Biology 2Z03 - SIMULATIONS AND DYNAMIC SYSTEMS IN BIOLOGY Winter 2010

INSTRUCTOR: Brian Golding, LSB-533, Ext. 24829; Golding@McMaster.CA

COURSE DESCRIPTION:

The purpose of this course is to establish basic skills that will enable students to learn how to manipulate and analyze DNA, protein, molecules, physiologies, ... virtually any biological entity by making use of the power of computers. Some of the more simple methods/algorithms will be examined in detail and more complex methods will be outlined.

The class will have formal lectures that describe the relevant principles followed by weekly computer-based exercises/laboratory exercises that provide a hands on experience in the application of these principles.

PREREQUISITES: Some previous knowledge of computer programming

FORMAT: Two lectures per week - TF 8:30 - 9:20 am T13/105
One computer laboratory - M 12:30 - 2:20 pm BSB/B142

Class web site: http://helix.biology.mcmaster.ca/courses.html

Textbooks: Computer Simulation in Biology - A BASIC introduction: Keen & Spain
Numerical Recipes in C: The Art of Scientific Computing: W.H.Press et al.
Computer Simulation and Data Analysis in Molecular Biology and Biophysics - An introduction using R: V. Bloomfield
Simulating Ecological and Evolutionary Systems in C: W. Wilson

Grades:

Class Lecture #1	- 20
Class Lecture #2	- 20
Programming Labs	- 40 (Pass/Fail)
Midterm	- 10
Exam	- 10

TENTATIVE SCHEDULE: completely subject to change

		Monday Laboratory		Tuesday		Friday optional
Jan	4		5	Course Outline	8	–
	11	Preliminaries	12	Introduction[1]	14	–
	18	Sub/Str/Debug	19	A	21	–
	25	Pop Growth	26	B	28	–
Feb	1	Physiology Models	2	C	5	–
	8	Diseases #1	9	D	12	–
				READING WEEK		
	22	Diseases #2	23	E	26	F
Mar	1	Simulating Genes #1	2	a	2	–
	8	Simulating Genes #2	9	b	9	c
	15	Simulating Genes #3	16	d	16	–
	22	Matrix Models	23	e	23	–
	29	Markov Models	30	f	30	–
Apr	5	MCMC	6	Review		

1 - Features of simulations: What are models? What types of simulations are there? Analytical, stochastic, dynamic, discrete, continuous.

A - Simple growth (or decay): Chpt 1.1-1.8 +? 8.1-8.3 +? 7.1, 7.4-7.6

B - Physiology (compartmental models): Chpt 15 +? Chpt 13 +? Chpt 14

C - Spread of diseases #1 (simple SIR models): Chpt 24 +?

D - Spread of diseases #2 (SEIR models, time delays): +?

E - Random genetic drift: Chpt 18.2, 20.1-20.2, 20.5 +?

F - Making use of randomness: How random number generators work. How to get different distributions of random numbers. (Numerical Recipes + Chpt 19.4-19.6, +?)

a - Simulating genetic drift with selection (?): TBA

b - Simulating genes backwards: TBA

c - Matrix models, age structured models: Chpt 16

d - Monte Carlo methods: Chpt 18

e - Markov Chain models: Chpt 21

f - The mysteries of a MCMC, Markov Chain Monte Carlo method: TBA