Computational Neuroscience – BIO 5483- Spring 2009

Class: Tuesday and Thursday 10:30-11:45 p.m. –
UTSA 1604 Campus, BSE 3.112 (Computational Biology Initiative Room)

Instructor: Dr. Fidel Santamaria Office Hours: M/W 4:00-5:00pm. BSB 1.03.28 (1604 Campus)

Text: *Biophysics of computation* by Christof Koch*. Supplementary reading: Dendrites* by Stuart, Sprutson, Hausser*. Theoretical Neuroscience* by Dayan and Abbott.

Course WEB Site: http://webct.utsa.edu

Course Description: The aim of the course is to study the biophysical foundations of how neurons process information. Students will be exposed to computational concepts that are applicable to study neurobiology. Class assignments will include reading, computer exercises, and projects.

Prerequisites: There are no special requirements. There will be computer and mathematical exercises but the main focus will be on concepts. There will be plenty of support to learn and do the computational modeling assignments. Similarly, there is no need to have taken a neurophysiology course since each topic will explain the basic information needed.

Attendance: **Attendance at all classes is strongly advised.** This course moves quickly, covers a large amount of material and continually builds on previous concepts. **It is also recommended that students prepare for lecture by reading the assigned chapters in advance.**

Grading:

Participation	100
Homework	500
Programming	200
Final project	300
	1000

Homework: Homeworks will include reading papers, data analysis, running tutorials in GENESIS and/or NEURON.

Programming: The students will be given a basic introduction to programming in Matlab. Simple problems will be given as homework, e. g. Multiplication of matrices, for-loops, data structure, file I/O.

Final project: Each student has to select a project to be carried out during the semester. The project could be related to the research carried out in his/her lab. The project could be literature review, data analysis, or simulations.

****There are no opportunities for extra credit**.**

Policy on cheating: Students are expected to be above reproach in scholastic activities. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the University. “Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an exam for another person, any act designed to give unfair advantage to a student of the attempt to commit such acts.” Regents’ Rules of Regulations, Part one, Chapter VI, section 3, Subsection 3.2 Subdivision 3.22. Since scholastic dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced.

Class Schedule

DATE			TOPIC	Chapter Koch	Home Work Due @ 8 am	
January	13	T	Introduction – Dynamical systems.	7	HW1 Program 1 'Hello World'	
	15	Th	Canonical computational structures.		HW 2 Program 2 Matrix multiplication	
	20	T	Computation in the Visual system. Programming vectors and matrices		HW 3 Program 3 For-loops	
	22	Th	Intro to neural excitability	5	HW 4 Program 4 Conditional statement	
	27	T	The cable equation Programming an equation	6-7	HW 5 Program 5 File I/O	
	29	Th	Presentations of Projects		HW 6 Program 6 Plot	
February	3	T	Dendritic computation	5	HW7 Program 7 Functions	
	5	Th	Ion channels		HW8 Program 8 Integrals and derivatives	
	10	T	Integrate-and-fire		HW9 Program 9 Simbio	
	12	Th	Rate code vs temporal code		HW10 Program 10 Parallelization I For-loops to matrices	
	17	T	Networks		HW11 Program 11 Parallelization II Speed gains	
	19	Th	Spikes		HW12 Program 12 Simulation I Integration	
	24	T	Spike trains		HW13 Program 13	

					Simulation II Integrate and fire	
	26	Th	**PRESENTATION OF PROJECTS**			
March	3	T	Temporal vs firing rate code		HW14 Program 14 Simulation III Two neurons	
	5	Th	Hodgkin and Huxley 1		HW15 Program 15 Simulation IV Networks	
	17	T	Hodgkin and Huxley 2		HW16 Program 16 Analysis I Correlation coefficient	
	19	Th	Voltage dependent ion channels		HW17 Program 17 Analysis II Cross-correlation	
	24	T	Spike train analysis I		HW18 Program 18 Analysis III PSTH, ISI	
	26	Th	Spike train analysis II		HW19 Program 19 Analysis IV CV	
	31	T	Information processing in spines		HW20 Program 20 Advanced modeling and analysis Monte Carlo: Sampling	
April	2	Th	**Presentation of projects**			
	7	T	Computational vision		HW21 Program 21 Monte Carlo: Simulation	
	9	Th	The cerebellar cortex		HW22 Program 22 Genetic algorithms	
	14	T	Olfaction		HW23 Program 23 Andvanced signal processing: Fourier transforms	

	16	Th	Artificial neural networks		HW24 Program 24 Filtering	
	21	T	Biochemical signaling		HW25 Program 25 Curve fitting	
	23	Th	Plasticity I		HW26	
	28	T	PLASITICTY II			