CS 378: Autonomous Intelligent Robotics

Instructor: Jivko Sinapov

http://www.cs.utexas.edu/~jsinapov/teaching/cs378/
Announcements

FRI Summer Research Fellowships:
https://cns.utexas.edu/fri/beyond-the-freshman-lab/fellowships

Applications are due March 1st but apply now!

Funding is available for 4-5 students per FRI stream
Announcements

A few volunteers needed for explore UT

– Help setup and run the mobile robots during the open house
– Help run a drone robot demo
– Saturday at 10 am (event starts at 11 am)
– Email me if interesting in helping out
– Everyone is welcome to the event
Progression

2D simulation

3D simulation

Real World
The Gazebo 3D simulator

• Install gazebo_ros package:
  
  ```
  sudo apt-get install ros-indigo-gazebo-ros
  ```

• Run the simulator:

  ```
  roslaunch gazebo_ros rubble_world.launch
  ```

• Guide for installing the gazebo simulator on Mac OS:
  
  http://gazebosim.org/tutorials?tut=install_from_source&cat=install


“What is Doug Lenat's CYC?

There is a search for an ultimate "ontology", or codification of all objects and their possible relationships,” -- is this the goal of relate to the study some of us participated at the beginning of the semester?”

- Kathryn
“For some of the “IS-A” relationships, I understood why the application was not accurate. However, given that most of these relationships seemed vague and unclear, what would be an entirely accurate “IS-A” relationship? If there are none, then how exactly can natural language interfaces be manufactured given how complex the simplest of English language constructs are? “

- Anrav
“What is his deal with the naming of these programs? I feel as though naming these programs something that normal people will understand might help the normalization of these programs to the general public. How would the naming scheme affect anything significantly?”

- Jonathan
The Verification Principle: An AI system can create and maintain knowledge only to the extent that it can verify that knowledge itself [8].
The Verification Principle

• The key to AI is a system that can tell whether or not it is working correctly
• An AI system must be in charge of its own learning
• Eventually, it will be widely adopted
“A proposition is said to be verifiable, in the strong sense of the term, if and only if, its truth could be conclusively established in experience. But it is verifiable, in the weak sense, if it is possible for experience to render it probable.”

“How do humans verify things? How does this affect how robots would verify? What would a robot need to do to make up for things that humans can do but robots cannot?”

- Kiana
“I would like to know how close we are today to having a fully autonomous verification system in robots. How much progress has been made in the last 15 years? How exactly would the robot verify the knowledge it's given?“

- Ruchira
“Was there any purpose of releasing two separate articles a single day apart instead of publishing them together?”

- Nathan
Readings for this week


Today

• Final Project Ideas

• Embodiment

• Homework 4 Q & A / Help
Types of Projects
Project Ideas

Vending Machine  Sonar Sensor
Project Ideas

Write ROS code to allow the robot to use an LED light strip
Project Ideas

Help the robot “see” something it currently cannot
Project Ideas
Project Ideas
Project Ideas
Project Ideas
Project Ideas

• ROS Driver / Controller for new devices (vending machine, sonar sensor, LED light strip)
• Help the robot see something new
• Creative ideas: make the robot dance
• Write a high level app that uses the existing code base (e.g., a message delivery task)
Project Ideas (cont'd)

• Find an interesting or useful ROS package and integrate it with our system:
  – http://www.ros.org/browse/list.php

• Find an interesting computer vision package or tutorial and implement it as a ROS node
  – http://pointclouds.org/documentation/tutorials/
  – http://docs.opencv.org/2.4/doc/tutorials/tutorials/tutorials.html
Final Project Timeline

- Project Proposal due: March 29\textsuperscript{th}

- Project Presentations / Demos: Last Week of Class (May 3\textsuperscript{rd} and 5\textsuperscript{th})

- Final Report due: May 11\textsuperscript{th}
Embodiment
Embodiment

No body

Body
“Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience.”
Traditional vs Embodied AI

- **Abstract intelligence**
  - attempt to simulate “highest” human faculties:
    - language, discursive reason, mathematics, abstract problem solving
- **Environment model**
  - Condition for problem solving in abstract way
  - “brain in a vat”

- **Embodiment**
  - knowledge is implicit in the fact that we have a body
    - embodiment is a foundation for brain development
- **Intelligence develops through interaction with environment**
  - Situated in a specific environment
  - Environment is its best model
Embodied AI

Embodied Intelligence (EI) is a mechanism that learns how to survive in a environment (potentially hostile)

• Mechanism: biological, mechanical or virtual agent with embodied sensors and actuators
• EI acts on environment and perceives its actions
• EI learns so it must have associative self-organizing memory
• Knowledge is acquired by EI
Embodied AI

Drawing by Ciarán O’Leary- Dublin Institute of Technology
“Embodiment of a mind is a mechanism under the control of the intelligence core that contains sensors and actuators connected to the core through communication channels.”

Drawing and quote by Janusz Starzyk
EECS, Ohio University
Embodied AI

Agent Architecture

Reason

Short-term Memory

Long-term Memory

Perceive ➔ Reason ➔ Act

INPUT ➔ Task ➔ OUTPUT

Simulation or Real-World System

From Randolph M. Jones, P : www.soartech.com
Embodiment in Humans
Embodiment in Humans

https://anagnk.files.wordpress.com/2013/03/fetal-growth.jpg
Embodiment in Humans

Source: Getty Images
Embodiment in Humans
Embodiment in Humans

Human Brain at Birth

6 Years Old

14 Years Old

Rethinking the Brain, Families and Work Institute, Rima Shore, 1997.
Synaptic Density over Time

And its 3D analog
Origins of the word Homunculus:

A miniature, fully formed individual believed by adherents of the early biological theory of preformation to be present in the sperm cell.
Discussion

• Would a robot's body ever need to change over time?

• Do human bodies change in addition to just growing up?
Next Time: Robot Bodies in ROS
Homework 4: Q&A / Help
THE END