

**Deadline: Wednesday, April 27, 2022 by 11:59pm**

**Early turn in bonus deadline: Monday, April 25, 2022 by 11:59pm**

In this homework, you will add new functionality to the asteroids game written by Fam Trinli (<https://www.youtube.com/watch?v=rWaSo2usU4A>). This program requires understanding of everything that we have learned in object-oriented programming including dynamic memory allocation, standard template library objects, object composition, inheritance, and polymorphism.

**IMPORTANT:** Please do not to add your `cmake-build-debug` or `.idea` directories or `.wav` files to SVN. You *should* still add your `cmake_modules` folder and its `FindSFML.cmake` file.

**IMPORTANT:** You must have permission to use any fonts, sounds and/or images that you use in your programs. This means that you need to cite where you got the work, whose work it is, and the license saying that you can use it. You should go to one of the many web sites with free material and cite the permission that they grant you to use their work.

**Part 1. [40pts]** Copy the `hw7` folder from the Public directory and paste it into your homework folder within your HawkID directory. Add comments to each block of code and variable to help you understand what the program is doing. You should reformat the code to make the program easier to read, i.e., you should add curly braces to if-statements and for-loops. You do not have to create setter and getter functions for class member variables for given classes unless you want to. You do not have to make member variables for existing classes private unless you want to.



**Part 2. [30pts]** Use polymorphism and inheritance to make a new UFO class.

- a. This class will inherit functionality from the **entity** class similar to the **asteroid**, **bullet** and **player** classes. At a minimum, you must define the constructor and update methods of the UFO class.
- b. The UFO object should appear on one edge of the screen and fly at a constant horizontal speed to the other edge. You may make the UFO starting position and direction constant or random. It is your choice.
- c. Your program should make a sound warning the player when the UFO is on the screen.
- d. You will need to find a free picture to use for the UFO (e.g., [www.flaticon.com](http://www.flaticon.com)). You must acknowledge in your code the source of the picture and follow its licensing rules.
- e. You will need to find a free sound to use for the UFO (e.g., [freesound.org](http://freesound.org)). You must acknowledge in your code the source of the sound and follow its licensing rules. The sound should be in `.ogg` format (no `.wav` files) and be no larger than 30kB.
- f. The UFO should explode if hit by a bullet. Both the UFO and bullet should be scheduled to be deleted and the UFO sound should stop.
- g. The UFO should explode if hit by the player. The UFO should be scheduled to be deleted and the UFO sound should stop. The player should be moved to the center of the window as just like it hit an asteroid.
- h. There should never be more than one UFO on the screen at the same time. UFO sightings are rare so some time should pass before the first UFO is seen and some amount of time should occur between UFO sightings. (See Part 3 below to find the place in the code to modify to spawn a UFO object.) **IMPORTANT: Don't make the pauses too long or else the TAs won't see the UFO when they grade your homework.**

**Part 3. [30pts]** Modifying the number of asteroids.

- a. Find the block of code that randomly adds asteroids to the game. Comment this block of code out so the number of asteroids decreases as they get blown up. Note, that this is the place in the code where you can create a new ufo instead of a new asteroid. You can either modify this code to spawn new ufos or get ideas how to spawn new ufos.
- b. Add a static count member variable to the asteroid class. This variable will keep count of how many asteroids are currently instantiated. Look at the lecture slides on ICON to see how to use a static count variable to keep track of the number of objects instantiated. This topic is also touched on in Sec. 8.18 of the textbook.
- c. You will need to modify the asteroid class constructor to increment the count when an asteroid is created.
- d. You will need to create an asteroid class destructor to decrement the count when an asteroid is deleted.
- e. When all the asteroids are destroyed, your program should create 15 new asteroids in a similar way to how the original 15 asteroids were created.

**Part 4. [Up to 20pts Extra Credit]** Add additional functionality to the program. Examples include: sounds for explosions, bullets, etc.; displaying the score; adding levels; keeping track of lives and displaying game over; adding a high score page; refactoring the code so it is properly formatted and follows best programming practices such as using private member variables, setter and getters, proper indentation with curly braces, modifying constructors to initialize all member variables, properly following the principle of least privilege using public, protected, and private, etc.

 **To get extra credit, you must clearly document at the top of your program in comments what extra you did in your program to deserve extra credit.** 

**Submission Instructions**

You must make a CLion project called "hw7" under your SVN homework directory. Check your homework into SVN.

*Hint: you can see the current version of your submission by opening this link in a web browser:*  
<https://class-svn.engineering.uiowa.edu/cie/projects/spring2022/>