

# Design and Analysis of a Game of Monopoly

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## Table Of Contents

<b>Table Of Contents</b>	<b>1</b>
<b>Abstract</b>	<b>1</b>
<b>Introduction</b>	<b>2</b>
<b>Analysis</b>	<b>2</b>
Requirements	2
Requirements Specification	2
Scenarios	4
Primary Class List	4
Class Diagrams	4
Use Case Diagrams	4
Result Of Structured Walkthrough	5
<b>Appendix</b>	<b>6</b>
Notes of Team Meetings	6
Meeting 1	6
References	6

## Abstract

The aim of this project is to design a game of monopoly using an Object-Oriented approach and following the Agile Scrum framework. This paper will outline the

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

research required for the design of monopoly and will begin with an analysis of the requirements, classes and use cases needed for the design of the game. The product will be designed with the use of object diagrams and user interface mockups as well as state machines. Classes will be modelled using a collection of diagrams to portray the structure of the project, these will include collaboration and sequence diagrams. Finally, the source code will be written and provided to the reader based on the designs.

## Introduction

This paper will seek to analyse, design and structure a game of monopoly with an Object Oriented Approach. The project is split into stages which include Analysis, Product Design, Class Design and finally the implementation. Source code for the game of monopoly will be provided and this will incorporate the designs and structure as outlined in the different stages.

## Analysis

The first stage of this project is the Analysis Stage. Here, the requirements will be defined, the scenarios will be described, a primary class list determined, class diagrams and use case diagrams will be created and the results of a structured walkthrough will be provided.

## Requirements

These requirements outline what the game will and will not do. They will highlight the scope of the project and give light to how the game will be developed. Below is the requirements specification of the game of monopoly.

### Requirements Specification

1. Allowing 2-8 players to join a game session.
2. Permitting each player to pick a game piece from a choice of 8.
3. Allocating money to players at the start of the game.
4. Enabling the player to navigate around the board by rolling two dice and moving the game piece.
5. Giving €200 to a player when they pass 'Go'.
6. Allowing player to take another go if a double is rolled.
7. Permitting players to purchase property if unowned.

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

8. Validating the property is unowned.
9. Giving out Title Deed Cards to players who have purchased a property.
10. Requiring the player to pay rent to another player who owns a property they landed on based on the rent price specified in the Title Deed Card if the owner of the property asks for it before the renter's turn ends.
11. Doubling the rent price for a set of properties once the complete set of properties is owned by one player.
12. Raising the rent price for a property when the property is improved with houses or hotels.
13. Auctioning a property if the property landed on is unwanted and unowned.
14. Permitting players to mortgage property according to property's worth as specified on the Title Deed Card.
15. Enforcing that a property has no improvements before being mortgaged.
16. Receive payment for a mortgaged property with 10% interest when a player wishes to unmortgage it.
17. Preventing the player from collecting rent on a mortgaged property.
18. Allowing players to purchase up to four houses on a property when they own the full set of streets of the same colour.
19. Validating that the houses a player is building on a grouping are being built evenly.
20. Allowing the player to purchase hotels once four houses have been purchased on a property.
21. Enforcing that only one hotel may be built on a given site.
22. Preventing players to build improvements on a site if any of the sites in the grouping are mortgaged.
23. Auctioning buildings in the case of a building shortage and more than one player wishes to purchase the same building.
24. Allowing the player to pick up a chance or community chest card when landing on the relevant space and permitting the user to follow the instruction given.
25. Allowing a player to go to jail when the player lands on 'Go To Jail', rolls three doubles or receives a card instructing them to do so.
26. Enforcing a player in jail to stay in jail unless 50€ is paid, player waits three turns and pays 50€, rolls a double on one of their three turns or the player has a 'Get Out Of Jail Free' card and wishes to use it.
27. Collecting taxes and fines from players.
28. Buying properties and buildings back from the user when the player wishes to sell.
29. Validating that a player's buildings are sold back evenly.
30. Allowing players to make deals with each other which can include trading money, property, or 'Get Out Of Jail Free' cards.

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

31. Eliminating the player from the game when they can no longer pay what they owe and declare bankruptcy.
32. Enforcing a bankrupt player to give their mortgaged properties and 'Get Out Of Jail Free' cards to the other player that they are in debt to.
33. Requiring that the player who receives assets from a bankrupt player to pay 10% interest on any received mortgaged properties at time of receiving.
34. Auctioning a player's mortgaged properties at full (unmortgaged price) and returning 'Get Out Of Jail Free' cards to the relevant decks when that user is bankrupt and in debt to the bank.
35. Allowing last player left in the game to win.

## Scenarios

Blah blah blah...

## Primary Class List

Below is a list of our primary domain-based classes.

1. Player
2. Bank
3. Board
4. Card
5. Property
6. Game
7. Square
8. Piece
9. Die

## Class Diagrams

Blah blah blah...

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Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

## Use Case Diagrams

### Use Cases

<b>Use Case 1</b>	Buying property	
<b>Goal In Context</b>	Purchasing a property from a user or the bank	
<b>Scope and Level</b>		
<b>Preconditions</b>	Property is unowned, user has adequate funds to purchase property.	
<b>Success End Condition</b>	Player purchases property	
<b>Failed End Condition</b>	Player does not purchase property	
<b>Primary,</b>	Player	
<b>Secondary Actors</b>	Bank, Other Players	
<b>Trigger</b>	Player lands on a property.	
<b>Description</b>	<b>Step</b>	<b>Action</b>
	1	Player lands on a property
	2	Player checks if property is unowned
	3	Player decides if they want to purchase the property
	4	Player checks if they have adequate funds to purchase property
	5	System takes money from players wallet and deposits the money in the bank
	6	The player receives the title deed card
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	2a	If property is owned, player pays rent on property
	3a	Player doesn't wish to purchase property so the property goes up for auction
	4a	Player cannot purchase property and property goes up for auction
	6a	If the player now owns all properties in a grouping, they can begin purchasing houses for those properties
<b>Variations</b>	<b>Branching Action</b>	

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

1	Player purchases property through auction or deals with another player.

<b>Use Case 2</b>		Going to Jail
<b>Goal In Context</b>		Player gets locked in jail
<b>Scope and Level</b>		
<b>Preconditions</b>		Player lands on 'Go To Jail' square
<b>Success End Condition</b>		Player goes to jail
<b>Failed End Condition</b>		Player does not go to jail
<b>Primary,</b>		Player
<b>Secondary Actors</b>		'Go To Jail' Square
<b>Trigger</b>		Player lands on 'Go To Jail' Square
<b>Description</b>	<b>Step</b>	<b>Action</b>
	1	Player lands on 'Go To Jail' Square
	2	Player navigates to the jail
	3	Player remains in jail for three turns
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	2a	Player cannot collect €200 if they pass Go.
<b>Variations</b>		<b>Branching Action</b>
	1	Player gets a chance or community chest card which orders them to go to jail. Player rolls three doubles in a row which means they must go to jail immediately.
	3a	Player uses a 'Get Out Of Jail Free' card and moves into 'Just Visiting'.
	3b	Player rolls a double on their next turn and moves into 'Just Visiting'.
	3c	Player pays €50 on their next turn and moves into 'Just Visiting'.

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

<b>Use Case 3</b>		Player declares bankruptcy
<b>Goal In Context</b>		Player declares bankruptcy when they no longer have adequate funds to pay off debt.
<b>Scope and Level</b>		
<b>Preconditions</b>		Player is in debt and does not have adequate funds
<b>Success End Condition</b>		Player declares bankruptcy
<b>Failed End Condition</b>		Player does not declare bankruptcy
<b>Primary, Secondary Actors</b>		Player Other players, Bank
<b>Trigger</b>		Player owes money and cannot pay off the debt
<b>Description</b>	<b>Step</b>	<b>Action</b>
	1	Player owes money
	2	Player pays with their leftover money
	3	Player checks the value of their assets
	4	Player declares bankruptcy
	5	Player must give away their assets
	6	Player is eliminated from the game
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	1a	Player can owe money to the bank or to another player
	4a	Player declares bankruptcy when the value of their assets is not sufficient to pay off the debt
	5a	Assets include properties and 'Get Out Of Jail Free' cards
	5b	If the player is in debt to the bank, the player's properties go for auction unmortgaged and 'Get Out Of Jail Free' cards are returned to the card piles
	5c	If the player is in debt to another player, the bankrupt player must give the other player all their mortgaged properties and "Get Out Of Jail Free' cards. The player receiving the mortgaged properties must pay 10% interest on them
	6a	The player can choose to quit the game or to watch the game play
<b>Variations</b>		<b>Branching Action</b>

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

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<b>Use Case 4</b>	Property Auction for unwanted, unowned property	
<b>Goal In Context</b>	Unwanted, unowned property is being auctioned and the player with the highest bid can purchase the property	
<b>Scope and Level</b>		
<b>Preconditions</b>	Player has sufficient funds for each of their bids, a player landed on the property being auctioned, the property being auctioned is unowned	
<b>Success End Condition</b>	Property up for auction is purchased by highest bidder	
<b>Failed End Condition</b>	Property being auctioned is not purchased as no bids are made	
<b>Primary,</b>	Bidders	
<b>Secondary Actors</b>	Auctioneer	
<b>Trigger</b>	Player lands on an unowned property and does not wish to purchase it.	
<b>Description</b>	<b>Step</b>	<b>Action</b>
	1	Player lands on property
	2	Player checks if property is owned
	3	Player decides not to purchase property
	4	Property goes up for auction
	5	First player to bid decides the initial bidding price
	6	Other players bid on the property
	7	The highest bidder purchases the property
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	4a	The player who lands on the property cannot participate in the bidding process
	5a	The initial bidder can make the initial bid for as low as €1
	7a	The highest bidder must purchase the property at their last bid value



# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

Variations	Branching Action
1a	Properties can go up for auction when a player declares bankruptcy and is in debt to the bank

Use Case 5	Purchasing a hotel								
Goal In Context	Player improves on their property by building a hotel on it								
Scope and Level									
Preconditions	Player has sufficient funds to purchase the hotel, the player has all the properties in the grouping they are building on, the player has four houses on the property.								
Success End Condition	Hotel is purchased								
Failed End Condition	Hotel is not purchased								
Primary, Secondary Actors	Player Bank								
Trigger	It is the player's turn and they wish to build a hotel on their property								
Description	<table> <tr> <th>Step</th><th>Action</th></tr> <tr> <td>1</td><td>Player decides to build a hotel on a property</td></tr> <tr> <td>2</td><td>System takes money from player's wallet and deposits it in the bank</td></tr> <tr> <td>3</td><td>The system replaces the houses on the property with a hotel</td></tr> </table>	Step	Action	1	Player decides to build a hotel on a property	2	System takes money from player's wallet and deposits it in the bank	3	The system replaces the houses on the property with a hotel
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1	Player decides to build a hotel on a property								
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Extensions	<table> <tr> <th>Step</th><th>Branching Action</th></tr> <tr> <td>1a</td><td>Player must have four houses on each property of the same grouping before they can purchase a hotel</td></tr> <tr> <td>1b</td><td>Player can only have one hotel per site</td></tr> <tr> <td>1c</td><td>The property must be unmortgaged to build a hotel on it</td></tr> </table>	Step	Branching Action	1a	Player must have four houses on each property of the same grouping before they can purchase a hotel	1b	Player can only have one hotel per site	1c	The property must be unmortgaged to build a hotel on it
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1a	Player must have four houses on each property of the same grouping before they can purchase a hotel								
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# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white

	<b>1d</b>	If no hotels are available, the player must wait until one becomes available
	<b>2a</b>	The cost of the hotel is specified on the title deed card for the property
	<b>3a</b>	The property is now worth the amount as specified on the title deed card
<b>Variations</b>		<b>Branching Action</b>
	<b>1a</b>	Players can purchase hotels in an auction in the occasion of a building shortage

## Result Of Structured Walkthrough

Blah blah blah...

## Appendix

### Notes of Team Meetings

#### Meeting 1

Blah blah blah...

## References

Blah blah blah...

# Design and Analysis of a Game of Monopoly

Aifric Nolan, Aine McKeon, Comfort Dopamu, Mahjabeen Soomro, Rachel white