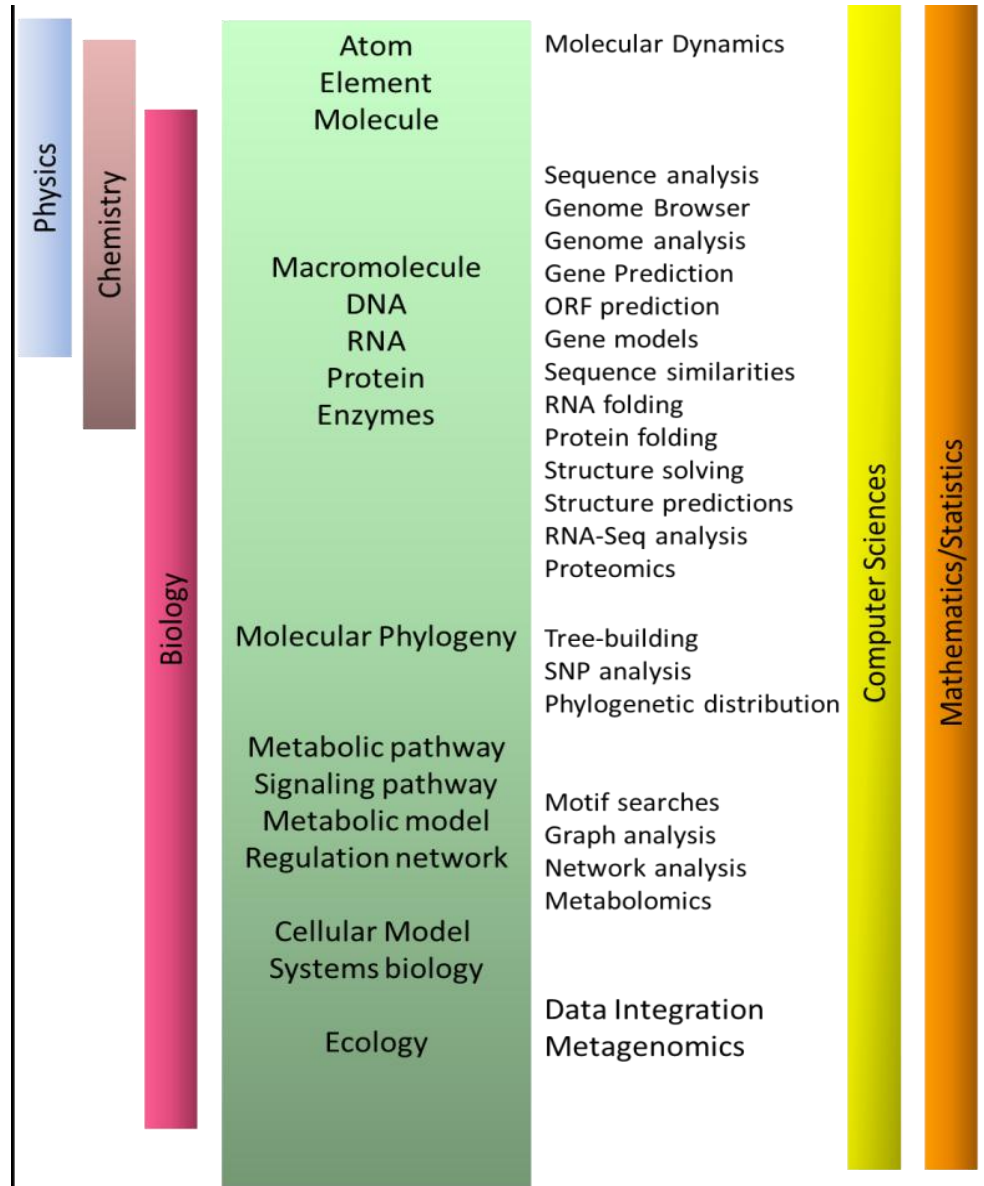


Educational and research resources in bioinformatics @UF: creating a community

Valérie de Crécy-Lagard
&
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Quantitative sciences are becoming an integral part of most aspects of biology



Bioinformatics for Biologists at UF

- **Training components**
 - Current research workforce
Post-docs, scientists and PIs
 - Future research workforce
Undergraduate & graduate
- **Research infrastructure**
 - Hardware and software resources
 - Personnel (interns, collaboration, fee for service)
- **Building a Community**
 - Seminar series
 - “Goto” websites for resources and exchanges

Bioinformatic training at UF

- Training

- Current workforce

Post-docs, scientists and PIs

- Future workforce

Undergraduate and graduate students

Undergraduate classes in Bioinformatics for Biology major at UF

- Bioinformatics minor
- New course: *Introduction to Human Bioinformatics* (Michele Tennant and Rolando Milian) starting this Spring
- Special topics classes in Biology once in a while
- Intervention in specific classes
 - PCB3063, undergraduate genetics – instruction in PubMed, GenBank, RefSeq, Structure, Entrez Gene, etc. Term project – poster presentation on genetics of specific human disorders
 - CHM4413L, biophysical chemistry – similar instruction with homework assignment

We have now created since Summer 2012 a Bioinformatics Minor for Undergraduates:
<http://microcell.ufl.edu/bioinfo3/>



The banner features a dark purple background. At the top, there is a navigation menu with the following items: Home (highlighted in a light grey box), Coordinators, Coursework and Plan of Study, Forms, Core Courses, and Apply now. Below the menu, the text "Bioinformatics Minor" is displayed in a white, sans-serif font. To the left of the text is a photograph of a microscope's objective lenses. To the right is the logo for the University of Florida Bioinformatics program, which includes the word "Bioinformatics" in a stylized font with a DNA double helix graphic, followed by "UNIVERSITY of FLORIDA" in blue and "Microbiology & Cell Science" in a smaller font below it.

The Microbiology & Cell Science Department is pleased to offer an undergraduate minor in Bioinformatics. This minor is offered to students majoring in any biology-related subject, including, but not limited to, Microbiology, Biology or Biochemistry.

Bioinformatics - which we define broadly as the use of computers to answer biological questions - has become a major component of modern biological science. So integrated is bioinformatics with biology that it is difficult to find an active research program that does not rely on bioinformatic analysis to achieve results. Unfortunately, the integration of bioinformatic and traditional methods is not stressed in many undergraduate programs, leaving the next generation of biologists without the skills they need to succeed in tomorrow's research environment.

We created the undergraduate minor in Bioinformatics to provide this critical training to future professionals in the biological disciplines.

Through participation in this minor, you will gain:

1. Advanced coursework in bioinformatics to learn new skills
2. Practical experience applying bioinformatics skills to solve real-world research problems
3. Mentorship and guidance for career development
4. A community of colleagues working to learn and apply bioinformatics skills

Your training will help position you as a future leader in your chosen biological discipline and provide you with the integrative technical skills necessary to excel.

Graduate training

- Edge: UF engineering online program
- In progress: new Computational Biology Masters program that could lead to Comp Bio concentrations in current PhD programs
- In progress: quantitative classes for students in Biology programs on campus

Edge/Bioinformatics track

- <http://www.ufedge.ufl.edu/>

http://www.ufedge.ufl.edu/docs/brochures/brochure-computer_information_science_engineering_degree_summary.pdf

CISE EDGE Courses Emphasizing 'Bioinformatics'

CAP 5510 Bioinformatics (3 credits)

Basic concepts of molecular biology and computer science. Sequence comparison and assembly, physical mapping of DNA, phylogenetic trees, genome rearrangements, gene identification, biomolecular cryptology, and molecular structure prediction

CIS 6930 Mathematical Techniques for Intelligent Systems (3 credits)

The course will cover a variety of mathematical topics commonly found in the computer vision and intelligent systems area, including matrix algebra and analysis, optimization via Lagrange multipliers, probability theory and estimation of probability density functions, information theory, and lattice theory. The focus of the course is on mathematical tools and concepts that are often used in applications of computing

CAP 5515 Computational Molecular Biology (3 credits)

Algorithms related to molecular biology. Sequence comparisons, pattern matching, pattern extraction, graph techniques in phylogeny construction, secondary structure prediction, multiple sequence alignment, contig search, DNA computing, computational learning theory, and genetic algorithms.

CAP 6610 Machine Learning (3 credits)

Review of attempts, within the artificial intelligence community, to construct computer programs that learn. Statistical pattern recognition with its applications to such areas as optical character recognition.

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Create a Master/PhD program at UF in Bioinformatics

The need: All aspects of biological/chemical sciences now require a workforce that can:

- analyze and interpret large and/or high dimensional data sets
- Understand and manipulate mathematical, statistical and computational models

This requires a combination of biological, mathematical, statistical and programming skills that are not taught in any PhD program at UF (Genetics and Genomics is the closest).

Many other large public research universities already have such programs.

UF must react quickly to remain competitive.

Comp Bio Master's working group

- Valérie de Crécy-Lagard (MCS, vcrecy@ufl.edu)
- Meera Sitharam (CISE, sitharam@cise.ufl.edu)
- Alberto Riva (MGM, ariva@ufl.edu)
- Pamela Soltis (Museum/Biology
psoltis@flmnh.ufl.edu)

Other courses as models

- Virginia Tech Genetics, Bioinformatics, and Computational Biology Graduate program
<http://graduateschool.vt.edu/academics/programs/gbcb/#nogo>
- Iowa State Bioinformatics and Computational Biology Graduate program
(<http://www.bcb.iastate.edu/Handbook.html#CourseDiagram>)
- Carnegie Mellon PhD program
(<http://www.compbio.cmu.edu/curriculum.html>)
- Rutgers/NJIT Biological sciences
(<http://runewarkbiology.rutgers.edu/department/CompBioGraduate.html>)
- Paris XI Master in Bioinformatics and statistics (<http://www.bibs.u-psud.fr/m1.php>)
- UGA Bioinformatics Master/PhD <http://iob.uga.edu/masters-phd/>
- UNC Curriculum in Bioinfo <http://bcb.unc.edu/training.htm>
- USF Master <http://gradaffairs.health.usf.edu/Bioinformatics.html>

Course plan for Masters in Computational Biology to start Fall 2015

Remedial classes		Credits	SEM
Mathematics	Mathematical methods for Biologists	3 MAP5XXX	Fall 1
Statistics	Introduction to Hypothesis Testing (STA)	1 GMS5XXX	Fall 1
Stats	Applied Statistical Techniques:	1 GMS5XXX	Fall 1
Bioinfo	Intro Bioinfo	2 BSC5XXX	Fall 1
	Pract Comp Bio Basic computational skills	1 BSC4/ 5XXX	Fall 1
	Pract Comp Bio Basic programming skills	1 BSC4/ 5XXX	Fall 1
	Pract Comp Bio Basic Database skills	1 BSC4/5XXX	Fall 1
BioInfo	Bioinformatics workflow	2 BSC4/5XXX	Spring 1
		12	
Then the class schedules will be adapted to students from different Backgrounds			
Example for Students with BioBackgrounds			
CS	Discrete math and applications	3 COT3100	Fall 1
CS	Data structures and algorithms	3 COP3530	Spring 1
Example for Students with CS background			
	Fundamentals Biomed Sciences	2 GMS6001	Fall 1
Core Classes for all students			
Bio	Advanced genetics	4 PCB5065	Fall 1
BioInfo	Microbial Comp genomics	1 MCB6318	Fall 1
BioInfo	Genomics and Bioinformatics	3 GMS6231	Spring 1
Math	Modeling mathematical biology	3 MAP5489	Fall 2
CS/bioinfo	Bioinformatics	3 CAP5510	Fall 2
CS	Intro to algorithms	3 COT5405	Fall 2
CS/Stats	Machine learning	3 CAP6610	Spring 2
Bioinfo	Evolution class (one in red below)	3	
		23	

Course plan for Masters in Computational Biology to start Fall 2015

- Student will be required to attend the GI seminar every semester and the Bioinformatics seminar in the Spring;
- Students will be required to complete an internship in the first summer;
- Students will be required to complete 9 to 12 credits in a concentration.

Concentrations for Masters in Computational Biology

Genomics & Evolutionary Biology Concentration		
	GMS5905	Intro to phylogenomics
	GMS6233	Quant Models Protein Evolution
	ZOO6927	Phylogenetics
	BOT6935/ZOO6927	Phylogenetics seminar
		Genome sequence structure function (barbazuk)
	BOT6935	Molecular Systematics
	BOT6935/ZOO6927	Principles of systematic Biology
		Molecular Ecology
	BOT6935/ZOO6927	Phylogenomics
	PHA 6449 – Section 8442	Pharmacogenomics
	AGR 6932	Plant chromosome and genomes
	GMS6234	Introduction to phylogenomics: a practical approach to molecular phylogenetics of pathogens
Structural Biology Concentration		
	COT4501	Numerical Analysis
	BCH6744	Molec Struct Determ X-ray
	BCH6744L	Molec Struct Determ X-ray (lab)
	BCH6745	Molec Struct Determ NMR
	BCH6745L	Molec Struct Determ NMR (lab)
	CHM6470	Chemical Bonding and Spectra I
	CHM 6586?	Computational Chemistry?
Algorithm and Data Concentration		
	CAP5515	Computational Molecular Biology
	CIS 6930	Data mining
	CIS 6930	Data science
	CIS 6930	Recent Advances in Bioinformatics
	CIS4301	Information and Database Systems 1
	COP 4720	Information and Database Systems 2
	COP 5725	Database Management Systems
	COP 6726	Database System Implementation

International component: Contacted by the Paris-Sud Bioinfo Master program to create an exchange Program for the Research Rotation

- Goal: create an exchange program to allow a few students from the UF to go to Orsay University and vice-versa.
- This could be expanded to joint degrees in the future.

Main issue

- Mechanism to create true interdisciplinary graduate program does NOT exist on campus
- Temporary solution To start in 2015: create new major in existing Masters (in process)

Graduate training

- Create Computational Biology Masters program that could lead to Comp Bio concentrations in current PhD programs
- Create quantitative classes for students in Biology programs on campus

Graduate training

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Biology has entered a new “Big data” era where mathematics, statistics and computational methods have to be used to generate and analyze biological data. The graduate students that are currently trained in Biology PhD programs on the UF campus need to acquire a minimal proficiency in the more quantitative disciplines to succeed in their research projects. With this goal in mind a series of remedial classes geared towards graduate students with Biology bachelor degrees has been developed to give these students access to more advanced modeling, systems biology and computational biology classes. The goal is to coordinate between the Graduate programs so that there is synergy and not overlap between these programs.

Mathematical methods for Biologists
3 credit (MAP5XXX Fall (Math Dpt)
Including 1 credit (first month linear alg)

Modeling Mathematical Biology
3 credit fall MAP 5489

Introduction to Statistical technique
1 credit GMS5XXX Fall LMcY

Applied Statistical Techniques:
1 credit GMS5XXX Fall L McY

Machine learning
3 credit Spring CAP6610

Basic computational skills
1 Credit fall MG or BK

Genomics and Bioinformatics
3 credit Spring GMS6231

Basic programing skill
1 credit fall MG or BK

GMS6232 - Advanced Applications of Bioinformatics
1 credit fall LZ

Basic Database skills 1 credit fall MG or BK

Bioinformatics CAP5510
3 credit fall

Bioinformatics workflow
2 credit Spring BK

Microbial Comp genomic 1 VDC credit fall

Application of Bioinformatics to genetics
GMS6014 Spring 1 credit LZ

Basic Bioinfo tools
2 Credit fall /online VDC

OR

Concerned programs on campus

- IDP (Paul Gulig)
- Microbiology and Cell Science (Tony Romeo)
- Genetics and Genomics (Connie Mulligan and Bungert, Jorg)
- Biology Brad Barbazuk
- PMCB Mark Settles and Anna-Lisa Paul
- Others ???

Current workforce training

- Recurring training
 - HPC and Galaxy ([Matt Gitzendanner](#), will present in a few minutes)
- Workshops
 - [Comparative genomic workshops](#)
 - Marco Salemi is trying to set up phylogenomics workshop
 - Health Science Library

Current Offerings at the HSCCL

- **Introduction to Genome Browsers**
 - Feb. 19, 12:00-1:00
- **BioMart: A Research Data Management Tool for the Biomedical Sciences**
 - Mar. 5, 12:00-1:00
- **Best Practices in Research Data Management**
 - Feb. 13, 9:00-10:00
 - Mar. 18, 1:00-2:00
 - Apr. 9, 11:00-12:00

See entire list of HSCCL workshops (literature searching, systematic reviews, RefWorks/EndNote, copyright, research impact, etc) at

http://training.health.ufl.edu/public_workshops_scheduled.aspx?sponsor=15

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- **Research infrastructure**
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- **Building a Community**
 - Seminar series
 - Goto websites for resources and exchanges

Who can help Biology labs solve a Bioinformatic dependent research problem?

- Interns
- ❖ Bioinformatics minor undergraduates (already today) (for credit)
- ❖ Comp Bio Masters students (Summer 2016)
- ❖ Existing students in CISE Bioinformatics Masters program
- Fee for service (ICBR Bioinformatics **Alberto will discuss in a future seminar**)
- Collaboration → Building a community

Building a Bioinfo community?

- Seminar series : **bioinfo-seminars-L**

<http://compbio.ufl.edu/events/bioinformatics-seminar-series/>

Want to sign up?

Computational Biology Bi-weekly seminar Genetic Institute Thursday 4pm Room TBA			
Date			
16-Jan			de Crecy, Matt
30-Jan			Azarian,Taj Hassan <taj.azarian@epi.ufl.edu>
13-Feb			
27-Feb			
13-Mar			
27-Mar			
17-Apr			Brad barbazuk (Barbazuk,William Bradley <bbarbazuk@ufl.edu>
1-May			

Building a Bioinfo community?

- Seminar series
- Websites Current:

<http://www.biotech.ufl.edu/cores-by-division/bioinformatics/>

<http://compbio.ufl.edu/>

<http://guides.uflib.ufl.edu/bioinformatics>

<http://bioinformatics.ufl.edu/>

How to make these vibrant and consolidate the information ??????

Resources , job exchanges, news and seminars