Realtime

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Time: Thursday, 7:00-9:00 pm
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COURSE ABSTRACT

Realtime will explore, modify, and develop a suite of real-time architecture and urban design assist tools using the Unreal Gaming Engine. To date, real-time software has predominantly been used in architecture and urban design to visualize environments and allow users to experience projects at the end of the design process. This course will reverse this process and use real-time software as the generator of design. We will do this by problematizing the application of external constraints on the production of architecture.

COURSE OVERVIEW

From zoning envelopes, to functional requirements, from budgetary realities, to material performance, the architectural design process constantly responds to constraints. These constraints are modeled and represented through land use plans, bubble diagrams, spreadsheets, or even rapid prototyping. These methods of representation have become industry standards, and most projects are at some point visualized, tested, and developed in concert with some type of constraint and convention of representation. In this course, we will model constraints that escape static visualization, but are desirous to industry and academia as design drivers. We will leverage the Unreal Engine's dual ability to handle computationally intensive tasks, and capacity to synthesize multiple datasets into a single visual domain to produce—and design with—a suite of dynamic architectural constraints. We will do this by experimenting with and producing new conventions of representation.

Students will work in teams to develop a research project in the Unreal Engine that explores simple constraints like zoning information, with more complex constraints like structural, wind, seismic, and energy forces, data driven global warming scenarios, as well as emerging drivers like autonomous navigation, crowd simulation, user-occupancy behavior, and IOT networks. Through weekly lectures, demos, and technical workshops, students will be provided with the introductory skills and concepts to develop real-time applications in the Unreal Engine that can be published as standalone Virtual Reality experiences, Augmented Reality smartphone apps, and WebGL applications.

METHOD

- Balance of technical and conceptual; Mini-lectures and demos to think through the possibilities.
- Students will be provided with knowledge and milestones along the way.
- Urban context accessible through connections with external datasets, apis and complementary tools. Connecting Unreal Engine to spatial datasets and CityEngine.
- Students provided with research prompts and topics.

Typical Weekly Format

7:00 pm: Lecture
7:45 pm : Review of Weekly Challenge
8:00 pm: Demo
8:45 pm: In-Class Challenge

Key Learning Objectives

- Develop a research project in relation to a research topic
- Conceive and execute on a real-time experience that creatively engages the research project
- Develop interactive experience in the Unreal Gaming Engine
- Import assets and information from external sources into the Unreal Gaming Engine
- Package and publish from the Unreal Gaming Engine to Standalone and Other Applications

DELIVERABLES

Individually: Four (4) Weekly Challenges.
As a Team: Mid-review Team Research Proposal.
As a Team: Final-review Team Project.
As a Team: Final Project Submission.

Final Team Project
Students will be asked to form teams during the second half of the semester to collaboratively develop the Final Team Project. Each team will be assigned one of five research topics, and will need to develop a research project, with a critical position around the topic.

ASSESSMENT

Evaluation and Grading
Students are expected to attend all classes, participate in all discussions, and complete all tasks. Grading will be based on participation, assignment completion, and the final project. The grading will be weighted as per below.

15% Discussions and participation
15% Weekly Assignments and Individual Challenges
20% Team Mid-Review Presentation
40% Team Final Project

Final Project
The final project will be evaluated based on:

- Quality and thoroughness of research method
- Development of research project with an awareness of context and precedent
- Creativity, originality and execution of final output

Team Work
All collaborations require compromise and negotiation, which can result in productive friction! Learning to work with other people is an essential professional and indeed life skill. All team members will be expected to present collectively as a team, and be responsible for all work collectively produced as a team. Students will be expected to resolve any team conflict.

Late Arrivals and Absences Policy
Absences due to acute illness, a personal crisis (e.g. a death in the family), religious observance, or for other reasons of comparable gravity may be excused. In all such cases, students must promptly email their instructors to communicate the reason for their absence and to arrange an opportunity to review any important information they may have missed.

Students who know they will miss a scheduled class due to religious holidays should email their instructor during the first week of classes with a list of dates for their anticipated absences.

Unexcused absences, late arrivals, or early departures from class will reduce your course grade. Three non-consecutive absences will result in a grade reduction by one-third. Three consecutive absences or four non-consecutive absences will be considered grounds for failing the course.

Late Submissions
Where extenuating circumstances occur, students must seek prior approval from the instructors for an extension. Students who submit work after the due date without an extension may see a reduction in their grade.

Office Hours
Available weekly by appointment.

Students with Special Needs
Students with specific needs that require attention should inform the instructors at the beginning of the semester. If you have a disability (physical, learning, or psychological) which may make it difficult for you to carry out the course work as outlined, and/or requires accommodation such as recruiting

note takers, readers, or extended time on presentations and assignments, please do let us know at your earliest convenience.

Columbia GSAPP Statement on the Expectation of Academic Honesty:
"The GSAPP has historically resolved that maintaining academic integrity is the preserve of all members of our intellectual community – including students, faculty and staff. As a consequence, all GSAPP community members must abide by the principles of academic honesty. In this way, we seek to build an academic community governed by our collective efforts, diligence, and Code of Honor. These principles are the cornerstone of educational integrity at Columbia. They also reflect the GSAPP's professional obligations of self-regulation. As such each member of this community is expected to uphold such standards and abide by all policies set forth (e.g. plagiarism and appropriate acknowledgment of sources, prerequisites, mandatory workshops, etc.) Academic dishonesty — attempted or actual — will not be tolerated."

https://www.arch.columbia.edu/honor-system
https://www.arch.columbia.edu/plagiarism-policy

SCHEDULE

W 1	Sep 5	Introduction

Lecture
Introductions; real-time urban systems; course overview, syllabus, schedule, and expectations.
Demo
Three target capabilities for students, or why Unreal and Gaming Engines: External data, AI, and Sequencer.

Homework

Challenge 1 Assigned!

Outside-of-class learning resource(s)
Your First Hour with Unreal Engine (Video Tutorial [link])

W 2	Sep 12	I. Autonomous

Lecture
Autonomous future projects.
Demo
Unreal Engine Basics:
Installing; overview of UI; high-level modules; something fun!

Homework

Challenge 1 Due!
Challenge 2 Assigned!

Outside-of-class learning resource(s)
Introducing Unreal Engine (Video Series [link])

W 3	Sep 19	II. Crisis

Lecture
Climate Catastrophes and Crisis Cycles.
Time; Ticks; Feeds; Hooks; Triggers.
Demo
Getting data into Unreal:
Blueprints intro; datasets; APIs; GIS; Actors; something fun!

Homework

Challenge 2 Due!
Challenge 3 Assigned!

Outside-of-class learning resource(s)
1) *Working with the Datasmith Pipeline* (Video Series [link])
2) *Import Real World Locations Into Unreal Engine 4* (YouTube [link]
3) *UE4 / Unreal Engine 4 / Data Tables (CSV & JSON)* (YouTube [link])

W 4   Sep 26   III. Attention

Lecture
No-Stop Classroom
Audio-visual education; Behavioural Science; Salient maps; Quantifying the gaze.
Demo
Interaction, Packaging and Deployment
An interactive blueprint system; deploying to HTML5, VR, AR, and Standalone Application; something fun!

Homework

<mark>Challenge 3 Due!</mark>
<mark>Challenge 4 Assigned!</mark>

Outside-of-class learning resource(s)
1) *Introduction to Packaging Projects* (Video Series [link])
2) *Creating Virtual Reality Walkthroughs* (Video Series [link])
3) Augmented Reality Quick Start (UE4 Documentation [link])

W 5   Oct 3   IV. The Street

Lecture
Traffic engineering, street sensors, machine vision, object tracking, pattern recognition, and anomaly detection.
Demo
Real-time actions:
Procedural Content Creation; CityEngine to Unreal.

Homework

<mark>Challenge 4 Due!</mark>
<mark>Mid-review Assigned!</mark>

Outside-of-class learning resource(s)
1) *Unreal and CityEngine* (YouTube [link])
2) *Blueprint Generating Procedural Rooms* (YouTube [link])
3) *Blueprint for Generating Procedural Building* (Video Tutorial [link])

W 6   Oct 10   V. Trump Tweets

Greg away   **Lecture**
Fictions, para-fictions, myth-making, fakes, hoaxes, and other subversive practices.
Demo
Twitter Spawner; Natural Language Processing; Frequency Analysis; Players and Characters.

Homework

<mark>Mid-review Check-In!</mark>

Outside-of-class learning resource(s)
1) *NLP-UE4* plugin (Github [link])
2) *The Unreal Donald Trip* (Turbosquid [link])

W 7	**Oct 17**	**Mid-review**
		Team presentations on research topics.

W 8	**Oct 24**	**In Detail**
	Greg	**Guest Detailed Demo** External Data, AI, Sequencer

W 9	**Oct 31**	**Team Desk-Crits**
	Greg+Farzin away away	Working prototype.

W 10	**Nov 7**	**Team Desk-Crits**
	Farzin away	Refined prototype.

W 11	**Nov 14**	**Team Desk-Crits**
		Polished assets.

W 12	**Nov 21**	**Realtime Final Review**
		Presentations, and demos of Final Team Project to invited guests

W 13	Tue Nov 26	Last Day of Architecture Classes
	Nov 29-28	Thanksgiving
W 14	Dec 5	GSAPP Studio Final Review Week
W 15	Dec 9 Dec 12	Last day of HP,UP, RED classes Study Period - No Class
W 15	**TBD**	**Real-Time Final Project Submission**