CS6.301: Design and Analysis of Software Systems Spring 2020

Assignment-3.1

Released: February 19th Deadline: March 5th

Instructions

- This assignment is designed to get you familiar with object oriented programming (OOPS) concepts. You have to use classes and objects to write good and modular code.

- Submit all your code files and a README.md as a zip file, named as ⟨rollnumber⟩.zip.

- The readme should describe your game, its rules, all the functionalities and any cool features! It must act like a quick start guide, describing all the controls and features.

- The deadline is March 5th, 23:55. This is a hard deadline and no submissions will be accepted after this.

- Start early! This assignment may take fairly long.

- TAs to contact : Bhavyajeet, Koushik, Abhijeeth, Pavani, Alapan

- Plagiarism detectors will be run on all submissions, so please do not copy. If found, you would be given a straight zero for the assignment.

- Please write a **modular** and **extensible** code for this assignment.

Introduction

Ashish is the founder of a clan called proraiders and wants to recruit new members to his clan. However he is very picky and wants all his new recruits to first show their skills at a miniature version of the clash of clans game. Help him by implementing this game so that he can use the same for testing his recruits.

For this assignment, you need to build a 2 D game in Python3 (terminal-based), heavily inspired by Clash of clans where the user will control the king, move it up, down, forward and backward, while destroying buildings and fighting defences on its way. Concepts of object oriented programming must be present within your code and the game must simulate a basic version of Clash of clans .

The objective of the game is to destroy as many buildings as possible, and collect the maximum amount of loot while doing so. There will be an army of troops to help the king clean up.

OOPS Concepts (20):

Your code must exhibit OOPS concepts, that is the main objective of the assignment.

- Inheritance: You could have one building class and have the different kinds of building inherit from the building class.

- Polymorphism: You could have one spell class and override various characteristics to exhibit different properties.

- Encapsulation: The fact that you're using classes and objects should suffice for this! Use a class and object based approach for all the functionality that you implement.

- Abstraction: Intuitive functionality like move(), attack() etc should be methods within the class. So for instance (no pun intended), if you declare an object 'player' of the person class, you can call the methods player.move() and player.attack(), stowing away inner details from the end user.

Game Specifications:

Village (20):

There will be a map of n*m dimensions representing your village level. Each village must have the following properties

- Spawning points:
    - There should be **three** predefined spawning points around the village.
    - Each spawning point will be controlled by a different key. Pressing the key of a certain spawning point will cause a troop to be spawned there.
- Town Hall:
    - The Town Hall is the central building of your village.
    - There is only **one** town hall per village.
    - Size: 4x3 tiles
- Huts:
    - There should be at least **five** huts in your village
    - Size of the hut can be defined by you.
- Walls:
    - There should be a sufficient number of walls in your village to protect your town hall from troops.
    - Size: 1x1 tiles
- At least two cannon
- Cannon:
    - There should be at least **two** cannons in your village.
    - Size can be defined by you.
    - The cannon will have a range and damage value (can be defined by you). The range (must be greater than 5 tiles) would define the area till which it can attack and the damage value should be a number telling the amount of damage it yields to a single troop in a second.
    - At a given point, the cannon can only target a single troop.
- Each building will have a certain amount of hitpoints (basically health) and the remaining hitpoints of the building would be denoted by its colour.
    - The hitpoints of the building should be split into at least **three** ranges, each with a different colour.
        - For example: Green: 50% to 100% hitpoints, Yellow: 20%-50% hitpoints, Red: 0%-20% hitpoints.
    - A building with 0 hit points is considered *destroyed* and should not be displayed on the screen or targeted by troops.

King (20):

The king is a user-controlled character capable of attacking and destroying buildings.

- Controls and Movements:
    - The King is to be controlled with W/A/S/D which correspond to Up/Left/Down?Right.
        - The King's movement speed is left to you to decide
    - <SPACE> will be used for attacks
        - The King will attack a single location with a sword. This location should be specified relative to the location of the king, any building present in that location would be damaged by the king's attack.
- Attributes:

    The values of each of the following attributes can be defined as you wish, the constraints on the values are given below.

    - Damage: The damage each attack of the king deals to a building
        - The damage the king deals should NOT exceed the maximum health of ANY building (i.e. the King can't one-shot anything).
    - Health: The king's health should be displayed as a health bar anywhere on the screen.
        - The health of the king should be higher than the damage dealt by any defensive building.
        - When the health of the king drops to 0, the King would be dead and cannot

move or attack anymore.
- ○ Movement Speed: The distance that the king moves in each time step.

Barbarians (15):

- Each barbarian will have the following attributes
  - ○ Damage - the amount of damage it will yield per attack
    - ■ Every troop attacks once per time step
  - ○ Health - the hitpoints it has - The health of the troop would be depicted by the colour of barbarian … the colour should change from dark to light with a change in health. This shift can be discrete.
    - ■ Once the health of a barbarian drops to 0, they are considered dead and cannot move or attack any longer.
  - ○ Movement speed

- Movement : The barbarians will always try to attack the nearest non-wall building and will always move towards it. The barbarian movement is automated. If there is a wall in its path then the barbarian is expected to first destroy the wall and then move forward.

Spells (5):

- Rage Spell:
  - ○ The Rage spell affects every troop alive in the game and the King.
  - ○ It doubles damage and movement speed.
- Heal Spell:
  - ○ The Heal spell affects every troop alive in the game and the King.
  - ○ It increases their health to 150% of the current health (capped at the maximum health)

Game Endings (5):

- Each game can end in either victory or defeat.
  - ○ Victory: All buildings (excluding walls) have been destroyed.
  - ○ Defeat: All troops and the King have died without destroying all buildings.
- Once either of these conditions is satisfied, the game would end.
- You are required to display the result of the game once it ends.

Replay (15):

- Implement a replay feature for all attacks. Any game that has been played should be available as a replay.

Bonus

- King's leviathan axe: the king instead of attacking a single building with a sword, now uses an axe to do an AoE (Area of Effect) attack to all buildings in a specific vicinity. (10 marks)
  - ○ For example: The King when using this attack would deal damage to any building in a 5 tile radius around him.
- Extra marks might be awarded for any other creative feature. (5 marks)
  - ○ You are free to add any features present in the original game or come up with new features of your own.
  - ○ Ensure that the feature uses different logic from what you have implemented in other parts of the game
  - ○ Ensure that the feature does not override or erase any other feature in the game.

Library Usage

• Your game must mandatorily be coded in Python3.

• No curses libraries (like pygame) are allowed. Only libraries allowed are colorama and numpy. In case of any doubts about whether a particular library is allowed, please post it on the Moodle

thread and get it clarified from one of the TAs.

Deliverable

File Structure:

- <Roll Number>
  - README.md
  - game.py: The main game file which will be run to play the game
  - src: folder containing any other code files
  - replays : folder storing the necessary files for the replay
  - replay.py : Python file needed for rendering a replay

A zip file, ⟨rollnumber⟩.zip containing the code files and README. For instance, 2018102022.zip when extracted must generate a folder with the name 2018102022. Inside that folder, all code files must be present. Ensure your code is modular with multiple python files. Please ensure to follow the submission format and submit ONLY .zip files.

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It is your game, make it as creative and fun as you can!

Happy coding 😇

Instructions

- This assignment is designed to extend your previous code from Assignment 3.1.
- Submit all your code files and a README.md as a zip file, named as ⟨rollnumber⟩.zip.
- The readme should describe your game, its rules, all the functionalities and any cool features! It must act like a quick start guide, describing all the controls and features.
- The deadline is April 8ᵗʰᵗ, 23:55. This is a hard deadline and no submissions will be accepted after this.
- TAs to contact : Abhijeeth, Bhavyajeet, Alapan, Khoushik, Pavani.
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Introduction

For this assignment, you need to extend your game from Assignment 3.1. The objective of this assignment is to test how extensible you have written the previous assignment. Provided your code is modular, this assignment should only take you a couple hours to do.

Game Additions:

Troops (30)

For each variety of troop, there should be a limit set on the number of those troops that can be spawned.

- For example: 6 barbarians, 6 archers, and 3 balloons.

For this assignment, you'll need to add **two new troops: Archers and Balloons**. As there are now 3 different kinds of troops, you will need different keys for spawning different kinds of troops in each spawning zone (a total of 9 different keys would need to be allotted for spawning troops)

Archers:

- Archers have the following attributes:
  - Damage:
    - The damage dealt by an archer is **half** the damage dealt by a barbarian.
  - Health:
    - The health of an archer is **half** the health of a barbarian.
  - Movement Speed:
    - The archer has **twice** the movement speed of a barbarian.

- ○ Range:
    - ■ The archer has any range greater than 1 that can be decided by you. The exact value of the range can be defined by you, but it is recommended to set it to be a few tiles larger than that of the cannon.
        - ● The archers' attacks work similarly to the cannon.
- ● Archers can attack OVER walls and buildings. I.e. They can attack anything in their range regardless of whether their path to the target is blocked or not.
- ● Movement: The archers move similarly to barbarians, they will find the nearest non-wall building and move to attack it. In case a wall appears in their path to the building, they are required to destroy the wall and proceed.

Balloon:

- ● The Balloon will be an **aerial** troop, i.e. walls and buildings do not affect its movement and certain defensive buildings can't attack it.
- ● Balloons have the following attributes:
    - ○ Damage:
        - ■ Balloons will deal *twice* the damage dealt by barbarians.
    - ○ Health:
        - ■ Balloons will have the same health as the barbarians.
    - ○ Movement speed:
        - ■ Balloons will have *twice* the movement speed of barbarians.
- ● Balloons attack differently from Barbarians, instead of targeting *any* non-wall building, Balloons will **prioritize attacking defensive buildings** (Cannons and Wizard Towers). Once all defensive buildings are destroyed, Balloons will then move destroying other non-wall buildings (choosing to attack the nearest one, similar to barbarians).
- ● Movement: Balloons can **fly over walls and other buildings**, i.e. once they select a building to attack, they can move to said building without caring about the presence of walls or other buildings in their path.

Archer Queen (25)

The Archer Queen, similar to the King, is a user-controlled character capable of attacking and destroying buildings.

- ● Controls and Movements:
    - ○ The Archer Queen is to be controlled with W/A/S/D which correspond to Up/Left/Down/Right.
        - ■ The Archer Queen's movement speed should be the same as the King's.
    - ○ <SPACE> will be used for attacks
        - ■ The Archer Queen will attack a distant AoE location with a volley of arrows. This location should be specified relative to the location of the queen, any building present in that location would be damaged by the queen's arrows.
        - ■ The AoE location should be a **5x5 area** whose center is **8 tiles away** from the queen's location in the **last-moved direction** of the queen.
            - ● In case you are using ASCII art to represent the queen, you may select a reference point within the queen's avatar to measure distance from.
- ● Attributes:

    The values of each of the following attributes can be defined as you wish, the constraints on the values are given below.

    - ○ Damage: The damage each attack of the queen deals to a building
        - ■ The damage the queen deals should be less than that of the King.
        - ■ The damage the Queen deals should be less than that of the King.
    - ○ Health: The Queen's health should be displayed as a health bar anywhere on the

screen.
- The health of the queen should be higher than the damage dealt by any defensive building.
- When the health of the queen drops to 0, the queen would be dead and cannot move or attack anymore.
    - Movement Speed: The distance that the queen moves in each time step.

As there are now two playable characters, you must allow the user to **choose which character** (The King or The Archer Queen) they would like to play as before the start of the game.

Buildings (20)

You are required to include **closely-packed buildings** as part of your village layout in order to test the AoE damage of the Archer Queen.

The cannon cannot attack aerial troops

You are also required to add a new building, the wizard tower.

Wizard Tower:

The wizard tower has the following characteristics and attributes:

- There should be at least **two** wizard towers in your village.
- The Wizard Tower **can attack aerial troops**.
- Size: can be defined by you.
- Range: Same as cannon.
- Damage Value: same damage as the cannon.
- At a given point, the wizard tower can only **target a single troop**.
- The wizard tower deals **AoE damage in a 3x3 tile area around the troop it is attacking**.
    - In case you have many troops stacked on one another, if the wizard tower were to target and attack one of them, all of them would take damage due to the AoE damage of the wizard tower.

Level (25)

You are required to implement a level system with **three** levels. For higher levels, the number of cannons and wizard towers should increase.

- For example:
    - Level 1: 2 cannons and 2 wizard towers
    - Level 2: 3 cannons and 3 wizard towers
    - Level 3: 4 cannons and 4 wizard towers

Each level will inevitably have different layouts (due to the differing number of buildings). You are free to design the levels as you wish (within the regulations above and those described in Assignment 3.1).

The troop limit will reset for each level.

Bonus:

Movement Avoiding Walls (15):
For this bonus you would need to write an alternate movement algorithm for all troops. Instead of choosing the previously described movement algorithm, the troops would move as follows:

- The troops would **avoid destroying walls** whenever possible. I.e. provided there is a path that they can take such that they do not need to break a wall, they will take that path regardless of how long the path is.
- This change does not affect balloons as they are not stopped by walls.
- Archers can still **attack over walls**, but if they need to destroy a wall to reach a certain place they will first search to see if there is a path they can take without destroying a wall.\

The Archer Queen's Eagle Arrow (15):

For this bonus you would need to implement an additional attack for the queen. NOTE: This does **NOT** replace the original attack of the queen but would be an additional attack that the queen can use. You would need to dedicate another key for this attack.

In this attack, the Archer Queen launches a volley of arrows high into the air attacking at a greater range and AoE. The arrows reach the ground **1 second after being shot**, dealing damage to all buildings in the AoE.

The damage dealt by this attack is the same as the Queen's original attack, but the tiles being attacked are different. The Queen now attacks a **9x9 tile area** at a **distance of 16 tiles** from the queen. The direction and distance calculations are done similarly to the queen's original attack.

Library Usage

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