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## Proposal to the Senate Educational Policy Committee

**PROPOSAL TITLE:** Revision the Core Curriculum of the Campus-Wide Master of Science (M.S.) in Bioinformatics Program.

**SPONSOR:** Gustavo Caetano-Anollés, Professor of Bioinformatics; Chair, M.S. in Bioinformatics Steering Committee, Illinois Informatics Institute; 333-8172, [gca@illinois.edu](mailto:gca@illinois.edu)

**COLLEGE CONTACT:** Allison McKinney, Director, Academic Programs, Policy and Academic Services, Graduate College, 333-0035, [agrindley@illinois.edu](mailto:agrindley@illinois.edu); Karin Readle, Education Coordinator, Illinois Informatics Institute, 244-1220, [kereadel@illinois.edu](mailto:kereadel@illinois.edu)

### BRIEF DESCRIPTION:

We are requesting a curriculum revision of the major core course requirement of the campus-wide M.S. in Bioinformatics program. The core demands fulfillment of four (4) hours of coursework in each of three core areas of the broad field of bioinformatics: (i) bioinformatics, (ii) biology, and (iii) computer science. The five accepted operating concentration options of the M.S. program currently contribute coursework in these three core areas (Appendix A). However, only two courses currently satisfy the needs of the computer science area, CS 411 Database systems and CS 473 Fundamental Algorithms. Here we are requesting inclusion of additional courses to this core area, which we are relabeling 'computer science and informatics', to satisfy current academic demands in bioinformatics. We are also updating course titles and removing courses that have been discontinued. Except for these changes, the number of hours required have not been changed.

### JUSTIFICATION:

The M.S. in Bioinformatics Steering Committee has identified the need to alleviate important shortcomings of the computer science core area of the program. First, seat reservations in the only two courses currently listed in this area are often unavailable to the students of the five different campus-wide options being offered. Both of these computer science courses are very popular and students complain about gaining access to them. Second, bioinformatics has expanded substantially on campus, including new initiatives on 'big data', new bioinformatic research programs across campus, substantive increases in computational resources (e.g. Blue Waters, Xsede) available for teaching, and

expanding initiatives in medical informatics. This diversity of interests and resources is not reflected in the computer science core area of instruction of this program, which only stresses databases and algorithms. The additional courses will enhance the diversity of offerings in this core area of study.

The area of bioinformatics is changing at very fast pace, incorporating fields that were not originally sought when designing this program almost a decade and a half ago (Sahinidis et al. 2005), including molecular dynamics, medical informatics, integrative data mining, and synthetic biology, to name just a few. Many students pursuing thesis research across campus under the M.S. in Bioinformatics program often inquire about the possible substitution of courses with a goal of strengthening their learning experience and matching coursework with their individual research program. At present, this is not possible. We are requesting a mechanism that would allow the M.S. in Bioinformatics Steering Committee to evaluate these substitution requests, case-by-case, and the possible inclusion of additional courses in the program's core course requirement. Recommendations made by the Steering Committee would only require approval from Graduate College before their implementation.

This mechanism was already anticipated in the umbrella proposal that jumpstarted this campus-wide program: *“As the discipline of bioinformatics is rapidly evolving and diverse, degree options offered by other units may involve different requirements in terms of numbers of units, thesis options, practical training, and design or research experiences. The common requirements for all options are that they: (a) satisfy the minimal Graduate College requirements for M.S. degrees; (b) include an acceptable number and type of the required bioinformatics core courses; (c) include requirements for a thesis or research experience on a bioinformatics topic performed under the direction of a faculty member affiliated with the bioinformatics program; and (d) be approved by the Steering Committee and the Graduate College as described in the umbrella proposal. The latter requirement will ensure a common core, maintain program quality, and avoid duplication among options.”*

The goal of this request fulfills the need to maintain quality education in a highly dynamic field.

Sahinidis NV, Harandi MT, Heath MT, Murphy L, Snor M, Wheeler RP, Zukoski CF (2005) Establishing a master's degree programme in Bioinformatics: challenges and opportunities. *IEEE Proc. Syst. Biol.* 152 (4), 269-275.

**BUDGETARY AND STAFF IMPLICATIONS:** *(Please respond to each of the following questions.)*

1) Resources

- a. How does the unit intend to financially support this proposal?

The additional suggested courses are currently part of the elective body of courses. The inclusion of those courses in the computer science core will not represent a financial burden.

- b. How will the unit create capacity or surplus to appropriately resource this program? If applicable, what functions or programs will the unit no longer support to create capacity?

Not applicable.

- c. Will the unit need to seek campus or other external resources? If so, please provide a summary of the sources and an indication of the approved support.

No investment of resources is needed.

- d. Please provide a letter of acknowledgment from the college that outlines the financial arrangements for the proposed program.

None provided since the change does not have financial implications to the program.

## 2) Resource Implications

- a. Please address the impact on faculty resources including the changes in numbers of faculty, class size, teaching loads, student-faculty ratios, etc.

Not applicable.

- b. Please address the impact on course enrollment in other units and provide an explanation of discussions with representatives of those units.

Not applicable.

- c. Please address the impact on the University Library

Not applicable

- d. Please address the impact on technology and space (e.g. computer use, laboratory use, equipment, etc.)

Not applicable.

**DESIRED EFFECTIVE DATE: January 1, 2017**

**STATEMENT FOR PROGRAMS OF STUDY CATALOG:**

**Master of Science in Bioinformatics**

The M.S. degree can be taken in a thesis or non-thesis format, depending on the department. For either format, the research adviser must be affiliated with the Bioinformatics program. Departments may have requirements in addition to those below. See the departmental entries in this Program of Study for more information.

**Thesis Option**

4 hours of coursework from the approved list of biology courses	4
4 hours of coursework from the approved list of bioinformatics courses	4
4 hours of coursework from the approved list of computer science courses	4
Thesis hours required (min/max applied towards degree):	4-8
<b>Total Hours</b>	<b>32 or 36</b>

Other Requirements<sup>1</sup>

Minimum Hours Required Within the Unit:	8
Minimum 500-level Hours Required Overall:	12
A concentration is required	

**Non-Thesis Option**

4 hours of coursework from the approved list of biology courses	4
4 hours of coursework from the approved list of bioinformatics courses	4
4 hours of coursework from the approved list of computer science courses	4
<b>Total Hours</b>	<b>32</b>

Other Requirements<sup>1</sup>

Other requirements may overlap	
A concentration is required	
Minimum Hours Required Within the Unit:	8
Minimum 500-level Hours Required Overall:	12

<sup>1</sup>For additional details and requirements refer to the [degree requirements](#), the appropriate department’s graduate handbook, and the Graduate [College Handbook](#).

**CLEARANCES:** (Clearances should include signatures and dates of approval. **These signatures must appear on a separate sheet.** If multiple departments or colleges are sponsoring the proposal, please add the appropriate signature lines below.)

## Appendix A: Proposed Curriculum Revisions

Current Requirements:	Current Hours	Revised Requirements:	Revised Hours
<b><i>Major Core Requirement</i></b>		<b><i>Major Core Requirement</i></b>	
<b><i>Fundamental Bioinformatics</i></b>		<b><i>Fundamental Bioinformatics</i></b>	
ANSC 591 – Bioinformatics*	2	(no longer offered)	
CHE 515 – Bioinformatics*	4	(no longer offered)	
MCB 440 – Computing in Molecular Biology*	3	MCB 432 Computing in Molecular Biology	3
ANSC 542 – Applied Bioinformatics (cross-listed CPSC 569 and IB 506)	4	ANSC 542 – Applied Bioinformatics (cross-listed CPSC 569 and IB 506)	4
ANSC 545 – Statistical Genomics (cross-listed IB 507)	3-4	ANSC 545 – Statistical Genomics (cross-listed CPSC 545, IB 507)	3-4
CHBE 571 – Bioinformatics (cross-listed ANSC 543, MCB 571, STAT 530)	4	CHBE 571 – Bioinformatics (cross-listed ANSC 543, MCB 571, STAT 530)	4
CPSC 567 – Bioinformatics and Systems Biology	4	CPSC 567 – Bioinformatics and Systems Biology	4
CS 466 Introduction to Bioinformatics	3-4	CS 466 Introduction to Bioinformatics	3-4
IB 467 Principles in Systematics	4	IB 467 Principles in Systematics	4
CHEM 574 – Genomics, Proteomics and Bioinformatics (cross-linked MCB 554)	4	(no longer offered)	
		†	
<b><i>Biology</i></b>		<b><i>Biology</i></b>	
CSB 401 – Cell Biology II*	4	(no longer offered)	
BIOCH 452 – General Biochemistry*	4	(no longer offered)	
BIOCH 453 – General Biochemistry*	4	(no longer offered)	
ANSC 441– Human Genetics (cross-listed ANTH 441)	3-4	ANSC 441– Human Genetics (cross-listed ANTH 441)	3-4
ANSC 444 – Applied Animal Genetics	3	ANSC 444 – Applied Animal Genetics	3
ANSC 446 – Population Genetics	3-4	ANSC 446 – Population Genetics (cross-listed IB 416)	3-4
ANSC 447 – Quantitative Genetics	3-4	(no longer offered)	
BIOP 401– Introduction to Biophysics (cross-listed PHYS 475)	3-4	BIOP 401– Introduction to Biophysics (cross-listed PHYS 475)	3-4
BIOP 420 – Molecular Biophysics	3-4	BIOP 550 Biomolecular Physics (cross-listed MCB 550, PHYS 550)	4
CPSC 452 Evolutionary Genetics and Genomics	3	CPSC 452 Evolutionary Genetics and Genomics	3


		CPSC 566 Genomics for Plant Improvement	2
CPSC 563 Chromosomes	3	CPSC 563 Chromosomes	3
CPSC 564 Molecular Marker Data Analyses	3	CPSC 564 Molecular Marker Data Analyses	3
CPSC 566 Plant Gene Regulation	4	CPSC 566 Plant Gene Regulation (cross-listed HORT 566)	4
MCB 400 Cancer Cell Biology	3	MCB 400 Cancer Cell Biology	3
MCB 450 Introductory Biochemistry	3	MCB 450 Introductory Biochemistry	3
MCB 501 Advanced Biochemistry	4	MCB 501 Advanced Biochemistry	4
MCB 502 Advanced Molecular Genetics	4	MCB 502 Advanced Molecular Genetics	4
		†	
<b><i>Computer Science</i></b>		<b><i>Computer Science and Informatics</i></b>	
CS 411 – Database Systems*	3-4	CS 411 – Database Systems	3-4
CS 473 – Combinatorial Algorithms*	3-4	CS 473 – Fundamental Algorithms (cross-listed CSE 414, MATH 473)	3-4
		CS 466 – Machine Learning	3-4
		CPSC 565 – Perl and UNIX for bioinformatics	2
		LIS 490 section DB– Introduction to databases	4
		LIS 542 – Data, statistics, info	4
		STAT 428 – Statistical computing (cross-listed CSE 428)	4
		STAT 440 – Statistical data management (cross-listed CSE 440)	4
		STAT 448– Advanced data analysis	4
		STAT 480 – Data science foundations	4
		STAT 525 – Computational Statistics (cross-listed CSE 525)	4
		†	
<b>Total Core Required Hours</b>	12	<b>Total Core Required Hours</b>	12
<b><i>Elective and Other Requirement</i></b>	20-24	<b><i>Elective and Other Requirement</i></b>	20-24

\* Courses listed in the original M.S. in Bioinformatics proposal (2004), which included only two options: (i) Computer Science, and (ii) Chemical and Biomolecular Engineering. The program currently includes 5 options provided by 5 academic units.

† When circumstances outside the student’s control prevent a student from attending one or more of the prescribed Core courses, the student can petition an exchange to the unit’s representative to the campus M.S. in Bioinformatics umbrella program. The M.S. in Bioinformatics unit representative can authorize substitution with other course or courses of comparable level, breadth and depth.

**CLEARANCES:** (Clearances should include signatures and dates of approval. These signatures must appear on a separate sheet. If multiple departments or colleges are sponsoring the proposal, please add the appropriate signature lines below.)

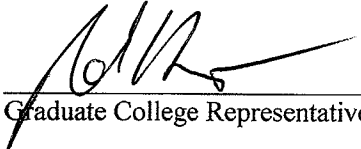
Signatures:

  
\_\_\_\_\_  
Unit Representative:

05/20/16  
\_\_\_\_\_  
Date:

Ramie Kramer  
\_\_\_\_\_  
College Representative:

5-24-16  
\_\_\_\_\_  
Date:

  
\_\_\_\_\_  
Graduate College Representative:

10/24/16  
\_\_\_\_\_  
Date:

\_\_\_\_\_  
Council on Teacher Education Representative:

\_\_\_\_\_  
Date:

**From:** [McKinney, Allison Ann](#)  
**To:** [Martensen, Kathy](#)  
**Cc:** [Readel, Karin](#)  
**Subject:** Grad Proposal - MS Bioinformatics  
**Date:** Tuesday, October 25, 2016 2:58:46 PM  
**Attachments:** [Bioinformatics Revision FA16.pdf](#)

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Dear Kathy,

Please see attached for a proposal from the Illinois Informatics Institute which seeks to “Revise the Core Curriculum of the Campus-Wide MS Program”. The Graduate College received the proposal on August 2, 2016. It was reviewed and approved without revision by the Graduate College Executive Committee on October 18, 2016.

We now forward the proposal for your review.

Sincerely,

Allison McKinney  
Director  
Academic Programs, Policy and Academic Services  
Graduate College



UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

EP.17.28

Office of the Provost and Vice Chancellor  
for Academic Affairs

Swanlund Administration Building  
601 East John Street  
Champaign, IL 61820



October 26, 2016

Bettina Francis, Chair  
Senate Committee on Educational Policy  
Office of the Senate  
228 English Building, MC-461

Dear Professor Francis:

Enclosed is a copy of a proposal from the Graduate College and the Illinois Informatics Institute to revise the Master of Science in Bioinformatics.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Kathryn A. Martensen'.

Kathryn A. Martensen  
Assistant Provost

Enclosures

c: A. McKinney  
K. Readel