

FORM TO REQUEST SUBSTANTIAL CHANGES TO AN EXISTING UNDERGRADUATE MAJOR

A request for substantial changes to an existing program requires approval from the school director/department head (managing administrator), college academic dean, Curricular Affairs, Undergraduate Council (UGC), and College Academic Administrators Council (CAAC). Additional approvals may be required, depending on the requested changes.

I. Requested by (College & School/Department): College of Science, Department of Computer Science

II. Proposer's name, title, email and phone number:

Dr. Saumya Debray, Professor and Director of Undergraduate Studies, debray@cs.arizona.edu, 520-621-4527

III. Degree, major and number of students enrolled in the major. If you have emphases (sub-plans), list the number of students enrolled by emphasis:

The plans impacted include the pre-majors (PRCSBAND, PRCSBSND) and major plans (COSCBA, COSCBS).

Plan	Number of students (from Current Plan Counts via UAnalytics)
Pre-major CS (used prior to Fall 2018)	12
Pre-major BA	162
Pre-major BS	697
BA in Computer Science	42
BS in Computer Science	435

IV. Describe proposed changes to the major. Provide a rationale and explanation for making changes to the major and include any relevant supporting data. Are the changes proposed a result of Annual Program Review (APR) and/or a result from the assessment of programmatic outcomes? If you are requesting a name change, please indicate if the subject code (course prefix) will also change. Include requested new prefix code and description.

We propose the following changes to the major:

1. Creation of a new lower-division course, *CSC 144: Discrete Mathematics for Computer Science I*. Modify existing CSC 245 into CSC 244: Discrete Mathematics for Computer Science II.

Rationale: In the current Computer Science curriculum, students are exposed to the mathematical foundations of computer science in just a single lower-division course, CSC 245. This has a number of problems:

- There is too much material crammed into the existing CSC 245. Many students complain that the course moves too fast and as a result they do not have enough time to cover the material in sufficient breadth and depth, and to absorb the material sufficiently.
- The amount of material that needs to be covered is too great for a single course. As the discipline of computer science has evolved with time, the foundational mathematical knowledge necessary for upper division courses has also grown. At this point, there is simply too much foundational material to be covered in a single course.
- Having a two-course sequence as proposed (CSC 144 + CSC 244) would allow us to address both these problems: there would be enough time to cover all of the necessary material at a speed that would make the material accessible to a diverse range of students.

2. Addition of the “new” courses into the Pre-Computer Science program

Rationale: Currently, the mathematical foundations of computer science are covered in a single course, CSC 245, which is in the Pre-CS major. As mentioned above, the CSC 144[new] + CSC 244 (modified 245) sequence would together cover the mathematical foundations of computer science in increased breadth and depth. It therefore seems natural to add the proposed new course CSC 144 to the Pre-CS major.

3. Creation of a new upper-division course, ***CSC 380: Introduction to Data Science***

Rationale: In today's world, topics such as Big Data, Artificial Intelligence, and Data Science are required knowledge for all computer science students. The Computer Science program currently does not have any course that can introduce students to this area and prepare them for 400-level electives covering these topics. As a result, students often graduate with gaps in their knowledge of this important area, which can place them at a disadvantage in their subsequent academic and professional careers. This course aims to address this shortcoming.

- V. **Comparison Chart**—complete the chart below using your existing [academic advisement report](#). You may not need to complete all portions. Highlight row(s) indicating the proposed significant changes. You can find course information to help complete the chart below by using the [UA course catalog](#) or [UAnalytics](#) (Catalog and Schedule Dashboard> “Printable Course Descriptions by Department” On Demand Report; right side of screen). Proposed changes resulting in similar curriculum with other plans (within department, college, or university) may require completion of an additional comparison chart. **Delete Example columns before submitting.**

	Existing Major Requirements	Requirements For Modified Major
Major, emphasis (if applicable) and degree *	Computer Science BS pre-major (PRCSBSND) and Computer Science, BS (COSCBS)	No change
CIP Code –lookup here or contact the Office of Curricular Affairs for assistance, if needed	11.0701, Computer Science	No change
Total units required to complete the degree*	120	No change
Upper -division units required to complete the degree	42	No change
Total CC transfer units that may apply to this degree*	64	No change
Foundation courses		
Math	Substantial Math Strand	No change
Second Language	Second Semester Proficiency	No change
General Education		
Tier I GE Requirements (150, 160, 170)	2- Tier 1 150 (INDV) 2- Tier 1 160 (TRAD)	No change
Tier II GE Requirements (Arts, HUMS, INDV, NATS)	3 units -Tier II Arts 1-Tier II Humanities 1- Tier II Individuals and Societies	No change
Pre-major? (Yes/No)	Yes	Yes
List any special requirements to declare or gain admission to this major (completion of specific coursework, minimum GPA, interview, application, etc.)	<p>Admission to the Computer Science major is competitive. Selections for major admission are made prior to the beginning of each fall and spring semester after final grades are posted for the previous semester. Students will remain in pre-Computer Science standing until they meet major admission requirements and are formally admitted to the major.</p> <p>In order to guarantee admission to the major, a student must have:</p> <ul style="list-style-type: none"> - a cumulative UA GPA of 2.4 or higher - GPA of 3.0 or higher in best attempts at CSC 120, 245 (or MATH 243 or MATH 323), & 210 taken at the UA or elsewhere - GPA of 2.0 or higher in all attempts at CSC courses (excluding GRO 1st attempts) taken at the UA - at least two programming courses completed at the UA. 	<p>Admission to the Computer Science major is competitive. Selections for major admission are made prior to the beginning of each fall and spring semester after final grades are posted for the previous semester. Students will remain in pre-Computer Science standing until they meet major admission requirements and are formally admitted to the major.</p> <p>In order to guarantee admission to the major, a student must have:</p> <ul style="list-style-type: none"> - a cumulative UA GPA of 2.4 or higher - GPA of 3.0 or higher in best attempts at CSC 120, 210 and CSC 244 (or MATH 243 or MATH 323), taken at the UA or elsewhere - GPA of 2.0 or higher in all attempts at CSC courses (excluding GRO 1st attempts) taken at the UA - at least two programming courses completed at the UA.

	<p>Complete the following courses as part of the pre-major:</p> <p><u>Computer Science I</u>: CSC 110 (4) Intro. to Computer Programming I or (hidden) ECE 175 (3) Computer Programming for Engineering Applications or (hidden) ISTA 130 (4) Computational Thinking and Doing</p> <p><u>Computer Science II</u>: CSC 120 (4) Intro. to Computer Programming II</p> <p><u>Software Development</u>: CSC 210 (4) Software Development</p> <p><u>Introduction to Discrete Structures</u>: CSC 245 (3) Introduction to Discrete Structures or (hidden) MATH 243 (3) Discrete Mathematics in Computer Science or (hidden) MATH 323 (3) Formal Mathematical Reasoning and Writing</p>	<p>Complete the following courses as part of the pre-major:</p> <p><u>Computer Science I</u>: CSC 110 (4) Intro. to Computer Programming I or (hidden) ECE 175 (3) Computer Programming for Engineering Applications or (hidden) ISTA 130 (4) Computational Thinking and Doing</p> <p><u>Computer Science II</u>: CSC 120 (4) Intro. to Computer Programming II</p> <p>Discrete Mathematics: CSC 144 (3, NEW) Discrete Mathematics for Computer Science I</p> <p><u>Software Development</u>: CSC 210 (4) Software Development</p> <p><u>Introduction to Discrete Structures</u>: CSC 244 (3) Discrete Mathematics for Computer Science II or (hidden) MATH 243 (3) Discrete Mathematics in Computer Science or (hidden) MATH 323 (3) Formal Mathematical Reasoning and Writing</p>
Minimum # of units required in the major (units counting towards major units and major GPA)	45	51
Minimum # of upper-division units required in the major (upper division units counting towards major GPA)	27	30
Minimum # of residency units to be completed in the major	30	30
Required supporting coursework (courses that do not count towards major units and major GPA, but are required for the major). Courses listed must include prefix, number, units, and title. Include any limits/restrictions in place/needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	<p>Supporting Mathematics, Complete 1 from the following: MATH 129 (3) Calculus II or MATH 313 (3) Introduction to Linear Algebra</p> <p>Supporting Science, Complete 2 from the following lab sciences: Refer to Appendix A</p>	No changes to supporting mathematics or supporting science requirements
Major requirements. List all major requirements including core and electives. If applicable, list the emphasis^ requirements. Courses listed count towards major units and major GPA. Courses listed must include prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions in place/needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses being	<p>All pre-major required courses</p> <p><u>Core Courses, Complete all 4:</u> CSC 252 (3) Computer Organization CSC 335 (3) Object-oriented Programming and Design CSC 345 (3) Analysis of Discrete Structures CSC 352 (3) Systems Programming and Unix</p>	<p>All pre-major required courses</p> <p>Core Courses, Complete all 5: CSC 252 (3) Computer Organization CSC 335 (3) Object-oriented Programming and Design CSC 345 (3) Analysis of Discrete Structures CSC 352 (3) Systems Programming and Unix CSC 380 (3, NEW) Introduction to Data Science</p>

added and are not owned by your department. Recommend ordering requirements in the same order as your advisement report.	<u>Paradigms Area Elective. Complete 1 course:</u> CSC 343 (3) Human Computer Interaction CSC 372 (3) Comparative Programming Languages CSC 422 (3) Intro. to Parallel and Distributed Programming CSC 460 (3) Database Design	No change to Paradigms Area Elective requirement
	<u>Theory and Writing Area Elective. Complete 1 course:</u> CSC 437 (3) Geometric Algorithms CSC 445 (3) Algorithms CSC 450 (3) Algorithms in Bioinformatics CSC 473 (3) Automata, Grammars and Languages	No change to Theory and Writing Area requirement
	<u>Systems Area Elective. Complete 1 course:</u> CSC 452 (3) Principles of Operating Systems CSC 453 (3) Compilers and Systems Software	No change to Systems Area Elective requirement
	<u>Elective.</u> Complete 1 course from list of options in Appendix B	No change to Elective requirement
	<u>Additional Elective.</u> Complete 1 course from list of options in Appendix C	No change to Additional Elective requirement
	<u>Additional Elective II.</u> Complete 1 course from list of options in Appendix D	No change to Additional Elective II requirement
Internship, practicum, applied course requirements. (Yes/No). If yes, provide description.	No	No change
Senior thesis or senior project required (Yes/No). If yes, provide description.	No	No change
Additional requirements (provide description)	None	No change
Minor (optional or required)	Optional	No change

*May require Arizona Board of Regents (ABOR) approval

^Emphases are officially recognized sub-specializations within the discipline. [ABOR Policy 2-221 c. Academic Degree Programs Subspecializations](#) requires all undergraduate emphases within a major to share at least 40% curricular commonality across emphases (known as “major core”). Total units required for each emphasis must be equal.

VI. Peer institution comparison- describe how your modified major requirements are similar and different from major requirements of two peer institutions. Select peers from (in order of priority) [ABOR approved institutions](#), [AAU members](#), and/or other relevant institutions recognized in the field.

1. University of Illinois at Urbana Champaign (UIUC)

UIUC has a two-course sequence that covers the foundations of computer science and is required for all computer science majors:

- CS 125, Intro to Computer Science. "Basic concepts in computing and fundamental techniques for solving computational problems. Intended as a first course for computer science majors and others with a deep interest in computing."
- CS 173, Discrete Structures. "Discrete mathematical structures frequently encountered in the study of Computer Science. Sets, propositions, Boolean algebra, induction, recursion, relations, functions, and graphs."

Currently CSC 245 covers some of the material in UIUC's CS125 and some of the material in UIUC's CS173. With the proposed change, the two-course sequence CSC 144 + CSC 244 would align with the content of UIUC's CS125 + CS173.

UIUC does not have a required course on Data Science and Machine Learning; instead it lists "Intelligence and Big Data" as a focus area that students can take courses in.

2. Rutgers University. Rutgers has a two-course sequence that covers the foundations of computer science and is required for all computer science majors:

- 01:198:205 - Introduction to Discrete Structures I. (The 01:198 prefix designates computer science courses.) "To introduce the student to the mathematical tools of logic and induction, and to the basic definitions and theorems concerning relations, functions, and sets. Later courses in the computer science curriculum build on the mathematical foundations covered here. Particular emphasis is placed on inductive definitions and proofs, with application to problems in computer science."
- 01:198:206 - Introduction to Discrete Structures II. "Provides the background in combinatorics and probability theory required in design and analysis of algorithms, in system analysis, and in other areas of computer science."

Currently, CSC 245 covers some of the topics in 01:198:205 and some of the topics in 01:198:206, but there are several topics in those courses that are not currently covered in CSC 245 (for example: discrete probability, conditional probability and related topics, graph theory topics). The new two-course sequence CSC 144 + CSC 244 will align with the content of Rutgers' 01:198:205 + 01:198:206.

Rutgers does not currently have a required course in data science.

VII. Faculty impact- indicate if new faculty hires will be required to deliver the proposed modified/new curriculum.

We plan to hire new faculty to teach the modified curriculum.

VIII. Budgetary impact- indicate new resources needed and source of funding to implement the proposed changes. If reallocating resources, indicate where resources will be taken from and the impact this will have on students/faculty/program/unit.

Computer Science has a large and growing major, and the proposed new courses will be required for all CS majors. Because of this, we expect that in a steady-state scenario, the RCM impact of the additional SCH generated due to these courses will more than offset the resources required to deliver the material.

IX. Required signatures

Managing unit administrator (print name and title): David K Lowenthal

Managing administrator's signature: David K Lowenthal


Date: Jan 21, 2021

Managing unit administrator (print name and title): _____

Managing administrator's signature: _____

Date: _____

Dean (print name): Rebecca L Gomez

Dean's signature: 

Date: Jan 22, 2021

Dean (print name): _____

Dean's signature: _____

Date: _____

Note: In some situations, signatures of more than one unit head and/or college dean may be required.

For use by Curricular Affairs:

Committee	Approval date
Academic Programs Subcommittee	
Undergraduate Council	
College Academic Administrators Council	
Arizona Board of Regents (if applicable)	

- Notify proposers of approval
- Upload proposal documents to relevant UAccess tables
- Notify ADVIP team and proposers

If ABOR approval required :

- If applicable, create approval memo
- Send memo to college/dept and acad_org listserv.
- If applicable, create new plan code (secondary too)
- If applicable, update emphases
- If applicable, add last admit term to prior plan code(s)
- Upload proposal docs to relevant UAccess table values
- Notify ADVIP team and proposers

Appendix A: Supporting Science Coursework Options

- Chemistry I, 4 units

CHEM 141/143 (4) General Chemistry Lecture I and Lab I: Quantitative **or**

CHEM 151 (4) General Chemistry I **or** CHEM 161/163 (4) Honors Fundamentals of Chemistry and Honors Fundamental Techniques of Chemistry

-Chemistry II, 4 units

CHEM 142/144 (4) General Chemistry Lecture and Lab II: Quantitative **or** CHEM 152 (4) General Chemistry II **or** CHEM 162/164 (4) Honors Fundamentals of Chemistry and Honors Fundamental Techniques of Chemistry

-Physics I, 4 units PHYS 102/181 (4) Intro. Physics I and Intro. Lab. I **or** PHYS 141 (4) Intro. Mechanics **or** PHYS 161H (4) Honors Intro. Mechanics

-Physics II, 4 units PHYS 103/182 (4) Intro. Physics II and Intro. Lab. II **or** PHYS 241 (4) Intro. Electricity and Magnetism **or** PHYS 261H (4) Honors Intro. Electricity and Magnetism

-Physics II- Option II, 3 units

PHYS 142 (3) Intro. Optics and Thermodynamics **or** PHYS 162H (4) Honors Intro. Optics and Thermodynamics

-Biology I, 4 units MCB 181R/181L (4) Intro. Biology I and Intro. Biology Lab. I **or** MCB 184 (4-5) Intro. Biology I: The Secrets of Life

-Biology II, 4 units ECOL 182R/182L (4) Intro. Biology II and Intro. Biology II Lab

-Other Supporting Science Options I, 3 units

GEOS 251(4) Physical Geology **or** GEOS 255 (4) Historical Geology **or** GEOS 308 (3) Paleontology **or** MSE 110 (4) Solid State Chemistry **or** PSIO 201 (4) Human Anatomy and Physiology I **or** PSIO 202 (4) Human Anatomy and Physiology II

-Other Supporting Science Options II, 3 units

GEOS 251(4) Physical Geology **or** GEOS 255 (4) Historical Geology **or** GEOS 308 (3) Paleontology **or** MSE 110 (4) Solid State Chemistry **or** PSIO 201 (4) Human Anatomy and Physiology I **or** PSIO 202 (4) Human Anatomy and Physiology II

Appendix B: Elective Options

CSC 343 (3) Human Computer Interaction
CSC/CSCV 372 (3) Comparative Programming Languages
CSC/CSCV 422 (3) Intro. to Parallel and Distributed Programming
CSC 425 (3) Computer Networking
CSC 433 (3) Computer Graphics
CSC 436 (3) Software Engineering
CSC 437 (3) Geometric Algorithms
CSC 444 (3) Data Visualization
CSC/CSCV 445 (3) Algorithms
CSC 447 (3) Green Computing
CSC 450 (3) Algorithms in Bioinformatics
CSC/CSCV 452 (3) Principles of Operating Systems
CSC/CSCV 453 (3) Compilers and Systems Software
CSC/CSCV 460 (3) Database Design
CSC 466 (3) Computer Security
CSC/CSCV 473 (3) Automata, Grammars and Languages
CSC 477 (3) Intro. to Computer Vision
CSC 483 (3) Text Retrieval and Web Search
CSCV 471 (3) Artificial Intelligence

Appendix C: Additional Elective

CSC 317 (3) Mobile Application Programming
CSC 337 (3) Web Programming
CSC 343 (3) Human Computer Interaction
CSC 346 (3) Cloud Computing
CSC/CSCV 372 (3) Comparative Programming Languages
CSC/CSCV 422 (3) Intro. to Parallel and Distributed Programming
CSC 425 (3) Computer Networking
CSC 433 (3) Computer Graphics
CSC 436 (3) Software Engineering
CSC 437 (3) Geometric Algorithms
CSC 444 (3) Data Visualization
CSC/CSCV 445 (3) Algorithms
CSC 447 (3) Green Computing
CSC 450 (3) Algorithms in Bioinformatics
CSC/CSCV 452 (3) Principles of Operating Systems
CSC/CSCV 453 (3) Compilers and Systems Software
CSC/CSCV 460 (3) Database Design
CSC 466 (3) Computer Security
CSC/CSCV 473 (3) Automata, Grammars and Languages
CSC 477 (3) Intro. to Computer Vision
CSC 483 (3) Text Retrieval and Web Search
CSCV 471 (3) Artificial Intelligence

Appendix D: Additional Elective II

CSC 343 (3) Human Computer Interaction
CSC/CSCV 372 (3) Comparative Programming Languages
CSC/CSCV 422 (3) Intro. to Parallel and Distributed Programming
CSC 425 (3) Computer Networking
CSC 433 (3) Computer Graphics
CSC 436 (3) Software Engineering
CSC 437 (3) Geometric Algorithms
CSC 444 (3) Data Visualization
CSC/CSCV 445 (3) Algorithms
CSC 447 (3) Green Computing
CSC 450 (3) Algorithms in Bioinformatics
CSC/CSCV 452 (3) Principles of Operating Systems
CSC/CSCV 453 (3) Compilers and Systems Software
CSC/CSCV 460 (3) Database Design
CSC 466 (3) Computer Security
CSC/CSCV 473 (3) Automata, Grammars and Languages
CSC 477 (3) Intro. to Computer Vision
CSC 483 (3) Text Retrieval and Web Search
CSCV 471 (3) Artificial Intelligence
ECE/CSC 474A (3) Computer-Aided Logic Design
LING/CSC/PSY 438 (3) Computational Linguistics
LING/ISTA/CSC 439 (3) Statistical Natural Language Processing
MATH/MATV/CSCV 402 (3) Mathematical Logic
MATH/MATV/CSCV 443 (3) Theory of Graphs and Networks
MATH 475A (3) Mathematical Principles of Numerical Analysis
MATH 475B (3) Mathematical Principles of Numerical Analysis
PHIL/CSC/MATH 401A (3) Symbolic Logic
PHIL/CSC/MATH 401B (3) Symbolic Logic
PHIL/CSC 455 (3) Philosophy and Artificial Intelligence









Curricular Changes Form: BS in Computer Science

Final Audit Report

2021-01-22

Created:	2021-01-21
By:	Martin Marquez (martinmarquez@email.arizona.edu)
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