02. Linux, ROS alapismeretek

Elmélet

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
```

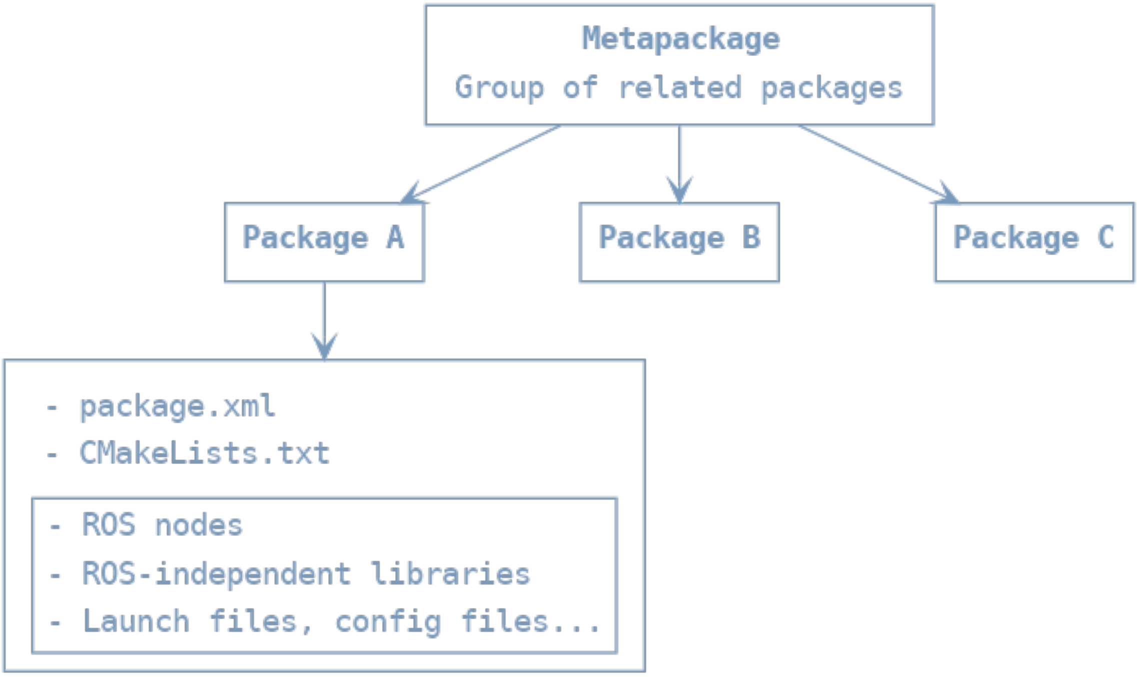
Linux commands

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

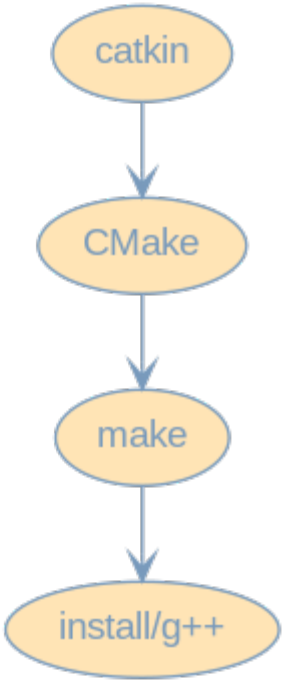
- Main unit to organize software in ROS
- Buildable and redistributable unit of ROS code
- Consosts of:
    - Manifest (package.xml): information about package
        - name
        - version
        - description
        - dependencies
        - etc.
    - CMakeLists.txt: *input for the CMake build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

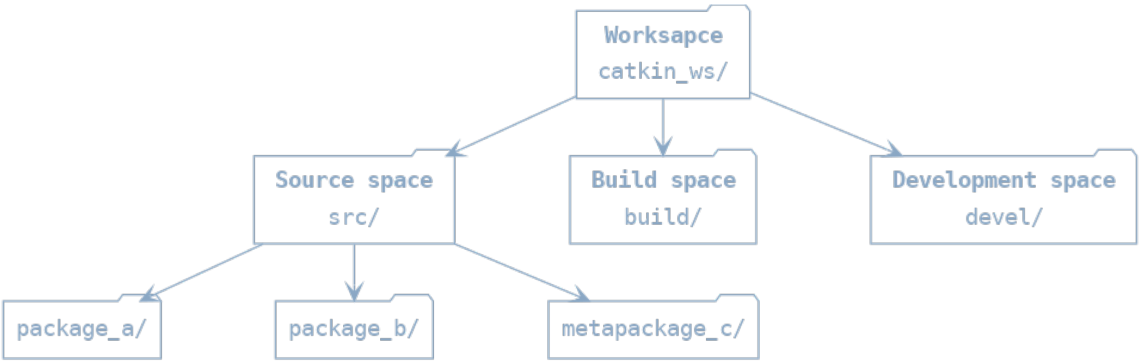
ROS build system---Catkin

- 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

> **Figyelem!**
>
> Az óra végén a **forráskódokat** mindenkinek fel kell tölteni **Moodle**-re egy zip archívumba csomagolva!

1: Turtlesim

1. Indítsuk el a ROS mastert, `turtlesim_node`-ot és a `turtle_teleop_key` node-ot az alábbi parancsokkal, külö-külön terminál ablakokban:

   > **Tip**
   >
   > **Terminator**-ban `Ctrl-Shift-O`, `Ctrl-Shift-E` billentyű kombinációkkal oszthatjuk tovább az adott ablakot. `Ctrl-Shift-W` bezárja az aktív ablakot.

   ```
   roscore
   rosrun turtlesim turtlesim_node
   rosrun turtlesim turtle_teleop_key
   ```

   > **Futtatás megszakítása**
   >
   > `Ctrl-C`

2. Az alábbi parancs segítségével jeleníttessük meg a futó rendszer node-jait és topic-jait:

   ```
   rosrun rqt_graph rqt_graph
   ```

3. Az alábbi ROS parancsok futtatása hasznos információkkal szolgálhat:

   ```
   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. Írjuk be a következő parancsot terminálba:

```
rostopic pub /turtle1/cmd_vel geometry_msgs/Twist -r 1 -- '[2.0, 0.0, 0.0]' '[0.0, 0.0, 1.8]'
```

2: Catkin workspace

1. Telepítsük a catkin build tools csomagot:

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

2. Másoljuk az alábbi sort a `~/.bashrc` fájl végére:

```
source /opt/ros/noetic/setup.bash   # replace noetic by whatever your ROS distribution is
```

3. Hozzuk létre a workspace-t:

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

3: ROS package létrehozása

1. Hozzunk létre új ROS package-et `ros_course` névvel.

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

Szintaxis

`catkin create pkg <PKG_NAME> --catkin-deps <DEP_1> <DEP_2>`

2. Nyissuk meg a `package.xml` fájlt, és töltsük fel a következő tag-eket:

```xml
<description>The beginner_tutorials package</description>

<maintainer email="you@yourdomain.tld">Your Name</maintainer>
```

3. Build-eljük a workspace-t.

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

> **Danger**
>
> **Soha** ne használjuk a `catkin build` és a `catkin_make` parancsokat ugyanabban a workspace-ben!

4. A `~/.bashrc` fájl végére illesszük be az alábbi sort:

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

4: Publisher implementálása Python-ban

1. Hozzunk létre egy mappát `scripts` névvel a `ros_course` package-ben.

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

2. Navigáljunk a `scripts` mappába és hozzuk létre a `talker.py` fájlt az alábbi tartalommal.

```python
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. A `CMakeLists.txt` -hez adjuk hozzá a következőt:

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

4. Build-eljük és futtassuk a node-ot:

```
cd ~/catkin_ws
catkin build
rosrun ros_course talker.py
```

Tip

A node futtatásához szükség van a ROS masterre. Egy külön terminál ablakban indítsuk el a `roscore` paranccsal.

5. Ellenőrizzük le a node kimenetét a `rostopic echo` parancs használatával.

5: Subscriber implementálása Python-ban

1. Navigáljunk a `scripts` mappába és hozzuk létre a `listener.py` fájlt az alábbi tartalommal.

```
import rospy
from std_msgs.msg import String

def callback(data):
    print(rospy.get_caller_id() + "I heard %s", 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. A `CMakeLists.txt` -hez adjuk hozzá a következőt:

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

3. Build-eljük és futtassuk mind a 2 node-ot:

```
cd ~/catkin_ws
catkin build
rosrun ros_course talker.py
```

```
rosrun ros_course listener.py
```

4. `rqt_graph` használatával jeleníttessük meg a futó rendszer node-jait és topic-jait:

```
rosrun rqt_graph rqt_graph
```

Figyelem!

Az óra végén a forráskódokat mindenkinek fel kell tölteni Moodle-re egy zip archívumba csomagolva!

Hasznos linkek

- ROS Tutorials
- Curiosity rover simulation