02. Linux and ROS principles

Theory

Linux principles



- Only OS supported by ROS
- Security
- Efficieny
- Open-source
- Community support
- User freedom
- Distributions: **Ubuntu**, Linux Mint, Debian, etc.
- Terminal usage more dominant

Suggestion

Install **Terminator** terminal emulator:

sudo apt update sudo apt install terminator

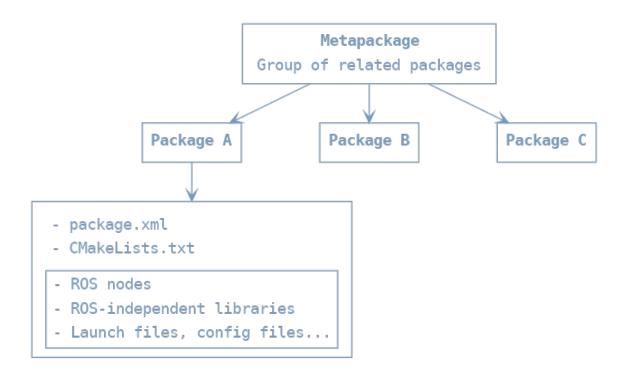
Linux commands

See some basic commands below:

- Run as administrator with sudo
- Manual of command man, e.g. man cp
- Package management apt, e.g. apt update, apt install
- Navigation cd
- List directory contents ls
- Copy file cp
- Move file mv
- Remove file rm
- Make directory mkdir
- Remove directory rmdir
- Make a file executable chmod +x <filename>
- Safe restart: Crtl + Alt + PrtScr + REISUB
- If not sure, just google the command

ROS principles

ROS file system



ROS package principle

Enough functionality to be useful, but not too much that the package is heavyweight and difficult to use from other software.

ROS package

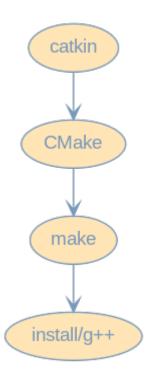
- Main unit to organize software in ROS
- Buildable and redistributable unit of ROS code
- Consosts of:
 - Manifest (package.xml): information about package
 - name
 - version
 - description
 - dependencies
 - etc.
 - CMakeLists.txt: input for the CMake build system
 - Anything else
- rosrun turtlesim turtlesim_node

ROS node

- Executable part of ROS:
 - python scripts
 - compiled C++ code
- A process that performs computation
- Inter-node communication:
 - ROS topics (streams)
 - ROS parameter server
 - Remote Procedure Calls (RPC)
 - ROS services
 - ROS actions
- Meant to operate at a fine-grained scale
- Typically, a robot control system consists of many nodes, like:
 - Trajectory planning
 - Localization
 - Read sensory data
 - Process sensory data
 - Motor control
 - User interface
 - etc.

ROS build system---Catkin

• System for building software packages in ROS

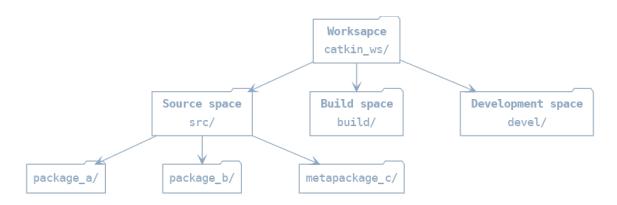


ROS workspace



Catkin workspace

A folder where catkin packages are modified, built, and installed.



- Source space:
 - Source code of catkin packages
 - Space where you can extract/checkout/clone source code for the packages you want to build
- Build space
 - CMake is invoked here to build the catkin packages

- CMake and catkin keep intermediate files here
- Devel space:
 - Built target are placed here prior to being installed

Environmental setup file

- setup.bash
- generated during init process of a new workspace
- extends shell environment
- ROS can find any resources that have been installed or built to that location

source ~/catkin_ws/devel/setup.bash

ROS master

roscore

- Registers:
 - Nodes
 - Topics
 - Services
 - Parameters
- One per system
- roslaunch launches ROS master automatically

Gyakorlat



Warning!

At the end of the lesson, everybody must upload their **sources** to **Moodle** as a zip archive!

1: Turtlesim

1. Launch ROS master, turtlesim_node and turtle_teleop_key node by typing the following commands to separate terminal windows:



Tip

In **Terminator**, Ctrl-Shift-O , Ctrl-Shift-E divides the terimal window, Ctrl-Shift-W closes the current window.

roscore
rosrun turtlesim turtlesim_node
rosrun turtlesim turtle_teleop_key



To stup running

Ctrl-C

2. Display the running nodes and topics using this command, in a separate terminal:

rosrun rqt_graph rqt_graph

3. Try the following commands to gain more information about the currently running system:

roswtf
rospack list
rospack find turtlesim
rosnode list
rosnode info
rosnode info /turtlesim
rostopic list
rostopic info /turtle1/cmd_vel
rosmsg show geometry_msgs/Twist
rostopic echo /turtle1/cmd_vel

4. Type (or copy) the following command to the terminal:

2: Catkin workspace

1. Install the catkin build tools package:

```
sudo apt update
sudo apt-get install python3-catkin-tools python3-osrf-pycommon
```

2. Copy the following file to the end of file \sim /.bashrc:

```
{\color{red} \textbf{source /opt/ros/noetic/setup.bash} \quad \textit{\# replace noetic by whatever your ROS distribution} \\ \textbf{is} \\
```

3. Create the workspace:

```
source /opt/ros/noetic/setup.bash
mkdir -p ~/catkin_ws/src
cd ~/catkin_ws
catkin init
```

3: Create a new ROS package

 Create a new ROS package named ros_course, depends packages std_msgs, rospy and roscpp:

```
cd ~/catkin_ws/src
catkin create pkg ros_course --catkin-deps std_msgs rospy roscpp
```



2. Open the file package.xml and fill the following tags:

```
<description>The beginner_tutorials package</description>
<maintainer email="you@yourdomain.tld">Your Name</maintainer>
```

3. Build the workspace:

```
cd ~/catkin_ws
catkin build
```



Danger

The commands catkin build and catkin_make are not meant to be used within the same workspace!

4. Append the following line to the file ~/.bashrc:

```
source ~/catkin_ws/devel/setup.bash
```

4: Implement a Publisher in Python

1. Create folder named scripts in the ros_course package:

```
cd ~/catkin_ws/src/ros_course
mkdir scripts
cd scripts
```

2. Navigate to the scripts folder and create the file talker.py , fill it with the following content:

```
import rospy
from std_msgs.msg import String

def talker():
    rospy.init_node('talker', anonymous=True)
    pub = rospy.Publisher('chatter', String, queue_size=10)

rate = rospy.Rate(10) # 10hz

while not rospy.is_shutdown():
    hello_str = "hello world %s" % rospy.get_time()
```

```
print(hello_str)
    pub.publish(hello_str)
    rate.sleep()

if __name__ == '__main__':
    try:
        talker()
    except rospy.ROSInterruptException:
        pass
```

3. Open CMakeLists.txt and find the commented out line starting with catkin_install_python (it is near line 167). Uncomment and edit as the following:

```
catkin_install_python(PROGRAMS scripts/talker.py
  DESTINATION ${CATKIN_PACKAGE_BIN_DESTINATION}
)
```

4. Build the node:

```
cd ~/catkin_ws
catkin build
```

5. Start ROS master and run the node. In separate terminal windows:

```
roscore
rosrun ros_course talker.py
```

6. Check the output of the node, in a separate terminal:

```
rostopic echo chatter
```

- 5: Implement a Subscriber in Python
 - 1. Navigate to the scripts folder and create the file listener.py:

```
import rospy
from std_msgs.msg import String

def callback(data):
```

```
print(rospy.get_caller_id() + "I heard " + data.data)

def listener():

# In ROS, nodes are uniquely named. If two nodes with the same
# name are launched, the previous one is kicked off. The
# anonymous=True flag means that rospy will choose a unique
# name for our 'listener' node so that multiple listeners can
# run simultaneously.
rospy.init_node('listener', anonymous=True)

rospy.Subscriber("chatter", String, callback)

# spin() simply keeps python from exiting until this node is stopped rospy.spin()

if __name__ == '__main__':
    listener()
```

2. Modify CMakeLists.txt:

```
catkin_install_python(PROGRAMS scripts/talker.py scripts/listener.py
   DESTINATION ${CATKIN_PACKAGE_BIN_DESTINATION}
)
```

3. Build the workspace:

```
cd ~/catkin_ws
catkin build
```

4. Start ROS master and run the 2 nodes. In separate terminal windows:

```
rosrun ros_course talker.py
rosrun ros_course listener.py
```

5. Check the nodes and topic of the system:

```
rosrun rqt_graph rqt_graph
```

Warning!

At the end of the lesson, everybody must upload their $\mathbf{sources}$ to \mathbf{Moodle} as a zip archive!

Links

- ROS Tutorials
- Curiosity rover simulation