Course Outline

Computational Perception COMP 546

Winter 2020

Tues./Thurs. 10:05 AM – 11:25 AM ENGTR 2120

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Office Hours:	Thursdays 12-2

Teaching Assistants (T.A.)

T.A. office hours and contacts will be posted on mycourses Announcements.

1 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. Our two main topics are vision and audition.

We will begin by examining the sensory signals from the environment, namely visual and auditory images, and the information that is contained in these images. For vision, we consider color, lightness and shading, binocular disparity, motion, and focus. For audition, we consider the spatiotemporal and frequency properties of sound and binaural timing and intensity differences between the ears.

We also examine how images are processed by the visual and auditory systems, using concepts and tools from linear system theory. For vision, we discuss how space-time images are filtered into orientation, motion, and disparity selective channels and how these channels can be combined. For audition, we discuss how sound waves are encoded into frequency bands and how interaural differences are computed.

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 and spatial position are estimated from motion, blur, disparity, and head position (vestibular) information. For audition, we consider how depth and direction of sources are estimated.

Time permitting, we will also discuss problems of perceptual organization, attention, and object and scene recognition.

The course content will consist mostly of lectures. Lecture slides, notes, and exercises will be given

as PDFs on mycourses. There will also be two poster sessions where you will have the opportunity to present research papers that they have read.

2 Course Materials

The materials will consist of a slides, lecture notes, and exercises which will be made available on mycourses or on the public web page. There is no course textbook.

3 Prerequisites

There are no official prerequisites for the course. It is assumed students can program in a high level language at least that level of COMP 250 and that 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. vector spaces, complex numbers
- probability (normal/Gaussian distributions and definitions such as mean and variance).
- waves and optics (CEGEP level or PHYS 101/102).

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

4 Evaluation

You will be evaluated based on the following.

Three Assignments ($3 \times 12.5\% = 37.5\%$)

The assignments will involve Matlab programming. You are not required to know Matlab prior to the course.

- A1 will be posted in mid-late January; it will cover basic retinal image processing.
- A2 will be posted in early February; it will cover early visual processing: orientation selection, binocular disparity, and motion.
- A3 will be posted approximately at the beginning of April and will cover linear systems theory (Fourier transforms) and sound analysis using spectrograms.

You will be given approximately two weeks to do each of the three Assignments. If you do not do an Assignment, then you will receive a grade of 0 for it. There are no exceptions. Extensions can be given only for unforeseen reasons, such as illness. The instructor reserves the right to ask for documentation.

Research Poster Presentation (12.5%)

For the research paper presentation, you will most likely work in teams of two. (This will depend on how many students are in the course at end of Add/Drop period.) You will be given a list of papers to choose from. You will read the paper, discuss it with your partner, write up a summary of the paper, and present it in a poster session. *A detailed PDF on the requirements and logistics will be posted in early February.*

Midterm Exam and Final Exam (50%)

The midterm exam will take place in class on the Tuesday March 10 which is the first Tuesday after the Study Break. There will be no makeup exam.

The Final Exam will be held during Final Examination Period.

Your grade for the exam component is a total of 50%, which will either be 15% for midterm and 35 % for final, or 0 % for the midterm and 50 % for final, whichever is higher. For example, if you do not write the midterm exam for whatever reason, then your grade will be 0 and your final exam will automatically be worth 50 % of your course grade.

Both exams will be *closed book*. No crib sheet or electronic devices are permitted.

Both exams will contain a mix of multiple choice questions and short answer questions.

McGill policy on the Evaluation scheme

As stated in Article 3.2.3, of the student assessment policy:
`https://www.mcgill.ca/secretariat/files/secretariat/2016-04_student_assessment_policy.pdf`
"*In the event of extraordinary circumstances beyond the University's control, the evaluation scheme in a Course is subject to change, provided that there be timely communications to the students regarding the change.*"

5 Miscellaneous Policies

5.1 Calculation of final course grade

There are many factors that determine your final grade, including how hard you works, how talented you are in this subject, how much time you devote to the course, what your academic background is, what your health or family situation is, etc. *However, these factors will not be considered when*

calculating your final course grade. Rather, your grade will be determined entirely by the above grading scheme.

Your final course grade will be rounded off to the nearest integer. If one has a grade of 84.4 then it rounds to 84 and one gets an A-, whereas if it is 84.6 then it rounds to 85 and one gets an A. If one's grade is 84.5, it will round it up to 85. The same round off procedure holds for low grades. If one's final course grade is 49.4 then it rounds to 49 which is an F. A very hard line is drawn here, so one does not want to fail then one should stay far away from that line. (Note that grad students need a 65 to pass.)

5.2 Regrading

Mistakes can occur when grading assignments or exams. Not surprisingly, requests for re-grading are always in situations in which students feel they received fewer points than deserved, rather than more points than deserved. With that upward tendency in mind, please note that if you wish the instructor or the TAs to re-grade a question on an exam or assignment, we will do so. However, to avoid upward grade ratcheting, *we reserve the right to re-grade other questions as well.*

5.3 Additional Work

If you receive a grade of D, F or J, you will *not* be given the opportunity to complete additional work to upgrade your grade.

5.4 Collaboration on assignments

We encourage you to discuss the assignment problems with each other, and to help each other out with debugging. We also encourage you to use the mycourses Discussion Boards. *However, there are limits to your collaboration.* You can give hints (and the TAs and instructors will give hints sometimes if you ask). However, the hints and discussion should not go so far that you are revealing the solutions to each other, and you must never copy code from each other. Any cases of suspected plagiarism will be reported to the higher authorities.

5.5 Supplemental/Deferred Exam

The Supplemental/Deferred Exam exam will be held in August. It will cover the same material as the Final Exam and will replace the Final Exam grade. The same "max" rule for midterm and final will apply.

For information on Supplemental Exams, see
`https://www.mcgill.ca/science/student/general/exams/supplemental`.

5.6 McGill language policy

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

https://www.mcgill.ca/study/2017-2018/university_regulations_and_resources/undergraduate/gi_lang_policy

5.7 McGill policy on academic integrity

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offenses under the Code of Student Conduct and Disciplinary Procedures. See http://www.mcgill.ca/students/srr/honest/ for more information