

USC Iovine and Young Academy

Arts, Technology and the Business of Innovation

IDSN 539 - Extended Reality Development

Spring 2025 | 4 Units

M,W 4pm - 5:50pm

Room IYH 111

John Bruneau

Office Hours: Fri 12-1pm

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IT Help

Hours: M-F 9:00am - 6:00pm

Contact Info: iyahelp@usc.edu

Course Description

Extended Reality Development is a comprehensive course designed to provide an overview of modern XR programming practices and hands-on implementations. The course will introduce students to the fundamentals of Unity development which are essential for any type of XR project. It will then explore concepts that will lead to richer user experiences, including 3D UX, physics forces, animations, behaviors, visual effects, and spatial audio. This course will teach students how to code C# scripts to produce mechanics that interact with XR devices, culminating in innovative virtual and mixed reality experiences. Lectures will also cover advancements in XR hardware and software APIs. The course is laid out as a progression of prototypes based around topics learned in class, building up to a final mixed reality project to be completed by the end of the semester.

Learning Objectives and Outcomes

By the end of this course students should be able to:

- Demonstrate an in-depth understanding of the virtual environment development process.
- Gain proficiency in C# and the Unity development pipeline.
- Have a fundamental understanding of scripting and programming concepts.
- Demonstrate a basic fluency in XR hardware features and constraints
- Apply UI, UX, interactivity, and visual design principles.
- Create engaging work of conceptual, interactive, and technical depth.

Recommended Courses

ACAD 217, and some familiarity with programming is recommended but not required.

Recommended Preparation

- Download and install all required software
- Create an itch.io and GitHub account
- Join the class Discord Server
- Complete the Roll-a-ball tutorial (<https://learn.unity.com/project/roll-a-ball>)

Course Notes

The class will be a mix of technical demonstrations, software workshop exercises, lectures on technology, design, and applications of immersive and extended reality experiences, as well as collective critique sessions. Technical demonstrations may be recorded and shared with the students afterward for further review.

Course Structure

Students are expected to participate in lecture discussions and critiques. Students are responsible for completing assignments and projects by stated deadlines. Assignments will be uploaded by students to their Itch.io page and submitted as a URL to Brightspace.

Technological Proficiency and Hardware/Software Required

Students must provide their own laptop running the most current operating system available. The laptop must be capable of running Unity smoothly as well as rendering 3D models, lighting and materials. If the student's laptop does not have the space or processing power to do this, it is time to upgrade.

Required Software:

Unity (latest LTS version) (<https://unity.com/download>)
Visual Studio Code (<https://code.visualstudio.com>)
VS Code Unity extension (<https://code.visualstudio.com/docs/other/unity>)
Adobe Photoshop (<https://www.adobe.com/products/photoshop.html>)
Git Client (Github Desktop, GitKraken, or Sourcetree)

Recommended Software:

Blender (<https://blender.org>)
Adobe Mixamo (<https://www.mixamo.com>)
Adobe Audition (<https://www.adobe.com/products/audition.html>)
Figma (<https://www.figma.com>)

Accounts:

Discord (<https://discord.com>)
Itch (<https://itch.io>)
Github (<https://github.com>)

How to Purchase Software at the Discounted Rate Through the USC Bookstore

The following first year software are now available for purchase online through the USC Iovine and Young software catalog at the Academy discounted rate:

Software	IYA Short-Term License at USC Bookstore
Adobe Creative Cloud	\$70 2022-2023 annual license

To purchase:

- Visit: <https://commerce.cashnet.com/IOVINE>
- Select the software license(s) you would like to purchase by clicking “View Details” or the software title, and make your purchase.
- You will receive an order confirmation receipt at the email address you provided.
- You will be notified by email when the software license has been activated.

If you have any questions about this process, please do not hesitate to contact Academy IT Support at iya.helpdesk@usc.edu.

Required Readings and Supplementary Materials

Supplemental reading will be drawn from textbooks, articles, papers, cases, videos, and online publications. In all instances, the material will be delivered via computer.

Recommended References and Reading

- Unity Development Docs (<http://docs.unity3d.com>)
- Unity Learning Modules (<https://learn.unity.com>)
- MDA Paper (<https://users.cs.northwestern.edu/~hunicke/MDA.pdf>)
- Rev Rant: Fun isn't Enough (<https://www.youtube.com/watch?v=otyXtzLNxol>)
- Video Games are Boring (<https://www.gamesindustry.biz/video-games-are-boring>)
- Robert Yang's Design Blog (<https://www.blog.radiator.debacl.us>)
- Introduction to Game Design by Jeremy Gibson Bond (<https://amzn.com/dp/0136619940>)
- Snow Crash: A Novel by Neal Stephenson (<https://amzn.com/dp/0553380958>)

Assessable Tasks

The following is a breakdown of the expectations for assignments and other assessable tasks. Unless otherwise noted, all submissions will be due 1 hour prior to class on Brightspace.

Participation

In-class participation is an important and required component of the learning methodology for this course. Students are expected to attend class on time and contribute to class discussions, both on and off line. Students must coordinate with classmates on group projects, as well as maintain communication and progression of your group assignments outside of class. It is the students responsibility to make up for missed class sessions or meetings.

Labs

Some class sessions will include an in-class lab exercise. Labs are completed by the end of the class session and will be checked off by the instructor, or assistant rather than submitted to Brightspace. Labs are each worth 1% of the total grade.

Lab 1

Create a WebGL build in Unity that simply prints “Hello World” to the screen. Publish the build to

Itch as an html embed. Make sure the dimensions are reasonable for most users screens.

Lab 2

Explore Generative art, self-replication and recursion. Using coroutines, instantiation, transform properties, shaders, conditionals, and randomness, create a system that generates a form of dynamic work. Experiment with code to generate something visually interesting and organic yet alien.

Lab 3

Using Physics Materials, Colliders, and Lighting add some bumpers to the Marble Exercise.

Lab 4

Using AudioSources and Triggers add dynamic sound effects and music to the Shmup exercise.

Lab 5

Find a character model, and animations that are fair use. Import them into unity and create an animator with an idle animation and at least 3 other animated states. Use key presses and the animator API to move between animations. After each animation the character should transition back into its idle loop.

Lab 6

Create a repo in GitHub and upload your current unity project. Make sure you include an appropriate git ignore. Every member the team must edit or contribute code and scene changes, then push and commit properly with comments.

Lab 7 and 9

Come up with at least 3 questions you would like answered from playtesting. Record playtesting feedback and take notes on possible revisions.

Lab 8

Create design docs for the current assignment. Write down your ideas on rules, mechanics, characters, and maps. Include some visual design sketches as well.

Lab 10

Create a proposal for the Final Project and pitch your idea to the class. Put together your design docs and a short slide presentation. Do your best to convince your colleagues to join your group. After the presentations, every student will vote by ranking their top 4 project ideas.

Exercises

The course will begin with a series of, one-week exercises that explore Unity and C# as a platform for development and experimentation. The exercises build on each other both in

concept and technical expectations. The focus here will be on creativity and discovery. Each exercise will be submitted via your itch.io page, accompanied by a screenshot and a paragraph description. The page should include one Windows build and one build for either MacOS or embedded WebGL. Each exercise is worth 5% of the total grade. Exercises are due one hour before class.

Exercise 1 - Rube Goldberg Machine

Create a Rube Goldberg Machine in Unity using only the physics engine, no code. With just basic geometry, rigidbodies, and colliders, it's easy to create rolling spheres and dominos. Create at least 3 cascades. Experiment with mass, constraints, and physics materials. How elaborate you can make your machine? The focus here will be on creativity and ingenuity.

Exercise 2 - Marble Physics

Create a simple 3D game where the player controls a ball or marble through an environment of obstacles. The game must have at least 3 levels that increase in difficulty. Use keyboard input to apply physics forces to the object. Experiment with mass, friction, gravity, physics materials, and any techniques you learned from the last exercise.

Exercise 3 - Shmup

Create a retro-style space shooter or shmup with 3 waves or levels. It doesn't need to be spaceships in space, specifically. You are encouraged to design something unique for the genre. Focus on player interactions. What happens when a projectile is fired, when an enemy is hit, when the player takes damage, when an item is collected? Use triggers and colliders, sound and visual effects. Consider simple UI in the form of a score, powerups, health or other indicators. Make your own player, enemy, item, and projectiles. Things like backgrounds, sound, and particles, can be free or fair use assets if they are given proper attribution on your itch page.

Exercise 4 - UX Pass

Add UI and create a polish pass on your shmup. Focus on the user experience. Create a title menu, credits page, win screen, and game over screen. Create buttons for navigation and UI to track life and score. Make sure you have a complete game loop. This means there is no situation where the player is forced to exit the game. When the game concludes the player is given the option to play again. Include an option to exit normally when the player presses Escape. You may also add more environmental reactions, feedback effects, sound and anything else the shmup needs to feel like a complete polished and "juicy" experience.

Assignments

Students are expected to produce professional level content that demonstrates a mastery of raw technique as well as an attention to aesthetic quality and user experience design. Assignments are group projects, developed over multi-week sprints, with milestones along the way. The focus here will be on rapid development and iterative design. Music, sound effects, ui, a way to exit, and a complete game loop are required. They will be submitted via an itch.io page,

accompanied by a writeup, documentation, and repo link. The accompanying documentation will consist of images or video of gameplay. The writeup will give an overview of the game, the development process, successes, challenges, what you learned, and possible future revisions. All assignments are due 1 hour before class. Every student in a group project must submit a link to the assignment. Each assignment is worth 15% of the total grade.

Assignment 1 - 3D Environments

Working in groups, create a first person interactive escape room environment. Brainstorm with your team ways in which a 3D environment with intractable objects can be used to convey a narrative. Create an interesting space for the user to explore. Utilize triggers, colliders, and a game manager. Consider how sound and lighting affect the player and how best to use variables to store states. Incorporate text and NPCs if needed. Emphasis will be placed on player interactions and environmental storytelling. Be creative. No attacking necessary.

Assignment 2 - Virtual Reality

Working in groups, create a multi-scene adventure in VR. Users will explore rooms or areas, and collect items. This world includes keys and locked doors as well as obstacles and traps. Progress must be gated in some manner that requires changing the game state. Consider how best to use scenes and variables to store persistent data. You may keep the aesthetic simple but there does need to be player feedback for all the forms of environmental interaction your group creates. Include 3D UI, a way for users to move in the space, position and rotation tracking for controllers, and a method for interaction. This assignment should run on the Quest 3 with a frame rate of 90fps or higher and no lower than 72fps.

Final - Immersive Reality

The Final is a fully flushed out large scale project with an emphasis on experimental interactions and research into virtual and mixed reality. Working in groups, examine new and innovative ways in which MR can be used that push the limitations of the medium. Include 3D UI, passthrough, hand tracking, and plane detection. This project is specifically looking at how well students convey their own ideas and how they explore the medium itself. Milestones and a groups ability to self-organize will be critical. The final projects begin with proposals that are voted on by the class. Betas will be presented and playtested. Final projects should run on mobile headsets with a frame rate of 90fps or higher and no lower than 72fps. The itch page documentation will also include a video trailer.

Extra Credit

Any outside but related project can be eligible for extra credit. Attending external talks and lectures may earn extra credit as well. Extra credit will also be given on any assignment where a student goes beyond the minimum requirements laid out by the instructor. The amount of extra credit is based solely on what is deemed appropriate by the instructor.

XR Lab Workshops

There are 8 workshops students can take in the XR lab that can help students who need more time to familiarize themselves with certain fundamentals. Some students may be required to attend these workshops if they need assistance in a specific area.

- XR Lab 1: Setting up the Dev Environment
- XR Lab 2: Overview of the Unity Editor
- XR Lab 3: C# Basics
- XR Lab 4: Making a Complete Game
- XR Lab 5: Animation
- XR Lab 6: Building VR for the Quest3
- XR Lab 7: XR Passthrough, Controllers, and Locomotion
- XR Lab 8: 3D Modeling with Blender

Grading Scale

Course final grades will be determined using the following scale:

A	94-100	C	73-76
A-	90-93	C-	70-72
B+	87-89	D+	67-69
B	83-86	D	63-66
B-	80-82	D-	60-62
C+	77-79	F	59 and below

Grading Breakdown

Assignment	Grade %
Class Participation	10%
Labs	10%
Exercises	20%
Assignments	30%
Final	30%
TOTAL	100%

Weekly Class Schedule (Subject to Change)

	Class	Assignment Due
Week 1	Introduction to Class Working with Unity Physics and Colliders, Textures and Materials Creating a build, Uploading on Itch	Lab1: WebGL Hello World

Week 2	Introduction to programming and C# Setting up your environment, VS Code and extensions Variables, Conditionals, Loops Coroutines, Lerp, and Slerp Interaction, Movement, Input	Ex1: Rube Goldberg Lab2: Generative Art
Week 3	Making a character controller Position, Rotation, Scale, Color Prefabs, Projectiles, Instantiate, Destroy Level Design Effects, Particle Systems	Ex2: Marble Physics Lab3: Bumpers
Week 4	Canvas UI, Menus Scene management, Transitions, Full game loop Sound and Music	Ex3: Shmup Lab4: Sound Effects
Week 5	Animating Avatars Using the Animation and Animator windows Rigging animation states, Using Animator API	Ex4: UX Pass Lab5: Animator
Week 6	Interaction in C# First Person Character Controller Triggers, Colliders, Feedback Git and Version Control	As1 Environments: Demo Lab6: Github
Week 7	Beta Playtesting Revisions, Feedback, Critique Environments, Terrain, Lighting, Skyboxes	As1 Environments: Beta Lab7: Playstesting
Week 8	Introduction to Quest and VR Setting up VR hardware Testing Playmode with link cable Building to an Android device	As1 Environments: Release
Week 9	Creating an OpenXR Character controller Moving in the world UI and UX in 3D	As2 VR: Demo Lab8: Design Docs
Week 10	Beta Playtesting Revisions, Feedback, Critique Individual help, Group work time	As2 VR: Beta Lab9: Playstesting
Week 11	Raycasting Picking up and throwing objects VR controller input Player prefs, Saving and loading files	Lab10: Final Proposal As2 VR: Release
Week 12	Mixed Reality Integrating passthrough Scanning the room and interacting with the physical environment	Final Design and Demo

Week 13	Hand Tracking and Gestures Bug fixing	
Week 14	Beta Playtesting Revisions, Feedback, Critique Individual help, Group work time	Final Beta
Week 15	Optimization Work Day	
Final	Final Presentations	Final Release, Website and Trailer

Assignment Rubrics

Student work will be assessed based on:

- Level of understanding and execution of software skills on assignments.
- Degree of complexity of the assignment goal both creatively and technically.
- Innovative application of tools and concepts covered in class.

Assignment Submission Policy

Upload your build and all of your digital assets for your assignments to itch.io and submit the URL to your assignment to Brightspace at least one hour prior to the start of the class session. Include a screenshot and description. For the assignments and the final, also include the required writings.

Grading Timeline

Milestones and assignments will be reviewed, graded, and provided with feedback within two weeks of submission.

Exam Policy

No make-up exams (except for documented medical or family emergencies).

Late Work and Resubmissions

Due dates and requirements for all assignments will be posted on Brightspace. It is the student's responsibility to submit work by the due date following the defined class procedures, even if they miss class. To receive credit, all projects must run. If the uploaded build(s) have errors then the score will be 0. Test the builds that have been uploaded.

Work turned in up to 1 week late will receive a 10% deduction. Work turned in up to 2 weeks late will receive a 20% reduction. **Work will not be accepted after two weeks past its due date.** To receive credit for late work you MUST email the professor that you posted a lab or assignment after the due date or you will not receive credit. Work may be resubmitted, but the same grading penalties apply. Work may not be resubmitted after 2 weeks.

Classroom norms

Students are expected to be seated in class **before the session begins** and treat learning as an opportunity. Students are to be respectful of each other and the space in which they inhabit. We are all here to have a positive learning experience, have fun, get to know each other, and grow as creative thinkers. Students being disruptive to the class who do not cease their activities will be asked to leave and if necessary will be escorted out.

Digital Storage & Data Loss

All work should be saved and backed up. Digital information does not exist unless it is saved in at least two locations. Back up everything in a git repo. Data loss for any reason is not an excuse. You have been warned.

Synchronous Session Recording Notice

Some synchronous sessions may be recorded and provided through Zoom. USC has a policy that prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

SCampus Section 11.12(B)

Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study is a violation of the USC Student Conduct Code. This includes, but is not limited to, providing materials for distribution by services publishing class notes. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the Internet or via any other media. (See Section C.1 Class Notes Policy).

Academy Attendance Policy

The Academy maintains rigorous academic standards for its students and on-time attendance at all class meetings is expected. Each student will be allowed **three** excused absences over the course of the semester for which no formal proof is required. Students are admonished to not waste excused absences on non-critical issues, and to use them carefully for illness or other issues that may arise unexpectedly. Except in the case of prolonged illness or other serious issue (see below), no additional absences will be excused. To request an excused absence, students must email the professor at least 1 hour before class. Each unexcused absence will result in the lowering of the final grade by 3.33% (e.g. A- will be lowered to a B+, etc.). In addition, being tardy to class will count as one-third of an absence. Three tardies will equal a full course absence. Missing more than 15 minutes of class will be counted as a full absence. Attendance is taken verbally the very first minute of class. Students must be in class before attendance starts to be counted as present. If a student arrives after attendance is taken, it is up to them to inform the teacher.

Students are expected to keep up with class activities and requirements each week. Missing even a single class will impact your attendance and participation and you will be responsible for making up for that impact. Students remain responsible for any missed work from excused or unexcused absences. Immediately following an absence, students should contact the instructor to obtain missed assignments or lecture notes and to confirm new deadlines or due dates. Extensions or other accommodations are at the discretion of the instructor.

Automatically excused absences normally may not be used for quiz, exam or presentation days. Using an excused absence for a quiz, exam or presentation, such as in the case of sudden illness or other emergency, is at the discretion of the instructor.

In the case of prolonged illness, family emergencies, or other unforeseen serious issues, the student should contact the instructor to arrange for accommodation. Accommodation may also be made for essential professional or career-related events or opportunities. Additionally, students who need accommodations for religious observations should provide advanced notice to instructors and student athletes should provide Travel Request Letters. All accommodations remain at the discretion of the instructor, and appropriate documentation may be required.

Spring 2023 addendum

- Unless students provide an accommodation letter from USC's Office of Student Accessibility Services (OSAS) or a letter from IYA Student Services detailing visa or travel restrictions, attendance and active participation is expected in the classroom. Any student with such accommodations should submit their accommodation document to the instructor as soon as possible to discuss appropriate accommodations. Either classroom recordings or live remote access to the class via Zoom will be provided.
- Students who are experiencing illness should not attend class in person. Please inform the instructor in advance of any class sessions that you can't attend for medical reasons, and accommodations will be arranged to view recorded lectures and submit alternatives to any missed class participation. Students will not be penalized for not attending class in person under these circumstances.
- In the event that you find yourself experiencing COVID-19 related symptoms, in keeping with university recommendations, you should Stay home! This is the best way to prevent spreading COVID-19 as supported by scientific evidence; Please do not come to an in-person class if you are feeling ill, particularly if you are experiencing symptoms of COVID-19.

Irvine and Young Hall Cleanout

The Academy is unable to store student projects and materials beyond the end of the semester. Students must remove all projects and personal materials from the Creators Studio, lockers/locker room, and other classrooms by the end of each semester. **All projects and materials left in Irvine and Young Hall will be discarded two days after final exams end. No exceptions.**

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Allowed and Prohibited uses of AI

AI is allowed for the purpose of creating sprites, music, models, and other art assets. AI may not be used to write papers, postmortems or documentation. Copilot and other AI assistants may be used for code hints and completion when programming. Using AI to write a whole script is not permitted.

Students and Disability Accommodations

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services

(RSVP) - (213) 740-9355(WELL), press “0” after hours - 24/7 on call

Studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

eeotix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776

osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 - 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 - 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu
chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.