Architecture

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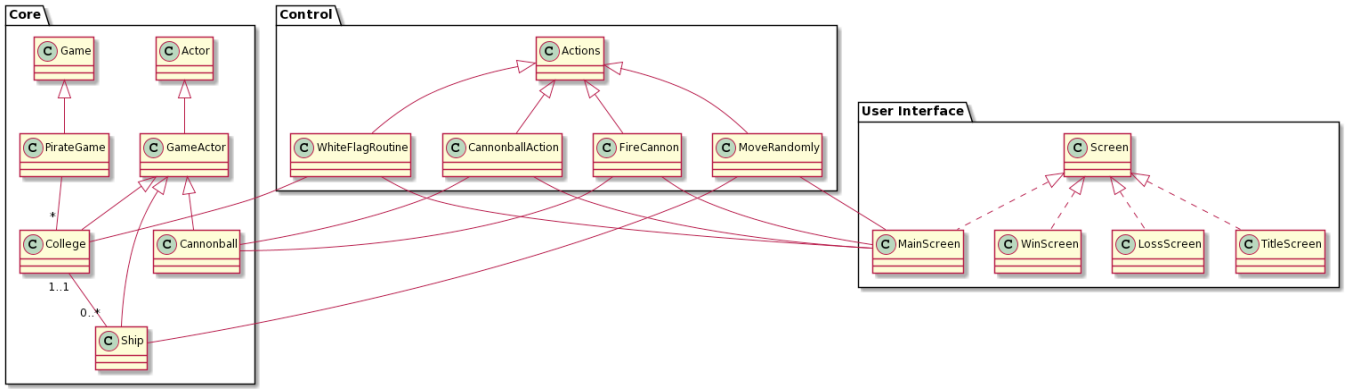
Overview

This document presents the architecture, which is based on an underlying Unified Modeling Language (UML) model developed using `plantuml.com`. Our design decisions were carefully thought out and refined by comparing other existing pirate games. We started with an abstract architecture using a package diagram, then went into more detail about the classes and relationships between them.

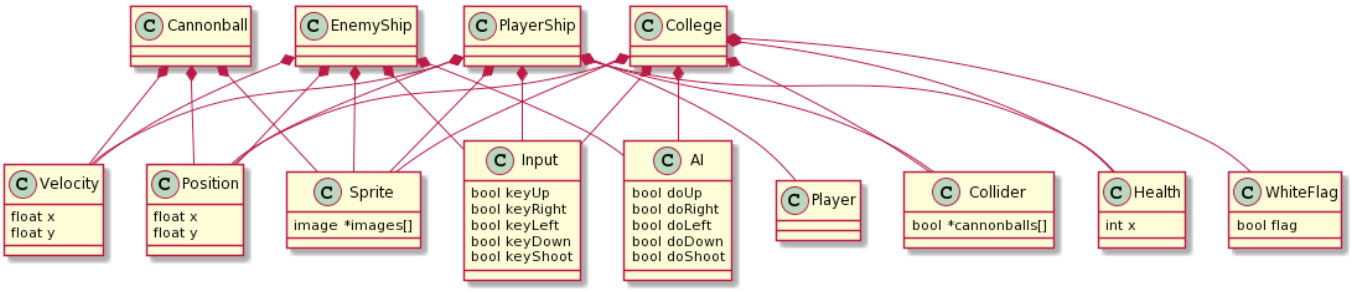
The architecture of this game will be based on three layers: `Core`, `Control` and `User Interface`. The package diagram below represents a low level view of how the layers interact.



The three game objects college, ship and cannonball are each initialized with at least one class from `Control`. The actions in the `Control` layer control what is displayed on the main screen.

Game logic

The game entities are the `Ship`, `College`, each of which can be associated with the Player or Enemy. Below is an entity-component diagram which shows what the data structures each object has.



- PlayerShip (Sprite, Input, Player, Position, Velocity, Health, Collider)
- EnemyShip (Sprite, Input, AI, Position, Velocity)
- College (Sprite, Input, AI, Position, Health, Collider, WhiteFlag)
- Cannonball (Sprite, Position, Velocity)

Systems

- Render (Sprite, Position) - Draws sprites at a position
- Movement (Position, Velocity) - Modifies direction of ship based on key pressed and updates x and y coordinates by the velocity
- PlayerControl (Input, Player) - Sets the player ship input according to keyboard controls: WASD to control movement and spacebar to shoot

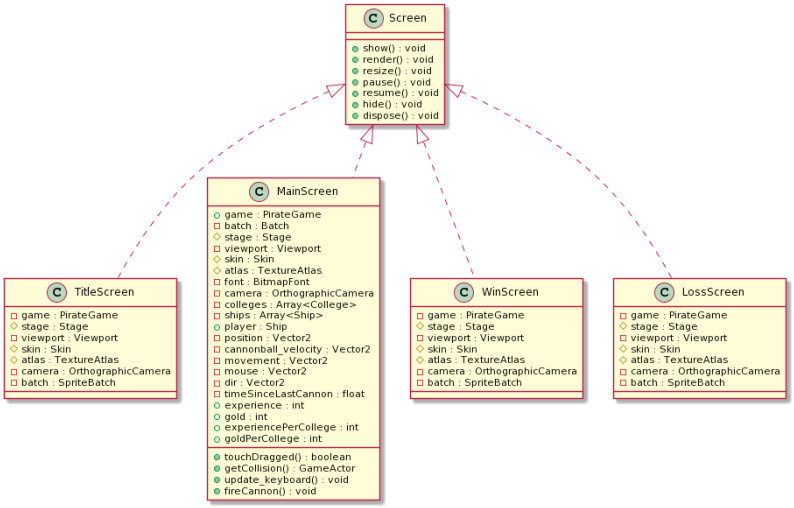
- Defeat (Health, WhiteFlag) - Sets college white flag when it is defeated (health is at 0)
- BotControl (Input, AI) - Set the enemy entity's input according to an AI agent
- PlayerVelocity (Velocity, Experience) - Speed of player ship is determined by some function of the experience value
- Damage (Collider, Health) - If the player ship or a college is in contact with a collider (cannonball), then modify its health value.

Concrete architecture

All the classes either implement or extend an existing class from libGDX namely Screen, Actions, Game and Actor. Where relevant, a static perspective of the class and its functions are shown.

User interface

There are four screens in total, which implement the class Screen from libGDX, which already contains the methods we need. The following represents the class diagram for the graphical user interface.



The title screen view is displayed at game start, and when the game is escaped. It gives access to the following actions:

- Play (which sets screen to `MainScreen`)
- Quit (which exits the game)

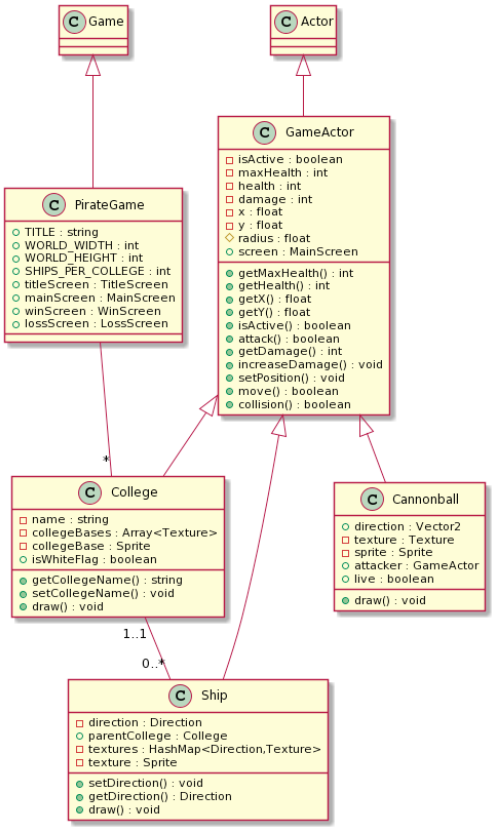
The main screen is where the game takes place. Stats such as health, experience and gold and viewable at a corner of the screen. Additionally, keyboard inputs are recorded and trigger ship movement or a cannonball to fire.

- `Esc` exits the game and displays `TitleScreen`

When the game ends, either `WinScreen` or `LossScreen` is displayed with a message. It gives access to the following actions:

- Play Again (which sets screen to a new instance of `MainScreen`)
- Quit (which exits the game)

Core



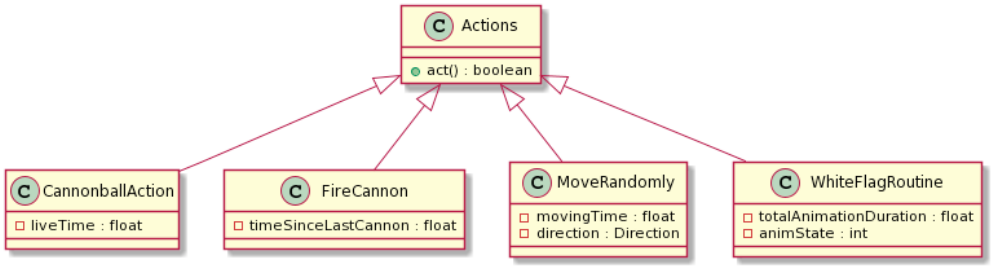
- PirateGame is initialized with four screens (`TitleScreen`, `MainScreen`, `WinScreen`, `LossScreen`) and sets the current screen to `TitleScreen`.
- Each game object College, Ship, and Cannonball inherit from a custom class `GameActor`. Very simply, initialization sets up "per instance" member variables and loads "per class" textures as seen in the diagram. Moreover, each game object will have at least one action (from the `Control` layer).

As an example, the college Class is initialized with the action `FireCannon`. When it is defeated, the action `WhiteFlagRoutine` is added.

```
Function CCollege::College
    Function: Performs initialization of the college object. Adds action
FireCannon.
    Inputs: MainScreen, String
    Outputs: None
    Returns: None

Function CCollege::attack
        Function: Attacks the college and deals damage, where the magnitude of
the damage is set by the input value. Adds action `WhiteFlagRoutine` when the
health reaches 0.
        Inputs: Integer
        Outputs: None
        Returns: None
```

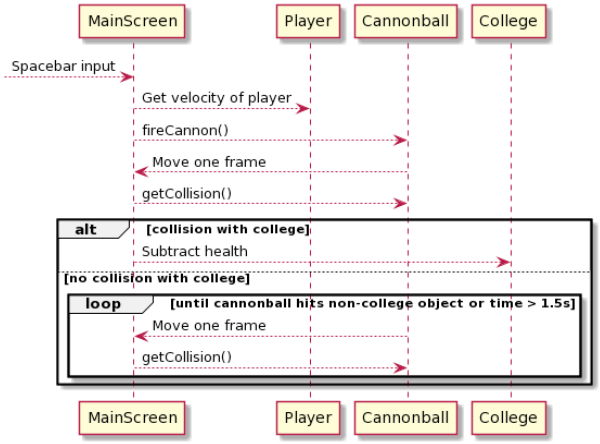
Control



- `CannonballAction` moves the cannonball and checks for a collision on the screen (using the `MainScreen` method `getCollision()` which is shown on the User Interface class diagram.)
- `FireCannon` defines the AI input for college combat - it will fire a cannonball at random intervals in the direction of the player ship.
- `MoveRandomly` defines the AI input for NPC ship movement.
- `WhiteFlagRoutine` is added to a college once it reaches 0 health. Then the player is able to either capture or destroy the college.

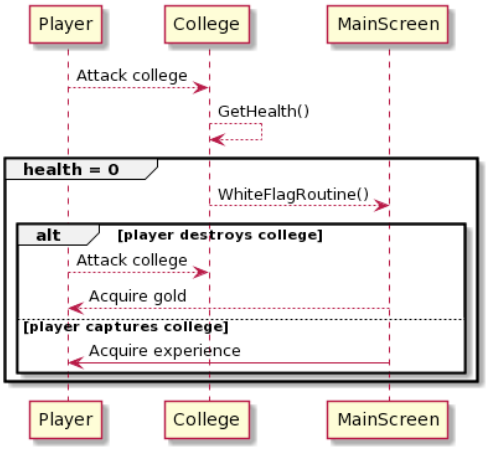
Scenarios

Scenario 1: CollegePlayer combat



- The `MainScreen` class records a spacebar input, which calls the `fireCannon()` method. This method initializes a new cannonball object with `CannonballAction`.
- A cannonball is spawned and is set moving towards its target. If a valid GameActor (player ship, college) is hit, then damage is applied.

Scenario 2: CollegeDefeat



- College health reaches 0 after sufficient cannonballs have been fired at it. A white flag is acquired by the college.
- If the player attacks it within the next 10 seconds, the college is destroyed and the player acquires gold.
- If it is not attacked, then it will be captured (join the player's college) and the player acquires experience.

Architecture justifications

Requirement	Architecture justification
`UR_FAIRNESS`	Four enemy colleges to destroy - this will not take too long or be too difficult. For consistency between replays, attributes such as ships per college and the number of colleges are constant.
`UR_CLEAR_GRAPHICS`	Similar to above, we chose four enemy colleges, to prevent over-crowdedness on the map.
`UR_EASY_TO_UNDERSTAND`	For convenience and easy playability, the gameplay and controls are on the title screen rather than adding an Options menu.
`FR_START_SCREEN`	There is a `Play` button on the `TitleScreen` to start the game.
`UR_CONTROLS`	Input controls use the WASD and spacebar keys
`UR_SAILING`,`UR_COLLEGE_COMBAT`	Controls are used for ship movement and firing.
`UR_COLLEGE_COMBAT`	Colleges will shoot cannonballs at random intervals.
`UR_UPGRADES`	Ship speed increases as experience is gained.
`UR_MUTE_SOUND`	At any point, the sound/music can be toggled with keypress `m`.
`UR_COLLEGE_CAPTURE`	After a college is defeated, they acquire a white flag to indicate it is captured.
`UR_COLLEGE_DESTROY`	After a college is defeated, attacking it will destroy the college to rubble.
`UR_WIN`	After all colleges are destroyed, `WinScreen` is displayed.
`UR_GOLD`	Gold is acquired by destroying enemy colleges.

Note that the view is at a 45 degree angle. Visually, each college and their ships can be identified by the colour of their flag. Due to our choice of angle, and most existing assets using a birds eye view approach, the art is hand-drawn (i.e. ships and colleges).

References

Garlan & Shaw (1994). "An Introduction to Software Architecture"

ISO/IEC/IEEE (2011). "ISO/IEC/IEEE 42010:2011 Systems and software engineering - Architecture description"

Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, Third Edition. Addison Wesley, 2012