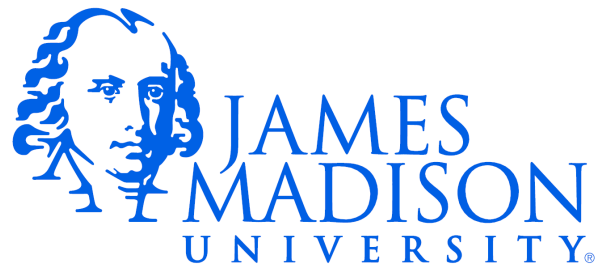# CS354

Why Study Robotics?

- We may actually, finally, be approaching a point where people routinely interact with autonomous mobile robots.

  - Autonomous Vehicles (Video)

  - Lowes Customer Service Robot (Video)

What Does "Robotics" Mean? (To Us)

- NOT electrical/mechanical engineering
- NOT developmental robotics (robotics as a platform for studying embodied learning)

What Does "Robotics" Mean? (To Us)

- We'll view robotics as a branch of AI that includes several problem areas:
  - Sensor fusion
  - Localization
  - Path planning
  - Mapping
  - Computer vision
  - Forward/Inverse Kinematics
  - Planning and Reasoning
  - Software architecture

What is ROS?

"The Robot Operating System (ROS) is a flexible framework for writing robot software. It is a collection of tools, libraries, and conventions that aim to simplify the task of creating complex and robust robot behavior across a wide variety of robotic platforms."

http://www.ros.org/about-ros/

History of ROS

- 2006 – Willow Garage founded

- 2007 – Willow Garage formally introduces ROS

- 2010 – Willow Garage begins shipping PR2 robots

- 2011 – Willow Garage introduces the Turtlebot as a low-cost alternative to the PR2 (Original design based on the iRobot Create)

- 2012 – Open Source Robotics Foundation (OSRF) takes over ROS development

- 2012 – Turtlebot 2 is introduced (Based on the Yujin Kobuki)

"Scott Hassan founded Willow Garage in late 2006 to accelerate the development of non-military robotics and advance open source robotics software. […] The goal was simple: to push the frontiers of robotics, both scientifically and commercially. Scott put together a funding package with the unique goals of impact first, return on capital second, with the strong belief that success in the first goal (impact) would provide plenty of opportunities to excel at the second (return on capital)."

https://www.willowgarage.com/pages/about-us/history

ROS Usage Metrics (July 2014)

- Approximately 1 million wiki views/month

- 49,153 Unique IPs/month downloading .debs

- 1216 academic papers have cited "ROS: an open-source Robot Operating System" (Quigley et al., 2009)

- Growth in supported robots:
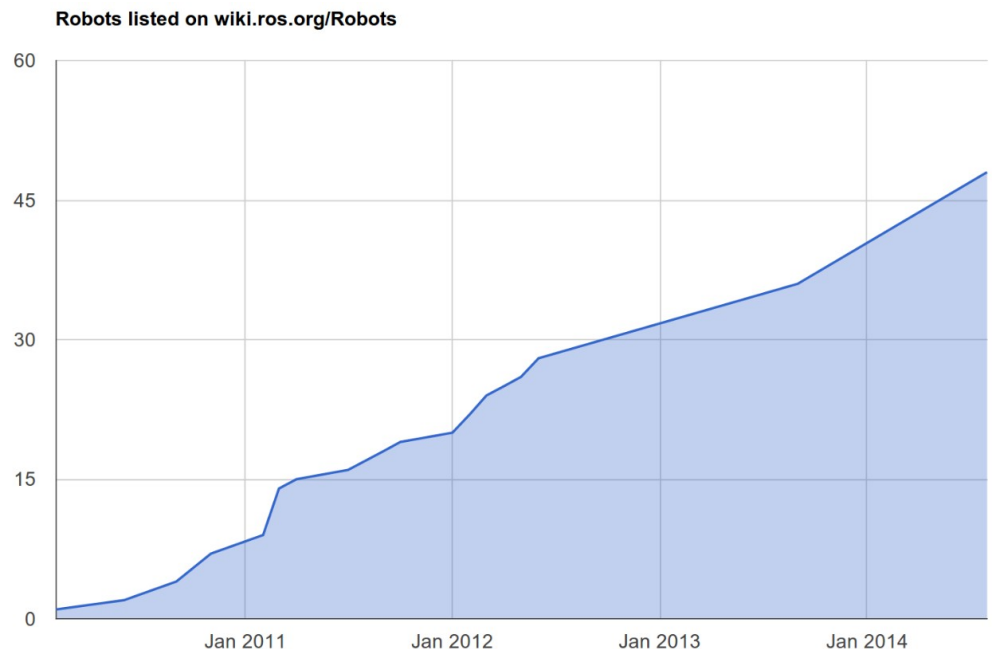
  http://wiki.ros.org/Metrics

Robots listed on wiki.ros.org/Robots

Turtlebot

- Kobuki Base (Manufactured By Yujin Robotics)
- Microsoft Kinect
- Notebook/Netbook
- Plates and Mounting Hardware
  - Open Source Design

http://www.turtlebot.com/

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Obtaining/Installing

- Most recent version is ROS Indigo
  - Targets Ubuntu 14.04 LTS (Trusty)
  - Turtlebot packages are not yet functional!!
- Previous release was ROS Hydro
  - Targets Ubuntu 12.04 LTS (Precise)
- Installation is easy (
  http://wiki.ros.org/hydro/Installation/Ubuntu)

  ```
  $ sudo apt-get install ros-hydro-desktop-full
  $ sudo apt-get install turtlebot*
  ```
- Plus a few more steps...

Nodes/Topics/Messages

- Nodes – "A process that perform computation"

- Topics – "Named buses over which nodes exchange messages"

- Messages – "Simple data structures, comprised of typed fields"

http://wiki.ros.org/ROS/Concepts

Turtlebot

- Kobuki Base (Manufactured By Yujin Robotics)
- Microsoft Kinect
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- Plates and Mounting Hardware
  - Open Source Design

http://www.turtlebot.com/

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ROS Tools - Rviz

- Rviz is the ROS 3D visualization tool.
- Let's take a look...

ROS Tools – Gazebo

- Gazebo is a 3D, physics-based, simulation package that ships with ROS.

Programming in ROS

- Fully supported languages:
  - C++, Python, Lisp
- Some support(?)
  - Java, Ruby, others...
- We'll focus on Python
- Let's look at approach.py...