CS 4482A/9511A,
Fall 2024 Game Programming
Syllabus

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 *re*usable 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.

Useful (Not Mandatory) Background Knowledge
• Working knowledge of multivariate calculus and linear algebra.
• Ability to code well in Object-Oriented C-like languages (C#,C++,Java).
• Experience coding with graphics and/or the OpenGL graphics API.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Teaching Staff + Office Hours

Instructor
Mathias Babin: mbabin2@uwo.ca + Monday 2:30pm - 3:30pm

Teaching Assistants
Jonathan Tan (App): jtan97@uwo.ca + By appointment:

Ali Ghavampour (Tools): aghavamp@uwo.ca + By appointment:

Email Contact
Students must use their Western (@uwo.ca) email addresses for communicating with teaching staff.
Include "CS4482" in the subject line or else your email may not receive a reply.

3. Course Topics, Class Schedule

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
Wednesday 1:30pm - 2:30pm

- Classes begin: September 5
- National Day for Truth and Reconciliation (observed at Western). No classes: Sept. 30
- Thanksgiving Weekend: October. 12–14
- Fall Reading Week: October 12–20
- Classes end: December 6

Contingency Plan
Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will **not** change. Any assessments affected will be conducted online as determined by the course instructor.

4. Course Materials

There is no required textbook for this course. Students are responsible for checking the course OWL site on a regular basis for news and updates. This 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 site on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

All course material will be posted to OWL: https://westernu.brightspace.com.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Methods of Evaluation

Student Evaluation

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. The only constraint is that the student must have completed **and passed** all "pre-requisite assignments" before submitting another assignment. 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 an 80%** in a traditional marking scheme. Occasionally, a particularly awesome assignment may be awarded "bonus XP".
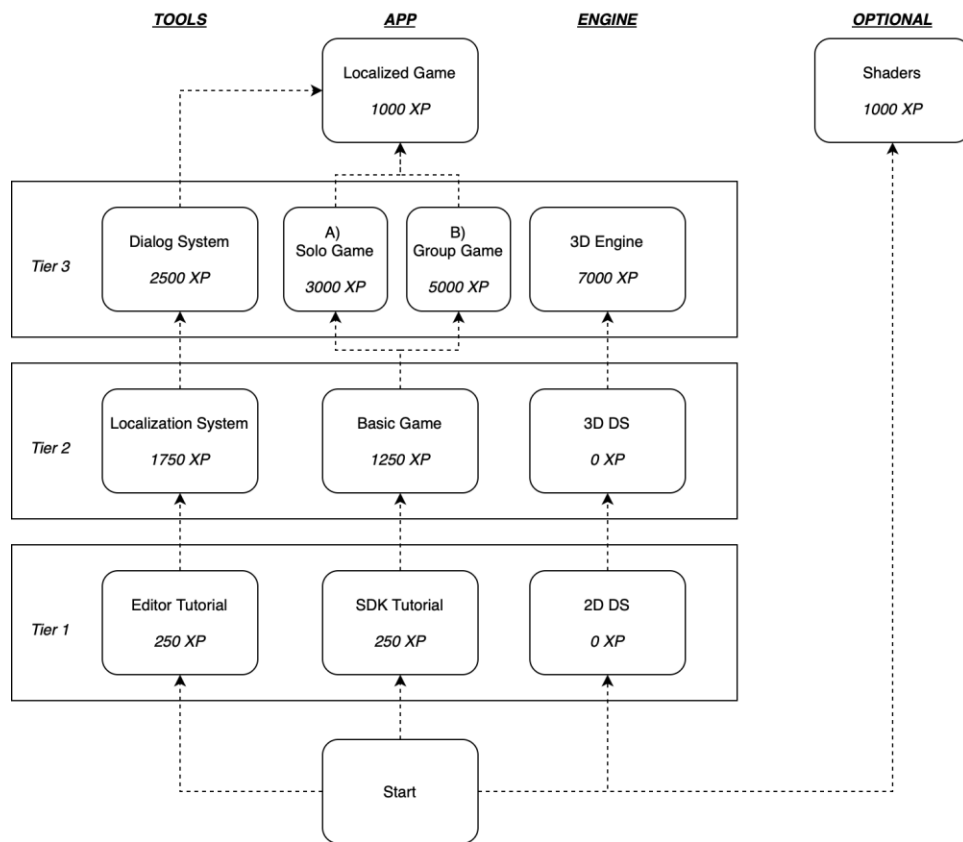
If you do not meet the requirements of the assignment, you will be informed which requirements were not met and you will receive no XP. However, you may continue to modify and resubmit your assignment until you pass, or until the final deadline, whichever comes first. **The *strict* final deadline is Friday, December 6th, 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, 3a**. 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, 3a; Tools 1, 2**. This is the recommended path. It gives a great mark in the course and 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, 3a; 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 helps team members contribute more effectively to making games.

The Adept (100%): **App 1, 2, 3a, 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.

Due to the mix-and-match aspect of this evaluation approach there are no firm due dates (*except December 6, 23:55*) 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 27 at 23:55.
- **Tier2:** Friday, November 1 at 23:55.
- **Tier3:** Friday, November 29 at 23:55.
- **Tier4:** Friday, November 29 at 23:55.
- **Optional:** Friday, November 29 at 23:55.
- **All submissions and *re-submissions* must be made by Friday, December 6th at 23:55. No re-submissions or modifications will be permitted following this date.**

Late Assignments
This course offers unlimited *re*-submissions until you pass an assignment. Due to the time required for marking, an assignment's submission date is based on the date of its *first submission*. A submission made on time, but which fails, will **not** be penalized if re-submitted *after* the due date. However, "place-holder" submissions will not be accepted. That is, making an empty or near-empty submission before the deadline to avoid a late penalty is unacceptable. Such a place-holder submissions will be considered void resulting in a grade of 0.

Note on re-submissions. Any assignment submitted before November 29, at 23:55 will be returned before December 6 and therefore be eligible for re-submission. Any assignment submitted after November 29 will be marked on a first-come, first-served basis, and as human resources allow. If you submit after November 29, you are not guaranteed to have your assignment returned in time to re-submit by December 6.

6. Academic Consideration for Student Absence

Students must familiarize themselves with the University Policy on Academic Consideration – Undergraduate Students in First Entry Programs posted on the Academic Calendar:

https://www.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.

Due to the built-in flexibility of the evaluation scheme for all assignments in this course, no academic considerations without documentation will be accepted. "

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. All documentation required for absences must be submitted to the Academic Counselling office of a student's Home Faculty

6. Accommodation and Accessibility

Religious Accommodation
When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling

office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

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_consideration.pdf

7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

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 e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

8. Support Services

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

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.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will 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 support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on 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.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.