SIMON FRASER UNIVERSITY

S.78-143

MEMORANDUM

To: Senate	From: N.R. Reilly, Chairman Senate Committee on Undergraduate Studies
Subject: Computing Science Program Revisions	Date: 15 November 1978

Action taken by the Senate Committee on Undergraduate Studies at its meeting on October 24 and November 14, 1978 gives rise to the following motion:

MOTION

That Senate approve and recommend approval to the Board of Governors of the proposed revisions to the Computing Science Program as outlined below and detailed in S78-143:

a) New Course Proposal - CMPT 405-3, Design and Analysis of Computing Algorithms
b) Changes in upper division course requirements
   (1) Requirements for a Major in CMPT.
   (2) Additional requirements for the degree.
   (3) Requirements for Honors in CMPT.
   (4) Additional requirements for the degree.

Norman R Reilly

N.R. Reilly

/kb

SIMON FRASER UNIVERSITY SCUS 78-52

MEMORANDUM

To: Mr. H.M. Evans
Registrar & Secretary, SCUS

From: J. Blanchet, Secretary to the
Faculty of Interdisciplinary Studies
Undergraduate Curriculum Committee

Subject: I.S.C. 78-19 - New Course Proposal
CMPT 405 - Design and Analysis of
Computing Algorithms

Date: October 13, 1978

The attached new course proposal, CMPT 405-3 - Design and Analysis of Computing Algorithms, was approved at the October 3, 1978 meeting of the Faculty of Interdisciplinary Studies Undergraduate Curriculum Committee, subject to circulation to other faculty curriculum committees for overlap consideration.

As per the attached memo, this course was sent out for overlap consideration October 11, 1978.

Please place this on the agenda for the next meeting of the Senate Committee on Undergraduate Studies.

J. M. Blanchet
Janet Blanchet

JB:jk

Attach.

SIMON FRASER UNIVERSITY

MEMORANDUM

CHAIRMEN OF FACULTY	From Doug Seeley
CURRICULUM COMMITTEES	Computing Science Department
Subject Proposed CMPT 405 Course	Date October 11, 1978

Faculty of Science - Dr. David Ryeburn
" Arts - Dr. Wyn Roberts
" Education - Dr. M.F. Wideen

Registrar - Mr. Harry M. Evans

Enclosed for your perusal, is the description of a proposed new course in Computing Science, that is being considered by the Faculty of Interdisciplinary Studies for forwarding to SCUS. Copies have also been sent to MATH some time ago. I trust that the rationale speaks for itself; if not please feel free to contact me.

DARS:ajj

U.S.C. 78-12

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Department: Computing Science

1. **Calendar Information**

Abbreviation Code: CMPT Course Number: 405 Credit Hours: 3 Vector: 3-0-0

Title of Course: Design and Analysis of Computing Algorithms

Calendar Description of Course:

Models of Computation; Methods of Algorithm Design; Complexity of Algorithms; Algorithms on Graphs and Integers, Sorting and Searching, NP-Complete Problems, Applications in Graphics and Artificial Intelligence.

Nature of Course

Prerequisites (or special instructions):

CMPT 201, CMPT 205, or MATH 243

What course (courses), if any, is being dropped from the calendar if this course is approved:

2. **Scheduling**

How frequently will the course be offered? Fall of each year, initially in 79-3

Semester in which the course will first be offered?

Which of your present faculty would be available to make the proposed offering possible?

J. Barenholtz, Doug Seeley, W. S. Havens

3. **Objectives of the Course**

To provide students with sufficient tools and understanding of the analysis of common computer algorithms that they may apply this knowledge to those algorithms which they will design.

4. **Budgetary and Space Requirements** (for information only)

What additional resources will be required in the following areas:

Faculty Faculty provided previously.

Staff

Library

Audio Visual NONE

Space

Equipment Computer time for a typical CMPT course say CMPT 305 Computing Center support of the language PASCAL.

5. **Approval**

Date: 1/29/78 13 Oct 78 15 Nov 78

Department Chairman — Dean — Chairman, SCUS

Rationale

Since the early 70's, this has been recognized as the primary core subject of Computing Science, and has been adopted by the vast majority of Computer Science programs in North America. Paraphrasing the proposed textbook:

> "The study of algorithms is at the very heart of computer science. In recent years a number of significant advances in the field of algorithms have been made. These advances have ranged from the development of faster algorithms, to the startling discovery of certain natural problems for which all algorithms are inefficient. These results have kindled considerable interest in the study of algorithms, and the area of algorithm design and analysis has blossomed into a field of immense interest. The interest of this course is to bring together the fundamental results in this area, so the unifying principles and underlying concepts of algorithm design may more easily be taught."

The introduction of this course is a major step in alleviating a perceived weakness in the current CMPT course offerings, i.e. the lack of a strong theoretical core. This does not imply that Computing Science is going to swing to the theoretical, but rather the broad coverage of the diversity of computing science in our curriculum will be complemented by a course of unifying concepts. This is a course that is concerned not just with applications of programming but with what constitutes a "good" or effective program (algorithm).

There exists some potential overlap with MATH 343; however where this can occur, the emphasis of CMPT 405 will be on the analysis of an algorithm's complexity and not on combinatorial theory. This matter has been discussed with appropriate members of the MATH faculty.

In summary, this course represents a well-defined body of knowledge that is perceived to be the key theoretical component of our discipline. This fact is recognized as well by its inclusion as a required course in a proposal for new Upper Division requirements.

Textbook -- Aho, Hopcroft, & Ullman, "The Design and Analysis of Algorithms.

References -- Knuth, "The Art of Computer Programming"

Vol. 1: Fundamental Algorithms

Vol. 3: Sorting & Searching

Shamos, "Computational Geometry"

COURSE OUTLINE

Proposed CSCT 405 Outline: Design and Analysis of Computer Algorithms

In all of the topics mentioned below, the emphasis is on the analysis of the computational complexity of algorithms in these areas.

1. **Models of Computation**: the complexity of algorithms, RAM programs stored program model, relationship between Turing Machines and RAM, a language for expressing algorithms.

2. **Methods of Algorithm Design** data structures, recursion, divide-and-conquer, balancing, backtrack programming, branch and bound, dynamic programming.

3. **Data Representation:** set operations, binary search trees, optimal search trees, balanced trees, dictionaries and priority queues.

4. **Sorting:** the types and uses of internal sorts, optimal sorts, Heapsort, Quicksort, order statistics, some methods of external sorting.

5. **Searching:** binary tree searching, balanced trees, interpolation search, hashing, retrieval on secondary keys.

6. **Elementary Numeric Algorithms**: integer multiplication and division, polynomial evaluation, modular arithmetic, matrix multiplication, Boolean matrix multiplication.

7. **Algorithms on Graphs**: spanning trees, depth-first search, path-finding, shortest paths.

8. **Computational Geometry**: convex hulls, inclusion problems, intersection problems, closest-point problems.

9. **Algorithms in Artificial Intelligence**: pattern matching, alphabeta pruning.

10. **NP-Complete Problems**: the classes NP and P, the equivalence of various NP-complete problems, intractable problems.

SIMON FRASER UNIVERSITY SCUS 78-69

MEMORANDUM

To: Mr. H. M. Evans,
Registrar & Secretary of SCUS.

From: J. Blanchet, Secretary of the Faculty of Interdisciplinary Studies Undergraduate Curriculum Committee.

Subject: I.S.C. 78-19 (a) revised. Computing Science Curriculum changes.

Date: October 30/78.

Changes to the requirements for the Computing Science Major and Honors were approved at a meeting of the Faculty of Interdisciplinary Studies Undergraduate Curriculum Committee held on October 10/78.

Computing Science subsequently modified the changes, and these have been approved via a telephone poll of the members of the Faculty of Interdisciplinary Studies Undergraduate Curriculum Committee. At the next formal meeting of this committee these items will be ratified.

Would you please place this item on the agenda for the next meeting of the Senate Committee on Undergraduate Studies.

J. M. Blanchet.
Janet Blanchet.

Attachment.

For the rationale below, the Department of Computing Science recommends calendar changes to reflect changes in Upper Division Course Requirements:

Rationale

Computing Science is a rapidly evolving and diverse discipline. It is intrinsically interdisciplinary, requiring knowledge of programming, the theory of computation, the logical circuits and hardware components of computers, the organization of information systems, numerical methods, graphic display, problem-solving, and the architecture of systems and machines.

A student with a degree in Computing Science should have both breadth and depth of knowledge in the field. The student should obtain experience of the above diversity through course work, yet have studied some of these areas in sufficient depth that the student may pursue graduate work or display recognized skills in the computing community.

The previous calendar requirements specified neither breadth nor depth, only required courses. The scheme described here not only provides this but supplies a coherence to the department's course offerings that will help the student select a well-rounded program of courses.

In addition, the courses required for the degree have been revised to more accurately reflect a core of knowledge that any computing scientist can be assumed to have.

Proposed Calendar Entry: (to replace material at current locations pages 296-297 from "Upper Division Course Requirements up until "Program for a Minor ...")

Upper Division Course Requirements

Attention is drawn to the lower division courses stated above. Majors and Honors students are required to consult a departmental advisor before submitting a program of study.

Requirements are structured according to the areas of concentration shown in Table 1. Each course appears in one area, but a few courses also overlap other areas to an extent that permits their use in other areas as well. These courses are enclosed in parentheses in Table 1. When a course is selected from an area to fulfill a breadth requirement, this course should normally be one of the key courses for the area, as indicated in Table 2.

Note that no upper division course may be counted for semester hour credit toward two separate requirements, although it may be used to fulfill course content purposes in more than one area. For example, MATH 306 may be counted toward the 30 hours of upper division Computing Science courses or as part of a 15 hour concentration in Mathematics but not for both.

TABLE 1

Area	Course	Title
Computer Design and Organization	CMPT 390	Digital Circuits & Systems
	CMPT 400	Hardware-Software Architecture I
	(CMPT 401)	Hardware-Software Architecture II
	CMPT 491	Computers in Real-Time Experiments
	MATH 401	Switching Theory & Logical Design
Software Systems*	CMPT 301	System Development Methodology
	CMPT 305	Computer Simulation & Modeling
	CMPT 401	Hardware-Software Architecture II
	CMPT 404	Computer System Measurement & Evaluation
	(CMPT 491)	Computers in Real-Time Experiments
Information Systems*	CMPT 302	System Development Projects
	CMPT 350	Information and Public Policy
	CMPT 354	Information Organization & Retrieval
	CMPT 370	Management & Information Systems I
	CMPT 371	Management & Information Systems II
Intensive Applications	CMPT 351	Introduction to Computer Graphics
	CMPT 380	Computational Linguistics
	CMPT 410	Artificial Intelligence
	CMPT 451	Interactive Graphics & Animation Systems
Theoretical Computing Science	CMPT 405	Design & Analysis of Algorithms
	MATH 306	Introduction to Automata Theory
	MATH 343	Combinatorial Aspects of Computing
	MATH 401	Switching Theory & Logical Design
	MATH 402	Automata & Formal Languages
	MATH 403	Algebraic Theory of Automata
Analytical Tools for Scientific Computation	(CMPT 305)	Computer Simulation & Modeling
	CMPT 360	Computation for Statistical Data Processing
	MATH 308	Linear Programming
	MATH 316	Numerical Analysis I
	(MATH 343)	Combinatorial Aspects of Computing
	MATH 408	Discrete Optimization

* Software in this context is distinguished from Information Systems which are meant to include data bases and systems for management decision-making.

TABLE 2

Area	Key Course(s)
Computer Design and Organization	CMPT 400
Software Systems	CMPT 301
Information Systems	CMPT 354
Intensive Applications	CMPT 410 or CMPT 351
Theoretical Computing Science	MATH 306
Analytic Tools for Scientific Computation	any course

PROGRAM FOR A MAJOR IN COMPUTING SCIENCE

Attention is drawn to lower division course requirements, as prerequisites, as described in the preceding sections.

(a) For a Major in Computing Science students must complete:-

thirty hours of upper division Computing Science courses including CMPT 354, 405, and 493. The 30 hours of Computing Science courses must satisfy the following distribution requirements:

i) Depth Requirement:
Concentrations consisting of 3 courses from two of the areas shown in Table 1. Theoretical Computing Science and Analytic Tools for Scientific Computation may not both be counted as Depth Areas.

Note: In exceptional circumstances, different depth areas may be considered and sanctioned with the approval of faculty sponsor and the Curriculum Committee.

ii) Breadth Requirement:
Three different courses from distinct areas selected from the remaining areas (each course should normally be a key course, in the area as indicated in Table 2 if not previously taken).

iii) Any other upper division Computing Science course to bring the total upper division hours to at least 30.

(b) In addition, for the general degree students must include a concentration in a discipline (department) other than Computing Science, approved by the program advisor, consisting of at least 15 semester hours, and including at least 6 hours of upper division credit.

(c) For a general degree with a Major in Computing Science a student must complete 120 semester hours, with an overall minimum of at least 45 hours of upper division credit.

Students are advised to consult the University and Faculty regulations governing graduation requirements which are specified elsewhere in the calendar.

PROGRAM FOR HONORS IN COMPUTING SCIENCE

Attention is drawn to lower division course requirements, as prerequisites, as described in the preceding sections.

(a) For Honors in Computing Science students must complete:-

fifty hours of upper division Computing Science courses including CMPT 354, 405, and 493. The 50 hours of Computing Science courses must satisfy the following distribution requirements:

i) Depth Requirement:
Concentrations consisting of 4 courses in one of the areas shown in Table 1 and 3 courses in each of two other areas. One of the three areas chosen must be Theoretical Computing Science

Note: In exceptional circumstances, different depth areas may be considered and sanctioned with the approval of faculty sponsor and the Curriculum Committee.

ii) Breadth Requirement:
Three different courses consisting of one course from each of the remaining areas (each course should normally be a key course in the area as indicated in Table 2, if not previously taken).

iii) Any other Computing Science courses to bring the total upper division hours to at least 50.

(b) In addition, for the Honors degree students must include a concentration in a discipline (department) other than Computing Science, approved by the program advisor, consisting of at least 15 semester hours, and including at least 6 hours of upper division credit.

(c) For a degree with Honors in Computing Science a student must complete 132 semester hours with an overall minimum of at least 60 hours of upper division credit.

Students are advised to consult the University and Faculty regulations governing graduation requirements which are specified elsewhere in the calendar.