Python for robotics

(Python + ROS)

2021-2022

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Agenda

• Samedi 16/10/21	10h00 – 12h00	Présentiel.
• Lundi 18/10/21	17h00 – 19h00	Microsoft Teams
• Lundi 25/10/21	17h00 – 19h00	Microsoft Teams
• Lundi 08/11/21	17h00 – 19h00	Microsoft Teams
• Samedi 20/11/21	09h00 – 12h00	Présentiel. (TP)

Python: the programming language

Created in 1991, python is designed for code readability using indentation

```python
n = int(input('Type a number, and its factorial will be printed: '))

if n < 0:
    raise ValueError('You must enter a non-negative integer')

factorial = 1
for i in range(2, n + 1):
    factorial *= i

print(factorial)
```

Let's try it

1) write a function that prints all the numbers between 0 and 20

2) write a function that computes the euclidean distance between two 2D points a=(x1, y1) and b=(x2, y2)

You can try your code using: Google collab notebook

https://www.pythoncheatsheet.org/#Python-Basics

ROS:
The Robot Operating System

Outline

Introduction

ROS technical

ROS related projects (gazebo inside)

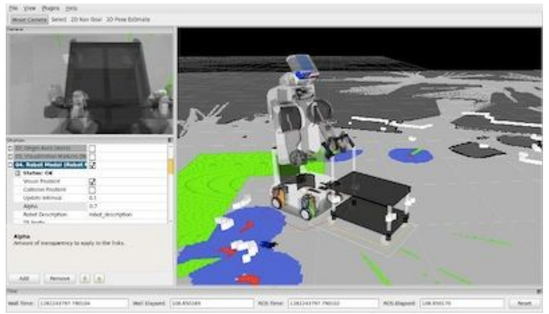
Future of ROS

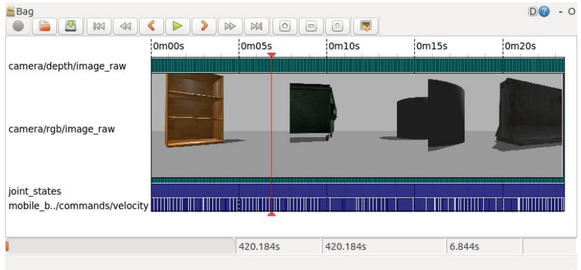
Introduction

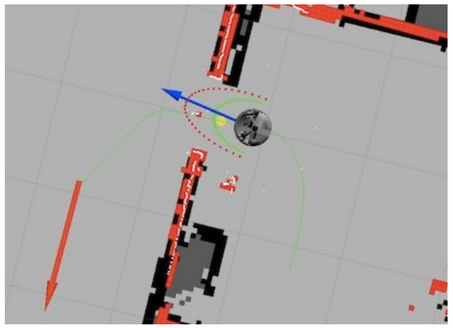
What is ROS ?

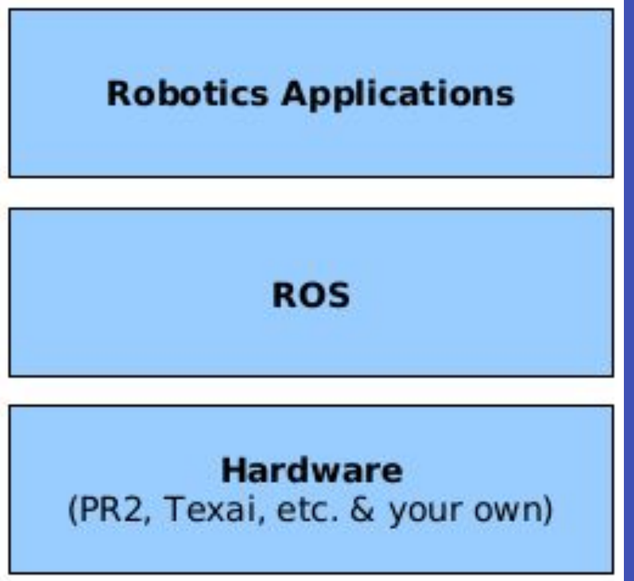
Collection of tools, libraries, conventions

to build robot software (i.e applications)









- Open-Source (Free Software - BSD license)
- Amazing community (ros answers, ros conference, github, wiki, user groups)

ROS goal ?

Support **code reuse** in robotics

Don't reinvent the wheel

Writing robot software is hard ->
collaboration is required

l'Histoire

ROS history

- Developed in 2007 (switchyard) by the Stanford AI LAB

- From 2008 - 2013: development performed at Willow Garage (robotic incubator, SF Bay area)

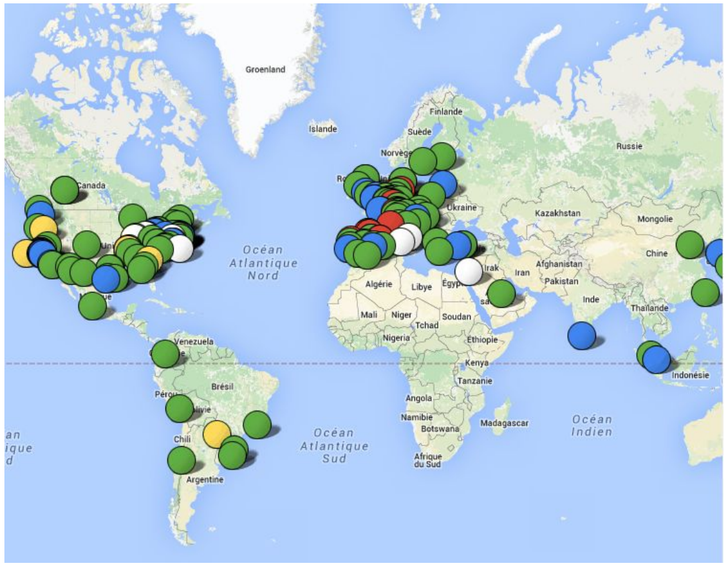
- From February 2013: Open Source Robotics Foundation

Open Source Robotics Foundation

Who is using ROS ?

80 types of robots are using ROS: wheeled robots of all sizes, legged humanoids, industrial arms, outdoor ground vehicles (including self-driving cars), aerial vehicles, surface vehicles

Nasa, BMW, Fraunhofer, PAL robotics, **Stanley-Robotics** etc..



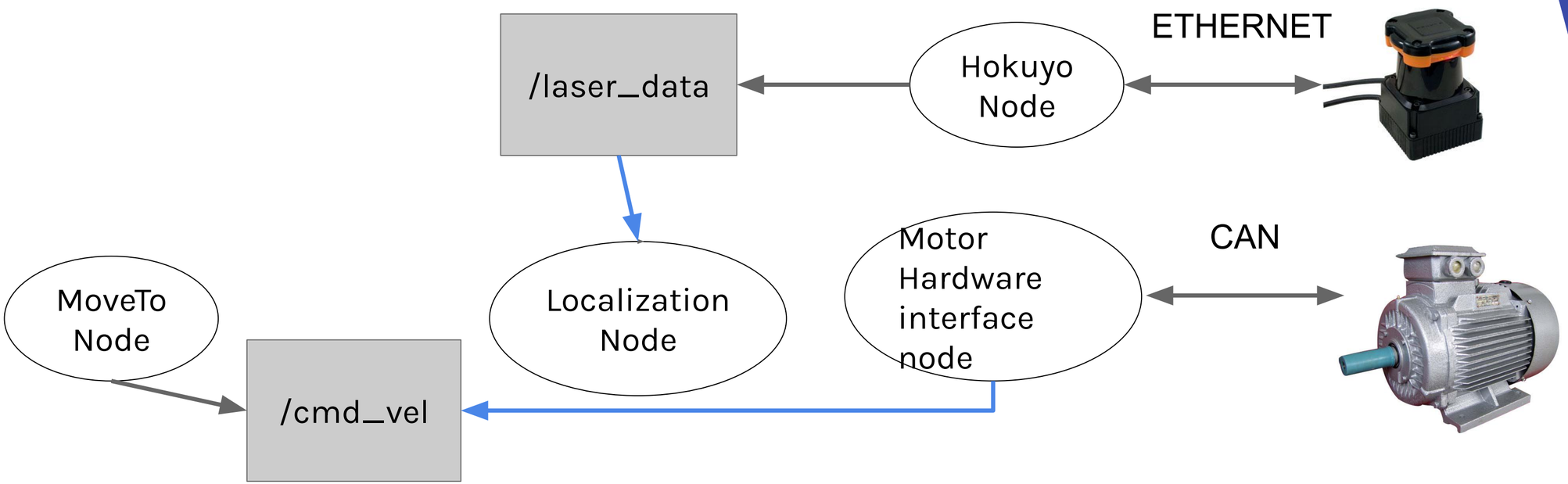
ROS
Technical part

Technical

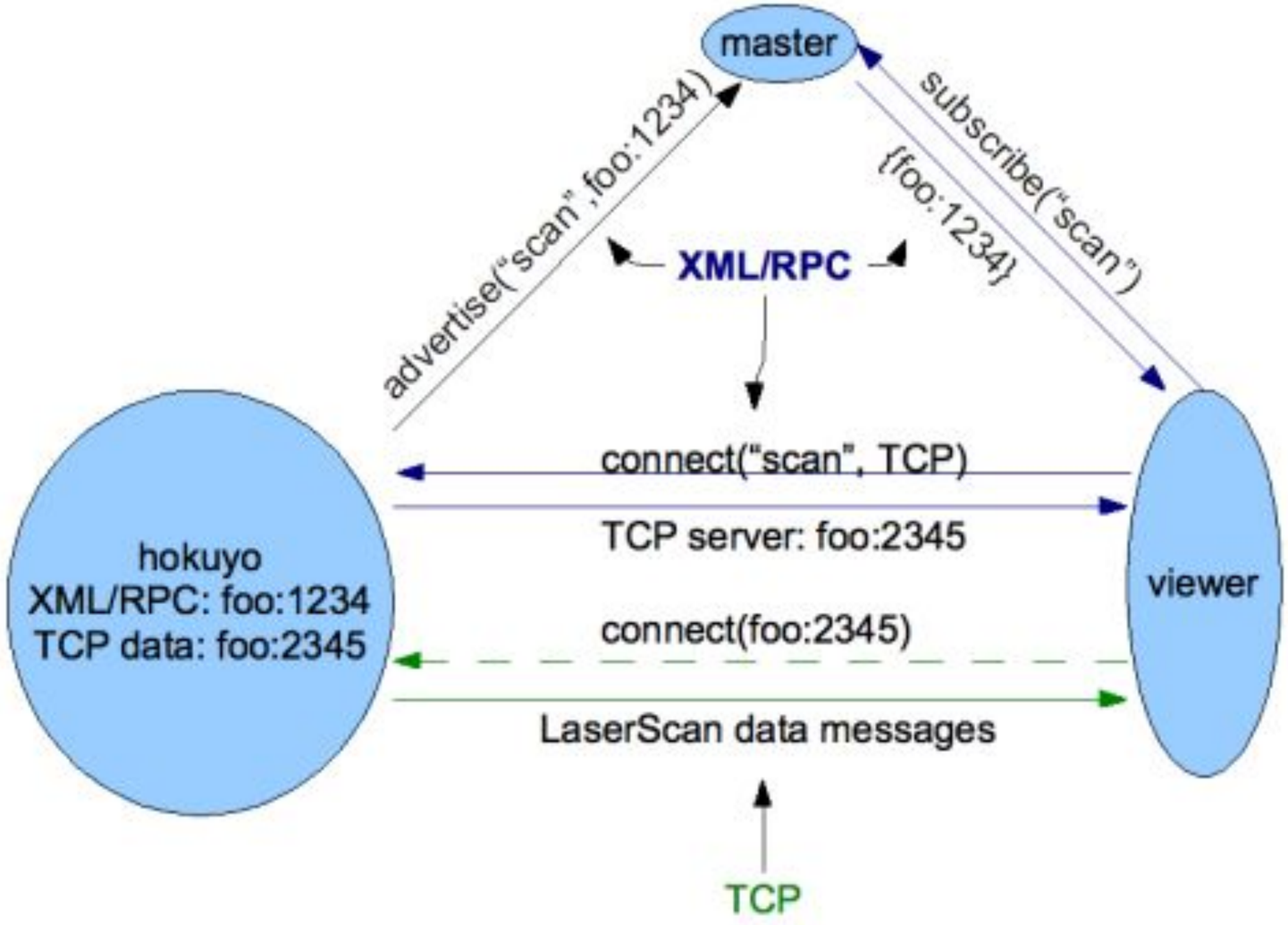
Open-source meta-operating system:

- hardware abstraction
- low level device control
- implementation of commonly-used functionality
- message passing between process (**plumbing**)

Ros Nodes


/laser_data
Hokuyo Node
ETHERNET
MoveTo Node
Localization Node
Motor Hardware interface node
CAN
/cmd_vel

Topic connection example



ROS

Languages:

- C++, **python**, java, lisp

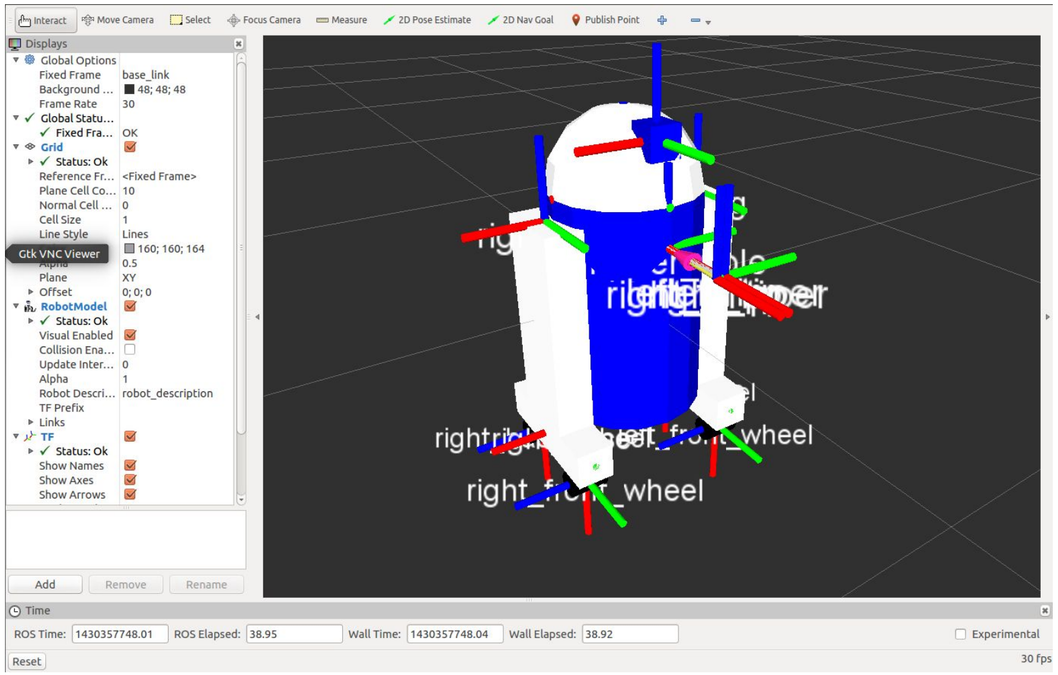
Supported platforms:

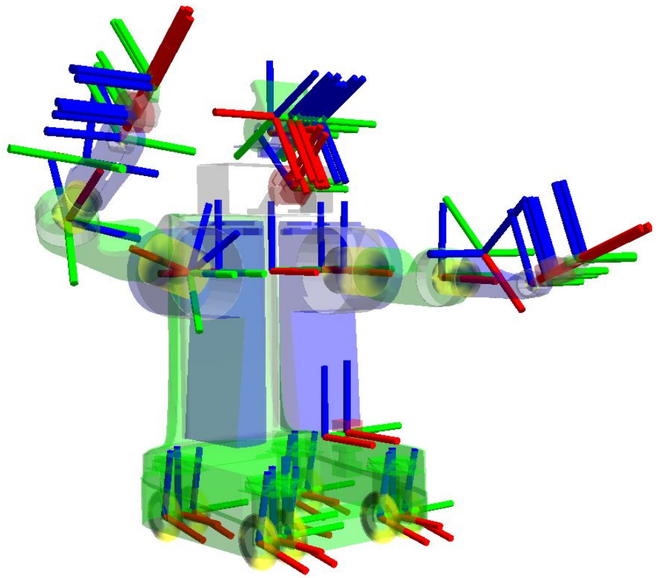
- Linux, MacOS, Android

Distro	Release date	Poster	*Tuturtle*, turtle in tutorial	EOL date
ROS Noetic Ninjemys (**Recommended**)	May 23rd, 2020			May, 2025 (Focal EOL)
ROS Melodic Morenia	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)
ROS Hydro Medusa	September 4th, 2013			May, 2015

Unified Robot Description Format (URDF)

XML format for representing a robot model



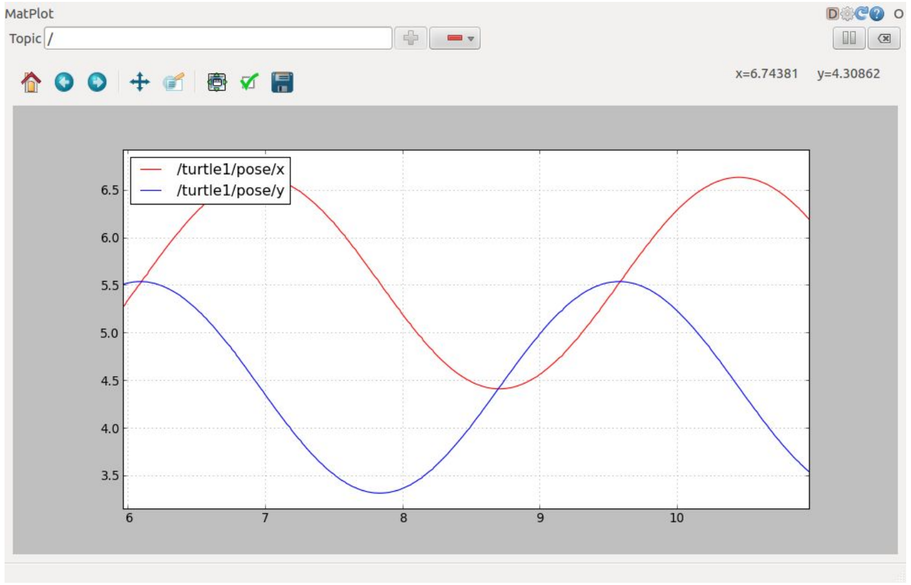


Tools

Rosbag: record robot data

RVIZ: visualization

Rqt plot: plot sensor data



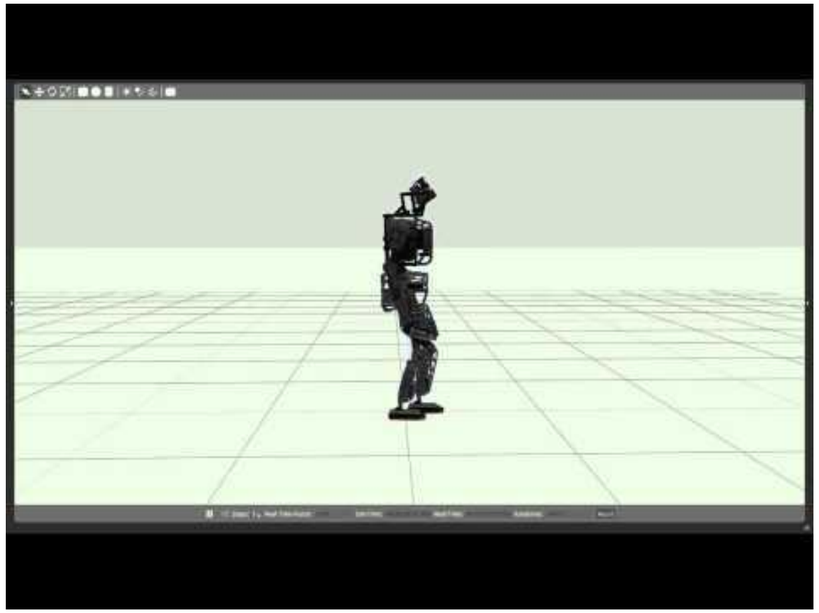
ROS related projects

GAZEBO: the robot simulator

rapidly test algorithms

design robots

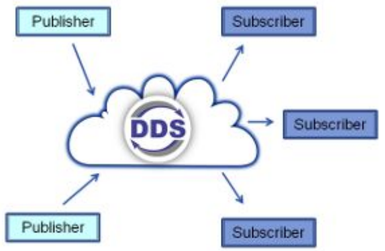
perform testing using realistic scenarios



Future of ROS

ROS 2

- multi-robots
- platform support (windows, microcontroller)
- support quality of service (profiles)



redis

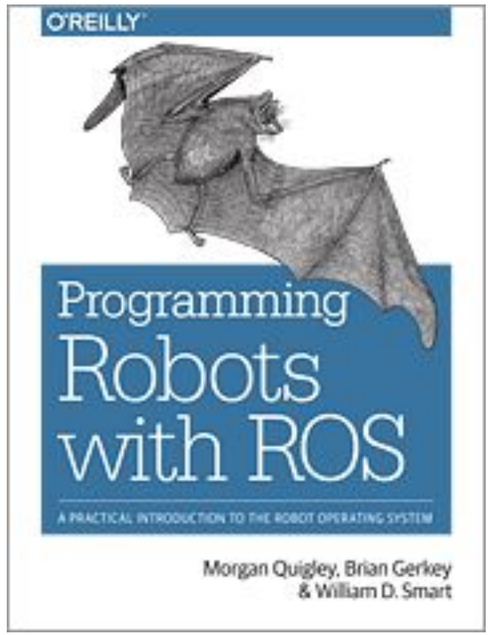
protobuf
Protocol Buffers - Google's data interchange format

ROS Industrial

ROS to manufacturing (e.g. support CAN OPEN)

Ressources

- **Programming Robots with ROS**



- Reddit: **/r/robotics/**

- ROS wiki

Contact

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CREDITS

Special thanks to all the people who made and released these awesome resources for free:

- Presentation template by SlidesCarnival
- Photographs by Death to the Stock Photo (license)