

COMPUTER SCIENCE

<http://www.cs.barnard.edu>

Departmental Office: 504 Milstein Center; 212-853-0305

Director: Dr. Rebecca Wright, chair-cs@barnard.edu

Barnard's computer science community is growing. The number of Computer Science majors at Barnard has doubled over the last several years. Barnard's Computer Science program offers meaningful computing education and experiences to all Barnard students and partners with Columbia's Computer Science department to offer a major in Computer Science. The program aims to expand students' use and understanding of computation and data analysis across disciplines; offer students opportunities to think critically about the social implications of technology, including how to harness it for social good; promote curricular and pedagogical advances in computer science and its multidisciplinary applications; and provide new models for engaging students and enhancing diversity in computing.

Program Director: Rebecca Wright

Professor: Rebecca Wright (Druckenmiller Professor of Computer Science)

Assistant Professor: Mark Santolucito

Faculty Fellows: Sarah Morrison-Smith (Roman Family Teaching and Research Fellow), Adam Poliak (Roman Family Teaching and Research Fellow)

For a list of other officers of the University offering courses in Computer Science, please see the Columbia Computer Science department website below:

<https://www.cs.columbia.edu/people/faculty/>

This QuickGuide is for Barnard students who are majoring or minoring in Computer Science. It explains how the program is structured, what courses to take and when. Please access the link below and view "BA in Computer Science (CC, GS, Barnard)" under Degree Programs.

<http://www.cs.columbia.edu/education/undergraduate/>

Barnard College Computer Science Courses

COMS BC1016 Introduction to Computational Thinking and Data Science. 3.00 points.

This course and its co-requisite lab course will introduce students to the methods and tools used in data science to obtain insights from data. Students will learn how to analyze data arising from real-world phenomena while mastering critical concepts and skills in computer programming and statistical inference. The course will involve hands-on analysis of real-world datasets, including economic data, document collections, geographical data, and social networks. The course is ideal for students looking to increase their digital literacy and expand their use and understanding of computation and data analysis across disciplines. No prior programming or college-level math background is required

Fall 2022: COMS BC1016

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1016	001/00776	T Th 6:10pm - 7:25pm LI103 Diana Center	Antonio Moretti	3.00	27/40

Spring 2023: COMS BC1016

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1016	001/00199	M W 2:40pm - 3:55pm LI103 Diana Center	Lisa Soros	3.00	41/43

COMS BC1017 Introduction to Computational Thinking and Data Science - Lab. 1.00 point.

This is the co-requisite lab to COMS BC 1016 (Introduction to Computational Thinking and Data Science) This course will introduce students to the methods and tools used in data science to obtain insights from data. Students will learn how to analyze data arising from real-world phenomena while mastering critical concepts and skills in computer programming and statistical inference. The course will involve hands-on analysis of real-world datasets, including economic data, document collections, geographical data, and social networks. This class is ideal for students looking to increase their digital literacy and expand their use and understanding of computation and data analysis across disciplines. No prior programming or math background is required

Fall 2022: COMS BC1017

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1017	001/00777	M 2:10pm - 4:00pm 516 Milstein Center	Antonio Moretti	1.00	10/24
COMS 1017	002/00778	W 5:30pm - 7:20pm 516 Milstein Center	Antonio Moretti	1.00	16/24

Spring 2023: COMS BC1017

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1017	001/00200	T 11:00am - 12:50pm 516 Milstein Center	Lisa Soros	1.00	20/25
COMS 1017	002/00204	Th 4:10pm - 6:00pm 516 Milstein Center	Lisa Soros	1.00	22/25

COMS BC3099 INDEPENDENT STUDY. 1.00-4.00 points.

Course can be taken for 1-4 points.

Independent Study. Instructor permission required**Fall 2022: COMS BC3099**

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3099	001/00739		Mark Santolucito	1.00-4.00	11/16
COMS 3099	002/00740		Rebecca Wright	1.00-4.00	5/7
COMS 3099	003/00758		Paul Blaer	1.00-4.00	1/5
COMS 3099	004/00796		Paul Blaer	1.00-4.00	1/1
COMS 3099	005/00885		Brian Plancher	1.00-4.00	0/1

Spring 2023: COMS BC3099

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3099	001/00001		Rebecca Wright	1.00-4.00	1/5
COMS 3099	002/00793		Mark Santolucito	1.00-4.00	1/5

COMS BC3162 Developing Accessible User Interfaces. 3 points.

Introduction to access technology and the development of accessible systems. In this course, students build and evaluate various access technologies. Topics include: text-to-speech, speech recognition, screen readers, screen magnification, alternative input, tactile displays, and web transformation. This course teaches students the deep inner workings of today's user interface technology and serve as a guide for building the user interfaces of the future.

Spring 2023: COMS BC3162

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3162	001/00215	T Th 6:10pm - 7:25pm LI103 Diana Center	Antonio Moretti	3	50/50

COMS BC3364 Introduction to Contextual Design for Technology. 3 points.

Introduces methods and tools used in Contextual Inquiry (CI) specifically the early stages of software design focused on meeting user needs. Key concepts include user research, contextual design, design thinking, ideation, iterative design, prototyping, and design documentation. Projects utilize software tools used in the industry.

COMS BC3420 Privacy in a Networked World. 4 points.

The ubiquity of computers and networks in business, government, recreation, and almost all aspects of daily life has led to a proliferation of online sensitive data: data that, if used improperly, can harm the data subjects. As a result, concern about the use, ownership, control, privacy, and accuracy of these data has become a top priority. This seminar course focuses on both the technical challenges of handling sensitive data, the privacy implications of various technologies, and the policy and legal issues facing data subjects, data owners, and data users.

Fall 2022: COMS BC3420

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3420	001/00646	W 4:10pm - 6:00pm LI017 Milstein Center	Rebecca Wright	4	24/24

COMS BC3430 Computational Sound. 3 points.

In this course, we explore the variety of roles that computation can play in the analysis, creation, and performance of music. We start with the fundamentals of sound in the digital domain, covering issues of representation and audio synthesis. We then move through various synthesis techniques including the additive, subtractive, frequency modulation (FM), and amplitude modulation (AM) synthesis. After covering some core DSP techniques, we put these concepts into performative practice by exploring "live coding". In the space of live coding, we examine various programming language designs to understand how various domain specific languages (DSLs) support live coding. For the third module, we turn our focus to automated composition and analysis, addressing challenges in music information retrieval, generative art, and autonomous improvisation systems. All the while, we continue to develop our fluency in live coding by putting new topics to practice.

Fall 2022: COMS BC3430

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3430	001/00647	T Th 2:40pm - 3:55pm 516 Milstein Center	Mark Santolucito	3	20/24

COMS BC3930 Creative Embedded Systems. 3.00 points.

Ubiquitous computing is creating new canvases and opportunities for creative ideas. This class explores the use of microprocessors, distributed sensor networks, IoT, and intermedia systems for the purposes of creative expression. The course is delivered in a mixed lecture and lab format that introduces the fundamental concepts and theory behind embedded systems as well as issues particular to their creative employment. The key objective of the course is for students to conceive of and implement creative uses of computation

Spring 2023: COMS BC3930

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3930	001/00229	T Th 1:10pm - 2:25pm 516 Milstein Center	Mark Santolucito	3.00	26/24

COMS BC3997 NEW DIRECTIONS IN COMPUTING. 1.00-3.00 points.

This is an undergraduate seminar for special topics in computing arranged as the need and availability arises. Topics are usually offered on a one-time basis. Participation requires permission of the instructor. Since the content of this course changes each time it is offered, it may be repeated for credit

Fall 2022: COMS BC3997

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3997	001/00648	M W 6:10pm - 7:25pm LI103 Diana Center	Brian Plancher	1.00-3.00	16/25
COMS 3997	002/00795	M W 1:10pm - 2:25pm 325 Milbank Hall	Lisa Soros	1.00-3.00	23/24

Spring 2023: COMS BC3997

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3997	001/00233	M 6:10pm - 8:00pm LI103 Diana Center	Brian Plancher	1.00-3.00	26/26
COMS 3997	002/00230	Th 9:00am - 10:50am 111 Milstein Center	Mark Santolucito	1.00-3.00	15/24

Columbia College Computer Science Courses

COMS W1001 Introduction to Information Science. 3 points.

Lect: 3.

Basic introduction to concepts and skills in Information Sciences: human-computer interfaces, representing information digitally, organizing and searching information on the internet, principles of algorithmic problem solving, introduction to database concepts, and introduction to programming in Python.

COMS W1002 COMPUTING IN CONTEXT. 4.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Introduction to elementary computing concepts and Python programming with domain-specific applications. Shared CS concepts and Python programming lectures with track-specific sections. Track themes will vary but may include computing for the social sciences, computing for economics and finance, digital humanities, and more. Intended for nonmajors. Students may only receive credit for one of ENGI E1006 or COMS W1002

Fall 2022: COMS W1002

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1002	001/10798	T Th 1:10pm - 2:25pm 301 Uris Hall	Adam Cannon	4.00	182/201
COMS 1002	002/10984	T Th 2:40pm - 3:55pm 301 Uris Hall	Adam Cannon	4.00	120/200

COMS W1004 Introduction to Computer Science and Programming in Java. 3 points.

Lect: 3.

A general introduction to computer science for science and engineering students interested in majoring in computer science or engineering. Covers fundamental concepts of computer science, algorithmic problem-solving capabilities, and introductory Java programming skills. Assumes no prior programming background. Columbia University students may receive credit for only one of the following two courses: 1004 or 1005.

Fall 2022: COMS W1004

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1004	001/10985	M W 2:40pm - 3:55pm 417 International Affairs Bldg	Paul Blaer	3	391/398
COMS 1004	002/10986	M W 5:40pm - 6:55pm 501 Northwest Corner	Paul Blaer	3	171/164
COMS 1004	H01/20439	M W 2:40pm - 3:55pm Online Only	Paul Blaer	3	4/40
COMS 1004	H02/20440	M W 5:40pm - 6:55pm Online Only	Paul Blaer	3	3/40

Spring 2023: COMS W1004

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1004	001/12396	T Th 11:40am - 12:55pm 417 International Affairs Bldg	Adam Cannon	3	257/350
COMS 1004	002/12398	T Th 1:10pm - 2:25pm 417 International Affairs Bldg	Adam Cannon	3	149/350

COMS W1005 Introduction to Computer Science and Programming in MATLAB. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

A general introduction to computer science concepts, algorithmic problem-solving capabilities, and programming skills in MATLAB. Assumes no prior programming background. Columbia University students may receive credit for only one of the following two courses: W1004 or W1005.

COMS W1007 Honors Introduction to Computer Science. 3 points.

Lect: 3.

Prerequisites: AP Computer Science with a grade of 4 or 5 or similar experience.

An honors-level introduction to computer science, intended primarily for students considering a major in computer science. Computer science as a science of abstraction. Creating models for reasoning about and solving problems. The basic elements of computers and computer programs. Implementing abstractions using data structures and algorithms. Taught in Java.

COMS W1404 Emerging Scholars Program Seminar. 1 point.

Pass/Fail only.

Prerequisites: the instructor's permission. Corequisites: COMS W1002 or COMS W1004 or COMS W1007

Corequisites: COMS W1004, COMS W1007, COMS W1002

Peer-led weekly seminar intended for first and second year undergraduates considering a major in Computer Science. Pass/fail only. May not be used towards satisfying the major or SEAS credit requirements.

Fall 2022: COMS W1404

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1404	001/20024	F 8:30am - 9:45am 253 Engineering Terrace	Adam Cannon	1	15/16
COMS 1404	002/20025	F 10:00am - 11:15am 253 Engineering Terrace	Adam Cannon	1	14/16
COMS 1404	003/20026	F 11:30am - 12:45pm 253 Engineering Terrace	Adam Cannon	1	14/16
COMS 1404	004/20027	F 1:00pm - 2:15pm 253 Engineering Terrace	Adam Cannon	1	0/16
COMS 1404	005/20029	F 2:30pm - 3:45pm 253 Engineering Terrace	Adam Cannon	1	15/16
COMS 1404	006/20030	F 4:00pm - 5:15pm 253 Engineering Terrace	Adam Cannon	1	10/16
COMS 1404	007/20031	F 9:30am - 10:45am 411 Kent Hall	Adam Cannon	1	14/16
COMS 1404	008/20032	F 11:00am - 12:15pm 411 Kent Hall	Adam Cannon	1	13/16
COMS 1404	009/20033	F 12:30pm - 1:45pm 411 Kent Hall	Adam Cannon	1	16/16
COMS 1404	010/20034	F 2:00pm - 3:15pm 411 Kent Hall	Adam Cannon	1	10/16

Spring 2023: COMS W1404

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 1404	001/13816	F 8:30am - 9:45am 522c Kent Hall	Adam Cannon	1	9/16
COMS 1404	002/13817	F 10:00am - 11:15am 522c Kent Hall	Adam Cannon	1	6/16
COMS 1404	003/13818	F 11:30am - 12:45pm 522c Kent Hall	Adam Cannon	1	6/16
COMS 1404	004/13819	F 1:00pm - 2:15pm 522c Kent Hall	Adam Cannon	1	4/16
COMS 1404	005/13827	F 2:30pm - 3:45pm 522c Kent Hall	Adam Cannon	1	12/16
COMS 1404	006/13830	F 4:00pm - 5:15pm 522c Kent Hall	Adam Cannon	1	0/16
COMS 1404	007/13831	F 9:30am - 10:45am 522b Kent Hall	Adam Cannon	1	7/16
COMS 1404	008/13832	F 11:00am - 12:15pm 522b Kent Hall	Adam Cannon	1	4/16
COMS 1404	009/13833	F Sa 12:30pm - 1:45pm 522b Kent Hall	Adam Cannon	1	5/16
COMS 1404	010/13837	F 2:00pm - 3:15pm 522b Kent Hall	Adam Cannon	1	8/16

COMS W3101 Programming Languages. 1 point.

Lect: 1.

Prerequisites: Fluency in at least one programming language. Introduction to a programming language. Each section is devoted to a specific language. Intended only for those who are already fluent in at least one programming language. Sections may meet for one hour per week for the whole term, for three hours per week for the first third of the term, or for two hours per week for the first six weeks. May be repeated for credit if different languages are involved.

COMS W3102 Development Technologies. 1-2 points.

Lect: 2. Lab: 0-2.

Prerequisites: Fluency in at least one programming language. Introduction to software development tools and environments. Each section devoted to a specific tool or environment. One-point sections meet for two hours each week for half a semester, and two point sections include an additional two-hour lab.

COMS W3107 Clean Object-Oriented Design. 3.00 points.

Prerequisites: Intro to Computer Science/Programming in Java (COMS W1004) or instructor's permission. May not take for credit if already received credit for COMS W1007.

Prerequisites: see notes re: points

A course in designing, documenting, coding, and testing robust computer software, according to object-oriented design patterns and clean coding practices. Taught in Java. Object-oriented design principles include: use cases; CRC; UML; javadoc; patterns (adapter, builder, command, composite, decorator, facade, factory, iterator, lazy evaluation, observer, singleton, strategy, template, visitor); design by contract; loop invariants; interfaces and inheritance hierarchies; anonymous classes and null objects; graphical widgets; events and listeners; Java's Object class; generic types; reflection; timers, threads, and locks

Fall 2022: COMS W3107

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3107	001/10997	M W 4:10pm - 5:25pm 633 Seeley W. Mudd Building	John Kender	3.00	50/70

COMS W3134 Data Structures in Java. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W1004) or knowledge of Java. Data types and structures: arrays, stacks, singly and doubly linked lists, queues, trees, sets, and graphs. Programming techniques for processing such structures: sorting and searching, hashing, garbage collection. Storage management. Rudiments of the analysis of algorithms. Taught in Java. Note: Due to significant overlap, students may receive credit for only one of the following three courses: *COMS W3134*, *COMS W3136*, *COMS W3137*.

Fall 2022: COMS W3134

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3134	001/10998	M W 4:10pm - 5:25pm 301 Uris Hall	Brian Borowski	3	216/250
COMS 3134	002/10999	M W 5:40pm - 6:55pm 301 Uris Hall	Brian Borowski	3	154/250

Spring 2023: COMS W3134

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3134	001/12399	M W 2:40pm - 3:55pm 417 International Affairs Bldg	Paul Blaer	3	366/398
COMS 3134	002/12400	M W 5:40pm - 6:55pm 501 Northwest Corner	Paul Blaer	3	153/164

COMS W3136 Data Structures with C/C++. 4 points.

Prerequisites: (COMS W1004) or (COMS W1005) or (COMS W1007) or (ENGI E1006)

A second programming course intended for nonmajors with at least one semester of introductory programming experience. Basic elements of programming in C and C++, arraybased data structures, heaps, linked lists, C programming in UNIX environment, object-oriented programming in C++, trees, graphs, generic programming, hash tables. Due to significant overlap, students may only receive credit for either COMS W3134, W3136, or W3137.

Fall 2022: COMS W3136

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3136	001/11000	T Th 5:40pm - 6:55pm 310 Fayerweather	Timothy Paine	4	31/60

COMS W3137 Honors Data Structures and Algorithms. 4 points.

Prerequisites: (COMS W1004) or (COMS W1007)

Corequisites: COMS W3203

An honors introduction to data types and structures: arrays, stacks, singly and doubly linked lists, queues, trees, sets, and graphs. Programming techniques for processing such structures: sorting and searching, hashing, garbage collection. Storage management. Design and analysis of algorithms. Taught in Java. Note: Due to significant overlap, students may receive credit for only one of the following three courses: *COMS W3134, W3136, or W3137.*

Spring 2023: COMS W3137

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3137	001/12401	M W 10:10am - 11:25am 627 Seeley W. Mudd Building	Daniel Bauer	4	26/50

COMS W3157 Advanced Programming. 4 points.

Lect: 4.

Prerequisites: (COMS W3134) or (COMS W3137)

C programming language and Unix systems programming. Also covers Git, Make, TCP/IP networking basics, C++ fundamentals.

Fall 2022: COMS W3157

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3157	001/11001	T Th 4:10pm - 5:25pm 417 International Affairs Bldg	Stephen Edwards, John Hui	4	362/398

Spring 2023: COMS W3157

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3157	001/12402	M W 4:10pm - 5:25pm 301 Uris Hall	Brian Borowski	4	248/266
COMS 3157	002/12403	M W 5:40pm - 6:55pm 301 Uris Hall	Brian Borowski	4	117/266

COMS W3203 DISCRETE MATHEMATICS. 4.00 points.

Lect: 3.

Prerequisites: Any introductory course in computer programming.

Prerequisites: Any introductory course in computer programming. Logic and formal proofs, sequences and summation, mathematical induction, binomial coefficients, elements of finite probability, recurrence relations, equivalence relations and partial orderings, and topics in graph theory (including isomorphism, traversability, planarity, and colorings)

Fall 2022: COMS W3203

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3203	001/11002	M W 1:10pm - 2:25pm 301 Uris Hall	Tony Dear	4.00	279/266

Spring 2023: COMS W3203

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3203	001/12404	T Th 10:10am - 11:25am 301 Uris Hall	Ansaf Salleb-Aouissi	4.00	152/164
COMS 3203	002/12405	T Th 11:40am - 12:55pm 301 Uris Hall	Ansaf Salleb-Aouissi	4.00	158/164
COMS 3203	003/18277	F 10:10am - 12:40pm 833 Seeley W. Mudd Building	Ansaf Salleb-Aouissi	4.00	114/164

COMS W3210 Scientific Computation. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: two terms of calculus.

Introduction to computation on digital computers. Design and analysis of numerical algorithms. Numerical solution of equations, integration, recurrences, chaos, differential equations. Introduction to Monte Carlo methods. Properties of floating point arithmetic. Applications to weather prediction, computational finance, computational science, and computational engineering.

COMS W3251 COMPUTATIONAL LINEAR ALGEBRA. 4.00 points.**Fall 2022: COMS W3251**

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3251	001/11003	T Th 10:10am - 11:25am 501 Northwest Corner	Daniel Hsu	4.00	128/164

Spring 2023: COMS W3251

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3251	001/18028	F 1:10pm - 3:40pm 402 Chandler	Tony Dear	4.00	107/126

COMS W3261 Computer Science Theory. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3203)

Corequisites: COMS W3134, COMS W3136, COMS W3137

Regular languages: deterministic and non-deterministic finite automata, regular expressions. Context-free languages: context-free grammars, push-down automata. Turing machines, the Chomsky hierarchy, and the Church-Turing thesis. Introduction to Complexity Theory and NP-Completeness.

Fall 2022: COMS W3261

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3261	001/11004	M W 8:40am - 9:55am 501 Northwest Corner	Tal Malkin	3	133/164
COMS 3261	002/11005	M W 10:10am - 11:25am 501 Northwest Corner	Tal Malkin	3	170/164

Spring 2023: COMS W3261

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3261	001/12406	M W 8:40am - 9:55am 451 Computer Science Bldg	Xi Chen	3	77/110
COMS 3261	002/12407	M W 10:10am - 11:25am 451 Computer Science Bldg	Xi Chen	3	100/110
COMS 3261	003/18382	M W 1:10pm - 2:25pm 501 Northwest Corner	Xi Chen	3	156/164

COMS W3410 Computers and Society. 3 points.

Lect: 3.

Broader impact of computers. Social networks and privacy. Employment, intellectual property, and the media. Science and engineering ethics. Suitable for nonmajors.

Fall 2022: COMS W3410

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3410	001/11006	W 4:10pm - 6:40pm 303 Uris Hall	Ronald Baecker	3	50/67

COMS W3902 Undergraduate Thesis. 1-6 points.

Prerequisites: Agreement by a faculty member to serve as thesis adviser. An independent theoretical or experimental investigation by an undergraduate major of an appropriate problem in computer science carried out under the supervision of a faculty member. A formal written report is mandatory and an oral presentation may also be required. May be taken over more than one term, in which case the grade is deferred until all 6 points have been completed. Consult the department for section assignment.

Fall 2022: COMS W3902

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3902	038/13963		Mohammed AlQuraishi	1-6	0/45

COMS W3995 Special Topics in Computer Science. 3 points.

Lect: 3.

Prerequisites: the instructor's permission.

Consult the department for section assignment. Special topics arranged as the need and availability arise. Topics are usually offered on a one-time basis. Since the content of this course changes each time it is offered, it may be repeated for credit.

COMS W3998 Undergraduate Projects in Computer Science. 1-3 points.

Prerequisites: Approval by a faculty member who agrees to supervise the work.

Independent project involving laboratory work, computer programming, analytical investigation, or engineering design. May be repeated for credit, but not for a total of more than 3 points of degree credit. Consult the department for section assignment.

Fall 2022: COMS W3998

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 3998	038/14049		Mohammed AlQuraishi	1-3	2/45

COMS W4111 INTRODUCTION TO DATABASES. 3.00 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: COMS W3134, COMS W3136, or COMS W3137; or the instructor's permission.

Prerequisites: (COMS W3134) or (COMS W3136) or (COMS W3137) or Prerequisites: (COMS W3134) or (COMS W3137) or (COMS W3136) and fluency in Java); or the instructor's permission. The fundamentals of database design and application development using databases: entity-relationship modeling, logical design of relational databases, relational data definition and manipulation languages, SQL, XML, query processing, physical database tuning, transaction processing, security. Programming projects are required

Fall 2022: COMS W4111

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4111	001/11007	T Th 1:10pm - 2:25pm 301 Pupin Laboratories	Luis Gravano	3.00	209/215
COMS 4111	002/11008	T Th 10:10am - 11:25am 451 Computer Science Bldg	Eugene Wu	3.00	87/110
COMS 4111	003/11009	F 10:10am - 12:40pm 417 International Affairs Bldg	Donald Ferguson	3.00	299/300
COMS 4111	H02/11010	T Th 10:10am - 11:25am None None	Eugene Wu	3.00	35/80
COMS 4111	V03/18260		Donald Ferguson	3.00	18/99

Spring 2023: COMS W4111

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4111	001/12408	M W 2:40pm - 3:55pm 309 Havemeyer Hall	Kenneth Ross	3.00	234/320
COMS 4111	002/12409	F 10:10am - 12:40pm 309 Havemeyer Hall	Donald Ferguson	3.00	317/320
COMS 4111	V02/19560		Donald Ferguson	3.00	7/99

COMS W4112 DATABASE SYSTEM IMPLEMENTATION. 3.00 points.

Lect: 2.5.

Prerequisites: (COMS W4111) and fluency in Java or C++. CSEE W3827 is recommended.

The principles and practice of building large-scale database management systems. Storage methods and indexing, query processing and optimization, materialized views, transaction processing and recovery, object-relational databases, parallel and distributed databases, performance considerations. Programming projects are required

COMS W4113 FUND-LARGE-SCALE DIST SYSTEMS. 3.00 points.

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) and (COMS W3157 or COMS W4118 or CSEE W4119)

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) and (COMS W3157 or COMS W4118 or CSEE W4119) Design and implementation of large-scale distributed and cloud systems. Teaches abstractions, design and implementation techniques that enable the building of fast, scalable, fault-tolerant distributed systems. Topics include distributed communication models (e.g. sockets, remote procedure calls, distributed shared memory), distributed synchronization (clock synchronization, logical clocks, distributed mutex), distributed file systems, replication, consistency models, fault tolerance, distributed transactions, agreement and commitment, Paxos-based consensus, MapReduce infrastructures, scalable distributed databases. Combines concepts and algorithms with descriptions of real-world implementations at Google, Facebook, Yahoo, Microsoft, LinkedIn, etc

Fall 2022: COMS W4113

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4113	001/11011	F 10:10am - 12:40pm 451 Computer Science Bldg	Roxana Geambasu	3.00	92/110
COMS 4113	H01/20441	F 10:10am - 12:40pm Online Only	Roxana Geambasu	3.00	5/40
COMS 4113	V01/18001		Roxana Geambasu	3.00	13/99

COMS W4115 Programming Languages and Translators. 3 points.

Lect: 3.

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) and (COMS W3261) and (CSEE W3827) or equivalent, or the instructor's permission.

Modern programming languages and compiler design. Imperative, object-oriented, declarative, functional, and scripting languages. Language syntax, control structures, data types, procedures and parameters, binding, scope, run-time organization, and exception handling. Implementation of language translation tools including compilers and interpreters. Lexical, syntactic and semantic analysis; code generation; introduction to code optimization. Teams implement a language and its compiler.

Fall 2022: COMS W4115

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4115	001/11012	M W 4:10pm - 5:25pm Cin Alfred Lerner Hall	Ronghui Gu	3	65/200
COMS 4115	V01/18866		Ronghui Gu	3	1/99

Spring 2023: COMS W4115

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4115	001/12811	M W 10:10am - 11:25am 833 Seeley W. Mudd Building	Baishakhi Ray	3	70/100
COMS 4115	V01/19689		Baishakhi Ray	3	3/99

COMS W4118 Operating Systems I. 3 points.

Lect: 3.

Prerequisites: (CSEE W3827) and knowledge of C and programming tools as covered in COMS W3136, W3157, or W3101, or the instructor's permission.

Design and implementation of operating systems. Topics include process management, process synchronization and interprocess communication, memory management, virtual memory, interrupt handling, processor scheduling, device management, I/O, and file systems. Case study of the UNIX operating system. A programming project is required.

Fall 2022: COMS W4118

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4118	001/13030	T Th 8:40am - 9:55am 417 International Affairs Bldg	Jason Nieh	3	95/150
COMS 4118	V01/18640		Jason Nieh	3	8/99

Spring 2023: COMS W4118

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4118	001/12815	T Th 5:40pm - 6:55pm 501 Schermerhorn Hall	Jae Lee, Hans Montero	3	157/189
COMS 4118	V01/18052		Jae Lee, Hans Montero	3	12/99

COMS W4119 COMPUTER NETWORKS. 3.00 points.

Introduction to computer networks and the technical foundations of the internet, including applications, protocols, local area networks, algorithms for routing and congestion control, security, elementary performance evaluation. Several written and programming assignments required

COMS W4121 Computer Systems for Data Science. 3 points.

Prerequisites: background in Computer System Organization and good working knowledge of C/C++

Corequisites: CSOR W4246, STAT GU4203

An introduction to computer architecture and distributed systems with an emphasis on warehouse scale computing systems. Topics will include fundamental tradeoffs in computer systems, hardware and software techniques for exploiting instruction-level parallelism, data-level parallelism and task level parallelism, scheduling, caching, prefetching, network and memory architecture, latency and throughput optimizations, specialization, and an introduction to programming data center computers.

COMS W4130 Principles and Practice of Parallel Programming. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3137 or COMS W3136 and experience in Java) and basic understanding of analysis of algorithms. Principles of parallel software design. Topics include task and data decomposition, load-balancing, reasoning about correctness, determinacy, safety, and deadlock-freedom. Application of techniques through semester-long design project implementing performant, parallel application in a modern parallel programming language.

COMS W4152 Engineering Software-as-a-Service. 3.00 points.

Modern software engineering concepts and practices including topics such as Software-as-a-Service, Service-oriented Architecture, Agile Development, Behavior-driven Development, Ruby on Rails, and Dev/ops

Fall 2022: COMS W4152

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4152	001/13219	T Th 8:40am - 9:55am 301 Pupin Laboratories	Junfeng Yang	3.00	194/200
COMS 4152	V01/18002		Junfeng Yang	3.00	24/99

COMS W4156 Advanced Software Engineering. 3 points.

Lect: 3.

Prerequisites: (COMS W3157) or equivalent.

Software lifecycle using frameworks, libraries and services. Major emphasis on software testing. Centers on a team project.

Fall 2022: COMS W4156

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4156	001/11013	T Th 10:10am - 11:25am 614 Schermerhorn Hall	Gail Kaiser	3	106/120

COMS W4160 Computer Graphics. 3 points.

Lect: 3.

Prerequisites: (COMS W3134) or (COMS W3136) or (COMS W3137) COMS W4156 is recommended. Strong programming background and some mathematical familiarity including linear algebra is required.

Introduction to computer graphics. Topics include 3D viewing and projections, geometric modeling using spline curves, graphics systems such as OpenGL, lighting and shading, and global illumination. Significant implementation is required: the final project involves writing an interactive 3D video game in OpenGL.

Fall 2022: COMS W4160

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4160	001/16850	T Th 6:40pm - 7:55pm 1024 Seeley W. Mudd Building	Hadi Fadaifard	3	45/50
COMS 4160	V01/20062		Hadi Fadaifard	3	2/99

COMS W4162 Advanced Computer Graphics. 3 points.

Lect: 3.

Prerequisites: (COMS W4160) or equivalent, or the instructor's permission.

A second course in computer graphics covering more advanced topics including image and signal processing, geometric modeling with meshes, advanced image synthesis including ray tracing and global illumination, and other topics as time permits. Emphasis will be placed both on implementation of systems and important mathematical and geometric concepts such as Fourier analysis, mesh algorithms and subdivision, and Monte Carlo sampling for rendering. Note: Course will be taught every two years.

COMS W4167 Computer Animation. 3 points.

Lect: 3.

Prerequisites: Multivariable calculus, linear algebra, C++ programming proficiency. COMS W4156 recommended.

Theory and practice of physics-based animation algorithms, including animated clothing, hair, smoke, water, collisions, impact, and kitchen sinks. Topics covered: Integration of ordinary differential equations, formulation of physical models, treatment of discontinuities including collisions/contact, animation control, constrained Lagrangian Mechanics, friction/dissipation, continuum mechanics, finite elements, rigid bodies, thin shells, discretization of Navier-Stokes equations. General education requirement: quantitative and deductive reasoning (QUA).

COMS W4170 User Interface Design. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137)

Introduction to the theory and practice of computer user interface design, emphasizing the software design of graphical user interfaces. Topics include basic interaction devices and techniques, human factors, interaction styles, dialogue design, and software infrastructure. Design and programming projects are required.

Fall 2022: COMS W4170

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4170	001/11014	M W 2:40pm - 3:55pm 833 Seeley W. Mudd Building	Brian Smith	3	119/120
COMS 4170	V01/18003		Brian Smith	3	7/99

COMS W4172 3D User Interfaces and Augmented Reality. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W4160) or (COMS W4170) or the instructor's permission.

Design, development, and evaluation of 3D user interfaces. Interaction techniques and metaphors, from desktop to immersive. Selection and manipulation. Travel and navigation. Symbolic, menu, gestural, and multimodal interaction. Dialogue design. 3D software support. 3D interaction devices and displays. Virtual and augmented reality. Tangible user interfaces. Review of relevant 3D math.

Spring 2023: COMS W4172

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4172	001/12817	T Th 1:10pm - 2:25pm 227 Seeley W. Mudd Building	Steven Feiner	3	47/45

COMS W4181 SECURITY I. 3.00 points.

Not offered during 2022-23 academic year.

Prerequisites: COMS W3157 or equivalent.

Introduction to security. Threat models. Operating system security features. Vulnerabilities and tools. Firewalls, virtual private networks, viruses. Mobile and app security. Usable security. Note: May not earn credit for both W4181 and W4180 or W4187

Fall 2022: COMS W4181

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4181	001/11015	M W 1:10pm - 2:25pm 451 Computer Science Bldg	Suman Jana	3.00	52/100

COMS W4182 SECURITY II. 3.00 points.
Not offered during 2022-23 academic year.

Prerequisites: COMS W4181, COMS W4118, COMS W4119
 Advanced security. Centralized, distributed, and cloud system security. Cryptographic protocol design choices. Hardware and software security techniques. Security testing and fuzzing. Blockchain. Human security issues. Note: May not earn credit for both W4182 and W4180 or W4187

Spring 2023: COMS W4182

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4182	001/12819	T Th 1:10pm - 2:25pm 524 Seeley W. Mudd Building	Steven Bellovin	3.00	34/55
COMS 4182	V01/18054		Steven Bellovin	3.00	1/99

COMS W4186 MALWARE ANALYSIS#REVERSE ENGINEERING. 3.00 points.
Not offered during 2022-23 academic year.

Prerequisites: COMS W3157 or equivalent. COMS W3827
 Hands-on analysis of malware. How hackers package and hide malware and viruses to evade analysis. Disassemblers, debuggers, and other tools for reverse engineering. Deep study of Windows Internals and x86 assembly

Fall 2022: COMS W4186

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4186	001/11016	Th 4:10pm - 6:40pm 415 Schapiro Cepser	Michael Sikorski	3.00	36/40

COMS W4203 Graph Theory. 3 points.
 Lect: 3.

Prerequisites: (COMS W3203)
 General introduction to graph theory. Isomorphism testing, algebraic specification, symmetries, spanning trees, traversability, planarity, drawings on higher-order surfaces, colorings, extremal graphs, random graphs, graphical measurement, directed graphs, Burnside-Polya counting, voltage graph theory.

COMS W4205 Combinatorial Theory. 3 points.
 Lect: 3. **Not offered during 2022-23 academic year.**

Prerequisites: (COMS W3203) and course in calculus.
 Sequences and recursions, calculus of finite differences and sums, elementary number theory, permutation group structures, binomial coefficients, Stirling numbers, harmonic numbers, generating functions.

COMS W4232 Advanced Algorithms. 3.00 points.
 Prerequisite: Analysis of Algorithms (COMS W4231).

Prerequisites: see notes re: points
 Introduces classic and modern algorithmic ideas that are central to many areas of Computer Science. The focus is on most powerful paradigms and techniques of how to design algorithms, and how to measure their efficiency. The intent is to be broad, covering a diversity of algorithmic techniques, rather than be deep. The covered topics have all been implemented and are widely used in industry. Topics include: hashing, sketching/streaming, nearest neighbor search, graph algorithms, spectral graph theory, linear programming, models for large-scale computation, and other related topics

Spring 2023: COMS W4232

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4232	001/12825	M W 2:40pm - 3:55pm 1127 Seeley W. Mudd Building	Alexandr Andoni	3.00	51/60
COMS 4232	V01/18055		Alexandr Andoni	3.00	6/99

COMS W4236 INTRO-COMPUTATIONAL COMPLEXITY. 3.00 points.
 Lect: 3.

Prerequisites: (COMS W3261)
 Prerequisites: (COMS W3261) Develops a quantitative theory of the computational difficulty of problems in terms of the resources (e.g. time, space) needed to solve them. Classification of problems into complexity classes, reductions, and completeness. Power and limitations of different modes of computation such as nondeterminism, randomization, interaction, and parallelism

Fall 2022: COMS W4236

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4236	001/11017	W 8:40am - 9:55am 1127 Seeley W. Mudd Building	Xi Chen	3.00	39/60
COMS 4236	V01/18004		Xi Chen	3.00	5/99

Spring 2023: COMS W4236

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4236	001/12835	M W 8:40am - 9:55am 524 Seeley W. Mudd Building	Rocco Servedio	3.00	51/55
COMS 4236	V01/18056		Rocco Servedio	3.00	4/99

COMS W4241 Numerical Algorithms and Complexity. 3 points.
 Lect: 3.

Prerequisites: Knowledge of a programming language. Some knowledge of scientific computation is desirable.
 Modern theory and practice of computation on digital computers. Introduction to concepts of computational complexity. Design and analysis of numerical algorithms. Applications to computational finance, computational science, and computational engineering.

COMS W4242 Numerical Algorithms and Their Complexity II. 3 points.
 Prerequisites: COMS W4241.
 A continuation of COMS W4241.

COMS W4252 Introduction to Computational Learning Theory. 3 points.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (CSOR W4231) or (COMS W4236) or *COMS W3203* and the instructor's permission, or *COMS W3261* and the instructor's permission. Possibilities and limitations of performing learning by computational agents. Topics include computational models of learning, polynomial time learnability, learning from examples and learning from queries to oracles. Computational and statistical limitations of learning. Applications to Boolean functions, geometric functions, automata.

Fall 2022: COMS W4252

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4252	001/11018	T Th 8:40am - 9:55am 402 Chandler	Rocco Servedio	3	98/126
COMS 4252	V01/18395		Rocco Servedio	3	7/99

COMS W4261 INTRO TO CRYPTOGRAPHY. 3.00 points.

Lect: 2.5.

Prerequisites: Comfort with basic discrete math and probability. Recommended: COMS W3261 or CSOR W4231. Prerequisites: Comfort with basic discrete math and probability. Recommended: COMS W3261 or CSOR W4231. An introduction to modern cryptography, focusing on the complexity-theoretic foundations of secure computation and communication in adversarial environments; a rigorous approach, based on precise definitions and provably secure protocols. Topics include private and public key encryption schemes, digital signatures, authentication, pseudorandom generators and functions, one-way functions, trapdoor functions, number theory and computational hardness, identification and zero knowledge protocols

COMS W4281 Introduction to Quantum Computing. 3 points.

Lect: 3.

Prerequisites: Knowledge of linear algebra. Prior knowledge of quantum mechanics is not required although helpful. Introduction to quantum computing. Shor's factoring algorithm, Grover's database search algorithm, the quantum summation algorithm. Relationship between classical and quantum computing. Potential power of quantum computers.

Fall 2022: COMS W4281

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4281	001/16902	M W 10:10am - 11:25am 140 Uris Hall	Henry Yuen	3	53/52

COMS W4419 Internet Technology, Economics, and Policy. 3 points.
Not offered during 2022-23 academic year.

Technology, economic and policy aspects of the Internet. Summarizes how the Internet works technically, including protocols, standards, radio spectrum, global infrastructure and interconnection. Micro-economics with a focus on media and telecommunication economic concerns, including competition and monopolies, platforms, and behavioral economics. US constitution, freedom of speech, administrative procedures act and regulatory process, universal service, role of FCC. Not a substitute for CSEE4119. Suitable for non-majors. May not be used as a track elective for the computer science major.

Fall 2022: COMS W4419

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4419	001/11019	T Th 5:40pm - 6:55pm 545 Seeley W. Mudd Building	Henning Schulzrinne	3	14/50
COMS 4419	V01/18005		Henning Schulzrinne	3	3/99

COMS W4444 Programming and Problem Solving. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) and (CSEE W3827)

Hands-on introduction to solving open-ended computational problems. Emphasis on creativity, cooperation, and collaboration. Projects spanning a variety of areas within computer science, typically requiring the development of computer programs. Generalization of solutions to broader problems, and specialization of complex problems to make them manageable. Team-oriented projects, student presentations, and in-class participation required.

Fall 2022: COMS W4444

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4444	001/11020	M W 1:10pm - 2:25pm 337 Seeley W. Mudd Building	Kenneth Ross	3	24/30

COMS W4460 Principles of Innovation and Entrepreneurship. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) or the instructor's permission.

Team project centered course focused on principles of planning, creating, and growing a technology venture. Topics include: identifying and analyzing opportunities created by technology paradigm shifts, designing innovative products, protecting intellectual property, engineering innovative business models.

Fall 2022: COMS W4460

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4460	001/11021	F 10:10am - 12:40pm 829 Seeley W. Mudd Building	William Reinisch	3	39/40

Spring 2023: COMS W4460

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4460	001/15565	M W 8:40am - 9:55am 829 Seeley W. Mudd Building	William Reinisch	3	42/40

COMS W4560 INTRO-COMP APPL-HLTH CRE/BIOMD. 3.00 points.

Lect: 3.

Prerequisites: Experience with computers and a passing familiarity with medicine and biology. Undergraduates in their senior or junior years may take this course only if they have adequate background in mathematics and receive the instructor's permission.

Undergraduates in their senior or junior years may take this course only if they have adequate background in mathematics and receive permission from the instructor. An overview of the field of biomedical informatics, combining perspectives from medicine, computer science, and social science. Use of computers and information in healthcare and the biomedical sciences, covering specific applications and general methods, current issues, capabilities and limitations of biomedical informatics. Biomedical Informatics studies the organization of medical information, the effective management of information using computer technology, and the impact of such technology on medical research, education, and patient care. The field explores techniques for assessing current information practices, determining the information needs of healthcare providers and patients, developing interventions using computer technology, and evaluating the impact of those interventions

COMS W4701 Artificial Intelligence. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) and any course on probability. Prior knowledge of Python is recommended. Provides a broad understanding of the basic techniques for building intelligent computer systems. Topics include state-space problem representations, problem reduction and and-or graphs, game playing and heuristic search, predicate calculus, and resolution theorem proving, AI systems and languages for knowledge representation, machine learning and concept formation and other topics such as natural language processing may be included as time permits.

Fall 2022: COMS W4701

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4701	001/11022	T Th 10:10am - 11:25am 501 Schermerhorn Hall	Ansaf Salleb-Aouissi	3	176/189
COMS 4701	002/11023	T Th 11:40am - 12:55pm 501 Schermerhorn Hall	Ansaf Salleb-Aouissi	3	180/189
COMS 4701	V01/18006		Ansaf Salleb-Aouissi	3	19/99

Spring 2023: COMS W4701

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4701	001/12837	M W 2:40pm - 3:55pm 301 Uris Hall	Tony Dear	3	181/220
COMS 4701	002/12838	M W 4:10pm - 5:25pm 501 Schermerhorn Hall	Tony Dear	3	155/180
COMS 4701	V01/18057		Tony Dear	3	21/99

COMS W4705 Natural Language Processing. 3 points.

Lect: 3.

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) or the instructor's permission.

Computational approaches to natural language generation and understanding. Recommended preparation: some previous or concurrent exposure to AI or Machine Learning. Topics include information extraction, summarization, machine translation, dialogue systems, and emotional speech. Particular attention is given to robust techniques that can handle understanding and generation for the large amounts of text on the Web or in other large corpora. Programming exercises in several of these areas.

Fall 2022: COMS W4705

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4705	001/11024	M W 2:40pm - 3:55pm 501 Schermerhorn Hall	Daniel Bauer	3	188/189
COMS 4705	H01/20442		Daniel Bauer	3	32/50
COMS 4705	V01/18007		Daniel Bauer	3	27/99

Spring 2023: COMS W4705

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4705	001/12839	M W 1:10pm - 2:25pm 417 International Affairs Bldg	Daniel Bauer	3	256/250
COMS 4705	002/18033	F 10:10am - 12:40pm 301 Pupin Laboratories	Daniel Bauer	3	170/175
COMS 4705	V01/18058		Daniel Bauer	3	22/99

COMS W4706 Spoken Language Processing. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137) or the instructor's permission.

Computational approaches to speech generation and understanding. Topics include speech recognition and understanding, speech analysis for computational linguistics research, and speech synthesis. Speech applications including dialogue systems, data mining, summarization, and translation. Exercises involve data analysis and building a small text-to-speech system.

COMS W4725 Knowledge representation and reasoning. 3 points.

Lect: 3. Not offered during 2022-23 academic year.

Prerequisites: (COMS W4701)

General aspects of knowledge representation (KR). The two fundamental paradigms (semantic networks and frames) and illustrative systems. Topics include hybrid systems, time, action/plans, defaults, abduction, and case-based reasoning. Throughout the course particular attention is paid to design trade-offs between language expressiveness and reasoning complexity, and issues relating to the use of KR systems in larger applications.

COMS W4731 Computer Vision I: First Principles. 3.00 points.

Lect: 3.

Prerequisites: Fundamentals of calculus, linear algebra, and C programming. Students without any of these prerequisites are advised to contact the instructor prior to taking the course.

Introductory course in computer vision. Topics include image formation and optics, image sensing, binary images, image processing and filtering, edge extraction and boundary detection, region growing and segmentation, pattern classification methods, brightness and reflectance, shape from shading and photometric stereo, texture, binocular stereo, optical flow and motion, 2D and 3D object representation, object recognition, vision systems and applications

Fall 2022: COMS W4731

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4731	001/11025	M W 10:10am - 11:25am 214 Pupin Laboratories	Shree Nayar	3.00	43/56
COMS 4731	H01/20095	M W 10:10am - 11:25am Online Only	Shree Nayar	3.00	33/44

COMS W4732 Computer Vision II: Learning. 3.00 points.

Advanced course in computer vision. Topics include convolutional networks and back-propagation, object and action recognition, self-supervised and few-shot learning, image synthesis and generative models, object tracking, vision and language, vision and audio, 3D representations, interpretability, and bias, ethics, and media deception

Spring 2023: COMS W4732

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4732	001/12843	F 10:10am - 12:40pm 501 Northwest Corner	Carl Vondrick	3.00	130/120
COMS 4732	V01/18059		Carl Vondrick	3.00	28/99

COMS W4733 Computational Aspects of Robotics. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: (COMS W3134 or COMS W3136COMS W3137)
Introduction to robotics from a computer science perspective. Topics include coordinate frames and kinematics, computer architectures for robotics, integration and use of sensors, world modeling systems, design and use of robotic programming languages, and applications of artificial intelligence for planning, assembly, and manipulation.

Spring 2023: COMS W4733

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4733	001/12844	F 10:10am - 12:40pm 428 Pupin Laboratories	Shuran Song	3	155/147
COMS 4733	V01/18060		Shuran Song	3	17/99

COMS W4735 Visual Interfaces to Computers. 3 points.

Lect: 3.

Prerequisites: (COMS W3134 or COMS W3136 or COMS W3137)
Visual input as data and for control of computer systems. Survey and analysis of architecture, algorithms, and underlying assumptions of commercial and research systems that recognize and interpret human gestures, analyze imagery such as fingerprint or iris patterns, generate natural language descriptions of medical or map imagery. Explores foundations in human psychophysics, cognitive science, and artificial intelligence.

Spring 2023: COMS W4735

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4735	001/12847	T Th 2:40pm - 3:55pm 209 Havemeyer Hall	John Kender	3	96/110
COMS 4735	H01/19939	T Th 2:40pm - 3:55pm Online Only	John Kender	3	11/30
COMS 4735	V01/19421		John Kender	3	7/99

COMS W4737 Biometrics. 3 points.

CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: a background at the sophomore level in computer science, engineering, or like discipline.

In this course, we will explore the latest advances in biometrics as well as the machine learning techniques behind them. Students will learn how these technologies work and how they are sometimes defeated. Grading will be based on homework assignments and a final project. There will be no midterm or final exam. This course shares lectures with *COMS E6737*. Students taking *COMS E6737* are required to complete additional homework problems and undertake a more rigorous final project. Students will only be allowed to earn credit for *COMS W4737* or *COMS E6737* and not both.

COMS W4762 Machine Learning for Functional Genomics. 3 points.

Prerequisites: Proficiency in a high-level programming language (Python/ R/Julia). An introductory machine learning class (such as COMS 4771 Machine Learning) will be helpful but is not required.

Prerequisites: see notes re: points

This course will introduce modern probabilistic machine learning methods using applications in data analysis tasks from functional genomics, where massively-parallel sequencing is used to measure the state of cells: e.g. what genes are being expressed, what regions of DNA ("chromatin") are active ("open") or bound by specific proteins.

COMS W4771 Machine Learning. 3 points.

Lect: 3.

Prerequisites: Any introductory course in linear algebra and any introductory course in statistics are both required. Highly recommended: COMS W4701 or knowledge of Artificial Intelligence.

Topics from generative and discriminative machine learning including least squares methods, support vector machines, kernel methods, neural networks, Gaussian distributions, linear classification, linear regression, maximum likelihood, exponential family distributions, Bayesian networks, Bayesian inference, mixture models, the EM algorithm, graphical models and hidden Markov models. Algorithms implemented in MATLAB.

Fall 2022: COMS W4771

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4771	001/11027	T Th 2:40pm - 3:55pm 833 Seeley W. Mudd Building	Nakul Verma	3	113/120
COMS 4771	V01/18009		Nakul Verma	3	10/99

Spring 2023: COMS W4771

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4771	001/12850	T Th 1:10pm - 2:25pm 451 Computer Science Bldg	Nakul Verma	3	74/110
COMS 4771	002/12861	T Th 2:40pm - 3:55pm 451 Computer Science Bldg	Nakul Verma	3	80/110
COMS 4771	003/18029	F 1:10pm - 3:40pm 501 Northwest Corner	Nakul Verma	3	78/150
COMS 4771	V01/18061		Nakul Verma	3	11/99

COMS W4772 Advanced Machine Learning. 3 points.

Lect: 3.

Prerequisites: (COMS W4771) or instructor's permission; knowledge of linear algebra & introductory probability or statistics is required.

An exploration of advanced machine learning tools for perception and behavior learning. How can machines perceive, learn from, and classify human activity computationally? Topics include appearance-based models, principal and independent components analysis, dimensionality reduction, kernel methods, manifold learning, latent models, regression, classification, Bayesian methods, maximum entropy methods, real-time tracking, extended Kalman filters, time series prediction, hidden Markov models, factorial HMMS, input-output HMMs, Markov random fields, variational methods, dynamic Bayesian networks, and Gaussian/Dirichlet processes. Links to cognitive science.

COMS W4773 Machine Learning Theory. 3 points.

Prerequisites: Machine Learning (COMS W4771). Background in probability and statistics, linear algebra, and multivariate calculus. Ability to program in a high-level language, and familiarity with basic algorithm design and coding principles.

Prerequisites: see notes re: points

Core topics from unsupervised learning such as clustering, dimensionality reduction and density estimation will be studied in detail. Topics in clustering: k-means clustering, hierarchical clustering, spectral clustering, clustering with various forms of feedback, good initialization techniques and convergence analysis of various clustering procedures. Topics in dimensionality reduction: linear techniques such as PCA, ICA, Factor Analysis, Random Projections, non-linear techniques such as LLE, IsoMap, Laplacian Eigenmaps, tSNE, and study of embeddings of general metric spaces, what sorts of theoretical guarantees can one provide about such techniques. Miscellaneous topics: design and analysis of data structures for fast Nearest Neighbor search such as Cover Trees and LSH. Algorithms will be implemented in either Matlab or Python.

COMS W4774 Unsupervised Learning. 3 points.

Prerequisites: Solid background in multivariate calculus, linear algebra, basic probability, and algorithms.

Prerequisites: see notes re: points

Theoretical study of algorithms for machine learning and high-dimensional data analysis. Topics include high-dimensional probability, theory of generalization and statistical learning, online learning and optimization, spectral analysis.

Fall 2022: COMS W4774

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4774	001/11028	T Th 1:10pm - 2:25pm 627 Seeley W. Mudd Building	Nakul Verma	3	40/50

COMS W4775 Causal Inference. 3.00 points.

Prerequisites: Discrete Math, Calculus, Statistics (basic probability, modeling, experimental design), some programming experience.

Prerequisites: see notes re: points

Causal Inference theory and applications. The theoretical topics include the 3-layer causal hierarchy, causal bayesian networks, structural learning, the identification problem and the do-calculus, linear identifiability, bounding, and counterfactual analysis. The applied part includes intersection with statistics, the empirical-data sciences (social and health), and AI and ML

Fall 2022: COMS W4775

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4775	001/11029	M W 4:10pm - 5:25pm 326 Uris Hall	Elias Bareinboim	3.00	53/65

COMS W4776 Machine Learning for Data Science. 3 points.

Lect.: 3

Prerequisites: (STAT GU4001 or IEOR E4150) and linear algebra.

Introduction to machine learning, emphasis on data science.

Topics include least square methods, Gaussian distributions, linear classification, linear regression, maximum likelihood, exponential family distributions, Bayesian networks, Bayesian inference, mixture models, the EM algorithm, graphical models, hidden Markov models, support vector machines kernel methods. Emphasizes methods and problems relevant to big data. Students may not receive credit for both COMS W4771 and W4776.

COMS W4824 COMPUTER ARCHITECTURE. 3.00 points.**COMS W4901 Projects in Computer Science. 1-3 points.**

Prerequisites: Approval by a faculty member who agrees to supervise the work.

A second-level independent project involving laboratory work, computer programming, analytical investigation, or engineering design. May be repeated for credit, but not for a total of more than 3 points of degree credit. Consult the department for section assignment.

COMS W4910 Curricular Practical Training. 1 point.

Prerequisites: obtained internship and approval from faculty advisor.

Only for M.S. students in the Computer Science department who need relevant work experience as part of their program of study. Final report required. This course may not be taken for pass/fail credit or audited.

COMS W4995 Special topics in computer science, I. 3 points.

Lect: 3.

Prerequisites: Instructor's permission.

Special topics arranged as the need and availability arises. Topics are usually offered on a one-time basis. Since the content of this course changes each time it is offered, it may be repeated for credit. Consult the department for section assignment.

Fall 2022: COMS W4995

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4995	001/11030	T 4:10pm - 6:40pm 415 Schapiro Cepser	Paul Blaer, Jason Cahill	3	38/40
COMS 4995	002/11031	M W 5:40pm - 6:55pm 451 Computer Science Bldg	Stephen Edwards	3	67/110
COMS 4995	003/11032	M W 11:40am - 12:55pm 829 Seeley W. Mudd Building	Michelle Levine	3	24/40
COMS 4995	004/11033	M W 2:40pm - 3:55pm 451 Computer Science Bldg	Richard Zemel	3	88/90
COMS 4995	005/11034	W 4:10pm - 6:40pm 331 Uris Hall	Toniann Pitassi	3	3/50
COMS 4995	006/13377	T Th 2:40pm - 3:55pm 451 Computer Science Bldg	Peter Belhumeur	3	111/125
COMS 4995	007/13874	T Th 5:40pm - 6:55pm 331 Uris Hall	Yongwhan Lim	3	47/50
COMS 4995	008/16691	M 7:00pm - 9:30pm 451 Computer Science Bldg	Yongwhan Lim	3	53/100
COMS 4995	009/18505	F 1:10pm - 3:40pm 327 Seeley W. Mudd Building	Bjarne Stroustrup	3	31/33
COMS 4995	010/11035	Th 7:00pm - 9:30pm Room TBA	Joshua Gordon	3	0/200
COMS 4995	011/11036	M 7:00pm - 9:30pm 833 Seeley W. Mudd Building	Vijay Pappu	3	116/120
COMS 4995	012/11037	W 7:00pm - 9:30pm 417 International Affairs Bldg	Bryan Gibson	3	186/200
COMS 4995	013/18870	W 4:10pm - 6:40pm 417 International Affairs Bldg	Vijay Pappu	3	115/120
COMS 4995	020/18683	Th 4:10pm - 6:40pm 627 Seeley W. Mudd Building	Homayoon Beigi	3	19/50
COMS 4995	021/18684	T Th 4:10pm - 5:25pm 401 Chandler	Apoorv Agarwal	3	36/36
COMS 4995	H10/20665	Th 7:00pm - 9:30pm 417 International Affairs Bldg	Joshua Gordon	3	169/170
COMS 4995	V02/18012		Stephen Edwards	3	3/99
COMS 4995	V04/18013		Richard Zemel	3	18/20
COMS 4995	V11/18015		Vijay Pappu	3	18/99
COMS 4995	V12/18016		Bryan Gibson	3	9/99
COMS 4995	V20/18717		Homayoon Beigi	3	5/99

Spring 2023: COMS W4995

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
COMS 4995	001/12872	F 10:10am - 12:40pm 524 Seeley W. Mudd Building	Augustin Chaintreau	3	27/55
COMS 4995	002/12873	T Th 8:40am - 9:55am 451 Computer Science Bldg	Andrew Blumberg	3	32/60
COMS 4995	003/12878	F 1:10pm - 3:40pm 644 Seeley W. Mudd Building	Suman Jana	3	11/40
COMS 4995	004/12880	M 10:10am - 12:40pm 825 Seeley W. Mudd	Elias Bareinboim	3	17/40

COMS W4996 Special topics in computer science, II. 3 points.

Lect: 3. **Not offered during 2022-23 academic year.**

Prerequisites: Instructor's permission.

A continuation of COMS W4995 when the special topic extends over two terms.