School of Engineering Science
Simon Fraser University

Graduate Directed Studies Guidelines

Graduate Directed Studies (DS) courses, ENSC 891-3 and ENSC 892-3, are meant to replace regular graduate courses in cases where such courses cannot be offered due to lack of teaching bandwidth, low anticipated enrollment etc. Since a DS course replaces one regular graduate course, **DS should be similar in content and spirit to a regular course**, rather than thesis research. Students perform their thesis research in addition to regular coursework and receive separate credit for it.

The DS course proposal should include the following:

- Course title
- Course description
- A list of weekly topics and the corresponding reading material
  - In case of books or theses, indicate chapters assigned for reading
  - In case of papers, include full citation
- Meeting schedule
  - Student and instructor are supposed to meet on a regular basis (e.g. weekly) to discuss the corresponding topics covered in the course.
- Grading scheme
  - Grading scheme should be similar to a regular course.
  - It can be based on various assessment tools used in regular courses, such as assignments, presentations, reports, quizzes, exams, or participation.
  - It is common for a DS course to have a final report, but this should not be the only assessment tool; there should be at least one other assessment, for example an interim report.
  - If the course includes a project, the project report may play the role of the final report. Project-related work should not account for more than 50% of the grade.

At the end of the course, all reports should be submitted to the Graduate Program Assistant at enscgsec@sfu.ca prior to grade approval.

A sample DS proposal is included below.

Simon Fraser University
School of Engineering Science

ENSC 891 Directed Study Project Proposal
Summer 2022

HEVC Compressed-Domain Object Detection

Student: [Student Name, Student ID] *Supervisor: [Name]*

Course Description and Objective:

Object detection is one of the main applications of computer vision. While typical computer vision pipelines rely on raw pixel data input, there is good engineering sense in trying to detect objects based on compressed-domain features, without decoding the video. Recent attempts have demonstrated that this is indeed feasible. In certain cases, the accuracy of object detection based on compressed features is comparable to conventional pixel-domain detection. The goal of this course is to investigate object detection from compressed High Efficiency Video Coding (HEVC) bitstreams.

The course is divided in two parts. In the first part, the background material on HEVC and object detection is introduced through assigned reading. In the second part, a course project will be carried out to combine the material learned in the first part and put it into practice. The goal of the project will be to design and develop a single-class object detector based on compressed-domain HEVC features. The specific class of the object will be determined in the first weeks of the course; some possibilities are vehicle detection, bicycle/bicyclist detection, etc. The project will be carried out in the SFU Multimedia Laboratory.

Meeting Schedule and Weekly Plan:

The student and the supervisor will meet on a weekly basis to discuss the reading material and subsequently the progress of the project. The meeting time is expected to be <u>2.5 hours per week</u>, on average. The course schedule is as follows.

Meeting Date

Week 1: Chapters 1 and 2 from [1] — 13 May
- Introduction
- Video Coding Fundamentals

Week 2: Chapters 3 and 4 from [1] — 20 May
- Design and Specification
- Coding Structures

Week 3: Chapters 5 and 6 from [1] — 27 May
- High-Level Syntax
- Intra Prediction

Week 4: Chapters 7 and 8 from [1] — 3 June
- Inter Prediction
- Residual Coding

Week 5: Module 1 from [2] — 10 June
- Single Object Classes

Week 6: Module 2 from [2] - Multiple Object Classes	17 June
Week 7: Interim report summarizing the above material	24 June
Week 8: Course project: Proposal Presentation	30 June
Week 9: Course project: Progress Presentation I	8 July
Week 10: Course project: Progress Presentation II	15 July
Week 11: Course project: Progress Presentation III	22 July
Week 12: Course project: Progress Presentation IV	29 July
Week 13: Project Report and Demonstration	5 August

We expect the student to spend an average of 10 hours per week on this study. The student will document the findings from literature search in the weekly presentations and summarize the findings in an application problem in the interim report. The second half of the study will focus on a real-life problem in developing functions and applications using object detection with justification of the design and recommendations on how to implement the algorithms and methodologies. This will be documented in a final project report as the output of this study.

Deliverables and Grading:

Deliverables (e.g. exam, quiz, report, presentations)	**Marking Scheme/Deliverable Description**	**Weight** (%)	**Due Date**
Weekly Presentation	Description: Present a news/published academic paper for the corresponding weekly topic. Grading: Student should demonstrate a range of knowledge and an accurate understanding of relevant concepts and theories. A range of examples is used to relate knowledge and understanding to case issues.	10%	Week 3 - 6
Interim Report	Description: A mini case study is given. Student should make use of the knowledge and topics covered in previous weeks to solve the case. Submit a report to explain the details in resolving the case. Grading: - Solution Feasibility (50%) and Efficiency (20%) - Conciseness (20%) - Writing and Style (10%) Late submission – 5% per day	45%	Week 7
Final Project	Description: Student looks for case relevant to the course topic to work and research on. Grading	45%	Week 8 -13

	- Proposal (30%)
	  o Difficulty (10%)
	  o Relevance (5%)
	  o Research Milestone/Plan (15%)
	- Progress Presentation (20%)
	  o 5% for each presentation
	- Final Report (50%)
	  o Solution Feasibility (20%)
	  o Solution Efficiency (20%)
	  o Writing and Style (10%)		

Reading Materials:

[1] M. Wien, High Efficiency Video Coding: Coding Tools and Specifications, Springer, 2015.

[2] L. Fei-Fei, R. Fergus, and A. Torralba, Recognizing and Learning Object Categories, ICCV Short Course, 2009. http://people.csail.mit.edu/torralba/shortCourseRLOC/index.html