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| FRUSTRATION  A SOFTWARE ENGINEERING DESIGN PROJECT | assignment 2017: gROUP pROJECT  GROUP  Rubab Ramzan - S00162293 Brain Mc Gowan - S00165159 Bryan Kerruish - S00173160 |

Table of Contents

[Project Overview 2](#_Toc477792322)

[Part 1: 2](#_Toc477792323)

[Draft Class Diagram 2](#_Toc477792324)

[Draft Class Diagram Notes 2](#_Toc477792325)

[Game Class: 2](#_Toc477792326)

[Board Class: 3](#_Toc477792327)

[Player Class: 3](#_Toc477792328)

[Piece Class: 3](#_Toc477792329)

[Dice Class: 3](#_Toc477792330)

[State Diagrams 3](#_Toc477792331)

[Part 2 5](#_Toc477792332)

[Method (Operation) Specification 5](#_Toc477792333)

[Decision Charts 6](#_Toc477792334)

[Draft Expanded Take Turn Decision Chart 6](#_Toc477792335)

[Final Take Turn (Simple) Decision Chart 7](#_Toc477792336)

[Part 3 8](#_Toc477792337)

[Detailed Class Diagram 8](#_Toc477792338)

[Part 4 8](#_Toc477792339)

[Implementation and Testing of Classes in C# 8](#_Toc477792340)

[Class: Game 8](#_Toc477792341)

[Class: Player 10](#_Toc477792342)

[Class: Board 11](#_Toc477792343)

[Class: Piece 12](#_Toc477792344)

[Class: Dice 13](#_Toc477792345)

[Testing Interface: 13](#_Toc477792346)

[Part 5 14](#_Toc477792347)

[Code and Walkthrough Notes 14](#_Toc477792348)

[Decoupling the interface from the application logic. 14](#_Toc477792349)

[DRY principles applied. 14](#_Toc477792350)

[Naming conventions. 14](#_Toc477792351)

[SOLID principle applied. 14](#_Toc477792352)

[Code structure. 15](#_Toc477792353)

[Code readability and maintainability. 15](#_Toc477792354)

[Appendix: 15](#_Toc477792355)

[Additional Notes: 15](#_Toc477792356)

# Project Overview

For this project, we decided upon developing an application to replicate the board game Frustration. Frustration is a simple board game in which players compete to be the first to send four pieces all the way around a board and is a version of the game Ludo.

This game has a concise set of rules and this documentation allowed for precise and accurate requirements gathering.

From the game’s documentation, we were able to generate a series of user stories and use case templates.

To further ensure we had captured the requirements fully, we developed a program flow chart and a number of process flow charts to cover the main methods.

# Part 1:

### Draft Class Diagram

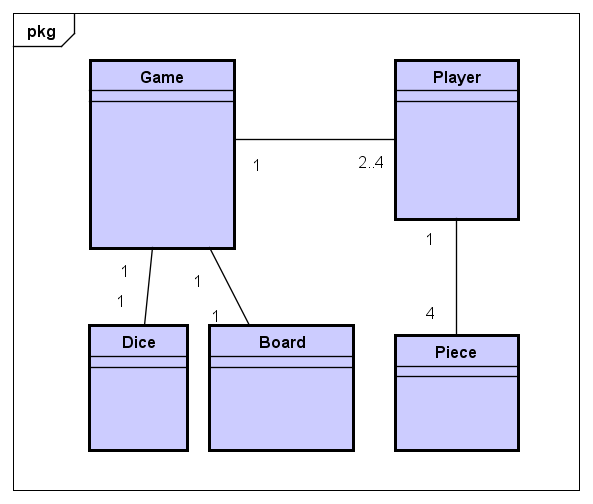


Figure 1 - First Draft Class Diagram

## Draft Class Diagram Notes

### Game Class:

This class will contain the game logic.

It will instantiate two to four players depending on user selection; a board and a dice.

* The game will have one board.
* The game will have two to four players.
* The game will have one dice.

### Board Class:

The board will contain the game logic for the board positions, home position and the pieces’ locations.

* The game will have one board.

### Player Class:

The player class will contain the logic of where the player starts on the board and the pieces they have.

The player will instantiate a list containing four pieces.

* The game will have two to four players.
* The player will have four pieces.

### Piece Class:

The piece will contain the logic for moving around the board and its state within the game.

* Each player will have four pieces.

### Dice Class:

The dice will contain the logic to generate a random number in the range of one to six.

* The game will have one dice.

## State Diagrams

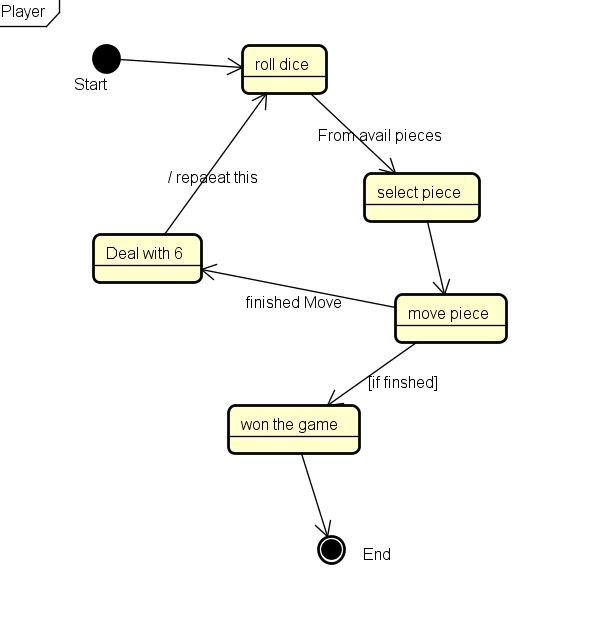
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Figure - Player State Diagram

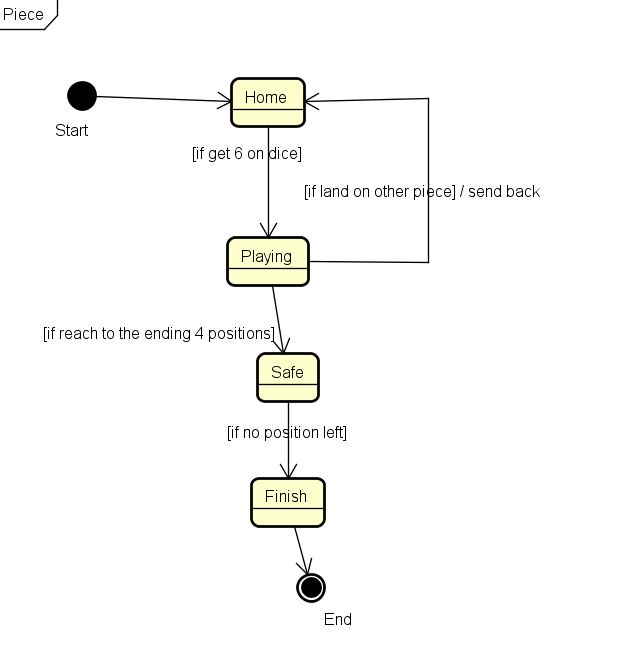
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Figure - Piece State Diagram

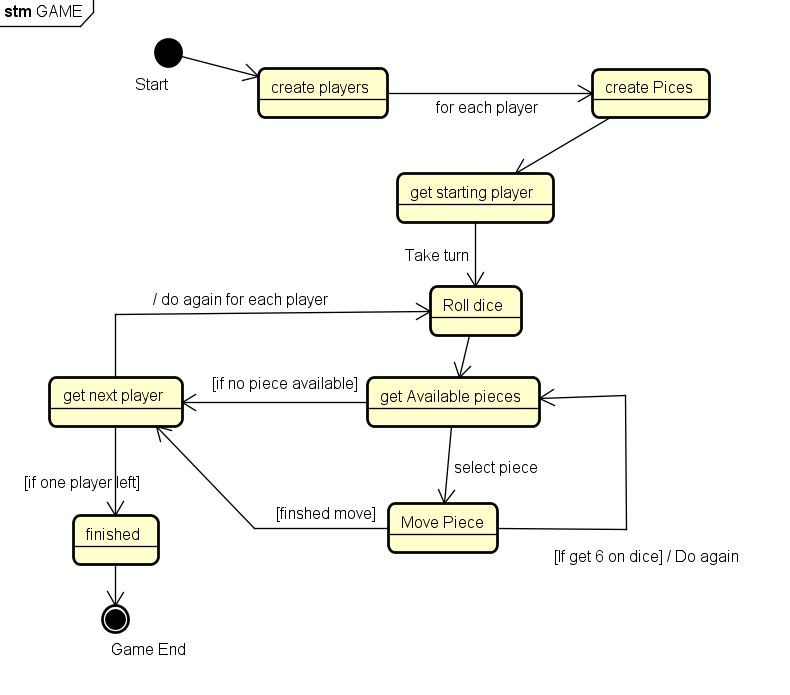
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Figure - Game State Diagram

# Part 2

### Method (Operation) Specification

### Simplified Take Turn Method:

**Take Turn**

**Roll the dice**

**If a selectable piece exists, move piece.**

**Check to see if game has been won.**

**Check if player can roll again.**

**Else, end turn**

**End turn**

## Decision Charts

### Draft Expanded Take Turn Decision Chart



Figure - Game Decision Chart

### Final Take Turn (Simple) Decision Chart



Figure - Simplified Take Turn

# Part 3

## Detailed Class Diagram



Figure - Detailed Class Diagram

# Part 4

## Implementation and Testing of Classes in C#

### Class: Game

class Game

    {

        public List<Player> Players { get; private set; }

        public List<Player> Winners { get; private set; }

        public Boolean RollAgain { get; private set; }

        public Player CurrentPlayer { get; private set; }

        private int playerIdx;

        public int DiceValue { get; private set; }

        public Board board { get; private set; }

        const int MAX\_PLAYERS = 4;

        internal const int BOARD\_MOVES = 28;

        internal const int HOME\_SPACES = 4;

        Dice dice;

        public Game(int nPlayers)

        {

            Players = new List<Player>();

            Winners = new List<Player>();

            dice = new Dice();

            board = new Board();

            CreatePlayers(nPlayers);

            RollAgain = false;

            playerIdx = 0;

        }

        public void SetNextPlayer()

        {

            if (playerIdx == (Players.Count))

            {

                playerIdx = 0;

            }

            CurrentPlayer = Players[playerIdx];

            playerIdx++;

        }

        public void MovePiece(Piece p)

        {

            p.Move(DiceValue);

            Piece returned = board.Move(p, DiceValue, CurrentPlayer.Offset);

            if (returned != null)

            {

                returned.ReturnHome();

            }

        }

        public void RollDice()

        {

            RollAgain = false;

            DiceValue = dice.Roll();

            if (DiceValue == 6)

                RollAgain = true;

        }

        public List<Piece> DisplayAvailablePieces()

        {

            try

            {

                List<Piece> availablePieces = CurrentPlayer.GetAvailablePieces(DiceValue);

                return availablePieces;

            }

            catch (NullReferenceException ex)

            {

                return null;

            }

        }

        private int GetPlayerOffset()

        {

            int offset = 0;

            switch (Players.Count)

            {

                case 1:

                    offset = 7;

                    break;

                case 2:

                    offset = 14;

                    break;

                case 3:

                    offset = 21;

                    break;

                default:

                    offset = 0;

                    break;

            }

            return offset;

        }

        private void CreatePlayers(int n)

        {

            Colour[] colours = { Colour.Blue, Colour.Green, Colour.Red, Colour.Yellow };

            for (int i = 0; i < n; i++)

            {

                Players.Add(new Player(colours[i], GetPlayerOffset(), "Player " + (i + 1)));

            }

        }

    }

### Class: Player

class Player

    {

        const int NUMBER\_OF\_PIECES = 4;

        public List<Piece> pieces { get; private set; }

        public int Offset { get; private set; }

        public String Name { get; private set; }

        public Player(Colour c, int offset, string name)

        {

            //record colour in player

            pieces = new List<Piece>();

            Name = name;

            Offset = offset;

            CreatePieces(c);

        }

        private void CreatePieces(Colour c)

        {

            for (int i = 0; i < NUMBER\_OF\_PIECES; i++)

            {

                pieces.Add(new Piece(c));

            }

        }

        public List<Piece> GetAvailablePieces(int diceValue)

        {

            List<Piece> availablePieces = new List<Piece>();

            foreach (var item in pieces)

            {

                if (item.IsAvailable(diceValue))

                {

                    availablePieces.Add(item);

                }

            }

            return availablePieces;

        }

        public Boolean CheckForWinner()

        {

            Boolean hasWon = false;

            hasWon = pieces.Any(p => p.State.Equals(PieceState.Finish));

            return hasWon;

        }

    }

### Class: Board

class Board

    {

        public Piece[] locations { get; private set; }

        public Board()

        {

            InitialiseLocations();

        }

        private void InitialiseLocations()

        {

            locations = new Piece[Game.BOARD\_MOVES];

        }

        public Piece Move(Piece playerPiece, int diceValue, int playerOffset)

        {

            int absoluteMove = playerPiece.Position + playerOffset;

            //moving around the board from 28 round to 0 again

            if (absoluteMove > locations.Length)

            {

                absoluteMove -= locations.Length;

            }

            //handle out of bounds exception if offset is 0

            if (absoluteMove - diceValue > 0)

                locations[absoluteMove - diceValue] = null;

            Piece boardPiece = locations[absoluteMove];

            locations[absoluteMove] = playerPiece;

            //if a piece has moved to home, remove from the board

            return boardPiece;

        }

        public List<String> DisplayBoard()

        {

            List<String> l = new List<String>();

            for (int i = 0; i < locations.Length; i++)

            {

                Piece p = locations[i];

                String colour = "Empty";

                String pieceLocation = "Empty";

                if (p != null)

                {

                    colour = p.Colour.ToString() ?? "Empty";

                    pieceLocation = p.Position.ToString() ?? "Empty";

                    l.Add(String.Format("{0} Relative Location: {1} Board Loaction: {2}", colour, pieceLocation, i));

                }

                else

                    l.Add(String.Format("{0} Empty", i));

            }

            return l;

        }

    }

### Class: Piece

enum PieceState { Playing, Home, Safe, Finish }

    enum Colour { Red, Yellow, Green, Blue }

    class Piece

    {

        public PieceState State { get; private set; }

        public int Position { get; private set; }

        public Colour Colour { get; private set; }

        public Piece(Colour pc)

        {

            ReturnHome();

            Colour = pc;

        }

        public Boolean Move(int diceValue)

        {

            Boolean complete = false;

            //if 6 and home

            if (diceValue == 6 && this.State.Equals(PieceState.Home))

            {

                complete = MoveOntoBoard();

            }

            else if (Position + diceValue <= Game.BOARD\_MOVES)

            {

                Position += diceValue;

                complete = true;

            }

            else if (Position + diceValue <= Game.BOARD\_MOVES + Game.HOME\_SPACES)

            {

                State = PieceState.Safe;

                Position += diceValue;

                complete = true;

            }

            return complete;

        }

        public Boolean IsAvailable(int diceRoll)

        {

            bool available = false;

            if (State.Equals(PieceState.Home) && diceRoll == 6)

            {

                available = true;

            }

            else if ((State.Equals(PieceState.Playing) || State.Equals(PieceState.Safe)) && Position + diceRoll <= Game.BOARD\_MOVES + Game.HOME\_SPACES)

            {

                available = true;

            }

            return available;

        }

        public void ReturnHome()

        {

            State = PieceState.Home;

            Position = 0;

        }

        public bool MoveOntoBoard()

        {

            State = PieceState.Playing;

            Position = 1;

            return true;

        }

        public override string ToString()

        {

            return String.Format("{0} {1} {2}", Colour, State, Position);

        }

    }

### Class: Dice

class Dice

    {

        static Random RandomFactory;

        const int DICE\_LIMIT = 6;

        public Dice()

        {

            RandomFactory = new Random();

        }

        public int Roll()

        {

            return RandomFactory.Next(1, DICE\_LIMIT + 1);

        }

    }

## Testing Interface:

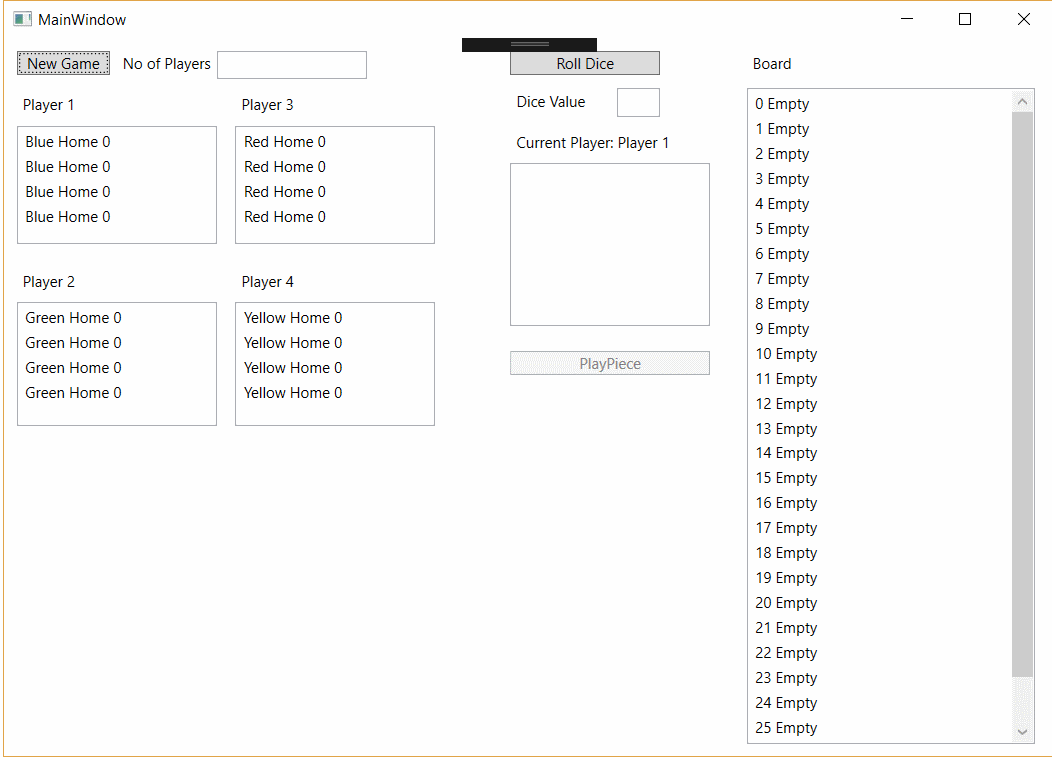
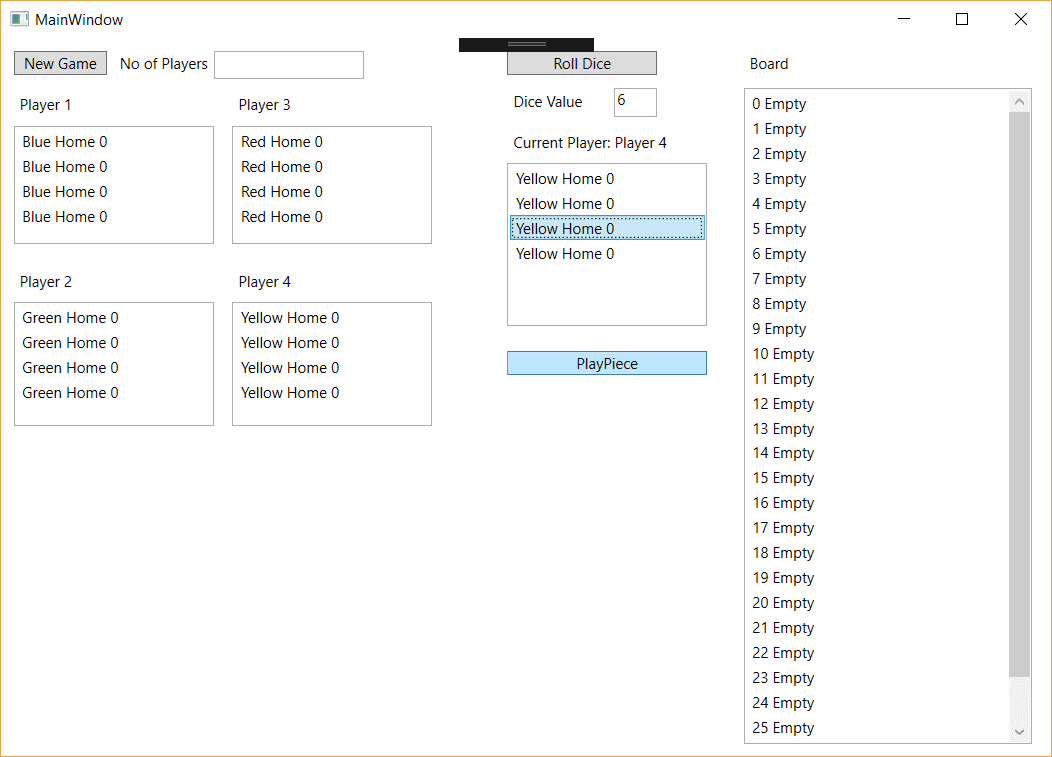


Figure - Testing Interface 1

****

# Part 5

## Code and Walkthrough Notes

### Decoupling the interface from the application logic.

The current interface is designed purely for testing the underlying code logic. The interface has been decoupled from the application layer.

### DRY principles applied.

The principle of “Do Not Repeat Yourself” has been integrated from the beginning. As the code developed we moved any duplicated (or partially duplicated) elements into common components / classes.

### Naming conventions.

The code has been written in camelCase and names have been as descriptive as possible.

### SOLID principle applied.

Despite the relatively small size of this application, we have endeavoured to apply the SOLID (Single responsibility, open-closed, Liskov substitution, interface segregation and dependency inversion) principles to allow this application to be easily maintainable and updateable.

### Code structure.

The code has been developed as part of a team using Visual Studio and GitHub for source control.

### Code readability and maintainability.

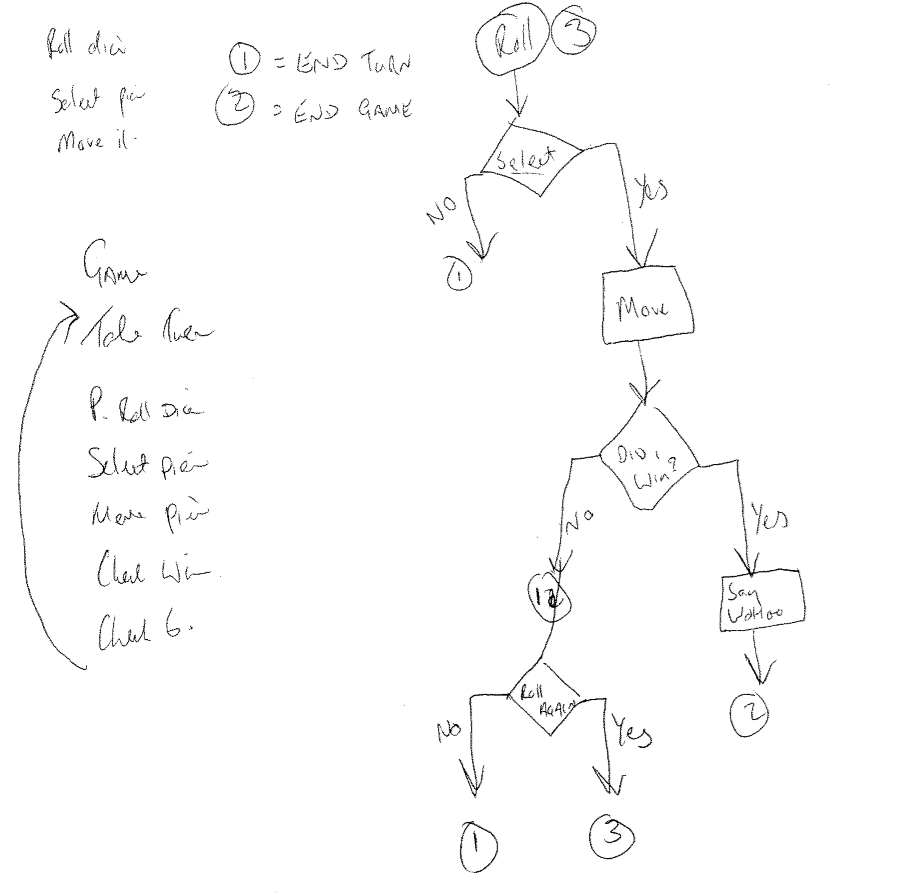
The code readability and maintainability has been a design decision from the offset. The code is fully commented except for obviously self-documenting code.

# Appendix:

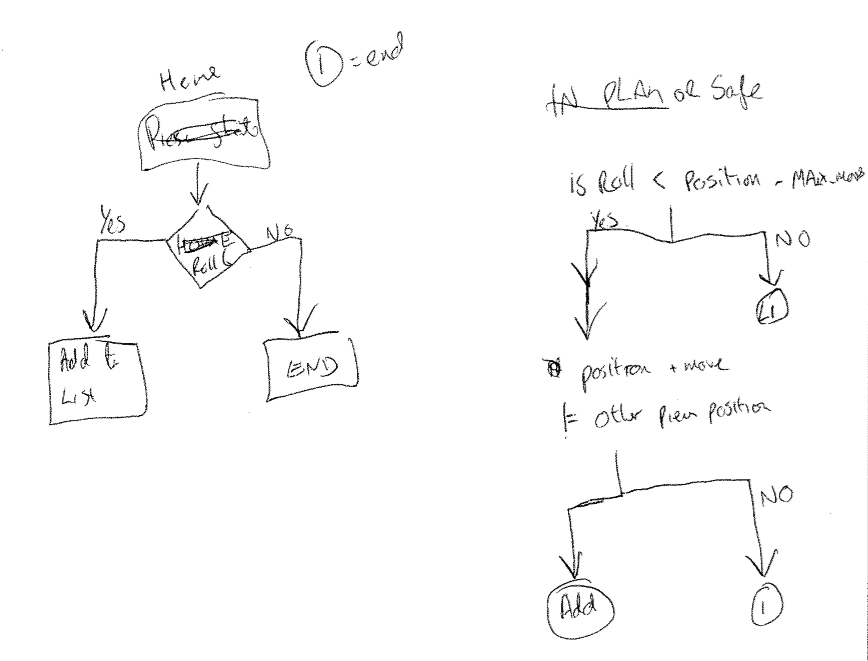
## Additional Notes:



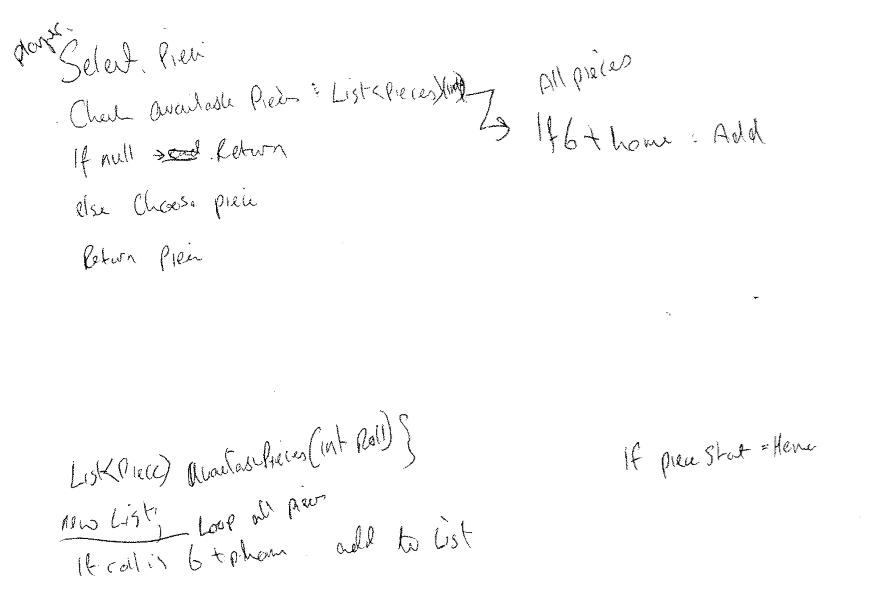
Draft Class Diagram



Desgin Notes



Design Notes



Design Notes