



Bilkent University

Department of Computer Engineering

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# Object-Oriented Software Engineering Group Project

*CS 319 Project: Monopoly Bidding War*

## Design Report

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## **1. Introduction**

### **1.1 Purpose of the System**

Monopoly Bidding War is a board game that will be offered on a digital platform. Rules are the same with the original Monopoly with a slight difference, every player will be given the chance to attend the auction for any estate and in any round. The winner will be the only person who left with money, so the players will buy estates, negotiate with each other, and build houses to bankrupt other players. The game is designed to eliminate the complexity for the users along with to give aesthetic satisfaction. The system also offers functional requirements such as, how to play, settings, etc., that also aims to provide convenience for the users.

### **1.2 Design Goals**

The aim of the game's design is to have high in-game and server performance, to be user-friendly and to be extendable. To do so, the plot of the game and the interfaces are designed to be more fluent and convenient for the users, its graphic designs are elaborate and also offers players many different alternatives.

#### **1.2.1 In-Game and Server Performance**

A database is used to interact and exchange data between users. The data flow between the database and the computer is very constricted, so there will be no loss of information. Host's computers will distribute the crucial and needed

information through the database. This feature will increase the efficiency of the game by making it faster and more fluent.

### **1.2.2 User-Friendly**

The game is designed in a logical way so that players will not come across with complexities. Taking turns and operation orders are done less complex, in order to maintain a user-friendly design. Also, the objects and the details in the game have smooth graphic designs. By the help of soft drawings and chirpy colors, it is aimed to bring aesthetic satisfaction to the users. Most of the buttons and control units are eliminated to sustain simplicity and to avoid confusion for the users.

### **1.2.3 User Interface**

The squares will be demonstrated as 3D objects and the cards are displayed fully to all the other players. The aim is to keep the players engaged to the game while bringing an aesthetic view. Also, players will be able to send each other trade requests that will allow players a chance to maintain a relationship with the other players. User interfaces are designed in a way to keep players interested and engaged with the game in order to give the best experience for them.

### **1.2.4 Extendibility**

#### **1.2.4.1 More Players**

The first release will have a multiplayer alternative that will allow users to play with their friends. The host will be given an id and he or she will be able to share this id on digital platforms. As another option, users will be able to join online games with

strangers. The aim is to expand choices and make the system extendable so that players will feel satisfied with the game.

#### **1.2.4.2 Single Player Mode**

The single player mode will let users play by themselves with the help of artificial intelligence. These bots will also offer different levels of difficulties, so that users will have alternatives and have a more qualified experience with the game.

#### **1.2.4.3 Customization**

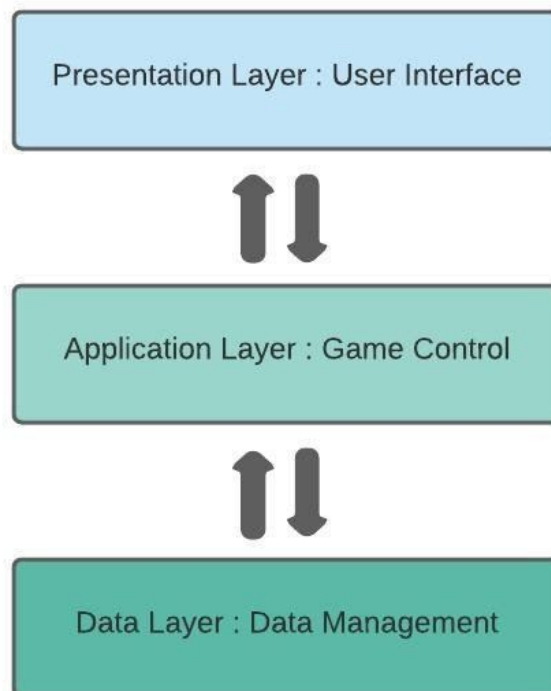
The system will offer customization for the users by letting them choose traditional objects or national animals as pawns. Also, there might be choices to pick different nations and to customize the dice, so that players will be more satisfied with the game.

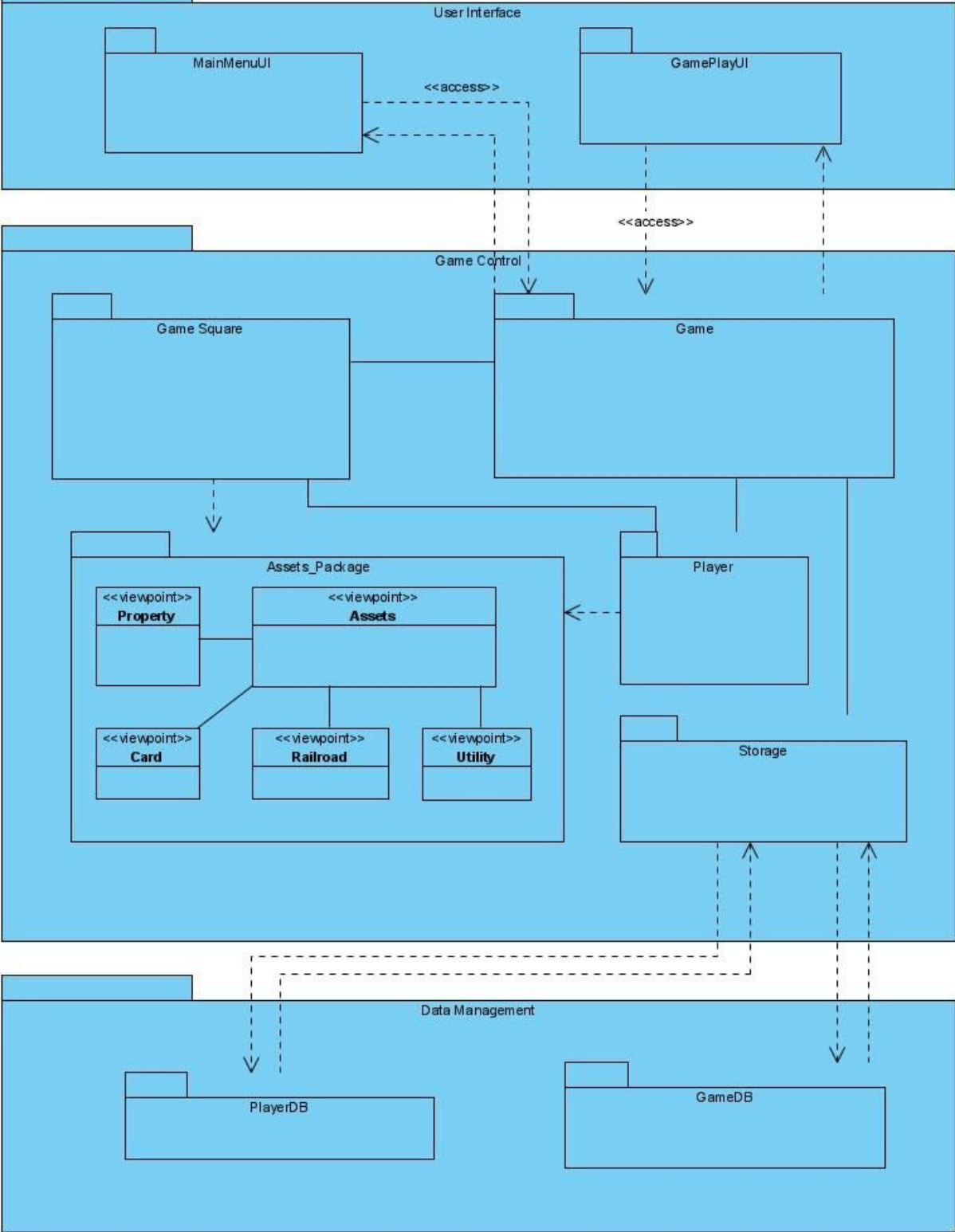
## **2. High-level Software Architecture**

### **2.1 Subsystem Decomposition**

We decided to use three layer Architectural Style in our project. Our architecture consists of a presentation layer, application layer and data layer. Presentation layer is the

user interface part of the game which provides communication between the user and the second layer. Application layer is the second layer which is also described as the Game Control subsystem. It consists of Game Square, Game, Player, Assets\_Package and Storage packages. Storage can be seen as a data access layer as well, it maintains the data flow between the database and the Game Control subsystem. Lastly, the third layer is the Data Layer named as Data Management subsystem. This layer contributes the data to all corresponding users.





## **2.2 Hardware/Software Mapping**

Our game doesn't require any hardware specification since it is a simple board game with database compatibility. It will only require up to 10MB available space in storage. Default hardware setup would manage the game without any additional build. Besides, in order to play the game, the one will need a computer, a monitor, a mouse for the certain inputs and a keyboard for the value that will be required to enter. We used the latest version of the Microsoft Visual Studio Runtime Environment which will be running on Windows.

## **2.3 Persistent Data Management**

We will be using Firebase to store the data and distribute only the required data to all players in the game. Our main goal is to carry the least amount of information possible and to create the least amount of classes possible. In order to make it, we decided to use a local distributor class named storage.

The storage class will take game board information and player information from the host. However, storage classes of non-host players will not take any information related to their game board from their system, it will be received from the host via database. In order to maintain our goal, the database will be checked by storage when a player makes a decision on the game. For example, when a bid routine has ended, the results which are provided by the database will be displayed.

## **2.4 Access Control and Security**

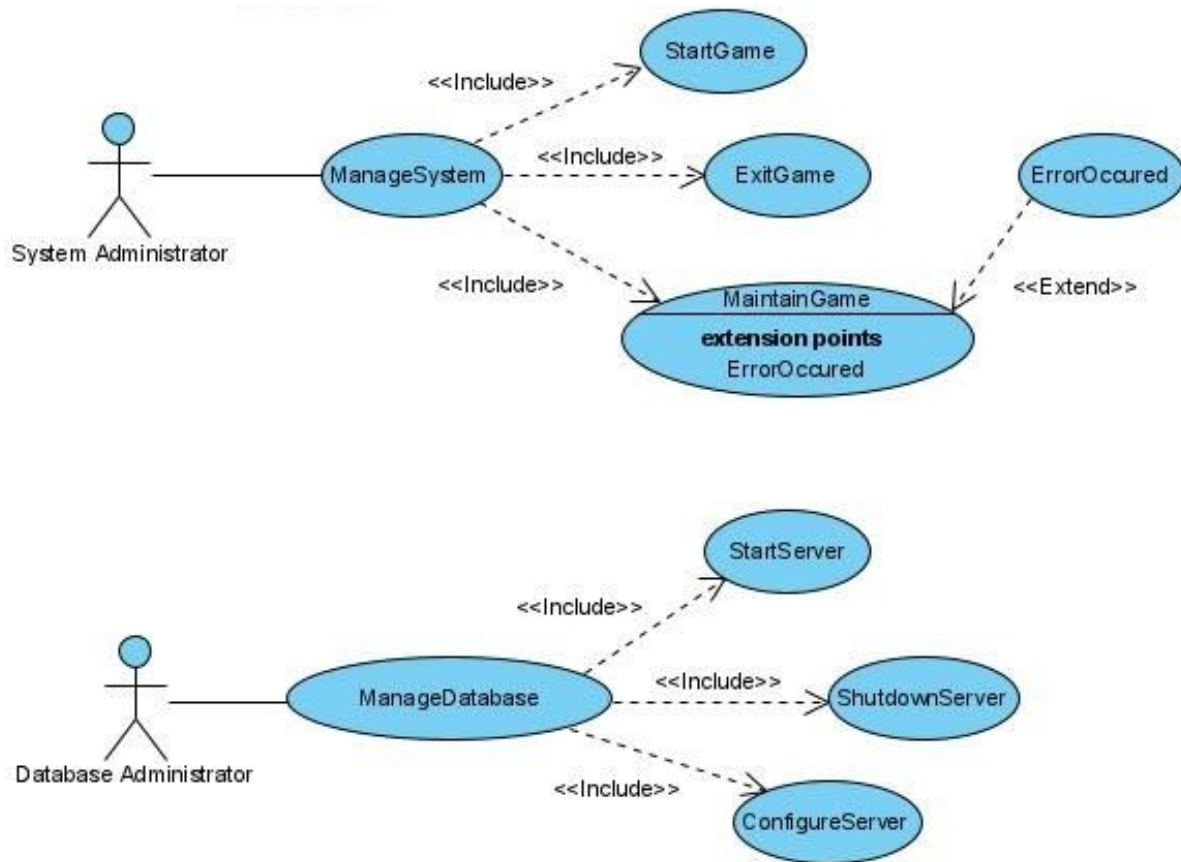
Only the host actor can create the 'GameSquare'. After the creation of the 'GameSquare' host actor has the same accessibility of an ordinary player. Once the 'GameSquare' is created, 'Game' initializes assets and creates a storage. In game routines



such as taking a turn, bidding and trading are in control of the 'Game', the host and other player(s) don't have access to these event's orders. However, the host and other player(s) can access and manipulate their own assets and events only in their turns. Exit option is always accessible to all players. The host and the player cannot directly access the database, however the 'Game' updates the changes made in the database instead of them. This data is reflected by the 'Game' to all other players via the user interface.

	GameSquare	Assets	Storage
Game	gameFinished() startBidRoutine() startTradeRoutine()	<<create>> update()	<<create>> update() getValue()
Host(Player)	<<create>> view() takeTurn() trade() veto() exit()i	<<create>> view() select() buy()	
Player	view() takeTurn() trade() veto() exit()	<<create>> view() select() buy()	

## 2.5 Boundary Conditions



Boundary Use Cases

### 2.5.1 Initialization

In order to start the application, the game doesn't require anything except visual studio runtime environment. While hosting a game, there should be an available server. If there is no unused server, the application will terminate a message and it will proceed to the main menu. If there is an available server, a file containing storage data will be created, and a utilizable space in the database will be created. While joining a game it will be checked if there is a corresponding server in the database. An error message will appear if there is no such game in the server and the application will proceed to the main menu. If there is a

suitable server, a file containing the player's information will be created in the database and in the storage.

### **2.5.2 Termination**

After the game finishes, all storage data and database data will be deleted. We don't provide a save feature since it is an online game.

### **2.5.3 Failure**

When the system confronts an error, current execution will be restarted just one more time. If it doesn't solve, it will proceed to ErrorOccured.

### **3. Low-level Design**

#### **3.1 Object Design Trade-offs**

##### **3.1.1 Quality vs Functionality**

While working on this project, a decision we took regarding our direction was to follow a path similar to Hasbro's. We did not want to define the whole genre from scratch, but rather wanted to create a fun, balanced and familiar monopoly game, which is different from the others, but still familiar enough. As a result of this decision, to create a familiar, balanced, enjoyable but still different enough game, we choose to introduce only a couple of new functionalities to the game. We added a bid and a veto option. Apart from our new functionalities, our approach was to use the fact that we have a computer-system as a platform, and use this platform to enhance the already existing features of a game. For example, the bidding in our game is done anonymously, only the computer knows all of the bids, and asks the person who landed on the square to bid again in the case of him not winning that bidding war. This functionality is a hard/impossible feature to add to a board game. However, to assure balance, quality and a sense of familiarity. We needed to opt out of many useful, fun or creative features.

##### **3.1.2 Processing Power & Memory vs Readability & Maintainability**

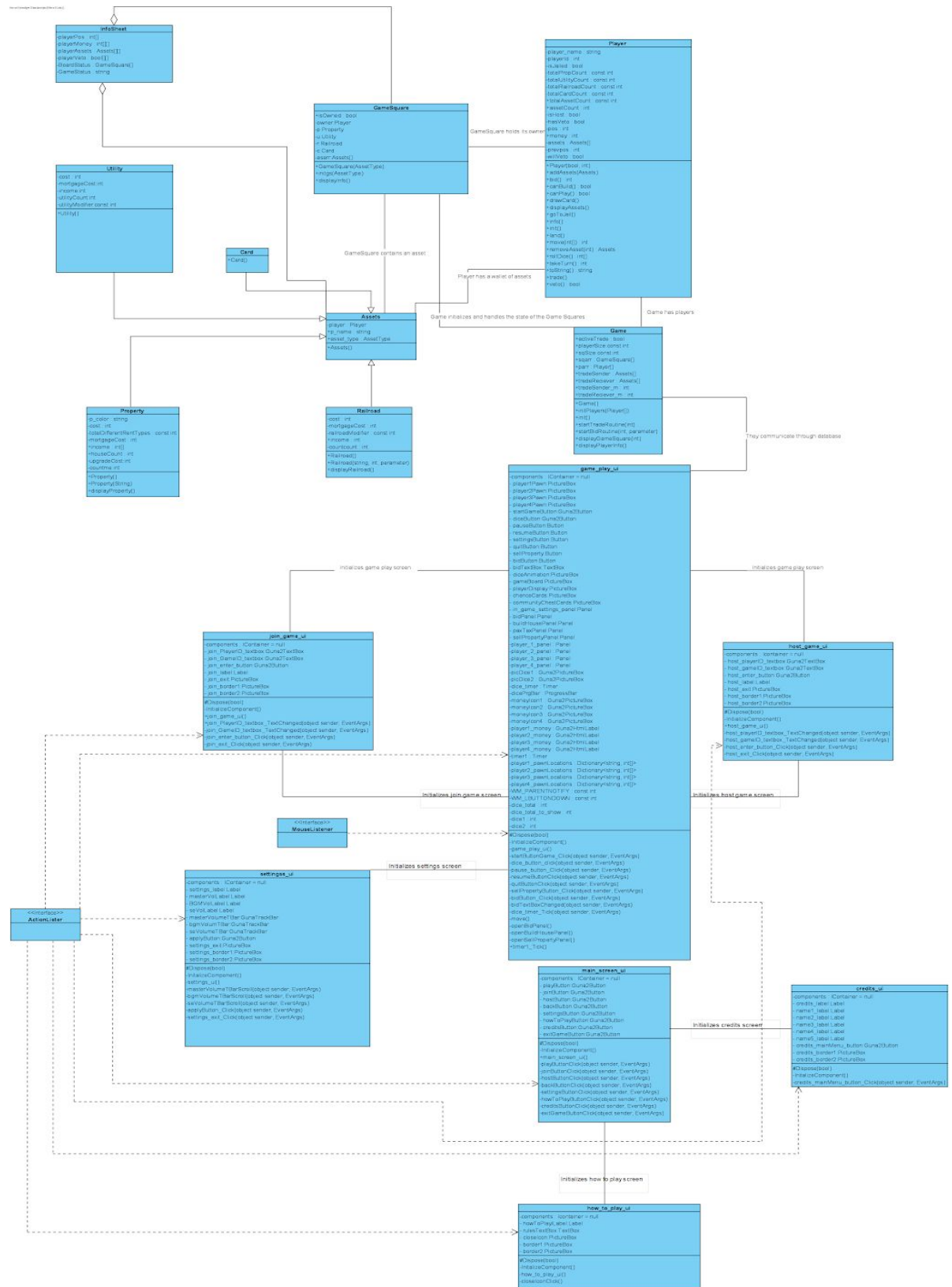
Since our project is relatively small, easy to build and light-weight for a computer these days, we decided to have well defined objects with a lot of variables clearly defined with their functionalities. We could have tried to write this game as efficiently as possible, with very little memory allocations, with as few objects as possible. But since this is a group project, communication is the hardest challenge to

overcome. We decided instead of having a code segment that is short & efficient, but really hard to understand and develop further, an easily understandable code with a little more memory allocations was a better approach.

### **3.1.3 Development Time vs User Experience**

During the analysis of the “Monopoly Bidding War” game, we have decided to implement interface components and graphics with Visual Studio since Visual Studio supports C# we decided to code the game with C#. Also during the analysis, we decided to implement an isometric game map to increase the user’s experience. To implement the game map, the player pawns in a better way, we have decided to use Guna 2 Framework which provides better-looking buttons, labels, and transparent picture boxes. By choosing implementation with Visual Studio, development time will be easier for us, and with the benefits of Guna 2 Framework, we will have better graphics and user experience.

### 3.2 Final Object Design



### **3.3 Packages**

#### **3.3.1 System.Drawing**

This package provides access to GDI+ basic graphics functionality. More advanced functionality is provided in the `System.Drawing.Drawing2D`, `System.Drawing.Imaging`, and `System.Drawing.Text` namespaces.

#### **3.3.2 System.Linq**

This package provides classes and interfaces that support queries that use Language-Integrated Query (LINQ).

#### **3.3.3 System.Text**

This package contains classes that represent ASCII and Unicode character encodings; abstract base classes for converting blocks of characters to and from blocks of bytes; and a helper class that manipulates and formats `String` objects without creating intermediate instances of `String`.

#### **3.3.4 System.Windows.Forms**

This package contains classes for creating Windows-based applications that take full advantage of the rich user interface features available in the Microsoft Windows operating system.

### **3.3.5 System.Component.Model**

This package provides classes that are used to implement the run-time and design-time behavior of components and controls.

### **3.3.6 System.Collections.Generic**

This package contains interfaces and classes that define generic collections, which allow users to create strongly typed collections that provide better type safety and performance than non-generic strongly typed collections.

### **3.3.7 System.Data**

This package provides access to classes that represent the ADO.NET architecture. ADO.NET lets you build components that efficiently manage data from multiple data sources.

### **3.3.8 System.Threading.Tasks**

This package Provides types that simplify the work of writing concurrent and asynchronous code. The main types are Task which represents an asynchronous operation that can be waited on and cancelled, and Task<TResult>, which is a task that can return a value. The TaskFactory class provides static methods for creating and starting tasks, and the TaskScheduler class provides the default thread scheduling infrastructure.



### **3.4 Class Interface**

#### **3.4.1 Action Listener**

This interface will be invoked when an action occurs and it will receive action events. We will implement this interface on `game_play_ui`, `join_game_ui`, `host_game_ui`, `settings_ui`, `main_screen_ui` and `credits_ui` classes. It will give action info to these classes to track action events.

#### **3.4.2 MouseListener**

This interface will be invoked whenever a mouse action is received from the user. This interface will track mouse locations. We will implement this interface on the `game_play_ui` class and `game_play_ui` class will perform the required operations depending on this interface.

## 4 Glossary & References

- [1] Object-Oriented Software Engineering, Using UML, Patterns, and Java, 3rd Edition, by Bernd Bruegge and Allen H. Dutoit, Prentice-Hall, 2010, ISBN-10: 0136066836.
- [2] <https://www.hasbro.com/common/instruct/monins.pdf>
- [3] Applying UML and Patterns - An Introduction to Object-Oriented Analysis and Design and Iterative Development, by Craig Larman, Prentice Hall, 2004, ISBN: 0-13-148906-2.
- [4] Microsoft Docs  
<https://docs.microsoft.com/en-us/dotnet/>