NAME OF SCHOOL OR DEPARTMENT:
Mathematical, Information and Computer Sciences (MICS)
Note that much of this proposal is for an interdisciplinary minor that has been developed in partnership with Biology, Chemistry and Physics/Engineering

ACTION ITEMS/SUBSTANTIVE CHANGES INCLUDE: addition/deletion of courses, additions/deletions of a major, changes in degree requirements and changes in general education requirements.

I. List proposal(s) with a one line abstract (examples):

Proposal I: To add a minor in Computational Science. This minor will allow students to emphasize any one of the following areas: Biology – Genetics, Biology – Environmental Science, Chemistry or Physics.

Proposal II: To add CSC302 (2) UNIX and Python Scripting for Computational Science

Proposal III: To add CSC311 (1) MATLAB for Computational Science

Proposal IV: To add CSC322 (2) Introduction to Databases for Computational Science

Proposal V: To revise the course and change the course description for ISS414 (4) Database Management Systems to include topics connected with computational science.

Proposal VI: To add CSC302 (2) UNIX and Python Scripting for Computational Science and CSC311 (1) MATLAB for Computational Science to the list of elective courses for the BS and BA in Computer Science.

Proposal VII: To add CSC311 (1) MATLAB for Computational Science to the list of elective courses for the BS and BA in Mathematics.

II. Rationale: Each proposal needs thorough explanations as to why the change is being suggested. Please answer the following questions in your rationale and include other appropriate reasons in this section.

1. How has assessment data informed the proposed change and how recently has your department or school completed a program review? For example, have alumni, outside reviewers, etc., suggested improvements?

Our department completed a program review in the fall of 2010. MICS was the department which piloted the new Program Review (the links to our program review can be found on our home page www.pointloma.edu/mics). Phase I of the Program Review can be found at:

https://portal.pointloma.edu/web/mathematical-information-and-computer-sciences/programreviewi and Phase II of the Program Review can be found at: https://portal.pointloma.edu/web/mathematical-information-and-computer-sciences/programreviewii. These two documents are web based and thus all the appendices are linked into the body of the document at the appropriate locations. The review involved a complete curriculum review and the involvement of all faculty, as well as participation by students and alumni. The program review also contains the comments of two external reviewers and the department's response to those comments.

As the result of that Program Review we:

- Proposed several curricular revisions in our department (which were approved)
- Proposed a minor in Computational Science, but also indicated that further discussion among the faculty in the science building would be necessary before a completed proposal could be brought forward. Thus we indicated that the proposal for a minor in Computational Science would be submitted in the fall of 2011.
- As part of our curricular revision in 2010-11 we reduced department load by 6.5 units per year to create space for this minor. Provost Kerry Fulcher agreed to allow us to "reserve" those units for this proposal (see 2010-11 submission for complete details).

Department of Labor statistics show the Computational Science is one of the fastest growing areas of employment. The premise of Computational Science is that much of the current scientific research (particularly that done in industrial settings involving biotechnology, nuclear power and national security) are done by interdisciplinary teams. The premise is that each member of the team is an expert in their field of study but is sufficiently conversant with the other disciplines of their team members to be able to function effectively in a team. For example, much of the current work on the human genome involves pattern matching. To do this work effectively, there needs to be a team member with knowledge of genetics and a team member with knowledge of computational techniques including database management and pattern matching.

The minor is designed to allow MICS students (Computer Science and Mathematics) to gain limited knowledge in one of Biology, Chemistry or Physics to be able to help scientists with the computational needs in their research. In a similar way the minor is designed to expose Biology, Chemistry and Physics majors to enough computational techniques to help them identify when a Mathematician or Computer Scientist could help with their research. The capstone of the minor requires students to complete an interdisciplinary team project which will involve pairing MICS students with science students to work on a joint project.

As is indicated below, the minor is designed to leverage coursework that students are already taking and to strengthen their knowledge of a complimentary discipline.

It should also be noted that all of the departments in the Science Building submitted a joint grant proposal to strengthen interdisciplinary learning in the science to the Howard Hughes Medical Institute. We will not know for some time if the grant will be awarded.

2. What are comparable universities and colleges doing?

Proposals I-V: Based on extensive research we have found that have both majors and minors in Computational Science, but the programs that appear to be the most successful are minors. PLNU is a perfect institution for building an interdisciplinary Computational Science minor

because of the long history of collaborative work among all departments in the Science Building.

It should be noted that the external reviewers for our Program Review were very favorable about the move to add a minor in Computational Science.

*Proposal V:*The small modification of content in ISS414 to include Computational Science tools and topics is consistent with the guild standards (ACM Association of Computing Machinery) for database classes.

Proposal VI-VII: Adding these courses as electives to the majors is consistent with guild standards.

3. Is the change related to stipulations imposed by outside accrediting agencies (addressing standards, etc.)?

Proposals I-VII: The proposed changes are consistent with guild standards. The design of the minor is the result of more than two years of research into successful programs and the skills that local employers are seeking. Lori Carter's sabbatical this Fall (2011) is focused on detailed course development of the new courses for this minor and building relationships with local companies to facilitate internships or research opportunities for the Computational Science minors.

4. How does the proposed change relate to the mission of the university?

Proposals I-VII: The addition of this minor provides new ways for our students minds to be "engaged and challenged" and is strengthens our commitment to interdisciplinary learning and interdepartmental collaboration.

The addition of the minor as well as the program that we hope to have funded by the Howard Hughes Medical Institute will also expand interdisciplinary research among the faculty.

5. How does the change accommodate the department or school's learning outcomes for the major, minor, concentration, etc.? For instance, does the change help balance out the curriculum, or does it fill in a missing gap that would help strengthen the program? Does it add breadth or depth, etc.?

Proposals I-VII: This proposal adds another opportunity for the students in the Science Building to broaden their scientific knowledge and gain skills that are valuable to employers. It is typical for students in the Science Building to combine a major in one department with a minor in another or to double major. It is anticipated that this will increase the number of students who study across disciplines. It may reduce by a small amount the number of Biology, Chemistry, Physics, and Physics/Engineering students who minor in Mathematics or Computer Science. However based on conversation among faculty in the building, particularly for Chemistry and Physics students, there are some circumstances in which the educational goals of the students will be better served by minoring in Mathematics or Computer Science.

6. What impact will it have on the size of the major, minor, etc.?

Proposals I-V: This will add a new minor, but it will require the creation of only 5 units of new

coursework to build the minor. The rest of the minor comes from existing courses. MICS freed up those five units in our most recent curriculum revision.

Proposals V-VII: These changes will not change the size of the majors to which they are connected.

7. Will the change(s) be sustainable with human and financial resources?

Proposals I-IV: Yes, as indicated above. Part of the MICS Program Review and APC proposal in 2010 was to reallocate human resources to make this possible. There will be a limited amount of computers and software required to support faculty and student Computational Science research, but the MICS Department has raised the necessary funds to purchase those items (less than $8000).

Proposals V-VII: There is no human or financial resource implications of these changes.

8. State other rationale that you deem appropriate.

Proposals I-VII: This minor leverages many of the classes that the students need to take for their major and it makes use of specific GE course selections. To see how this is accomplished see the table below The catalog description for an analysis of the impact in each major.

III. Tentative Syllabus/Course Learning Outcomes: If you are proposing new courses, please include a tentative syllabus with course learning outcomes. This should not include textbooks, calendar, etc., but merely an idea of what the course content will include as well as what you hope the student will accomplish by the end of the course. **State four course learning outcomes at the most.**

Syllabus:
CSC302 (2) UNIX AND PYTHON SCRIPTING FOR COMPUTATIONAL SCIENCE

Background:
Students will have had one semester of basic computer programming before taking this course. The focus of the course is on working with data in various formats using tools that are widely used in computational science applications (this comes from research in the industry).

Outcomes:
Students will:

- become competent users of the UNIX operating system.
- be able to find and manipulate data from various file formats (including text, FASTA, HTML, XML) using regular expressions with UNIX and Python scripts.
- use Python for data analysis and for more specialized purposes using third party modules including NumPy, BioPython, and Tkinter.

Syllabus:
CSC311 (1) MATLAB FOR COMPUTATIONAL SCIENCE

Background:
MATLAB is a commonly used tool for numerical computation and data visualization. The Physics and Engineering department teaches the use of this tool to their freshmen. However, they use that class as a way to build relationships among their freshmen cohort and after conversation it became clear that it would interfere with the pedagogical purpose of that class to make if available to all computational science students. Before taking this class students will have had one semester of programming. That is important because the logic involved in writing computer code is the same as the logic needed to write commands in MATLAB.

Outcomes:
Students will:

- be able to use MATLAB for numerical computation, visualization and data analysis on data generated in scientific research.
- be able to select the appropriate tool from the MATLAB toolboxs to solve specific problems.

Syllabus:
CSC322 (2) INTRODUCTION TO DATABASES FOR COMPUTATIONAL SCIENCE

Background:
Computer Science and Computer Information Systems majors take a four unit class on databases (ISS414). This course depends on significantly more programming experience than can be acquired by taking one semester of computer programing. CSC322 has been designed as an alternative to ISS414 for Computational Science minors from disciplines other than CS and CIS. Before taking this class, students will have completed CSC302 UNIX and Python Scripting for Computational Science.

Outcomes:
Students will:

- learn to design, create, and query relational databases using the MySQL DBMS and SQL query language.
- be able to access and use popular science-related databases and analysis tools (including BLAST)
- be able to access these databases and tools using Python scripts and web-based gateways.

IV. Catalog Copy: What will these changes look like in the catalog?

1. If proposing to substitute new courses for old ones, **list old and new course descriptions side by side.**
2. State with precision what a new major, concentration, minor will look like.

    - Keep in mind academic policies with regard to number of units for major, minors, etc. See resource section at the end of this template.

Catalog Description for Minor Students must take the following classes and then select one of the four emphases listed below MTH144 (4) Calculus with Applications (GE) OR MTH164 (4) Calculus I (GE)	4 units
MTH362 (2) Calculus Based Statistics OR MTH382 (2) Mathematical Statistics	2 units
CSC143 (3)	3 units
CSC302 (2) UNIX and Python Scripting for Computational Science	2 units
CSC311 (1) MATLAB for Computational Science OR ERG120 (1) Computational Methods for Engineers and Scientists II	1 unit
CSC322 (2) Introduction to Databases for Computational Science OR ISS414 (4) Database Management Systems	2-4 units
Capstone Experience: HON498 (2) Honors Seminar I and HON499 (1) Honors Seminar II OR MTH496 (2) Service Learning in Mathematics I and MTH497 (1) Service Learning in Mathematics II OR CSC496 (2) Service Learning in Computer Science I and CSC497 (1) Service Learning in Computer Science II OR Phy*** (2) Physics capstone	2-3 units
Pick one area of Emphasis: <u>Biology – Environmental Science Emphasis</u> BIO211 (4) Ecological and Evolutionary Systems – GE status change being submitted by Biology to APC BIO360 (3) Ecology	7 units
<u>Biology - Genetics Emphasis</u> BIO210 (4) Cell Biology and Biochemistry - GE BIO345 (4) Genetics	8 units
<u>Chemistry Emphasis</u> CHE153 (4) General Chemistry I - GE CHE153 (4) General Chemistry II CHE213 (3) Analytical Chemistry (Required for Mathematics or Chemistry	

majors completing a Computational Science Minor with a Chemistry Emphasis, Recommended for all others) CHE325 (5) Physical Chemistry I (Required for Mathematics or Chemistry majors completing a Computational Science Minor with a Chemistry Emphasis, Recommended others)	8-16 units
<u>Physics Emphasis</u> PHY241 (4) University Physics I (GE) PHY242 (4) University Physics II PHY304 (4) Modern Physics (Required for Physics or Mathematics majors who choose the emphasis, required for all others)	8-12 units
Total	23-32 units (see grid below)

Major	GE Classes	Classes in Major	Additional Classes for Minor
Biology Bio-Chem Env Science	MTH144 (4) BIO210 (4) or BIO211(4)	MTH362 (2) BIO360 (3) or BIO345 (4)	CSC143 (3) CSC302 (2) CSC311 (1) CSC322 (2) Capstone (3)
	8 units	5-6 units	11 units
24-25 units total for the minor, 11 units distinct from the major, 13-14 upper division units			
Chemistry	MTH164 (4) CHE152 (4)	CHE153 (3) CHE213* (3) CHE315* (5)	MTH362 (2) or MTH382 (2) CSC143 (3) CSC302 (2) CSC311 (1) CSC322 (2) Capstone (3)
	8 units	11 units	13 units
32 units total for the minor, 13 units distinct from the major, 15 upper division units (additional chemistry that is required by the major added so that the total upper division units exceed 12).			
Computer Science or Computer Information Systems	MTH164 (4) BIO210 (4) or BIO211(4) or CHE152 (4) or PHY241 (4)	CSC143 (3) ISS414 (4) Capstone (3)	MTH382 (2) CSC302 (2) CSC311 (1) Second science course (3-4)
	8 units	10 units	8-9 units
26-27 units for the minor, 12-13 units distinct from the major, 12-16 upper division units (depending on science selected).			
Mathematics with Biological Emphasis	MTH164 (4) BIO210 (4) or BIO211(4)	CSC143 (3) MTH382 (2) Capstone (3)	CSC302 (2) CSC311 (1) CSC322 (2) BIO345 (4) or BIO360 (3)
	8 units	8 units	8-9 units
24-25 units for the minor, 12-13 units distinct from the major, 13-14 upper division units.			
Mathematics with a Chemistry Emphasis	MTH164 (4) BIO210 (4) or BIO211(4) or CHE152 (4)	CSC143 (3) MTH382 (2) Capstone (3)	CSC302 (2) CSC311 (1) CSC322 (2) CHE213 (3) CHE315 (5)
	8 units	8 units	13 units
31 units for the minor, 13 units distinct from the major, 15 upper division units (note that the additional chemistry is listed to raise the total of upper division units above 12).			
Mathematics with Physics Emphasis	MTH164 (4) PHY241**(4)	CSC143 (3) MTH382 (2) Capstone (3)	CSC302 (2) CSC311 (1) CSC322 (2) PHY242** (4) PHY304** (4)
	8 units	8 units	13 units
31 units for the minor, 13 units distinct from major, 14 upper division units (PHY304 added to raise the total number of upper division units above 12, also note that PHY241 is required by the mathematics major).			
Physics and Physics Engineering	MTH164 (4) PHY241(4)	PHY242 (4) PHY304*** (4) Physics Capstone (2) EGR120 (1)	CSC143(3) CSC302 (2) CSC322 (2) MTH382 (2)
	8 units	11 units	9 units
28 units for the minor, 9 units distinct from the major, 12 upper division units (PHY304 which is required by the Physics major, is added to bring the total number of upper division units above 12).			

Old Descriptions	New Descriptions
N/A new class	CSC302 (2) UNIX AND PYTHON SCRIPTING FOR COMPUTATIONAL SCIENCE An introduction to UNIX and Python scripting in the context of applications to scientific research. Students will become competent users of the UNIX operating system. They will learn to find and manipulate data from various file formats (including text, FASTA, HTML, XML) using regular expressions with UNIX and Python scripts. They will learn to use Python for data analysis and for more specialized purposes using third party modules including NumPy, BioPython, and Tkinter. *Prerequisite CSC 143 with a grade of C- or better.* Note that to make the minor flexible for students, this class will be taught annually.
N/A new class	CSC311 (1) MATLAB FOR COMPUTATIONAL SCIENCE MatLab will be introduced as a tool for numerical computation, visualization, and data analysis in science-related research. Various toolboxes will be explored. Students will gain experience in selecting and using the appropriate tool for the job. *Prerequisite CSC 143 with a grade of C- or better.* Note that to make the minor flexible for students, this class will be taught annually.
N/A new class	CSC322 (2) INTRODUCTION TO DATABASES FOR COMPUTATIONAL SCIENCE An introduction to databases in the context of scientific research. Students will learn to design, create, and query relational databases using the MySQL DBMS and SQL query language. They will become familiar with popular science-related databases and analysis tools (e.g. BLAST) and gain experience accessing them using Python scripts and web-based gateways. *Prerequisite Computer Science 302* Note that to make the minor flexible for students, this class will be taught annually.

Old Descriptions	New Descriptions
ISS 414 (4) DATA BASE MANAGEMENT SYSTEMS An introduction to database management systems covering data models (including relational, network, hierarchical, and object oriented), relational databases, query languages, relational database design, transaction processing, distributed databases, and physical database design. Offered 2011-2012. *Prerequisite: Computer Science 153.*	ISS 414 (4) DATA BASE MANAGEMENT SYSTEMS An introduction to database management systems covering data models (including relational, network, hierarchical, and object oriented), relational databases, query languages, relational database design, transaction processing, distributed databases, and physical database design. Students will see examples from both business and science. They will become familiar with analysis tools associated with scientific databases (e.g. BLAST) and gain experience accessing databases using Python scripts and web-based gateways. Offered 2011-2012. *Prerequisite: Computer Science 153.* Alternating year class.

V. Recorded Department/School Vote:

Please state the number and percentage of department school faculty who voted for the proposal. If other departments are affected, please inform the committee how those departments voted.

This proposal was developed collaboratively with all the academic departments in Rohr Science.

VI. Library Impact:

What new library acquisitions, if any, will be needed to support the proposed changes? (If none, please state that.)

None.

VII. Technological Impact:

What new software, hardware or additional lab space will be needed to support the proposed changes? (If none, please state that.)

We expect to need to purchase on research server (a computer) that can be shared by faculty and students in the department. We will also need a limited amount of software for visualization and at least one more MATLAB license. As mentioned above, MICS has already raised the needed funds to purchase these materials.

VIII. Final Summary: Review course and staffing impact with your College Dean.

Total course additions: 3

Total course deletions: 0

Total unit additions: 5

Total unit deletions: 0

Rotation of courses or deletion of sections to accommodate additions:
As mentioned above, the MICS Department freed up 6.5 units per year in faculty load to support this project. This is within that amount and it allows the department 1.5 units per year of "wiggle room" to accommodate increased in sections of classes to support this program or the needs of various department that we serve (e.g. we are working with the School of Business to change the timing on when student take MTH123 and that means that for one year, we will need to have an additional section of MTH123 to accomplish this transition).

Staffing impact/increase or decrease:
None, we had the units of staffing to cover this.

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