جامعة خليفة
Khalifa University

Introduction to ROS

TUESDAY, JULY 19, 2022

What is ROS (Robot Operating System)?

ROS

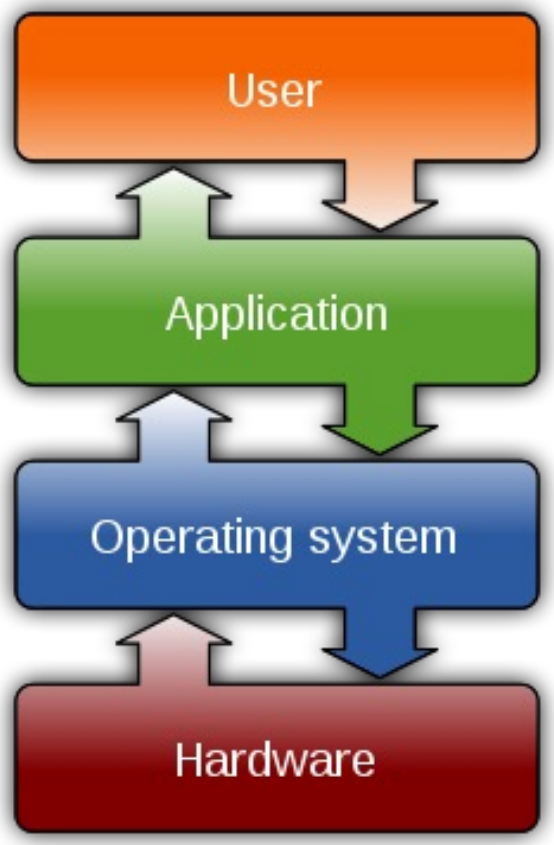
- It is not a Operating System (OS)
- It is not an Application Programming Interface (API)
- It is not a «simple» framework

ROS is a middleware for robotic programming, specifically designed for complex applications

BTW, What are OS, API, Framework and Middleware?
Which are the differences?

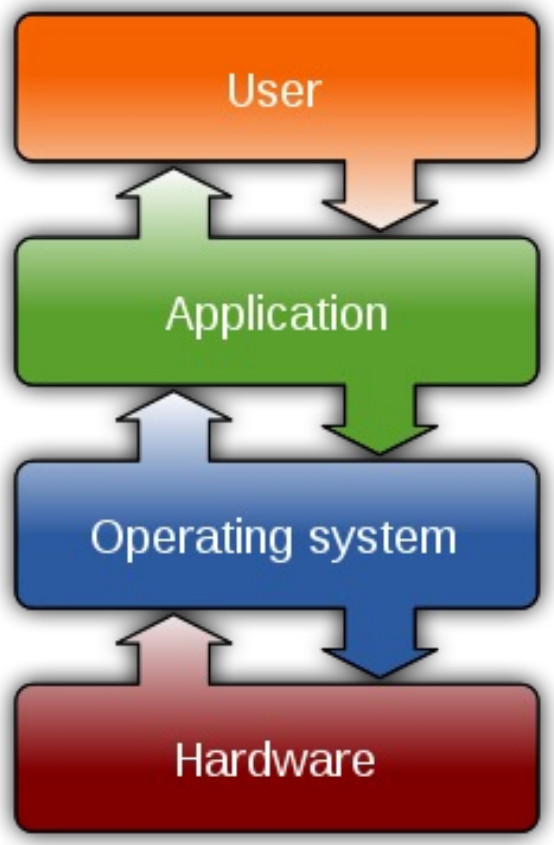
What are OS, API, Framework and Middleware?

- An application programming interface (API) is an interface (e.g. set of functions and methods, data types)intended to simplify the implementation and maintenance of software.
- An operating system (OS) is system software that manages computer hardware, software resources, and provides common services for computer programs.



What are OS, API, Framework and Middleware?

- Framework provide an infrastructure and a methodology for quickly developing and distributing complex software applications. Do not try to do things not supported by the framework!
- Middleware is a set of software tools (including APIs and Frameworks) that provides services to applications to enable easy communication and integration of different modules/functionalities. It can be described as "software glue".



Why a middleware for robotic programming?

- Simplify development process
- Provide simple and transparent inter-processes communication
- Provide software functionalities that are frequently needed in robotic applications
- Abstract high complexity and heterogeneity of different hardware and software components
- Provide an automatic and efficient process for configuring and managing different resources and components
- Supporting embedded system and “low-resources devices”

Quick background about robotic middleware

Many robotic middleware have been proposed, for example:

- **Player/Stage**: based on client-server architecture
- **Miro - Middleware for Robots**: distributed inter-process communication(based on CORBA)

- **OROCOS**: designed for real-time applications
- **URBI:** focusing on component architecture and management

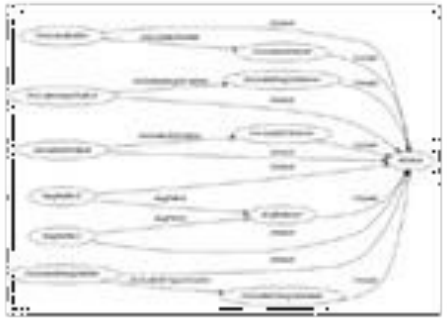
- **YARP**: Yet another robotic platform ☺

Robotic middleware:
https://en.wikipedia.org/wiki/Robotics_middleware

Quick background about ROS

- Originally developed, around 2007, from Stanford University, Artificial Intelligence Lab
- Then developed with the collaboration of other research groups, in particular Willow Garage
- Since 2013 developed and maintained by Open Source Robotic Foundation (OSRF)
- It is de-facto standard for high level robotic programming in research environment
- Recently the development of ROS2 has started but it is still in a early stage. There is also a consortium called ROS Industrial focused in transferring ROS modules in industrial applications


ROS Characteristics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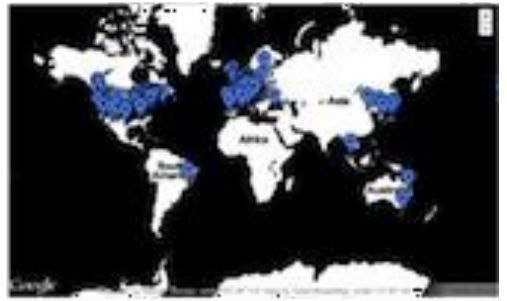


Plumbing

- Process management
- Inter-process communication
- Device drivers

Tools

- Simulation
- Visualization
- Graphical user interface
- Data logging

Capabilities

- Control
- Planning
- Perception
- Mapping
- Manipulation

Ecosystem

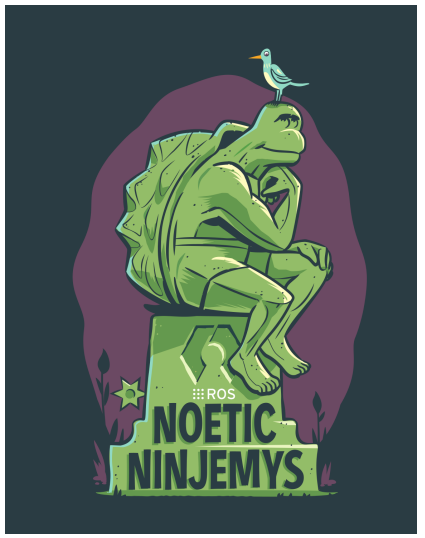
- Package organization
- Software distribution
- Documentation
- Tutorials

ROS Philosophy

- **Peer to peer :** Individual programs communicate over defined API (ROS *messages*, *services*, etc.).
- **Distributed:** Programs can be run on multiple computers and communicate over the network.
- **Multi-language support:** ROS modules can be written in any programming language for which a client library exists (C++, Python, MATLAB, Java, etc.).
- **Light-weight:** Stand-alone libraries are wrapped around with a thin ROS layer.
- **Free and open-source:** Most ROS software is open-source and free to use.

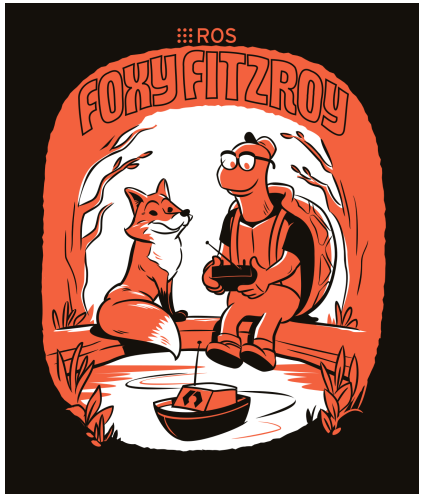
ROS Distributions

- A ROS distribution is a versioned set of ROS packages.
- These are similar to Linux distributions (e.g. Ubuntu).
- The purpose of the ROS distributions is to let developers work against a relatively stable codebase



Release rules

- ROS release timing is based on need and available resources
- All future ROS 1 releases are LTS, supported for five years
- ROS releases will drop support for EOL Ubuntu distributions, even if the ROS release is still supported.



Partial List of ROS and Ubuntu Distributions

Distro	Release date	Poster	*Tuturtle*, turtle in tutorial	EOL date
ROS Noetic Ninjemys	May, 2020 (planned, see Upcoming Releases)	TBA	TBA	May, 2025 (planned)
ROS Melodic Morenia (**Recommended**)	May 23rd, 2018			May, 2023 (Bionic EOL)
ROS Lunar Loggerhead	May 23rd, 2017			May, 2019
ROS Kinetic Kame	May 23rd, 2016			April, 2021 (Xenial EOL)
ROS Jade Turtle	May 23rd, 2015			May, 2017
ROS Indigo Igloo	July 22nd, 2014			April, 2019 (Trusty EOL)

Applications

ROS

Operating System (Linux Ubuntu)

Version	Code name	Release date	Supported until
14.04 LTS	Trusty Tahr[91]	2014-04-17	2019-04
14.10	Utopic Unicorn[92]	2014-10-23[93]	2015-07-23
15.04	Vivid Vervet[94]	2015-04-23	2016-02-04
15.10	Wily Werewolf[95]	2015-10-22[96]	2016-07-28[97]
16.04 LTS	Xenial Xerus[98]	2016-04-21[99]	2021-04
16.10	Yakkety Yak[100]	2016-10-13[101]	2017-07-20[102]
17.04	Zesty Zapus	2017-04-13[103]	2018-01-13[104]
17.10	Artful Aardvark	2017-10-19[105]	2018-07-19[106]
18.04 LTS	Bionic Beaver	2018-04-26[107]	2028-04[19]
18.10	Cosmic Cuttlefish[108]	2018-10-18[109]	**2019-07**
19.04	Disco Dingo[110]	2019-04	2020-01

Legend: Old version | Older version, still supported | **Latest version** | Future release

Reference

- Video: https://vimeo.com/245826128
- Complete timeline/History: http://www.ros.org/history