Systems Biology BIOL-GA 1128 – Syllabus and Schedule

Administrative

Details:
New York University | Fall 2017
Schedule (current): Tues. & Thurs., 3:30-4:45pm at Tisch Hall Room:LC11
Location: Washington Square (near Stern Building)
Start: Tuesday, September 5, 2017
End: Thursday, December 22, 2017
Midterm exam:
Final:
The course URL will be provided via email and NYU Classes.

Prerequisites:
Biocore I or by permission by instructor. No programming skills are required. Basic statistics knowledge is required or will have to be acquired during the semester.

Instructor / Contact:
Christine Vogel, PhD
Department of Biology
Email: cvogel@nyu.edu
Office: Center for Genomics & Systems Biology, 403 – 12 Waverly Pl
Office hours: By appointment, please email or talk to me before/after class
Emergency contact: (212) 998-8200 (NYU Department of Biology)

Course goals and objectives:
The goal of this course is to provide students with an overview of current methods, applications, analysis approaches, and results in different fields of systems biology. Students will both acquire and apply the new knowledge through examination of relevant research publications.

Students will…
1. Get to know large-scale methods used in systems biology research and their basic data types
2. List limitations of current systems biology methods and needs for future development
3. Discuss examples of the latest research publications that mark the frontier of the field of systems biology
4. Interpret supplementary data from research publications in form of summaries and discussions
5. Compare different systems biology approaches in their advantages and disadvantages
6. Design mini-proposals that suggest next experiments to further elucidate the current knowledge

Course organization:

General. The course comprises lectures, one midterm, one final exam, and project work. Each session will start with a review and discussion of the class content from the week before, and a lecture on the next topic. The lecture will be given by the instructor or guest lecturers. The lectures will provide the background to the projects and paper readings. Note that while we do mention computational/ statistical/ mathematical methods, we place the emphasis on results and their impact on biology. This class does neither require nor teach programming, as this is covered by plenty of other classes. There is no programming component in the class.
Materials. Slides and other materials will be posted on NYU classes. There is no textbook as most topics are rapidly evolving and we teach at the frontiers of current knowledge! However, all students are encouraged to use the e-Book that we have been creating over the years: https://wikis.nyu.edu/display/Vogel/Systems+Biology

The book contains definitions and concepts discussed in class. Note that for the exam etc, materials discussed in class will be tested only – if you see something in the e-Book that we didn’t discuss, it will not be tested. Note that there is no guaranty that the content of the book is correct. If you have doubts or find an error, email or discuss it before/during/after class. You can gain bonus/participation points by making substantial contributions to the e-book (beyond correcting typos).

Expectations. Students can expect from the lectures to provide the foundation for the class content, major concepts and definitions and examples for their application. Students can also expect plenty of guidance and instructions for the project work, including individual and group feedback. The e-book project will be based on detailed outlines provided by the lecturer and again incorporate detailed feedback. Transitioning from purely knowing the facts to creative scientific research is a difficult process, and my goal is to help students to move towards this stage.

Students are expected to attend classes – unexcused absence will be noted. Students are expected to arrive on time and stay for the entire class (unless discussed otherwise prior to class). There is no cell phone usage during class. Students are also expected to participate actively in all parts of the class during the face-to-face class time and online forum. As a rule of thumb, this participation should involve about one or two questions per discussion / lecture session per student. All students are expected to review last week’s lecture material for questions and open issues. All students are expected to hand in assignments/project work on time unless discussed otherwise. Again, students who contribute to the evolving e-book in a constructive and interactive way (outside the assigned session) will receive bonus points.

Class components
Sessions (75 min) will consist of three parts that help students to acquire, review, and apply knowledge.

Lectures - ACQUIRE KNOWLEDGE. The lecture part (and the course) will cover methods, applications, approaches to analysis, and results in the field of systems biology. Lectures will cover the topics listed below, subject to minor modifications. Lectures will discuss the background to each topic, the scientific questions involved, quantitative experimental approaches, and computational analysis techniques. The lectures will also discuss major scientific and technological breakthroughs and remaining obstacles and questions.

Towards a Systems Biology Wiki-Book – REVIEWING KNOWLEDGE. As there is currently no textbook available which covers comprehensively what I consider Systems Biology, our major goal is to write our own ‘evolving’ textbook with the lecture contents and a discussion of most relevant publications! This e-book will serve as a guide for exam preparation and to train future generations of systems biologists. The book will evolve over the next years. Students will review last week’s lecture and prepare a Wiki page on the respective topic, based on the lecture content. The Wiki page will be reviewed and extended by all class participants. Each page and topic discussion will be extended over the years. Students are encouraged to interact with the lecturer and other classmates when writing on the e-book.

Project work– APPLICATION OF KNOWLEDGE. This time will be dedicated to applying the knowledge gained in the lectures in various ways. The class projects include discussion of scientific publications, re-analysis of systems biology datasets, and discussion of mini-proposals that use methods in the class to enter new research areas. The goal of this part is to help students to truly
understand the concepts and methods taught in the lectures, and to manifest this knowledge through working with it.

**Participation in discussion and lectures – ACTIVE LEARNING.** Even if it is MUCH more painful to do something yourself rather than passively listening to a lecture, your retention of knowledge will be much higher if you apply the knowledge in tasks and projects. It is therefore in everyone’s best interest to participate in the discussions, projects, and review sessions as actively as possible. It will save you LOTS of time later on when studying for the exam. Since there is no textbook, active participation in the lectures, projects, and discussion is key to understanding the material. Interesting questions asked by students count as much as comments on relevant papers that you may have read outside the assignments. **This course is taught at graduate level: you are responsible for your learning.** If you do not understand something, it is your obligation to ask about it. For these reasons, class participation counts towards the final grade.

**Midterm and final exam.** Each exam will consist of brief questions that cover the lecture and/or project work. Our goal is to have the e-book help with exam preparations. The instructor will provide a set of training questions beforehand and a subset of these will be on the exam. If you miss an exam, you must provide a documented medical excuse. If you have a conflict with the exam date, you need to inform the lecturer as early as possible, **AT LEAST two weeks prior** to the exam.

**Assignments / Grading:**

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class attendance and participation</td>
<td>20%</td>
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<tr>
<td>Assignments, project work, and presentation</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm</td>
<td>25%</td>
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<tr>
<td>Final exam</td>
<td>30%</td>
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<tr>
<td>Bonus (up to 5%)</td>
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Exams are taken in-class. If missing an exam, the student needs to discuss with the instructor when to take an alternative exam. If submitting an assignment late, the instructor needs to be informed PRIOR to the deadline (via email). Failure to do so will result in deduction of points. Points will also be deducted for every day that the assignment is late (without a valid excuse).

Class/exams/assignment due dates can be missed because of a religious holiday or a university-scheduled athletic event (if you are a university-sanctioned athlete). However, the instructor needs to be informed **at least two weeks prior** to the date. In case of an emergency or other reasons why classes/exams/due dates were missed, the student needs to contact the instructor and the decision will be made at a case-by-case basis.

All students must follow NYU CAS’s code of honor - [http://cas.nyu.edu/page/honorcode](http://cas.nyu.edu/page/honorcode). Students also need to review the definition of NYU CAS’s Academic Integrity - [http://cas.nyu.edu/page/academicintegrity](http://cas.nyu.edu/page/academicintegrity).
Lecture topics
Subjects and order might be subject to change.

- Network I - intro
- Network II - inference
- Network III - inference
- Genomics I - HMM
- Online: sequencing
- Genomics II - Metagenomics
- Chromosomics
- Transcriptomics I
- Transcriptomics II - Data normalization and analysis
- Transcriptomics III - single cell
- RNA degradation I
- RNA degradation II - Alternative polyA
- Translatomics I
- Translatomics II
- Proteomics I - Identification
- Proteomics II - Quantitation
- Proteomics III - single cell
- Proteome dynamics - rates, degradation
- Proteome dynamics - translation
- Integromics I - Translation rates and others
- Integromics II - PECA
- Interactomics I - protein-protein
- Interactomics II - protein-RNA
- Metabolomics
- Phenomics - CRISPR
- Statistical genetics
- Presentations, discussions, review