Coms 331 **Assignment 13** **Fall 2019**

Introduction

We have finished implementing the lighting model, including material properties. Now we will begin to create objects, starting with the canal boat. Because of the narrow locks, canal boats needed to be equally narrow. To compensate, they were made very long in order to be able to carry enough cargo.

Our canal boat will have a pointed bow and a square stern. The hull will have vertical sides and a flat bottom. The cabin will be a long rectangular box.

The User Interface

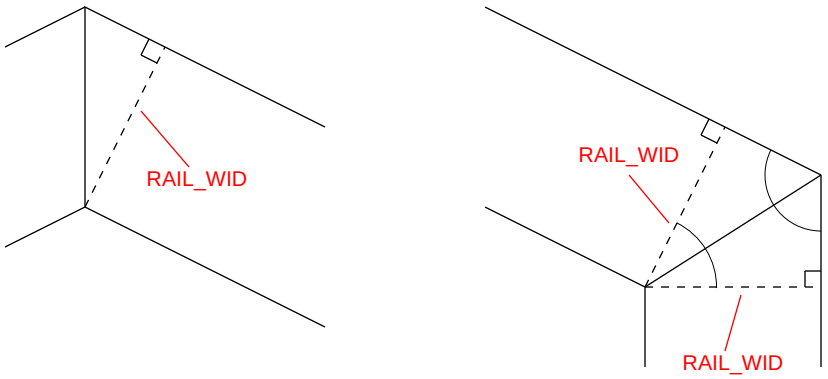
The user interface is the same as in Assignment 12. In the next assignment, we will add mouse controls to replace the arrow keys.

The `Boat` Class

Create a `Boat` class as we did the `Wall` class. The `Boat` class will follow exactly the pattern established in the `Wall` class, except that there will be several components (hull, deck, rail,

cabin) and many more vertices. The diagrams at the end of this document show the design. (You may want to make separate `Hull`, `Deck`, `Rail`, and `Cabin` classes.)

You will need to do some geometric calculations at the bow end of the railing.

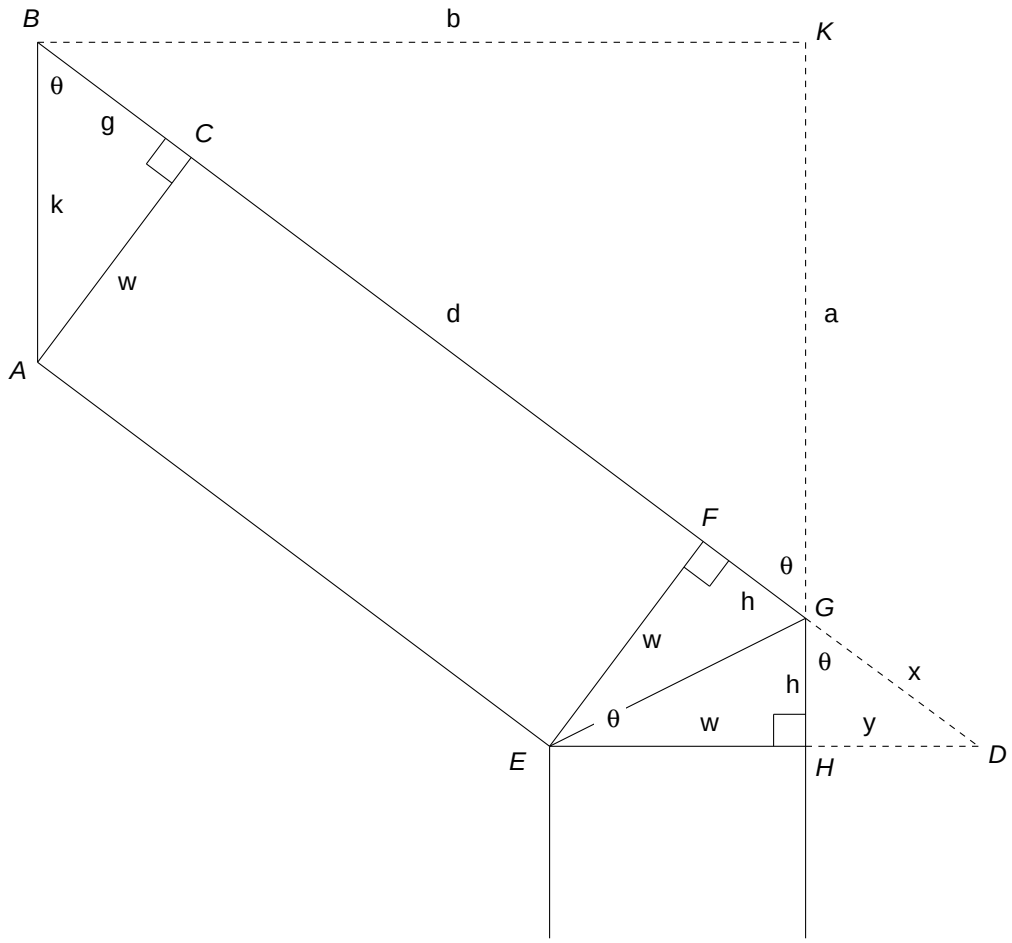


Use similar triangles and the Pythagorean Theorem to calculate the distances from the inside corner of the railing to the outside corner. In each case, that line should bisect the angles formed by the sides of the railing.

Drawing the Objects

You will want to make the cabin, the hull, and the rail different colors, yet it is simpler if we make them all part of the Boat class. To facilitate this, inside the `draw()` function, you can create three different for loops `for` drawing (one half of) the boat. You will need to manually count the number of quads in each part (hull/deck, rail, cabin) and use those numbers to control the `for` loops. Then, right before each `for` look, set the material properties for that part of the boat.

Analysis of the Bow



We need to determine the lengths k and h in order to be able to locate vertices A and E as offsets from B and G. We will use similar triangles. The basic triangle is ΔBGK with sides

$$a = \texttt{BOAT\_BOW\_LEN},$$
$$b = \tfrac{1}{2} \cdot \texttt{BOAT\_WID}.$$

The hypotenuse is d. Now define $r = b/a$ (which happens to be $\tan\theta$). Then the lengths of the three sides a, b, d are in the proportion $1 : r : \sqrt{1+r^2}$.

Applying this to the leg w and the hypotenuse k of ΔABC, we get

$$k = w\left(\frac{\sqrt{1+r^2}}{r}\right).$$

Applying it to the leg w and the hypothenuse $w + y$ of ΔEDF, we get

$$w = \frac{w+y}{\sqrt{1+r^2}},$$

which we can solve for y and get $y = w(\sqrt{1+r^2} - 1)$. Finally, applying the proportions to the legs y and h of ΔGDH, we get

$$h = \frac{y}{r} = w\left(\frac{\sqrt{1+r^2}-1}{r}\right).$$

Due Date

This assignment will be due by Friday, November 8. Place your work (main file, `Wall` class, `Boat` class, and both shaders, and any other classes) in a folder named Assignment 13 and drop it in the dropbox.