Lab 4: Wall-Following

Part I: Exercises to be done individually

**Problem 1:** Describe the similarities and differences between the subsumption architecture and potential fields/schemas. Have the programs that you’ve written so far in lab had qualities of either of these two reactive architectures?

**Problem 2:** Assume we have a round robot with 8 distance sensors, placed at N, NE, E, SE, S, SW, W, and NW. What will happen if we have a program written to avoid obstacles that uses the “force” felt by each distance sensor to determine the amount to move away from the obstacle(s)? For example, imagine that we are using potential fields and each distance sensor will generate a vector to move 180 degrees in the reverse direction inversely proportional to how close an obstacle is to that sensor – if something is very close to the N sensor, a large vector in the S direction will be generated. If there is no reading (or a very far reading) on the N sensor, a small (or no) vector in the S direction will be generated. What happens if one of the sensors breaks, continually returning the same value X? What will be the robot’s emergent behavior?

Part II: Lab (write one shared report)

In this lab, you’ll use the optical rangefinder sensor (‘ET’) to build a wall-following robot. The sensor’s range is 4 to 30 inches. Low values indicate a large distance and high values indicate a distance approximating 4 inches. If something is closer than 4 inches, the values will go high again.

Mount the sensor on one side of your robot (again, you can continue to use the your robot base or redesign your robot to your liking). If you mount on the left, your robot will follow walls to its left; if you mount on the right, your robot will follow walls to its right. (If you’d like, you may mount sensors on both sides, and then choose to follow whichever side is near a wall.) Since the sensor values invert when something is closer than 4 inches, it can be helpful to mount the sensor towards the center of your robot.

There are two ways to write a wall following program:
1. The first is to have two states: one if the sensor reading indicates that the robot is too close to the wall and the other that the robot is too far. In the too close state, the robot should turn away from the wall. In the too far state, the robot would turn towards the wall. You may select the distance at which you’d like to follow the wall. I’d recommend that you pick a distance a bit away from the 4” minimum, since you’ll get readings that increase from this point whether you get closer or farther away. Implement this solution. Turn in your code.

2. The second way to implement wall following code is to have three states: too close, just right, and too far. Modify your code to include the third state, the ideal distance from the wall. In this state, you’ll drive forward. Experiment with the width of the “just right” range. What works best? Turn in your code.

How do the two programs compare? Which one does a better job following the wall? How far can your robot travel down the hall? What does it do when there are doorways with open doors? What does it do with recessed doors?

At the start of next week’s class, you will show me your wall following robot in the hallway, demonstrating the method that you think is best.