program directors		
Term Hours:		17-18
Spring semester		
CMSC 401	Algorithm Analysis with Advanced Data Structures	3
CMSC 408	Databases	3
CMSC 440	Data Communication and Networking	3
MATH upper-level (300 to 400)		3
General education course (select BOK for humanities/fine arts)		3
Term Hours:		15
Secure approval from the undergraduate program director		
Apply to the M.S. program		

Senior year

Fall semester		
CMSC 441	Senior Design Studio I (Laboratory/Project Time)	2
CMSC 451	Senior Project I	1
CMSC 501	Advanced Algorithms	3
CMSC 516	Advanced Natural Language Processing	3
Open electives		6
Term Hours:		15
Spring semester		
CMSC 312	Introduction to Operating Systems	3
CMSC 442	Senior Design Studio II (Laboratory/Project Time)	2
CMSC 452	Senior Project II	1
CMSC 525	Introduction to Software Analysis, Testing and Verification (counts toward B.S. and M.S.)	3
CMSC 5XX (Select fourth shared graduate course from list above.)		3
Term Hours:		12
Fifth year		
Fall semester		
M.S. foundational area courses (theory, systems and applied) [1]		9
Term Hours:		9
Spring semester		
Graduate didactic course work		9
Term Hours:		9

[1]

See the Graduate Bulletin for the list of theory, systems and applied foundational area courses.