CPSC 601.73 — Biological Computation — Winter 2003

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Jan 14	Introduction	
	Part I. Computers Go Biological	
Jan 16	**A Crash Course in Genetics**	CJ
Jan 21	**DNA Computing** • An Introduction	CJ
Jan 23	• Biological Mathematics: A General DNA Splicing Model	CJ
Jan 28	• DNA Computers: What's the State of the Art?	Omair Quraishi
Jan 30	**Immune System Computing** • The Immune System—An Introduction	CJ
Feb 04	• Applications of Immune System Computing	Ricardo Hoar
Feb 06	**Evolution and Development** • L-systems, Cellular Encoding, and Genetic Programming	CJ
Feb 11	• (Co-)Evolution of Morphologies and Behavior	Seamus Carrol Jie Gao
Feb 13	*VIDEO*	
Feb 25	*Introductory Project Presentations (1)*	
Feb 27	*Introductory Project Presentations (2)*	
Mar 04	• Evolvable Hardware: The Darwin Chip—Dream or Reality?	Deyasini Majunday

	Part II. Biology Goes Digital	
Mar 06	**Explorations in Complexity** • Cellular Automata and the World of Simple Programs	CJ
Mar 11	• Evolution of Cellular Automata Machines	Al Fedoruk
Mar 13	• Substitution Systems and Beyond	CJ
Mar 18	• Small-World Phenomena in Networks	Jeroen Keijser
Mar 20	• Self-Organized Criticality	Tino Duong
Mar 25	**Artificial Chemistries** • An Overview	CJ
Mar 27	• Autocatalytic Sets, Catalytic Networks, and Self-Reproduction	Mark Baumback
Apr 01	• Classifier Systems and Random Boolean Networks	CJ
Apr 03	• Self-Organization, Reaction and Gene Regulatory Networks	Yimin Liu Glorious Tsui
Apr 08	*Project Presentations (1)*	
Apr 10	*Project Presentations (2)*	
Apr 15	*Project Presentations (3)*	
Apr 17	*Project Presentations (4)*	

Lecture: TR, 11:00 – 12:15, MS 773

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Part I. **Computers Go Biological**

- **A Crash Course in Genetics**
- **DNA Computing**
    - An Introduction
    - Biological Mathematics: A General DNA Splicing Model
    - DNA Computers: What's the State of the Art?
        - Pâun, G., G. Rozenberg, et al. (1998). DNA Computing: New Computing Paradigms. Berlin, Springer.
        - Rubin, H. and D. H. Wood, Eds. (1999). DNA Based Computers III. DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, American Mathematical Society.
        - DNA9, Ninth International Meeting on DNA Based Computers, June 1-4, 2003, Madison, Wisconsin (http://analytical.chem.wisc.edu/DNA9/).
- **Immune System Computing**
    - The Immune System—An Introduction
    - Applications of Immune System Computing
        - Corne, D. W., M. Dorigo, et al., Eds. (1999). New Ideas in Optimization, McGraw-Hill.
        - Dasgupta, Dipankar (2002). Artificial Immune Systems: Theory and Applications, Tutorial, CEC 2002, Congress on Evolutionary Computation, Hawaii, 2002.
- **Evolution and Development**
    - L-systems, Cellular Encoding, and Genetic Programming
    - (Co-)Evolution of Morphologies and Behaviors
        - Work of Karl Sims, GenArts Inc., http://www.genarts.com/karl/.

        - Hod Lipson and Jordan B. Pollack. Automatic Design and Manufacture of Robotic Life Forms, GOLEM (http://demo.cs.brandeis.edu/golem/).

    - Evolvable Hardware: The Darwin Chip—Dream or Reality?

        - M. Sipper and D. Mange, Eds., *IEEE Transactions on Evolutionary Computation: Special Issue -- From Biology to Hardware and Back* , vol. 3, no. 3, September 1999.
        - M. Sipper and E. M. A. Ronald, A New Species of Hardware, *IEEE Spectrum, March 2000*, pp. 59-71.

Part II. **Biology Goes Digital**

- **Explorations in Complexity**

    - Cellular Automata and the World of Simple Programs

    - Evolution of Parallel Cellular Machines

        - Sipper, M. (1997). Evolution of Parallel Cellular Machines: The Cellular Programming Approach. Berlin, Springer.

    - Substitution Systems and Beyond

    - Small-World Phenomena in Networks

        - Watts, D. J. (1999). Small Worlds: The Dynamics of Networks between Order and Randomness. Princeton, NJ, Princeton University Press.

    - Self-Organized Criticality

        - Jensen, H. J. (1998). Self-Organized Criticality: Emergent Complex Behavior in Physical and Biological Systems. Cambridge, Cambridge University Press.

- **Artificial Chemistries**

    - **An Overview**

    - Autocatalytic Sets, Random Catalytic Networks, and Self-reproduction

        - Dittrich, P., J. Ziegler, et al. (2001). "Artificial Chemistries—A Review." Artificial Life **7**(3): 225-275.

    - Classifier Systems and Random Boolean Networks

    - Self-organization, Reaction and Gene Regulatory Networks

- Kauffman, S. (1995). At Home in the Universe: The Search for Laws of Self-Organization and Complexity. Oxford, Oxford University Press.