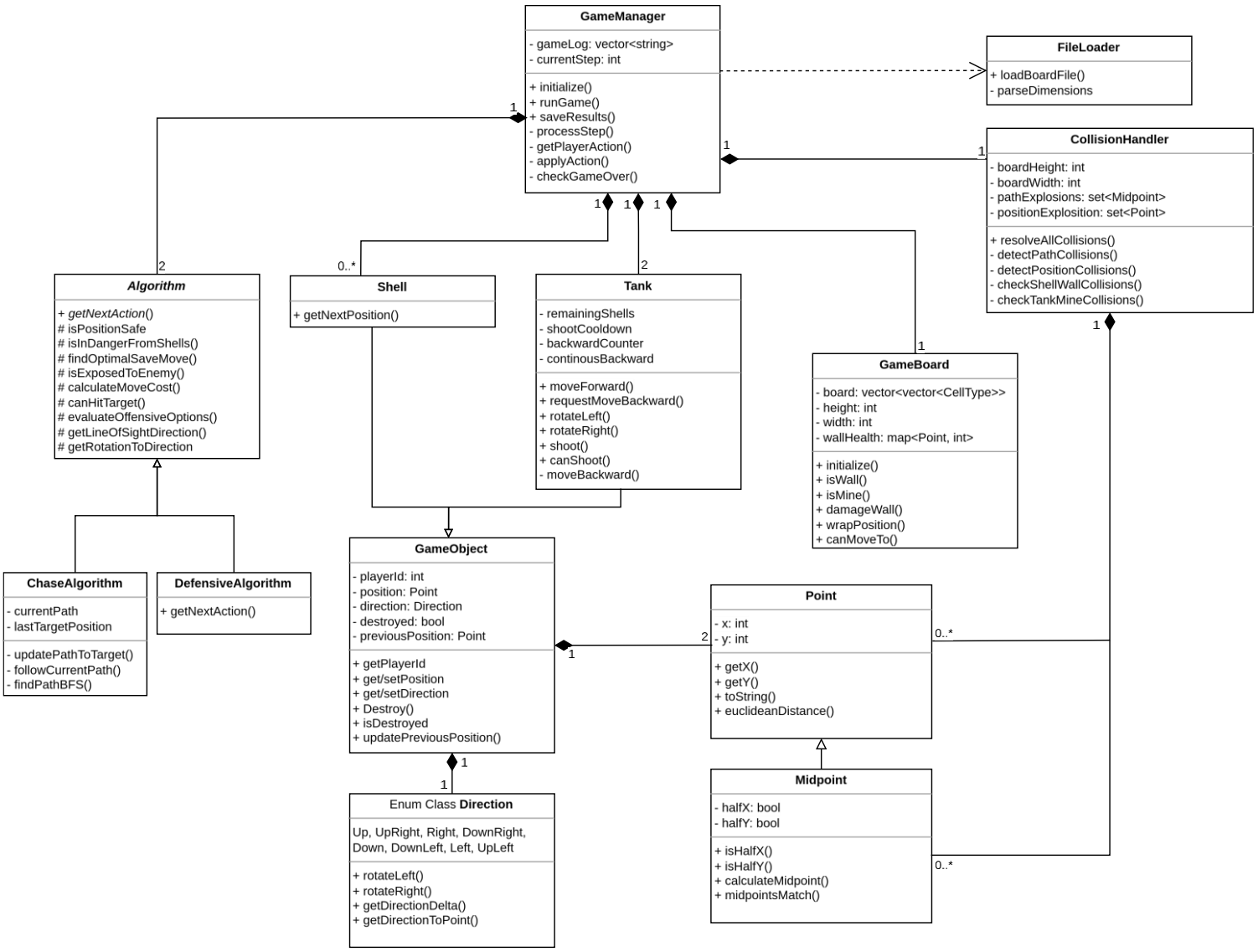
Tank Battle Game - High-Level Design

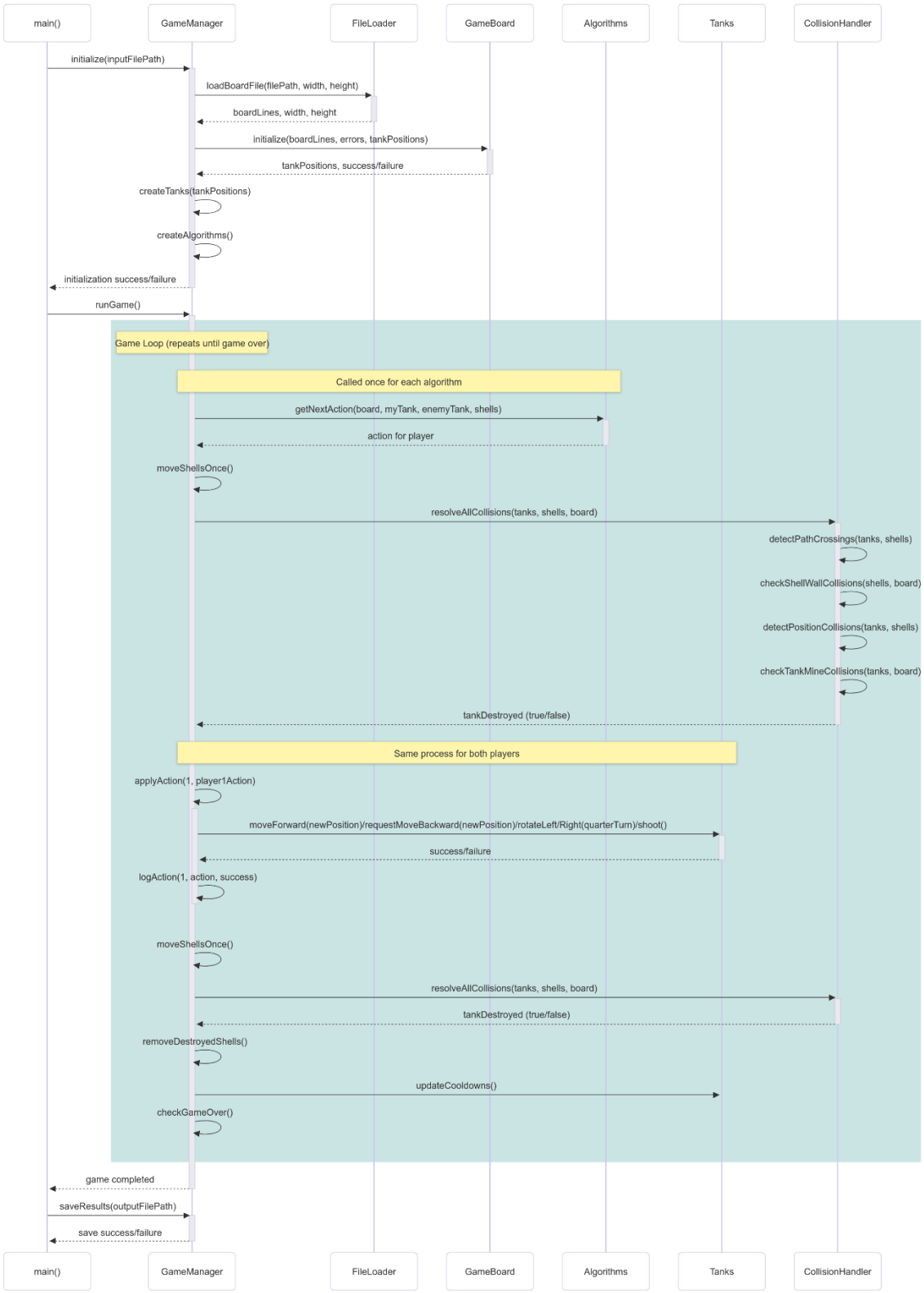
1. Introduction

This document outlines the high-level design for the Tank Battle Game assignment. The game simulates two tanks battling on a 2D board, with features including movement, shooting, collision detection, and algorithm-driven tank behavior.

2. Class Diagram



3. Sequence Diagram for Main Game Flow



4. Design Considerations and Alternatives

4.1 Game Management

- The Game Manager acts as a central coordinator, owning the game loop and managing the life cycle of all game objects.
- Chosen over distributed control to enforce the requirement that algorithms can't modify game state directly
- Allows centralized validation of actions and tracking of invalid moves

4.2 Game State

- Separation between Board (static environment), Tank/Shell (dynamic objects) -
    - Tanks and shells perform action on each game step, requiring efficient handling (doesn’t require changing the game board representation on every step).
    - Only change board when a wall/mine state changes.
- Board handles position wrapping, objects not aware of board dimensions and therefore require the game manager mediation to determine the real positions on the board.
- Chosen over a unified state class as the game state is currently simple. This allows to avoid a level of indirection that needs to be updated on each step.

4.3 Algorithms

- A very extensive base class with basic utils for making algorithm decisions - prevents code duplications and allows the derived classes to focus on core mechanics and specialized priority management.

4.4 Collision Handler

- Dedicated class for detection and resolution of various collision types.
- Centralizes complex collision logic that would otherwise clutter GameManager.
- Storing last known position in object classes in order to be able to handle path collisions.

4.5 Utility Classes

- Contains reusable components like Point, Direction, and Action to avoid duplication.

- Provides consistent handling of wrapped coordinates and direction calculations
- The MidPoint class is derived from Point and provides a special handling for positions between adjacent cells, enabling the collision handler to avoid inaccurate float representation.

5. Testing Approach

5.1 Unit Testing

Each class is tested using Google Test framework with:

- Tests for constructors and basic properties
- Tests for core functionality under normal conditions
- Boundary and edge case testing

5.2 Integration Testing

Component interactions are tested by:

- Testing GameManager with mock algorithms
- Verifying the complete game cycle
- Validating file input/output operations

5.3 Manual Testing with Visualization

The visualization component serves as both a bonus feature and a valuable testing tool:

- **Game State Verification**: The visual representation allows direct inspection of game state after each step
- **Collision Detection**: Visualizing object movements and collisions helps verify complex interaction scenarios
- **Algorithm Behavior Analysis**: Visual patterns of tank movement help validate algorithm decision-making
- **Edge Case Identification**: Unusual game states become more apparent when visualized
- **Debugging Aid**: The step-by-step visual replay simplifies tracing the source of unexpected behaviors
- **Mock algorithms:** creating a Mock Class with the option to set a sequence of actions to test specific test scenarios.