CPSC 689-603 Computations in Neural and Biological Systems: Spring 2005

Course Advertisement (1/6/04)

Syllabus

NEWS: *1/19/05, 02:11AM (Wed)*
• [1/19] Syllabus ready for Spring 2005. • [1/19] If you already took one of my "Intelligence in Neural Systems" course, please do not sign up for this course.
Read-Only Bulletin Board: 1/6/05, 04:42PM (Thu)

Page last modified: 1/19/05, 02:21AM Wednesday.

General Information | Resources | Reading List | Weekly Schedule | Lecture Notes

I. General Information

Instructor:

Dr. Yoonsuck Choe
Email: choe(a)tamu.edu
Office: HRBB 322B
Phone: 845-5466
Office hours: TBA

Prerequisite/Restrictions:

CPSC 625, or consent of instructor.

Lectures:

MWF 11:30am-12:20pm HRBB115.

Introduction:

What is the nature of computation in neural and biological systems that enable complex adaptive behavior in organisms? The focus of this course is to address this very question from various different perspectives. Select topics from computational neuroscience, computational vision, and cognitive science (and artificial intelligence) will be reviewed and critiqued. In the first few weeks, basic computational and mathematical preliminaries, as well as neuroscience basics will be covered. Afterwards, a selected collection of current research papers will be discussed. The course is designed to be open-ended to some degree, and a large portion of the time will be dedicated to discussion of the topics.

Goal:

The goal of this course is to

1. learn basic computational and mathematical tools for investigating computations in neural and biological systems;
2. get acquaninted with diverse computational approaches to the understanding of brain function; and
3. explore how the seemingly disjoint topics can be integrated in a unique synthesis.

Textbook:

- Required: Dana Ballard, "Introduction to Natural Computation", MIT Press, 1997.
- Required: paper collection compiled by the instructor. Most of the papers are available online.
- Optional, but *highly* recommended: Michael A. Arbib (Editor), "The Handbook of Brain Theory and Neural Networks", Second Edition, MIT Press, 2002
- Optional: Pfeifer and Scheier, "Understanding Intelligence", MIT Press, 1999.

Administrative Trivia:

1. Computer accounts: if you do not have a unix account, ask for one on the CS web page.
2. We will use Matlab(tm) (there is also an excellent open source clone called GNU/Octave). Matlab is installed on all SunOS machines (and also on the Windows machines -- I've got to check).

Topics to be covered:

See the Weekly Schedule section for more details.

- nervous system overview
- computational tools and basic theoretical concepts
- natural sensory statistics and neural coding,
- visual illusions and their neural mechanisms,
- inhibition and disinhibition in neural systems,
- self-organization in neural networks,
- connectivity analysis in biological networks,
- active approach and analogy,

- understanding the behavior of dynamical agents,
- evolutionary computation,
- time in perception and cognition, and
- semantics and the role of action in perception and cognition.

Grading:

1. Assignments (~~30%~~20%): short programming assignment (~~10% each~~).
2. Paper comments (20%): for the reading assignments each week, a brief (one paragraph) comment/critique must be submitted. Occasionally, the instructor will ask a specific question or ask the student to comment on a particular aspect of the paper.
3. Paper presentation (10%): each student will study and present a paper from the reading list. The term project may be loosely based on this paper.
4. Term project (30%): 6-7 page term paper (double spaced) describing the project, and project demo and a presentation (20 minutes + 5 minutes Q/A). The project can either be done individually or as a team of two to three.
5. Take-home midterm (10%)

Grading will be on the absolute scale. The cutoff for an 'A' will be at most 90% of total score, 80% for a 'B', 70% for a 'C', and 60% for a 'D'. However, these cutoffs might be lowered at the end of the semester to accomodate the actual distribution of grades.

Academic Policy:

The TAMU student rules (http://student-rules.tamu.edu/), Part I Rule 20 will be **strictly** enforced.

Students with Disabilities:

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life: Services for Students with Disabilities in Room 126 of the Koldus Building, or call 845-1637. (The source of this passage is TAMU Phil320 Syllabus.)

Resources:

1. Neural Networks: Sharewares and Freewares (Thanks to Subru)
2. Thalamus slices
3. Neuroscience Tutorial at The Washington University School of Medicine. (Thanks to Barani)
4. Research resources page
5. Ganeral reading list (u: p:): includes short blurb about how to find, read, and critique others' work. This list is **not** the course reading list.

III. Weekly Schedule and Class Notes

- **Lecture notes (in PDF format)**: all notes will be uploaded in this directory.
- It is **your responsibility** to download, print, and bring the notes to the class. Notes will be available 24 hours before each class.
- See the **2005 Spring TAMU Calendar** for breaks, etc. May 4th is the last class day (note that it is Tuesday).
- This is a very rough draft: More detail will be available as we go along.

Under heavy construction

Week	Date	Topic	Reading	Assignments	Notices and Dues	Notes
1	1/17	MLK Day (Holiday)				
1	1/19	Introduction				
1	1/21	Nervous system basics				
2	1/24	Intro wrap up	Bell (1999; reading list)			
2	1/26	Probability/Bayesian framework				
2	1/28	Information theory				
3	1/31	Bayesian vs. Info Theory	Ballard chapter 2			
3	2/2	Cognition/ Redundancy/ Learning	Langlois and Garrouste (1997)			
3	2/4	Basic computational tools	Ballard chapter 4, chapter 6			
4	2/7	Computationalism	Searle (1997; reading list; photocopy)			
4	2/9	"	"			
4	2/11	Schema theory	Arbib (1996; reading list; photocopy)			
5	2/14	Imitation	Arbib (2003; pp606-611; photocopy)			
5	2/16	Imitation using Bayesian approach	Rao et al. (2004)			
5	2/18	Visual illusions	Yu and Choe (2004)			
6	2/21	Interactive vision	Churchland et al. (1994; readling list; photocopy)			
6	2/23	Action and Semantics	Choe and Bhamidipati (2004; reading list; Bio-ADIT)			
6	2/25	Eigenbehavior	Von Foerster			
7	2/28	Thalamus	Hill and Tononi (2003; reading list); Guillery and Sherman (2002; reading list)			

7	3/2	Thalamus and Analogy	Choe (2003; reading list; IJCNN pp.1480-1485)		
7	3/4	Analogy with Binary Spatter Code	Kanerva (1998; reading list -- both)		
8	3/7	Evolutionary Learning	Gomez and Miikkulainen (1998; reading list)		
8	3/9	Time in the neural system			
8	3/11	Time in the neural system			
9	3/14	**Spring Break**			No class
9	3/16	**Spring Break**			No class
9	3/18	**Spring Break**			No class
10	3/21	Neural mechanism of delay compensation			
10	3/23	Rhythm recognition	Buisson, J.-C., A rhythm recognition computer program to advocate interactivist perception, *Cognitive Science*, 28:75-87, 2004 [PDF] (demo)		
10	3/25	**Reading Day**	**No Class**		
11	3/28	Dynamical systems	Beer (2000; reading list); Ballard chapter 5		
11	3/30	Natural scene statistics	Lee and Choe (2003; reading list; IJCNN pp.206-211), Barlow (2001)		
11	4/1	**No class**		To attend WAM-BAMM'05; Make-up TBA	
12	4/4	Natural scene statistics and neural coding			**4/5: Q-drop**
12	4/6	Self-organization in the visual cortex	Choe and Miikkulainen (Biol. Cyb. 2004)		
12	4/8	Self-organization in the visual cortex	Choe and Miikkulainen (Biol. Cyb. 2004)		
13	4/11	Paper presentation 1			
13	4/13	Paper presentation 2			
13	4/15	Alternative essenses of AI	Brooks (1998; reading list)		
14	4/18	Active Vision	Granlund (1998)		
14	4/20	Topic TBA			
14	4/22	Topic TBA			
15	4/25	Topic TBA			
15	4/27	Topic TBA			
15	4/29	Topic TBA			
16	5/2	Project presentation			
16	5/4	Project presentation			
16	5/3	Course wrapup			

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