GEOGR 6010 –GeoComputation– Spring 2004	
Instructor:	Prof. Harvey J. Miller
Meeting time and place	MW 12:45 PM – 1:55 PM OSH 215
Office hours and location:	Monday, Wednesday 10:00 – 11:30 am OSH 270 or by appointment. (Feel free to contact me about an appointment!)
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TEXTS

1. Gary William Flake (1999) *The Computational Beauty of Nature*, MIT Press.
2. Jo Wood (2002) *Java Programming for Spatial Scientists*, Taylor and Francis

Additional readings on reserve at Marriott library.

COURSE DESCRIPTION

It is likely that most of your previous education in quantitative research methods has focused on statistical and mathematical techniques. While classical statistical and mathematical modeling is useful, it has its limits. Increasingly, digital geographic data are voluminous, complex, ill-structured and doesn't always fit the assumptions of classical statistics. Many geographic phenomena and problems are too complex to fit the assumptions of classical mathematical modeling (e.g., smooth, continuous and well-behaved functions).

GeoComputation concerns the application of computers to analyze and communicate digital representations of the Earth. While GIS provides the environment, geocomputation is distinct since it emphasizes dynamic processes over static form and user interaction over passive receipt of information. Geocomputational tools can tackle difficult geographic analysis problems and data sets that cannot be handled using traditional math and statistical techniques.

LEARNING OBJECTIVES

This course is a high-level, rigorous survey of computational techniques as applied to human and physical systems. Successful completion of this course will meet the following learning objectives.

1. An understanding of the complexities of geographic data and phenomena
2. An understanding of the limits of classical quantitative methods in geographical analysis and modeling
3. Basic understanding of computation principles and specific geocomputational techniques sufficient to begin advanced exploration and application of these techniques in geography and geographic information science

COURSE FORMAT AND EVALUATION

Examinations — 65% of final grade

There will be a total of six examinations on the following topics:

- Computational science, geocomputation and the nature of computation
- Fractals
- Chaos
- Complex systems
- Adaptation
- Neural networks

Assignments — 35% of final grade

POLICIES

- Individual extra credit will not be assigned
- An "incomplete" will be given only in extreme cases when conditions beyond the student's control require an extended period of absence.
- The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you need accommodations in this class, reasonable prior notice needs to be given to the instructor and the Center for Disabled Student Services, 581-5020 (voice or TDD).

IMPORTANT DATES FOR SPRING SEMESTER 2004

- Martin Luther King Jr. Day holiday - Mon, January 19
- President's Day holiday - Mon, February 16
- Spring Break - Mon-Fri, March 15-19
- Classes end - Wed, April 28
- Final exam period April 30-May 6

ASSIGNMENTS

In order to give you "hands-on," "nuts and bolts" experience with computation, there will be a series of Java programming assignments based on the Wood (2002) text. These exercises are not designed to make you a professional-grade programmer but rather introduce you to programming, and also how a computer and software work at a more detailed and deeper level than the discussion in the text and lectures. You will be required to read this text on your own and complete short programming exercises associated with each chapter. The schedule and assignments will be posted at the WebCT site.

If you are an experienced programmer, you can propose a term project as an alternative to the elementary programming exercises. Please contact the instructor as soon as possible.

WEB TOOLS

Online course materials and links to relevant websites will be provided through a WebCT course homepage (http://webct.tacc.utah.edu/). **Students are responsible for all material posted on this page and are expected to check this page frequently for these materials and any announcements.** Students should treat webpages similarly to assigned readings, in other words, explore and **study** these pages in advance of the corresponding class meeting.

COURSE OUTLINE AND READINGS	
Topic	**Reading**
1. Computational science and geocomputation	
1.1. Overview of computational science	Flake Chp. 1
1.2. Geocomputation	Benenson and Torrens (2004); Couclelis (1998a, 1998b), Openshaw (2000)
2. The nature of computation	
2.1. Number systems and infinity	Flake Chp. 2
2.2. Computability and incomputability	Flake Chp. 3 & 4
3. Fractals	
3.1. Self-similarity and fractal geometry	Flake Chp. 5
3.2. L-systems and fractal growth	Flake Chp. 6
3.3. Affine transformation fractals	Flake Chp. 7
3.4. The Mandlebrot set and Julia sets	Flake Chp, 8
3.5. Postscript: Fractals	Flake Chp. 9
4. Chaos	
4.1. Nonlinear dynamics in simple maps	Flake Chp. 10
4.2. Strange attractors	Flake Chp. 11
4.3. Producer-consumer dynamics	Flake Chp. 12
4.4. Postscript: Chaos	Flake Chp. 14
5. Complex systems	
5.1. Cellular automata	Flake Chp. 15
5.2. Autonomous agents and self-organization	Flake Chp. 16
5.3. Competition and cooperation	Flake Chp. 17
5.4. Postscript: Complex systems	Flake Chp. 19
6. Adaptation	
6.1. Genetics and evolution	Flake Chp. 20
6.2. Natural and analog computation	Flake Chp. 18
6.3. Neural networks and learning	Flake Chp. 22
6.4. Postscript: Adaptation	Flake Chp. 23

OTHER READINGS

Benenson, I. and Torrens, P. (2004) "Geosimulation: Object-based modeling of urban phenomena," *Computers, Environment and Urban Systems*, 28, 1-8.

Couclelis, H. (1998a) "Geocomputation and space," *Environment and Planning B*, 41-47.

Couclelis, H. (1998b) "Geocomputation in context," in P. A. Longley, S. M. Brroks, R. McDonnell and Bill Macmillan (eds.) *Geocomputation: A Primer*, John Wiley, 17-29.

Openshaw, S. (2000) "GeoComputation," in S. Openshaw and R. J. Abrahart (eds.) *GeoComputation*, 1-31.