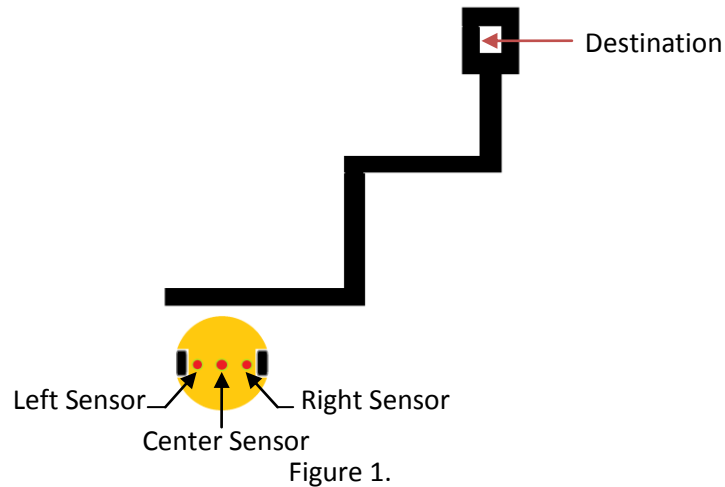Sample State Machine Problem

You are tasked to create a line following robot that can solve a maze. For an initial test setup, you are given a simple track for your robot to follow. The track is given in figure 1 with your robot placed as shown.

Figure 1.

For the test track, your robot is to first move forward until it identifies the line. It should then proceed to orient itself in the proper direction. Next, the robot should follow the line to the final destination. Once the destination is reached the robot should shut down and cease moving.

Your robot has 3 input sensors facing the ground: the left sensor, a right sensor, and a center sensor. Each of these sensors will output a high signal if it detects a black line, otherwise it will output a low signal. The sensors are spaced such that if the robot is centered and oriented on the line, both the left and right sensors will read low, and the center sensor will read high. It is also not possible for all the sensors to read low if the robot is following the line i.e. there are no blind spots between the sensors.

The robot also has 2 outputs: move the right motor forward, abbreviated 'RF'; move the left motor forward, abbreviated 'LF'. When RF is high, the right motor will move in the forward direction, and when it is low the right motor will stop. The left motor moves forward when LF is high, and stops when LF is low. If both the outputs are high, the robot will move forward; if both the outputs are low, the robot will stop. If only one of the outputs is high, and the other one low, the robot will turn pivoted around the wheel whose motor is not moving forward. The two left and right sensors are positioned such that when such a turn occurs, and if the non-turning wheel is on a line, the corresponding sensor will be high e.g. if the robot is turning clockwise about the right wheel, then the right sensor will remain high.

The destination is a square which when passed over correctly will trigger only the left and the right sensor, and not the center sensor.

You are to design a state machine that realizes the controller described above:

- Identify all the input and output signals of the state machine and state the physical meaning for their binary representations
- Sketch a state transition diagram for your FSM. Be sure to include a legend that identifies your inputs and outputs.
- Generate a state transition table (***next-state*** table) for your FSM.
- Write Arduino code that implements the FSM with the corresponding pins:

Pin 2	Pin3	Pin 4	Pin 12	Pin 13
Left Sensor	Center Sensor	Right Sensor	Left Forward	Right Forward

Note: Even with the best of state machines, your robot may fail to complete the test course. Identify any causes of failure, and suggest and evaluate a solution.