BPL001 Introduction to Robotics

Instructor: Carlos Ambrozak

Spring 2016

General Information

Class Time

Monday 4-530PM

Classroom Location

Main Library Tech Lab, 480 Primrose Rd. Burlingame, CA 94010

Contact Info

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Website

https://github.com/cambrozak/bpl001 (https://github.com/cambrozak/bpl001)

Course Description

The field of Robotics is at a fascinating and exciting point in its evolution. Robots are no longer confined to the realms of industry and research, they are rapidly becoming a part of daily life.

This course provides Middle School students with an introduction to fundamental concepts and practical application of tools and techniques for building robotic systems in order to inspire further study and participation in High School and College programs.

Hands-on laboratory exercises and short lectures explore programming, circuits, embedded systems, motors, sensors and servos.

Prerequisites

None! This class is for motivated beginners.

Objectives

- Have Fun!
- Write lots of programs to provide a robot with interesting autonomous behaviours
- Understand the fundamentals of electricity and circuits
- Hands-on experience with robot hardware: embedded systems, LCDs, sensors, gyros, accelerometers, motors, servos, cameras
- Connect concepts to robots in the real world

Teaching and Learning Styles

Technical subjects are often presented bottom-up, in a way that favors visual/abstract learning over audio/kinesthetic styles.

This course takes a holistic approach to learning styles by presenting the subject in a broad top-down manner and filling in bottom-up details with applicable hands-on laboratory exercises.

This approach enables beggining students to engage all learning modes, learn through experience and become effective with the technology immediately.

Class Format

Each classroom session follows a *Lab-Lecture-Lab* format:

A simple lab exercise is completed as a group to start the session. Students follow along with the instructor to load prewritten software, connect components to the Robot and observe resulting physical behavior. The sesssion does not proceed until every Robot is performing as expected.

A short lecture explains how and why the lab exercise worked and answers open questions. The lecture also connects the lab exercise to examples in the real world.

A final lab exercise challenges students to implement their own original ideas by combining the first lab with previous learning.

Class Values and Conduct

1. Win together by sharing and listening thoughtfully to ideas.
2. Handle delicate equipment with care and safety.
3. Fun is Mandatory.

Schedule

Session One: Introductions, Orientation, First Program

Lecture: Robots Declassified -- What's a Robot?

Lab: First Program -- Name the Robot and display on LCD

Session Two: Introduction to Programming, Movement with Motors, Positioning with Compass and Gyroscope

Lab: Move the Robot, Edge Detection, Program motor control using libraries & APIs
Lecture: Introduction to Programming with C and Python
Lab: Turn the Robot, Speed control, Positioning with the Gyro and Compass

Session Three: Line Following, More Programming, The Art of Debugging

Lab: Line following, IR LED/Phototransistor input processing
Lecture: Scope, Functions, The Art of Debugging
Lab: Debugging in Practice, IDE, Simulator for Arduino

Session Four: Electricity, Circuits

Lab: Build a Battery from scratch, light an LED, measure Current, Voltage and Resistance with a Multimeter
Lecture: Intro to Electricity: Electrons, Current, Voltage, Resistance, Series, Parallel, Ground
Lab: Build a Reference Circuit using a battery, LED, Switch and Ground. Debug the three types of circuit failures: Short Circuits, Grounded Circuits, Open Circuits

Session Five: Roaming

Lab: Detect collisions with accelerometer, Detect objects in space with proximity sensors.
Lecture: Why Accelerometers and proximity sensors work.
Lab: Advanced Roaming, navigating terrain, avoiding moving obstacles.

Session Six: Servo Mechanical Control

Lab: Attach Pan-Tilt servo arm to the Robot
Lecture: Servo safety, how servos work
Lab: Point the servo arm at detected objects

Session Seven: Pattern Recognition

Lab: Attach Pixy CMUcam5 image sensor to servo arm
Lecture: Image Sensors and Pattern Recognition
Lab: Program robot to follow or flee when it recognizes certain image patterns.

Session Eight: Open Lab

Lab: TBD
Lecture: TBD
Lab: TBD

Equipment

All equipment is kept in the lab at all times.

Laptop

- Dell, Windows 10

Software

- Arduino IDE (https://www.arduino.cc/en/Main/Software)
- Simulator for Arduino (http://www.virtronics.com.au/Simulator-for-Arduino.html)

Hardware

- Zumo 32U4 (https://www.pololu.com/product/3126/resources)
- Mini Pan-Tilt Arm and Micro Servos (https://www.adafruit.com/products/1967)
- Pixy CMUcam5 Sensor (https://www.adafruit.com/products/1906)

Text and Reference Material

Purdum, Jack J. *Beginning C for Arduino* New York: Apress, 2012. Print.

Atmel ATmega32U4 (http://www.atmel.com/devices/atmega32u4.aspx)

Arduino (https://www.arduino.cc/)

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