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| CS4227 2015 Project |
| Maze Game Framework |
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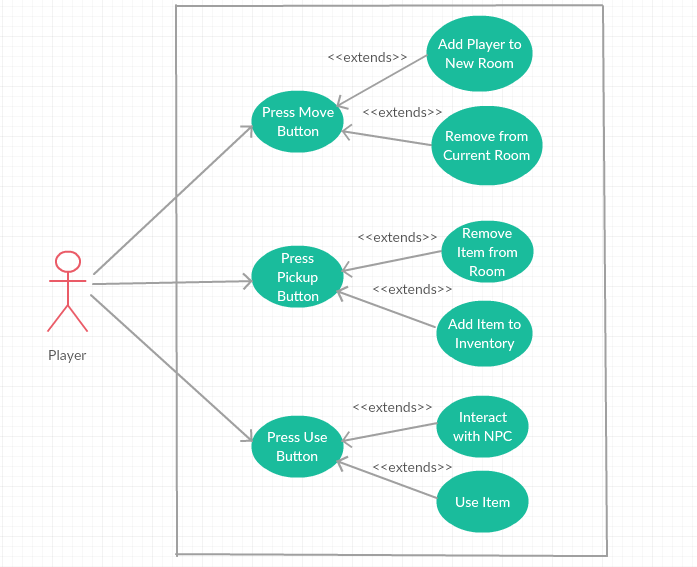
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***Requirements***

**Scenario**

The Scenario for this project is that we have been asked to develop a basic framework for the generation of a game and game world. The world should consist of a series of connected rooms, that the player is able to move between. Each room should also have object within them that the player can interact with. Furthermore there should be support for the inclusion of Non-Player-Characters with options for third party clients to develop their own artificial intelligence systems for them.

**Narrative & Use Case Diagram**



Player joins game. System randomly generates the random rooms in which the Player can navigate around. Player has options to press buttons “Move”, “Pickup” and “Use”.

Within the **Move** action, the Player is given additional optional actions to take such as to “Add Player to Room” and “Remove from Room”.

Within the **Pickup** action, the Player is given additional optional actions to take such as to “Remove Item from Room” and “Add Item to Inventory”.

Within the **Use** action, the Player is given additional optional actions to take such as to “Interact with NPC” and “Use Item”.

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| --- | --- | --- |
| Use Case | Press Move Button | |
| Description | A player moves into a new room­ | |
| Preconditions | 1. Player is logged in the game | |
| Success End Condition | Player moves to a new room | |
| Failed End Condition | Player does not move to a new room | |
| Actors | Player | |
| Trigger | Game starts | |
| DESCRIPTION | Step Number | Action |
|  | 1 | Game begins |
|  | 2 | Player clicks move button |
| 3 | Player moves into a new room |
| EXTENSIONS | Step Number | Branching Action |
|  | 1.a | Rooms are created by system for Player to navigate around |
|  | 3.a | Player has an option to add a player to a room |
|  | 3.b | Player has an option to remove a player from a room |

|  |  |  |
| --- | --- | --- |
| Use Case | Press Pickup Button | |
| Description | A player picks up an item from a room | |
| Preconditions | 1. Player is logged in the game  2. Player is in a room with item(s) | |
| Success End Condition | Player picks up an item | |
| Failed End Condition | Player does not pick up an item | |
| Actors | Player | |
| Trigger | Player is in a room with item(s) | |
| DESCRIPTION | Step Number | Action |
|  | 1 | Player in is a room with item(s) |
|  | 2 | Player picks up an item from a room. |
| EXTENSIONS | Step Number | Branching Action |
|  | 1.a | System generates items in rooms for Player to pick up |
| 2.a | Player has an option to add an item to their inventory |
| 2.b | Player has an option to remove an item from the room |

|  |  |  |
| --- | --- | --- |
| Use Case | Press Use Button | |
| Description | A player uses an item/action | |
| Preconditions | 1. Player is logged in the game  2. Player has an item/action to use | |
| Success End Condition | Player uses an item/action to interact with game | |
| Failed End Condition | Player does not use an item/action | |
| Actors | Player | |
| Trigger | Player wants/needs to use an item/action | |
| DESCRIPTION | Step Number | Action |
|  | 1 | Player has an item/action to use |
|  | 2 | Player wants/needs to use an item/action |
| 3 | Player uses item/action |
| EXTENSIONS | Step Number | Branching Action |
|  | 1.a | System shows items the Player has and actions the Player can do |
| 2.a | Player has an option to use an item |
| 2.b | Player has an option to interact with NPC |

# Discussion of Architectural and Design Patterns

This section lists the various design patterns being used in the project, where they are being used and why they are being used.

## Abstract Factory

The Abstract Factory is being used for the construction of Rooms, in this way it is easy to extend the game with the introduction of new types of rooms while maintaining encapsulation by distancing the client from the actual instantiation of the Rooms.

## Decorator

Is being used to create items that would be found within rooms, it is not being used to add the items to rooms rather it is being used to create the items themselves. By using the decorator design pattern we can allow the creation of a plethora of items from a smaller pool of methods, e.g. we can use “makeBroken(makeGolden(makeChair())))” , “makeBroken(makeChair())” , “makeGolden(makeChair())”, “makeChair()” to create 4 different objects using only 3 methods, rather than having to create 4 separate classes.

## Observer

The Observer is being used to notify NPC’s as to when and where to the player moves, with the Player class being the subject and the NPC’s being observers. In this way NPC’s will be aware of the Player’s current position within the game, allowing 3rd party clients to create AI for npc’s that takes the player’s position into account.

## Strategy

The Strategy pattern is being used to allow for the AI of NPC’s, it will allow 3rd party developers to easily develop alternative AI programs for NPC and swap them out with easy, thus supporting extensibility.

## Façade

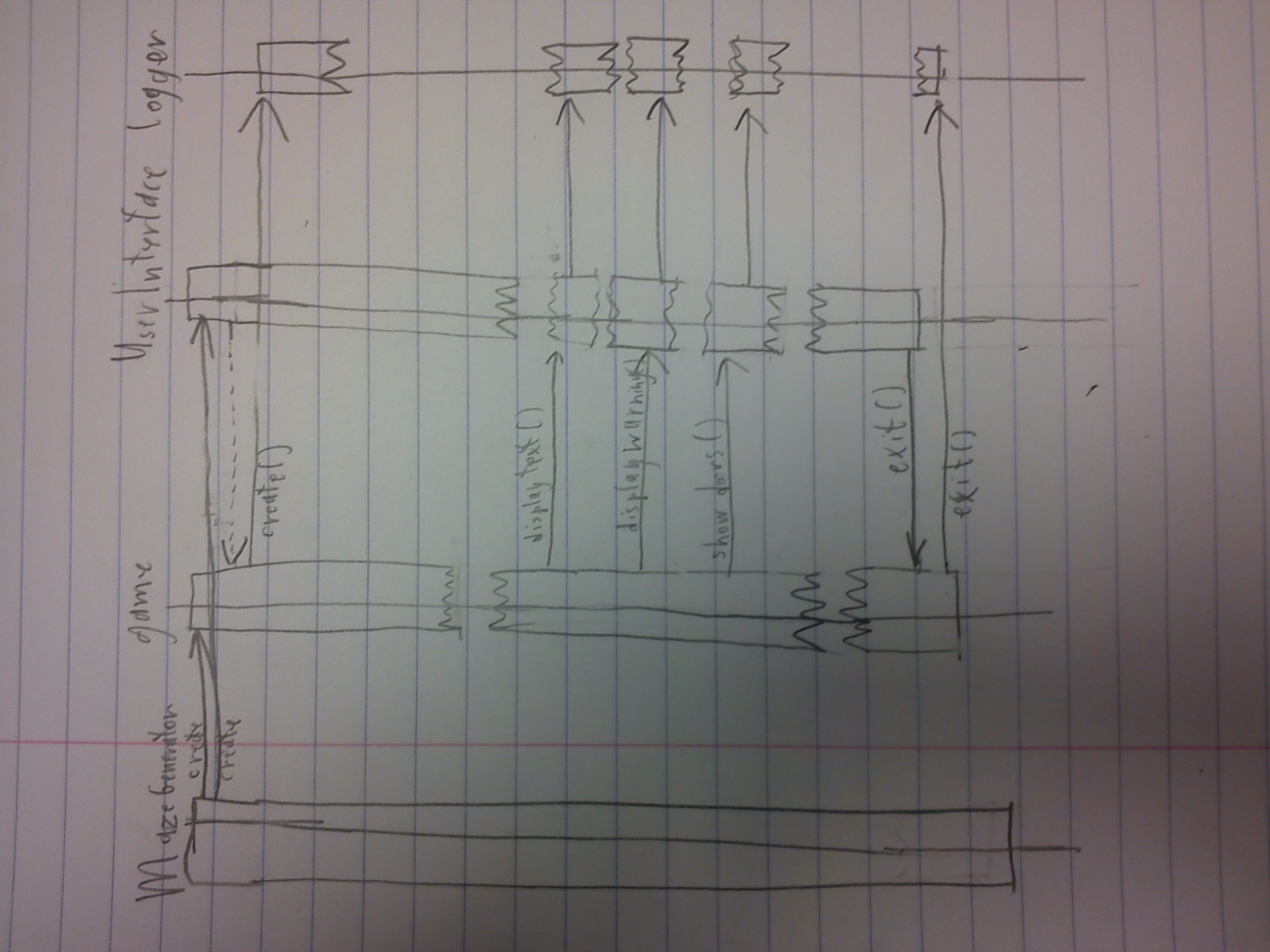
The Façade is being used to simplify the creation of the game world, as one class will be provided at the front end that will provide one method that calls all the commands for the creation of rooms(through the abstract factory), the creation of items(through use of the decorator) and the adding of items to rooms. This will make it far easier for 3rd party developers who simply want to create a replace GUI for the game rather than modify the game itself, as it will hide all the game’s construction behind 1 method in the Façade Class. This is the Pattern we selected through self-guided research.

## Interceptor

The Interceptor is being deployed in-between the game and the GUI, this is in order to provide 3rd party developers with hooks between the User-experience and the game program itself. These hooks will allow them to create interceptors to extend or listen for events and use these in their own implementation of the GUI.

# Structural Diagram

# Runtime Diagram of Interceptor



***Added Value***

***Evidence of testing***

**Discussion on NFRs with a focus on Architectural Use Cases (Quality Attributes)**

The Non-Functional Requirements that we focused on that covers the main tasks and functions which our system is trying accomplish are:

**Extensibility** – We have designed our system to allow 3rd party developers to easily modify our implementation of generating random types of rooms to generate more specifically designed rooms as they wish.

**Scalability** – We have also designed our system to allow 3rd party users to potentially enlarge the implementation of the system in order to accommodate any requirements they may have which will result to addition of multiple functions the system can do

**Portability** – As a team we decided to program our system with the use of the Java programming language as it allows great system portability. Based on research, the Java programming language is the most common language known to all software engineers. This will enable ourselves to find many other programmers to maintain and update our system.

**Performance** – We have also incorporated some HPC (High-Performance Computing) techniques in our system using Java threads. (Discussed in greater detail in Performance Engineering section).

***Performance Engineering***

Performance Engineering is supported in our project through the use of multi-threading within the observer design pattern. Specifically it is used to multi-thread the notification of all Observers by the subject. To achieve this a sequentialNotifyAll() method was included in the Player class that called notifyThisObserver() on each Observer, alongside a threadedNotifyAll() method which created one thread for each observer which then called notify() on its observer.

Coding Fragment:

Within Player.java:

public void threadedNotifyAll()// a multithreaded version of notifyAll

{

for(int i = 0; i < myObservers.size(); i++)

{

Thread athread = new Thread(new RunnableNotify(myObservers.getElementAt(i), "Notifier Thread " + i));

//notifyThisObserver is called inside run() of RunnableNotify()

athread.start();

}

}

RunnableNotify.java:

package characterStructure;

public class RunnableNotify implements Runnable

{

private ObserverOfCharacter observerToNotify;

private String name;

public RunnableNotify(ObserverOfCharacter observerIn, String inName)

{

observerToNotify = observerIn;

name = inName;

}

public void run()

{

observerToNotify.notifyThisObserver();

System.out.println(this.name + " has completed.");

}

public String getRunnableName()

{

return this.name;

}

}

As our system was intended as a framework for a game we used simple tests to simulate process’s being executed by the Observers in response to being notified. After running the system using both methods the run time’s for each of these were:

SequencialNotifyAll(): 1000 Millisecond

ThreadedNotifyAll(): 200 Millisecond

However without any such processing by the Observers in response to being notified, the results were:

SequencialNotifyAll(): 1 Millisecond

ThreadedNotifyAll(): 8 Millisecond

Thus we concluded that although in our implementation of the code, the extra overhead of threading every notify() only reduced speed, but in the interest of supporting extensibility, clients would undoubtedly extend the NPC’s that would serve as observers, and thus add extra processing to when these classes are notified thus warranting the inclusion of this multi-threaded NotifyAll() in our implementation of the Observer Design Pattern.

# References