Texas Workforce Commission, Girl CodeRunner @ UTSA

This handout is also available on this weblink: https://tiny.cc/twc_day2

Introduction to LEGO Mindstorms, Sensors, Motors
Challenge 1: Robot racing
Challenge 2: Line Following Robot

Task 0: Understanding whats in the box given to you

Welcome to the 2nd day of this 5-day camp! Today we will learn robotics and create robots that follow lines and race against each other.

PRIZES: All girls who attend at least 4 out of 5 days will win a prize and a certificate. To get the prize and certificate, you will need to be present on the 5th day. You will also get tickets for completing the activities on each of the days. At the end, you we will put all tickets in the box (only if you have attended 4 out of 5 days) and draw out two tickets for a grand prize — chromebook (a laptop/tablet). Note that getting more tickets improves your chances of winning the grand prize.

Open internet explore or any other browse and go to "google.com". Now search for "what does a robotics engineer do". Next, open YouTube and find at least three useful applications of robotics. Discuss with your team.
Assignment 0: Call and discuss with the student assistant.

The equipment given to you includes:

- **Boxes:** 1 LEGO Core set. Information about parts is here https://education.lego.com/en-us/products/lego-mindstorms-education-ev3-core-set-/5003400 (If the link is dead search for LEGO Core Set). See Figures 1.
- **Computer:** 1 NXT Brick and 1 USB cable to connect brick to your computer.
- **Actuators:** 2 large motors and 1 medium size motor.
- **Sensors:** 1 Color sensor, 1 Gyro sensor, 1 Ultrasonic Sensor, 1 Infraredsensor, 1 Touch Sensor, Cables to connect sensors to bricks
- **Battery:** 1 Rechargeable battery and charger

Question: Can you identify the different sensors and motors in Fig. 1 (bottom picture)?
HINT: Look at this link: http://www.lego.com/en-us/mindstorms/products/mindstorms-ev3-31313 (If the link does not work for LEGO Mindstorms EV3).

Task 1: Introduction to brick programing, sensors, and motors

Brick programming

This video shows how to write a basic program that plays a sound using the brick.
Video: https://youtu.be/81hctQt6Cp8 (Duration: 4 min 29 sec)

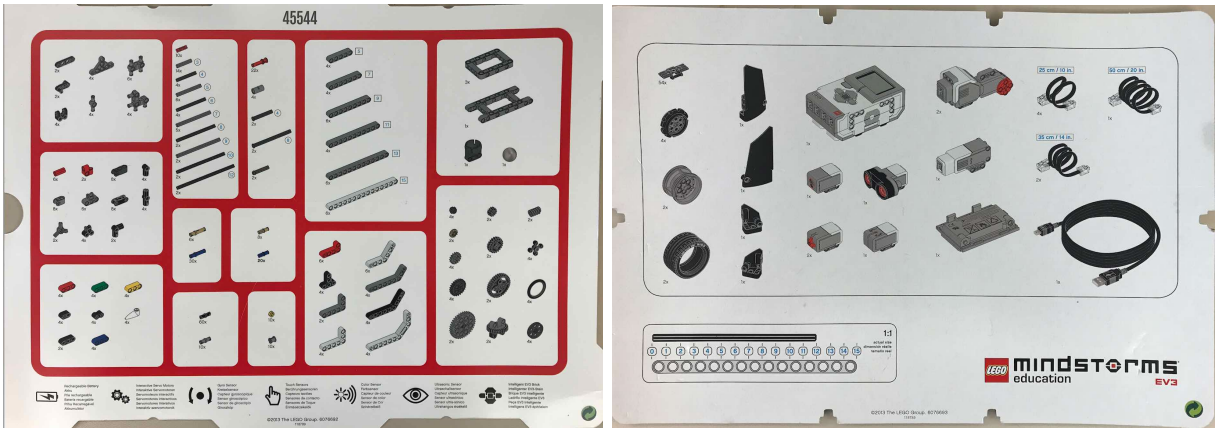

Figure 1: This picture shows descriptions of components in the boxes.

Assignment 1: Follow the video and show your work to the student assistant.

Programming color sensor

Program the brick so that when the color sensor is shown one of the three colors; red, green, and blue; it is displayed on the brick. The student assistant will test the program by showing one of the three colors to the color sensor. Ask the student assistant to give you the color chart (For the student instructor: The link to the colors is here: https://coderunners2019.github.io/lego_colors1.pdf)
Assignment 2: Follow the video and show your work to the student assistant.

Programming motors

The video shows you how to make a motor move. At the end of this video you will be able to control the speed (magnitude and duration), and also control the angle of spin.
Video: https://youtu.be/liKa_I55ADM (Duration: 4 min 58 sec).
Assignment3: Follow the video and show your work to the student assistant.

Task 2: Robot racing

Develop a mobile car

1. Build the car shown here: https://youtu.be/HsLqiShzP0k or use the booklet provided to you in the box (Duration 2 min 42 sec).

2. Program the car to move in the following fashion: (1) move straight for 2 seconds; (2) take a 90 turn to the right; (3) move straight for 2 seconds; (4) come to a stop. *HINT:* See the tutorial here. https://youtu.be/8C01X72_Xfk (Duration: 3 min 29 sec). Write your team's name on a piece of paper and stick it on the car, somewhere on the top, such that when we make a video of your car with the camera pointing down, it is easy to distinguish your car.

Assignment 4: Follow the video and show your work to the student assistant.

Reacting to sensor measurements

The next task is a race that will be played by all teams together as shown in Fig. 2. The goal is to program your car to move from start to end as shown. The moment the TA says "Go" you will press a button on the brick initiating your car to move in a straight line towards the a black line as shown. The car which comes to a complete stop on the black line (color sensor on the car should be above the black line) first will be declared a winner.

Assignment 5: Contact the student assistant once you are ready to race.

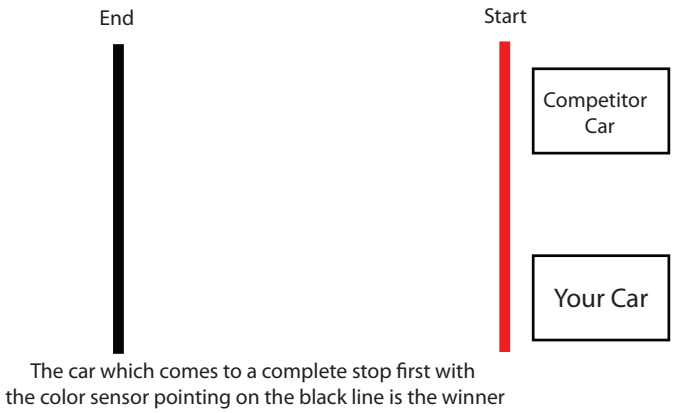

Figure 2: Car racing conceptual diagram.

Task 3: Line Following Robot

Motivation: Automated Guided Vehicles (AGV) are used in manufacturing facility and warehouses to move equipment, people, and material. These AGV's follow predefined lines marked on the floor to navigate.

Goal: In this lab, you will build and program a line following mobile robot that can go from a predefined start to a predefined end point in the given time. You will be evaluated based on how well you can follow the given line in a set amount of time.

Building an autonomous (not tele-operated) mobile robot: Build a mobile robot that can turn and incorporate the color sensor that will enable the robot to see the line. Feel free to reuse the design you used earlier. Here is an example mobile robot but feel free to use your own design or customize this one:
http://pab47.github.io/info/lego/lego_vehicle.pdf (5.4 MB)

Tasks

1. Your robot should use only the color sensor for this task. No other sensors are allowed.

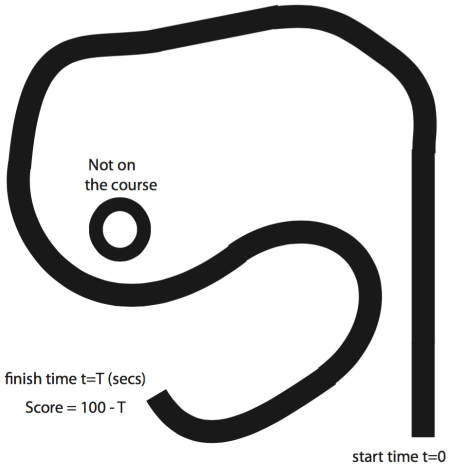

Figure 3: The course for line following robot

2. Your robot needs to follow the black continuous line at all times. We will also keep a track of the time from start to end. HINT: Here is a tutorial on programming a line following robot: https://youtu.be/ODAGVeeDagk

3. One person from each team will place the robot in the orientation of her/his choice at the start point (which will be clearly marked). When the TA/instructor says, 'Ready-Set-Go', the team member will press a button on the brick to get the robot moving. Your time will start when the TA/instructor says 'Go'. Your robot has to follow the line from start to end.

4. If your robot does not reach the finish (end of the line) you will get zero points.

5. If you robot does reach the finish (end of line) then your score will be computed using the formula, Score = 100 - T, where T is the time taken by the robot from start to finish in seconds.

6. You will have two attempts to improve your scores.

NOTE: The TA/instructors decision is final when making a judgement on the interpretation of any of these rules.

Assignment 6: Contact the student assistant once you are ready to race. Note for the student assistant:

1. The link to the map is here: https://coderunners2019.github.io/lego_trajectory2.pdf. Open with Adobe Reader. Then File $-->$ Print $-->$ Poster $-->$ Print. This will print the map on 16 letter size pages. You will have to tape these together to get the complete map.

2. Make a video for each team. Ensure that a label indicating the team's name is pasted on top of the team such that that gets recorded on the video. Use the camp YouTube log in given to you to upload the video. After uploading is complete please tell the team to keep track of the YouTube link, that is, for the YouTube link, https://youtu.be/2_DPlcHHD1c, just keep a track of 2_DPlcHHD1c, as we will need it on the WebDesign day.

Packing up

Please dis-assemble the robot and put contents in the correct location in the box. Please ensure that parts, sensors, motors, brick, **cables**, **usb cables** are returned to the box. The complete list is in the handout is in Task 1. Please hand over the box to the teaching assistant.