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# Lab 10: How We Got Chocolate

Introduction to Robotics  
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Lab TAs: Farida Abdelmoneum, Jordi Bejar, Jeffery Cao, Harry Huang,  
Cary Jin, Sophia Li, Tahaseen Shaik, Freda Su, Sumayya Syeda, Ruijia  
Xing, Ella Zhao

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## Learning Goals

- Make a robot that uses two light sensors.
- Use odometry to turn 90 degrees (maybe).
- Pick up and place an object in a certain location.
- Complete requirements within a specific time limit.

## Introduction

**Once upon a time**, in a not so far away place, Howie arrived home and decided to eat some delicious chocolate. But alas, although he searched high and low, there was no chocolate to be found 😞 (perhaps his kids are too good at hiding their Halloween candy nowadays).

Only you, brave adventurer(s), with your knowledge of Legos, Python, and assorted other talents, will be able to deliver Howie's much-needed sweets in a timely fashion.

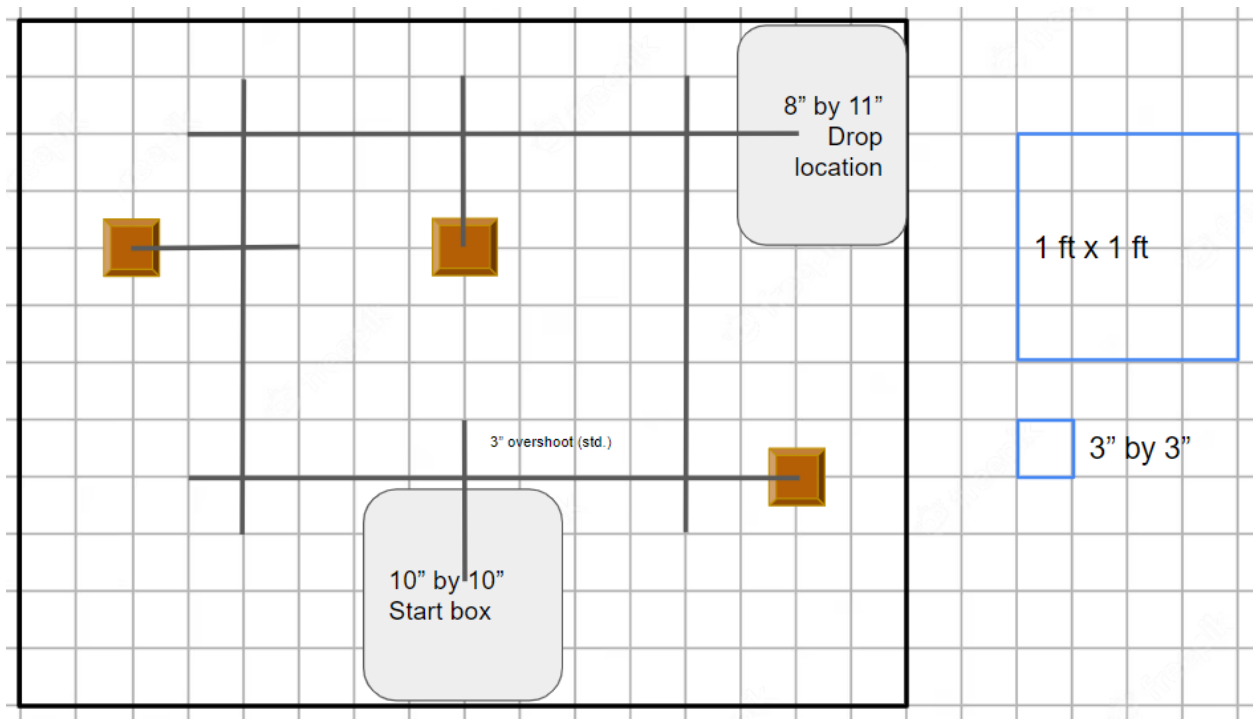
If you are able to complete this quest autonomously, you will win Howie's undying gratitude, and a little chocolate to keep (oh and maybe 100 on the final but that's a tale for another day...).

## Requirements

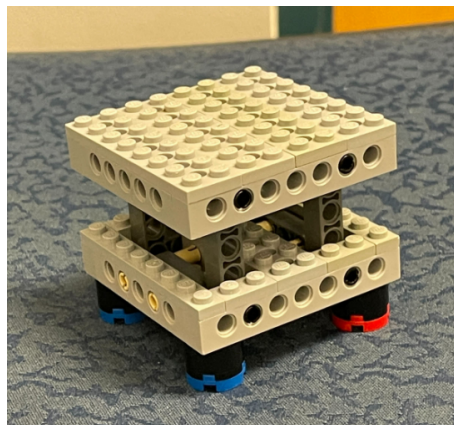
- The base of the robot should be no larger than **10 inches by 10 inches**.
- The height of the robot should be no taller than **12 inches**.
- You are allowed to use any sensors included in your kit.
- Every task should be done autonomously.

## Lab Course

- There will be 4.5" guaranteed inches of clearance on all sides of the black lines
- Junction points have guaranteed 3" of black tape on all sides of junction
- All junctions are 90 degree angles
- All measurements correct up to  $\frac{1}{4}$ "



In the drawing above, the brown blocks are 3 chocolates that your robot can pick up. Below is a picture of the actual block that will be used on the demo day.



## Individual Q & A

- At the end of your team's demo, we will ask each member of your group one question (3 total questions) that can be related to design decisions, challenges you faced/solved.
- **Make sure** you fully understand every aspect of your team's implementation before the demo.
- You will **NOT** be allowed to consult with your teammates when we ask you a question.

## Grading

The Demo will be on Wednesday April 26th during class time.

## Demo

- There will be **2 trials**. Score is the best trial.
- The time limit is **120 seconds**, starting from when your robot begins moving. No overtime is allowed.
- The base of the robot should be no larger than 8 inches by 9 inches, and the height should not exceed 9 inches. The robot must fit inside the size bounding box (**10"x10"x12"**).
- Your robot should be **fully autonomous**.
- Your robot will start inside the start box indicated on the course.
- To meet the criteria for "visiting goal", the robot must drive on to the path segment that connects the dropoff box with the rest of the course.
- To meet the criteria "contact", the robot must be in contact with the block continuously for at least 2 seconds, or the robot must be able to meet the criteria "pick up" or "delivery".
- To meet the criteria "pick up", the robot must either lift the block off the ground for at least 2 seconds or move the block with the robot for at least 2 inches.
- To meet the criteria "delivery", the robot must drop off the block inside the goal box on the course.
- Don't forget your grading sheet!
- Demo Signups are here: [link](#)

## Score Calculation

- Link to Rubric: [link](#)
- Grading will be out of 100 pts, but there are 115 points available. 85 (or 100) pts will be from the demo and 15 pts will be from the Q&A session.



## Tips and Tricks

### Tips on Line Following

- Line-following sounds like an easy algorithm, BUT it can take some time to tune if you want to go very fast.
- Consider how the position of the two light sensors on your robot affect the precision of their readings.
- Consider how the design of your robot (wheel size, weight, width) affects the accuracy of your odometry.
- To combat the difference in lighting conditions, consider a calibration method.

### Tips on Robot Construction

- The base of the robot is recommended to be no larger than **8 inches by 9 inches**.
- The height of the robot is recommended to be no taller than **9 inches**.

## Getting Started

- Build your robot and specialized mechanics that can handle all the tasks.
- Work you have done for Lab3 should be helpful.
- Carefully tune your robot to enable it to turn correctly, pick up and place chocolate at the intended target positions.
- Make sure your robot can “hold” the block and successfully deliver it to the target position
- Start early!!! You may need time tuning parameters for your line following and odometry.

## Video Submission

You can submit a video for partial credit [here](#).

Make sure the timer is visible, and measure your robot.