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COMP614 - Circles

Python code

The CodeSkulptor file can be accessed using the link here.

Circle Questions

Q1. How will the midpoint, slope, and perp functions help to find the center and/or radius of the circle?

All three functions are used as helper functions in the main function which will help us find the (x, y) coordinates of the center of the circle and its radius.

To understand how we are using these functions, let's first break down how they work.

The midpoint function takes 4 inputs, (x, y) coordinates of each of the two points, and finds the midpoint. We can call this function to find the midpoint of other lines too (like line 2, which passes through point1 and point2).

The slope function calculates the slope of a specific line that passes between two points. We use it twice to calculate the slope of line 1 (point0 to point1) and line 2 (point1 to point 2).

The perp function only has 1 input, the slope of a line, and returns the slope of its perp bisector. So given the slope of a line, this function will calculate the perpendicular bisector of that. We will repeat this process for both to find the midpoints, slopes, and perpendicular bisectors.

Q2. How will the intersect function help to find the center and/or radius of the circle?

The intersect function will calculate the intersection point, which is the circle's center, by taking the slope and one point from each of the two perp bisectors.

We are calling that function to find the intersection point of the two perpendicular bisectors, given these input values:

- Midpoint of line 1 and slope of the perpendicular bisector that passes through midpoint1
- Midpoint of line 2 and slope of the perpendicular bisector that passes through midpoint2

Then, the intersect function will return a set of coordinates (x, y) which will be the point where the two perpendicular bisectors meet. That is also the center of the circle, so the function circle_center is represented by the (x, y) coordinates.

To make it more clear, let's look at the code. The three inputs all represent the following

- perp1 - the slope
- midpoint1[0] - the first value that the function midpoint1 returns (x coordinate)
- midpoint1[1] - the second output that function midpoint1 returns (y coordinate)

The other 3 inputs are similar but for midpoint2.

Q3. How will the distance function help to find the center and/or radius of the circle?

The distance function will help us compute the distance between two specific points, when given 4 inputs (x, y) coordinates of each point. Here, it measures the distance from the center of the circle to point0.

The distance function uses circle_center[0], which returns the x coordinate (computed using the intersect function), circle_center[1] which returns the y coordinate, and the coordinates point0x and point0y.

As we know, the distance between the center of the circle and any point that is in the circle will be the radius.

Discussion

Q1. Describe an algebraic method for finding the center of the circle.

To solve this problem using a different approach, let's take a look at the equation of a circle:

$$(x - h)^2 + (y - k)^2 = r^2$$

In this formula, (h, k) are the coordinates for the center of the circle, and r is the radius. Meanwhile, (x, y) is the coordinate of any point that is in the circle. As we know, the distance from any point in the circle to the center would be radius.

In the make_circle function we have 3 inputs, which are the coordinates of three different points (point0, point1, point2) that the circle passes through. That means that each of those inputs satisfies the equation above. So the first step is substituting each point in the formula, to get three different formulas:

$$(x_0 - h)^2 + (y_0 - k)^2 = r^2$$
$$(x_1 - h)^2 + (y_1 - k)^2 = r^2$$
$$(x_2 - h)^2 + (y_2 - k)^2 = r^2$$

From here on, we just try to solve a system of equations to simplify the system and cancel out any unknowns. We can see that all the equations are equal to each other, so we can create a new system equating the first equation with the second, and the second with the third. This would remove r^2 and the new system would look like this:

$$(x_0 - h)^2 + (y_0 - k)^2 = (x_1 - h)^2 + (y_1 - k)^2$$
$$(x_1 - h)^2 + (y_1 - k)^2 = (x_2 - h)^2 + (y_2 - k)^2$$

Now we can focus on simplifying this new system. To do that, we simply put all the equations on one side. That means we will be subtracting the 2nd equation from the 1st and the 3rd from the 2nd. After that, we expand all the terms and we will be left with two new equations that are linear in h and k, because h^2 and k^2 get cancelled out.

Given that we have a system of two new linear equations with only h and k as unknowns, we can finally solve the system using elimination technique. That will give us the coordinates of the circle's center.

Once we have the coordinates of the center (h, k), we can insert that in the original formula for the circle with any of the inputs (point0, point1, or point2) and that will give us the radius.

Reflection

Q1. I believe the main concepts were creating functions and using them as helper functions to solve a bigger problem. Moreover, this HW helped me reinforce basic Python syntax, code styling, and mathematical thinking. These concepts are quite important in Data Science as they are the foundation for larger and more complex problems that we will most probably encounter in the future.

Q2. I think these skills will transcend beyond geometry or mathematical equations. I could use the knowledge I gained about helper functions in the future, including for other data science classes, allowing me to break down complex tasks and data science problems.

Q3. I think what I did well was revisiting mathematical concepts and theory to help me understand the problem better. However, I struggled to see where I was supposed to use helper functions at first, so if I could do this assignment over I would first practice using smaller helper functions with DataCamp, which I only did after having already spent some time with the HW.

Q4. I believe that for the most part I am quite comfortable with functions, helper functions, and mathematical thinking and writing that as Python code. I think that after the homework I would be able to explain to a peer how functions are used, when we can call them, the inner loop of a function and the outer loop (the whole code), how they work together, and how we can use helper functions.