

# CMPUT 651: Topics in Artificial Intelligence with Applications to Video Games

<https://eclass.srv.ualberta.ca/course/view.php?id=12832>

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## Abstract

The founding purpose of Artificial Intelligence (AI) is to build human-level (or stronger) intelligence in an artificial entity. Video games provide a suitable testbed as they are rich enough to be challenging for AI algorithms yet simple enough to get traction and make progress. From the application perspective, procedural content and behavior generation is becoming critical in making the development of AAA titles tractable. Video game companies are interested in generating high-fidelity non-playable-character (NPC) behavior including dialogue, emotional reactions and routine activities. In this course we will survey classic and state-of-the-art AI methods used in video games. We will consider the theoretical foundations (e.g., Markov decision processes) as well as software technology involved. Certain lectures may be given by representatives of the industry (e.g., BioWare staff). Students in the class will pick a specific aspect of NPC behavior and work in teams on implementing it. Some projects may be extended into a thesis after the course.

## 1 Course Objectives

This course pursues the following objectives: (i) gaining an understanding of current challenges in video game AI; (ii) learning classic and state-of-the-art AI algorithms applicable to the challenges; (iii) presenting and critiquing those algorithms in class; (iv) gaining hands-on experience and working knowledge of some of the algorithms; (v) doing original research in the form of a team-based term project; (vi) writing a conference-level report on the research; (vii) gaining ideas for your M.Sc./Ph.D. degree project.

## 2 Scope

We will focus on the following topics:<sup>1</sup>

1. AI for NPC behavior:

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<sup>1</sup>The list is tentative and can be adjusted before and during the term.

- (a) emotion modeling in NPC and its effects on NPC behavior and appearance;
  - (b) culture and social norm modeling in NPC;
  - (c) player modeling for realistic NPC behavior;
  - (d) different levels of behavior simulation fidelity;
  - (e) group AI (e.g., RTS economy and combat).
2. AI for game direction:
- (a) player preference and emotion modeling for narrative selection and difficulty adjustment;
  - (b) socially consistent character recruitment.
3. AI for content generation:
- (a) narrative generation;
  - (b) routine NPC behavior generation;
  - (c) level generation;
  - (d) generation of aesthetics.

For each topic we will discuss one or more papers presenting the relevant algorithms and implementations. We will consider a few case studies in the form of research prototypes and commercial games. We will also discuss various forms of measuring progress (e.g., various forms of the Turing test, game AI competitions such as the StarCraft or PacMan AI competitions and man-machine matches).

### **3 Course Structure**

The class will have two lectures per week on Tuesdays and Thursdays, 9:00am to 10:20am between September 5th and December 3rd, 2013. Our lecture room is CSC B-41. The office hours are by appointment in ATH 3-38.

#### **3.1 Lectures**

Most lectures will be of the seminar type where we will discuss papers and case studies. Everyone in class will read the papers or play the game ahead of time. One student will present the paper/game in class with slides and/or live demonstrations. Everybody else will hand-in their written review of the paper at the beginning of the class. Following each presentation, we will have a discussion led by the presenter. The presentations and the written reviews will be marked by the instructor. Marking templates and review/presentation guides will be provided.

#### **3.2 Term Projects**

The students will form 2-3 person teams and work together throughout the term. They will propose a research topic to explore and, upon instructor's approval, follow several milestones (e.g., a midterm report, an in-class presentation, a final report, etc.) until the end of the term. Guidelines for all of these will be provided in class.

In the past versions of this course a number of final reports were developed into conference papers published at upper tier conferences. Additionally, several thesis projects have started as a CMPUT 651 term project.

## 4 Marking

Final grades will be assigned at the end of the term once cumulative term marks are available.<sup>2</sup> This will be done by setting cut-off points (e.g., an ‘A’ is at least  $x\%$  of the maximum possible term mark). The cut-offs are absolute and not based on any *a priori* defined distribution/curve. Your mark depends on your and your team’s performance. You are not in competition with other students. Term marks are computed as a weighted sum of the following components:

Component	Weight	Date	Weight shift under EA	Type
Paper presentations	17%	throughout the term	other presentations	individual
Paper reviews	17%	throughout the term	other reviews	individual
In-class participation	5%	throughout the term	n/a	individual
Project proposal	1%	Sep 19 @ 7pm	project midterm report	team
Project midterm presentation	10%	Oct 22 in class	project midterm report	team
Project midterm report	10%	Oct 22 in class	project final report	team
Project final presentation	10%	Nov 21, 26, 28 in class	project final report	team
Project final report	30%	Dec 4 @ 7pm	n/a	team

If you miss a marked component you may apply for an excused absence (EA) which, if granted, will shift the weight of the component as listed above.

## 5 Course Prerequisites

An interest in Artificial Intelligence and video games. An undergraduate-level background in AI is a plus but not required.

## 6 Course Policies

Teamwork is required on the term projects. While the work may be divided among the team members, every team member must have an understanding of any part of the project (although does not have to be an expert on that part). Presentations and reviews are, on the other hand, individual work (“solo effort”) with no collaboration allowed.

This course is governed by CS Department policies. You are required to familiarize yourself with them: <https://www.cs.ualberta.ca/resources-services/policy-information/departement-course-policies>

<sup>2</sup>Grades are unofficial until approved by the Department and/or Faculty offering the course.

## **7 Textbooks**

There are no required textbooks. The research papers and any additional materials will be provided during the term.

## **8 Contact**

The best way to contact the instructor is by e-mail: [bulitko@ualberta.ca](mailto:bulitko@ualberta.ca)

## **9 Additional Information**

Students who require accommodation in this course due to a disability are advised to discuss their needs with Specialized Support and Disability Services (2-800 Students Union Building). Students who require additional help in developing strategies for better time management, study skills or examination skills should contact the Academic Support Centre (2-300 Students Union Building).