ECE49595NL: Natural Language Processing

Spring 2025

Homework 2

Due 5pm Friday 25 April 2025

For this homework, each team will construct a system to drive a a Duckiebot robot purely with spoken English.

1. Run in a fashion similar to hw1.
2. Upload your code to Brightspace by 5pm EDT Friday 25 April 2025.
3. Every team member independently upload code.
4. Competition.
5. Monday 28 April 2025 4pm-10pm EDT.
6. Brackets/Ladder Pairs of teams compete 1-on-1 in each level of the bracket. All teams compete in the first level of the bracket. Whoever wins each level of the bracket advances to the next level, until we have first, second, and third place teams.
7. Racetrack Tiles with straight sections, left turns, right turns, tees, and crossing. This is done by placing yellow and white tape on the raw tiles. We have not done this yet but will set this up in the coming days. The tiles can be reconfigured to make different layouts. We will set up a layout for trials, for you to develop and debug your software, prior to race day. We have not yet determined the time and place for trials. On the race day, the layout will change, likely between each bracket, to make sure you don't hardwire anything particular to the layout in your system.
8. Assemble the robot. We do not have the resources to assemble all the robots. The TA has assembled one and can give you guidance during office hours. It does not require soldering. You only have to connect and bolt the parts together. Took the TA 5 hours.
9. Flashing the image of the OS onto the SD card. If you wish, we will flash the image for you. Easy to flash if you have access to Linux. If not, you can run Linux inside a virtual machine like VMware or VirtualBox. Runs ARM Linux with Jetson Nano GPU.
10. Guidance on Brightspace.
11. Robots are property of the Elmore Family School of ECE. Return them in good working order at the end of the semester. We plan to use them in future offerings of this and other courses (Introduction to Computer Vision) for the next several years.
12. Numbers on the robots. To keep track of them.
13. The kit contains a few extra spare parts like screws etc. Please save them in the box you receive them in so we can repair the robots in the future if needed.
14. Please keep all of the packing material, the box etc., so we can store the robot and the spare parts for use in future semesters.
15. Objective is to develop software that allows you to drive the robot purely by spoken input without touching the robot or your laptop.
16. The robot has WiFi so you can connect to your robot from your laptop.
17. You can write and run software on the robot, on your laptop, or on a combination of both.
18. Your laptop can run whatever you want to run on it, Windows, MacOS, or Linux. You can write code for your laptop in whatever language you wish. The Robot runs Linux. I believe it has Python and can run PyTorch on the onboard GPU. You can write code for the robot in whatever language or system you can find to download to the robot.
19. You can access Microsoft Azure speech-to-text and text-to-speech. You can access Microsoft Azure OpenAI GPT.
20. The robot has onboard a number of sensors. A front facing camera. You can use that to send a running video stream on your laptop or to detect things in the racetrack environment. The racetrack will have traffic signs and traffic lights. There will also be the competing race car. Potentially, we will control the color of the traffic lights. It has a time-of-flight sensor that can measure the distance to obstacles. You can write code on the robot to do obstacle avoidance. It has shaft encoders on the left and right wheels that allow it to do dead reckoning. But beware, dead reckoning suffers from drift and is very inaccurate. The robot has onboard a number of actuators. There are two LEDs in the front of the car and two LEDs in the back of car. The color and brightness of these

can be controlled independently, and changed over time. I don't anticipate that you will need to control these for this project but you can if you wish. You can control the left and right rear motors individually to go forward and backward at different speeds to do differential steering.

21. The objective is that you talk to your robot in spoken English to drive it around the race track and win the race.
22. Free to use whatever tools you want to use.
23. No cheating. Stay within the lane boundaries of the race track.
24. We will make the lanes wide enough to allow passing.
25. No birds-eye view. You, the driver (by speech), will have an exogenous view of the racetrack.
26. Can have varying degrees of autonomy but there must be some level of spoken English control of the vehicle.

This is an ambitious exercise. Do not leave this to the last minute. The details of this will be fleshed out as we go along.