Course Syllabus for “From Eye to AI Digital Phantoms for Medical Imaging”

High School / Undergraduate Students

1. Basic Information about the Course

Course Number	TBD	Course Code	TBD	Offering Department	C. Light Data Science Department
Course Title	From Eye to AI: Digital Phantoms for Medical Imaging				
Course Objectives	Learn how to build and simulate digital phantoms of the human eye using 3D tools. Discover how these virtual models are used in healthcare to help doctors understand medical conditions and help engineers train AI systems for medical imaging.				

<table>
<tr><td>Expected Learning Outcomes</td><td colspan="5">By the end of this course, students will be able to:
Use 3D modeling tools like Unity3D to create and render anatomical structures (e.g., the eye).
Apply version control systems (VCS) to manage and track their C# code.
Set up Continuous Integration/Continuous Deployment (CI/CD) pipelines to automate building and testing of projects.
Understand and implement basic Unity design patterns (such as Model-View–Controller).
Translate anatomy and biology data into 3D structures, bridging science and technology.
Simulate medical imaging data with high fidelity to support doctors and AI engineers.
Generate synthetic datasets that can be used to train AI models in healthcare.</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Professor Joe Xing</td></tr>
<tr><td>Teaching Team</td><td colspan="5">TBD</td></tr>
<tr><td>Credit Hours
32</td><td>Credits
TBD (18)</td><td>Total Credit Hours (Lecture Hours + Practical Hours)</td><td>32</td><td>Course Schedule of Hours</td><td>32/ 4/ 16
In-class Lecture Hours/Lab Hours/Self Study Hours</td></tr>
<tr><td>Course Classification</td><td colspan="5">Undergraduate (including high-school students)</td></tr>
<tr><td>Course Type</td><td colspan="5">Application oriented</td></tr>
</table>

Language of Instruction	Course materials, slides, and technical terminology will be provided in English, and instruction will be delivered in English.
Course Highlights	In this course, students will explore the exciting world of Unity3D, using powerful 3D graphics tools to build and simulate a digital phantom of the human eye. These virtual models aren't just fun to create, they are extremely valuable in the medical and healthcare industry, helping doctors understand complex conditions and giving engineers high-quality data to train AI models for medical imaging. Along the way, students will also pick up real-world coding, testing, and teamwork skills used by professional software engineers.
Assessment Methods	Examination（x） Comprehensive evaluation（x） Mid-term exam + final project
Textbooks and References	Unity in Action: Multiplatform Game Development in C# by Joseph Hocking (great intro, student-friendly). An Introduction to Medical Imaging: Physics, Engineering and Clinical Applications by Nadine Barrie Smith & Andrew Webb
Prerequisites	Introduction to Programming (C Sharp, Python) Algebra & Geometry Introduction to Machine Learning / Data Science (recommended, not mandatory)
Applicable Schools and Majors	School of Medicine (Clinical Medicine, Public Health, Medical Imaging, etc.) Department of Computer Science and Technology Department of Biomedical Engineering, Engineering Physics Department of Automation Department of Electronic Engineering And other related majors with interest in the intersection of AI and healthcare.

2. Course Content Overview

This course introduces students to the exciting intersection of 3D graphics, medical science, and artificial intelligence. Using Unity3D, students will build and simulate digital phantoms of the human eye and other anatomy, learning how these virtual models are used in healthcare to support doctors and train AI systems for medical imaging.

Course Description

Over 16 classes, students will explore how modern 3D modeling tools like Unity3D can be applied beyond gaming to solve real problems in medicine. Starting with the basics of Unity and C# programming, students will learn how to design, render, and simulate anatomical structures — with a focus on building a **digital eye phantom**. Along the way, they will connect biology and anatomy to 3D structures, practice software engineering skills such as version control, unit testing, and CI/CD, and discover how digital phantoms are used to generate high-quality data for AI training in medical imaging. The course combines lectures, hands-on labs, and a final project where students present their own digital phantom simulations, demonstrating how creative coding and medical science come together to shape the future of healthcare.

3. Grading Criteria

Weighting (%)	Class Participation 10%: Engagement in discussions and teamwork Homework & Labs 20%: Timeliness, accuracy, completeness Quizzes: 10% Understanding of core concepts Midterm Exam: 20% Comprehensive test of knowledge & application Final Project 40%: Design (10%) + Report (20%) + Presentation (10%) Total: 100%

4. Teaching Arrangement

Lecture	Content	Teaching Elements	Credit Hour（45 min each credit hour）	Lab hour	Self-study	
1	Introduction & Course Overview	Welcome, course objectives, expected outcomes Why digital phantoms matter in medicine and	2			

		AI Intro to Unity3D and tour of the 3D environment				
2	Unity3D Basics	Setting up projects and Unity interface Importing 3D assets and basic rendering Hands-on: create your first 3D object!	2			
3	Anatomy Meets 3D	Introduction to eye anatomy (focus on structures we'll model) How to translate anatomy data into 3D models Demo: simple 3D eye structure in Unity	2			
4	Coding in Unity (C# Basics)	Introduction to C# scripting in Unity Variables, functions, and controlling objects	2			

		Hands-on: make the eye model interactive				
5	Design Patterns in Unity	Intro to Model–View–Controller (MVC) in Unity Why design patterns matter in simulations Lab: apply MVC to control eye movement	2			
6	Adding Realism: Materials & Lighting	Rendering basics: textures, shaders, lighting Simulating realistic anatomy appearance Hands-on: make your eye look alive	2			
7	Medical Imaging & Digital Phantoms	What are digital phantoms? Why they matter for imaging Examples of eye phantoms in healthcare Lab: simulate	2			

		imaging of your digital eye				
8	Version Control with Git & GitHub	Introduction to VCS (Git) and repositories Committing, branching, and collaboration Hands-on: push your Unity project to GitHub	2			
9	Mid-Term Exam	Covers Unity basics, C# scripting, MVC, anatomy-to-3D translation, and VCS	2			
10	AI & Synthetic Data in Healthcare	How digital phantoms generate training data for AI Case studies in medical AI Hands-on: export phantom data for simple AI use	2			
11	Software Quality: Unit Testing	What are unit tests and why they matter Writing simple tests in C# for Unity scripts	2			

		Hands-on: test your eye simulation code				
12	Automated Testing & CI/CD	Introduction to Continuous Integration & Deployment Setting up automated builds and tests (GitHub Actions or similar) Demo: run automated tests on Unity project	2			
13	Advanced Simulation Fidelity	How to improve realism in digital phantoms Basics of physics simulation in Unity Hands-on: simulate light interaction with the eye	2			
14	Connecting Biology to 3D Structures	Integrating anatomy/biology data into Unity Preparing your project for real-world	2			

		medical uses Lab: expand your phantom with biological realism				
15	Final Project Workshop	In-class project building session Instructor + peers give feedback and help troubleshoot Prepare for project presentations	2			
16	Final Project Presentations	Students present their digital phantom projects Each student/team explains their model, simulation, and AI/data applications Peer + instructor feedback	2			
Total credit hours 32	Lecture Credit Hours 28		Lab Credit Hours 4 (workshop and		Self-Study Hours 16 (final project)	

			presentations)			