CSC 481/581 Course Syllabus

CSC 481/581 – Game Engine Foundations

Section 001

Fall 2023

3 Credit Hours

Course Description

The purpose of this course is to familiarize students with issues and techniques of computer games design in general, and more specifically game engine design. With the proliferation of computer games, a number of distinct genres have emerged. Each genre of computer game provides a unique set of design challenges for designers. While there are no "one size fits all" solutions to game design problems, there are a number of techniques common to many different games. These commonalities have given rise to ***game engines*** which are software tools to aid designers. Behind almost all successful commercial games are a game engine.

In this course we will examine some of the components of a commercial strength game engine. We will survey different genres of games, using some of the unique design challenges each genre provides as a motivation for an in-depth examination of the affordances games engines provide for designing games of that genre. We will cover topics ranging from data structures, resource management, game loops and logical timing systems, scripting, error logging, and networking.

Students will be given a sequence of multi-week homework assignments, or mini-projects, related to the lecture material. These assignments will require students to implement and/or evaluate some of the algorithms or techniques we are covering during course lectures. Each assignment will build upon previous assignments, and by the end of the course students will have implemented a limited functionality game engine of their own.

Learning Outcomes

Students will:

1. develop a conceptual framework and vocabulary for computer game engines, their components, and designs as well as an understanding the role of a game engine in the game design process.
2. identify the different game engine systems, how they interact with each other, how they enable the design of various genres of computer games, and how they enable game engine reuse across games and/or game genres.
3. implement various engine systems, and combine them into a functional, simple game engine with sufficient capabilities to support the design of a game.

Course Structure

This will be a lecture course covering topics in computer game design and game engine design. Students will be given a sequence of multi-week homework assignments throughout the semester.

Course Policies

Homework:

Students will submit homework individually unless otherwise specified in the assignment (see the section on "Academic Integrity"). The assignments will either be posted on the course webpage, posted on the course moodle page, or distributed in class. If a student is unable to attend class, it is their responsibility to determine if an assignment was given. Unless otherwise indicated, all assignments will be due by the start of class on the date they are due, and must be submitted using the course moodle page. If assigment due dates fall on days when there is no class meeting, the assignment will be due at the time class meetings typically start.

Homework Grading:

Homework submissions will be graded according to the criteria outlined in the assignment. Missing components or lateness will be penalized accordingly.

Health and Well-Being Resources:

These are difficult times, and academic and personal stress is a natural result. Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center (https://counseling.dasa.ncsu.edu/)
- Health Center (https://healthypack.dasa.ncsu.edu/)
- If the personal behavior of a classmate concerns or worries you, either for the classmate's wellbeing or yours, we encourage you to report this behavior to the NC State CARES team: (https://advising.dasa.ncsu.edu/resources-for-advisors/advisors-toolkit/cares/)
- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program (https://dasa.ncsu.edu/pack-essentials/).

Other Important Resources:

- Keep Learning: https://dasa.ncsu.edu/students/keep-learning/
- Protect the Pack FAQs: https://www.ncsu.edu/coronavirus/frequently-asked-questions/
- NC State Protect the Pack Resources for Students: https://www.ncsu.edu/coronavirus/reactivating-campus/resources-for-students/
- NC State Keep Learning, tips for students opting to take courses remotely: https://dasa.ncsu.edu/students/keep-learning/
- Introduction to Zoom for students: https://youtu.be/5LbPzzPbYEw
- Learning with Moodle, a student's guide to using Moodle: https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226

Instructors

Dr. Alexander Card (acard) - *Instructor*
Email: acard@ncsu.edu
Office Location: Engineering Building II 2292
Office Hours: https://go.ncsu.edu/csc281-office-hours

Course Meetings

Lecture

Days: T/Th
Time: 10:15am - 11:30am
Campus: Centennial
Location: 02201 Engineering Building 3

Course Materials

Textbooks

Game Engine Architecture - *Jason Gregory*
Edition: 3rd
ISBN: 978-1-1380-3545-4
Cost: $55
This textbook is optional.

Expenses

None.

Materials

None.

Requisites and Restrictions

Prerequisites

For 481: CSC 316 or ECE 309
For 581: None

Co-requisites

None.

Restrictions

For 481: CSC Majors only
For 581: None

Transportation

This course will not require students to provide their own transportation.

Safety & Risk Assumptions

None.

Grading

Grade Components

Component	Weight	Details
Homeworks	**100**	There will be five homework assignments of equal weight (20% of your final grade) throughout the semester. Homework assignments will contain 125 points of material. Students enrolled in 481 will be graded out of 100, but may attempt all 125 points if they choose (although scores will be capped at 100). Students enrolled in 581 will be graded out of 125. All homework assignments will be comprised of code and a writeup. All homework assignments are individual assignments. Any late penalties will be applied after the final score on the assignment is calculated.

Letter Grades

This Course uses Standard NCSU Letter Grading:

97	≤	**A+**	≤	100
93	≤	**A**	<	97
90	≤	**A-**	<	93
87	≤	**B+**	<	90
83	≤	**B**	<	87
80	≤	**B-**	<	83
77	≤	**C+**	<	80
73	≤	**C**	<	77
70	≤	**C-**	<	73
67	≤	**D+**	<	70
63	≤	**D**	<	67
60	≤	**D-**	<	63
0	≤	**F**	<	60

Requirements for Credit-Only (S/U) Grading

In order to receive a grade of S, students are required to take all exams and quizzes, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to http://policies.ncsu.edu/regulation/reg-02-20-15.

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at http://policies.ncsu.edu/regulation/reg-02-20-04.

Policies on Incomplete Grades

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an

incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at http://policies.ncsu.edu/regulation/reg-02-50-3.

Late Assignments

Unless otherwise requested, completed assignments should be turned in by the beginning of the class period on the date they are due. For assignments for which email or other electronic submission is requested, the submission should be completed before the start of the class period on the date they are due. Every student has four days which they may allocate to late assignments throughout the semester at a cost of five points per day. Once the allotment of four days has been used, there will be no more late submissions accepted. Use of late days is ***not*** pro rated. For example, a student who submits the first assignment two days, 8 hours, and 24 minutes late will receive 15 points off of their grade, and only has one day remaining for all subsequent assignments. ***Note:*** For students enrolled in 481 who attempt more than 100 points on homework assignments, the late penalty will be assessed *after* your grade is calculated on the assignment, *e.g.*, if you attempt all 125 points and earn a score of 115 points which translates to a 100 on the assignment, but turn in the assignment 3 days late, your final grade on the assignment will be an 85.

Valid excuses such as illnesses with a note from a doctor or a death in the family (with documentation) will be granted extensions to deadlines, provided the documentation is presented to the instructor in a timely manner. Other extensions may be granted for other scholarly activities provided arrangements are made with the instructor ***well in advance*** of the deadline.

Attendance Policy

For complete attendance and excused absence policies, please see http://policies.ncsu.edu/regulation/reg-02-20-03

Attendance Policy

Attendance at class sessions is not required; however, absences that are unexcused according to the university's excused absence policy (http://policies.ncsu.edu/regulation/reg-02-20-03) and that result in late assignments or missed announcements may negatively affect students' grades. Documented medical excuses or other excused absences will not adversely affect grades. Conference travel or other scholarly duties discussed well in advance of a missed session may be excused at the discretion of the instructor.

Absences Policy

While attendance is not required at class sessions, the university's excused absense policy (http://policies.ncsu.edu/regulation/reg-02-20-03) will be used to determine when assignments are considered late or not.

Makeup Work Policy

There will be no makeup work given for unexcused missed assignments.

Additional Excuses Policy

None.

Academic Integrity

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at http://policies.ncsu.edu/policy/pol-11-35-01

All members of the University community, students, faculty and other employees, have the responsibility to report academic misconduct to the appropriate authority.

Students are expected to behave professionally and respectfully at all times, in class, on campus, online, and in course feedback surveys and student evaluations. That means there is to be no offensive language, no threats, and absolutely no discussion/hints/threats of violence. Disrespectful language will not be tolerated and will be reported to Campus Police if the instructor deems that such language may be harmful to the psychological and/or physical well-being of others or represents a need for assistance by the offending student.

All work that you turn in for grading must be your own! This means that all work must be an independent and individual creation by you. Any attempt to gain an unfair advantage in grading, whether for yourself or another, is a violation of academic integrity. You may only work on an assignment with other student(s) in the class if explicitly stated in the assignment.

You may use AI in creative projects, such as generating art, music, or creative writing. However, it is important to maintain your creative input and provide proper attribution if AI-generated content is used in your work. Using AI to plagiarize or produce work without proper attribution is strictly prohibited. Using AI to generate responses for your reflection journal is prohibited. Per the Code of Student Conduct, all work submitted must be your original creation, with appropriate citations when referring to external sources.

Academic Honesty

See http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty.

Honor Pledge

Your signature on any test or assignment indicates you "have neither given nor received unauthorized aid on this test or assignment." Additionally, by uploading an assignment to the course moodle page, you are certifying that you "have neither given nor received unauthorized aid on this test or assignment." Note, it is your responsiblity to keep your passwords private and limit access to your moodle account.

Digital Course Components

Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Digital Course Components: Moodle will be used for dissemination of course materials. The Google group mailing list will be the official channel for communications. Other course communications may take place using Discord, Slack, etc., but don't constitute an official

means of communication. Student participation on Moodle and Google groups is required---participation on other channels (e.g., Discord) is optional.

Accommodations for Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01) (https://policies.ncsu.edu/regulation/reg-02-20-01/).

Non-Discrimination Policy

NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation ("Prohibited Conduct") that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively, "Protected Status"). Additional information as to each Protected Status is included in NCSU REG 04.25.02 (Discrimination, Harassment and Retaliation Complaint Procedure). NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at http://policies.ncsu.edu/policy/pol-04-25-05 or https://oied.ncsu.edu/divweb/. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

Course Schedule

NOTE: The course schedule is subject to change.

Lecture T/Th 10:15am - 11:30am — Lectures — 08/22/2022 - 12/05/2022

This is the anticipated course schedule. Dates and topics are subject to change throughout the course of the semester; see the course Moodle page for the most up-to-date schedule. Any changes in deadlines will be communicated via in-class announcement and/or emails. It is the student's responsibility to ensure to obtain any information, including changes to the schedule, that were missed in class and to check their email regularly.

Date	Topic	Deadlines/Notes
8/22	Welcome, Introduction, Course Overview	***HW 1 Assigned***
8/24	Engine architecture	***NOTE: Friday 8/25 is the last day to add without instructor permission***
8/29	Gameplay Foundations, Low-level Engine Systems	
8/31	Game Loop Architectures	***NOTE: Census date Friday, 9/1***
9/5	Game Loop Architectures	
9/7	Networking, Networked Game Loop Architectures	**HW 1 Due** **HW 2 Assigned**
9/12	Measuring Time; Timelines	
9/14	Runtime Object Models	
9/19		***NOTE: No class, Wellness Day***
9/21	Object-centric models	
9/26	Object-centric models	
9/28	Property-centric models	**HW 2 Due** **HW 3 Assigned**
10/3	Event Management	
10/5	Event Management	
10/10		***NOTE: No class, Fall Break***
10/12	Event Management	
10/17	Memory Management	
10/19	Memory Management	**NOTE: Drop deadline is 10/19** **HW 3 Due** **HW 4 Assigned**
10/24	Event Synchronization	
10/26	Event Synchronization	
10/31	Scripting	
11/2	Scripting	
11/7	Scripting	
11/9	HIDs	**HW 4 Due** **HW 5 Assigned**

11/14	HIDs	
11/16	HIDs	
11/21	HIDs	
11/23		***NOTE: No class, Thanksgiving Break***
11/28	Resource Management	
11/30	I/O, Configuration Management	
12/5	Parting Thoughts	***HW 5 Due***