University of Florida
Department of Microbiology and Cell Science

Comparative Microbial Genomics
MCB 6318 Section 162B (2 credits)
MCB 6318 Section 069F (2 credits)

Spring SEMESTER 2023

COURSE DESCRIPTION: Methods to allow experimental scientists lacking computer programming skills to efficiently use the genomic and post-genomic data that is freely available over the web to predict protein function. Examples will be mainly taken from the field of microbial metabolism and regulation.

PREREQUISITE COURSES: Grade A⁻ or higher in BSC6459

COURSE INSTRUCTORS & OFFICE HOURS: Dr. Valerie de Crécy-Lagard

Every **Monday 5-6PM** through the Canvas ZOOM tool

E-mail for appointments: I prefer that you use the email through CANVAS. For emergencies you can email us to vcrecy@ufl.edu

WEB PAGE: https://ufl.instructure.com/courses/472285

COURSE OBJECTIVES:
- The students will be able to perform database search in order to identify genes that are physically linked or that follow specific phylogenetic distribution patterns.
- The students will be able to extract information related to genome wide experimental data (gene or protein expression, phenotype, interaction data) gene or protein expression from databases and use this as building blocks or input for research projects
- The students will be able to use databases to search and identify structural homolog or catalytic domains in proteins to elaborate upon the function of unknown proteins
- The students will be able to use databases that integrate different types of data and use advanced visualization tools.
- The students will apply these methods to current issues in microbial physiology and metabolism.

STUDENT RESPONSIBILITIES: Students are expected to meet the deadlines for their assignments, project updates, peer reviews and final project. No extension for the module assignments will be given without prior approval by the instructor and only for catastrophic events (such as hurricanes). Because of the peer review process and the tight deadline for course grade submission, all deadlines for the Final project (four updates, 3 peer reviews and final submission) will be strictly enforced with NO possibilities of extension.

STUDENT EVALUATION:
Students will be evaluated on the basis of:

Assignments: 25%
Project updates: 15%
Peer Reviews: 10%
Final Project: 35%
Final Exam: 15%

Final grades will be based on the following performance standard:

100 - 92 %	=	**A**
< 92 - **88** %	=	A-
< 88 – 85 %	**=**	**B+**
< 85 - 82 %	=	B
< 82 - 78 %	=	**B-**
< 78 - 75 %	=	**C+**
< 75 - 70 %	=	**C**
< 70 - 68 %	=	**C-**
< 68 - 65 %	=	**D+**
< 65 - 60 %	=	**D**
< 60 - 58 %	=	**D-**
Less than 58 %	=	**E**

ASSIGNMENTS (total 25% of the grade): For each module, the student will complete between 4 and 9 assignments. Each assignment is designed to apply the concepts, methods or websites covered during the lectures.

FINAL EXAM (15% of the grade):
This is the only proctored assignment that will use the Honorlock Test Management System. It will cover all the material taught in class in small application exercises. Students must abide by the Honorlock proctoring rules and regulations. Cameras must be turned ON and the student's face must be visible throughout the entire duration of the exam. The students are expected to provide their own computer/laptop and secure a testing location that meets the Honorlock standards.

FINAL PROJECT(total 60 % of the grade): At the end of the course, the student is required to submit a final project in which the goal is to make a hypothesis of the function of a hypothetical protein/family of proteins by applying the knowledge gained during the course. The student will be given a gene family and using a combination of data-mining, comparative genomic analysis, phylogenomics and protein sequence and structure analysis tools the student will have to present what can be inferred about the protein family and a prediction of function or a link to a pathway or a specific metabolic area.

The final project has 3 components that will be graded individually.

1.   Weekly updates (15% of the grade). To help the student organize the information gathered, three updates are required.

Update 1 : Summarize the results of a literature search you did on your family. Summarize the blast and family searches you did on this family Show a multiple alignment, a phylogenetic tree of the family and potential active sites visualized using Logos. What associations can you find

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using the String database. Any physical clustering with genes of known function? Any gene fusions?

Update 2: Can you find any associations with other genes using Microarray or RNA seq databases? Did you find binding sites for known transcription factors? Did you find any associations using other types of experimental data (fitness, phenotypes, physical interactions)?

Update 3: What structural information is there about members of your family? Were you able to build a structural model? Did you find or can you predict any ligand bound in the structure? Is this ligand biologically relevant or not? Can you predict interactions with nucleic acids or other proteins?

Update 4: Explore advanced tools that you can use on you family and present at least two. These can be: compare logos, Itol tree or mapping transcriptomic data (or metabolomic) to pathway maps.

IMPORTANT: The updates have to be submitted on time or you will not be able to participate in the peer-reviews assignments. I will be very strict on enforcing the deadlines with 50% off of the Update grade when submitted 12 hours late, and a zero on the assignment after 24H (plus a zero on the peer-review grade).

2. **Peer review** (10% of the grade)

The student will be assigned to two peer-reviews for each update (a total of 6). The student will need to complete the rubric provided as well as the feedback section. The grading performed by the student is only part of the author's feedback and will not affect the grade of the author. The feedback and analysis of the updates will be graded by the instructors (15% of the grade).

3. **Written component individual assignment - Final Paper** (35% of the grade)

The student will need to propose a functional hypothesis for your "unknown" and defend it in the paper using bioinformatic evidence. We **do not** expect a concatenation of the updates. An example of the type of work expected is the DUF71 paper that student will read in Module 4. The evaluation will be based on the clarity and the logic of your argumentation as well as the quality of the bioinformatic data presented. Finally, the adherence to correct scientific writing style will be evaluated.

STEPS:
1. Initial submission for per review
2. Peer review
3. Submission of final paper

COURSE SCHEDULE and DEADLINES are listed on CANVAS

Module 1 Dealing with the avalanche of data
Week 1: Extracting genomes and proteins from databases

Module 2 Linking gene and function
Week 2: From gene to pathway and from pathway to gene
Week 3: Using comparative genomic methods to identify missing genes

Module 3 Genome-wide analysis of experimental data & data Integration

Week 4: Techniques to study global gene expression. Mining gene expression databases and regulatory sites identifications
Week 5: Analyzing fitness and phenotype data, data integration, mapping data to pathway

Module 4 Mining and predicting 3D structures
Week 6: 3D structure visualization and mining and predicting of protein-protein, protein-ligand and protein nucleic acid interactions

Module 5 Data Visualization
Week 7: Visualization tools (Mapping data to phylogenetic trees, comparing logos, etc)

Final project submission and Final Exam, week 8
<u>March 3</u>   Final paper submission
March X   Final exam deadline

REFERENCE TEXTBOOKS:

These books are not required but cover many of the topics we will discuss in class:

Bioinformatics. A practical guide to the analysis of genes and proteins (Third Edition). Editors A.D. Baxevanis and B.F.F. Ouellette. 2004. John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN 0-471-47878-4 (a fourth edition is in the works, but not released yet).

Bioinformatics: Genes, Proteins and Computers (First edition). Editors C.A. Orengo, D. Jones , J. Thornton. 2003. Bios Scientific Publisher, Oxford, UK. ISBN-10: 1859960545.

<u>University of Florida Policies</u>

Grades and Grade Points
For information on current UF policies for assigning grade points, see
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Attendance and Make-Up Work
Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Services for Students with Disabilities
The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

Campus Helping Resources
Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575,* www.counseling.ufl.edu
    Counseling Services
    Groups and Workshops
    Outreach and Consultation
    Self-Help Library
    Wellness Coaching

- U Matter We Care, www.umatter.ufl.edu/

- *Career Connections Center,* First Floor JWRU, 392-1601, https://career.ufl.edu/.

Academic Resources
- E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://elearning.ufl.edu/student-help-faqs/
- Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. http://www.crc.ufl.edu/
- Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. http://teachingcenter.ufl.edu/
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. http://writing.ufl.edu/writing-studio/

Course Evaluation
Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. These evaluations are conducted online at https://evaluations.ufl.edu. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.

Netiquette guide for online courses
It is important to recognize that the online classroom is in fact a classroom, and certain behaviors are expected when you communicate with both your peers and your instructors. These guidelines for online behavior and interaction are known as netiquette.
http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf

<u>Academic Honesty</u>
As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "*We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.*" You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

Additional comments regarding academic integrity:
Students are encouraged to discuss material with each other from the course, help each other understand concepts, study together, and even discuss assessment questions with each other once the quiz window is closed. However, the following is considered academic dishonesty, and I expect that no student will ever do any of the following:

- Have another person complete a quiz in this course
- Copy another student's quiz in this course
- Collaborate with anyone during a quiz in this course
- Discuss the questions and answers of a quiz with other students while the quiz window is still open
- Manipulate and/or distribute any materials provided in this course for any purpose (including course lecture slides).
- Use any materials provided by a previous student in the course

<u>Software Use</u>

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

<u>Microsoft Office 365 Software is free for UF students</u>

http://www.it.ufl.edu/gatorcloud/free-office-365-downloads/

Other free software is available at:

http://www.software.ufl.edu/

To check for availability of the media and technical requirements, contact the UF Computing Help Desk at (352)392-HELP(4357).

<u>University of Florida Complaints Policy and Student Complaint Process</u>
Most problems, questions and concerns about the course will be resolved by professionally communicating with the instructor or the TAs.

The University of Florida believes strongly in the ability of students to express concerns regarding their experiences at the University. The University encourages its students who wish to file a written complaint to submit that complaint directly to the department that manages that policy.

If a problem really cannot be resolved by communicating with the instructor or the TAs you can contact

- Residential Course: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/.

- Online Course: http://www.distance.ufl.edu/student-complaint-process.

This said, professionalism is a two-way-street. Unprofessional behavior of students includes, among other things: lack of communication, blaming other people or external factors, lying, affecting others negatively in a group or in the class, not accepting criticism and not being proactive in solving problems or seeking help. Furthermore, faculty often have family and other obligations to tend to. Over the weekend, replies to your inquiries or questions maybe delayed.

If a student is lacking professionalism repeatedly, the instructor has the rights to file formal complaint against the student through the Dean of Student office.