Unbounded Innovation Lab Graphics + AI Curriculum

Welcome to the Unbounded Innovation Lab Graphics + AI Curriculum! This 6-month mentorship program is designed to empower participants with the knowledge, skills, and experience needed to excel in computer graphics and AI. Throughout the course, participants will develop a strong foundation in computer graphics, research methodology, shader programming, and AI, while working on real-world projects and publishing research papers. Alongside technical skills, participants will also cultivate critical soft skills, such as teamwork, communication, and problem-solving, which will prepare them for future academic and professional success. Below is a detailed outline of the week-by-week journey during this program.

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Core Instruction

Week 1

Activities

- Program orientation and introduction to the course structure
- Setting up the computer environment (installing necessary software and tools)
- Lecture and discussion on the fundamentals of computer graphics
- Meeting your team members

- Introducing the mentors and their roles
- Overview of computer graphics research and the importance of scientific literature
- Setting up a suitable workspace

Learning Outcomes

- Understand the purpose of computer graphics science
- Understand the benefits and deficiencies of programming on a GPU
- Set up their environment (connect to remote desktop virtual machine)

Deliverables

- None

Week 2

Activities

- Lecture and demonstration on fragment shaders, shader attributes, and shader uniforms
- Hands-on practice with ShaderToy, creating simple fragment shaders
- Guided project: ShaderToy art project using fragment shaders, attributes, and uniforms

Learning Outcomes

- Analyze the role of shader attributes and shader uniforms in fragment shaders
- Create a ShaderToy art project using fragment shaders, attributes, and uniforms

Deliverables

- Completion of simple coding and shader exercises (via shadertoy)

Week 3

Activities

- Lecture and demonstration on vertex shader, noise functions and applications of shaders: lighting, texture mapping, shadows, reflections, etc.
- Introduction to Three.js and its use in computer graphics
- Guided project: Building a Three.js scene with custom fragment and vertex shaders

Learning Outcomes

- Evaluate the role of vertex shaders in computer graphics
- Apply noise functions in shaders

- Understand various applications of shaders
- Create a Three.js scene utilizing both fragment shaders and vertex shaders

Deliverables

- Completion of Three.js scene with custom fragment and vertex shaders

Week 4

Activities

- Overview of artificial intelligence in computer graphics
- Introduction to machine learning and deep learning techniques
- Hands-on experience with deep learning libraries (TensorFlow, PyTorch, etc.)

Learning Outcomes

- Evaluate the roles and purposes of various methods of producing AI models
- Make a simple AI model
- Evaluate the role of AI as it pertains to computer graphics science

Deliverables

- Completion of machine learning exercises in computer graphics context

Week 5

Activities

- Describe optimizations in computer graphics
- Apply real-time rendering techniques
- Examine GPU performance tools and profilers
- Identifying and analyzing rendering bottlenecks

Learning Outcomes

- Understanding of Computer Graphics Optimizations
- Proficiency in Real-time Rendering Techniques
- Familiarity with GPU Performance Tools and Profilers
- Capability to Identify and Analyze Rendering Bottlenecks

Deliverables

- Completion of optimization exercises

Week 6

Activities

- Lecture on how to implementing AI into a computer graphics tool
- Build project using AI and shaders
- Examine the performance of the project using knowledge from the previous week.

Deliverables

- Integrate AI in Computer Graphics Tools
- Use with AI and Shaders
- Performance Evaluation and Optimization

Collaboration With Scientists

Week 7

Activities

- Lecture on git, and various project management techniques and skills.
- Practice pushing and pulling code from the same repository
- Introduction to an Unbounded R&D open source project
- Setup the project on local machine
- Push code to project

Learning Outcomes

- Understanding Git and Project Management Techniques
- Exposure to Unbounded R&D Open Source Project
- Project Setup and Configuration
- Contributing to Open Source Projects

Deliverables

- Unbounded R&D open source project is setup and running on local machine
- Code is pushed to repository

Week 8-13

Activities

- Brainstorming on what we can add as a team to the open source project
- Developing tasks that can be divided amongst team members
- Implementing tasks
- Pushing code to the repo

Learning Outcomes

- Collaborative Brainstorming
- Task Development and Distribution
- Task Implementation

Deliverables

- Code is pushed to repository
- Kanban taskboard

Research and Development

Week 14

Activities

- Identify potential research topics
- Discuss project planning, milestones, and deliverables
- Assigning roles within the group
- Identifying available resources (software, hardware, etc.)

Learning Outcomes

- Identify research topics
- Project Planning and Management
- Role Assignment and Teamwork
- Resource Identification and Utilization

Deliverables

- A research topic chosen by each group
- Preliminary project plan

Week 15 - Week 20

Activities

- Catalog research and development of chosen projects
- Discuss progress and challenges in weekly meetings with mentors
- Reflect on feedback from mentors after regular checkpoints
- Align research with goals and objectives
- Draft research paper: Introduction, background, methodology, results, and conclusion

Learning Outcomes

- Document research and development
- Discussion progress and challenges
- Align research with predefined goals and objectives
- Draft a research paper

Deliverables

- Weekly progress updates
- Iterative improvements to a working prototype of the project
- Draft version of research paper

Week 21

Activities

- Integrate feedback from mentors
- Verify and finalize references of the research paper
- Lecture on the process of publishing research papers
- Prepare presentation

Learning Outcomes

- Integrate feedback in a research paper
- Verify sources
- Create presentation based on paper

Deliverables

- Completed research project
- Submission-ready research paper
- Draft of presentation

Week 22

Activities

- Submitting the research paper to conferences and/or journals
- Preparing a project presentation
- Celebrating the achievements and hard work of the participating students
- Present research

Learning Outcomes

- none

Deliverables

- A submitted research paper
- A final presentation showcasing the project