INSTITUTE FOR PERSONAL ROBOTS IN EDUCATION

CS2951-A

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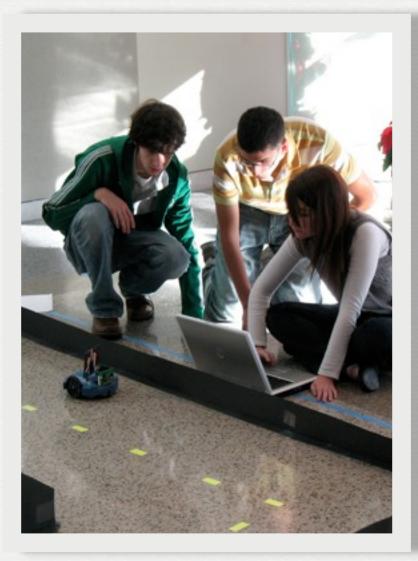
presenter: Alex Unger

OVERVIEW

- Questions to answer about the Institute for Personal Robots in Education:

    - What is ipre?

    - Why should we look at ipre?

    - Who's part of ipre?

    - How is ipre implemented in universities?

    - Is ipre worth it?

    - How is ipre related to Brown CS?

    - What can we bring to ipre?

WHAT IS IPRE?

- Collaboration between MSR, Georgia Tech, and Bryn Mawr

- Goal: apply and evaluate robots as a context for CS education

- Targeted at "CS-1" as an exciting new approach to CS and computation

- roboteducation.org

WHAT IS IPRE? (PHILOSOPHY)

- Encourage students to be engaged in introductory CS courses by give each student hands on experience and feedback on their code in the form of a robot.

- Students will be more engaged when working with something that feels real

- Robots add a coolness factor to computing and CS

- Working with Robots gives CS adds a creative aspect to the topics being learned

WHAT IS IPRE? (TEACHING)

- ipre has developed a textbook and lesson plans for intro CS courses: *Learning Computing With Robots*

- ipre focuses on college level students

  - CS110: Introduction to Computing, Bryn Mawr College

  - CS 1301: Learning Computing with Robots, Georgia Institute of Technology

  - introduces: python programming, functions, control structures, basic algorithms, and reactive robot control patterns

- Middle School program focuses on sequential reasoning, loops, and conditionals.

WHAT IS IPRE? (TECHNOLOGY)

- Hardware:

  - An off-the-shelf Scribbler robot from Parallax

  - A special plug in "Fluke" module provides:

    - color vision

    - IR range sensing

    - internal voltage sensing

    - a controllable LED

WHAT IS IPRE? (TECHNOLOGY)

- Software:

  - Myro, short for My Robot, is software that enables you to easily program your own personal robot. Myro is Python-based, and it includes many features and functions for controlling the IPRE robot platforms.

  - Myro and Scribbler control functions have been ported to other languages like Java and Scheme.

http://www.roboteducation.org/guides.html

WHAT IS IPRE? (HARDWARE)

- Engaging form factor

- Previously sold in "lunchbox" which felt fun and approachable

- Simple presentation make it less intimidating

- Plug and play, all included

WHAT IS IPRE? (SAMPLE CODE)

```
from myro import *
initialize()
while True:
    if getObstacle("right"):
        backward(1, .1)
        turnLeft(0.7, .1)
    elif getObstacle("left"):
        backward(1, .1)
        turnRight(0.7, .1)
    else:
        forward(1)
    wait(.1)
```

- myro has functions specific to these robots and their sensors

- can detect obstacles and directly control motors

- motor control is abstracted into functions like
  `backward(speed, time)`

WHY SHOULD WE LOOK AT IPRE?

- ipre provides a window into the level of other intro CS programs using robots

    - ipre curricula, for the most part, focuses on procedural programming with little to no talk of functional or oop

- ipre is a fairly well adopted curriculum for engaging students in learning computer science topics

- represents a robust and simple system that requires little knowledge to start programing

WHO'S PART OF IPRE?

- Georgia Tech and Bryn Mawr College faculty members lead the program and have developed all the lessons, labs, and textbook. Microsoft Research is interested in increasing excitement around Computer Science education.

- Georgia Tech:
    - Associate Professor Tucker Balch, IPRE Director
- Bryn Mawr College:
    - Associate Professor Douglas Blank, IPRE Co-Director, Lead Software Design
- Microsoft Research:
    - Dr. Stewart Tansley, Program Manager, Microsoft Research
    - Jared Jackson, Software Development Engineer, Microsoft Research

SCHOOLS USING THE IPRE RESOURCES

- Austin College
- Bard College, Keith O'Hara
- Boston College, Robert Signorile
- Butler University, Panos Linos
- Bradley University, Monica McGill
- Bryn Mawr College, Doug Blank and Deepak Kumar
- Duke University
- Fayetteville State University, Sambit Bhattacharya
- Florida Virtual School, Bill Jordan
- Georgia Institute of Technology, Jay Summet
- Georgia Tech Savannah
- Georgia State University, K.N. King and Stefanie Markham
- Harvey Mudd College, Zach Dodd
- Instituto Tecnológico y de Estudios Superiores de Monterrey, Roberto Martínez

- Lake Washington School District, WA
- Macalester College, Susan Fox
- National Central University of Taiwan, Wei-Feng Kao
- Phillips Exeter Academy, Kenney M. Chan
- Presbyterian College
- Rowan University, Jennifer Kay
- Shorter College, Anthony Nichols
- Texas Tech University, Mohan Sridharan
- University at Albany, George Berg and Seth Chaiken
- University of California, Los Angeles, Dustin Torres
- University of Georgia, Maria Hybinette
- University of Northern Colorado, Terry Scott
- University of Tennessee Knoxville, Bruce MacLennan
- University of Vermont, Jeanne Douglas
- University of British Columbia

http://roboteducation.org/schools.html

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HOW IS IPRE IMPLEMENTED IN UNIVERSITIES?

- Each student has a robot

- Assignments are done both as pairs and individuals

- Most but not all assignments in the course involve the robot

- Sample mid semester assignment:

  Your robot will be randomly placed in an arena of size 5′ x 3′ that will have one yellow wall segment (11″ long). You need to write a program to get your robot to within 6″ of the yellow wall segment within two (2) minutes, without hitting walls of other colors.

- ## Week 1 - Introduction, Background, and Graphics
  - Intro to Robots; Python: variables, expressions, and statements
  - asgn 1: intro to MYRO

- ## Week 2 - Numbering Systems, Functions, and Expressions
  - Using and defining functions; Python evaluation model
  - asgn 2: functions (unit converter and tip calculator)

- ## Week 3 - Control Flow
  - Loops, user input, and iteration
  - lab 1: intro to system

- ## Week 4 - Iteration and Strings
  - More on for loops, python strings, try except pattern
  - asgn 3: isPrime(), nextPrime(); Basic robot movement through "Robot Dance"

- ## Week 5 - Robot Sensors & History
  - Reactive control mechanisms; using light sensors; list data structures

- ## Week 6 - Compound Data Types - Strings, Tuples, Lists
  - Subsumption; Randomness; Use of data types to facilitate robot control
  - asgn 4: avoidWalls(); timing to avoid walls for 35seconds
- ## Week 7 - File I/O
  - lab 2: basic unix
  - asgn 5: binary to decimal converter
- ## Week 8 - Images and Dictionaries
  - Pixel representation of images
  - asgn 6: work with lists; read in and parse a file to control robot
- ## Week 9 - Computer Vision
  - Blob finders: how an image is represented, how they work, and how to use them
  - lab 3: building a website
- ## Week 10 - Starmaps and Javascript
  - More python practice and an intro to Javascript

- ## Week 11 - Searching and Sorting
  - Linear Search, Binary Search, Insertion Sort, and Merge Sort
  - lab 4: basics of Excel

- ## Week 12 - Functional Programming and Recursion
  - Fibs, Recursion (list of lists and elements [1, [2, 3], 6])
  - asgn 7: special effects: use the camera on the robot to create interesting image effects (looping and pixel manipulation)

- ## Week 13 - Tag Cloud Example and AI
  - Use map and filter to demonstrate function programming; MiniMax (tic-tac-toe)
  - asgn 8: robot movies: film the robots acting in a funny / silly story

- ## Week 14 - n-Grams, & Barcodes
  - Filler week on interesting but not related topics

- ## Week 15 - Object Oriented Programming
  - Intro to creating classes and object instances
  - asgn 9: write anything interesting in python
  - lab 5: basics of Powerpoint

http://www.cc.gatech.edu/classes/AY2010/cs1301_spring/

EXAMPLE ROBOT "DANCE" ASSIGNMENT (ASGN 3)

IS IPRE WORTH IT?

- Alexandra Funk of Bryn Mawr found students from all majors more engaged in CS when Robots and creativity are the focus

- Robots expose students to the human and real world aspects of CS

- For younger students especially, robots provide a hands on learning environment which increases engagement

- The simple form factor of the robot makes it extremely simple for educators to get started using

http://wiki.roboteducation.org/wiki/images/b/b4/CompEducation.pdf

HOW IS IPRE RELATED TO BROWN CS?

- Robot hardware must be very cheap

- Robots must be easy to program without boilerplate code

- The programming environment should not limit what can be accomplished as skill increases

- Should teach skills that are extendable to other Robot platforms

- Concepts covered should not require advanced algorithms and data structure knowledge

WHAT CAN WE BRING TO IPRE?

- Myro currently works with Scribbler but interfaces for SRV-1, Create, Roomba, and a simulator are under development

    - Myro and Scribbler capabilities:

        - motion via: forward(amount, seconds), backward(...), turnLeft(...), motors(left, right)

        - light, IR, and line sensors

        - blob finder

- Building a bridge between ROS and Myro opens Myro and the ipre curriculum to new platforms

- The simple programming environment of Myro could hide the difficulties of working with ROS

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WHAT CAN WE BRING TO IPRE?

- Controlling Scribbler with Scratch via ROS

    - Scribbler and Scratch have similar APIs and capabilities (motion and sensing)

    - ROS as middle man

    - Scribbler is a durable and friendly robot

    - Scratch is a durable and friendly programming lang

    - Removing syntax allows for more thinking

QUESTIONS?