

# CS381: Game Engine Architecture

**Spring 2023**

**Location and Time: Mondays, Wednesdays WPEB 100 (lab)**

<https://www.cse.unr.edu/~sushil/class/381/>

## Course Information

### Instructor and Teaching Assistant/Fellow Information

**Instructor:** Sushil J Louis

**Office:** WPEB 409

**Office Phone:** 7757484315

**Email:** [sushil@unr.edu](mailto:sushil@unr.edu)

**Office Hours:** In WPEB 409 and/or on Zoom. **MW: 2:30 to 3:30** and by appointment. The zoom link is on the class canvas page. For appointments: check [my calendar](#) for an available (not busy) time and send me a **calendar meeting invitation** to [sushil@unr.edu](mailto:sushil@unr.edu) for that time. In the invitation, let me know what you want to discuss.

**Teaching Fellow: Joshua Dahl**

**Office:** WPEB 100. Check Canvas/Piazza for Zoom office hours links

**Email:** [joshuadahl@nevada.unr.edu](mailto:joshuadahl@nevada.unr.edu)

**Office Hours:** and by appointment

**Piazza:** This term we will be using Piazza for class discussion. Piazza quickly and efficiently gets you help from classmates, the TF, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email [team@piazza.com](mailto:team@piazza.com).

Find our class signup link at: <https://piazza.com/unr/spring2023/cs3811001gameenginearchitecture>

### Course Description

Introduction to the technical elements of modern videogame and the pipeline for assembling them, plus issues of interface design, quality assurance, and business practice.

### Required Texts/Course Materials

List of required course materials for reading, in-class work, writing, homework, viewing, and listening, including calculators, specialized materials or equipment, and computer software.

### Textbooks:

- Required: [Ogre Documentation and Manual](#)
- Required: [Ogre Tutorials](#)
- Required: Blender Wiki/Manual. <https://www.blender.org/support/>
- Required: Tutorial Videos for CS381:  
<https://www.cse.unr.edu/~sushil/class/381/tutorials/movies/2022/>

### Computing and Networking:

We expect this class to be in person this semester. These instructions will change if circumstances change.

Lab computers have been setup for CS381 in WPEB 100 (the lab). All assignments will be graded while running on the lab's computers. Assignments will not be graded under any other environment and **you will get a 0 for the assignment** if it is not demonstrated to be running on lab computers.

- **You may install the CS381 environment on your personal computer (Linux/Windows).** Canvas will contain instructions on getting this setup. You may also work with the teaching assistant and teaching fellow to get help on this during the first two weeks of the course. We do not have the resources to provide support for this after February 3, 2023 and there is no guarantee that you will be able to configure and use your personal computer even with our help. **In any case, it is your responsibility to have assignments (transferred and) running and available on the lab machines for grading.**
- **Note again, that your assignments will be graded while running on lab machines, and will not be graded even if it is running on your personal computer.**
- You may also remotely access lab computing resources. Graphics intensive programming assignments for this course cannot be done easily through remote access and you should not think of remote access to these computers as sufficient for classwork. Extensively using remote computer resources will significantly and negatively impact your ability to complete the class.:
  - Remote engineering computing center computing access
  - Windows: Remote ECC Machines: <https://remote.engr.unr.edu>
  - Windows: Remote Desktops: <https://remote.unr.edu>
  - Linux: Request remote access to ECC Linux resources using: [https://nevada.formstack.com/forms/cse\\_remote\\_linux\\_desktop\\_request](https://nevada.formstack.com/forms/cse_remote_linux_desktop_request). This is good to have even if you already have a personal linux box or linux installed on your Virtual Machine

- If you would like a piece of software added or upgraded, please fill out the form below:  
[Remote Engineering Desktop Software Request](#)

## Course objectives, structure, requirements, and outcomes

This course introduces students to game engine architecture and the game development pipeline by teaching students how to design and implement a 3D game engine based (this semester) on the open source [Ogre](#) graphics engine for visualization, OIS for input, and their own physics and AI. Then students use the [Unity Game Engine](#) to rebuild their work in a commercial game engine. The course is heavily focused on programming assignments with in-class demos of assignments for evaluation. Groups are encouraged for the final projects and final project demonstrations. The course covers:

- What are the main components of a game engine?
- How might we connect these components in order to enable easy game programming?
- What is our game engine's architecture?
- How do we use Ogre to implement our graphics component?
  - Adding 3D models to a Scene
- How do we manage multiple entities?
- How do we add simple 2D physics to entities so they can move realistically?
- How do we add entity interaction?
  - Selection
  - Keyboard interaction
  - Mouse interaction
- How do we add intelligence to entities?
  - Move, follow, intercept commands
- How does a commercial game engine like Unity support major game engine components?
  - How do we re-implement what we did in our CS381 game engine in a commercial engine like Unity?
- Students put together all that they have learned to build their final project game.

## Course Arrangement

The course has two components: Lecture and Laboratory. Both lecture and lab components are mandatory. Note specifically that the laboratory component is mandatory. All assignments, homework, quizzes, and exams are required.

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Find our class signup link at: <https://piazza.com/unr/spring2023/cs3811001gameenginearchitecture>

## Unique Class Procedures/Structures

We have several unique aspects in CS381.

- Every week, class will generally consist of one lecture on Mondays and one lab on Wednesdays.
- Students will be expected to demo assignments for grading during lab and will be expected to code during lab as they prepare for subsequent work/assignments.
- We **require** in class student assignment demonstrations, for grading.
- Peer review of final projects
- There is no textbook. You will use online lecture slides, tutorials, movies, and other materials.
- Expected independent learning from online tutorials

## Important Dates

- Exam 1: Tentative: March 6, 2023 in class
- Exam 2: Tentative: April 10, 2023 in class
- **Final Exam Project Presentations: Monday May 15, 2023, 9:50 a.m. – 11:50 a.m. If you cannot make this time, you must drop this course.**

## Assignments

Assignments first require writing C/C++ programs to integrate and “glue” existing and newly created components into a game engine. You will be using lab computers installed with the necessary components to do your assignments. Each programming assignment will be demonstrated in class/lab and graded on the demonstration. The set of assignments will culminate in a CS381, 3D game engine. You will then switch to the Unity game engine, program in C#, and recreate your final assignment in Unity. Then, in groups, you will brainstorm, design, and build an exemplar 3D computer game.

## Course Rules

- Late programming assignments or exercises will not be accepted.
- Exams, tests, and quizzes are individual efforts. The penalty for academic dishonesty on assignments or exams, tests, and quizzes **is failure in the course.**

- Each assignment will specify whether the assignment is an individual effort or a group assignment. Maximum group size for assignments is two (2).
- For individual assignments, **do not show, exchange, or copy** code. Using another person's code or having another person "ghost write" a lab will be considered academic dishonesty. For group assignments, if you are in a group do not show, exchange, or copy code outside your group.
- The final project is a group project.

## Grading and Assessment

Students will be assigned letter grades. Your grade will be one of A, B, C, D, or F. We will use the +/- grading system.

- There will be a number of programming assignments. Again, no late assignments will be accepted.
- There will be one or two exams. Exams are in class in person.
- **The Final Exam Project Presentations are on Monday May 15, 2023 from 9:50 a.m. - 11:50 a.m. If you cannot make this date, you must drop this course.**
- There will be announced and **unannounced** quizzes.

Tentatively, your final grade will be based on

Item	Percentage
Midterm exam (s)	40%
Assignments	20%
Final Project	20%
Quizzes and Exercises	20%

## Communications

If I need to communicate with the class as group, I'll email you through canvas or post an announcement on the class canvas page. You are required to check the class website, class canvas, and your UNR email every day. Make sure your email information in MyNevada and Canvas is up to date and implement mail forwarding if you need to. Other resources can be found on the class web page/canvas.

**Piazza:** **Note again** that this term we will be using Piazza for class discussion. Piazza quickly and efficiently gets you help from classmates, the TA/TF, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email [team@piazza.com](mailto:team@piazza.com).

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## Preliminary course outline

This outline is approximate

Topic	Material	# Lectures
Introduction	Syllabus	1
GFX: Setting up Ogre	Tutorial 1	1
GFX: Coord Systems, Scenes	Tutorials 1, 2, 3	3
Entity Management	Notes	1
Unrealistic Entity Movement	Notes	1
UI: Input/Output Systems	Tutorials 4, 5	2
PHX: oriented physics	Notes	1
Component architecture	Notes	2
AI: Unit artificial intelligence	Notes	2
AI: Group AI	Notes	1
Unity 3D	Notes, online tutorials	2
Unity UI, sound, first person	Notes, online tutorials	1
NET: Game networking overview	Notes	2
Final project brainstorming		1
Final project coordination	Notes, group meetings	2
Game Alpha demos	Online screen sharing	1
Game Beta demos	Online screen sharing	1
Game Final demos	Online screen sharing	1
Exams		2

## Student Learning Outcomes

- SLO1. (1, 2) Students will have an ability to apply knowledge of computing, mathematics, science, and engineering. In addition, students will have an ability to analyze a problem, and identify, formulate and use the appropriate computing and engineering requirements for obtaining its solution.
  - You will demonstrate this ability by applying your knowledge of programming, physics, vector math, and software design to build and use a game engine.
  - Strategies and Actions: Lectures, assignments, and projects covering game engine architecture, game physics, game AI, and sample code.
  - ABET Criteria covered:
    - (1) an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

- (6) an ability to identify, analyze, and solve broadly-defined engineering technology problems
- Program Objectives covered: Demonstrate strong analytic, design, and implementation skills required to formulate and solve computer science or computer engineering problems in a professional or research environment.
- Assessment: Programming assignments and projects. Test/Exams.
- SLO2. (3, 4) Students will have an ability to apply design and development principles in the construction of software systems or computer systems of varying complexity. In addition, Students will have an ability to use current techniques, skills, and tools necessary for computing and engineering practice.
  - Students demonstrate they can learn to design and implement computing solutions using modern computing tools such as an Integrated Development Environment in the pursuit of broader assignment and project goals.
  - Strategies and Actions: Lectures, assignments, and projects covering the design and development of a game engine from components.
  - ABET Criteria covered:
    - (1) an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities
    - (6) an ability to identify, analyze, and solve broadly-defined engineering technology problems
  - Program Objectives covered: Demonstrate strong analytic, design, and implementation skills required to formulate and solve computer science or computer engineering problems in a professional or research environment.
  - Assessment: Programming assignments and final project.

### Late Work or Make-up Exams Policies

Late assignments will not be accepted.

### Academic Standards Policy for **Writing Code for assignments**

#### **CSE Department, University of Nevada, Reno**

A student may receive academic and disciplinary sanctions for cheating, plagiarism or other attempts to obtain or earn grades under false pretenses. In addition to University definitions of academic dishonesty, the following rules define plagiarism and cheating for students in computer science and engineering classes:

1. Sharing ideas with other students is fine, but you should write your own code. Never copy or read other students code, including code from previous years. Cosmetic changes, such

as rewriting comments, changing variable names, and so forth to disguise the fact that your work is copied from someone else, is easy to detect and not allowed.

2. It is your responsibility to keep your code private. Sharing your code in public is prohibited, and may result in zero credit for the assignment.
3. If you find some external code (such as an open-sourced project) that could be reused as part of your assignment, you should first contact the instructor to see whether it is fine to reuse it. If the instructor permits it, she/he may announce it to the entire class so that all students could use it. And if you decide to reuse the external code, you should clearly cite it in comments and keep the original copyright in your code, if applicable.
4. If you use an external AI for your code, you must cite it in your comments and post the code and conversation/prompts/query sequence that led to your code.
5. You should be prepared to explain any code you submit, including code copied/modified from external sources. If you cannot explain it to our satisfaction, you will not get credit for the assignment.
6. Every student will be asked to sign the following statement for every programming assignment: "This code is my own work. It was written without consulting a tutor or code written by other students."

## University Policies

### Statement on COVID-19 Policies

#### Face Coverings

Pursuant to Nevada law, NSHE **employees, students and members of the public are not required to wear face coverings while inside NSHE buildings irrespective of vaccination status**. However, students may elect wear face coverings if they choose.

#### Disinfecting Your Learning Space

Disinfecting supplies are provided for your convenience to disinfect your learning space. You may also use your own disinfecting supplies.

#### Testing Positive for COVID-19 or Exhibiting COVID-19 Symptoms

Students testing positive for COVID 19 or exhibiting COVID 19 symptoms will not be allowed to attend in-person instructional activities and must leave the venue immediately. Students should contact the [Student Health Center](#) or their health care provider to receive care and information pertaining to the latest COVID 19 quarantine and self-isolation protocols. If you are required to quarantine or self-isolate, you must contact your instructor immediately to make instructional and learning arrangements.

#### Accommodations for COVID 19 Quarantined Students



For students who are required to quarantine or self-isolate due to testing positive for COVID or exhibiting COVID 19 symptoms, instructors must provide opportunities to make-up missed course work, including assignments, quizzes or exams. In courses with mandatory attendance policies, instructors shall not penalize students for missing classes while quarantined.

## Statement on Academic Dishonesty

"The University Academic Standards Policy defines academic dishonesty, and mandates specific sanctions for violations. See the University Academic Standards policy: [UAM 6,502](#)."

Please also read the Academic Standards Policy for **Writing Code for assignments** above.

## Statement of Disability Services

### ***For Traditional and Seated Classrooms:***

"Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the [Disability Resource Center](#) (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations."

**This course may leverage 3<sup>rd</sup> party web/multimedia content, if you experience any issues accessing this content, please notify me ([sushil@unr.edu](mailto:sushil@unr.edu)).**

## Statement on Audio and Video Recording

### **Student-created Recordings**

"Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped, or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."

### **Instructor-created Recordings**

Class sessions may be audio-visually recorded for students in the class to review and for enrolled students who are unable to attend live to view. Students who participate with their camera on or who use a profile image are consenting to have their video or image

recorded. If you do not consent to have your profile or video image recorded, keep your camera off and do not use a profile image. Students who un-mute during class and participate orally are consenting to have their voices recorded. If you do not consent to have your voice recorded during class, keep your mute button activated and only communicate by using the "chat" feature, which allows you to type questions and comments live.

## Statement on Maintaining a Safe Learning and Work Environment

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit the [Equal Opportunity and Title IX](#) page.

- If I need to communicate with the class as a group, I'll email you through canvas or post an announcement on the class canvas page. You are required to check the class website, class canvas, and your UNR email every day. Make sure your email information in MyNevada and Canvas is up to date and implement mail forwarding if you need to. Other resources can be found on the class web page.
- Make sure you read the section above on "Academic Standards Policy for Writing Code for assignments."
- **Statement for academic success services:** "Your student fees cover usage of the [University Math Center](https://www.unr.edu/university-math-center) (https://www.unr.edu/university-math-center), (775) 784-4433; [University Tutoring Center](https://www.unr.edu/tutoring-center) (https://www.unr.edu/tutoring-center), (775) 784-6801; and [University Writing & Speaking Center](https://www.unr.edu/writing-speaking-center) (https://www.unr.edu/writing-speaking-center), (775) 784-6030. These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student."