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**Line Follow with Fuzzy Logic Lab**

1. While we were using the reflective-opto sensors we had trouble getting values from the sensors that we wanted. When both sensors were over the white we expected the values to be similar to each other, but found one sensor to be much higher than the other to the point that our robot thought it needed to turn in order to follow the line. After switching out the sensor we believed to be faulty, our robot was able to follow the line until it reached a turn. One of the sensors would pass over the line, sense the difference in light, slow down, but not not turn. This was fixed after completely redesigning our fuzzy logic implementation and changing from the reflective-opto sensors to the light sensors. By switching to the light sensors the left and right values were more similar while over the white and was able to detect a more drastic change when sensing the black line. No significant changes were made to the robot design other than adding pieces to the front of the robot to mount the light sensors.
2. Delta was calculated by subtracting the two crisp inputs: the left sensor’s value on the robot and the right sensor’s value. The fuzzification was simple. Because the sensors are analog and read on a scale from 0 to 255, we decided to divide the difference by 255. This gave us the fuzzy value where the value is between 0 and 1, inclusively. To translate into a crisp output, the fuzzy value was multiplied by 100 (to get the number to be an integer value for the motors) and then multiplied by 4. We decided on multiplying by 4 after real-time testing with the robot with the turns. The defuzzification went a step farther depending on whether the fuzzy value was positive or negative. If the fuzzy value was negative, the fuzzy value will be added to the right motor’s speed and subtracted from the left motor’s speed. If the fuzzy value was positive, the fuzzy value will be subtracted from the right motor’s speed and added to the left motor’s speed. If the delta is 0 (and therefore, the fuzzy value will be 0), no value will be added to/subtracted from each motor’s power.
3. Initially, we decided to use the reflective-opto sensors because they would provide much more definitive values for the black tape and the white board. However, we had problems trying to implement fuzzy logic because of having such extreme values. We changed to using light sensors because of the more variable value ranges available. Turns were more subtle with the light sensor than the opto-reflective sensor after the fuzzification of the crisp inputs.