Software Lecture 1:

Introduction to ROS

(And Linux!)

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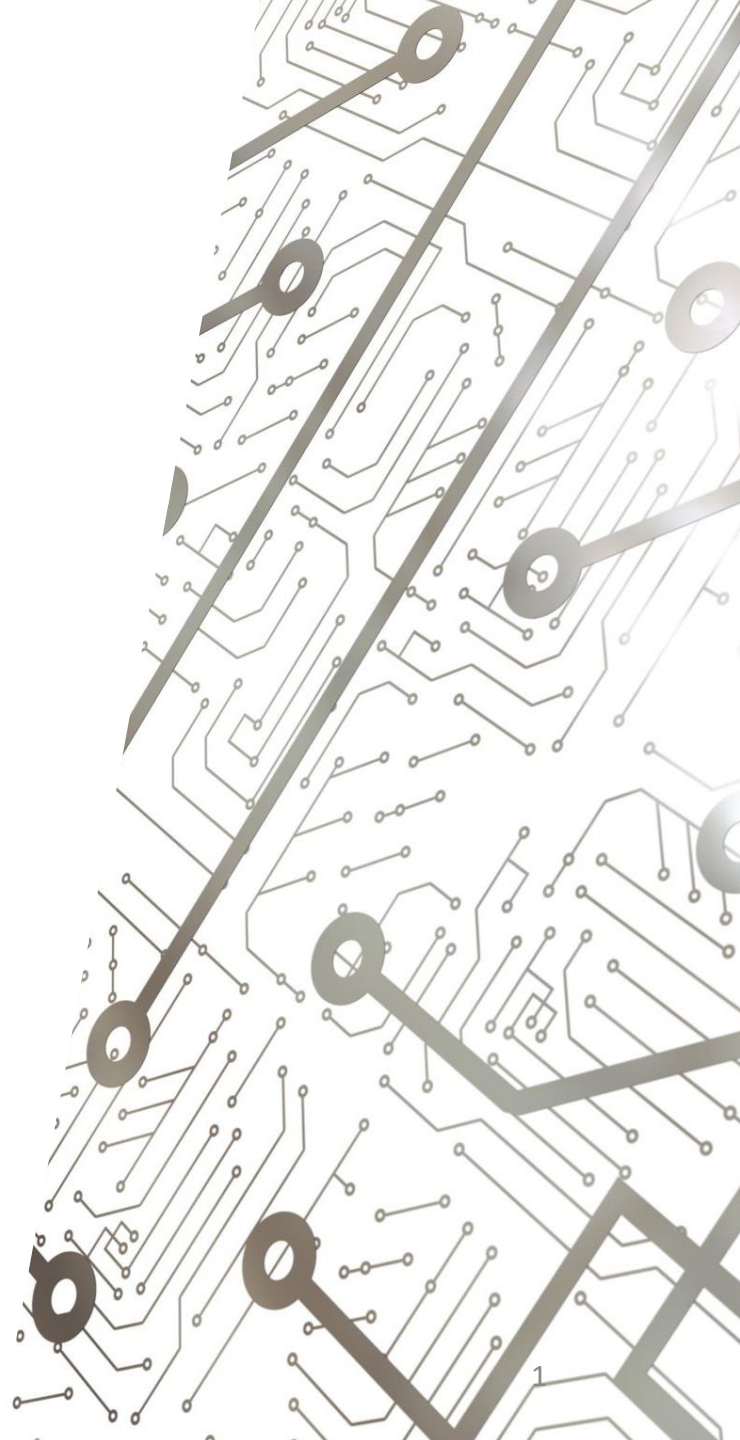


What is ROS?

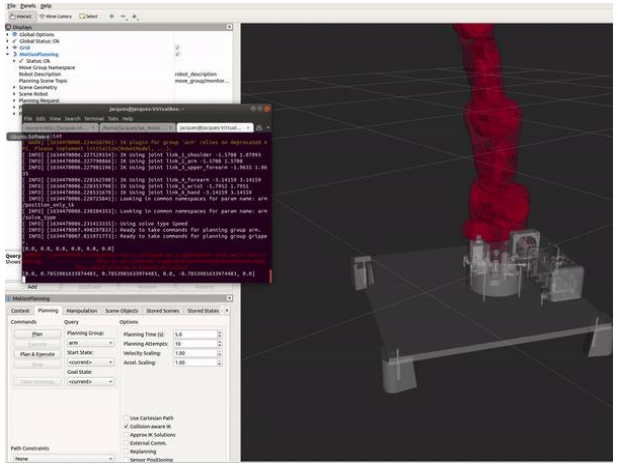
- "Robot Operating System"
(Not really an operating system!)

- Framework that allows us to easily manage complex robotics-based systems

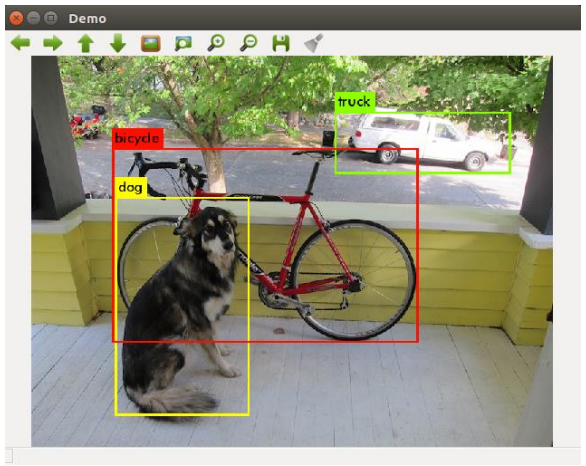
- Provides a wide array of useful software libraries and tools

- Entirely open source! (Good thing for us!)

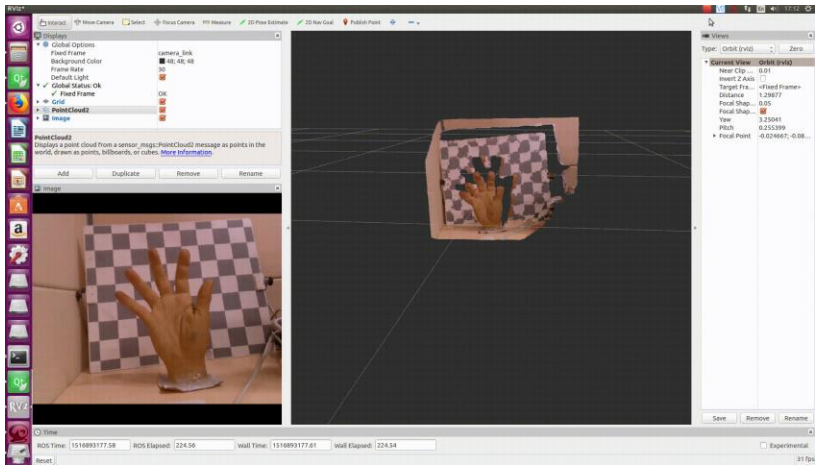
Example ROS applications?



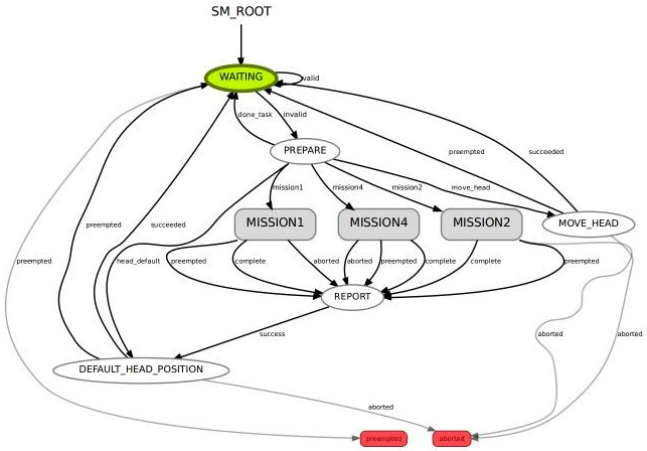
Motion-Planning



Object Detection



Analysing Point Cloud Data



State Machines

Communication with Hardware

...and so many more!

- ROS not only provides open-source packages for all these applications...
- … but also lets them all simultaneously communicate with each other in a simple, streamlined manner!

Nodes, Publishers, Subscribers, Topics

- Each program is run as a node in the ROS network
- Nodes communicate by sending messages to each other
- Messages are communicated across topics (basically act like communication lines, or data buses)
- Publisher nodes send out messages onto a topic
- Subscriber nodes listen to messages on a topic

ABSOLUTELY CRITICAL to learn and be familiar with this terminology! But don't worry, here's an analogy...

Analogy – Sushi Conveyor Belt

Credit to Sneha!

- Sushi chefs put new plates of sushi on the conveyor belt
- Customers at the conveyor belt then take sushi from these plates

Analogy – Sushi Conveyor Belt

Credit to Sneha!

- Chefs and customers are nodes
- Chefs act as publishers
- Customers act as subscribers
- Conveyer belt is the topic
- Sushi itself is the message!

Some Further Notes

- A node can be both a publisher and/or a subscriber to multiple topics! You can also easily set up new topics!

- When a publisher publishes a message to a topic, ALL subscribers to that topic receive the message

ALL customers at the same conveyor belt get a piece of sushi from the new plate!

- Programs can also interact with each other using (very useful) ROS actions and services, but we will cover these later down the line...

Okay, Enough Theory (For Now...)

- To use ROS, you first need to have Linux on your machine
- If you have a Windows or Mac OS laptop, I suggest creating an Ubuntu virtual machine...

VirtualBox

Installing Virtualbox

https://www.virtualbox.org/

- Download the installer for your OS and follow the instructions to install VirtualBox

Installing Ubuntu as a Virtual Machine

https://releases.ubuntu.com/20.04.4/

1. Download the 64-bit PC (AMD64) Ubuntu 20.04 desktop image (it will be a .iso file)

Important to specifically download the image for version 20.04!

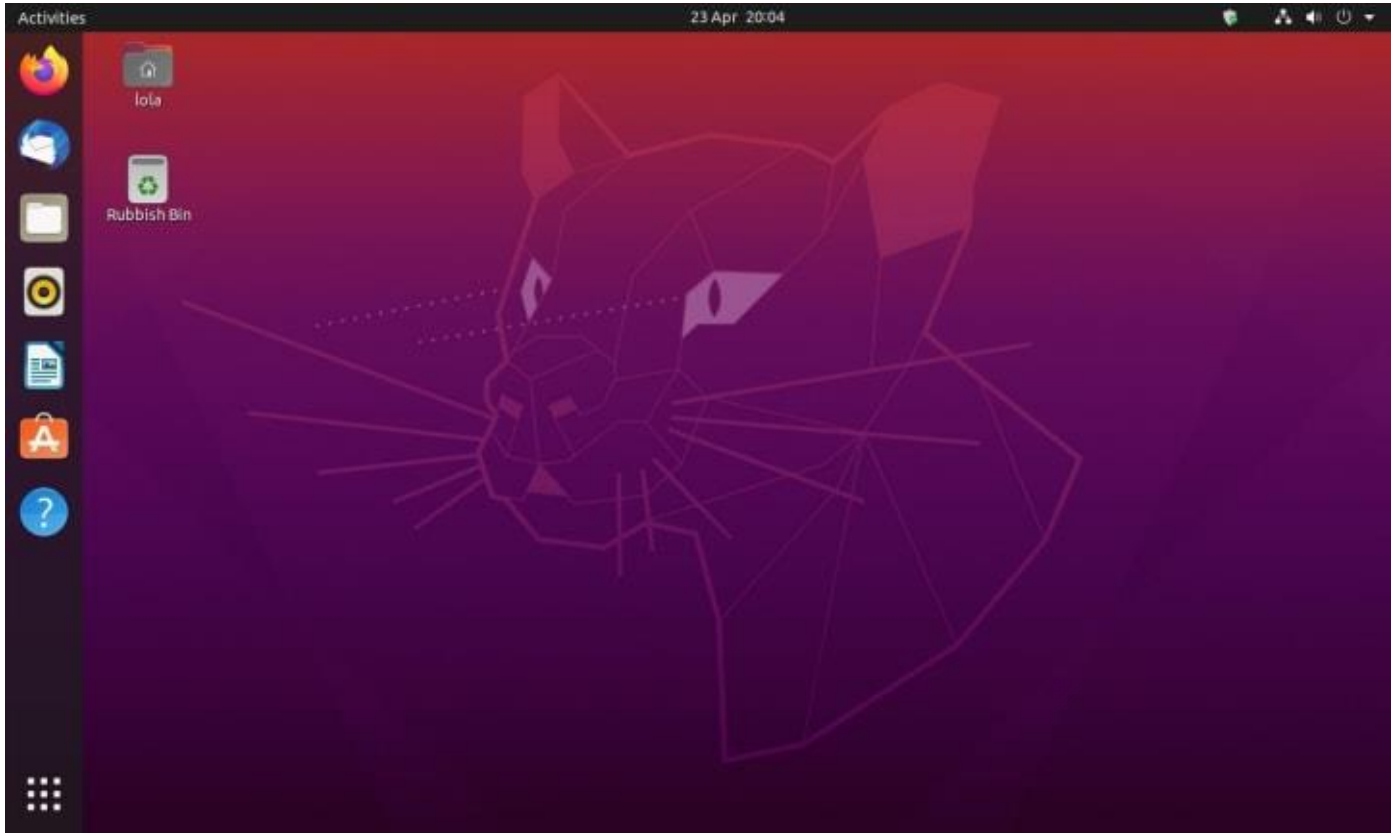
https://ubuntu.com/tutorials/how-to-run-ubuntu-desktop-on-a-virtual-machine-using-virtualbox#2-create-a-new-virtual-machine

2. Open VirtualBox and follow steps 2-4 in the linked tutorial

I recommend allocating your virtual machine at least 4GB memory and 30GB storage!

Welcome to Ubuntu!

- Familiarise yourself with your Ubuntu system



The Command Line (or 'Terminal')

- Uses a text-based interface to control your computer

Commands are written in Bash, a command language

- You will be using it A LOT! We will practice now…

1. Click 'Show Applications' (bottom-left icon on the screen) and search for Terminal

When you find it, I suggest right-clicking and adding to favourites! It will now appear in the taskbar

2. Run Terminal

3. Type cd Documents and press Enter

This will navigate your active directory to Documents

4. Type nano Hello_World.txt and press Enter to start making a text document (named Hello_World)

5. Type Hello World! and press Ctrl+X

6. Type Y or y to agree to the changes made, and then press Enter to write the file.

7. To read the contents of the file, type cat Hello_World.txt and press Enter

8. If you want to edit the file, simply type nano Hello_World.txt again

9. Let's create a new folder and move our text file into it - type mkdir MyFolder and press Enter to create a new folder (named MyFolder)

10. Type mv Hello_World.txt MyFolder to move the text file into the folder

- To finish, let's clean up the mess we've made

11. Type cd MyFolder to navigate into the folder and then type rm Hello_World.txt to delete the text file

12. Type cd .. to exit out of the folder and then type rm –rd MyFolder to delete the folder

Basic Commands

- Navigate between folders: cd <folder path>

Note: cd .. exits the current folder

You can navigate to a specific directory in one go! Use cd ~/<entire directory (from home)>

- Opening files: cat <file name>
- Creating folder: mkdir <folder name>
- Creating/editing files: nano <file name>
- Copying files: cp <source file> <target location>
- Copying folders: cp –r <source folder> <target location>
- Deleting files: rm <filename>
- Deleting folders: rm –rd <folder name>

Many, MANY more commands exist!

https://ubuntu.com/community/Beginners/BashScripting

- Try the above link for more information on using the Command Line (and for much more practice!)
- I would recommend getting familiar with it sooner rather than later – you will really value this as we start working with ROS!

Summary

We covered:

- Overview of what ROS is
- How ROS works (nodes, publishers, subscribers, etc.)
- Introduction to VirtualBox and then Ubuntu
- The Command Line

Next time, we will install ROS and start using it!