Design Overview for Descend Below (Lite)

Name: Ta Quang Tung
Student ID: 104222196

Summary of Program

Descend Below (Lite) is a roguelike video game where the player battle enemies to progress through endless floors. Each floor is made up of rooms, which contain enemies and exits that lead to other rooms. One room in each floor contains a staircase that can be clicked on to enter a new floor.

The player attack enemies by left clicking. Enemies attack the player by firing projectiles at them. The game ends when the player's health reaches 0, after which the game can be reset.

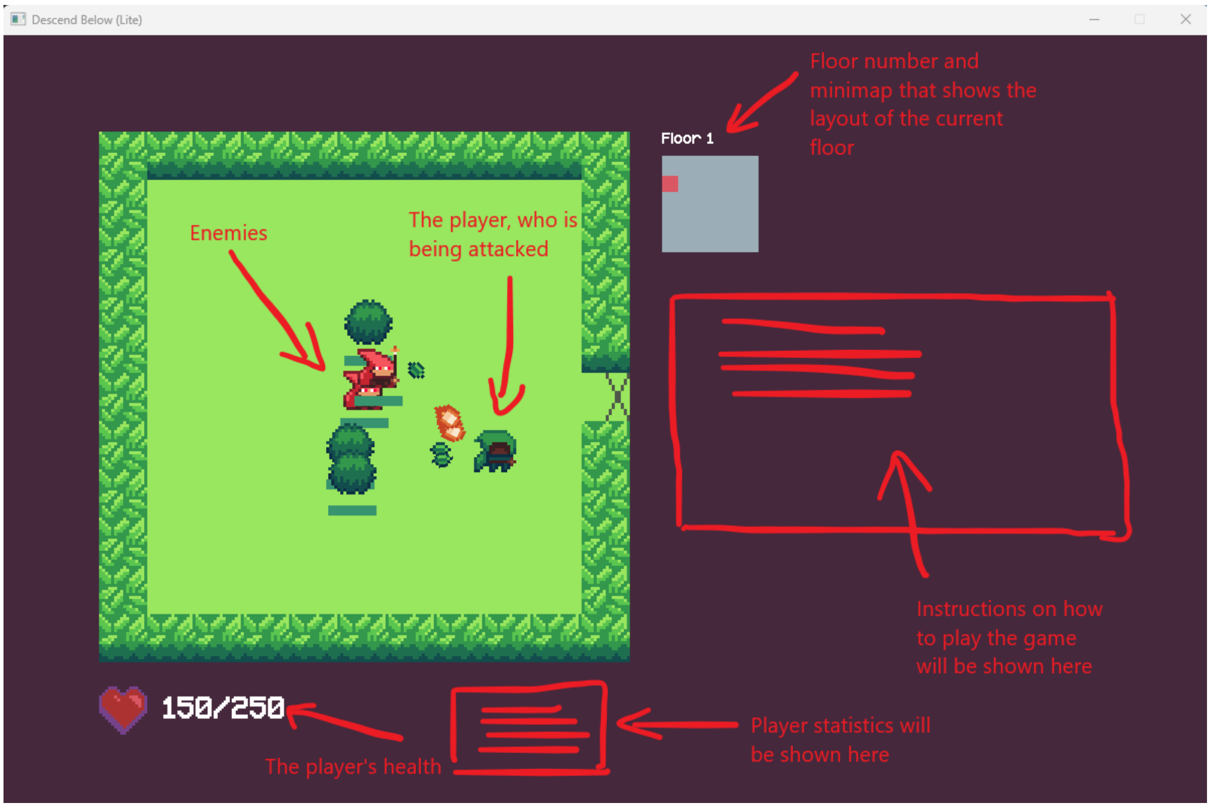

Descend Below (Lite)
Floor number and minimap that shows the layout of the current floor
Floor 1
Enemies
The player, who is being attacked
Instructions on how to play the game will be shown here
150/250
The player's health
Player statistics will be shown here

Figure 1: Sketch of final output (more details will be added later)

Required Roles

Table 1: GameObject abstract class details

Responsibility	Type Details	Notes
_position	protected field, Point2D	The position of the game object.
_width	protected field, double	The width of the game object.
_height	protected field, double	The height of the game object.
_sprite	protected field, Bitmap	The sprite (image) of the game object.
_zIndex	protected field, int	A number that controls how the game object will be drawn in relation to other objects. Objects with higher z-indices are drawn on top.
GameObject	public constructor, parameters (Point2D position, double width, double height, Bitmap sprite, int zIndex = 1)	Used to create a new game object.
Draw	public virtual method, parameter (DrawingOptions options), returns void	Draws the game object to the screen, using the provided DrawingOptions.
Update	public abstract method, parameter (uint fps), returns void	Updates the game object.

Table 2: Collider class details

Responsibility	Type Details	Notes
_gameObject	private field, GameObject	The game object associated with the collider.
_baseColliderBox	private field, Quad	A rectangle representing the collider whose center is rooted at (0, 0). The Quad type is chosen over Rectangle because the collider can be rotated.
Collider	public constructor, parameters (GameObject gameObject, double rotation)	Used to create a new collider object.
IsCollidingWith	public method, parameter (Collider c), returns bool	Determines if the collider is colliding with another collider.
GetColliderBox	private method, no paremeters, returns Quad	Returns a new Quad after moving the base collider

		box to the position of the game object.
GameObject	public readonly property, returns GameObject	Used to retrieve the game object associated with the collider.

Table 3: StaticObject abstract class details

Responsibility	Type Details	Notes
… StaticObject inherits from GameObject		
StaticObject	public constructor, parameters (Point2D position, double width, double height, Bitmap sprite, int zIndex = 1)	Used to create a new static game object.
Update	public override method, parameter (uint fps), returns void	Updates the static game object.

Table 4: DynamicObject abstract class details

Responsibility	Type Details	Notes
… DynamicObject inherits from GameObject		
_velocity	protected field, Vector2D	The velocity of the dynamic object.
DynamicObject	public constructor, parameters (Point2D position, double width, double height, Bitmap sprite, Vector2D velocity, int zIndex = 1)	Used to create a new dynamic game object.
Draw	public override method, parameter (DrawingOptions options), returns void	Draws the dynamic object, flipping the sprite across the Y axis depending on its FacingDirection.
Update	public override method, parameter (uint fps), returns void	Updates the dynamic game object, moving it by its velocity.
MoveTo	public method, parameter (Point2D point), returns void	Moves the object to the specified position.
MoveBy	public method, parameter (Vector2D displacement), returns void	Moves the object along the specified vector.
GetFacingDirection	protected virtual method, no parameters, returns FacingDirection	Determines the FacingDirection of the dynamic object, which can be used for drawing.

Table 5: Projectile class details

Responsibility	Type Details	Notes
… Projectile inherits from DynamicObject and implements the ICollidable and IDestroyable interfaces		

_rotation	private field, double	The projectile's rotation measured counter-clockwise from the vector (1, 0). Used to draw the projectile and set up its collider.
_collider	private field, Collider	The Collider object associated with the projectile.
_canDestroy	private field, bool	Whether the projectile can be destroyed or not.
_projectileType	private field, ProjectileType	The type of the projectile. Can be either Friendly or Hostile.
_damage	private field, int	The projectile's damage.
Projectile	public constructor, parameters (Point2D position, double width, double height, Bitmap sprite, Vector2D initialVelocity, double targetSpeed, ProjectileType type, int damage)	Used to create a new projectile.
Draw	public override method, parameter (DrawingOptions options), returns void	Draws the projectile, rotating it by _rotation.
Collide	public virtual method, parameter (Collider c), returns void	Defines the projectile's behavior on colliding with an object.
Collider	public readonly property, returns Collider	Used to retrieve the projectile's collider.
CanDestroy	public readonly property, returns bool	Used to determine if the projectile can be destroyed.

Table 6: ICollidable interface details

Responsibility	Type Details	Notes
Collider	readonly property, returns Collider	Used to retrieve the collider (a hitbox) associated with a game object.
Collide	method, parameter (Collider collider), returns void	A method that defines the object's behavior upon collision with another object.

Table 7: IDestroyable interface details

Responsibility	Type Details	Notes

CanDestroy	readonly property, returns bool	Used to determine whether an object can be destroyed or not. Destroying means removing all references to an object.

Table 8: Character abstract class details

Responsibility	Type Details	Notes
Character inherits from DynamicObject and ICollidable		
_health	protected field, int	The character's current health.
_maxHealth	protected field, int	The character's maximum health.
_collider	private field, Collider	The collider associated with the character.
Character	public constructor, parameters (Point2D position, double width, double height, Bitmap sprite, Vector2D initialVelocity, int maxHealth, int zIndex = 1)	Used to create a new character.
Collider	public readonly property, returns Collider	Used to retrieve the character's collider.
Collide	public virtual method, parameters (Collider c), returns void	Defines the character's behavior on colliding with an object.
Damage	public virtual method, parameters (int amount), returns void	Damages the character by a particular amount.
Heal	public virtual method, parameters (int amount), returns void	Heals the character by a particular amount.
IsDead	public method, no parameters, returns bool	Used to determine if the character is dead.

Table 9: Player class details

Responsibility	Type Details	Notes
Player inherits from Character		
_weapon	private field, Weapon	The player's equipped weapon.
Player	public constructor, parameters (Point2D position, Vector2D initialVelocity, int maxHealth)	Used to create a new player.
Halt	public method, returns void	Sets the player's velocity to 0.
MoveAlong	public method, parameters (Vector2D direction)	Sets the player's velocity to move along the specified direction.

Attack	public method, parameters (Point2D target)	Attacks a target at the specified location.

Table 10: Enemy abstract class details

Responsibility	**Type Details**	**Notes**
	Enemy inherits from Character and IDestroyable	
Enemy	public constructor, parameters (Point2D position, double width, double height, Bitmap sprite, Vector2D initialVelocity, int maxHealth)	Used to create a new enemy.
Attack	public abstract method, parameters (Player p)	Attacks the player specified by p. Must be implemented by derived classes.
Move	public virtual method, parameters (Player p)	Moves towards the player specified by p.
CanDestroy	public readonly property, returns bool	Used to determine if the enemy object can be destroyed.

Table 11: Wall class details

Responsibility	**Type Details**	**Notes**
	Wall inherits from StaticObject and ICollidable	
_collider	private field, Collider	The collider object associated with the wall.
Wall	public constructor, parameters Point2D position, double width, double height, Bitmap sprite	Used to create a new wall.
Collider	public readonly property, returns Collider	Used to retrieve _collider.
Collide	public method, parameter Collider c	Defines the wall’s behavior on collision with another object.

Table 12: Exit class details

Responsibility	**Type Details**	**Notes**
	Exit inherits from StaticObject and ICollidable	
_collider	private field, Collider	The collider object associated with the exit.
_sourceRoom, _destinationRoom	private fields, Room	The source and destination rooms associated with the exit.
_direction	private field, Direction	The direction of the exit.
Exit	public constructor, parameters Point2D position, double width,	Used to create a new exit.

	double height, Bitmap sprite, Direction direction, Room sourceRoom, Room destinationRoom	
Collider	public readonly property, returns Collider	Used to retrieve _collider.
Collide	public method, parameter Collider c	Defines the exit’s behavior on collision with another object.

Table 13: Interactable abstract class details

Responsibility	**Type Details**	**Notes**
Interactable inherits from StaticObject		
_range	private field, double	The range within which the object can be interacted with.
Interactable	public constructor, parameters Point2D position, double width, double height, Bitmap sprite, double range	Used to create a new interactable object.
IsNearPlayer	public method, parameter Player p, returns bool	Determines whether the specified player is within range of the interactable.
IsHoveredOn	public method, parameter Point2D mousePosition, returns bool	Determines whether the mouse is on top of the interactable.
HandleInteraction	public abstract method, returns void	Defines the behavior of the interactable when it is clicked on. Must be implemented by derived classes.

Table 14: Staircase class details

Responsibility	**Type Details**	**Notes**
Staircase inherits from Interactable		
Staircase	public constructor, parameter Point2D position	Used to create a new staircase object.
HandleInteraction	public override method, returns void	Defines the behavior when the staircase is clicked on.

Table 15: Weapon abstract class details

Responsibility	**Type Details**	**Notes**
_damage	private field, int	The weapon’s damage
_attackCooldown	private field, double	The weapon’s attack cooldown in seconds.

Weapon	public constructor, parameters int damage, double attackCooldown	Used to create a new weapon object.
ReadyForAttack	protected method, returns bool	Determines if the weapon is off cooldown for an attack.
IncurCooldown	protected method, returns void	Puts the weapon on cooldown after an attack.
Attack	public abstract method, parameters Point2D startPosition, Point2D target	Attacks the target at the specified location. Must be implemented by derived classes.

Table 16: Bow class details

Responsibility	Type Details	Notes
	Bow inherits from Weapon	
Bow	public constructor, parameters int damage, double attackCooldown	Used to create a new bow object.
Attack	public override method, parameters Point2D startPosition, Point2D target	Defines the bow's attack behavior.

Table 17: Room class details

Responsibility	Type Details	Notes
_gameObjects	private field, List<GameObject>	The list of game objects in the room.
Room	private constructor	Used to create a new Room object. Can only be used inside the Room class.
CreateRoom	public static method, parameters bool hasNorthExit, bool hasEastExit, bool hasSouthExit, bool hasWestExit, returns Room	Creates a normal room. Use this method to create a new room outside the Room class.
CreateEndRoom	public static method, parameters bool hasNorthExit, bool hasEastExit, bool hasSouthExit, bool hasWestExit, returns Room	Creates a room with a staircase that can be clicked on to enter a new floor. Use this method to create a new room outside the Room class.
IsClear	public method, return bool	Determines if a room is cleared of all enemies.
GameObjects	public readonly property, returns List<GameObject>	Used to retrieve the list of game objects in the room.
AddExit	public method, parameters Direction direction, Room destination	Adds an exit in the specified direction that leads to the specified room.

Table 18: Floor class details

Responsibility	Type Details	Notes
_rooms	private field, Array of Rooms	A two-dimensional array of rooms in the floor.
_startRoom	private field, Room	The starting room of the floor.
Floor	private constructor	Can only be used inside the class to create a new floor.
CreateFloor	public static method, returns Floor	Used to create a new floor outside the Floor class.
DrawMinimap	public method, parameters double x, double y, Room currentRoom	Draws the minimap showing the floor layout.
StartRoom	public readonly property, returns Room	Used to retrieve the starting room.

Table 19: Game class details

Responsibility	Type Details	Notes
CurrentGame	public static field, Game?	The current and only running game instance.
_window	private field, Window	The game window.
_state	private field, GameState	The state of the game.
_floor	private field, Floor	The current floor object.
_floorCounter	private field, int	The current floor number.
_currentRoom	private field, Room	The current room the player is in.
_objectsOnScreen	private field, List<GameObject>	The list of game objects currently on the screen.
_player	private field, Player	The active player.
Game	private constructor	Used to create a new Game instance from inside the class.
CreateGame	public static method, returns Game	Creates and returns a new Game instance if there is none, otherwise returns CurrentGame.
Run	public method, returns void	Runs the game loop, which consists of: handling inputs, updating the game logic, handling collisions, and drawing objects.
CleanUp	public method, returns void	Cleans up the resources loaded for the game.

LoadResources	private method, returns void	Loads the game resources.
HandleInputs	private method, returns void	Handles the user’s inputs.
Update	private method, returns void	Updates the game logic.
HandleCollisions	private method, returns void	Handles collisions between game objects.
Draw	private method, returns void	Draws game objects onto the screen.
AddGameObjectOnScreen	public method, parameter GameObject gameObject, returns void	Used to add a game object onto the screen (e.g., a projectile).
EnterRoom	public method, parameters Room room, Direction enterDirection, returns void	Enters the specified room from the specified direction.
CurrentPlayer	public readonly property, returns Player	Used to retrieve the active player.
EnterNewFloor	public method, returns void	Creates and enters a new floor, incrementing the floor number.
ResetGame	private method, returns void	Resets the game after the player has died.

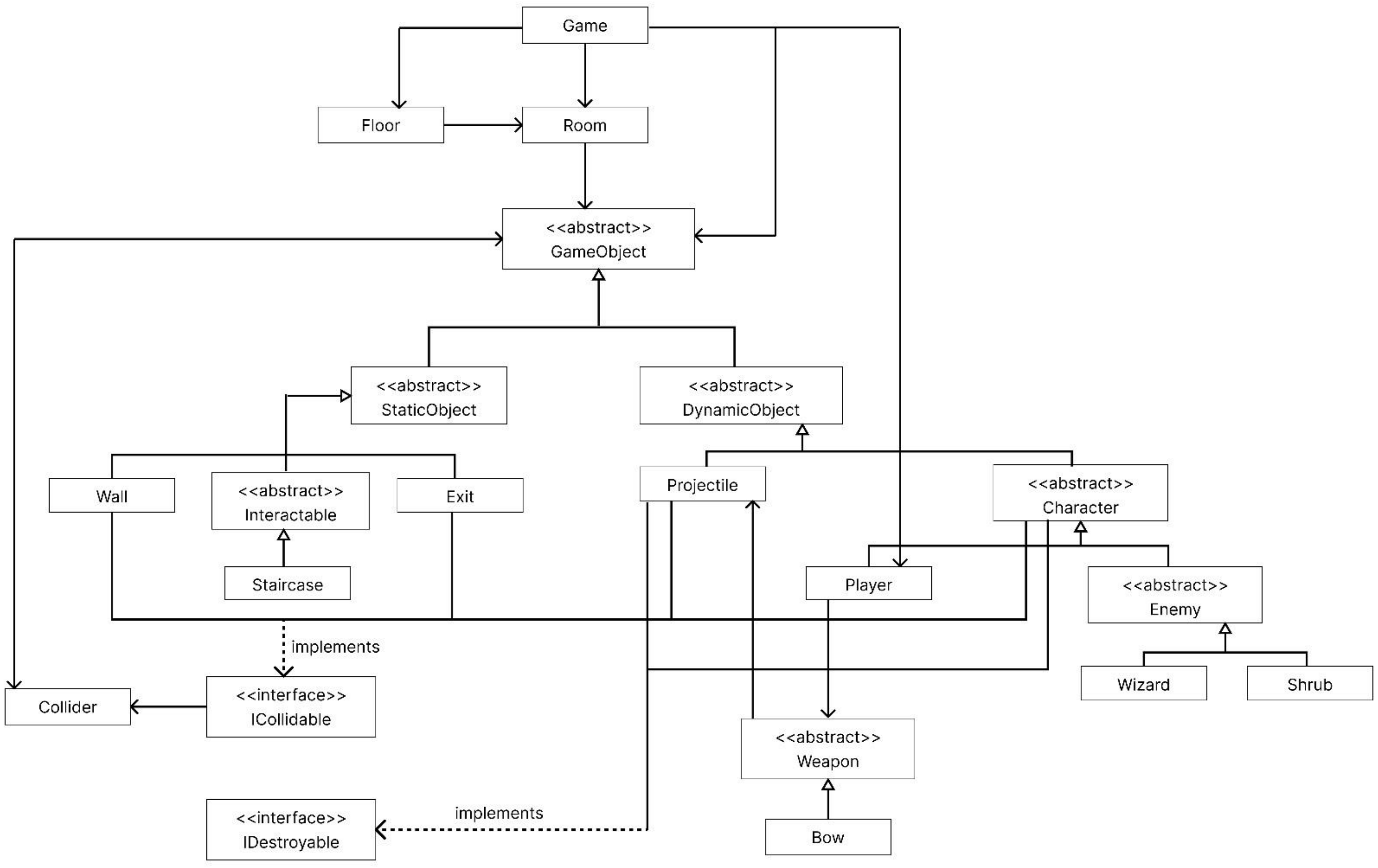
Table 20: Direction enumeration details

Value	**Notes**
North	Cardinal directions of exit gates.
East	
South	
West	

Table 21: GameState enumeration details

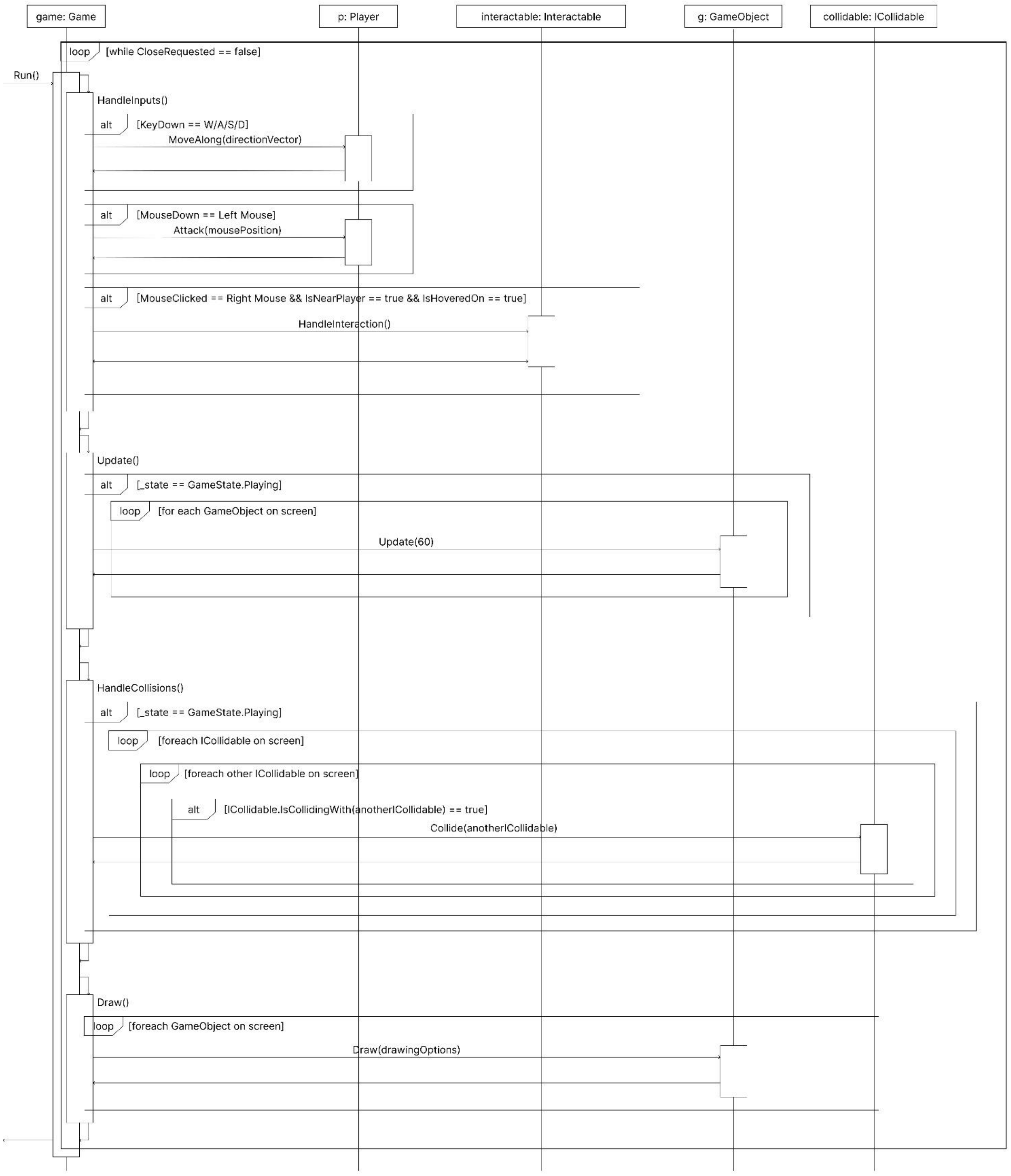
Value	**Notes**
Playing	The player can press ESC to pause/unpause.
Paused	
Lost	The game state is Lost when the player’s health reaches 0.

Class Diagram



The program's class diagram. Details of the classes and interfaces are shown in the previous section.

Sequence Diagram



game: Game
p: Player
interactable: Interactable
g: GameObject
collidable: ICollidable
loop [while CloseRequested == false]
Run()
HandleInputs()
alt [KeyDown == W/A/S/D]
MoveAlong(directionVector)
alt [MouseDown == Left Mouse]
Attack(mousePosition)
alt [MouseClicked == Right Mouse && IsNearPlayer == true && IsHoveredOn == true]
HandleInteraction()
Update()
alt [_state == GameState.Playing]
loop [for each GameObject on screen]
Update(60)
HandleCollisions()
alt [_state == GameState.Playing]
loop [foreach ICollidable on screen]
loop [foreach other ICollidable on screen]
alt [ICollidable.IsCollidingWith(anotherICollidable) == true]
Collide(anotherICollidable)
Draw()
loop [foreach GameObject on screen]
Draw(drawingOptions)

This sequence diagram shows how the game loop works. The Run method of the Game instance is called to initiate the game loop. The loop terminates when the user closes the game window.