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PennWest University
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Introduction

Within the realm of video game development, there are many skills required to be successful, several of which I received through my education. The programming classes, including ECSC330, Object Oriented Programming, provided me with an invaluable base understanding of the C++ language, as well as programming as a whole. ECSC340, Game Programming, laid a fine foundation to my skills with regard to the tool I will be utilizing, Unreal Engine, while CCIS411, Systems Development Project, and ECSC408, Software Engineering, both presented me with opportunities to practice my skill set and gain experience in working with a team on a long term project. I have achieved countless other skills throughout other courses required of my major, as well as through time spent outside courses, learning on my own.

Despite my progress, I still feel that there is much more I could learn about and put into practice. With the courses I have had available to me, I feel that I am able to further pursue knowledge in techniques, practices, and industry standards through this independent study. I hope to gain additional skills necessary as an aspiring game developer.

After careful and extensive consideration, I believe an area to focus my efforts in would be that of design patterns and, more specifically, how to use them within Unreal Engine in tandem with C++. While I will first investigate C++'s use within Unreal Engine, such as how to do so and how to do so effectively, I intend to explore specific design patterns that may be used for game design and development, such as the factory design pattern for example. It is my goal

to add these patterns to my collection of techniques by understanding them before implementing them into projects, including new smaller projects for the purpose of this study and pre-existing projects such as what was worked on for my senior project course.

Background

The main software to be used through the majority of this study will be Unreal Engine for multiple reasons. In addition to being a powerful and widely used tool within the video game industry, it fits well within the educational structure here at PennWest, as it utilizes C++ well, which is the programming language I have received a solid background in through my education here, and is the engine of choice in the Game Programming course, ECSC340. While Unreal Engine does support C++ and I have received valuable instruction on C++, there was no instruction on the integration of the two in my curriculum. Instead, Unreal Engine's second method of implementation was used, this being its own visual scripting system named Blueprints. By learning how to use C++ within Unreal Engine and how to integrate it with Blueprints, new possibilities in design can be achieved, both in what can be done and how efficiently those things can be done. A game developer by the name of Alex Forsythe (2021) discusses the uses of C++ and Blueprints and how in some cases, certain considerations must be taken in determining which medium best fits the task at hand (min. 8:54). It would seem that C++ within Unreal Engine is common among the computer scientists who work in game development at a more technical level, where Blueprints, although are great to be familiar with, serve a purpose closer to what artists and other developers at the less technical level would require.

In part of reaching these new possibilities, the use of design patterns may be learned and implemented for even greater results. James Maioriello defines design patterns as "time-tested

solutions to recurring design problems" (2021, para. 2). Through design patterns, one can identify which technique is best suited for different situations; what solution is best used to solve a given problem. They are paths to optimization and the ever-important modularity that object-oriented programming demands. Utilization of patterns will also allow for a greater ease in testing and debugging, as well as greater expandability, an essential aspect to game design and development.

By learning about and putting different design patterns into practice, I will be able to increase the quality of work I am able to do within Unreal Engine. As they are a common practice in the industry I have a great desire to flourish in, I believe they will be an invaluable tool in both securing a position and in practice.

From a general standpoint, design patterns were briefly covered in ECSC330, but seeing as how there is much more to a topic that appears as important as this, I would like to explore it further as an advanced student.

As a start, I would like to gain experience and understanding in the factory design pattern, a pattern that "provides an interface for creating objects in a superclass, but allows subclasses to alter the type of objects that will be created" (Refactoring Guru, n.d., para. 1). In other words, it deals with a dedicated "factory" with the sole purpose of creating the objects that object-oriented programming revolves around. Considering the nature of video games where objects are most often constantly being spawned and created, this seems to be a valuable pattern to learn about.

Furthermore, I look forward to covering additional subsequent patterns that I may be recommended by my instructor for this study or that I may discover along the way. Conducting preliminary research on my topic of study also suggests that I become familiar with the singleton

pattern – where an object is globally accessible (Awesome Tuts - Anyone Can Learn To Make Games, 2022, 6:02) – and the observer pattern – where there are "subjects that have a list of dependent properties or objects that are observing what happens with this subject and then the subject automatically notifies those observers of changes" (Jason Weimann, 2018, 0:12).

Methods

Through the duration of this study, my intentions are to develop a foundation in using C++ with Unreal Engine's Blueprints to become familiar with key design patterns for use in video game design and development, as well as to demonstrate this growth via revisiting the senior project I was a part of. What I propose to focus my overarching efforts on is to implement a generic factory at the C++ level and incorporate it into the existing project to produce items within the game, documenting my experiences and findings along the way.

Should time allow it, I plan to familiarize myself with additional patterns common within the video game industry, adopting similar goals to my goals relating to the factory design pattern. Additionally, finalized progress may be demonstrated through additional ways, such as, for example, a report that may be given at a formal conference or a working demo, in addition to the planned documentation.

The first third or so of the semester will be spent focussing my efforts in becoming familiar with the use of C++ within Unreal Engine, as well as distinguishing appropriate uses of C++ with Blueprints to effectively use the two in tandem. Ideally, I will be able to use C++ and Blueprints in the same project, neither of which will provide me with common, avoidable difficulties.

Roughly, the second third of the semester will see me investigating the factory design pattern, both by educating myself of its uses and what situations are correct for it, as well as

working on and completing an implementation in C++.

Finally, the process will be finished by returning to my senior project, refactoring the new tool that will be the factory pattern into the already-complete project, emphasizing its effectiveness and differences.

Should this objective be actualized before the semester's end, any remaining time will be allocated towards the acquisition of additional design pattern methodologies and techniques. Ultimately, this study experience will provide me the opportunity to expand my skill set and further my education in video game design and development.

References

Alex Forsythe. (2021, March 12). Blueprints vs. C++: how they fit together and why you should use both [Video]. YouTube. https://www.youtube.com/watch?v=VMZftEVDuCE

Awesome Tuts - Anyone Can Learn To Make Games. (2022, February 22). Unreal Engine C++ & blueprints programming design patterns - code like a pro [Video]. YouTube. https://www.youtube.com/watch?v=slPRKn5wkCY

Factory method. (n.d.). Factory Guru. https://refactoring.guru/design-patterns/factory-method

James Maioriello. (2021, October 2). What are design patterns and do I need them? Developer.com. https://www.developer.com/design/what-are-design-patterns-and-do-i-need-them/

Jason Weimann. (2018, October 15). Observer pattern - game programming patterns in Unity & C# [Video]. YouTube. https://www.youtube.com/watch?v=Yy7Dt2usGy0

Form to fill out?
Plan a meeting?
CS Club?

Requirements? (3-4 pages, abstract, bibliography, 15 week schedule, assignments/deadlines)
- Why I want to do it, interesting academically, why there isn't a class for it
- Show that I am an outstanding student
  - danbennett360@gmail.com
- Write so you don't need CS knowledge, but that a smart person can understand

Independent Study
- When does the proposal have to be in by?
  - Late summer
- Is there a guide/guidelines for me to follow?
  - Abstract
  - 3-4 page what I'm going to do and why
  - 15 week schedule
  - Itemized list of assignments/deadlines
  - Bibliography
- Bennett or Puharic?
  - Bennett might be booked, I could go with Puharic instead if I need to
- How can I get 4 credits? What's the different between a 4 cred Ind Study and a 3 cred?
  - Nothing really, just apply for 4
- What topic?
  - Rhythm Game?
    - Explore Timing, Audio, Save Games/Level Editor, File Importing
  - Factory?
  - Design Patterns in general?
- What else to do?
  - Determine Schedule with Bennett (or whoever I study with)

Introduction
- *abstract/executive summary, use big words, sound impressive*
- *Investigate c++ within*
- *Big picture of what I want to do*
- *What topic? Factory design, design patterns in general, blueprint + c++, other stuff?*
  - *Narrow down the topic*
  - *Pick something i have interest in*
  - *1 Topic is academically interesting*
  - *2 I am worthy*
  - *"In the end, I would like to have a working C++ factory that can be used in games"*
  - *Design patterns books*
    - *Design patterns, gamma, helm, johnson, vlissides, the gang of four*

Head First Design Patterns

Background

2 - 3 pages

Explain unreal engine, explain how it's implemented 2 ways, blueprint is easy, c++ is uncommon, what does it allow me to do, briefly discussed in game classes, why it's important, not taught, interesting

Design patterns

What they are, why I want to learn about them, how they relate, thye are common practice

WHY IS THIS IMPORTANT

Design patterns are only briefly covered in 330, is important, I'd like to cover it as an advanced student

Describe specific patterns I might want to cover

What is c++, what is unreal engine, what is a factory pattern, etc

Methods

Method's section

What do I intend to do

For example: Employ a factory in my senior project

"What I propose to do is…" Implement a generic factory at the c++ level and incorporate it into the existing game to produce all items in the game

If time allows, do this thing

Match what I talked about in the beginning (background)

Set of stuff to accomplish

Going to have implemented a factory

Going to have modified this game

Going to have documented it all

"I will produce a report to give at PACISE 2024, I will produce a demo, …" 3 or 4 things

Schedule

"First third of the semester, learning c++ in unreal engine"

"Next third, implement c++ factory"

"Integrate into game and produce final report

Sources

Define Design pattern, factory pattern, describe c++ in unreal engine, find a talk about importance of c++ in unreal engine

5 or 6 is good!

Show that I can do some planning, and that I've got some