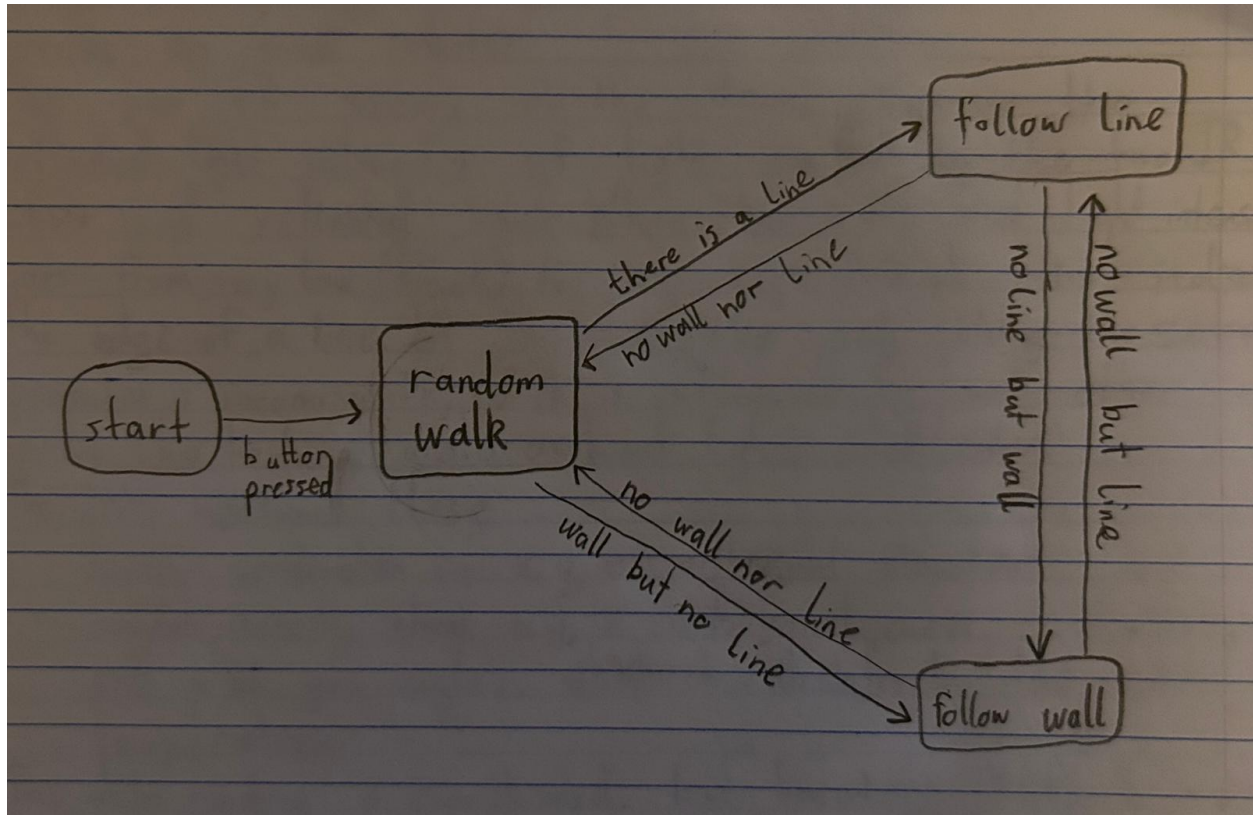Aengus Kennedy
2025 04 07
Tufts ME0134
Lab 2

Diagram of State Machine

In the presence of both a line and a wall, the state machine stays in the state that it was in previously. If the robot was random walking, it prioritizes line following.

Milestones completed

- **Wall following:** The robot maintains a consistent distance of 20 cm between the ultrasonic sensor and the wall. The proportional controller that steers using the ultrasonic data drives smoothly without significant oscillation.
- **Line following:** The robot consistently follows the tape line around loop. The camera's proportional controller also steers smoothly.
- **Random walk with line detection:** The robot walks randomly using drivetrain.arcade and random.uniform, and it consistently stops at the first line it crosses. It is able to find its way to a line even when starting from a random position not facing the line.

- **Integrate all modes:** The robot's state transitions are reliable and enabled it to round the track 2.5 times in a row without error. The transitions from line following to wall following and back are not jerky and the robot does not stop moving forward during the transition.
- **Bonus challenge:** The robot is able to find its way to a line even when starting from a random position not facing the line.

Timestamps for key transitions

- Start: 0:05
- Initiating line-following mode (1):   0:17
- Initiating wall-following mode (1):   0:43
- Returning to line-following mode (1):   1:01
- Returning to the start in line-following mode (2): 1:45
- Initiating wall-following mode (2):   2:11
- Returning to line-following mode (2):   2:27
- Returning to the start in line-following mode (3): 3:13
- Initiating wall-following mode (3):   3:45
- Returning to line-following mode (3) (failure):   3:58

Challenges encountered

The most challenging parts of this lab were processing data from the noisy sensors we were using.

I started trying to line-follow using the IR reflectance sensor on the bottom of the robot, but the difference in reflectance between the gray floor and the black tape was so small that the robot left the line frequently and it was very hard to get the robot to know when it had found a line while it was random walking. Switching to the HuskyLens camera fixed both issues.

The ultrasonic sensor for wall following was also challenging because of its unpredictable tendency to give spurious readings of 65535. Implementing a median filter fixed this issue.