

TENTATIVE SYLLABUS - ICS 491 – Software Design for Robotics – Fall 2008 – Modified 4/14/2008

Programming for Robotics is a specialized area of programming involving the integrated knowledge of both hardware and software into a working robotic system. Current technology has made robotic hardware relatively inexpensive and so trivial that engineers have turned their attention to robotic devices that can operate in hazardous or exotic environments. The potential of robotics operating in normal environments is limited by the computer science profession, more specifically, computer science professionals adept in both the software and hardware of robotics.

This course is the first undergraduate course specifically focusing on software design for robotics at the UH. The “Software Design for Robotics” course complements related courses offered by the Information and Computer Sciences department such as: Computer Vision, Multi-Agent Systems, Machine Learning and Artificial Intelligence.

The purpose and objective of this course is to fill this gap by providing information and computer science students with knowledge of and hands-on experience with both robotic hardware and advance software tools used in robotics.

By the end of the course, students will have achieved the following learning objectives:

- Students will have completed several programming assignments and will also have implemented a project so that they can acquire experience in software design for robotics.
- Students will understand basic hardware aspects of robotics and how programming is influenced by robotic hardware issues.
- Students will understand the design principles and implement dataflow programming for robotics.
- Students will understand the programming issues of robotic programming for individual robots as well as multiple cooperating robots.
- Students will be proficient at programming both semi-autonomous and autonomous robotic systems.
- Students will learn to add robustness to their software to compensate for sensor and actuator problems.

Computer Requirements:

You need to have a computer that you can download Microsoft Robotics Studio 1.5 and supporting software such as Visual Studio 2005. A laptop would be best since you'll need to download programs via a USB port to robots. For system requirements see:

<http://msdn2.microsoft.com/en-us/robotics/default.aspx>

<http://www.microsoft.com/downloads/details.aspx?FamilyId=73092FF6-E37B-45C6-8E5E-C23D5D632B1E&displaylang=en>

Text

Programming Microsoft® Robotics Studio (Paperback) by Sara Morgan (Author), cost approximately \$35.

Prerequisite

The prerequisite for this course is ICS 331 (Logic Design and Microprocessors). ICS331 is a prerequisite as students should have mastery of computer hardware, digital logic and microprocessor design in order for the student to understand the computer hardware aspects of robotics. ICS311 (Algorithms) and ICS313 (Programming Language Theory) are highly recommended classes.

Grading

The student's work will be evaluated by means of 7 robot assignments (30%), one final programming project (20%), a midterm examination (20%), and a final examination (30%).

The tentative syllabus is likely to change to better follow the text.

Tentative 16-Week Syllabus:

Week 1: Introduction

- What is Robotics
- What Type of Software Platforms are Used to Control Robots

Week 2: Robotics Hardware

- Introduction to Robotics Using Lego Mindstorms Robots
- Sensors, Actuators and Control Processors
- Programming Assignment #1 - A Robot in Simulation and in Hardware

Week 3: Robotics Hardware/Software Issues and the Programming Platform

- Introduction to Microsoft Robotic Studio
- Programming Assignment #2 - Joystick Control of a Robot in Simulation and in Hardware

Week 4: Software Architectures

- Software Control Architectures, Localization, Navigation, Sensing, Planning, and Uncertainty

Week 5: Paradigms of Robotic Software Design

- Data Flow Programming
- Agent Based Systems
- Programming Assignment #3 - Advanced Motion

Week 6: Robust Software

- Designing Robust Software to Compensate for Sensor and Actuator Problems.

Week 7: Signal Processing Algorithms

- Sampling Theory
- Fourier Transform and other Signal Processing Methods
- Programming Assignment #4 - Sensing and Simple Behaviors

Week 8: Computer Vision Primer

- Object Segmentation
- Object Recognition and Representation

Week 9: Computer Vision and Robotics

- Sequential Image Analysis
- Current Computer Vision Systems
- Programming Assignment #5 – Robot Vision to Estimate the Distance to an Object

Week 10: AI Paradigms of Machine Learning for Robotics

- Expert Systems, Case Based Reasoning, Bayes Network, Behavior Based AI

Week 11: Paradigms of Machine Learning

- Neural Networks
- Programming Assignment #6 – Task Learning via Human Robot Interaction

Week 12: Robots Interfacing to Humans

- Human-Computer Interaction Aspect of Robotics

Week 13: Computer Based Speech and Natural Language Interface

- Programming Assignment #7 - Robot Control via Bi-directional Speech

Week 14: Advance Robotic Topics

- Most Recent Advances in Software Tools for Robotics and Current Research in the Field of Robotics.

Week 15-16: Student Robotic Programming Project Presentations and Discussion

- Robotic Software Project Presentations