Assignment 1. Robot Operating System

Complete by **TBA**

In this assignment, you will learn the basics of Robot Operating System (ROS). You will install ROS on your own computer, and write some simple programs.

1 ROS

Robot Operating System (ROS) is the most widely-used free software platform for robot programming. It has a well-designed architecture, many functionalities, and a strong user community. However, it is a complex programming system. This assignment helps you get started. After completing this assignment, you should have ROS working on your own computer.

2 Installation

Officially, ROS supports Ubuntu Linux only. Compiling ROS on other Linux distributions, e.g., ArchLinux, or Mac OS is often difficult. Further, ROS releases are tightly bound to Ubuntu. For example, ROS Kinetic requires Ubuntu 16.04 to work properly. Various packages require particular versions of Ubuntu. We advise that as a beginner, you follow the instructions here closely to avoid unnecessary setbacks. After gaining some experiences, you are, of course, free to explore alternatives.

2.1 Installing Ubuntu 16.04

The cleanest and the recommended way to install Ubuntu 16.04 is to create a separate drive partition on your computer and install Ubuntu there.

- *Linux users.* We assume that you already know how to do this, as you have already installed your own Linux distribution.
- *Windows users.* Follow this tutorial, which shows how to install Ubuntu alongside Windows and make your computer dual boot.
- *Mac users.* Dual booting with Ubuntu is not easy, and the recommended way is to install on a virtual machine, e.g., Oracle VM VirtualBox, which is free. First, Install the virtual machine on your Mac computer, and then install Ubuntu within the virtual machine.

The virtual machine installation works for non-Mac users as well, but the dual-boot installation provides better performance.

2.2 Installing ROS Kinetic

Next, install ROS Kinetic by following the official tutorial *step by step* closely. You should install ros-kinetic-desktop-full:

```
$ sudo apt install ros-kinetic-desktop-full
```

This gives you full access to most of the ROS packages. After completing the installation, open a new terminal and type

```
$ roscore
```

You installation is successful if this launches properly.

3 ROS Basics

ROS provides the services you would expect from an operating system, including hardware abstraction, low-level device control, implementations of commonly-used functionalities, message-passing between processes, and package management. It also provides tools and libraries for obtaining, building, writing, and running code across multiple computers. For an overview, see the tutorial slides. The video recording is also available on Luminus under *Web Lectures*.

Follow the ROS official tutorial (Section 1.1.1 to 1.1.12) and try out the examples on your own system. You should be able to

- understand key concepts, such as ROS master, topics, nodes, messages (Section 1.1.5 and 1.1.6);
- create your own catkin workspace and package (Section 1.1.2 to 1.1.4);
- write publishers and subscribers (Section 1.1.11 to 1.1.12).