PROGRAM TITLE: Computer Science Bachelor of Science (BS)

PLEASE CHECK: GRADUATE □ UNDERGRADUATE □

DEPARTMENT: Computer Science HEAD/CHAIR: Andrew Barto

SCHOOL OR COLLEGE: Natural Sciences and Mathematics DEAN: George Langford

Submission Date: April 17, 2008 Proposed Starting Date: Jan. 1, 2009

I. PROPOSAL DEVELOPMENT

A. Describe the Proposal.

The BS in Computer Science requires 14 computer science courses (not including 305) for a minimum of 48 credits, 4 math courses, and an approved science sequence.

Two (2) introductory computer science courses:
- CMPSCI 121 Introduction to Problem Solving with Computers (4 credits)
- CMPSCI 187 Programming with Data Structures (4 credits)
  (or equivalent courses/AP placements)

Four (4) core computer science courses:
- CMPSCI 201 Architecture and Assembly Language Programming (4 credits)
- CMPSCI 220/291A Programming Methodology (4 credits)
- CMPSCI 240/291B Reasoning About Uncertainty (4 credits)
- CMPSCI 250 Introduction to Computation (4 credits)

The Junior Year Writing Course: CMPSCI 305 Social Issues in Computing (3 credits)

Eight (8) Computer Science Electives at the 300-level or higher. Students who want to specialize in a specific area of Computer Science are encouraged to choose a designated track within the program. Students who do not want to specialize in any one area of Computer Science do not need to declare a track, but students without a track must satisfy the following requirements to complete the BS:

- CMPSCI 311 Introduction to Algorithms (4 credits)
- CMPSCI 377 Operating Systems (4 credits)
- CMPSCI 383 Artificial Intelligence (3 credits)
- 2 free electives >= 300 (not including CMPSCI 305) (6 credits)
- 3 additional free electives >= 400 (9 credits)

Four (4) Math Courses. MATH 131, MATH 132, MATH 235, and one of either MATH 233 or STATISTICS 515 (equivalent courses or appropriate AP exam placements are acceptable in place of MATH 131-132).

An Approved Science Sequence. Two of the three General Education Science courses must be introductory courses (with labs) intended for majors in some department in the College of Natural Sciences and Mathematics (8 total credits). Currently allowed courses are:
- BIOLOGY 100 Introduction to Biology
- BIOLOGY 101 Introduction to Biology
  (or equivalent Biology courses*)
- CHEM 111 General Chemistry for Science and Engineering Majors
- CHEM 112 General Chemistry for Science and Engineering Majors
- CHEM 121 General Chemistry
- CHEM 122 General Chemistry
  (or equivalent Chemistry courses*)
- GEO-SCI 101 The Earth (with lab)
  (or equivalent Geo-Science courses*)
- PHYSICS 151/3 General Physics I (with lab)
PHYSICS 152/4 General Physics II (with lab)
PHYSICS 181/3 Physics I - Mechanics (with lab)
PHYSICS 182/4 Physics II - Electricity and Magnetism (with lab)
(or equivalent Physics courses*)

*Equivalent courses as determined by the offering department.

Variances from this requirement may be allowed under unusual circumstances. Students interested in counting a different science course toward this requirement should contact the Computer Science Undergraduate Program Director.

BS computer science electives must be chosen from the department's regularly numbered courses 300 or higher. Experimental classes (numbered x91 or x95) and independent studies (numbered x96) require Undergraduate Program Director (UPD) approval or an explicit designation indicating that the course can be used as an elective (e.g. inclusion in a track). No course taken on a pass/fail basis can be used to fulfill the BS requirements. Moreover, a cumulative grade point average of 2.0 or better must be achieved in courses required for the major. Students may petition to substitute courses taken outside the Computer Science Department (including non-computer science courses in special cases).

Note: All BS students graduating before 2012 are required to take 377 (Operating Systems), and all BS students graduating before 2012 may substitute 287 for 220/291A and 383 for 240/291B.

OPTIONAL TRACKS

We have ten track options. Each track consists of eight electives which are usually 3-credit courses. In some cases, these may be 4-credit courses.

The Software Engineering Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Four required courses:

311 (Algorithms)
320 (Software Engineering)
520 (SE-Synthesis)
521 (SE-Analysis & Evaluation)

Any two courses from the following options:

325/491I (Usability)
365/491C (Digital Forensics)
377 (Operating Systems)
401 (Formal Languages)
410 (Compilers)
445 (Information Systems)
453 (Networks)
460/491S (Security)
513/591L (Logic)
529/591F (SE Management Practicum)
575 (Combinatorics and Graph Theory)
499 (Capstone Ind. Study) or an equivalent course

Two additional electives >= 300 (not including 305)

The Artificial Intelligence Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Three required courses:

311 (Algorithms)
320 (Software Engineering)
383 (Artificial Intelligence)

Any two courses from the following options:

370/391B (Computer Vision)
403 (Robotics)
503/591C (Embedded Systems)
585 (Natural Language Processing)
589 (Machine Learning)
683 (Advanced Artificial Intelligence)

3 additional electives >= 300 (not including 305) which may include one of 496/499T/499Y or an equivalent course

At least 3 of the 8 track courses must be >= 400

The Theory of Computation Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Three required courses:

311 (Algorithms)
320 (Software Engineering)
401 (Formal Languages)

Any one course from the following options:

377 (Operating Systems)
445 (Information Systems)
453 (Networks)
535 (Architecture)

Any two courses from the following options:

513/591L (Logic)
575 (Combinatorics and Graph Theory)
601 (Computation Theory)
611 (Advanced Algorithms)
one of 496/499T/499Y or an equivalent course
MATH 411

2 additional electives >= 300 (not including 305)

The Information Assurance Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Three required courses:

311 (Algorithms)
377 (Operating Systems)
460/491S (Security)

Any one course from the following options:

445 (Information Systems)
453 (Networks)

Any two courses from the following options:

365/491C (Digital Forensics)
466/591D (Applied Cryptography)
660/691CC (Advanced Security)
2 additional electives >= 300 (not including 305)

The Computer Architecture Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Four required courses:

- 311 (Algorithms)
- 320 (Software Engineering)
- 535 (Architecture)
- 635 (Modern Architecture)

Any two courses from the following options:

- 377 (Operating Systems)
- 401 (Formal Languages)
- 410 (Compilers)
- 445 (Information Systems)
- 453 (Networks)
- 520 (SE-Synthesis I)
- 530 (Programming Languages)
- 610 (Compiler Techniques)
- 653 (Adv. Networks)
- 677 (Adv. Operating Systems)
- one of 496/499T/499Y or an equivalent course
- ECE 353 (Digital Logic I)
- ECE 354 (Digital Logic II)
- ECE 558 (Architecture)

One additional elective >= 300 not on the above list (and not including 305)
One additional elective >= 300 (not including 305)

The Search and Data Mining Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Six required courses:

- 311 (Algorithms)
- 320 (Software Engineering)
- 348/591Y (Knowledge Discovery and Data Mining)
- 445 (Information Systems)
- 446/591I (Search Engines)
- 585 (Natural Language Processing)

Two additional electives >= 300 (not including 305)

The Robotics, Vision, and Graphics Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Five required courses:

- 311 (Algorithms)
- 320 (Software Engineering)
- 370/391B (Computer Vision)
- 403 (Intro.Robotics)
- 473/591B (Computer Graphics)
Any one course from the following options:

- 474/491K (Adv. Image Synthesis)
- 503/591C (Embedded Systems)
- 603 (Robotics)
- 617/691G (Computational Geometry)

Two additional electives >= 300 (not including 305)

The Networking Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Four required courses:

- 311 (Algorithms)
- 377 (Operating Systems)
- 453 (Networks)
- 454/591G (Networks Lab)

Any two courses from the following options:

- 320 (Software Engineering)
- 445 (Information Systems)
- 460/491S (Security)
- 466/591D (Applied Cryptography)
- 653 (Adv. Networks)

Two additional electives >= 300 (not including 305)

The Software Systems Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Four required courses:

- 311 (Algorithms)
- 320 (Software Engineering)
- 377 (Operating Systems)
- 445 (Information Systems)

Any two courses from the following options:

- 325/491I (Usability)
- 453 (Networks)
- 460/491S (Security)
- 466/591D (Applied Cryptography)
- 535 (Architecture)
- 577/591EE (OS Implementation)
- 677 (Operating Systems)

Two additional electives >= 300 (not including 305)

The Programming Languages and Compilers Track
(all course numbers refer to CMPSCI courses unless designated otherwise)

Four required courses:

- 311 (Algorithms)
Any two courses from the following options:

320 (Software Engineering)
445 (Information Systems)
535 (Architecture)

one of 496/499T/499Y or an equivalent course

Two additional electives >= 300 (not including 305)

B. Provide a brief overview of the process for developing the Proposal.

The Department of Computer Science has been debating major curriculum revisions in its undergraduate courses and programs for more than a year now. Our departmental Curriculum Committee has taken the lead, but lengthy discussions have been conducted in faculty meetings as well. This proposal was approved by a unanimous vote of the Computer Science Faculty on March 31, 2008.

II. PURPOSE AND GOALS

Describe the Proposal's purpose and the particular knowledge and skills to be acquired.

This proposal represents a revision of a BS degree program in Computer Science that has not been updated for about 20 years. In a dynamic field that has undergone astonishing change, it is remarkable that our old degree program was able to function as long as it did. Unfortunately, its age is showing. The field has changed, and much of that change has trickled down to the undergraduate level. Course requirements that made sense in 1985 are difficult to defend today, and many of our courses feel old and out of touch as well.

We have therefore revised our undergraduate curriculum to accommodate a more diverse student population, a more competitive global workforce, and an entire generation whose daily routines rely on state-of-the-art computer technologies. We are introducing many new courses: often bringing material previously reserved for graduate students into our undergraduate classrooms. As a result, our undergraduates will be able to explore more specialty areas in greater depth, and follow course progressions that connect ideas coming from many different directions. We cannot hope to deliver the best possible educational experience in a "one size fits all" curriculum. Today's students need to exercise more freedom of choice in order to pursue interests and directions that no one could have anticipated five years ago. Our degree program needs to be more fluid and less brittle if we want to keep our requirements and our students current.

As we redesigned our courses, it became clear that we also needed a new structure in our degree program to encourage flexible and multiple pathways through the undergraduate curriculum. In particular, we felt that we should offer our students a number of optional "tracks" designed to encourage and support mastery in a variety of interest areas. A curriculum with tracks is inherently more flexible than one without: as new specialties emerge, we can always create new tracks.

We therefore propose a program that offers ten optional tracks along with a generic option for students who do not wish to declare a track. Students who opt for the generic program will have more latitude to pursue multiple interests that are not necessarily connected by a unifying theme. Students who declare a track will be guided toward in-depth mastery in a specific area of interest. Either way, our students will be able to customize their educational experience to a much greater degree than was previously possible. Furthermore, each track represents active research areas within the department, and will therefore serve to bring our undergraduates into contact with world-class researchers at the forefront of their chosen fields.