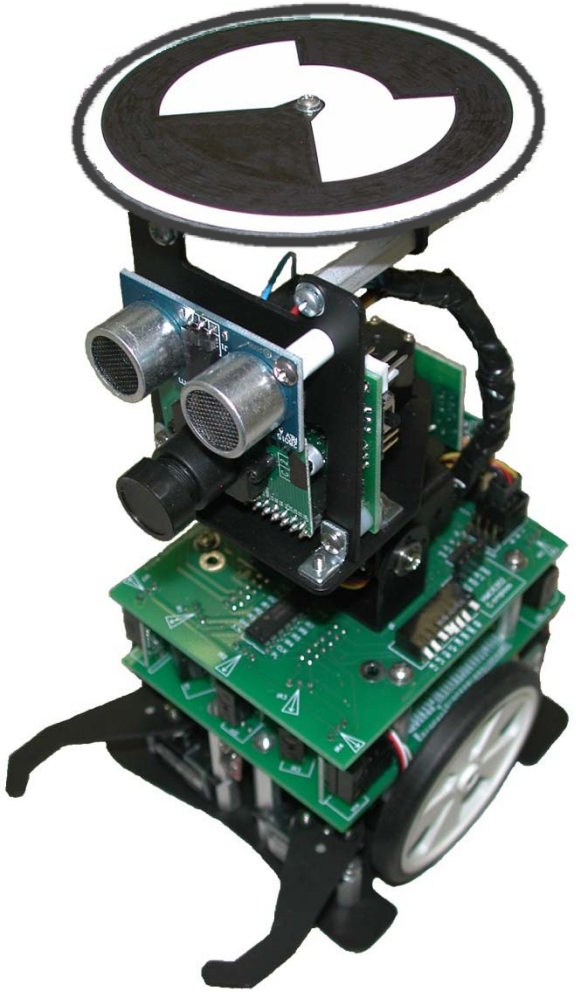
COMP 4807

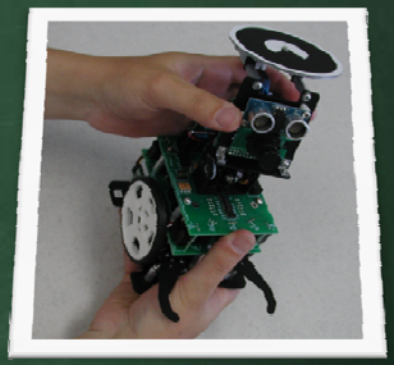
Introduction to Mobile Robot Programming

(Fall 2012)



Course Objectives

- To provide you with an introduction to robotics so that you will understand some of the issues involved with programming mobile robots.



- To give you hands-on experience in working with real hardware that:
  - does not always perform as you would expect due to noisy data and timing problems
  - has limited programming space, requiring you to write efficient code.
- To have fun !

Course Objectives

- This course **WILL NOT** teach you:
  - mechanical/electrical aspects of designing/building robots
  - kinematics behind controlling robotic arms
  - how to program a variety of robots
  - advanced problems in robotics (e.g., 3D, laser vision, SLAM (Simultaneous Localization And Mapping))
  - artificial intelligence and its various learning techniques, although neural networks will be discussed
  - strategies for team robotics (e.g., robocup)

Is This Course Useful ?

- You will likely NOT find work in robotics
  - demand is not there yet, but becoming more popular with numerous competitions annually throughout the world.

- You will gain experience with respect to:
  - common hardware problems and issues: e.g., noise, timing, memory constraints, etc…
  - using wireless technology (bluetooth) to combine embedded programming with JAVA-based applications.
  - how to coordinate efforts of two robots to solve a problem

Course Grading Scheme

- Here is a breakdown of the grading scheme:
  - 4 Lab Assignments 40%
  - Midterm 15%
  - Lab Competition 20%
  - Final Exam 25%
- Lab assignments must be handed in on time. Late submissions will not be accepted.
- Midterm will be in class, anyone missing it will get zero :(

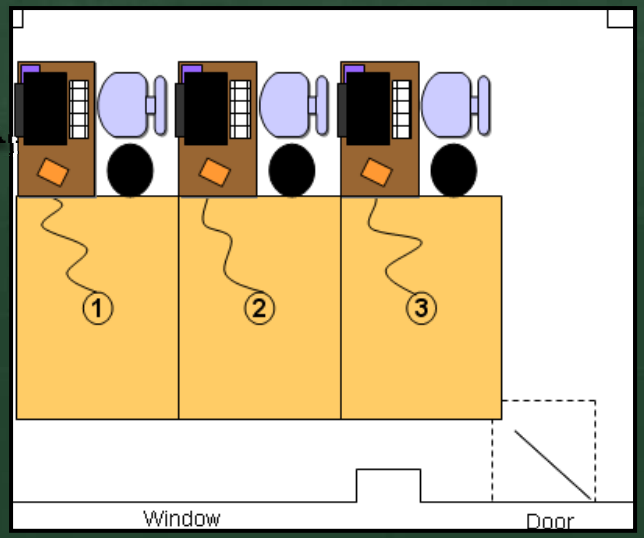
LABS

- All lab assignments must be done in room 5174HP:
  - each lab MUST be completed during your designated timeslot ... likely two 3 hour timeslots depending on the class size. (You will write up the lab report later).
- You need to get your access card enabled for the lab by heading over to the admin building

LABS - Equipment

- The lab contains 3 work centers:
  - a PC with a bluetooth USB adapter for communicating with the robot and a webcam to track the robot
  - 2 PropBots with battery packs and a battery charger
  - a rectangular roaming area for the robot (7' x 5')

You should always sit at the same workstation for all of your labs.



LABS - Leaving

- Just before leaving the lab, ensure that:
  - The robot does not contain your code
    - simply download a blank program onto it.
  - The robot is turned off.
  - No battery packs are being charged (they can overheat!)
  - The robot is placed back on the desktop and is turned off and the robot's roaming area is clean and back to the same configuration as when you started.
  - You backed up your files and then remove your code from the PC. Leave the PC on at all times.

LABS - Arriving

- Upon arriving in the lab, ensure that:
  - You sit in the same location as last time.
  - The roaming area is configured the way you need it for the lab experiment.
  - At least one battery pack is charged.
    - Plug one of the battery packs into the charger to fully charge it:
      - plug it in (use barrel connector) … press start button
      - wait until charged (i.e., beep 3 times), then unplug

    - Remove the battery pack from the charger once it is charged … be careful …it may be hot.
    - DO NOT leave battery pack in charger when you leave room lab

LAB Assignments

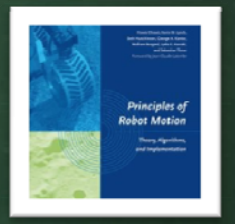
- You will hand in files (through CULearn) for each lab which will include:
  - all your code and trace files (more on this later)
  - all results (e.g., snapshots & maps)
- You will also hand in captured videos of your robot moving around in the environment
  - these may or may not be too large for CULearn. You might need to post them on a website and hand in a readme.txt file directing the TA to the webpage containing the videos (which must be up and running).

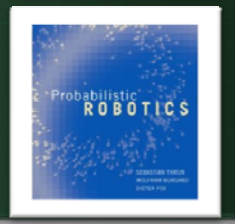
Lab Competition

- Will likely combine teams of 3 students each.
- The teams will be formed from those who share the same weekly timeslots, so as to allow cooperation.
- The competition will involve coordinated efforts of the 3 robots to accomplish a particular goal (revealed later in order to keep you in suspense)
- You will submit a report on your portion of the competition.
- Grade will be 15% for your part and 5% for the entire team's competence.

Books

- There is no assigned textbook in this course, but here are some good ones:
  - Principles of Robot Motion
    (ISBN: 0262033275)
  - Introduction to Autonomous Mobile Robots
    (ISBN: 0262195027)
  - Behavior-Based Robotics
    (ISBN: 0262011654)
  - Probabilistic Robotics
    (ISBN: 0262201623)





Course Topics

- Here is a rough overview of the course material:

1. Course Introduction
2. Introduction to Robotics
3. Spin Language and PropBot Programming
4. Behavior-Based Programming
5. Position Estimation
6. Goal-Directed Navigation
7. Roadmap-Based Path Planning
8. Sensors and Range Measurement
9. Sensor Models and Mapping
10. Coverage Algorithms
11. Multi-Robot Coordination