Stuart T. Weinberg
picked up on March 26, '79

The Undergraduate Major in Computer Science

December 14, 1978

Starting in 1979-80, the Department of Mathematics will offer an undergraduate major in computer science in addition to the major in mathematics. Historically, academic work in computer science at Dartmouth has had its focus in the Department of Mathematics. This situation results not only from the close ties between the Department and the Kiewit Computation Center, but also from the fact that a strong background in mathematics is needed for serious work in computer science and from the substantial overlap between the two disciplines.

In the past, the Department of Mathematics has offered a computer science option on the major in mathematics, several regular courses in computer science, and occasional special offerings. The new major and the courses associated with it will strengthen these offerings and will provide academic work in computer science commensurate with Dartmouth's established reputation in the use of computers in education.

The major in computer science is designed to provide a broader coverage of the growing discipline of computer science than is afforded by the computer science option on the major in mathematics. It will enable interested students to focus their studies directly, rather than indirectly, in computer science. The major in computer science will also provide a valuable academic complement to the excellent professional experience that some students now receive through employment in the Kiewit Computation Center.

For students with primary interests in other disciplines, the new courses will make it easier to construct meaningful majors modified with computer science. Furthermore, restructured introductory courses will provide a foundation for all students who wish to make serious use of computing.

Requirements for the major

The following requirements must be fulfilled by students wishing to major in computer science.

Prerequisites: Mathematics 3, 4, 13 (or 14 and 15), and 18.

Major requirements: Eight courses are required beyond the prerequisites. These include

(1) Mathematics 28,
(2) at least three courses in computer systems (Mathematics 37, 38, 48, 58, 68),
(3) at least one course in the theory of computation (Mathematics 45, 47, 59),
(4) at least two courses in mathematics related to computation (Mathematics 20, 21, 26, 40, 41, 50, 56), and
(5) one other course, either from the above list or from the offerings of the Mathematics Department with course numbers above 20. either 26 or 36 ~~or 28~~

Students must have their major programs approved by the Department.

(For students who have begun their study of computer science prior to 1979-80, the following adjustments may be made in the requirements for the computer science major. The prerequisite of Mathematics 18 may be satisfied by the old Mathematics 28, and any course numbered 20 or above offered by the Department may be substituted for the new Mathematics 28 in requirement (1). The old versions of Mathematics 48 and 58 count towards the fulfillment of requirement (2). Mathematics 88 in 1978W and 1978S serve to fulfill requirement (3), as does Mathematics 69 in 1977X.)

Math 27

Courses

Following are descriptions of the computer science courses to be offered by the Department of Mathematics. These courses replace the former versions of Mathematics 28, 48, and 58; they also regularize certain past offerings of Mathematics 69 and 88.

Mathematics 16. The role of the computer outside the sciences

66016 79X, 80W, 80X, 81W, 81X, 82W

This course studies nonscientific applications of computing and is designed primarily for students having little or no computing experience. Topics may include game playing, information retrieval, and musical composition. Each student will be trained in the use of the computer and will be expected to do a project involving extensive use of the computer.

This course does not count towards the major in mathematics or the major in computer science. Prospective majors, as well as students who intend to take further courses in computer science, should elect Mathematics 18. Not open to students who have completed Mathematics 18.

Prerequisite: Mathematics 6 or 20, or permission of the instructor.

Mathematics 18. Introduction to computer science

66018 79F, 80S, 80F, 81S, 81F, 82S

This course provides an introduction to the fundamental concepts and techniques of computer science. Through a survey of applications of computing, it focuses attention on the design and implementation of efficient algorithms for the manipulation of data and for the solution of both numerical and nonnumerical problems on a computer. Particular algorithms for searching, sorting, simulation, approximation, and text processing are studied in some detail. Students are introduced to programming in a high-level computer language.

Prerequisite: Mathematics 4, or Mathematics 3 and 6.

(Commentary: This course is practically identical to the old Mathematics 28 minus its requirement for a significant term project, which is deferred to the new Mathematics 28. Students will be able to use the time formerly devoted to the term project

to acquire a more thorough grounding in the fundamentals of programming and algorithm development. The prerequisites for the course have been reduced to be more in line with what is actually demanded of students and to enable students to elect a course in computer science prior to the time they must select a major.)

Mathematics 28. Programming system design and development

66028 80W, 80F, 81W, 81F, 82W

This course extends Mathematics 18 by considering more substantial applications of computing. Emphasis is placed equally on programming techniques and methodology. Techniques covered include recursion, coroutines, list processing, and parsing. Methodology is developed for combining small modules into large systems. Students will complete a substantial term project on a topic of their own choosing.

Prerequisite: Mathematics 18.

(Commentary: This new course covers the material that spilled over from the old Mathematics 28 into Mathematics 48, preventing that course from giving a thorough treatment of advanced topics. The prerequisite of Mathematics 18 together with the emphasis in this course on large systems and programming methodology will enable students to undertake a more significant term project than is possible in a first course on computing.)

Mathematics 37. Computer architecture

(66037) 79X, 80X, 81X

The architecture and organization of a simple computer system is revealed by an examination of how a particular computer implements the programming features provided by its assembly language. Topics covered include how information is represented in memory, how the central processor is controlled by a program, and how data are transferred to and from peripheral devices.

Prerequisite: Mathematics 18.

(Commentary: This is a new course which will provide a tie between the computer science offerings of the Department of Mathematics and the digital electronics courses of the Department of Engineering Science.)

Mathematics 38. Information systems

(66038) 80S, 81F

This course concentrates on schemes for representing complex information structures within a computer system and also on the design of efficient algorithms for processing these structures and for retrieving the information they contain. Algorithms for storage allocation and deallocation are examined in some detail, as are techniques for storing, retrieving, and manipulating large amounts of data. The techniques discussed are applied to the construction and analysis of specific information systems. Attention is also paid to the effect of system design on the users of information systems and on society at large.

Prerequisite: Mathematics 28.

(Commentary: This course is identical in content to the old Mathematics 58, but is moved earlier in the curriculum to place greater emphasis on an important application of computing.)

Mathematics 45. Design and analysis of algorithms

(66045) 81W

A combinatorial study is made of algorithms for applications such as searching, sorting, counting, graph and tree manipulation, scheduling, pattern matching, and Fourier transformations. Estimates of the time and space required by specific algorithms are obtained, and the intrinsic complexity of problems is measured by the minimum resources that must be consumed by any algorithms for their solution. Methods for establishing the correctness of algorithms are also treated.

Prerequisite: Mathematics 28. Mathematics 20 or 21 also provide useful background, but are not required.

(Commentary: This course was offered for the first time in 1978-79. It and the new Mathametics 47 will be offered in alternate years.)

Mathematics 47. Mathematical models in linguistics

66047 80W, 82W

This course studies the formal theories of syntax arising from the work of Chomsky. Regular, context-free, context-sensitive, and unrestricted grammars are introduced together with finite state, pushdown, linear-bounded, and Turing automata capable of recognizing the languages generated by these grammars. Applications are made of the general theory to the study of both natural and computer languages.

Prerequisite: Mathematics 18.

(Commentary: Related courses in linguistics are offered by other departments. This course will strengthen the linguistics and computer science offerings of the College. It will be offered in years alternate to Mathematics 45.)

Mathematics 48. Programming languages and their implementation

66048 80F, 82S

The design of programming languages is studied together with formalisms for specifying their syntax and semantics and together with techniques for processing programs written in these languages. Various languages are compared with respect to their handling of expressions, control structures, procedures, data structures, and input-output. The implementation of language processors is addressed through a study of assemblers, interpreters, compilers, linkers, and loaders.

Prerequisite: Mathematics 28.

(Commentary: Some of this material was covered in the old Mathematics 48. Treatment in greater depth is made possible by moving introductory material on programming methodology to the new Mathematics 28 and by replacing it with material more directly related to programming language design.)

Mathematics 58. Operating systems

66058 79F, 81S

This course studies how computer operating systems allocate resources and create virtual machines for the execution of user jobs. Topics covered include storage management, scheduling, concurrent processing, shared access to files, synchronization, and data protection. Both abstract models and actual examples of operating systems will be studied.

Prerequisite: Mathematics 28 and 37.

(Commentary: This is a new course, though some of the topics contained in it have been covered sporadically in past offerings of Mathematics 48.)

Mathematics 59. Theory of computation

66059 80S, 82S

A precise mathematical formulation is given for the notion of computability in order to address questions concerning uncomputability and the intrinsic complexity of computation. Topics covered include models for computation, recursive and recursively enumerable sets, unsolvable problems, reducibilities and their associated degree structures, and the complexity of decision procedures. Implications of the results obtained for the foundations of mathematics are also considered.

Prerequisite: Mathematics 45 or 47. Mathematics 39 or 69 also provide useful background, but are not required.

(Commentary: This course provides for a more thorough treatment of results on undecidability and incompleteness than is possible in Mathematics 39 and 69, thereby strengthening the logic and computer science offerings of the Department. It will be offered in years alternate to Mathematics 89.)

Mathematics 68. Topics in computer science

66068 81S

Each offering of this course will concentrate on a particular topic of current interest in computer science. Representative topics include artifical intelligence, natural language processing, computer graphics, or simulation and modeling.

(Commentary: This course will be offered in alternate years. Special topics in computer science were offered formerly under the rubric of Mathematics 88.)

In addition to the above courses, the following courses in mathematics related to computation can be used to fulfill the requirements of the major in computer science.

Mathematics 20. Discrete probability
Mathematics 21. Introduction to combinatorics
Mathematics 26. Introduction to numerical analysis
Mathematics 40. Probability and statistical inference
Mathematics 41. Linear algebra
Mathematics 50. Applied probability and statistics
Mathematics 56. Numerical analysis

Schedule of course offerings

The current and future schedule of course offerings in computer science is shown by term and by year.

Current

1977-78	X	F	W	S
Introductory	16	28◦	16	28
Systems			48	58
Theory	69		88	88

1978-79	X	F	W	S
Introductory	16	[28]	16	28◦
Systems			48	58
Theory		45		

◦ Two sections offered.

Future

1979-80	X	F	W	S
Introductory	~~16~~	~~18~~	~~16~~, (28)	18
Systems	[37]	58		[38]
Theory			47	59

1980-81	X	F	W	S
Introductory	~~16~~	~~18~~, ~~28~~	~~16~~, ~~28~~	~~18~~
Systems	[37]	[48]		58
Theory			[45]	
Topics		(38 ?)		68
		It's in "Prospectus"		

~~1981-82~~	X	F	W	S
~~Introductory~~	16	~~18~~, 28	16, 28	18
~~Systems~~	37	38		48
~~Theory~~			47	~~59~~