# CS at UMD

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UNIVERSITY OF MARYLAND



### CS at UMD is Popular



Declared CS majors, 2011 - 2018

https://reports.umd.edu

### CS at UMD is Popular



### All CS Students: At Least One Internship

From survey of 2018 graduates, with data gathered from 343 of 512 total (67%)

**Internship Frequency among Students** 



### Where CS Students End Up

<b>REPORTED OUTCOMES OF 2016 GRADUATES</b>						
Outcome	#	%				
Employed FT	282	83%				
Employed PT	5	1%				
Continuing Education	34	10%				
Participating in a volunteer or service program	0	0%				
Serving in the military	0	0%				
Starting a business	4	1%				
Unplaced	3	1%				
Unresolved	10	3%				
TOTAL	341	100%				
Not seeking	3					



From survey of 2018 graduates, with data gathered from 343 of 512 total (67%)

### Where CS Students **OUTSIDE US** End Up 0% **OTHER US** 12% NY MD 6% 31% WA 7% CA 8% VA D.C 25% 11%

From survey of 2018

#### graduates, with data

### Sample of companies ered from 343

- Capitol One of 512 total (67%)
- Amazon
- Microsoft
- Goldman Sachs
- Leidos
- Facebook
- Booz Allen Hamilton
- TripAdvisor
- SalesForce
- AirBNB
- Accenture
- Northrop Grumman
- Appian
- Boeing
- US Dept State
- Bloomberg
- Epic
- NIH
- Google
- ...

### Outline

- Curriculum structure
- Overview of courses
- Course support
- Non-course activities
- In the Works

# Curriculum

## Computer Science (CS) at UMD in a nutshell

- CS is one of several computing-oriented majors at UMD (more later)
- CS course structure has foundations, breadth, and depth. It's a tree!
  - Tall, thick trunk of foundational courses the "intro sequence"
  - Many branches of application courses
    - With a requirement of taking courses in many of them
- And there's more
  - Clubs: code:BLACK, robotics, VR, cybersecurity club, Association of Computing Machinery chapter, Linux Users Group, Association of Women in Computing
  - Hackathons: Bitcamp, Technica
  - 1-credit student-run courses (10-15 per semester),
  - Maryland Center for Women in Computing (MCWIC)
- Lots of information at <u>https://undergrad.cs.umd.edu/</u>



## Limited Enrollment Program (LEP): Fall'19

- As of this Fall, UMD CS enrollment is limited at admission time
  - FAQ at <u>https://cmns.umd.edu/undergraduate/admissions/new-faqs-</u> <u>computer-science-limited-enrollment</u>
- Not a quota
  - Those who don't immediately qualify will qualify if they pass the gateway courses
- More on LEP, and other computing majors, in the next presentation
  - CS, InfoSci, and CE total about 5000 students: 16.5% of all UMD undergrads!

### Required CS Courses

- CMSC 131 Object Oriented Programming I
- CMSC 132 Object Oriented Programming II
- CMSC 216 Introduction to Computer Systems
- CMSC 250 Discrete Structures
- CMSC 330 Organization of Programming Languages
- CMSC 351 Algorithms
- All required for CS major, CS minor, and CompEng major
- More on CS courses overall at <a href="http://www.cs.umd.edu/class/">http://www.cs.umd.edu/class/</a>



### Non-major CS Courses

- CMSC 106 Introduction to Programming in C
- CMSC 122 Introduction to Programming via the Web
  - Gen-Ed credit: Distributive Studies Scholarship in Practice
- New for Fall 2019 (and beyond): CMSC 131 and 132 are required for the CS major, but **may also be taken by non-majors** 
  - They are two of the gateway courses for the LEP
- No course corresponding to AP CS Principles (yet)

### Other Required Courses

- MATH 140 Calculus I
  - This is an LEP Gateway
- MATH 141 Calculus II
- STAT 4XX advanced statistics class (must have 141 as pre-req)
  - E.g., intro to probability and statistics
- STAT/MATH XXX advanced class (must have 141 as pre-req)
  - E.g., linear algebra

### Upper-level Required Courses

Five Upper-level (3XX or 4XX courses) across at least three *areas* 

- Systems,
- Information Processing,
- Software Engineering and Programming Languages,
- Theory,
- Numerical Analysis

Also two elective courses; may be drawn from these



### Systems

- CMSC 411 Computer Systems Architecture
- CMSC 412 Operating Systems
- CMSC 414 Computer and Network Security
- CMSC 417 Computer Networks

## Information Processing (the grab bag!)

- CMSC 420 Data Structures
- CMSC 421 Introduction to Artificial Intelligence
- CMSC 422 Machine Learning
- CMSC 423 Bioinformatic Algorithms, Databases, and Tools
- CMSC 424 Database Design
- CMSC 425 Game Programming
- CMSC 426 Computer Vision
- CMSC 427 Computer Graphics
- CMSC 470 Introduction to Natural Language Processing

### Software Engineering and Prog. Languages

- CMSC 430 Introduction to Compilers
- CMSC 433 Programming Language Technologies and Paradigms
- CMSC 434 Introduction to Human-Computer Interaction
- CMSC 435 Software Engineering
- CMSC 436 Hand Held Programming Devices

### Theory and Numerical Analysis

- CMSC 451 Design and Analysis of Computer Algorithms
- CMSC 452 Elementary Theory of Computation
- CMSC 456 Cryptology
- CMSC 457 Introduction to Quantum Computing
- CMSC 460 Computational Methods
- CMSC 466 Introduction to Numerical Analysis

### Specializations and Concentrations

- Students may specialize in Data Science or Cybersecurity
  - Amounts to a refinement of the upper level course requirements
    - Focus on courses most relevant to the area of interest
  - Annotation on diploma
- Upper level **concentration**: *All* students must complete a minimum of 12 credit hours of 300 400 level courses in one discipline outside of Computer Science
  - Not so different than CS+X programs sprouting around (e.g., at Illinois) except that UMD CS has had this for decades!

# The Intro Sequence

### Exemption Exams

- Passing an exam permits you to skip the corresponding course
  - But does not provide course credit, which impacts total credit hours earned
- May be taken by external transfers only
  - Only just prior to their first semester at UMD
- May take one exam per session (usually one per day)
  - Many days scheduled throughout the summer; fewer during winter
- Must pass exemption exams in order: 131 > 132 > (216 and/or 250)
  - If you fail an earlier/lower-level exam (e.g., 131), score on later exam not counted (e.g., for 250)
  - This avoids inconsistencies with matching prerequisites for CMSC courses

### CMSC 131 – Object Oriented Programming I

- Introduction to programming and computer science. Emphasizes understanding and implementation of applications using object-oriented techniques. Develops skills such as program design and testing as well as implementation of programs using a graphical IDE. Programming done in Java
- Exemption exam available
  - Matches AP CSA exemption granted for 131 with a score of 5
- Gateway course for LEP
- Articulated with MCC CMSC 203
- Sample materials on request

### CMSC 132 – Object Oriented Programming II

- Introduction to use of computers to solve problems using software engineering principles. Design, build, test, and debug medium-sized software systems and learn to use relevant tools. Use object-oriented methods to create effective and efficient problem solutions. Use and implement application programming interfaces (APIs). Programming done in Java.
- Exemption exam available
- Gateway course for LEP
- Articulated with MCC CMSC 204
- Sample materials on request

### CMSC 216 – Intro to Computer Systems

- Introduction to the interaction between user programs and the operating system/hardware. Major topics include C programming, introductory systems programming, and assembly language. Other concepts covered include UNIX, machine data representation, thread management, optimization, and virtual memory. Programming is done in the Linux Environment
- Exemption exam available
- Only for CMSC and majors and minors, or CE majors

### Course IT Support

- Key component of UMD CS education is outside-of-class projects
  - Submit server custom auto-grading infrastructure
  - Grace cluster (runs Linux)
- In-class instructional support
  - Panopto video-recording lectures, in-sync slides
  - Turningpoint Clickers in-class quizzes/polls
- Scaling up
  - Grades server, ELMS grades and other course management
  - Office hours app managing TA office hours
  - Gradescope managing paper-based exam grading
- More ...

## Submit Server



#### mhicks2: | Student view | CMSC330 | code reviews | P7



Logout

#### **P7: Introduction to Cybersecurity**

**Deadline:** Tue, 14 May at 11:59 PM

Overview | Utilities | Baseline | History | Test details | Inconsistencies

Show just section: CMSC330-0101 📀 😡

#### Results for each test case for each students' most recent submission

			#			Public											
#	Name	<u>Acct</u>	subs	submitted at	<u>Score</u>	1	2	3	4	5	6	7	8	9	10	11	12
1			10	<u>Mon, 13 May at 01:31</u> <u>PM</u>	0												
2			2	<u>Thu, 02 May at 01:15</u> <u>PM</u>	28												
3			33	<u>Mon, 13 May at 10:52</u> <u>AM</u>	0												
4			3	<u>Mon, 13 May at 10:22</u> <u>AM</u>	0												
5			7	<u>Mon, 13 May at 01:31</u> <u>PM</u>	100												
6			4	<u>Tue, 14 May at 03:04</u> <u>PM</u>	30												
7			1	<u>Thu, 02 May at 12:53</u> PM	100												

## Office Hours App

#### Live student queue

Num	Student	Description	Date submitted
No students in queue			

Logout

#### **Student statistics**



Name	Total tickets	Avg tickets/week	Last ticket date
	2	2	N/A
	7	1.75	N/A
	1	1	N/A
	8	1.143	N/A
	14	2.667	N/A
	107	7.929	N/A
	104	8.75	N/A

### Grace Cluster



- Class Web Pages
- Management Tool
- Directory Layout
- Expiration Calendar
- Accessing Files
- Unix Shell Access

#### **GRACE** for Instructors

Overview of GRACE Requesting/Configuring Your GRACE Space Requesting Software **Overview of GRACE** 

This page is intended to give an overview of GRACE for instructors of courses, as well as some answers about how things are typically done.

GRACE is intended as an environment to facilitate many of the computing needs for the University's role as a teaching institution. Due to the breadth and scope of the departments and courses at the University, no single environment can completely fit the needs of every single class, but it is hoped that this environment can fit the needs of most courses. GRACE provides:

## Grades Server



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User Michael W. Hicks **Navigation** Cou **Report Absence** <u>CM</u> Become DB Admin <u>CM</u> View All Illnesses <u>CM</u> Add My Classes <u>CM</u> Another Class <u>CM</u> **Change Profile** <u>CM</u> <u>CM</u> Scheduling CM **Download TA Hours** CM Show Missing TA Hours <u>CM</u> **Office Hours** <u>CM</u> Prereq Check <u>CM</u> **Teaching Times** CM Schedule Edit <u>CM</u> Server Issues CM **Grades Feature Request** CM **Report Issue with Server** <u>CM</u> Logout <u>CM</u> CM

### DEPARTMENT OF COMPUTER SCIENCE

#### **Select Desired Course**

urse	Semester	Role
<u>ISC389N</u>	Summer 2019	Instructor
<u>ISC330</u>	Spring 2019	Instructor
<u>ISC3881</u>	Spring 2019	Instructor
<u>ISC389N</u>	Spring 2019	Instructor
<u>ISC388A</u>	Winter 2019	Instructor
<u>ISC388B</u>	Winter 2019	Instructor
<u>ISC389N</u>	Summer 2018	Instructor
<u>ISC330</u>	Spring 2018	Instructor
<u>ISC631</u>	Fall 2017	Instructor
<u>ISC330</u>	Spring 2017	Instructor
<u>ISC330 (0101 0301)</u>	Fall 2016	Instructor
<u>ISC396H</u>	Fall 2016	Instructor
<u>ISC838G</u>	Spring 2016	Instructor
<u>ISC330</u>	Fall 2015	Instructor
<u>ISC330</u>	Spring 2015	Instructor
<u>ISC433</u>	Fall 2014	Instructor
<u>ISC838G</u>	Spring 2014	Instructor
<u>ISC433</u>	Fall 2013	Instructor
<u>ISC330 (0101 0201)</u>	Spring 2013	Instructor

#### cmns at the edge of discovery ...

| 😵

### CMSC 250 – Discrete Structures

- Fundamental mathematical concepts related to computer science, including finite and infinite sets, relations, functions, and propositional logic. Introduction to other techniques, modeling and solving problems in computer science. Introduction to permutations, combinations, graphs, and trees with selected applications.
- Exemption exam available
- Only for CMSC and majors and minors, or CE majors
- Articulated with MCC CMSC 207

### CMSC 330 – Organization of Prog. Languages

- A study of programming languages, including their syntax, semantics, and implementation. Several different models of languages are discussed, including dynamic, scripting (e.g., Ruby, Python) functional (e.g., OCaml, Haskell, Scheme), and memory safe systems programming (e.g., Rust). Explores language features such as formal syntax, scoping and binding of variables, higher-order programming, typing, and type polymorphism. Introduces finite automata, context free grammars, parsing, lambda calculus, and basics of security attacks and software security.
- Only for CMSC and majors and minors, or CE majors

### CMSC 351 – Algorithms

- A systematic study of the complexity of some elementary algorithms related to sorting, graphs and trees, and combinatorics. Algorithms are analyzed using mathematical techniques to solve recurrences and summations.
- Only for CMSC and majors and minors, or CE majors

## Outside of the Classroom



Singh Sandbox and Makerspace 

### Hackathons

- Bitcamp hackathon hosted at UMD since 2014
  - Collegiate-level participation
  - 36-hour challenges



- "Bitcamp is a hackathon that values participant experience and mentorship over competitiveness and points. Come to have fun with your friends, learn something new, eat s'mores, and have a generally awesome time."
- Technica the largest all-women and non-binary hackathon
  - First held in 2017. Student organized.
  - Collegiate CS majors and non-majors, and teens and tweens
  - 872 hackers in 2019, produced more than 100 project demos
  - Supported by 36 sponsors and 153 mentors



### Clubs and STICs

- Many clubs organized and run by students, for students
  - code: BLACK
  - VR club
  - Cybersecurity club
  - Association of Women in Computing
  - Robotics club
  - ...
- STudent-Initiated Courses (STICs), 1-credit
  - Introduction to ethical hacking, visualization through Mathematica, 2D game engine design, creative approaches to computing:arts and tech, functional pearls, VR game development, Webassembly OS, bitcoin and other cryptocurrencies, digital logic through Minecraft, introduction to reverse engineering, ... dozens more !

## Maryland Center for Women in Computing

- The Maryland Center for Women in Computing (MCWIC) works to increase diversity in all fields of computing by providing a variety of opportunities for women and other underrepresented minorities
  - supports, educates and mentors women majoring in computing fields at the University of Maryland
  - collaborates with the K-12 community in order to to encourage all students especially those from underrepresented populations to participate in computing
  - sustains a vibrant community of scholars, researchers, students and educators working together to increase the involvement—and success—of women interested in earning a computer science and other technical degrees
  - Provides a **dedicated learning and meeting space**
- **News**: The Iribe Initiative for Inclusion and Diversity in Computing was created in February 2019 with a \$1 million gift from Brendan Iribe



# In the Works

### Problem: Uneven Background in CMSC 131

- Fall'17, Fall'18 surveys: 70% of CMSC 131 students have some computing background
- Summer'18 CMSC 131 exemption exams: 43% passed, while 26% within 20 points of passing
- Anecdote: At least some of the 30% with no background feel imposter syndrome
  - those around them seem to already know what's being taught!
- Idea: Separate little-or-no-background population from nearlyenough population. But how?

### CMSC 133: the "second half" of CMSC 131

- Piloting this Fall and next Spring
- Exemption exam determines placement
  - Divided into two parts if you pass the first part but not the second, you can qualify for 133
- 2 credits (not four)
  - Motivation: Frees up schedule for another Gen-Ed

### Immersive Media Design Major (IMDM)

- Joint major administered by CMSC (CMNS) and ART (ARHU)
- Two tracks: Computing focus vs. Arts focus
  - Former is substantial subset of CS curriculum
  - Latter is substantial subset of Art curriculum
- Both tracks meet and collaborate in special IMDM studio classes
  - Other IMDM-specific classes also developed, for both tracks
- Past several levels of approval. Hoped-for rollout in Fall'20.

## Task Force on Computing

Convened by the Provost in Fall 2017, delivered report after one year

- Comprised of interested Deans, Chairs, Administrators across campus
- Goal: Explore ways to expand and enhance computing education at UMD

Some key recommendations

- Aggressive hiring to address massive student influx
- Academy of Computing, to support X+CS instruction
- School, or even College, of Computing to organize campus activities

### Conclusion: CS at UMD is vibrant!

- CS is the most popular major on campus (>11% of all UMD undergrads)
- CS course structure has foundations, breadth, and depth
  - Six foundational courses the "intro sequence"
  - Five courses drawn from application courses, with specializations
- CS has richer opportunities beyond the classroom
  - Clubs, Hackathons, Internships, Conference trips, ...
  - Makerspace
  - 1-credit student-run courses (10-15 per semester),
  - Maryland Center for Women in Computing (MCWIC),
- CS graduates go to top companies: Capitol One, Amazon, Facebook, Microsoft, Google, Northrup Grumman, Appian, Booz Allen, Bloomberg, ...
- CS continues to evolve and expand!

## Some other statistics



