CS8650-1-13-09-P1

Course Introduction

CS 8650
Introduction to Robotics & AI
Dr. Ken Hoganson

Class

Will

Start

Momentarily…

- Contents
- Overview of syllabus (insert from web site)
  - Description
  - Textbook
  - Robotics Kit – Vex Robotics Kit
  - Grading
  - Robotics Project – Construction&Programming
  - Dates/due dates/schedules – to be posted

Lectures

- ePop recorded lectures
- Each lecture at most about 1:10 minutes long
- 2 Lecture pieces per day
- Some class periods will be used for non-lectures
  - AI Project Development
  - Robotics Project Development
  - Robotics Project Demonstration
    - Can be a remote demonstration using your web camera – more details to work out. We have tested the capability.

Snap course web page

Go to syllabus:

Doc camera text1

Doc camera text 2

Doc camera robotics kit

Syllabus: grading

Robotics Project1

- Build the tutorial mobile robot as per the kit instructions

Robotics Project

- Fun, easy, but will take some time to do well.
  - Basically, build a robot to move blocks from one place to another, repeating the round trip. Details to follow.
- I will give you some class time, and will help if you get stuck.
- Enclosed KIT and CD includes a tutorial
- Start playing with soon – familiarize yourself with the components and the system.
- Note that a you will turn in an Analysis and Design document on March 11.
- The complete project is due April 30.
- A robotics project presentation is due May 1.

Intro Robotics

- What is a robot?
- **Autonomous** – able to act on its own, make decisions without control by human.
- Note that many students design non-robots that are remote controlled by humans – there is even a robotics contest that operates this way. Machines controlled remotely are tele-operated machines, or simply remote-controlled devices.

Intro Robotics

- What is a robot?
- **Exists in the physical world** – many teach robotic control ideas with virtuatl (software) robots systems that operate in a virtual world.
- Robots that exist only in a virtual world are simulations. Simulations are interesting and fun and can be useful design tools, but are not robots.

- What is a robot?
- **Sense its environment**– robots include devices that provide sensory input.
- Autonomous robots require inputs from sensors in order to make decisions. Remote control devices may not need sensors.
- Many types of sensors –
  - Mechanical – sensing positions of appendages, sensing rotational degrees and speed of axles, touch and "bump" sensors, sensors that perceive light or other radiation, etc.

Intro Robotics

- What is a robot?
- **Can take action in response** – robots can take action to affect the physical world, based on inputs from sensors and its internal programming.
- Autonomous robots require inputs from sensors in order to make decisions. Remote control devices rely on human decisions to take actions.
- **Achieve goals** – robots are design for a purpose or can be directed to achieve goals.

- A robot is an autonomous system which exists in the physical world, can sense its environment, and can act on it to achieve some goals.

Overview of AI

- What is Artificial Intelligence?
- Attempt to “mimic” human intelligence?
  - One approach – capture human expert intelligence so the machine evaluates and responds as the human would.
- Machine “appearw intelligent” to an unbiased observer?
  - Turning Test (Alan Turning, 1950)
- Make a machine act intelligently – make rational decisions. (within a limited problem domain)
- Model human thought processes
- Function using mathematical reasoning
- Learning – required for intelligence?
- Perceptions: vision is very very difficult. Limited sensors are easy.
- Fuzzy definition: “We know it when we see it.”

Intelligence

- If a human's behavior can be perfectly modeled with an artificial device
  - does that mean that the device is intelligent?
  - or that people are bio-mechanical machines after all?

- One of the crucial aspects is the 4th dimension: TIME.
- If you could "freeze" an organism, and then analyze it, you would find merely organic compounds and electro-chemical processes.
- Without time progressing: organisms cannot change their state over time.
- So one key is building a complicated enough machine with enough possible states, and then enable feedback processes to allow the machine to change state in an orderly progression.

Expert System Example:

- Set of data (recorded as written facts)
- A process for reasoning
- A set of rules to govern the reasoning – allow new data to be deduced or inferred from existing knowledge.
- Allow time to progress while allowing the reasoning "engine" to run.

- Neural Networks
- A network of nerve cells, with many connections between each cell
- Artificial networks order the nerve cells into a regular structure.
- When one cell fires (change state), it sends a signal to other cells (which may then also change state).
- “Knowledge” is stored in the aggregate connections between the cells, and in the internal requirements for each cell to fire.
- Time to allow cells to fire and feedback and cycle.

AI History

- 1940s Early idea- recognition that sufficiently complex networks could learn. (Hebb)
- Neural network computer (Minsky 1951)
- Turning Test (1950)
- Early Enthusiasm – great predictions, none of which came to pass
  - Complexity – the world is extremely complex with many variables, events, relationships. Early machines did not have enough power
  - Chess champion computer – took 40 years rather than 10 years.

Expert Systems

- 1970s 80s – Expert systems
- Capture human reasoning abstractly
- Computer runs program that computes using captured human intelligence
- Successful in a variety of applications

- Note: I graduated in the first class of students at the U.S. Army's AI School, and was invited to become an instructor (1986). We concentrated mostly on applying expert systems.

Intelligent Agents

- 1995 – based on OO SW design ideas
- An agent may be composed of multiple threads capable of concurrent processing and interaction
- Agents perceive “sensory inputs” and respond
- Some web-based search engines use this concept in navigating/searching the web

Game Playing

- Game playing is a useful environment
- Limited, controlled possibilities
- Finite number of states.
- Fixed rules that govern play, or govern actions in the artificial world
- Excellent testing/learning/teaching ground for AI concepts and ideas.
- We will look at some simple games – possible project ideas.
- I did AI in a game in the early 1980s – (a wargame, sold a few copies).
- Chess, checkers, other games have been largely explored.
- Note that the best computer chess programs use the searching power of the computer to find better moves than a human will find using our experience and insight.

End of Lecture

End

Of

Today's

Lecture.