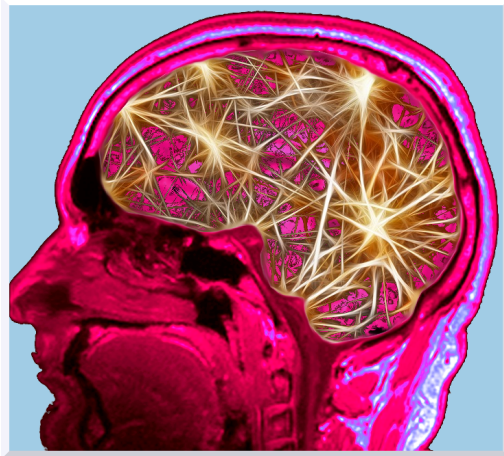


From Neurons to Thoughts

Honors 290 (6), Fall 2015

Tu/Th 11:00am - 12:15pm

Mohinish Shukla, Psychology



Where does a *thought* come from? What constitutes the *mind*? These fascinating questions have long intrigued philosophers, biologists, psychologists, creative artists, and, more recently, computer scientists and roboticists. Cognitive Science is a multi-disciplinary field that includes research from all these disciplines and more! A central element of the field is the idea that the mind can be conceived very generally as an information-processing device that resides in the biological tissue of our brains. In particular, researchers have shown that networks of neurons can help

us understand processes in various cognitive domains like perception, memory, or language.

The primary goal of this class is to understand how the broadest conception of the mind can be related to how neurons work. Students will first be exposed to the prominent philosophical view of the mind, followed by an introduction to the brain as a whole. We will then explore neurons and the neural architecture in the brain (pathways and areas). We will then examine simple mathematical models for neurons, and build small neural networks. Note: the only mathematical prerequisites is high school arithmetic! The focus will be to understand the logic behind neural computing, and build a simple network that can recognize objects (a *perceptron*). We will explore other views of perceiving object, and briefly cover the major themes in cognitive science – attention, memory, and language.

Classes are expected to be highly interactive, and group work will be encouraged. We will read articles, watch clips from resources like TED Talks and *Star Trek*, and read one short story. Grades will be based on class attendance and participation (15%), in-class and take-home quizzes and short papers (35%), group exercises and presentations (30%), and a final, 5+ page paper.

UMass Boston

Honors 290(06), Fall 2015: From Neurons to Thoughts

Tue/Thu, 11:00am to 12:15pm

Course syllabus and guidelines

NB: This syllabus is subject to change, depending on class progression

Instructor: Mohinish Shukla
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McCormack-4-261 Ph: 617-287-6302

Office hours: Tue/Thu, 2:00pm to 3:30pm,
and by appointment

Course description: Where does a thought come from? What constitutes the mind? These fascinating questions have long intrigued philosophers, biologists, psychologists, creative artists, and, more recently, computer scientists and roboticists. Cognitive Science is a multi-disciplinary field that includes research from all these disciplines and more! A central element of the field is the idea that the mind can be conceived very generally as an information-processing device that resides in the biological tissue of our brains. In particular, researchers have shown that networks of neurons can help us understand processes in various cognitive domains like perception, memory, or language.

The primary goal of this class is to understand how the broadest conception of the mind can be related to how neurons work. Students will first be exposed to the prominent philosophical view of the mind, followed by an introduction to the brain as a whole. We will then briefly explore neurons and the neural architecture in the brain (pathways and areas). Then, we will study simple mathematical models for neurons, and build small neural networks. Note: the only mathematical prerequisite is high school arithmetic! The focus will be to understand the logic behind neural computing, and build a simple network that can recognize “objects” (a perceptron). We will explore other views of perceiving objects, and briefly cover the major themes in cognitive science – attention, memory, and language.

Classes are expected to be highly interactive, and group work will be required. We will read articles, watch clips from resources like TED Talks and Star Trek, and read one short story. Grades will be based on class attendance and participation, in-class and take-home quizzes and short papers, group exercises and presentations, and a final paper. Work on the final paper will begin towards the beginning of the class, continue in parallel throughout the semester, and will require a fair amount of independent research and thought on your part.

It is your responsibility to read and understand this syllabus thoroughly, and discuss any questions/concerns with the instructor by the end of the second class.

☪ **This is an interactive, research focused class.** We will discuss theoretical and empirical research in cognitive science. Bring your best interactive and analytic skills to the classroom! This will count towards your final grade.

☪ **This class requires significant group work.** You will make presentations and work on the outline of your final paper in groups. This will count towards your final grade.

Reading and note taking: There is no single textbook. All readings will be posted on Blackboard. Any slides will be posted to Blackboard after the class when they are shown. Given the interactive nature of the class, you are required to take extensive notes! Please maintain an active class notebook (see assessments below).

Attendance: Daily attendance is required. If you cannot make any class please let the instructor know asap. Keep in mind that regular attendance will count positively towards your final grade.

Class communication: The instructor will post any assignments, notes, readings, preliminary scores, and other instructions primarily through Blackboard and/or your UMB email ids. It is your responsibility to check your email and Blackboard often.

Participation: Students are expected to complete reading assignments before class. You are required to participate in class discussions and to ask questions and request clarifications. This is a very important part of the class. If you are uncomfortable or unable to engage in discussions during the class, please discuss this with the instructor.

Electronic devices: Unless required for the coursework, they must be put away.

Evaluations:

Please note that it is your responsibility to make sure you attend the exams and turn in your assignments on time (see below for late/missed deadline penalties).

Summary table of assessments

Assessment	Point breakdown	Contribution to final
8 short papers / in-class quizzes	5 points each (drop lowest score)	35
3 group presentations	10 points each	30
Final paper	5 points for outline (group) 10 points for draft 5 points for final, revised version	20
Classroom participation, notes	10 points	10
Attendance	5 points	5

1) **Eight short take-home papers and/or in-class quizzes** (each worth 5 points). Quizzes will consist of short-answer and/or multiple-choice questions. Short papers will be assigned on certain Thursdays (please note: these are NOT marked on the timetable!), and will be due in class the following Thursday. The 7 best scores will be considered towards your final grade. NOTE: missed quizzes will be given a zero and will count as your lowest score. So, if you miss one quiz/short paper, please make sure you complete all the rest, so that you don't lose points.

2) **Three group presentations** (worth 10 points each). Each group will be required to make three presentations on designated days, which will be announced in class. You will have at least a week to prepare a short, 10-min presentation. Points will be assigned for content (5), clarity (3), and conciseness (2). Content refers to the actual content of the presentation: is the presentation a comprehensive summary of the provided topic? Clarity and conciseness go hand-in-hand: you want your presentation to be brief, but also very clear.

3) **One final paper** (worth 20 points). In the first few weeks, you will be introduced to a short article (available through Blackboard), which will serve as the inspiration for your final paper. You will be required to read this article, and plan a paper around its central theme. Your final paper must include at least five supporting sources (primary or secondary). You will begin research on a topic related to the provided short article in

groups, but the final paper must be your own (see below). Precise details of your final writing assignment will be discussed in class.

Please check Blackboard for the article, a resource for reading scientific articles, and a template for writing the outline and the final paper. Minimum length: 1500 words. Only hard copies of outlines/drafts/papers, using the provided template, will be considered!

Your paper will go through three stages. The first is an outline, worth 5 points. You will work out the outline in groups. An outline provides the skeleton for your final paper, and must include at least three additional resources. The outline should indicate the major sections and sub-sections of your final paper, so the overall goal of the final paper is adequately conveyed. Each group only needs to submit a single outline.

The second stage will be the complete draft version. This is a complete version of your paper, with all sections and references, and will be evaluated to make sure that it does a good job in keeping with the original goal that you have provided in your outline. It will also be evaluated – and feedback will be provided – regarding the readability, logical soundness, clarity, and style. The draft is the major part of this assignment, and is worth 10 points. Each student is required to work on the draft individually.

Based on feedback and comments on the draft, you will prepare your final paper. Here, evaluation will consist of looking at how you have improved your draft, based on the provided comments/feedback. This will be worth 5 points, and will be due on the day of your final exam. Note, there is no final exam; all you need to do on the final exam day is turn in your final paper! Keep in mind: the better your draft version, the less you need to work on your final version!

Please check the timetable for deadlines! Take-home assignments and papers will be penalized 20% of the points each day they are late, and will get an automatic 0 after 5 days.

4) **This is an interactive class.** You are encouraged to engage in rational, analytic discussion at all times. Since we don't have a single textbook source, most of the learning will emerge through our discussions and readings, and so it is imperative that you take good, comprehensive notes. These notes can be elaborated upon even outside the classroom, when you are researching material for your presentations or your written assignments, or when you have group discussions. I will occasionally ask to see your notes (check the timetable), to gain insight into how you are engaging with the class. I will assess your involvement through classroom discussions and your notes, and this will be worth 10 points.

5) **Attendance.** Given the interactive nature of the class, attendance is vital, and will count for 5 points.

Expectations for written work: In order to get a good score, your writing must be (a) creative (b) organized and (c) technically sound. Creativity implies both that you have thought critically about the material, and that you are able to clearly express your own thoughts, and not just repeat what you hear or read. Organized refers to how you structure your thoughts and the document. Is there a clear "flow" of ideas? Is the text broken down into a logically connected series of sections and sub-sections? Technically sound implies that your text is free of misspellings and grammatical errors, and that you use a consistent style and formatting of the document, including citations.

Academic dishonesty: Any act of academic dishonesty will incur penalties ranging from getting a failing grade on an individual evaluation to failing the entire course. Be particularly aware that, when writing your open-ended essays, you use your own thoughts and words. If you do copy something (a sentence, a passage) from another source, you should properly acknowledge the source; failure to do so constitutes plagiarism. But be aware: since we are also interested in your creativity, using too many quoted sources will also lead to a poorer score. Please contact the instructor if you have any questions. For additional information, consult the university website at http://www.umb.edu/life_on_campus/policies/regulations/

Makeup exams and incompletes: Makeup exams are not allowed except under rare circumstances, and only in the case of a properly documented exigency. Make-ups will be by pre-arrangement with the instructor only, and will be decided on a case-by-case basis. Each student is allowed only one make-up exam for the course. Incompletes will only be considered for documented extreme medical or family emergencies. Please contact the instructor to work out the details, should the need arise. Please remember that the university rules require that you successfully finish at least 50% of the course material in order to be considered for an incomplete.

Enhancing your learning: There are several resources on campus for enhancing your learning experience. Please contact staff and members of the various resources - they will be happy to help you. In addition to the Healey library, there are academic support programs (including writing tutors); see the website at: http://www.umb.edu/academics/vpass/academic_support/

Students with disabilities can find appropriate services at the Ross Center. Please get in touch with the Ross center and inform the instructor as early as possible if you require disability accommodations.

Upsetting Material: Course material in psychology may cause strong emotional reactions for students. Please feel free to discuss your reactions with the instructor. If major difficulties are encountered during the semester, students can access the University Counseling Center, 2nd floor, Quinn Administration Building.

Timetable

Please note: timetable might change, including the posting of additional reading materials as the class progresses. Please check the course website and your email before each class.

Week	Day, date	Topic	Notes
Week 1	Tue, 9/8 Thu, 9/10	Introduction: what is science? What is cognitive science? The mind & information processing.	Note taking debate.
Week 2	Tue, 9/15 Thu, 9/17	Representations and computations, Marr's levels of analysis, Functionalism, Star Trek clip.	Add/drop ends. Illusions Quiz
Week 3	Tue, 9/22 Thu, 9/24	The biology of the brain: structure, function, ontogeny, and phylogeny. Sensory areas and sensory maps.	Group presentation 1: brain lobes & fn.
Week 4	Tue, 9/29 Thu, 10/1	Modular organization in the brain: pathways for vision. Visual illusions. Ramachandran video.	Mona Lisa article, final paper group discussion Show me your notes!
Week 5	Tue, 10/6 Thu, 10/8	The biology of neurons: Suzana video, Hubel video.	Quiz
Week 6	Tue, 10/13 Thu, 10/15*	What neurons do. Squid giant axon videos.	Instructor away*
Week 7	Tue, 10/20 Thu, 10/22 (note location)	Building a model of neurons and their connections. Memory in neurons. Simple circuits. Building a perceptron.	Paper outline due --Class in H-UL-42--
Week 8	Tue, 10/27 Thu, 10/29	Layers, supervision. A coffee bean sorter.	Quiz
Week 9	Tue, 11/3 Thu, 11/5	Many opportunities to play with your own networks. Network theory: semantic networks & priming.	Group presentation 2: simple circuits
Week 10	Tue, 11/10 Thu, 11/12	Structure and dynamics of networks. From networks to states. Finite state machines.	Show me your notes!
Week 11	Tue, 11/17 Thu, 11/19	Building our own finite state machines. A general theory of computing.	Quiz
Week 12	Tue, 11/24 Thu, 11/26	Back to the algorithmic level: object recognition. Holiday	P/F/W deadline, 11/25 Thanksgiving
Week 13	Tue, 12/1 Thu, 12/3	Models for object recognition. Attention – allocating mental resources.	Paper (final draft) due
Week 14	Tue, 12/8 Thu, 12/10	Human language & thought. Fry & Laurie clip. Thoughts and memories.	Group presentation 3: aspects of language

*On Thursday, 10/15, you will watch a short video about illusions during your class time. You are required to write a short, take-home paper based on this video, and also use this time to discuss/reflect on your own paper outlines. Details will be discussed in the preceding class.