Ankara Yıldırım Beyazıt University
Department of Computer Engineering

CENG 201 – Object Oriented Programming
Course Project

G18: Catan Game

Design Report

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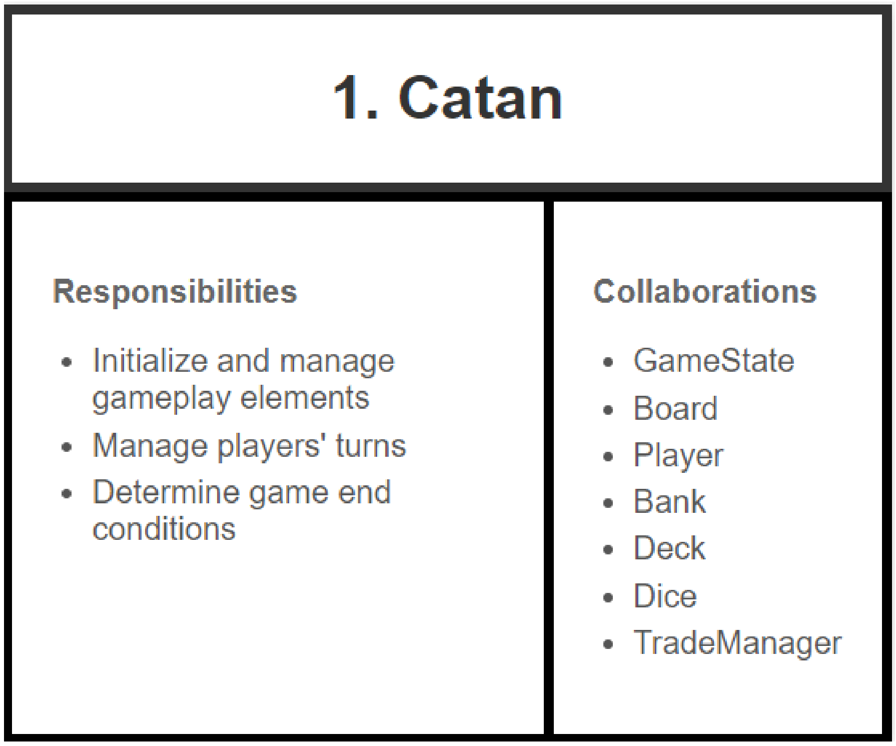
1. Introduction

This report presents the class design and Class-Responsibility-Collaborator (CRC) cards for developing a digital version of Catan using C++. It explores the system architecture, detailing essential classes and their interactions. Emphasizing modularity and scalability, the design ensures that Catan's strategic gameplay and complex mechanics are effectively and reliably reproduced in a software environment.

2. Class-responsibility-collaboration (CRC) cards



1. Catan	
Responsibilities	**Collaborations**
• Initialize and manage gameplay elements • Manage players' turns • Determine game end conditions	• GameState • Board • Player • Bank • Deck • Dice • TradeManager

2. GameState

Responsibilities	Collaborations
• Store each game state • Enable undo/redo functionality	• Catan • Board • Player • Bank • Deck • Dice • TradeManager

3. Board

Responsibilities	Collaborations
• Represent board structure • Provide robber event management • Manage hex, edge, and vertex for building	• Hex • Edge • Vertex • Harbor

4. Player

Responsibilities

- Manage player's resources and development cards
- Provide building actions and card actions
- Track victory points, longest road, and largest army

Collaborations

- DevelopmentCard
- Settlement
- City
- Road
- Bank
- Harbor
- TradeManager
- ResourceType

5. Bank

Responsibilities

- Manage resources
- Handle player-to-bank trades

Collaborations

- Player
- ResourceType

6. Deck

Responsibilities	Collaborations
• Manage development cards • Allow players to buy development cards	• DevelopmentCard • Player

7. Dice

Responsibilities	Collaborations
• Simulate dice rolls • Return a number between 2-12	• Catan

8. TradeManager

Responsibilities	Collaborations
• Manage trade between players	• Player • ResourceType

9. Hex

Responsibilities	Collaborations
• Store resource type, terrain type, and dice number • Represent terrain tiles • Store adjacent edges and vertices	• Board • Player • Edge • Vertex • ResourceType • TerrainType

10. Edge

Responsibilities	Collaborations
• Store information about building roads • Represent connection between vertices • Store adjacent vertices	• Board • Vertex • Road

11. Vertex

Responsibilities	Collaborations
• Store information about building settlements or cities • Represent points where edges meet	• Board • Building • Settlement • City

12. Harbor

Responsibilities	Collaborations
• Provide trading opportunities for players • Enforce special trade ratios	• Vertex • Player • ResourceType

13. Building

Responsibilities	Collaborations
• Serve as base class for Settlement and City	• Player • Settlement • City

14. Settlement

Responsibilities	Collaborations
• Represent a player's settlement on the board	• Player • Vertex

15. City

Responsibilities	Collaborations
• Represent a player's city on the board • Upgraded version of Settlement	• Player • Vertex

16. Road

Responsibilities	Collaborations
• Represent a player's road on the board	• Player • Edge

17. DevelopmentCard

Responsibilities	Collaborations
• Serve as base class for development cards • Allow players to use or purchase development cards	• Player • KnightCard • VictoryPointCard • RoadBuildingCard • MonopolyCard • YearOfPlentyCard

18. KnightCard

Responsibilities	Collaborations
• Allow player to move robber • Included in largest army calculation	• Player

19. VictoryPointCard

Responsibilities	Collaborations
• Provide 1 victory point to player	• Player

20. RoadBuildingCard

Responsibilities	**Collaborations**
• Allow player to build two roads for free	• Player • Road

21. MonopolyCard

Responsibilities	**Collaborations**
• Allow player to get all of one type of resource from other players	• Player • ResourceType

22. YearOfPlentyCard

Responsibilities	**Collaborations**
• Allow player to take any two resource cards from the bank	• Player • Bank • ResourceType

23. ResourceType

Responsibilities	Collaborations
• Define the type of resources available in game	• Player • Hex • Bank • TradeManager • Harbor • MonopolyCard • YearOfPlentyCard

24. TerrainType

Responsibilities	Collaborations
• Define the types of terrains for hex tiles	• Hex

3. Class Diagram

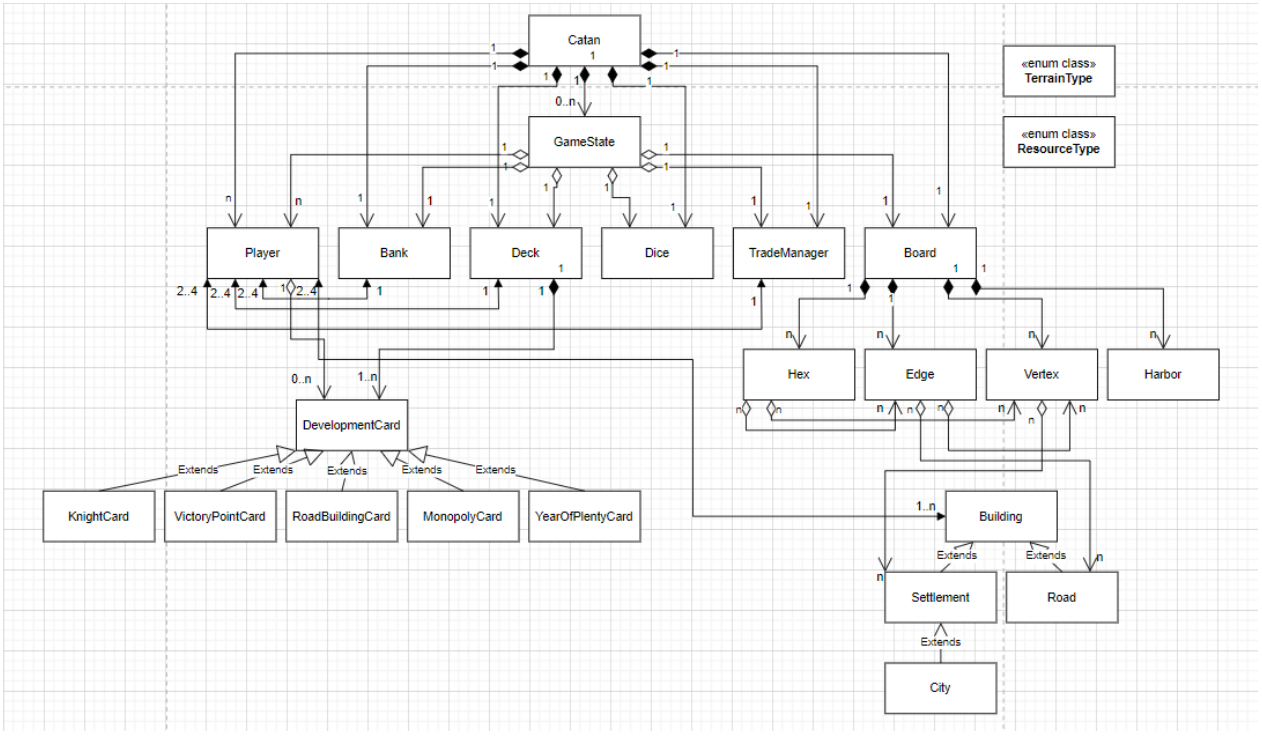
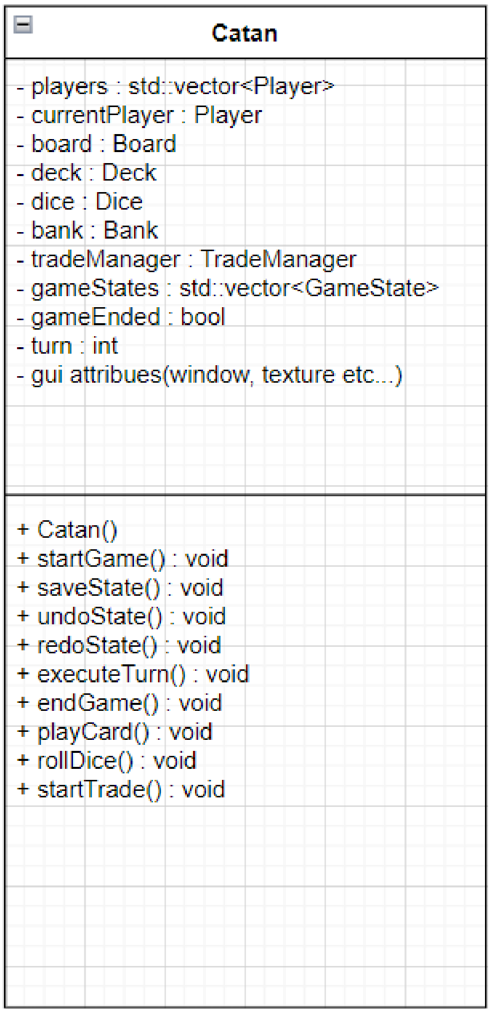
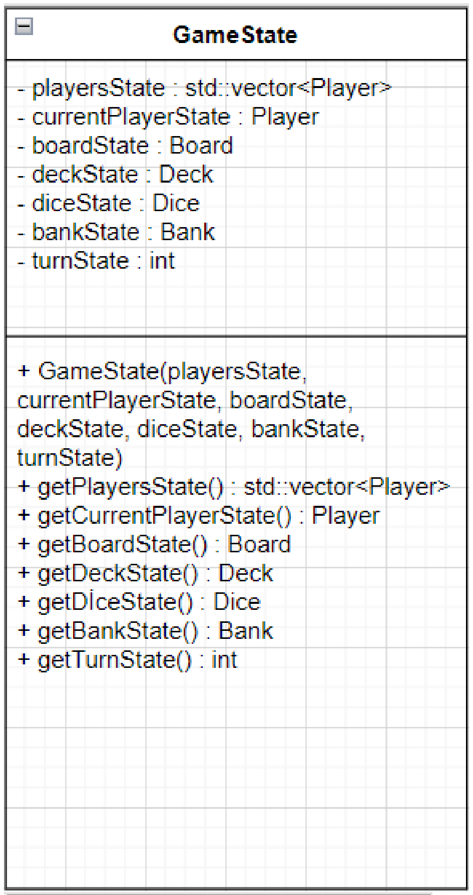


Figure-1 Class Design


Catan

- players : std::vector<Player>
- currentPlayer : Player
- board : Board
- deck : Deck
- dice : Dice
- bank : Bank
- tradeManager : TradeManager
- gameStates : std::vector<GameState>
- gameEnded : bool
- turn : int
- gui attribues(window, texture etc...)

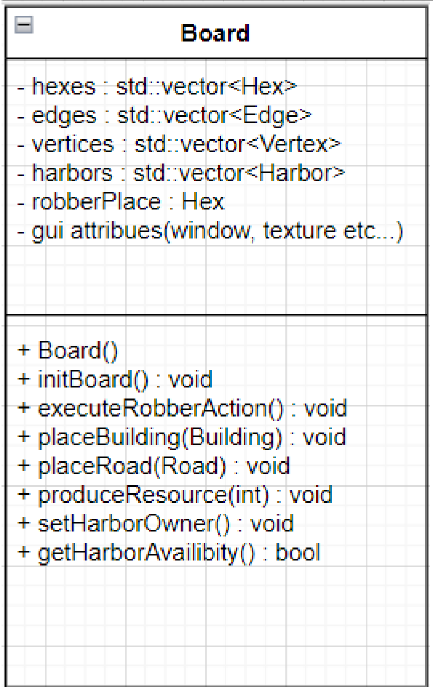
+ Catan()
+ startGame() : void
+ saveState() : void
+ undoState() : void
+ redoState() : void
+ executeTurn() : void
+ endGame() : void
+ playCard() : void
+ rollDice() : void
+ startTrade() : void



GameState

- playersState : std::vector<Player>
- currentPlayerState : Player
- boardState : Board
- deckState : Deck
- diceState : Dice
- bankState : Bank
- turnState : int

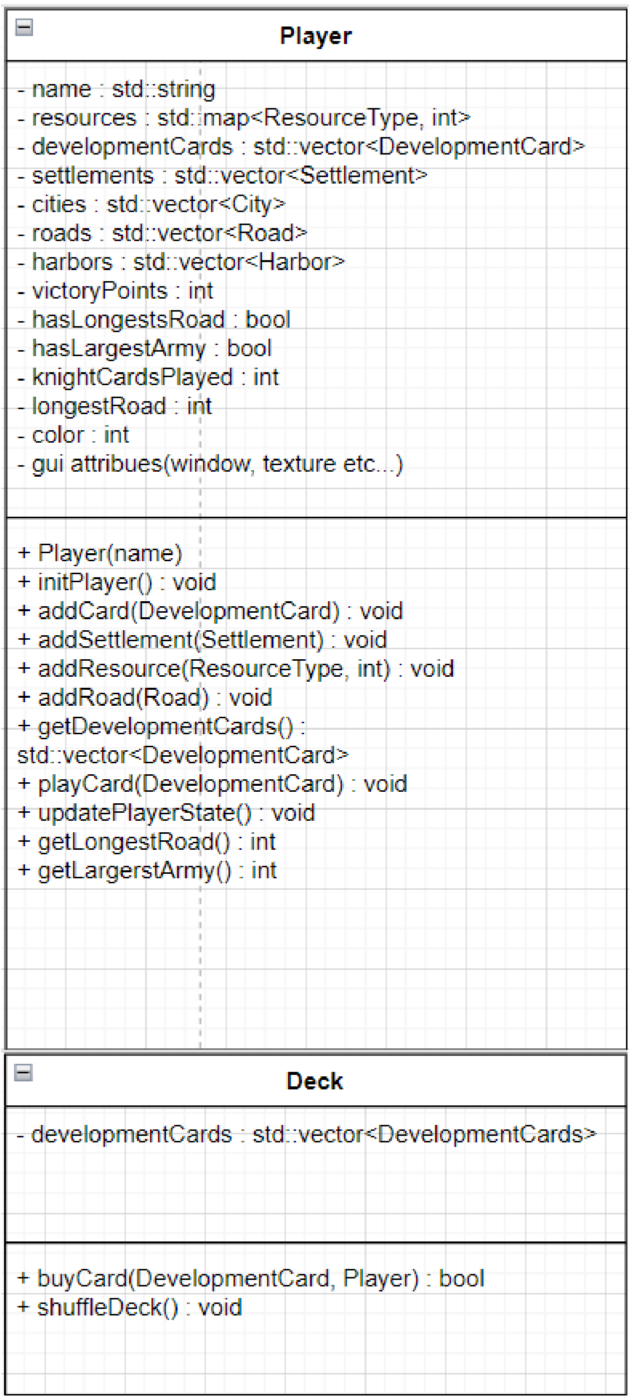
+ GameState(playersState, currentPlayerState, boardState, deckState, diceState, bankState, turnState)
+ getPlayersState() : std::vector<Player>
+ getCurrentPlayerState() : Player
+ getBoardState() : Board
+ getDeckState() : Deck
+ getDİceState() : Dice
+ getBankState() : Bank
+ getTurnState() : int



Board

- hexes : std::vector<Hex>
- edges : std::vector<Edge>
- vertices : std::vector<Vertex>
- harbors : std::vector<Harbor>
- robberPlace : Hex
- gui attribues(window, texture etc...)

+ Board()
+ initBoard() : void
+ executeRobberAction() : void
+ placeBuilding(Building) : void
+ placeRoad(Road) : void
+ produceResource(int) : void
+ setHarborOwner() : void
+ getHarborAvailibity() : bool



Player

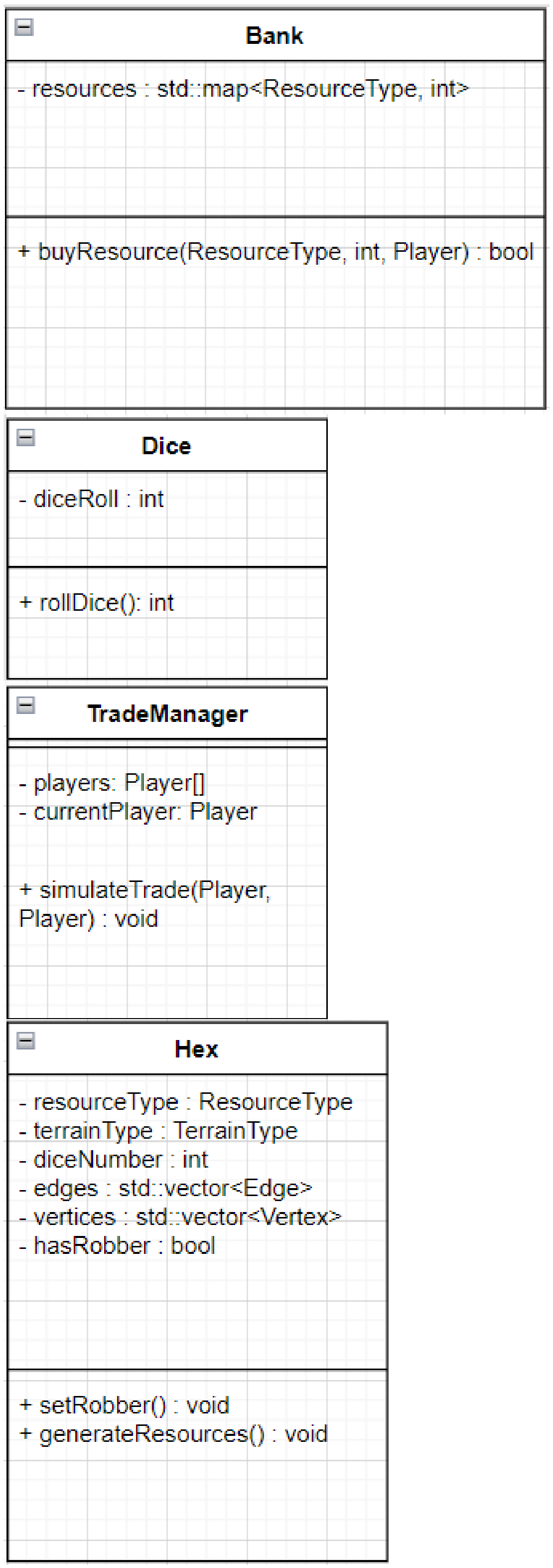
- name : std::string
- resources : std::map<ResourceType, int>
- developmentCards : std::vector<DevelopmentCard>
- settlements : std::vector<Settlement>
- cities : std::vector<City>
- roads : std::vector<Road>
- harbors : std::vector<Harbor>
- victoryPoints : int
- hasLongestsRoad : bool
- hasLargestArmy : bool
- knightCardsPlayed : int
- longestRoad : int
- color : int
- gui attribues(window, texture etc...)

+ Player(name)
+ initPlayer() : void
+ addCard(DevelopmentCard) : void
+ addSettlement(Settlement) : void
+ addResource(ResourceType, int) : void
+ addRoad(Road) : void
+ getDevelopmentCards() : std::vector<DevelopmentCard>
+ playCard(DevelopmentCard) : void
+ updatePlayerState() : void
+ getLongestRoad() : int
+ getLargerstArmy() : int

Deck

- developmentCards : std::vector<DevelopmentCards>

+ buyCard(DevelopmentCard, Player) : bool
+ shuffleDeck() : void



Bank

- resources : std::map<ResourceType, int>

+ buyResource(ResourceType, int, Player) : bool

Dice

- diceRoll : int

+ rollDice(): int

TradeManager

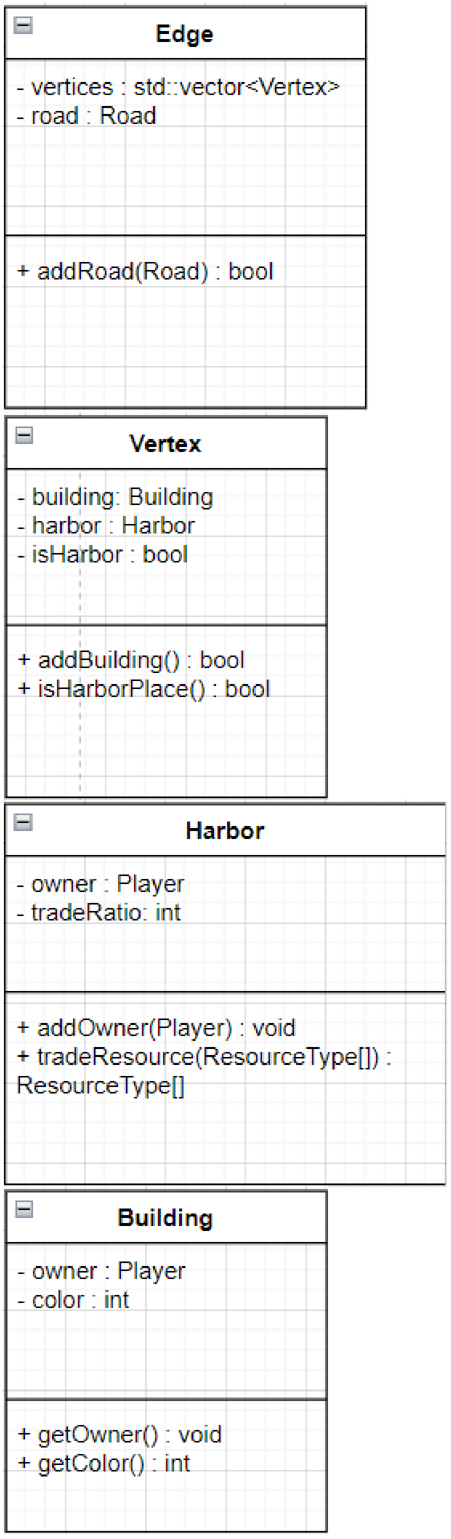
- players: Player[]
- currentPlayer: Player

+ simulateTrade(Player, Player) : void

Hex

- resourceType : ResourceType
- terrainType : TerrainType
- diceNumber : int
- edges : std::vector<Edge>
- vertices : std::vector<Vertex>
- hasRobber : bool

+ setRobber() : void
+ generateResources() : void



Edge

- vertices : std::vector<Vertex>
- road : Road

+ addRoad(Road) : bool

Vertex

- building: Building
- harbor : Harbor
- isHarbor : bool

+ addBuilding() : bool
+ isHarborPlace() : bool

Harbor

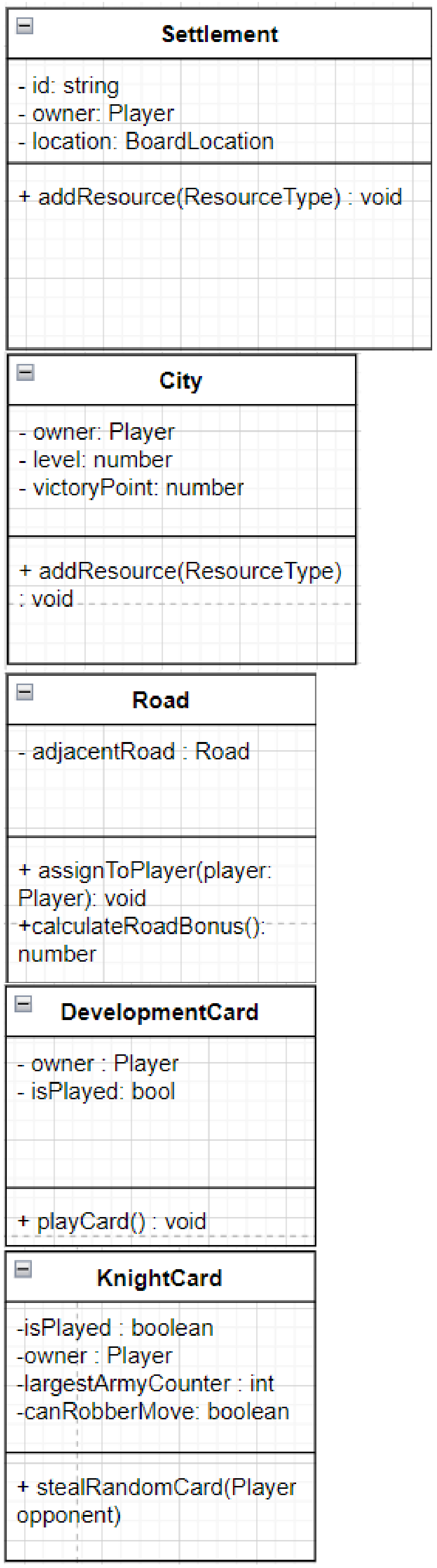
- owner : Player
- tradeRatio: int

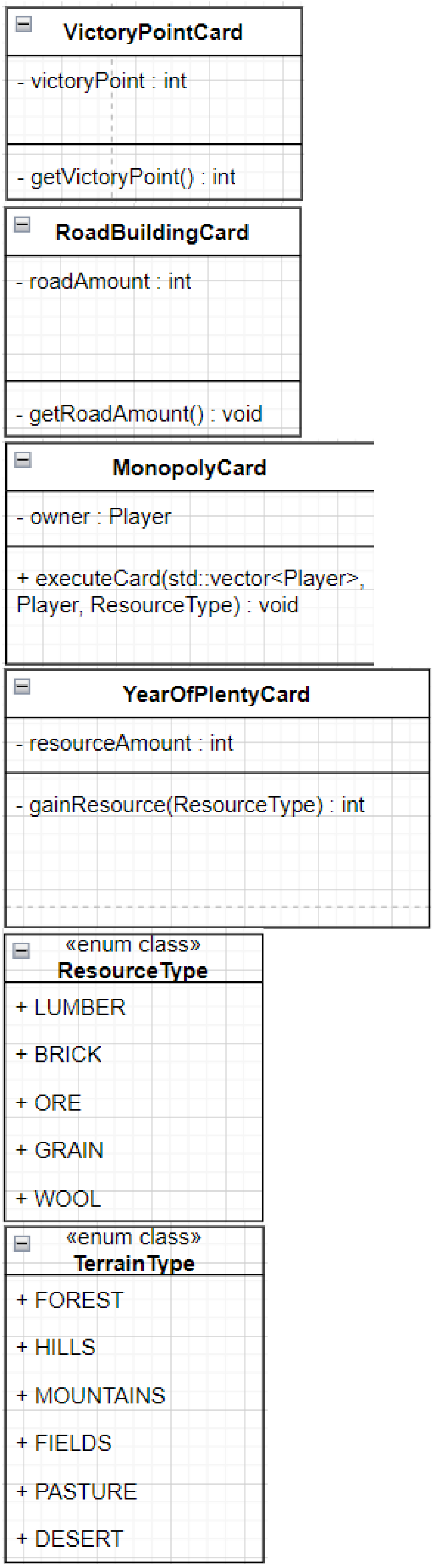
+ addOwner(Player) : void
+ tradeResource(ResourceType[]) : ResourceType[]

Building

- owner : Player
- color : int

+ getOwner() : void
+ getColor() : int


Settlement
- id: string
- owner: Player
- location: BoardLocation
+ addResource(ResourceType) : void
City
- owner: Player
- level: number
- victoryPoint: number
+ addResource(ResourceType) : void
Road
- adjacentRoad : Road
+ assignToPlayer(player: Player): void
+calculateRoadBonus(): number
DevelopmentCard
- owner : Player
- isPlayed: bool
+ playCard() : void
KnightCard
-isPlayed : boolean
-owner : Player
-largestArmyCounter : int
-canRobberMove: boolean
+ stealRandomCard(Player opponent)



VictoryPointCard

- victoryPoint : int

- getVictoryPoint() : int

RoadBuildingCard

- roadAmount : int

- getRoadAmount() : void

MonopolyCard

- owner : Player

+ executeCard(std::vector<Player>, Player, ResourceType) : void

YearOfPlentyCard

- resourceAmount : int

- gainResource(ResourceType) : int

«enum class»
ResourceType

+ LUMBER
+ BRICK
+ ORE
+ GRAIN
+ WOOL

«enum class»
TerrainType

+ FOREST
+ HILLS
+ MOUNTAINS
+ FIELDS
+ PASTURE
+ DESERT

4. Conclusion

This report details the development plan for the Catan console game, focusing on class design and Class-Responsibility-Collaborator (CRC) cards. By creating comprehensive CRC cards and detailed class diagrams, we established a clear architectural framework to guide the coding phase. We are a team of four people and we divide contents by four to contribute equally.