UNDERGRADUATE RESEARCH INITIATIVE: MATHEMATICS AND COMPUTER SCIENCE DEPARTMENTAL PROPOSAL

Revised March 17, 2009

1. Background

Since 1960 the faculty of the Department of Mathematics (now Mathematics and Computer Science) has been mentoring undergraduates on summer research projects. These projects provide invaluable experience for our majors, positioning them well both for graduate studies and for careers in industry. Many of these research projects (close to 60) have resulted in published papers. Between 1960 and 1980 these projects were funded in part by the National Science Foundation, funding which included a stipend for faculty. During these years, the number of resulting published papers averaged 1-2 per year. In the late 80's the NSF shifted funds away from this type of undergraduate research grant, and the department lost support for faculty stipends. As a result, the student publication rate dropped by a factor of 2; however, faculty continued to volunteer time during the summer to engage our strongest majors in research, relying on the department's own Pennello Fund (set up initially by an alumnus of the department) to provide a stipend for the students. In recent years, the Department has had from 2 to 4 student research projects per year. In light of recent trends and the increased public awareness of the benefits of undergraduate research, the Department expects to see a further increase in the number of interested students.

The nature of undergraduate research in mathematics and computer science places uncharacteristic demands on both faculty and students for the following reasons. First, the projects are self-contained and usually do not contribute directly to the faculty member's primary research program. Finding a problem that has not been solved, yet is of sufficient interest to the academic community is already a challenge for faculty members' own projects; but adding to that the need for the problem to be accessible and solvable by an undergraduate is even more difficult. Second, the background, context, and relevant methods for these problems are usually at a level typical for a graduate student. Bringing an undergraduate student up to speed requires both concentrated individual study on the part of the student and intensive one-on-one contact with the faculty mentor. Students typically spend upwards of 4 hours each day working on their own, and spend anywhere from 1 to 3 hours per session with their faculty mentor.

It is because of this necessity for students and faculty to have large blocks of time to work that these research projects take place primarily during the summer. Since summer is also

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the time that faculty are expected to accomplish much of their own research, the commitment to work with a student or students during the summer has a negative impact on the faculty member's own scholarship. The goal of this proposal is to reward faculty for engaging in student research projects by giving teaching credit to faculty who work with students on high-quality research projects (that have the potential to lead to publication). Ideally, these credits will allow faculty to mentor more student projects and free up additional time during the academic year for faculty to pursue their own scholarship.

2. Description and Proposed Implementation

As part of the Undergraduate Research Initiative, the Department of Mathematics and Computer Science will award teaching credit for mentoring student research projects. The mentoring process for faculty-guided student research projects will take a variety of different forms, but all such projects will require dedicated time on the part of the student(s) as well as significant contact time with the faculty mentor. Typically, the bulk of the research work will be during the summer, but projects during the academic year that meet the qualifications described below will also be considered.

Eligibility and expectations. All tenured and tenure-track faculty in the Department are eligible to participate. Each is responsible for recruiting students, developing the project, mentoring the student(s), and guiding the student(s) through the writing and presenting stage.

Qualifying projects. The type of project that this proposal targets is one in which:

- the topic or problem has the potential for original, publishable results, and
- the student or students are able to understand the project and its context well enough to contribute in a meaningful way.

Project approval/selection. Prior to the start of any project, a one-page project description will be submitted to the Department Chair for approval. The description will include enough detail for the Chair to determine whether the two criteria above are met. In addition, the student name(s), estimated expenses (including student stipends), and estimated total contact hours will be provided. In the event that there are more qualifying projects than available funds, the Chair will use his/her discretion to select the best projects (this can either be done informally by consulting with faculty or by appointing a committee to review the proposals).

Project requirements. Before teaching credit will be awarded to the faculty mentor, student(s) must do both of the following:

1. Enroll in and complete a 1-2 unit Undergraduate Research course MATH/CSCI 192 taught by the faculty mentor during one quarter of the academic year, **and**
2. Demonstrate progress on the project in the form of an article, a presentation at a conference (or the departmental colloquium series), or a poster at a regional meeting or on-campus event.

The precise format and content of the MATH/CSCI 192 course will depend on the project, but two typical scenarios will be:

- The MATH/CSCI 192 course will be offered in the spring *prior to the summer work* to introduce relevant material and bring the student(s) up to speed on the topic. Then during the following academic year, the student will present the results of the project in the form of an article, talk, or poster.
- The project will begin during the summer and then be followed by a MATH/CSCI 192 course in the fall (or winter). In this case, the focus of the 192 course would be to finalize the project and work on the final article, talk, or poster.

Earning credit. Upon completion of the MATH/CSCI 192 course and demonstration of progress, teaching credit will be awarded as follows.

- 30 hours of contact with a student or students on an approved research project will earn 1/4 of a course credit. 60 hours of contact with a student or students on an approved research project will earn 1/2 of a course credit. Meeting with more than one student simultaneously counts the same as meeting with one student. Contact hours will include the MATH/CSCI 192 course.
- A faculty member cannot accumulate more than 1/2 course credit per qualified project, and cannot accumulate more that 1/2 course credit in one annual cycle. The annual cycle will begin in the spring and end the following winter.
- No more than four projects (for the entire Department) will be approved for course credit in any given annual cycle.
- Faculty can bank earned credit up to a maximum of 2 full courses. These can be held indefinitely.

Redeeming credit. Once a faculty member has accrued a full course credit, he or she may apply it toward his or her usual teaching load. (With the Chair's approval, faculty who have earned 1/2 course credit for undergraduate research and who have accumulated 1/2 course credit or 1/2 course release for other activities, may combine the two.) No more than one full course credit may be redeemed per faculty per academic year, and in some instances, the Chair may delay the course credit in response to departmental teaching needs.

3. Impact on Section Targets

In recent years, the number of projects in the Department that fall within the scope of this proposal has averaged about 2 per year. With the limits set above, the number of approved projects would never exceed 4 (although, a faculty member may still opt to mentor a student without getting teaching credit). We would therefore expect between 1 and 2 course credits earned per year. Ideally, we would ask that the Department's annual section targets be increased by one course to help compensate for this credit. Any remaining teaching credits could then be managed by using the Chair's discretion in cancelling and combining sections based on enrollment variations. For example, certain classes that we offer every year (Math 103, Math 166) are occasionally under-enrolled, and might be postponed to the following year. Alternatively, combining two sections of calculus with low enrollment might also free

up a section. Although neither of these options is ideal, rewarding and recognizing the work faculty put into student research is a priority for the Department.

4. Participating Faculty

All tenured and tenure-track faculty in the Department are eligible to participate.

Faculty CV's can be provided upon request. The attached publication list shows most of the Department's student publications over the past 45 years.

5. Timeline

Since it will take at least two years before a single course credit could be earned, and since the number of projects will vary depending on qualified students and faculty availability, we believe extending the proposal period to at least 3 years will give the best indication of long-term viability.

6. Budget and Justification

The proposal solicitation allows for a budget request of up to $\$15,000$. We are requesting this full sum (spread over the proposed 3-year period) to provide additional summer stipends for students, to provide software or other equipment needed for the projects, and to provide funds for student travel to regional conferences to present their work. Currently, the Department uses its own Pennello Fund to provide student stipends. This fund relies on donations and has seen a decline in recent years (and we anticipate a further decline in the near future). The funds provided by this grant would expand our present capacity to provide student stipends during the summer.