AC 2010-374: RENAISSANCE SOFTWARE DESIGN: THE DEVELOPMENT OF THE COMPUTER SCIENCE FELLOWS PROGRAM AT BAYLOR UNIVERSITY

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Renaissance Software Design: The Development of the Computer Science Fellows Program at Baylor University

Abstract

The Computer Science Fellows Program at Baylor University was designed for intellectually gifted, highly motivated students entering the School of Engineering & Computer Science (ECS) with a wide range of interests, who desire a more diverse experience across the disciplines. The program seeks to broaden Computer Science Fellows' backgrounds in their chosen area(s) of diversification while preparing them for a graduate studies or for successful careers. The Computer Science Fellows is a major within the School of Engineering & Computer Science where fellows are free to create an individualized course of study with the advice of a program director who mentors them throughout the entire undergraduate experience. The program has course requirements in computer science as well as other core courses required by the university, but seeks to allow eligible students the flexibility to go deeper in multiple disciplines.

This paper will present a review of the research in various honors programs that integrate honors disciplines with the more technical disciplines of engineering and computer science, the design and development of the computer science fellows program, the partnerships required across disciplines and the university in general, and the implementation of the first year of the program. It will also document the logistical details of attaining regent approval for a new degree (Bachelor of Science in Computing, majoring in Computer Science Fellows), building consensus within the department and school leadership and faculty, and recruiting students for the program.

Introduction

Declines in computer science enrollments over the last eight years[1, 2] have caused educators to increase efforts to attract and retain students in computer science. To that end new computer science curricula and courses are being designed and implemented. Many of these new programs involve research experiences, diversity, and interdisciplinary programs. There is also a move to develop social communities of students within the computer science majors at a given university.

It has been proven that students involved in undergraduate research projects have a higher tendency to stay in computer science and as well as pursue post-graduate work.[3, 4] Likewise, research activities at the undergraduate level increase community building and a sense of belonging.[4] All of these attributes of research are important in building a successful undergraduate computer science degree program.

As important as research is to an undergraduate program, diversity is at least a close second. We have an increasing number of students who want more than just a computer science degree. They enjoy computer science but have other interests or at least want to see how computer science applies to other disciplines. Pearce and Nakazawa have reported a surge in computer science as a result of using the funnel approach.[5] The funnel approach gets students interested in computer science through secondary disciplines. We see that approach being used in a broader

sense at Baylor University and San Jose State University[6] by introducing new degree programs like Bioinformatics within the Computer Science Department. We also see gaming programs being used to attract students.

Additionally, preliminary results at Baylor University show significantly higher retention when computer science students are involved in any number of social communities. In 2002 a study was done to determine whether involvement in the Baylor student section of the Society of Women Engineers (SWE), which includes both engineering as well as computer science student members, impacted female retention.[7] Given the data and the analysis performed, there was support for the hypothesis that the proportion of SWE student members leaving the ECS program is less than the proportion of non-SWE student members leaving the program.

G.P. Peterson presented a seminar at the 2007 ABET Annual Meeting that outlined the challenges facing engineering and computer science educators.[8] He states that the challenges are enormous because we are preparing students for future jobs that may not currently exist that use technologies that have not been invented to solve problems that we don't even know exist. Peterson also says that "institutions must design degree programs – with relevant content, condensed time investment, and modified requirements – to meet the changing needs of non-traditional students". He also points out that the employers of our students will expect them not only to be "well prepared in the discipline, but also to possess ingenuity, innovation, creativity, and entrepreneurial capabilities". He states that we must develop students that are comfortable with lifelong learning.

To address a few of these challenges, the Computer Science Fellows (CS Fellows) Program was developed at Baylor University in 2008.

The Computer Science Fellows Program

The Computer Science Fellows (CSF) Program embraces Baylor's mission "to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community." To this end, the program provides an individualized academic experience for intellectually gifted, highly motivated computer science students entering the School of Engineering & Computer Science with a wide range of interests who desire a more diverse experience across the disciplines.

The program seeks to broaden Computer Science Fellows' backgrounds in their chosen area(s) of diversification while preparing them for graduate studies or for successful computer science careers. The Computer Science Fellows is a major within the School of Engineering & Computer Science where Fellows are free to create an individualized, albeit rigorous, course of study with the advice of a program director. Thus, rather than being subject to the specialized course requirements of a traditional major, Fellows are mentored throughout their undergraduate years by the CSF Director and the Computer Science Review Committee.

Admission to Computer Science Fellows Major is competitive and is separate from and subsequent to admission to Baylor University. Although the major is designed to appeal to students with high ACT/SAT scores and class rank, or National Merit designees, admission is

not based solely on scores and grades. Consideration is given to genuine intellectual curiosity and a desire to excel in computer science studies as well as achieve a broad education in the humanities. Computer Science Fellows, while being interested in computer science as a discipline, will also be interested in a wider variety of disciplines. They seek a rigorous program in Computer Science that also allows them the flexibility to study across disciplines while still being prepared for either graduate school or successful careers.

Program Organization

The Computer Science Fellows (CSF) Program is a degree plan within the Department of Computer Science. Its organization is comprised of the Director, the Fellows Review Committee, and an Honors College Advocate. In addition, as each Fellow develops their junior reading list, they will request a Computer Science faculty member to serve as their Fellows Research Advisor.

The Director of the Computer Science Fellows program is appointed by the Chair of Computer Science and approved by the Dean of the School of Engineering & Computer Science. He/she will serve at the pleasure of the Chair, with periodic reviews of the program and its execution. The Director will chair the Fellows Review Committee and oversee the CSF program, and track each Fellow's progress through their approved plan.

The Fellows Review Committee is chaired by the CSF Director, and is further comprised of the Chair of Computer Science, and one other faculty member in Computer Science. The Fellows Review Committee will oversee the program and approve each fellow's last two-year plan. The Fellows Review Committee will meet once a semester (usually at the beginning of each regular semester) to approve new Fellows, monitor the progress of the current Fellows, and review the two-year plans of Fellows being accepted into the Upper Division of the Fellows program.

During the spring semester of their sophomore year, Fellows will review their reading list with the CSF Director and make a preliminary decision on a field within computer science upon which they will concentrate their Junior readings and then their Senior research and thesis. A Fellows Research Advisor will be selected, based on the Fellow's selected area of interest. Fellows Research Advisors will be tenured or tenure-track faculty members in the Computer Science department.

The Dean of the Honors College will appoint a liaison to the Fellows Review Committee. This Honors College Advocate will assist those Fellows opting to go through the CSF program and the Honors Program concurrently. The Honors College Advocate will also meet with the Fellows Review Committee at least once a year to go over any changes in the Honors Program or the University Scholars program.

Program Structure and Policies

Admission Process

Most students enter the Computer Science Fellows Program as freshmen. A student must first

be accepted to Baylor before applying. In order to receive word by the May 1st college notification deadline, the applicant must ensure that the completed form, the required essay, and three letters of recommendation arrive in the CSF office by April 1st. Otherwise, applications will be accepted and reviewed until the beginning of the semester in which the student matriculates or transfers. The director of the program and the CS Review Committee will select all students admitted into the program.

The major is open to incoming freshmen, transfer students with less than 36 Baylor credit hours after previous school credits have transferred, current Baylor students with less than 36 v credit hours at time of application, or current students in good standing transferring from the Baylor University Scholars Program. Acceptances are made on a rolling basis, and letters of admission are sent in the month following receipt of a complete application.

Criteria for Admission

In order of priority, the following are the five criteria for admission into Computer Science Fellows:

1. Because of the great disparity in the level of secondary school programs throughout the country, primary emphasis is necessarily placed on SAT/ACT scores.
2. Class rank and GPA
3. A detailed essay stating the student's reasons for applying to the program and the applicant's planned course of study
    - The applicant should discuss how the Computer Science Fellows program will help them attain their academic and professional goals
    - This essay/plan should sufficiently detail the applicant's planned course of study over their four years at Baylor University
    - The 4-year plan should be updated as any changes occur in the applicant's planned course of study
4. Three letters of recommendation from individuals familiar with the applicant's academic record and potential for success at the university level
5. Since Computer Science Fellows are exempt from taking many of the specialized course requirements of a traditional major, the number and type of Advanced Placement or college-level courses previously taken will be considered.

Late Entries and Transfers

In order that students derive the full benefit from the program, Computer Science Fellows will not ordinarily accept students who have fewer than three years or 90 hours remaining to complete their undergraduate degree at Baylor. Computer Science Fellows are therefore generally expected to complete at least 90 hours as students within the program. Students who enter late, i.e., after their freshman year or as a transfer student with more than 36 Baylor credit hours, need to seek a special waiver to this requirement from the Program Director before they can be admitted to the program.

Maintaining Computer Science Fellows Status

Computer Science Fellows will be required to maintain a 3.5 GPA through their sophomore-level courses (including CSI 3471, "Software Engineering I", CSI 3344, "Introduction to Algorithms", and MTH 1322, "Calculus II"). Once admitted to the Upper Division of the Computer Science Fellows program (courses beyond those listed above), they must have at least a 3.25 GPA to graduate. If dismissed from the program, students must select another major and then fulfill the general requirements of the University as well as requirements for the new major.

At any time a Fellow's term and/or cumulative GPA is below 3.5 before they are admitted to the Upper Division of CSF, the CSF Director will notify the student that he or she will be placed on academic probation in the CSF program during the upcoming term. If at the end of the first probation term the student's term GPA is again below a 3.5, the student will be suspended from the CSF program. However, if at the end of the first probation term the student's term GPA is 3.5 or above but the student's cumulative GPA is still below 3.5, the student will be continued on probation within the CSF program. The same criteria for suspension, continued probation, or removal from probation will apply at the end of each succeeding semester on probation. The probation/suspension policy for the CSF program differs from the policy and procedure for Academic Probation and Suspension in the current undergraduate catalog, but does not replace the University's policy, which applies to the student's academic status in the University in general, rather than within a specific program.

The minimum GPA policies will be strictly enforced for the benefit of the student, since a Computer Science Fellow cannot be admitted to the CSF Upper Division with less than a 3.5 cumulative GPA, and cannot graduate from Baylor with a Computer Science Fellows major with less than a 3.25 cumulative average. Students at risk of not reaching the minimum GPA must therefore change majors within enough time to complete both the core curricular courses and the requirements for another major. Students who drop below a 3.25 GPA after being accepted into the CSF Upper Division will go through the same probationary review process. The decision to remain in or resign from the program will rest with the Fellows Review Committee and the student's research advisor.

Course Load

Fellows will demonstrate their love of learning through consistent coursework. The highest ranked graduate and professional schools consider not only grades and test scores but also the quality of courses and the number of hours completed per semester. Therefore, in order to enhance their academic profile, Computer Science Fellows are expected to take a minimum of 15 hours each semester, unless they petition for and are granted an exemption from the CSF Director prior to registration for the following semester. Computer Science Fellows are never allowed to take courses on a pass/fail basis, with the exception of HP courses.

Academic Majors and Minors

Computer Science Fellows may not declare an additional major, but may have academic minors. They graduate from Baylor with a Bachelor of Science in Computing degree with a Computer Science Fellows major. Nevertheless, Fellows may fulfill the regular requirements of one or more majors in order to state that they hold the equivalent of that major. With the assistance of

the CSF Director, Fellows should carefully plan their course of study in order to reflect their academic interests and career goals.

Computer Science Fellows Requirements*

The BSC with a major in Computer Science Fellows degree has the following course requirements:

- REL 1310 and 1350
- Two semesters of Chapel
- MTH 1321, 1322, 2311
- Eight semester hours of science courses with associated labs chosen from among Biology, Chemistry, Geology, Neuroscience, or Physics. Each course must apply to a major in its department.
- STA 3381
- Computer Science courses:
    - CSI 1430, 1440, 2334, 2350, 3334, 3344, 3471
    - 5 additional upper-level CSI courses
- CSF 3101, "Independent Readings I," and 3102, "Independent Readings II," junior independent readings courses
- CSF 3001, "Independent Reading Survey," an exit survey to summarize a student's independent readings, and ascertain readiness for the senior thesis
- CSF 4v01, "Research/Fellows Thesis I," and 4302, "Fellows Thesis" (presentation in the annual ECS Scholar's Day is mandatory for the fulfillment of CSF 4302)
- CSI 4001, "Senior Exit Survey," the exit survey for all Computer Science graduates
- Completion of 124 hours, including 36 hours of "3000"-"4000" level credits
- The requirement for advanced credit, residence, chapel, and maximum credit are the same as for the Bachelor of Science in Computer Science degree.
- Additional information about requirements is listed under the "General University Regulations." Computer Science Fellows cannot declare additional majors. Committee approval is required for graduation.

* Students who enter the CSF program after the fall of their freshman year should meet with the CSF Director to discuss how best to complete the required courses.

CSF Four-Year Plan

After initial acceptance into the CSF program, Fellows must complete their first four-year plan. This should happen sometime after completing 15 semester hours of work at Baylor and before completing 30 hours. After their initial 4-year plan is developed and approved by the Fellows Review Committee, each Fellow will review their 4-year plan with the CSF Director every semester. If any changes are needed in the plan, a new plan must be developed and approved by the Fellows Review Committee. In particular, during the spring semester of the sophomore year but prior to admittance to the Fellows Upper Division, each Fellow must revise their 4-year plan to reflect their remaining 60 hours.

The Independent Reading List (Freshman through Junior Year)

Fellows will select a number of texts that they will read on their own during the first three years of the program. The first two years, the Fellows reading list will be approved by the CSF Director. During the spring of their sophomore year, in preparation for their junior year and admittance to the Fellows Upper Division, Fellows will develop a junior reading list with the help of a Fellows Research Advisor. This list should reflect the research interests of the Fellow, and may include texts, white papers, journal articles, or other scholarly material approved by their Research Advisor. The resulting list will comprise the requirements for the registration in both CSF 3101, "Independent Readings I," and CSF 3102, "Independent Readings II". If Fellows wish to make changes subsequent to the approval of their Junior Reading list, they must submit a new list and have it signed by their Research Advisor and the CSF Director.

Computer Science Fellows Upper Division

During the spring semester of their sophomore year, Fellows must officially apply for admission to the Upper Division of the Computer Science Fellows program. The requirements for Upper Division admission are:

- Maintenance of 3.5 cumulative GPA during previous semesters
- Submission of updated CSF Four-Year Plan, updated to reflect changes to the Fellow's last 60 hours, along with a copy of their current degree audit
- The approved Junior reading list and assigned Fellows Research Advisor

The Junior Readings Interview (Spring of Junior Year)

Fellows must register to take CSF 3001, "Independent Reading Survey" during the spring semester of their junior year. In this interview they will demonstrate their knowledge of the texts on their reading list in an Exit Interview, which generally lasts from 45 minutes to one hour. The interview committee will consist of the CSF Review Committee and the Fellow's Research Advisor.

Junior Readings Interviews will take place during the last month of the spring semester of the Junior year (or during the last month of the semester in which they are enrolled in CSF 3001). Fellows must register for the interview (CSF 3001) along with the other courses they will take during the semester in which they plan to do the interview, leaving one year to complete their senior research and thesis.

To schedule the junior readings interview, Fellows should contact the CSF Director one month ahead of the time their desired interview date and time. For most students this contact will take place in the second month of the spring semester of their junior year.

The Senior Thesis (Fall of Senior Year)

For their Senior Thesis, Fellows will register for CSF 4v01, "Research/Fellows Thesis I". They will work with their Research Advisor to determine the scope of work required in CSF 4v01, so the Fellow will be ready to register for CSF 4302, "Fellows Thesis," during the spring semester of their senior year. The research done in the fall, and the completion of the thesis in the spring

of the senior year can be independent work conducted with their Research Advisor, but can also be an extension of one of the Senior Capstone projects available to all Computer Science majors. In partial fulfillment of the requirements of CSF 4302, all Fellows will present their thesis during the annual ECS Scholar's Day, even if their work is not yet complete.

The Fellow's Research Advisor will direct the thesis. In addition, Fellows must invite a second professor in that field as well as a third professor outside of that field to serve as readers. In the spring of the junior year, Scholars register for CSF 4v01 to be taken in the fall of the senior year. A detailed outline, the first chapter of the thesis, and a bibliography must be submitted to the research advisor and the CSF Director at the end of that semester. In the fall of the senior year, students register for CSF 4302 to complete the thesis in the spring.

A complete draft of the thesis must be turned in to the research advisor and readers by April 1st. After this draft has been read by the three faculty members, students must present themselves before them for a formal defense of their thesis. Thesis defenses will take place between April 5th and April 15th. As with the Exit Interview, students are responsible for arranging the date and time of their defense. A final copy of the thesis including all additions and corrections recommended by the faculty is due to the CSF Director no later than April 30th. For students graduating in December, a completed thesis must be turned in by November 1st with the defense scheduled between November 5th and November 15th. A final copy is due before December 1st.

Fellows must complete and defend a thesis in order to graduate from Baylor Universtsiy. Without successful completion of the thesis, a Fellow will not be permitted to graduate from the program, even if all other required courses have been completed.

Fellows in the Honors Program fulfill the CSF thesis requirement by completing the Honors Thesis and should coordinate their thesis preparations with the Honors Program Office.

Computer Science Fellows and Other Programs

Computer Science Fellows are also encouraged to participate in the Honors Program or the Baylor Interdisciplinary Core (BIC). However, Computer Science Fellows enrolled in BIC must fulfill the core requirements of that program. Those requirements include a lab science course, a mathematics course, and two hours of Human Performance in addition to the BIC courses. Since the BIC is a separate program, completion of BIC requirements is the responsibility of the student with the assistance of the BIC advisors. The CSF director, however, will make every effort to assist with BIC compliance. Computer Science Fellows in BIC should meet with their BIC advisors each semester to determine that their BIC requirements are being met. Similarly, fulfillment of Honors Program requirements is the responsibility of the student, with the assistance of the Honors Program advisors.

Summary

The Computer Science Fellows Program is in its infancy, with only three students currently enrolled. Without exception, these students are fulfilling the degree requirements for a Bachelor

of Science in Computer Science degree, with two of them focusing on the Gaming and Simulated Environments track. Despite the fact that the degree is not accredited by ABET (due to the lack of specificity in the CS Fellows requirements), it is anticipated that CS Fellows, because of their drive and potential, will have transcripts that would satisfy ABET.

We plan to track all CS Fellows through graduation, conducting a longitudinal study in the future.

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