Ryerson University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

Course Outline (W2020)

ELE725: Basics of Multimedia Systems

Instructor(s)	Naimul Mefraz Khan [Coordinator] Office: ENG438 Phone: (416) 979-5000 x 6479 Email: n77khan@ryerson.ca Office Hours: Wedensdays 3-4 PM
Calendar Description	This course will cover the basic theories and principles on multimedia, including topics on: source coders, linear predictive coding, transform-domain coders, multimedia compression standards such as JPEG and MPEG series, an overview of multimedia communication across networks, and basic multimedia content analysis.
Prerequisites	ELE 532
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. Fundamentals of Multimedia, Ze-Nian Li and Mark S. Drew, Springer, 2014.
Reference Text(s):	1. Multimedia Systems: Algorithms, Standards and Industry Practices, Parag Havaldar and Gerard Medioni, Course Technology, Cengage Learning, 2010. 2. The Essential Guide to Video Processing, 2nd Edition, Al Bovik (ed), Elsevier, 2009.
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1. Interconnect concepts of engineering knowledge (signal processing, information theory and computer engineering) to design and solve real world engineering problems, pertaining to multimedia systems and coding processes for efficient storage and transmission. Learn to employ specialized engineering knowledge to understand and design core sub-components of the JPEG and H.261 video codec pipeline, and to apply statistical and structural description techniques for basic multimedia search and retrieval. (**1c**) 2. Interconnect concepts of engineering knowledge (signal processing, information theory and computer engineering) to design and solve real world engineering problems, pertaining to multimedia systems and coding processes for efficient storage and transmission. Learn to employ specialized engineering knowledge to understand and design core sub-components of the JPEG and H.261 video codec pipeline, and to apply statistical and structural description techniques for basic multimedia search and retrieval. (**1d**) 3. Integrate the calculations of error and uncertainty as integral components of investigations. Evaluate performance tradeoffs (computational and fidelity) inherent in the use of lossless, lossy, and hybrid compression techniques for audio, image and video compression. (**3b**), (**3a**) 4. Determine the optimal parameters for various multimedia encoding strategies given specific storage, bandwidth and bit error rate criteria. (**5b**) 5. Learn efficient use of MATLAB/ OpenCV programming environments to design and develop software tools. (**5a**) 6. Communicate key design choices and justify experimental outcomes in a clear/concise manner through formal technical reports. Construct effective arguments and draw conclusions using evidence collected via simulation. (**7a**) 7. Demonstrate main features of project work and answer critical questions during demo and oral sessions. (**7b**) 8. Investigate and communicate recent developments in a selected multimedia research topic. Critically evaluate the procured information for authority, currency and objectivity and make accurate and appropriate use of technical literature. (**12a**), (**12b**) **NOTE:** *Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*

Course Organization	3.0 hours of lecture per week for 13 weeks 2.0 hours of lab/tutorial per week for 12 weeks
Teaching Assistants	Please contact the TA first for any lab-related issues. Rodina Bassiouny (Sections 1-3-6) - rbassiouny@ryerson.ca Jonathan Pisaila (Sections 2-4-5) - jonathan.psaila@ryerson.ca

Course Evaluation

Theory	
Midterm Exam	30 %
Assignments	10 %
Final Exam	40 %
Laboratory	
Lab + Reports	20 %
TOTAL:	100 %

Note: In order for a student to pass a course with **"Theory and Laboratory"** components, in addition to earning a minimum overall course mark of 50%, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the **"Course Evaluation"** section for details on the Theory and Laboratory components.

Examinations	Midterm exam on February 25, two hours, multiple-choice and short answer questions, closed book (covers Weeks 1-6). Final exam, during exam period, three hours, multiple-choice, short answer, design, closed-book (covers entire course).
Other Evaluation Information	None
Other Information	None

Course Content

Week	Hours	Chapters / Section	Topic, description
1	3	1.1-1.4; 2.1-2.5; 3.1-3.2	Introduction graphics/image representation
2	3	8.4; 6.1	Sampling quantization digital audio basics
3	3	4;5	Color theory and video

4	3	6.3.2-6.3.5; 7.1-7.4; 7.7	Lossless compression methods
5	3	8.5.1	Lossy compression methods
6	3	9.1	The JPEG standard
8	2		Midterm Exam (February 25)
8	1	10.1-10.3	Video compression
9	3	11.1-11.3	Video compression
10	3	14.1-14.2.3	Audio compression
11	3	Handout	Content analysis: audio/visual content descriptors
12	3	Handout	Content analysis: introduction to multimedia search
13	3	Handout	Special topic - Cloud Computing
14	3		Course Review

Laboratory/Tutorials/Activity Schedule

Week	Lab	Description
2	ENG310/406	Lab 0: Introduction to image & video processing with MATLAB/OpenCV
3-4	ENG310/406	Lab 1: Sampling and Quantization

5-7	ENG310/406	Lab 2: Entropy based coding
8-10	ENG310/406	Lab 3: Intra- and Inter-frame coding
11-12	ENG310/406	Lab 4: Video Compression / Content Analysis

Policies & Important Information:

1. Students are required to obtain and maintain a Ryerson e-mail account for timely communications between the instructor and the students;
2. Any changes in the course outline, test dates, marking or evaluation will be discussed in class prior to being implemented;
3. Assignments, projects, reports and other deadline-bound course assessment components handed in past the due date will receive a mark of ZERO, unless otherwise stated. Marking information will be made available at the time when such course assessment components are announced.
4. Refer to our **Departmental FAQ** page for information on common questions and issues at the following link: https://www.ee.ryerson.ca/guides/Student.Academic.FAQ.html.

Missed Classes and/or Evaluations

When possible, students are required to inform their instructors of any situation which arises during the semester which may have an adverse effect upon their academic performance, and must request any consideration and accommodation according to the relevant policies as far in advance as possible. Failure to do so may jeopardize any academic appeals.

1. *Health certificates* - If a student misses the deadline for submitting an assignment, or the date of an exam or other evaluation component for health reasons, they should notify their instructor as soon as possible, and submit a Ryerson Student Health Certificate AND an Academic Consideration Request form within 3 working days of the missed date. Both documents are available at https://www.ryerson.ca/senate/forms/medical.pdf.. **If you are a full-time or part-time degree student, then you submit your forms to your own program department or school;**
2. *Religious, Aboriginal and Spiritual observance* - If a student needs accommodation because of religious, Aboriginal or spiritual observance, they must submit a Request for Accommodation of Student Religious, Aboriginal and Spiritual Observance AND an Academic Consideration Request form within the first 2 weeks of the class or, for a final examination, within 2 weeks of the posting of the examination schedule. If the requested absence occurs within the first 2 weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these forms should be submitted with as much lead time as possible in advance of the absence. Both documents are available at www.ryerson.ca/senate/forms/relobservforminstr.pdf. **If you are a full-time or part-time degree student, then you submit the forms to your own program department or school;**
3. *Academic Accommodation Support* - Before the first graded work is due, students registered with the Academic Accommodation Support office (AAS - www.ryerson.ca/studentlearningsupport/academic-accommodation-support) should provide their instructors with an Academic Accommodation letter that describes their academic accommodation plan.

Academic Integrity

Ryerson's Policy 60 (the Academic Integrity policy) applies to all students at the University. Forms of academic misconduct include plagiarism, cheating, supplying false information to the University, and other acts. The most common form of academic misconduct is plagiarism - a serious academic offence, with potentially severe penalties and other consequences. It is expected, therefore, that all examinations and work submitted for evaluation and course credit will be the product of each student's individual effort (or an authorized group of students). Submitting the same work for credit to more than one course, without instructor approval, can also be considered a form of plagiarism.

Suspicions of academic misconduct may be referred to the Academic Integrity Office (AIO). Students who are found to have committed academic misconduct will have a Disciplinary Notation (DN) placed on their academic record (not on their transcript) and will normally be assigned one or more of the following penalties:

1. A grade reduction for the work, ranging up to an including a zero on the work (minimum penalty for graduate work is a zero on the work);
2. A grade reduction in the course greater than a zero on the work. (Note that this penalty can only be applied to course components worth 10% or less, and any additional penalty cannot exceed 10% of the final course grade. Students must be given prior notice that such a penalty will be assigned (e.g. in the course outline or on the assignment handout);
3. An F in the course;
4. More serious penalties up to and including expulsion from the University.

The unauthorized use of intellectual property of others, including your professor, for distribution, sale, or profit is expressly prohibited, in accordance with Policy 60 (Sections 2.8 and 2.10). Intellectual property includes, but is not limited to:

1. Slides
2. Lecture notes

3. Presentation materials used in and outside of class
4. Lab manuals
5. Course packs
6. Exams

For more detailed information on these issues, please refer to the Academic Integrity policy(https://www.ryerson.ca/senate/policies/pol60.pdf) and to the Academic Integrity Office website (https://www.ryerson.ca/academicintegrity/).

Important Resources Available at Ryerson

1. The Library (https://library.ryerson.ca/) provides research workshops and individual assistance. Inquire at the Reference Desk on the second floor of the library, or go to library.ryerson.ca/guides/workshops
2. Student Learning Support(https://www.ryerson.ca/studentlearningsupport) offers group-based and individual help with writing, math, study skills and transition support, and other issues.