Computer Science 101 – Winter 2024

Project Design Document

Score Four Design Document

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Chapter 1

Introduction

This document, authored by Team *454 Horse Power* for CPSC 101 in Winter 2024, presents the first design specifications for a Score Four Game, aiming to apply the fundamental principles of Object-Oriented Design. Detailed game rules and specifications are given in Appendix A.

1.1 Work Distributuion to Date

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In the initial phase of implementation, we plan to collectively focus on the larger, more complex features to make the game playable in a console –based environment as swiftly as possible. Our goal is to leverage our combined efforts to quickly establish a working model that captures the fundamental game dynamics. Following this, we will individually branch out to tackle smaller, more specialized tasks tailored to our personal interests and strengths. These tasks will be pursued outside of our group meeting times, allowing us to efficiently build upon the game's functionality and refine its features and interactivity, making the game feel polished and complete.

1.2 Document History

Version	Date
1.0 Initial version	January 29, 2024
1.1 Meeting 2 Draft	January 31, 2024
1.2 Meeting 3 Draft	February 5, 2024
1.3 Final Version	February 8, 2024

Chapter 2

Design Elements

This chapter provides a compilation of nouns and a list of facts about the game. The following chapter provides an in-depth design analysis of each noun.

2.1 List of Nouns

This list has been sorted alphabetically and written in singular form.

- AI
- Ball
- Board
- Color
- Command
- Command Reader
- Draw
- Game
- Line
- Move
- Peg
- Player
- Referee
- Turn
- Win

2.2 List of Facts

This list is not sorted.

- Score Four is played on a 4x4 grid of pegs.
- Each peg can hold a maximum depth of 4 balls.
- Players are given white or black balls to distinguish their pieces.
- The player can quit at any time.
- Players take alternate turns, placing a ball on a peg.
- A ball must be placed on each turn. No turn can be skipped.
- The game is played against an AI player.
- The game features an interactive mode that allows the player to play within a GUI.
- The victor is announced as soon as a winning line is seen.
- There are 76 possible winning lines.
- In testing mode, the AI will not respond with a move unless prompted.
- The objective is to align 4 balls of the same color in a straight line, which can be horizontal, vertical, diagonal (singly or doubly skewed) lines.
- The game ends in a win to the player that aligns 4 balls is a straight line first.
- A draw can be met if the board is filled without any winning line.
- Once a ball is placed it cannot be removed in normal play.
- When a ball is placed on a peg, it falls to the lowest open position.
- White balls are given the advantage to play first.
- The game features a testing mode played within the console through commands.
- Testing mode allows the tester to place/remove balls from any peg.
- Testing mode allows for the AI to recommend a move to either color through commands.
- When playing in the console the board can be viewed in either a coordinate list [A-D,1-4] or an ASCII representation.
- Every command ends in a period (.).
- GUI mode can be entered at any time.

Chapter 3

Noun-Based Class Specifications

Each entry provides relevant information about the noun, accompanied by a concise description. Assuming the noun qualifies as a class candidate, A brief description of attributes, behaviors, and collaborations are provided.

3.1 AI

3.1.2 Facts

- Acts as a computer-controlled opponent or helper.
- Analyzes the board and plays based off the current state of the board.

3.1.3 Behaviours

- Evaluates board state and moves.
- Chooses moves that maximize winning chances or block the opponent.
- Recommends or plays a generated move.

3.1.4 Collaborations

- Interacts with the board to analyze it and validate ball placement.
- Works with commands to recommend moves.

3.1.5 Summary

The AI serves as a computer-controlled opponent and helper to recommend winning moves. Through algorithms it analyzes the current state of the game and makes decisions based off gained information.

3.2 Ball

3.2.1 Facts

- Balls are the primary game pieces used in Score Four.
- Each ball represents one move in the game by a player.
- There are exactly two colors of balls, black and white, to represent two players.
- Each ball is uniform size and shape.

3.2.2 Attributes

- Each ball has a colored black or white, indicating the player it belongs to.

3.2.3 Collaborations

- A ball is placed by the player.
- A ball is placed onto a peg, which belongs on the board.

3.2.4 Behaviours

- The color of the ball can be identified to recognize ownership.

3.2.5 Summary

The ball is the primary game piece that comes in two colors: black or white. Each color represents one of the two players in the game. The balls are used to play the game by placing them onto pegs on the board, aiming to align four in a row.

3.3 Board

3.3.1 Facts

- The board is the playing surface for the game.
- It consists of a 4x4 matrix of pegs.

3.3.2 Attributes

- The board holds a 4x4 grid of pegs.

3.3.3 Colloborations

- The board maintains the 4x4 grid of pegs.
- The board is the principal component to the game.
- Players interact with the board to place balls on the pegs.

3.3.4 Behaviours

- Display the current state of the board.
- Accept or deny ball placement.
- Reset the board.

3.3.5 Summary

The board is the foundation of Score Four, featuring a 4x4 grid of pegs where players place their balls. It handles gameplay through ball placements, Interacting with the players, pegs, and balls.

3.4 Color

3.4.1 Facts

- The game uses black or white colors for the balls
- Colors distinguish between the two players' balls in the game.

3.4.2 Attributes

- The color can be black or white.

3.4.3 Collaborations

- Color is used to determine ownership of the balls.

3.4.4 Summary

Color is crucial for distinguishing between the two players' pieces, with black and white used to represent each player.

3.5 Command

3.5.1 Facts

- Represents a command in the Score Four game.
- Used for input and interaction with games.
- Includes functionalities like placing balls, resetting the board, transferring to interactive mode, and quitting the game.

3.5.2 Attributes

- Text that represents what the command is named and its purpose.

3.5.3 Collaborations

- Collaborates with other classes such as Player, Board, Ball, and Game to execute commands and manage game state.
- Interacts with the Command Reader to receive user input.

3.5.4 Behaviour

- Interprets user input to determine the type and parameters of the command.
- Executes the corresponding action based on the command.

3.5.5 Summary

The Command class represents user commands in the Score Four game. It handles parsing user input, interpreting commands and executing corresponding actions. Additionally, it interacts with the Command Reader to receive user input and executes commands accordingly.

3.6 Command Reader

3.6.1 Facts

- Read user input in the Score Four game.
- Provides an interface for receiving commands from the player.

3.6.2 Behaviour

- Read user input from the console or GUI.
- Provides input validation.
- Communicates with Command class to pass user commands for execution.

3.6.3 Collaborations

- Collaborates with Command class to pass user commands.
- Interacts with the player to receive commands.

3.6.4 Summary

The Command Reader is responsible for reading user input in the Score Four game. It provides an interface for receiving commands from the player and communicates with the Command class to execute those commands.

3.7 Draw

3.7.1 Facts

- A draw occurs when the board is filled without any player aligning four balls in a straight line.
- It represents a stalemate where neither player achieves the game's objective.

3.7.2 Summary

In Score Four, A draw signifies when the board is full, and no more moves are possible. This is unlikely to be a class but a part of the game state.

3.8 Game

3.8.1 Facts

- Central structure for Score Four, orchestrating all gameplay elements.
- Manages the game board, players, state.

3.8.2 Attributes

- Holds the main game board.
- Manages both players, Human and computer controlled.
- Tracks of the current game state whether it be ongoing, win or a draw.
- Oversees possible incoming commands.

3.8.3 Behaviours

- Initializes the game, setting up the board and players.
- Processes player moves, updating the board and checking for win conditions.
- Alternates turns between players.
- Determining the game outcome.
- Concludes the game when a win or draw is detected, displaying the outcome.

3.8.4 Collaborations

- Interacts with player (human or AI) inputs to execute game moves.
- Works with the AI subsystem for move suggestions and AI player actions.
- Coordinates with the board to update game state based on player actions
- Reads incoming commands to the game.

3.8.5 Summary

The Game class serves as the backbone of Score Four, integrating all aspects from start to finish.

3.9 Line

3.9.1 Facts

- A Line in Score Four is defined as a straight sequence of four balls of the same color placed horizontally, vertically, diagonally, or in a skewed pattern.
- The game recognizes 76 possible winning lines on the board.
- Lines are the game's objective, with the first player to form a line of four balls of their color being declared the winner.

3.9.2 Attributes

- The board positions (A1 to D4), That comprises the line.

3.9.3 Behaviours

- Determines whether a line is equal to a winning line.

3.9.4 Colloborations

- Lines are formed based on the placement of balls on the board's pegs.
- Both human and AI players work towards creating lines as part of their strategy to win the game.
- The Referee can detect a winning line.

3.9.5 Summary

In Score Four, Lines are fundamental to the gameplay and strategy, representing the primary goal players aim to achieve.

3.10 Move

3.10.1 Facts

- A move is an action taken by either player (Human or AI) to place a ball of their respective color on a peg.
- Moves are constrained by the game rules, such as only being able to place a ball on non-full pegs and the requirement that each turn must involve placing a ball.
- The game alternates moves between players.

3.10.2 Summary

In Score Four, a Move is a fundamental action that represents a turn by the player. Likely to be a part of the Players behaviors.

3.11 Peg

3.11.1 Facts

- The arrangement of pegs in a 4x4 grid forms the foundational structure of the game board.
- Pegs are the vertical elements on the board that hold the balls.
- Each peg can accommodate up to four balls.
- When a ball is placed on a peg it falls to the bottommost location available.

3.11.2 Attributes

- Tracks the number of balls currently on the peg, Fixed at four balls.

3.11.3 Behaviours

- Place a new ball onto the peg if there is available capacity.
- Determines if the peg has reached its capacity and can no longer hold additional balls.
- Retrieves information about a specified ball at a location on the peg.

3.11.4 Collaborations

- Holds balls placed by players during their turns.
- An integral part of the board structure interacts with the board to update the game state.

3.11.5 Summary

Pegs are a critical component of Score Four's gameplay mechanics, serving as the receptacles for players' moves.

3.12 Player

3.12.1 Facts

- Players in Score Four are the participants of the game, which can be either human or controlled by AI.
- Each player is assigned a color (white or black) at the start of the game, with white typically having the first move.
- A Player has a maximum has 36 turns.
- The interaction and decisions of players determine the placement of balls on the board and the game's outcome.

3.12.2 Attributes

- Identifies the player's ball color, crucial for game play and strategy.
- Distinguishes between a human player and an AI-controlled player.

3.12.3 Behaviours

- Executes a move by placing a ball on the board.

3.12.4 Collaborations

- Interacts with the board for placing balls on pegs.
- In cases where the player is AI-controlled, it utilizes AI algorithms to determine moves.

3.12.5 Summary

The Player class encapsulates all aspects of a participant in the Score Four game, encompassing both human players and their AI counterparts.

3.13 Referee

3.13.1 Facts

- The Referee in Score Four is a conceptual component responsible for overseeing the game rules, ensuring fair play, and determining the outcome of matches.
- It checks for winning lines to declare a winner and can also identify a draw when the board is filled without winning lines.

3.13.2 Attributes

- A comprehensive list of all possible winning line configurations for quick reference during checks.

3.13.3 Behaviours

- Analyzes the board after each move to identify any sequences of four balls of the same color in a line.
- Announces the game's winner upon detecting a winning line, updating the game status accordingly.
- Determines if the game has reached a draw state, with no further moves possible and no winner.

3.13.4 Collaborations

- Interacts with the board to assess ball placement and determine winning lines.
- Coordinates with the overall game structure to update the game state based on assessments of winning conditions or draws.

3.13.5 Summary

The Referee is an essential element of Score Four, serving as the mechanism for enforcing game rules, validating moves, and determining the outcome of the game through assessments after each turn. By checking for winning lines and potential draws.

3.14 Turn

3.14.1 Facts

- A Turn in Score Four refers to the opportunity for a player to make a move by placing a ball on the board.
- The game operates on an alternating turn basis, with players taking actions one after the other.
- The rule that a ball must be placed on each turn.

3.14.2 Summary

The concept of a Turn in Score Four is fundamental, serving as the mechanism through which players interact with the game.

3.15 Win

3.15.1 Facts

- A Win in Score Four is achieved when a player successfully aligns four balls of the same color in a straight line, horizontally, vertically, diagonally, or in a skewed pattern, (A Line).
- The game immediately concludes when the win condition is met.

3.15.2 Summary

Achieving a Win in Score Four marks the successful conclusion of the game for a player.

Appendix A

Game Rules & Project Specifications

Score Four is a game where a player competes against an AI opponent, each taking turns to strategically place colored balls onto a vertical 4x4 grid of pegs. The aim is to align four balls of their color in a straight line—horizontally, vertically, or diagonally. The lines can also be skewed, either singly or doubly, as the game recognizes 76 possible winning lines. Each peg on the board can accommodate up to four balls (vertically), with each ball automatically settling at the lowest available position on the peg. Players are assigned either white or black balls, and the game proceeds with alternate turns, with the stipulation that a ball must be placed on every turn, thus no turn can be skipped. White balls are traditionally given the first move advantage. The game proceeds until a player aligns four balls in a straight line, thereby winning the game. If the board is filled without any winning line, the game is declared a draw. The game also features an interactive mode, enabling gameplay within a Graphical User Interface (GUI), enhancing the visual experience. There is also a testing mode, accessible via the console, which allows for direct command input to place or remove balls in any order, and for the AI to suggest moves without responding automatically. The game is supervised by a conceptual referee, which ensures adherence to the rules, and determines the match's outcome by checking for winning lines or a draw condition. Score Four is a game of strategy and spatial planning, where a player faces off against an AI opponent, each maneuvering to be the first to create a line of four balls in a pattern that secures a win, or to strategically block their opponent.