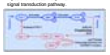
Computational Analysis of Biological Networks
Organizers: Fumi Katagiri (Plant Bio) and Claudia Neuhauser (EEB)

EEB 8990 Graduate Research Training Program in
Computational Analysis of Biological Networks

Biological function arises from complex interactions among components. These interactions can often be represented within the framework of networks. One major trend in biological network research is studying topological organizations of large networks, which led to the discovery of prevalence of scale-free networks across all scales of biological organization, from gene networks to ecosystem networks. Mechanisms and evolution of how such a common feature in the network topology arises are not well understood. Another major trend is dynamic modelling of well defined networks to simulate complex behaviors of networks. A major challenge is how to utilize the large amount of data generated by high throughput technologies. This seminar focuses on cutting edges and challenges in this new area of biology research based on journal paper readings and invited speakers to be chosen by the participants.

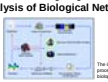


FALL 2004
Monday, 11:45-12:35
505 Ecology
Register for EEB 8990, Section 5
Organizational Meeting: September 13

Organizers:
Claudia Neuhauser, EEB
612-624-6291 or cneuhaus@cbs.umn.edu
Fumiaki Katagiri, Plant Biology
katagiri@umn.edu
With funds from the Digital Technology Center

Figures from Jeong et al. Nature 2000, Wolkenhauer et al. IEEE 2004, and from Venter et al. Science 2004

EEB 8990 Graduate Research Training Program in
Computational Analysis of Biological Networks



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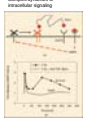

Spring 2005
Monday, 11:45-12:35
505 Ecology
Register for EEB 8990, Section 3
Organizational Meeting: January 24
Organizers:
Claudia Neuhauser, EEB
612-624-6291 or cneuhaus@cbs.umn.edu
Fumiaki Katagiri, Plant Biology
katagiri@umn.edu
Neil Olszewski, Plant Biology
neilo@umn.umn.edu
With funds from the Digital Technology Center

Figures from Shvartsman et al. 2004 IEEE Control Systems Magazine, Jeong et al. Nature 2000, Wolkenhauer et al. IEEE 2004, and from Friedman et al. Journal of Comp. Biol. 2000

Training Program

•HHMI-NIBIB Phase I Interfaces

21 Participants:

Students, postdocs, and faculty from EEB, Plant Biology, Neuroscience, Physics, Mathematics, Conservation Biology, Lab Medicine, Biosystems and Agricultural Engineering, Microbiology, Bioinformatics

September 13, 2004
Organizing the seminar

September 20, 2004: Preparing for Steven Wiley's talk
Chen et al. 2004. Induced Autocrine Signaling through the Epidermal Growth Factor
Receptor Contributes to the Response of Mammary Epithelial Cells to Tumor Necrosis Factor α*. The Journal of Biological Chemistry* 279: 18488-18496.
Hendriks et al. 2003. Quantitative Analysis of HER2-mediated Effects on HER2 and
Epidermal Growth Factor Receptor Endocytosis. *The Journal of Biological Chemistry* 278: 23343-23351.
Resat et al. 2003. An Integrated Model of Epidermal Growth Factor Receptor
Trafficking and Signal Transduction. *Biophysical Journal* 85: 730-743.
Shvartsman et al. 2004. Epidermal Growth Factor Receptor Signaling in Tissues. *IEEE Control Systems Magazine*, 53-61.
Wiley et al. 2003. Computational modeling of the EGF-receptor system: a paradigm for systems biology. Trends in Cell Biology 13: 43-50.

Wednesday, September 22, 2004, 4:00 pm, 105 Cargill
Dr. Steven Wiley (Pacific Northwest National Laboratory)
"Using a Systems Approach to Understand Cell Signaling"
Biochemistry, Molecular Biology, and Biophysics Department Seminars

September 27, 2004
Discussion of Dr. Wiley's talk

October 4, 2004
Dr. Fumi Katagiri discussed plant disease resistance.

October 11, 2004 Bayesian Networks (Fumi Katagiri)
Pe'er et al. 2001. Inferring subnetworks from perturbed expression profiles. Bioinformatics 17:S215-S224.
Friedman et al. 2000. Using Bayesian Networks to Analyze Expression Data. Journal of Computational Biology 7: 601-620.
Segal et al. 2003. Module networks: identifying regulatory modules and their condition-specific regulators from gene expression data. Nature Genetics 34:166-176.

October 18, 2004: Neural Networks (Clarence Lehman)
1. Chapter 2 of a good book on neural networks, by Muller and Reinhardt:
http://www.cedarcreek.umn.edu/lehman/neural/readings/MullerReinhardt1991.pdf
2. A recent Science article by Laughlin and Sejnowski, part of a special networks section late last year:
http://www.cedarcreek.umn.edu/lehman/neural/readings/LaughlinScience301.pdf
3. A Nature letter by Enquist and Arak, as an illustration of an early application of neural network theory to animal behavior:
http://www.cedarcreek.umn.edu/lehman/neural/readings/EnquistArakNature351.pdf

October 25, 2004: Preparing for Dr. Welch's talk
Welch et al. 2003. A genetic neural network model of flowering time control in *Arabidopsis thaliana*. Agron. J. 95:71-81.
Halliday et al. 2003. Phytochrome control of flowering is temperature sensitive and correlates with expression of the floral integrator FT. The Plant Journal 33:875-885.
Welch et al. 2004. Merging genomic control networks and soil-plant-atmosphere-continuum models. Agricultural Systems. Galley Proof.

Tuesday, October 26, 3:30 pm, 105 Cargill
Dr. Steve Welch (Kansas State University)
"Genetic Network Modeling of Flowering Time Control"
Plant Biological Sciences Colloquium Series

November 1, 2004
Discussion of Dr. Welch's talk

November 8, 2004: Preparing for Dr. Martinez' talk
Williams and Martinez. Diversity, Complexity, and Persistence in Large Model Ecosystems. Preprint.
Williams and Martinez. 2004. Stabilization of chaotic and non-permanent food-web dynamics. *The European Physical Journal B* 38:297-303.
Williams and Martinez. 2004. Limits to trophic levels and omnivory in complex food webs: theory and data. *The American Naturalist* 163: 458-468.
Williams and Martinez. 2000. Simple rules yield complex food webs. *Nature* 404:180-183.

Wednesday, November 10, 4 pm, 335 Borlaug
Dr. Neo Martinez (Pacific Ecoinformatics and Computational Ecology Lab) "Computational Approaches to Complex Ecological Networks Elucidate 'Devious Strategies' for Stabilizing Diversity"
Ecology, Evolution, and Behavior Department Seminars

November 22, 2004
Discussion of Dr. Martinez' talk

November 29, 2004: Preparing for Dr. Lauffenburger's talk
Asthagiri and Lauffenburger. 2000. Bioengineering models of cell signaling. Annu. Rev. Biomed. Eng. 2:31-53.
Shvartsman et al. 2002. Autocrine loops with positive feedback enable context-dependent cell signaling. Am. J. Physiol. Cell Physiol. 282:C545-C559.
Lauffenburger. 2000. Cell signaling pathways as control modules: complexity for simplicity. PNAS 97:5031-5033.
Sachs et al. 2002. Bayesian network approach to cell signaling pathway modeling. Science's STKE. www.stke.org/cgi/content/full/sigtrans;2002/148/pe38
Werner. 2003. In silico cell signaling underground. Science's STKE. www.stke.org/cgi/content/full/sigtrans;2003/170/pe8

December 6, 2004: Boolean Networks (Claudia Neuhauser)
Akutsu et al. 2000. Algorithms for Identifying Boolean Networks and Related Biological Networks Based on Matrix Multiplication and Fingerprint Function. Journal of Computational Biology 7: 331-343
D'haeseleer et al. 2000. Genetic network inference: from co-expression clustering to reverse engineering. Bioinformatics 16: 707-726.
Liang, S. 1998. REVEAL, a general reverse engineering algorithm for inference of genetic network architectures. Pacific Symposium on Biocomputing 3:18-29.

December 13, 2004
Wrap-up session

January 24, 2005
Organizing the seminar

January 31, 2005
Tutorial on transcription: Fumi Katagiri

February 7, 2005
The ENCODE (ENCyclopedia of DNA Elements) Project. 2004. Science 306: 636-640.
S.T. Kosak and M. Groudine. 2004. Gene Order and Dynamic Domains. Science 306: 644-647.
T. Pastinen and T.J. 2004. Hudson. Human Genome. Science 306: 647-650.

February 14, 2005
Tutorial on differential equations: Claudia Neuhauser

February 21, 2005
Tutorial on bifurcation: Claudia Neuhauser

February 28, 2005
Readings on metabolic networks and bifurcation

March 7, 2005
Preparing for Dr. Evelyn Fox Keller's visit

March 14, 2005
Spring Break

March 21, 2005
Preparing for Dr. Shai Shen-Orr's visit

March 28, 2005
Preparing for Magnus Nordborg's visit

Tuesday, March 29, 2005
Special Lecture
Magnus Nordborg (U. of Southern Cal)
"The Pattern of Polymorphism in Arabidopsis thaliana"
Plant Bio Seminar, 3:30 pm, 335 Borlaug

April 4, 2005
Discussion of Dr. Nordborg's talk

April 11, 2005
Special Lecture: Evelyn Fox Keller

April 18, 2005
Special Lecture: Shai Shen-Orr

April 25, 2005
Discussion of Dr. Orr's talk

May 2, 2005
Wrap-up session and finalizing web page

Web Page for Computational Resources

- Faculty
  - Names and home pages of faculty at the 'U' in the area of computational biology
- Graduate Programs
  - Bioinformatics
  - Neuroscience
  - EEB
  - Chemical Engineering
  - Mathematics
  - Plant Biology
  - Computer Science
- Seminars
  - Departmental seminars (EEB, Neuroscience, Plant Bio, Chemical Engineering, Mathematics, Computer Science, Bioinformatics)
  - DTC Seminar (this is our own seminar)
- Other Universities
  - Links to similar programs
- Funding Opportunities
- News
  - Research news
- Courses at the U
- Summer programs
- Meetings
- Organizations
  - Society for Mathematical Biology (http://www.smb.org/)
  - Institute for Mathematics and its Applications (http://www.ima.umn.edu/)
  - DIMACS (http://dimacs.rutgers.edu/)
  - MBI (http://mbi.osu.edu/)
- Useful tools
  - Center for Computational Genomics and Bioinformatics (http://www.ccgb.umn.edu/Facilities)
  - Supercomputing Institute (http://www.msi.umn.edu/)
- Education
  - BioQuest (http://www.bioquest.org/)
  - Reinvention Center (http://www.sunysb.edu/Reinventioncenter/)

Supported through funds from the Digital Technology Center