Syllabus (subject to update**)**

Course #/name: PH797, Special Topics: introduction to systems biology

Credit hour: 2-4
|
Textbook An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon (http://www.weizmann.ac.il/mcb/UriAlon/)

pre-requisite: basic understanding of differential equations are required.

Course meets at: F 2:30-4:00 pm, in SH1215 (subject to change)
limit: <10 people

Course Description:
This course will go through the textbook (perhaps in two semesters), which offered a concise view of the general designing principles of complex networks in living systems, using concepts rooted from statistical mechanics, equilibrium and non-equilibrium thermodynamics, nonlinear dynamics, complex systems, etc. It utilizes several well-studied biological systems to demonstrate key principles, most importantly, why a system is designed in particular way, can we identify the smallest functional/structural unit in order to understand system dynamics, etc. It provides a simple mathematical framework which can be used to understand and even design biological circuits. Main topics include

- Explains the basic circuitry in transcription regulation, signal transduction, and developmental networks. emphasize on the topological structure and over-represented structural motifs.
- Includes examples ranging from bacterial chemotaxis through developmental patterning and neuronal circuits to immune recognition
- Examines the principle of robustness
- Details how constrained evolutionary optimization can be used to understand optimal circuit design
- Considers how kinetic proofreading and other mechanisms can minimize errors made in biological information-processing
- Includes solved problems after each chapter that detail topics not discussed in the main text

The class is expected to be small, informal, and interactive; with one (or two) person lead the discussions for most of the sessions rather than a formal lecture format. The instructors will lead the most of the discussions initially.

Learning Objectives:

1. know the key questions and the presently approaches in the study of systems biology (complex networks in living systems)
2. learn the basic models and simulations
3. learn how to simplify the complex systems and formulate the relevant problems

Instructor: Xujing Wang (934-8186, xujingw@uab.edu), Shouguo Gao (sgao@uab.edu), John Hartman (jhartman@uab.edu)
Office: CH303, Shelby 1203 (same phone #).
Course duration: 01/07/11-04/22/11 (15 week)
Office hour: M 1:20-2:30, W, 11:00-12:00pm, CH303
Fri 1:30-2:30pm Shelby 1203
or by appointment

Grading Scheme:
Course grades in terms of letter grade (A-D), or "P" or "F" upon request, will be determined based on attendance, homework (moderate amount of written homework will be assigned) and one presentation. Each student is expected to lead the discussion minimally one time, of one paper, or one topic in one of textbook chapters, assigned or self-selected, presentation can be 15-30 min. Students can also partner in presentation. Reading of the relevant chapters before the class is required. After each chapter, the book list some relevant article, some are key, historic articles along the development of this field, some will be selected for presentation

Course schedule (to be update)

There are 12 chapters, and we have 15 classes, putatively plan to go through half of the book this semester, 1 chapter/2 weeks, padded with the key, historic articles, and presentations and discussions. We expect the course to be interactive, informal, and the progression through the book can be modified based on discussion and interest of the class.

week	date	Topics	Required reading
1	01/07	introduction	Background, ch1-2
2	01/14		Chapter 2
3	01/21	Transcription networks	CH2
4	01/28		CH2
5	02/04		CH3
6	02/11		CH3
7	02/18		
8	02/25		4
9	03/04		
10	03/11		5
11	03/18	Spring break	
12	03/25		6
13	04/01		
14	04/08		
15	04/15		
16	04/22		Summary

Some reviews of the textbook

"[This text deserves] serious attention from any quantitative scientist or physicist who hopes to learn about modern biology. [It] is well written … Alon's book is [a good] place for physicists to start. It assumes no prior knowledge of or even interest in biology. Yet right from chapter 1 the author succeeds in explaining in an intellectually exciting way what the cell does and what degrees of freedom enable it to function … Alon ends his book with an epilogue of simplicity in biology. He draws the detailed strands together into an appealing and inspiring overview of biology. One final aspect of the An Introduction to Systems Biology that must be mentioned is the wonderful set of exercises that accompany each chapter … Alon's book should become a standard part of the training of graduate students in biological physics."
Nigel Goldenfeld, Physics Today, June 2007

Physics Today, 2007. http://www.weizmann.ac.il/mcb/UriAlon/Papers/bookReviewPhysicsToday.pdf

"Uri Alon's An Introduction to Systems Biology is a superb, beautifully written and organized work that takes an engineering approach to systems biology. Alon provides nicely written appendices to explain the basic mathematical and biological concepts clearly and succinctly without interfering with the main text. He starts with a mathematical description of transcriptional activation and then describes some basic transcription-network motifs (patterns) that can be combined to form larger networks … Alon investigates networks at a higher level, including genomic regulatory networks. He does an excellent job of explaining and motivating a useful toolbox of engineering models and methods using network-based controls."
Nature, Vol. 446, No. 29, March 2007

Nature, 2007: http://www.weizmann.ac.il/mcb/UriAlon/Papers/bookReviewNature.pdf

Further reading material

Physics of networks: http://www.phy.uab.edu/~xwang/The%20physics%20of%20networks.pdf