Course Outline

Computational Perception
COMP 546 (4 credits)
Winter 2018
Tues/Thurs 8:35-9:55 ENGTR 1080

Instructor: Professor Michael Langer
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Official Course Description from McGill Calendar

Computational models of visual perception and audition. Vision problems include stereopsis, motion, focus, perspective, color. Audition problems include source localization and recognition. Emphasis on physics of image formation, sensory signal processing, neural pathways and computation, psychophysical methods.

Overview

This course examines fundamental computational problems in visual and auditory perception. Unlike traditional perception courses offered in Psychology or Physiology departments which emphasize neural mechanisms, this course emphasizes computational aspects of perception. The course consists of two main topics, namely vision and audition. For both of these perceptual modalities, we begin by examining the signals from the environment, namely visual and auditory images, and the information that is contained in these images. For vision, we consider color, shading, binocular disparity, motion, and focus. For audition, we consider information carried by impact vs, non-impact sounds, echos, as well as binaural timing and intensity differences. For both vision and audition, we then examine how images are processed by the sensory system, using concepts and tools from linear system theory. For vision, we discuss retinal and cortical processing. For audition, we discuss how sound waves are decomposed into frequency bands by the ear and encoded by the auditory cortex. We then examine how properties of the environment can be inferred from the information that is extracted from images. For vision, we consider how depth is estimated and for audition, we consider how depth and direction are estimated. We will also briefly discuss problems of object and scene recognition.

Detailed Course Content and Materials

The course will consist of 25 lectures, each 80 minutes. Lecture slides, notes, and exercises will be given as PDFs on the public course web page . Students will be examined on this posted material. There is no textbook for the course.

Prerequisites

There are no official prerequisites for the course. However, it is assumed students can program in a

high level language, at least that level of COMP 250, and are comfortable with basic mathematics needed for an undergrad degree in computer science, in particular:

- multivariable calculus (MATH 222 or equivalent)
- linear algebra (MATH 223 or equivalent) - e.g. orthonormal basis for vector space, complex numbers
- probability (normal/Gaussian distributions and definitions such as mean and variance, joint and conditional probabilities).
- waves and optics (CEGEP level or PHYS 101/102).

The course will cover basic psychology and physiology of vision and audition. It will also cover the basic tools of linear system theory (convolution, Fourier transforms). No prior knowledge of these topics is assumed.

Evaluation

The course grade will be determined as follows:

- **Assignments** (30%)

  There will be three assignments, each worth 10% of your final course grade.

  Assignments will involve some MATLAB programming. You are not required to know MATLAB prior to the course.

  Assignments 1 and 2 will be posted around Mon. Jan. 23 and Mon. Feb. 6, respectively. These assignments will cover early visual processing. Assignment 3 will be posted much later in the course - around Mon. Mar. 27. It will cover early auditory processing.

  Policy on lateness: Without a medical excuse, students will be penalized by 2 course percentage points per day for handing in a late assignment, up to a maximum of 3 days late after which assignments will not be accepted.

- **Exams** (70 %)

  - **Midterm exam**

    The midterm exam will take place on Tues. March 13 which is the first class after the Study Break. There will be no makeup exam.

  - **Final Exam**

    The final exam will take place during the final exam period. It will cover the whole course, with a slightly heavier weighting on the material covered after the midterm.

  Your grade for the exams will either be 20% for midterm and 50% for final, or 70% for final exam, whichever is higher. If you do not write the midterm exam, your final exam will be worth 70%.

  Exams are closed book. No electronic devices are allowed. (No cell phones. No calculators.)

Other Policies/Rules

- According to School of Graduate Studies rules, M.Sc. and Ph.D. students must achieve a grade of 65 or more to pass the course.
- *Re-grading:* Mistakes can occur when grading. Not surprisingly, requests for re-grading almost always involve those mistakes in which the student receives fewer points than they deserved, rather than more. With that in mind, note that if you wish me to re-grade a question on an exam or assignment, I will do so. However, to avoid grade ratcheting, I reserve the right to re-grade other questions as well.
- *Bonus points:* If you contribute to the course by informing me of errors in the lecture slides, exercises, or assignments, then I will be very appreciative and I will make a note of it. If your final grade is just below some threshold, then your contributions may elevate your grade over that threshold.
- *Final grade:* There are many factors that determine your grades including how hard you work, how talented you are in this area, how much time you have available because of other commitments, what your academic background is, what your health situation or family situation is, etc. However, when I assign your final course grade, I will not take these other factors into account. I assign the final grade only based on your assignment and exam scores.
- *Additional Work:* Students with grades of D, F or J will not be given the opportunity to complete additional work to upgrade their grade.
- *There will be no Supplemental Exam for the course.*
- The Supplement/Deferred Exam will cover the material uniformly from the entire course and will replace the midterm + final exam grades.
- *Cheating/Collaboration:* I encourage you to discuss the assignments with each other. But no sharing code! Your discussion should be public in the sense that anyone including me should be allowed to listen in.

MyCourses Discussion Board

The instructor will moderate the mycourses discussion board. Please adhere to the following:

- Be clear: Take an extra minute and make sure that what you have written makes sense.
- Choose a suitable subject line, and stick to one topic per posting/thread in order to allow easier indexing.
- Use the search feature to see if your question has been asked before.
- Do not email the instructor with a technical question about the course material. Instead, post the question on the discussion board so that everyone can benefit from the correspondence.
- If you would like your posting to be removed – for example, because you realized that your question or comment made no sense – add a request within the thread and the instructor will remove it. No problem.

Academic Integrity

> *McGill University values academic integrity . Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures.*