CS557: Computational Systems Biology

Syllabus, Spring 2015

Computational systems biology is a graduate level course, which focusses on recent computational problems in biological systems. Topics include computational methods for understanding and reconstructing biological networks; phenotype prediction based on systems biology approaches, microRNA target prediction, genome-wide association studies. In each of these cases, we will focus on available biological data and methods for solving the pertinent computational problem. The methods of the course will draw from machine learning, data mining, network analysis, etc. No background in biology is assumed. Background in basic probability and statistics, machine learning and experience in programming are required.

Schedule

Lectures: Tue 10:40 - 12:30 am; Fri 9:40 - 10:30 am. We will resort to the space hour whenever necessary on Fri: 8:30 - 9:30 am
Location: EA502
Office Hours: By appointment, EA 429

Contact Information

Instructor: Oznur Tastan, `oznur.tastan@cs.bilkent.edu.tr`

Course Webpage

We will be using Moodle. Please check regularly the Moodle page of the course for lecture notes, discussions and announcements.

Textbook

No required textbook. There will be required readings posted on Moodle. We will be extensively make use of published scientific literature. Recommend sources:

- Computational biology journals: Bioinformatics, PloS Computational Biology, BMC Systems Biology, Biology Journals: Nature, Science, Cell, Molecular Systems Biology, PNAS, NAR, Genome Biology, Genome Research, PLoS series, etc.
- Conference proceedings: RECOMB, ISMB, PSB, NIPS, ICML, KDD, ECCB, etc.

Grading

The final grades will be based on the following:

- **45 %** Project
- **40 %** Topic review
- **10 %** Paper questions
- **5 %** Participation

Late day policy: Each student will have total of four free late (calendar) days to use for reports. If it is a group project, it will be consume late days of each members. Once these late days are exhausted, any deliverable turned in late will be penalized and will incur a reduction of 33% in the final score, for each day (or part thereof) it is late. For example, if an assignment is up to 24 hours late, it incurs a penalty of 33%. If it is 72 or more hours late, it will receive no credit.

Project

The purpose of the project is to increase your knowledge about computational systems biology research and get hands-on research experience. Any relevant project can be proposed in computational systems biology field. The project can involve applying known methods to solve an interesting question or may alternatively involve coming up with new methodologies to solve an existing problem on an existing data set. You are responsible for the proposal of the data and the algorithms. You are required to discuss the project with the instructor and check its validity before the official proposal document submission date. You may work by yourself or in teams of two. More output will be expected from lager groups. You will give a peer grade to the project partners, which will affect the overall grade. Project deliverables include:

- a proposal write up, presentation (2 points out of 45)
- a progress report and presentation (total 13 points out of 45)
- and a final report and presentation (total 30 points out of 45)

The deadlines for these deliverables will be announced on the course webpage.

Proposal write up: A one-page (single-spaced) proposal. It should contain the following information: (1) project title, (2) team mates, (3) description of the data, (4) precise description of the question you are trying to answer with the data, (5) what you aim to accomplish by the progress report deadline (6) references to related papers.

Proposal presentation: There will be 5 minute presentations in class.

Progress report: You are expected to start the implementation and have preliminary results. The report should be at least four pages (single-spaced). Reports must include: (i) a high quality introduction and literature review, (ii) what have you achieved so far, (iii) what remains to be done, and (iv) a clear description of the division of work among teammates, if applicable.

Progress presentation: Will be a 15 minute in-class presentation.

Final report: The paper should be maximum 8 pages (single spaced). You may have an appendix with extra material if needed. Include a clear description of the contribution of each person in the appendix. You should additionally submit the code along with your project. The paper should be in the following format:

- Introduction: A summary of the problem, methods and results.
- Problem description: Detailed description of the problem. What question are you trying to address?
- Methods: Description of methods used and the data set used.
- Results: The results of applying the methods to the data set.
- Discussion: Interpretation and discussion of the results. This part should be detailed.
- Conclusion: What is the answer to the question? Mention any future directions of interest.

Final project presentation: Will be an 30 minute in-class presentation.

Topic Review

Each person will review a topic from a list posted on the course web site. Few key papers will be assigned; you are expected to identify other key approaches and conduct a thorough literature review. You are encouraged to suggest a topic. You will provide i) a presentation ii) and a review paper on the topic review.

Presentation: There will be a presentation where you present the topic. The length of the presentation will be announced. Be prepared to answer your peer's questions and/or lead the discussion in the class (15 points out of 40).

Review paper: The review paper must be a minimum of 6 pages in length (single space), summarizing coherent selection of papers; a discussion of the limits and strengths of the methods employed should also be addressed (25 points out of 40).

Paper Questions

Speaker of the topic reviewer assigns two papers to the class to read and the audience is expected to prepare two questions or discussion point regarding the paper. These questions should have scientific metric (not on the form of "what is the definition of x?"). You will submit these questions before the class and ask in the class to the speaker. The quality of the questions will affect the 10 % of the grade.

Participation

The students are expected to actively participate and this will effect 5% of the grade.