Western Science

Department of Computer Science

CS 4482A/9511A Course Outline

1. Course Information

Course Information
This course will provide a high-level look at the design, implementation, and usage of video game engines. The primary goal of this course is to offer a basic understanding of (i) the requirements of programming for video games and (ii) the systems required to create a usable and reusable foundation for game development. Extra time will be spent examining and working in existing game engines in order to demonstrate good (or bad) design.

Some focus will be given to the graphical nature of game engines and will therefore include an introduction to computer graphics, (similar to and expanding on CS3388), shaders, animation techniques, and optimization algorithms. Depth will be given in selected areas, but the student will be expected to do a reasonable amount of independent reading and learning outside of the lecture hours.

List of Prerequisites
Prerequisite(s): (Computer Science 3305A/B, Computer Science 3307A/B/Y, Computer Science 3340A/B); or (Software Engineering 2205A/B, Software Engineering 3310A/B, Software Engineering 3313A/B, and Software Engineering 3350A/B); and 0.5 course from Mathematics 1600A/B or Applied Mathematics 1411A/B.
Corequisites: None

Unless students have either the prerequisites for this course or written special permission from the Department of Computer Science to enroll in it, they may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on their academic record. This decision may not be appealed.

2. Instructor Information

Instructors	Email	Office	Office Hours
Dr. Mathias Babin (Course Coordinator)	[redacted]	[redacted]	[redacted]
Ismail Fakhr	[redacted]	[redacted]	[redacted]
Goose Terpstra	[redacted]	[redacted]	[redacted]

Students must use their Western (@uwo.ca) email addresses when contacting their instructors. Include "CS4482"/"CS9511" in the subject line or else your email may not receive a reply.

3. Course Topics, Schedule, Delivery Mode

Course Topics

This is a list of possible course topics. We will cover a subset based on the interests of the class and time constraints. Topics will not necessarily be presented in the order listed here.

- History of Game Development
- Unity3D - A Game Engine.
- User Interface, User Experience Design
- Engine Tools Development
- Real-Time Rendering
    - Character Animation: Explicit and Implicit
    - Shading: Lighting models, NPR, Shadows, Full-screen effects
- Physics Engines, Simulations
    - Kinematics, Kinetics, Collisions.
- Multiplayer Gaming
- Procedural Content Generation

As there simply is not enough class time to teach the above topics in detail, the course will proceed in a "breadth-first" manner. For many of the topics, we will provide references to material you already know from your basic CS education, along with instruction on how to apply that knowledge to the domain of video games. We will provide a starting point and a helpful push. To get the most out of these topics, and apply the topics of interest to your projects, you will have to do some studying on your own.

Class Schedule

Monday 12:30pm - 2:30pm, [redacted]
Wednesday 1:30pm - 2:30pm, [redacted]

Classes begin: September 9, 2026
Fall Reading Week: October 10 – 18, 2026
Classes end: December 9, 2026
Exam period: December 11 – 22, 2026

4. Course Materials

There is no required textbook for this course. The course's OWL site is the primary method by which information will be disseminated to all students in the class. Some interesting supplemental material:

- *Game Engine Architecture, Second or Third Edition, by Jason Gregory.*
- *GPU Gems, GPU Gems 2, GPU Gems 3: https://developer.nvidia.com/gpugems/.*

Students are responsible for checking the course OWL Brightspace site regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL Brightspace site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at [redacted] or [redacted].

Technical Requirements

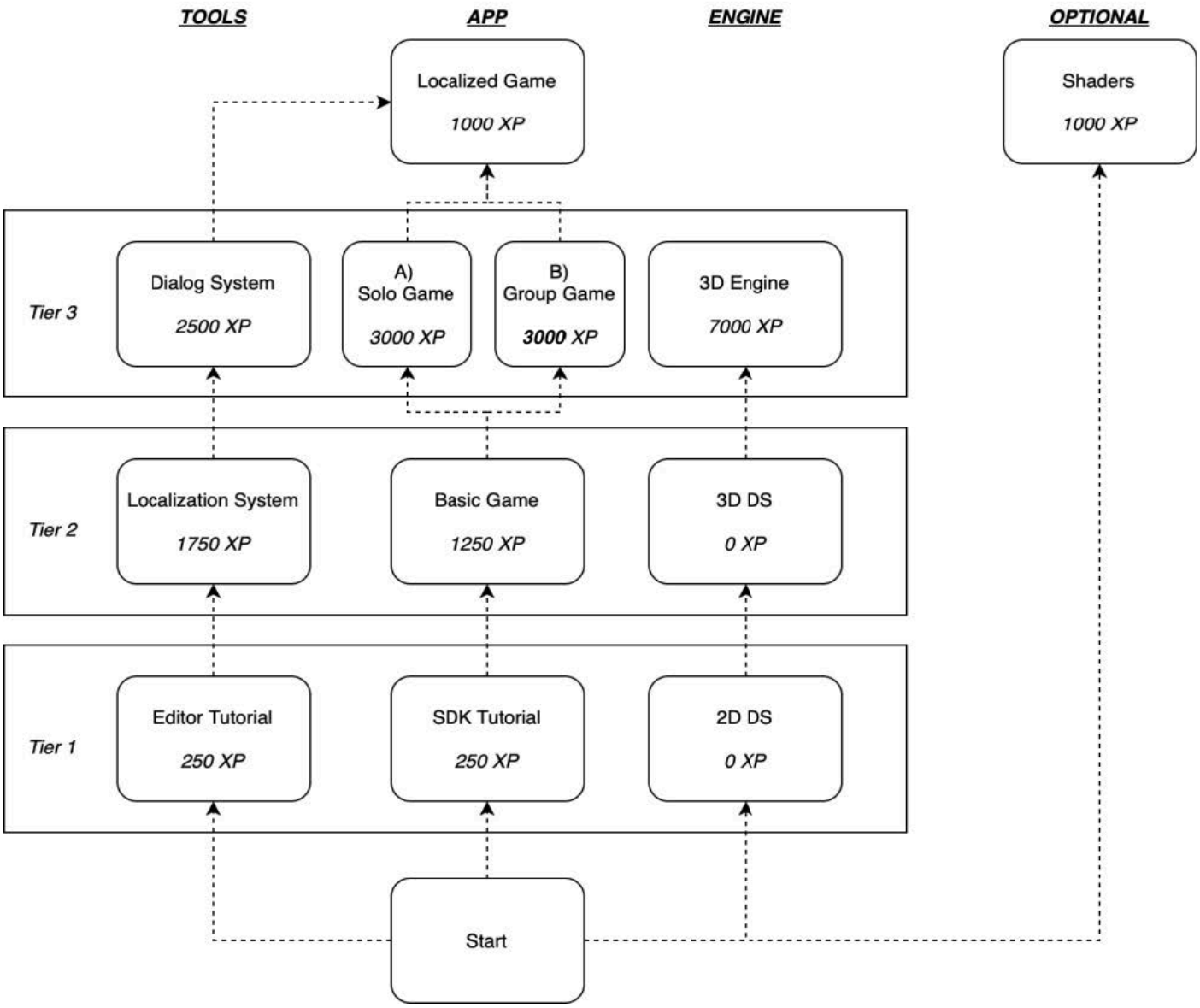
- Stable Internet Connection
- Home computer or laptop capable of running the Unity Game Engine: https://docs.unity3d.com/6000.5/Documentation/Manual/system-requirements.html

5. Methods of Evaluation

Grading Scheme and Assessment Dates

Most of a student's mark comes from applying what is learned in and out of class to a progressive series of assignments. There are three primary 'streams' of assignments: Game Programmer, Engine Developer, and Tools Programmer. Students may pick and choose which assignments they wish to complete according to their interests and career aspirations. Assignments within a single branch may not be completed concurrently. The figure below shows these branches and prerequisite structure; it's a *quest chain.*

Each assignment has an "experience point value" (XP for short). Completing the assignment results in the student being awarded the associated amount of XP. Note that there are no specific grades given for assignments, they are strictly pass/fail. If you meet the specified requirements for the assignment, you pass, and are awarded the associated XP. In this case, a "pass" corresponds to roughly 80% in a traditional marking scheme. Occasionally, a particularly awesome assignment may be awarded "bonus XP".



If you do not meet the requirements of the assignment, you will be informed which requirements were not met and you will receive no XP. However, you may continue to modify and resubmit your assignment until you pass, or until the final deadline, whichever comes first. The **strict final deadline is Wednesday, December 9th, at 23:55**, no re-submissions will be accepted after that time (see Assignment Schedule below). Any remaining failing submissions will be graded on a standard 0-100% scale for partial XP. Please note, you may only submit/resubmit an assignment a total of 5 times, to which it will receive 0 thereafter.

Computing Your Final Grade

Every good RPG has an "XP curve". In this course, your final grade follows a simple XP curve:

$$\text{Current Grade} = \sqrt{xp}$$

That's it. That's your mark in the course. You add up the XP you've earned so far and take the square root. There is no final exam and the assignments are all pass/fail. This means there is no nondeterminism in your grade. You can decide, right now, which assignments you're going to do and, if you put in the work, you know *exactly* what your final grade will be.

WARNING: READ THIS

The important consequence of this marking scheme: make sure you plan to do (at least) one of the Tier-3 assignments at the end of a particular skill tree and proceed accordingly. The goal of the skill tree system is to provide flexibility for students with different interests. Under no circumstance should you plan to complete every assignment in the skill tree... unless you are independently wealthy, don't work, have no other classes, or really like learning under stress.

Suggested Paths

At a minimum, each student should complete at least one "Tier 3" assignment. Some suggested paths, and their resulting final grade are shown below. You are free to choose any combination of assignments (as long you meet the prerequisites), but here are some combinations I suggest:

- **Basic Gamer (67%):** App 1, 2, 3. You like games, and you want to have a fun semester, but don't want to do that much work.
- **Basic Front-End (67%):** Tools 1, 2, 3. You like user interfaces, accessibility, and front-end development.
- **The Recommended (80%):** App 1, 2, 3; Tools 1, 2. This is the recommended path. It gives a great mark in the course and a great learning opportunity for making games and using game engines.
- **Basic Backend (84%):** Engine 1, 2, 3. You're not afraid of C++ or OpenGL. You like software design, graphics, and how games work.
- **The Apprentice (95%):** App 1, 2, 3; Tools 1, 2, 3. You like games and you like making games. Making games is more than just making games; you need to make games and make tools which help team members contribute more effectively to making games.
- **The Adept (100%):** App 1, 2, 3, 4/Optional; Tools 1, 2, 3. You are looking forward to a career in the video game industry. This path gives you the most experience in making games and using video game engines.
- **Graphic Gamer (100%):** App 1, 2, 3a; Engine 1, 2, 3. You are looking forward to a career in the video game industry. This path gives you the most experience in making games and game engines.

This non-traditional grading scheme is frightening to me. What can I do?
Ignore everything above and come see me. We can decide together which assignments are best for your interests and which will give you an overall great mark in the course.

Assignment Schedule

There is a great deal of flexibility in assignment choice in this course and with that flexibility comes great responsibility. Much like the real world, you must manage your time accordingly for the different tasks involved in completing your projects. The (not-so) secret evaluation mechanism of this course is time-management.

You can attempt every assignment from day 1, submitting and re-submitting until you pass. **However**, it is expected that you submit assignments regularly through-out the term to show progression and engagement with the assignments. In particular, you must meet the following deadlines:

- Tier1: Friday, September 25 at 23:55.
- Tier2: Friday, October 30 at 23:55.
- Tier3: Friday, November 27 at 23:55.
- Tier4: Friday, November 27 at 23:55.
- Optional: Friday, November 27 at 23:55.
- **All submissions and re-submissions must be made by Wednesday, December 9th at 23:55. No re-submissions or modifications will be permitted following this date.**

Essential Learning Requirements

When a student has not demonstrated proficiency in an essential learning requirement listed above, and when the shortfall results from a granted Academic Consideration, they will be withdrawn (WDN) from the course. The student may appeal to the Associate Dean (Academic) for reinstatement with an Incomplete (INC) standing. Where an appeal for INC is granted, their maximum course load may be reduced during the term in which they complete the outstanding course requirements.

Information about Missed Coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs,* posted on the Academic Calendar: https://uwo.ca/univsec//pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person. The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage: https://registrar.uwo.ca/academics/academic_considerations/
All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

Deadlines: The 48-Hour No-Late-Penalty Period
All take-home assignments, quizzes, and labs with a stated due date include an automatic 48-hour period after the deadline during which students may still submit without a late penalty. For example, if an assignment is due on November 5, they may submit it until November 7 without penalty. After this 48-hour period, no further submissions will be accepted, and students do not need to request Academic Consideration for a missed deadline; their grade for this component will be calculated as described above.

Special Examination
Per university policy, Academic Consideration requests with supporting documentation are required for the final examinations scheduled during official examination periods by the Registrar's Office.

If the student has been approved by the Academic Advising Office to write a Special Examination (SPC) and the final exam is their only outstanding course component, an SPC will be assigned to them and scheduled by the instructor per university policy.

If the student misses their SPC exam and is approved for Academic Consideration, they will be withdrawn from the course without academic penalty. If they experienced extenuating circumstances such as prolonged illness, they may appeal to the Associate Dean (Academic), on a case-by-case basis, for the opportunity to write the final exam the next time the course is offered. An outstanding SPC will reduce their course load for the term in which the exam is deferred, as outlined in the Definitions of Types of Examinations policy.

If the student misses their SPC exam and Academic Consideration is not approved, or was not requested, they will receive a grade of zero on the exam.

6. Additional Statements

6.1 Religious Accommodation
When a recognized religious holiday either requires a student to be absent from the University, or requires or prohibits an activity that makes it impossible for them to complete an academic requirement scheduled that day, they are entitled to accommodation. No student will be penalized for an absence for religious reasons, and an alternative means of satisfying the requirement will be arranged. This accommodation is provided in accordance with the University's policy on Accommodation for Religious Holidays:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

The student should submit their requests through the Student Absence Portal (SAP), identifying the conflict and the specific course component(s) affected (e.g., test, midterm, exam).

> **Midterms and Tests**: If a religious observance conflicts with a midterm test, they must submit their request no later than **one week** before the test. Their instructor will arrange an early sitting of the test. As set out above, no makeup test is offered for any other reason; this early sitting is available specifically for this accommodation.

Final Examinations: If a religious observance conflicts with the final exam, the student must submit their request no later than **two weeks** before the exam. Their instructor will arrange a Special Examination to take place no later than one month after the end of the examination period.

Students are responsible for finding out what was covered in any class they miss due to a religious observance, and for taking the appropriate steps to keep up with the course.

If a suitable arrangement cannot be reached between a student and their instructor, they should consult the Undergraduate Chair of the department offering the course, and if necessary, the Associate Dean (Academic) of the Faculty of Science.

For a list of recognized religious observances, please visit the calendars posted on the Equity, Diversity & Inclusion website - https://www.edi.uwo.ca (About Us – Resources – Additional Resources – Calendars).

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

6.3 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as "appeals")

Policy on Request for Relief from Academic Decision:
https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

Procedures on Request for Relief from Academic Decision (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Procedures on Scholastic Offences (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the **possession** of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, hidden cameras and wireless earbuds.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at a student's desk, on their person, or within reach during an assessment will be treated as a scholastic offence, **even if the device is not in use**.

Effective September 2026, the typical penalty for this offence is a failing grade in the course AND a 12-month prohibition on retaking the course.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is their responsibility to review and comply with these expectations.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is the student's responsibility to seek clarification before using any AI tools in academic work.

6.5 Support Services

Academic Advising. Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: https://www.uwo.ca/sci/advising/.

Mental Health Support. Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Gender-Based and Sexual Violence. Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If a student has experienced GBSV (either recently or in the past), they can find information about support services for survivors, including emergency contacts, at:

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact [redacted].

Accessibility for Coursework. A student may contact the course instructor if they require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to them. If they have any questions regarding accommodations, they may also contact Accessible Education at http://academicsupport.uwo.ca/accessible_education/index.html

Learning Development and Success. Learning-skills counsellors at Learning Development and Success (https://learning.uwo.ca) are ready to help students improve their learning skills. The facility offers strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Student Councils.
Student-run support services are offered by the University Students' Council (https://westernusc.ca) and the Science Students' Council (https://www.westernssc.ca).