Methods and Problems in Computer Science

COMS 12XX

Instructor Info

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Course Info —

Prereq: None

M Tu Tr Fr

75 min Lecture, 4x/week

516 Milstein

Capped at 24 students

"Computer Science is as much about computers as astronomy is about telescopes."

–E. Dijkstra (1970), or maybe M. Fellows (1991)

Overview

While the act of programming is indisputably central to Computer Science, there is far more to the field. From a programming perspective, this course will cover loops, variables, branching, and functions. We will then take these core concepts and unwind them to understand what it is that computer scientists consider to be Computer Science. This course might also be titled "Cocktail Computer Science" - at the end of this class you will be able to discuss most of the key problems in computer science with experts in the field. You should have the tools at the end of this course to continue your exploration of programming, or computer science, or both, on your own.

Grading Scheme

10%	Participation
40%	~5 Homeworks at ~8% each
20%	Midterm Takehome Exam
30%	Final Takehome Exam

Learning Outcomes

- Articulate the difference between computer science and computer programming
- Appreciate the societal importance of computer science, from low-level systems to theoretical results
- Understand design issues in programming languages, as a vehicle for both execution and expression
- Discuss the meaning and consequences of P vs NP
- Write basic programs to manipulate data

Material

Required Texts

The Nature of Computation

`http://nature-of-computation.org/~moore/noc/`

This text is available through the library as a .pdf

Late Policy

Any late assignment (that is submitted before the due date) will be docked 10% of total possible points on that assignment, up to two weeks after original due date, at which point no credit will be awarded. This policy does not apply to the final project, which cannot be accepted after the due date except in exceptional circumstances.

Class Attendance Policy

Beyond the 10% of your grade that is allocated to participation as stated above, you are expected to attend every class period. Excessive absences will require consultation.

Class Laptop Policy

Some classes will require the use of laptops. If using a laptop in class is not possible for any student, we will pair program. In class meetings that do not explicitly note the need for a laptop, all digital assistants (laptops, phones, smart watches, AR glasses, etc) should be stored for the entirety of class.

FAQs

Will I learn how to program?

Yes, though this course covers only the most essential topics in programming. You might say this course doesn't focus on teaching you how to program - it teaches you to how learn to program.

Do I need a strong background in mathematics to take this course?

No, in fact, nothing anyone learned from high school mathematics is likely help you here - the mathematics of computer science is a fresh beast for us all.

Is this a replacement for Intro to CS

No, this class is not intended to directly prepare you for any other CS courses or the CS major. It may well do that in practice, but not from an administrative perspective.

Honor Code

You are expected to hold yourself to the highest standard of academic integrity and honesty, as reflected in the Barnard Honor Code. Approved by the student body in 1912 and updated in 2016, the Code states:

We, the students of Barnard College, resolve to uphold the honor of the College by engaging with integrity in all of our academic pursuits. We affirm that academic integrity is the honorable creation and presentation of our own work. We acknowledge that it is our responsibility to seek clarification of proper forms of collaboration and use of academic resources in all assignments or exams. We consider academic integrity to include the proper use and care for all print, electronic, or other academic resources. We will respect the rights of others to engage in pursuit of learning in order to uphold our commitment to honor. We pledge to do all that is in our power to create a spirit of honesty and honor for its own sake.

Wellness Statement

It is important for undergraduates to recognize and identify the different pressures, burdens, and stressors you may be facing, whether personal, emotional, physical, financial, mental, or academic. We as a community urge you to make yourself–your own health, sanity, and wellness–your priority throughout this term and your career here. Sleep, exercise, and eating well can all be a part of a healthy regimen to cope with stress. Resources exist to support you in several sectors of your life, and we encourage you to make use of them. Should you have any questions about navigating these resources, please visit these sites:

- `http://barnard.edu/primarycare`
- `https://barnard.edu/about-counseling`
- `http://barnard.edu/wellwoman/about`
- Stressbusters Support Network

Center for Accessibility Resources & Disability Services

If you believe you may encounter barriers to the academic environment due to a documented disability or emerging health challenges, please feel free to contact me and/or the Center for Accessibility Resources & Disability Services (CARDS). Any student with approved academic accommodations is encouraged to contact me during office hours or via email. If you have questions regarding registering a disability or receiving accommodations for the semester, please contact CARDS at (212) 854-4634, cards@barnard.edu, or learn more at `barnard.edu/disabilityservices`. CARDS is located in 101 Altschul Hall.

Affordable Access to Course Texts & Materials

All students deserve to be able to study and make use of course texts and materials regardless of cost. Barnard librarians have partnered with students, faculty, and staff to find ways to increase student access to textbooks. By the first day of advance registration for each term, faculty will have provided information about required texts for each course on CourseWorks (including ISBN or author, title, publisher, copyright date, and price), which can be viewed by students. A number of cost-free or low-cost methods for accessing some types of courses texts are detailed on the Barnard Library Textbook Affordability guide (library.barnard.edu/textbook-affordability). Undergraduate students who identify as first-generation and/or low-income students may check out items from the FLIP lending libraries in the Barnard Library (library.barnard.edu/flip) and in Butler Library for an entire semester. Students may also consult with their professors, the Dean of Studies, and the Financial Aid Office about additional affordable alternatives for having access to course texts. Visit the guide and talk to your professors and your librarian for more details.

Class Schedule

This course is offered in the immersive format. It will meet 4x a week (twice the frequency of a semester-long course) for six weeks.

Readings from The Nature of Computation abbreviated by NoC.

MODULE 1: Graphs & Code & Algorithms - oh my!

This module introduces the basics of programming - the "literacy" of computer science.

Week 1	Variables and Purity	
	Loops vs Maps	
	Conditionals & Etymology: Algorithm	NoC, Chapter 1: Prologue
Week 2	First Class Functions	NoC, Chapter 2: Basics
	What is an algorithm?	NoC, Chapter 3: Insights and Algorithms
	Using graphs to represent problems	Fellows, M. (1991). Computer SCIENCE and Mathematics in the Elementary Schools.

MODULE 2: P vs NP

This module looks at computer science beyond programming - what are *discoveries* and what are *inventions*?

Week 3	How hard is a problem?	NoC, Chap 4: Needles in a Haystack: the class NP
	NP in the wild	NoC, Chap 5: NP-completeness
Midterm Exam	The midterm will be a takehome exam focused on short response and multiple choice questions.	
Week 4	Security and Complexity	NoC, Chap 6: The Deep Question: P vs NP
	Quantum Computing	

MODULE 3: The Grand Unified Theory of Computation

This module covers languages, automata, and different models of computation

Week 5	Lambda Calculus	NoC, Chap 7: The Grand Unified Theory of Computation
		
		To Dissect a Mockingbird: A Graphical Notation for the Lambda Calculus with Animated Reduction (`http://dkeenan.com/Lambda/index.htm`)
		
		`http://www.nyu.edu/projects/barker/Lambda/`
		
		`http://worrydream.com/AlligatorEggs/`

Week 6	Automata	Conway's Game of Life
	Models of Computing	
Final Exam	The takehome final exam will be a combination of short response/multiple choice questions, as well as questions in a narrative style, long response format.	