Computer Simulations
an Introduction to Scientific Research

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Computer Simulations — Intro to Scientific Research

Interdisciplinary Capstone Course (Seniors) : Computer Simulations

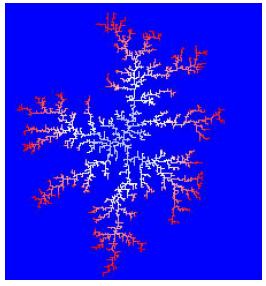
Goals:

- computer simulations & modeling
- scientific research

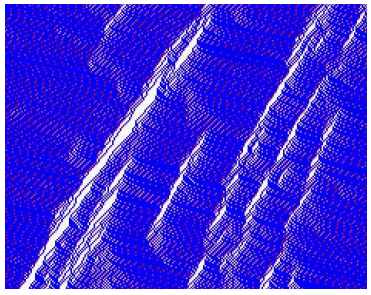
Date	In Class (mostly lab)	Individual Project (seminar,homework, office hours)
Jan. 15	Introduction to C++	Literature Search (Specify Model)
Jan. 20		
Jan. 22		
Jan. 27		
Jan. 29	Cellular Automata: Game of Life	Background Reading
Feb. 3		
Feb. 5		
Feb. 10		
Feb. 12	Mini Project I	
Feb. 17	Traffic Flow	Scientific Paper
Feb. 19		
Feb. 24		
Feb. 26		
March 3	Talks Intro	
March 5	Mini Project II	

Date	In Class (mostly lab)	Individual Project (seminar,homework, office hours)
March 17	Talks I	Flow Diagram & Program
March 19		
March 24		
March 26	Fractal Growth	Program & Analysis
March 31		
April 2		
April 7		
April 9		
April 14	Project III	
April 16	Guest Speaker	Abstract
April 21	Symposium: Talks II	Scientific Paper
April 23		
April 28		

Final Public Talks: Poster



Computer Simulation Symposium



April 21 (Tuesday) in Olin 264:

9:30 am *Garrett O'Malley, "Simulations of Front Propagation in a Switching Vortex Array'*
9:50 am *Steve LoFurno, "Computer Simulation of The Game Risk"*
10:10 am *Mark Ryan, "A Simulation of Gene Flow in a Species"*

April 23 (Thursday) in Olin 264:

9:30 am *Rob Trangucci, "Bankruptcy Prediction Modeling Using an Artificial Neural Netwo*
9:50 am *Brandon Liebeskind, "Projecting The Incidence of Cornoary Heart Disease" And It's Associated Medical Costs: Ranging From 2005 To 201*
10:10 am *Kyle VanBuskirk, "Composition of Music With a Computer Simulation"*
10:30 am *Evan Wessler, "Altruism And The Prisoner's Dilemma: A Computer Simulation"*

April 28 (Tuesday) in Olin 264:

9:30 am *Kerry Boyle, "Game Al: An Analysis of Adversaries"*
9:50 am *Deborah Vicinsky, "Prime Number Races"*
10:10 am *John O'Neill, "Simulation of Our Solar System"*

These presentations are part of CAPS 499–11: Computer Simulations (K. Vollmayr–Lee)

Models

In Class Topics:

- Game of Life
- Traffic Flow
- Fractal Growth

Student Topics:

- Synchronization of Fireflies
- Protein Folding
- Car Trade
- Foraging Ants
- Forest Fire
- Population Dynamics
- Composition of Music
- Bankruptcy Prediction
- etc.

Game of Life

John Conway's Game of Life:

[M. Garnder, Scientific American **223**, 120 (1970)]

0	0	0	0	0	0	0	1	1	0
0	1	0	1	0	0	1	1	0	0
0	0	1	1	0	1	0	0	0	1
0	1	0	1	0	1	1	0	1	1
1	0	1	0	0	1	0	0	0	0
0	1	0	0	1	0	0	1	0	0
0	0	0	0	0	0	1	0	0	1
1	1	0	0	1	1	0	0	1	0
0	0	1	0	1	0	0	1	0	0
0	1	1	0	0	0	0	0	0	0

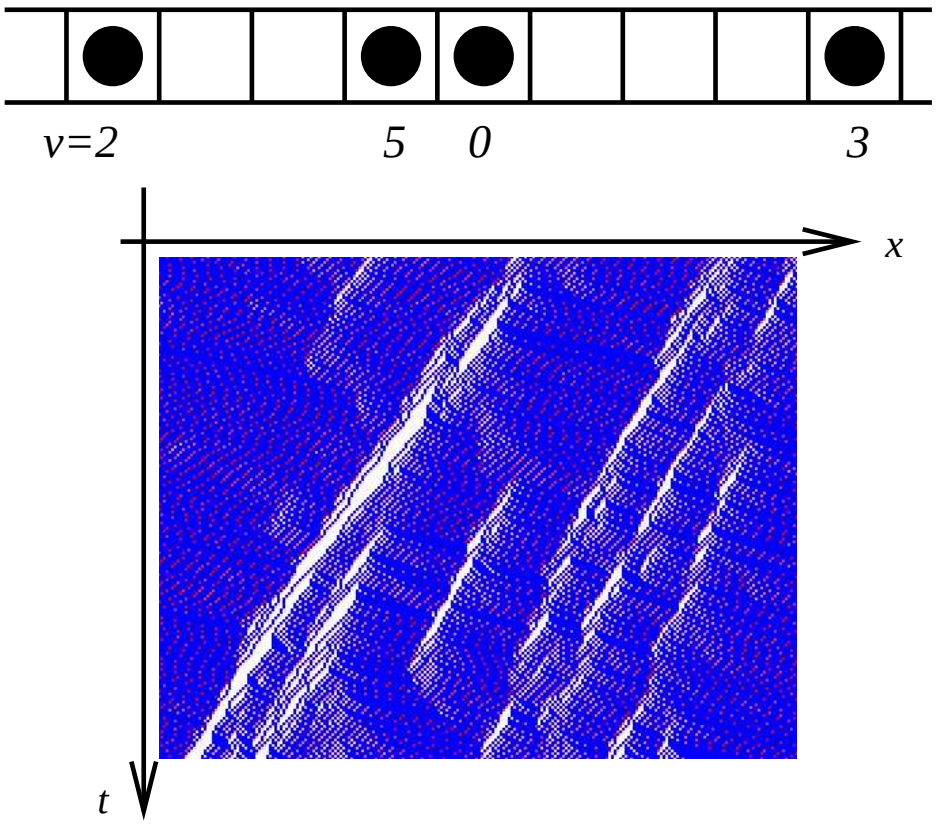
0=alive

1=dead

Traffic Flow Model

Nagel-Schreckenberg Model:

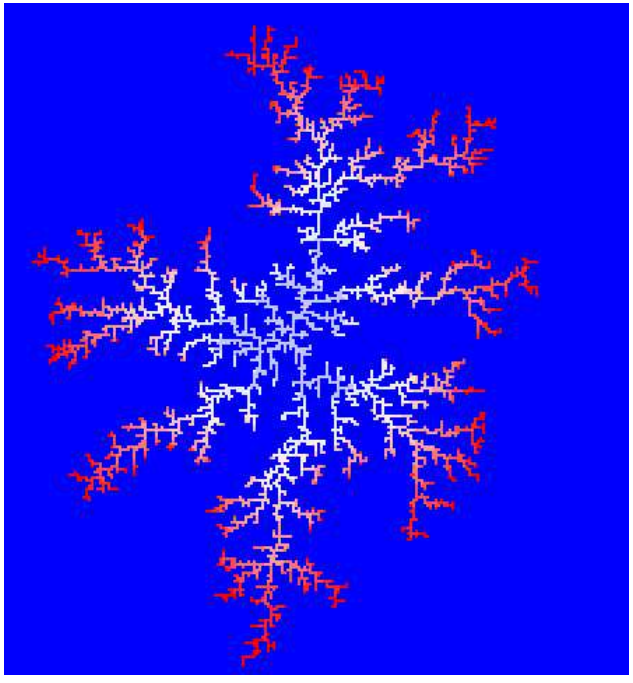
[D. Chowdhury, L. Santen and A. Schadschneider, Curr. Sci. India **77**, 411 (1999)]



Fractal Growth Model

Diffusion **L**imited **A**ggregation:

[T. A. Witten and L. M. Sander, Phys. Rev. Lett. **47**, 1400 (1981)]



Analysis: Fractal Dimension

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Challenges & Successes

Challenges:

- huge variety of programming background
- computer lab with many students but one instructor
- senioritis & last minute work
- time (many research students)

Successes:

- modeling
- research experience
- students diving into project (joy of research)

Course Webpage:

http://www.eg.bucknell.edu/~kvollmay/caps_s2009/

References:

H. Gould and J. Tobochnik, "An Introduction to Computer Simulation Methods"

R. J. Gaylord and P. R. Wellin, "Computer Simulations with Mathematica"