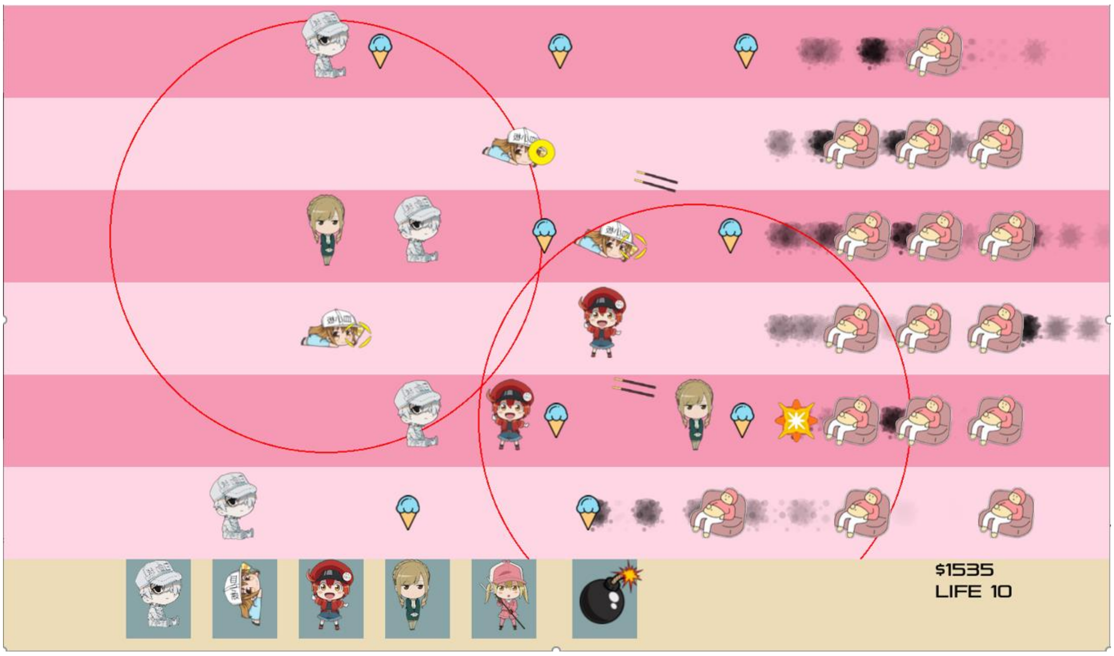
MiniProject #2

Tower Defense Game

Due: 2020/06/06 (Sun.) 23:59

Problem Description

Read the source code and finish the implementation of the completed Tower Defense game.

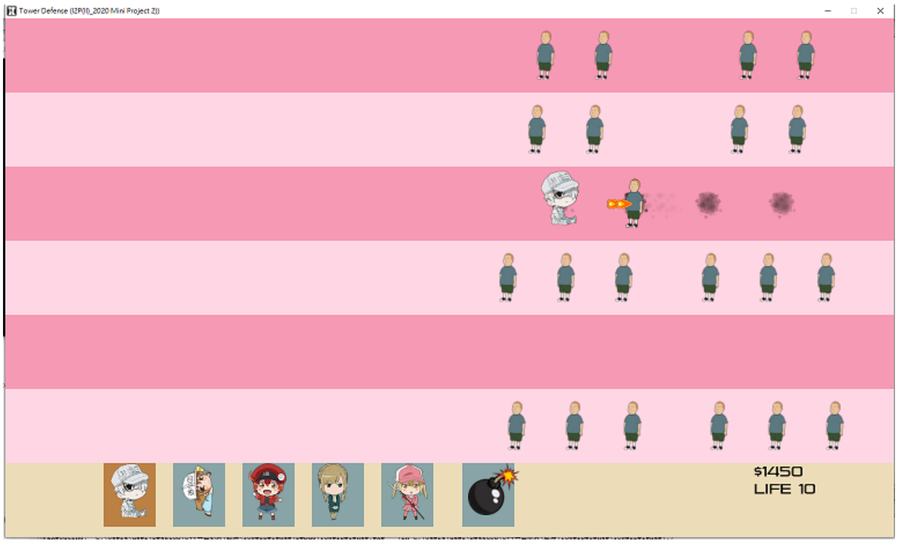


In the playing scene, press key 0-9 to change the speed multiplier; press Q, W, E to perform quick select on different turrets; click on the empty spaces in the map to place the selected turret; press TAB to swap to debug mode. If you finished the requirement of the hackthon, then the functions should be work.

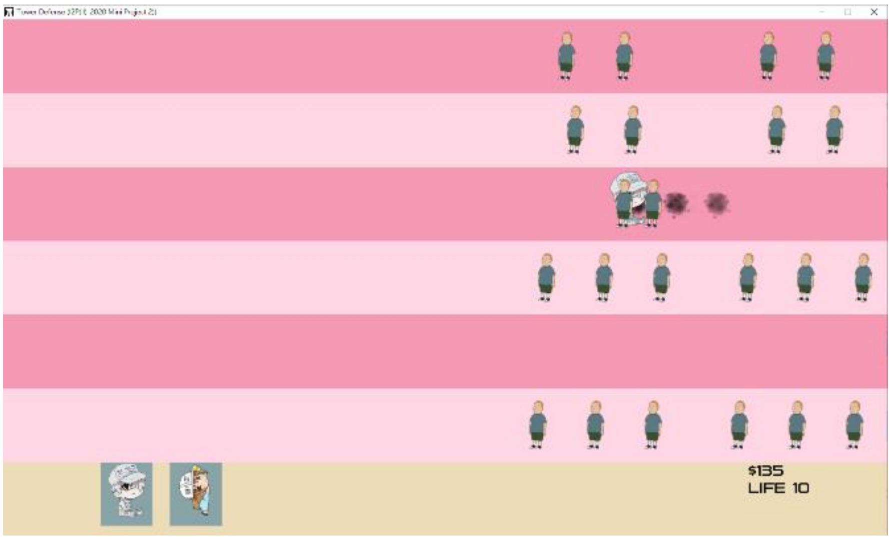
Coding Requirements (Finish the Game)

1. Add HP to the turrets. (1.5%)
   a. Every turret can be destroyed by enemies.
   b. The enemies shoot bullets to attack the turrets in the same lane. The bullets of enemy can't reach other turret, they should stop at the turret that is attacked.
   c. Each turret needs to have the same explosive effect as the enemy.
   d. The enemies should stop when they meet the turrets in the same lane. If the turret is destroyed then enemies can pass.

Enemy stop and shoot

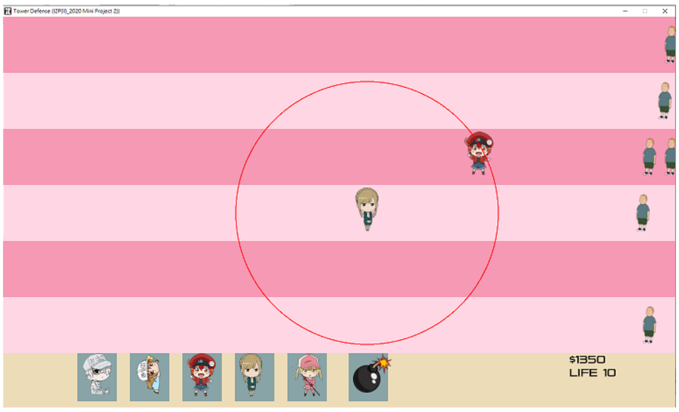


This is wrong when enemy pass the turret

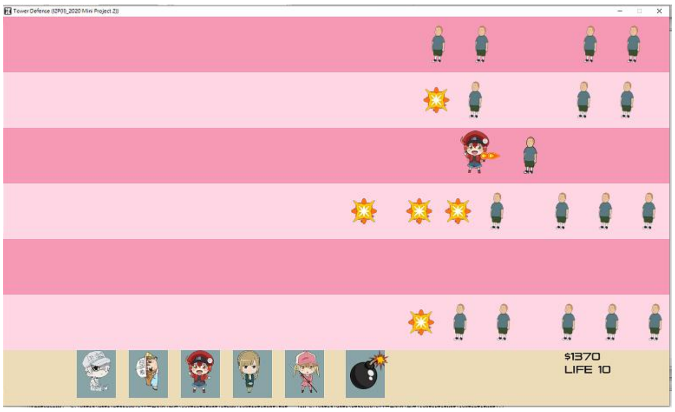


2. Add a new turret. (0.5%)
   a. Add a new turret that can be placed and won't attack enemies.
   b. The turret can be destroyed by enemies.
3. Add a new turret. (1%)
   a. Add a new turret that can be placed and won't attack enemies.
   b. The turret has only 1 hp.
   c. The turret will ruin the enemies that are in a fixed distance when the turret is destroyed.
   d. The distance should be marked in the map.

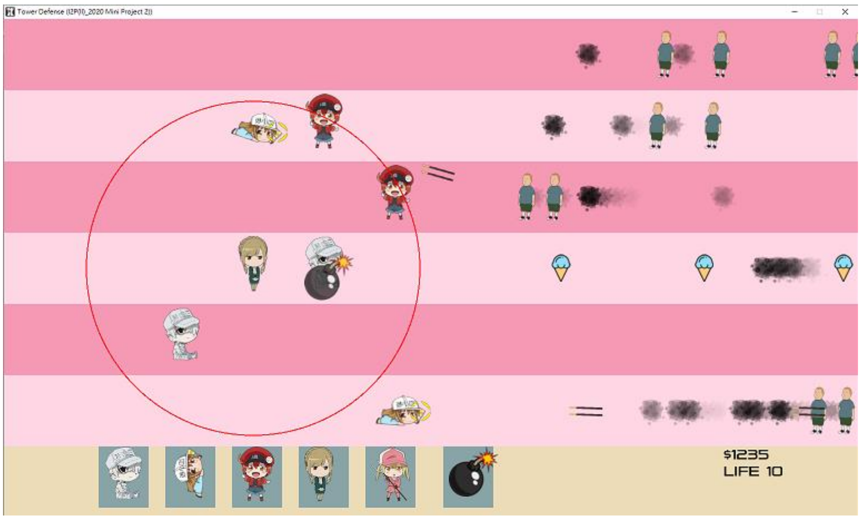
The explosion distance of the turret

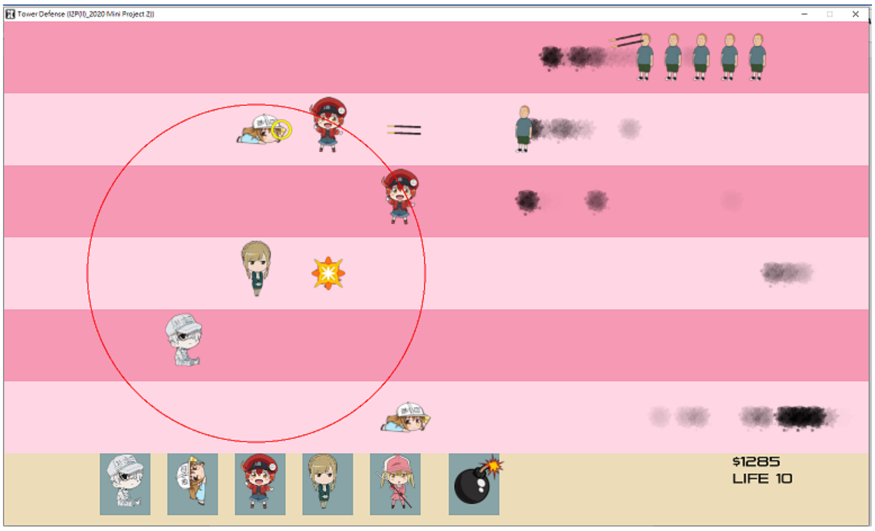


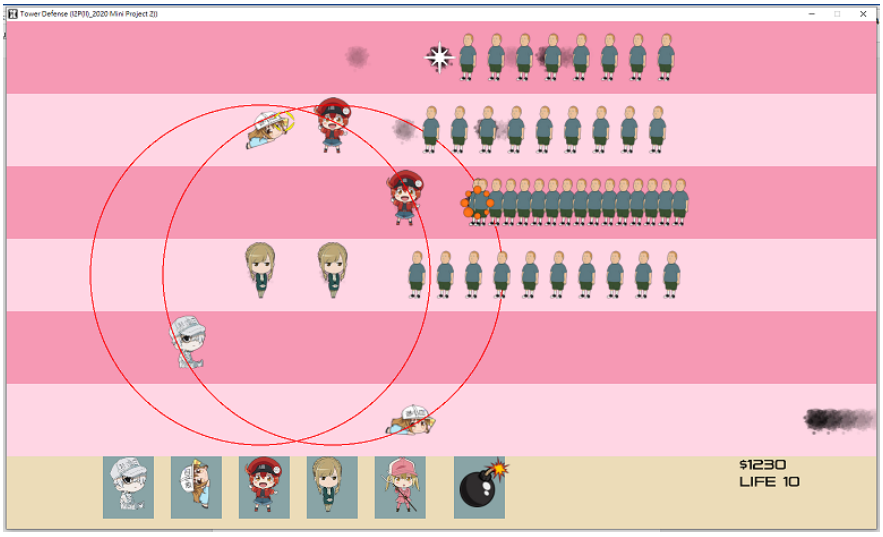
The turret ruin the enemies that are in a fixed distance when it is destroyed



4. Add a new function button. (1%)
   a. This function button can clear the turret that I don't need it.
   b. I can place other turret when the turret is removed.
   c. If It click the object that is not the turret and it won't have any other effect.
   d. It should act as other turret button(such as the image showed below, there is an image moving along with the mouse).







5. Do extra functions that are not mentioned in the above. (Bonus) (1%)
   Please use your creativity to do what you want. If you don't have any idea then you can implement in the following:

   EX1: Create a boss that every turret can fight with it.

   EX2: Create a new type of enemy, they will enter our base with their unique path, and this path is not directly from right to left.

Questions

If your answer is ambiguous during the demo, TA will ask more details regarding that question to validate your understanding. If the TA cannot understand what you wish to convey, the scores are graded subjectively by the TA in terms of your performance.

A. **Easy Questions** (0.5%)

1. Explain the concept of "Encapsulation". Show a short code snippet to illustrate why "Encapsulation" is useful and what might happen if we do not use it.

2. Explain the concept of “Inheritance”. Show a short code snippet to illustrate why “Inheritance” is useful and what might happen if we do not use it.
3. Explain the concept of “Polymorphism”. Show a short code snippet to illustrate why “Polymorphism” is useful and what might happen if we do not use it.
4. What is the difference between Procedural Programming and Object-Oriented Programming? Name at least three advantages of OOP.
5. In what condition should we call the base class function from a derived class function? In what condition can we omit the call? Elaborate them on the constructor, deconstructor, and other general overridden virtual functions
6. How does it feel to add a new object (e.g. Scene, Button, Turret, Enemy, …) in OOP style instead of Procedural Programming style? In your opinion, which coding style is better?
7. The game crashes when an enemy reach our base. What tools and techniques did you try to find the bug? Why does the bug crash the game? What have you learned through this debugging experience?
8. When there are a certain number of enemies in the “danger zone”, the speed multiplier is forced to be lower than one and an intense BGM starts playing. What is the filename of the BGM? What will happen to the intense BGM if the player gets through the current crisis but immediately encountered another crisis?
9. When will the function main return the exit value zero?

B. **Medium Questions** (0.5%)

1. How does the game parse the file containing the map and the file containing the enemy sequence? How are the enemies generated according to the timer ticks?
2. What did the template do to achieve different speed multipliers? When the speed multiplier is zero, can the player build new turrets? Why or why not?
3. In the Play scene, multiple Engine::Groups are used for storing different objects. What will happen if we remove the groups and add all new objects directly into the scene?
4. The public change scene function of Engine::GameEngine does not change the scene immediately but waits until the next update. What might happen if the scene is changed immediately when the public function is called?
5. There is a deltaTime parameter in the update function, what are the benefits of using this parameter? What might happen if we remove the

threshold of this parameter in Engine::GameEngine?

6. In Engine::Group, there are two linked-lists, storing objects and controls respectively. Can we simplify this into a single linked-list? What are the advantages and disadvantages of storing them in different linked-lists?
7. Engine::Group is a class derived from Engine::IObject, while storing a linkedlist of pointers to many Engine::IObjects. Why do we store the pointer to Engine::IObjects instead of directly storing the value of Engine::IObjects.
8. Can we put all members in the Engine::Sprite class into Engine::Image class to combine them into a single class? What are the pros and cons of separating them?
9. In Win scene, the code allocates space by the new statement but does not delete them in the same file. Is this a memory leak issue? Why or why not? If the memory leakage issue exists, how can we fix it?

C. **Hard Questions** (1%)

1. What is Memory Leak? Can the invention of Smart Pointers reduce this problem? How are Smart Pointers implemented and what are the benefits of using them? Elaborate on the difference between std::unique_ptr, std::shared_ptr, and std::weak_ptr.
2. Many high-level languages forbid the usage of raw pointers. Does it mean that raw pointers are deprecated in this day and age? Come up with three situations when raw pointers are necessary.
3. Garbage Collection is a clever concept introduced in Lisp and become widely popular in higher-level programming languages such as Java, C#, Python. What does the code in Engine::Resources do? What are the benefits and drawbacks of automatically managing the resources?
4. Crash Reports are designed to send logs with detailed information to the developer, allowing them to analyze and prevent the program from crashing again. If you want to implement such a system, how can Engine::LOG help?
5. Try-Catch statements can intercept the error thrown by the inner code. Why are Try-Catches preferred instead of error codes in modern programming? List out five advantages of the Try-Catch statement.
6. There are multiple std::binds and std::functions in the template code. What are them for? How do they work? Also, elaborate on the difference between a normal function pointer and a member function pointer.
7. Factory Method can be seen as a virtual constructor while Template is a feature for classes to deal with generic types. Which concept suits better to

simplifying the instantiation of different turrets? Furthermore, which of them can achieve constructing and deconstructing each scene on scene change? (In the current template we keep a single instance of each scene for simplicity)

Program Submission

1. Please use Allegro & C++ to finish the game.
2. Your source file must be named as "<Student>_project2.zip" and please make sure that all characters of the filename are in lower case. For example, if your student id is 109062000, the name of your program file should be 109062000_project2.zip. Error file name -1%.
3. Please only include the ".cpp" files, ".hpp" files and the resources in the zip file.
4. 0 points will be given to Plagiarism . NEVER SHOW YOUR CODE to others and you must write your code by yourself. If the codes are similar to other people and you can't explain your code properly, you will be identified as plagiarism.

Question

1. Please fully understand this package. TA will randomly choose questions from three part and you will be asked in the demo of MiniProjetc2.

Grading Policy

1. The project accounts for 9 points of your total grade
2. You must submit your source code. Remember the submission rules mentioned above, or you will be punished on your grade. No late submission is allowed.
3. The bonus score for the bonus questions can exceed the total 9 points.

●	Hackthon	+3.6 points
●	Miniproject2	+5 points
●	Questions	+2 points