University of Massachusetts Boston



CS460 Fall 2021

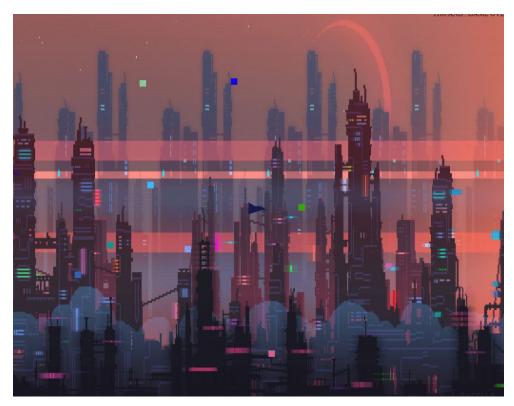
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Assignment 4: A WebGL Game!

WebGL without a framework is hard. But this makes it even more rewarding when we create cool stuff!

In class, we learned how to draw multiple objects (rectangles) with different properties (colors and offset). We also made the rectangles move! In this assignment, we will create a simple but fun video game based on the things we learned. In the game, the player can control an airplane using the UP, DOWN, LEFT, RIGHT arrow keys in a scene to avoid obstacles. The longer the player can fly around without colliding with the obstacles, the more points are awarded. Once the player hits an obstacle, the game is over and the website can be reloaded to play again. The screenshot below shows the black airplane roughly in the center and multiple square obstacles in different colors. The mountains, sky, and stars are a background image that is added via CSS (as always, feel free to replace and change any design aspects).



Starter code: Please use the code from https://cs460.org/shortcuts/16 and copy it to your fork as 04/index.html.

Part 1 Coding: Extend the createAirplane method. (25 points)

First, we need to create the airplane. Take a look at the existing createAirplane method. **This method needs to be extended.** We will use triangles to create a shape similar to the one pictured below. Please figure out the triangles we need and set the vertices array. We can assume that the center of the airplane is 0,0,0 in viewport coordinates. Then, please setup the vertex buffer v_buffer (and remember create, bind, put data in, unbind). There is no need to change

the return statement of the method. This returned array contains the name of the object, the vertex buffer, the vertices, an offset, a color, and the primitive type—the drawing code of the animate method needs this array in this exact order.



Part 2 Coding: Extend the createObstacle method. (25 points)

Now we will extend the createObstacle method. This method creates a single square obstacle. There are different ways of rendering a square but the simplest is to use a single vertex and the gl.POINTS primitive. Make sure that gl_PointSize is set appropriately in the vertex shader! We use 0,0,0 as our vertex and then control the position of the obstacle using the offset vector. Please modify the code to set the x and y offsets to random values between -1 and 1 (viewport coordinates). The color of an obstacle is already set to random and the return statement follows the same order as in Part 1. Once this method is complete, multiple obstacles should appear at random positions on the screen (9 in total as added to the objects array after linking the shaders).

Part 3 Explaining: Detect collisions using the calculateBoundingBox and detectCollision method. (20 points)

In class we learned about bounding boxes. The starter code includes collision detection using bounding box calculation of the airplane and the offset of an obstacle. Please study the existing calculateBoundingBox and detectCollision methods and describe how it works and when the collision detection is happening:

In order to detect collision between two objects. Most of the time you will have to check if the bounding box of the first object is collided with the bounding box of the second objects. So in the code for function calculateBoundingBox we can see that the function calculateBoundingBox takes two parameters which is the vertices and the offset of the airplanes and create an invisible bounding box surround the airplane (and follow the air plane as we pass in the offset value).

Next step is to detect whenever an object is in contact with that bounding box. In order to achieve this, we want to create a function to detect Collision between two objects. The function will check if any objects is in contact or collide with the invisible bounding box (for example: point[0] >= bbox[0]) of the airplane the function will return true when this happens. From this we know that the player (air plane) is collided with another object and stop the game.

Part 4 Coding: Extend the window.onkeyup callback. (20 point)

We want to allow the player to use the arrow keys to move the airplane. Please take a look at the existing window. onkeyup method. The if statement checks which arrow key was pressed. Please extend this method to move the airplane. Hint: Like in class, we just need to set the step_x, step_y values and the direction_x, direction_y based on which arrow key was pressed.

Part 5 Cleanup: Replace the screenshot above, activate Github pages, edit the URL below, and add this PDF to your repo. Then, send a pull request for assignment submission (or do the bonus first). (10 points)

Link to your assignment: https://beshu78910.github.io/cs460student/04/index.html

Bonus (33 points):

Part 1 (11 points): Please add code to move the obstacles! Flying the airplane around static obstacles is half the fun. The obstacles should really move! Please write code to move the obstacles every frame. The obstacles should just move in x direction from right to left to create a flying illusion for the airplane. This can be done with little code by modifying the offsets accordingly at the right place!

Part 2 (11 points): Make the obstacles move faster the longer the game is played! Right now, the game is not very hard and a skilled pilot can play it for a very long time. Currently, the scoreboard updates roughly every 5 seconds. What if we also increase the speed of the obstacles every 5 seconds? Please write code to do so. This can be done in one line-of-code!

Part 3 (11 points): Save resources with an indexed geometry! As discussed in class, an indexed geometry saves redundancy and reduces memory consumption. Please write code to introduce a gl.ELEMENT_ARRAY_BUFFER for the airplane. Of course, we do not need to change anything for the obstacles since a single vertex does not need an index:).