

ROS packages and nodes

Robot Operating System (ROS), which is a collection of software packages to aid researchers and developers using robotic systems.

ROS is sometimes called a Meta operating system because it performs many functions of an operating system, but it requires a computer's operating system such as Linux. One of its main purposes is to provide communication between the user, the computer's operating system, and equipment external to the computer. This equipment can include sensors, cameras, as well as robots. As with any operating system, the benefit of ROS is the hardware abstraction and its ability to control a robot without the user having to know all of the details of the robot.

For example, to move a robot's arms, a ROS command is issued or scripts in Python or C++ written by the robot designers cause the robot to respond as commanded. The scripts can, in turn, call various control programs that cause the actual motion of the robot's arms. It is also possible to design and simulate your own robot using ROS.

Creating a catkin workspace

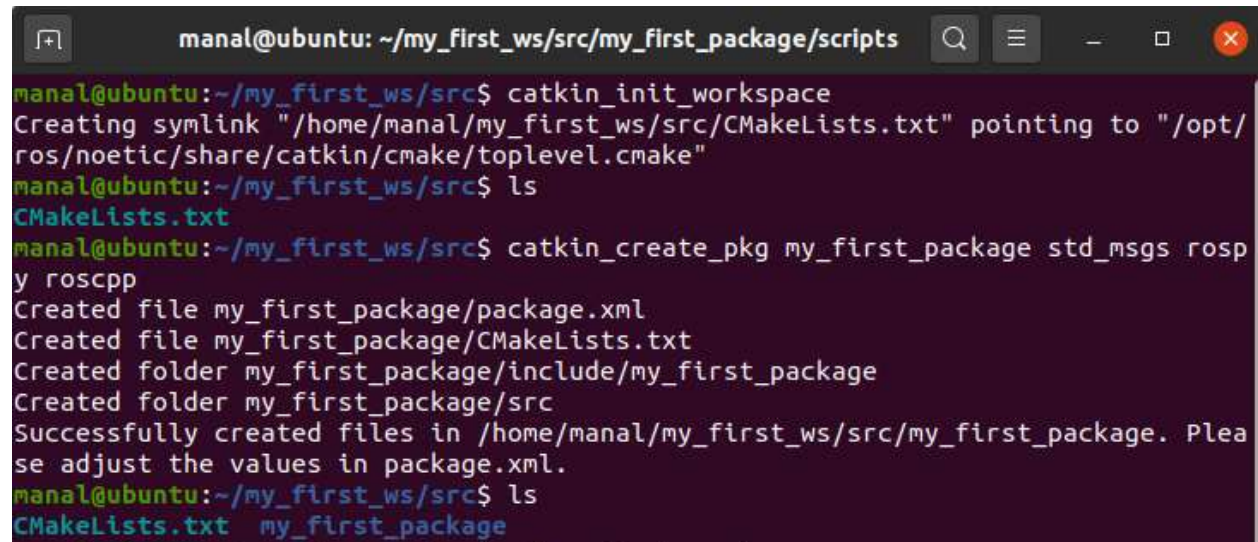
The next step is to create a catkin workspace. A catkin workspace is a directory (folder) in which you can create or modify existing catkin packages. The catkin structure simplifies the build and installation process for your ROS packages. The ROS wiki website is http://wiki.ros.org/catkin/Tutorials/create_a_workspace.

A catkin workspace can contain up to three or more different subdirectories (`/build`, `/devel`, and `/src`), each of which serve a different role in the software development process.

We will label our catkin workspace `catkin_ws`. To create the catkin workspace, type the following commands:

Creating and initialize catkin workspace

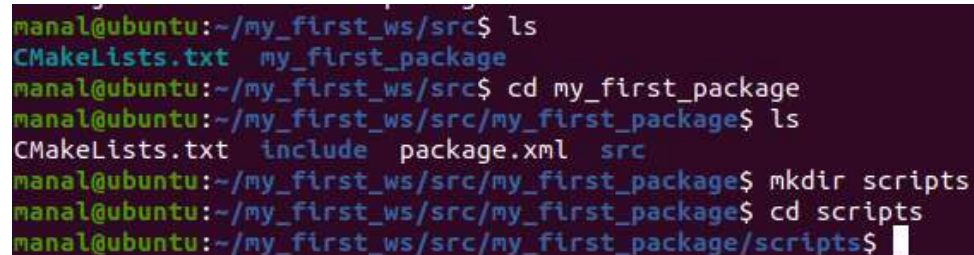
```
mkdir -p ~/file_name/src  
mkdir -p/my_firs_ws/src  
cd my_firs_ws  
cd src
```



A terminal window titled "manal@ubuntu: ~/my_first_ws/src/my_first_package/scripts" showing the following commands and output:

```
manal@ubuntu:~/my_first_ws/src$ catkin_init_workspace  
Creating symlink "/home/manal/my_first_ws/src/CMakeLists.txt" pointing to "/opt/  
ros/noetic/share/catkin/cmake/toplevel.cmake"  
manal@ubuntu:~/my_first_ws/src$ ls  
CMakeLists.txt  
manal@ubuntu:~/my_first_ws/src$ catkin_create_pkg my_first_package std_msgs rosp  
y roscpp  
Created file my_first_package/package.xml  
Created file my_first_package/CMakeLists.txt  
Created folder my_first_package/include/my_first_package  
Created folder my_first_package/src  
Successfully created files in /home/manal/my_first_ws/src/my_first_package. Plea  
se adjust the values in package.xml.  
manal@ubuntu:~/my_first_ws/src$ ls  
CMakeLists.txt  my_first_package
```

Create new package and scripts folder

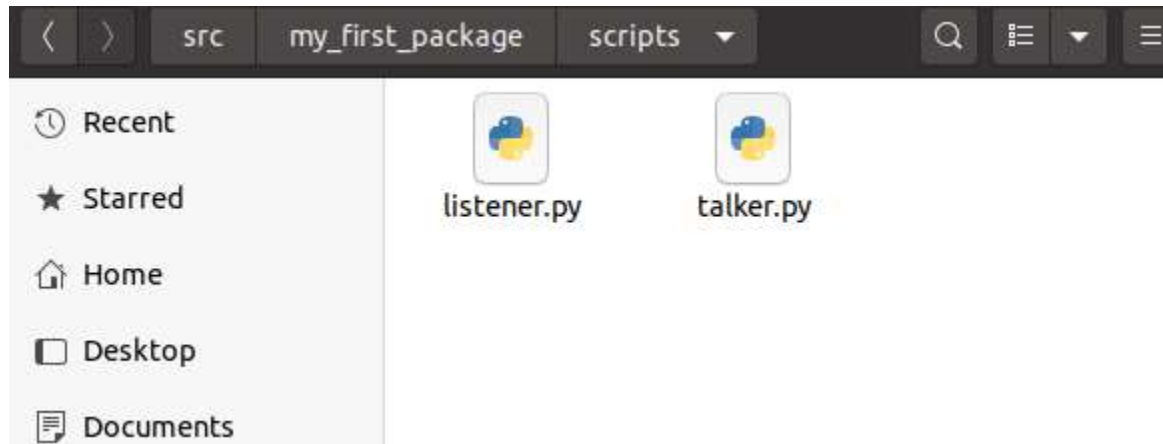


A terminal window showing the following commands and output:

```
manal@ubuntu:~/my_first_ws/src$ ls  
CMakeLists.txt  my_first_package  
manal@ubuntu:~/my_first_ws/src$ cd my_first_package  
manal@ubuntu:~/my_first_ws/src/my_first_package$ ls  
CMakeLists.txt  include  package.xml  src  
manal@ubuntu:~/my_first_ws/src/my_first_package$ mkdir scripts  
manal@ubuntu:~/my_first_ws/src/my_first_package$ cd scripts  
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$
```

Then create listener.py and talker.py files

```
manal@ubuntu: ~/my_first_ws
manal@ubuntu:~/my_first_ws/src/my_first_package$ mkdir scripts
manal@ubuntu:~/my_first_ws/src/my_first_package$ cd scripts
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$ touch listener
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$ touch listener.py
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$ touch talker.py
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$ ls
listener.py  talker.py
```



Write the **talker.py** node

```
Open  [icon]  listener.py  Save
~/my_first_ws/src/my_first_package/scripts

1 #!/usr/bin/env python
2 import rospy
3 from std_msgs.msg import String
4
5 def callback(data):
6     rospy.loginfo(rospy.get_caller_id() + "I heard %s", data.data)
7
8 def listener():
9
10    # In ROS, nodes are uniquely named. If two nodes with the same
11    # name are launched, the previous one is kicked off. The
12    # anonymous=True flag means that rospy will choose a unique
13    # name for our 'listener' node so that multiple listeners can
14    # run simultaneously.
15    rospy.init_node('listener', anonymous=True)
16
17    rospy.Subscriber("chatter", String, callback)
18
19    # spin() simply keeps python from exiting until this node is stopped
20    rospy.spin()
21
22 if __name__ == '__main__':
23     listener()
```

Write the **listener.py** node

```
Open  [icon]  talker.py
~/my_first_ws/src/my_first_package/scripts

1#!/usr/bin/env python
2# license removed for brevity
3import rospy
4from std_msgs.msg import String
5
6def talker():
7    pub = rospy.Publisher('chatter', String, queue_size=10)
8    rospy.init_node('talker', anonymous=True)
9    rate = rospy.Rate(10) # 10hz
10    while not rospy.is_shutdown():
11        hello_str = "hello world %s" % rospy.get_time()
12        rospy.loginfo(hello_str)
13        pub.publish(hello_str)
14        rate.sleep()
15
16if __name__ == '__main__':
17    try:
18        talker()
19    except rospy.ROSInterruptException:
20        pass
```

Make **listener.py** and **talker.py** file executable

```
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$ chmod +x listener.py
manal@ubuntu:~/my_first_ws/src/my_first_package/scripts$ chmod +x talker.py
```

Run the subscriber publisher

```
roscore http://ubuntu:11311/
roscore http://ubuntu:11311/  manal@ubuntu: ~/my_first_ws
manal@ubuntu:~/my_first_ws$ roscore
... logging to /home/manal/.ros/log/db156a0a-bdd7-11ea-89a8-8d1aec8ad836/roslaunch
ch-ubuntu-9047.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://ubuntu:33323/
ros_comm version 1.15.7

SUMMARY
*****
PARAMETERS
 * /rostdistro: noetic
 * /rosversion: 1.15.7

NODES
auto-starting new master
process[master]: started with pid [9071]
ROS_MASTER_URI=http://ubuntu:11311/

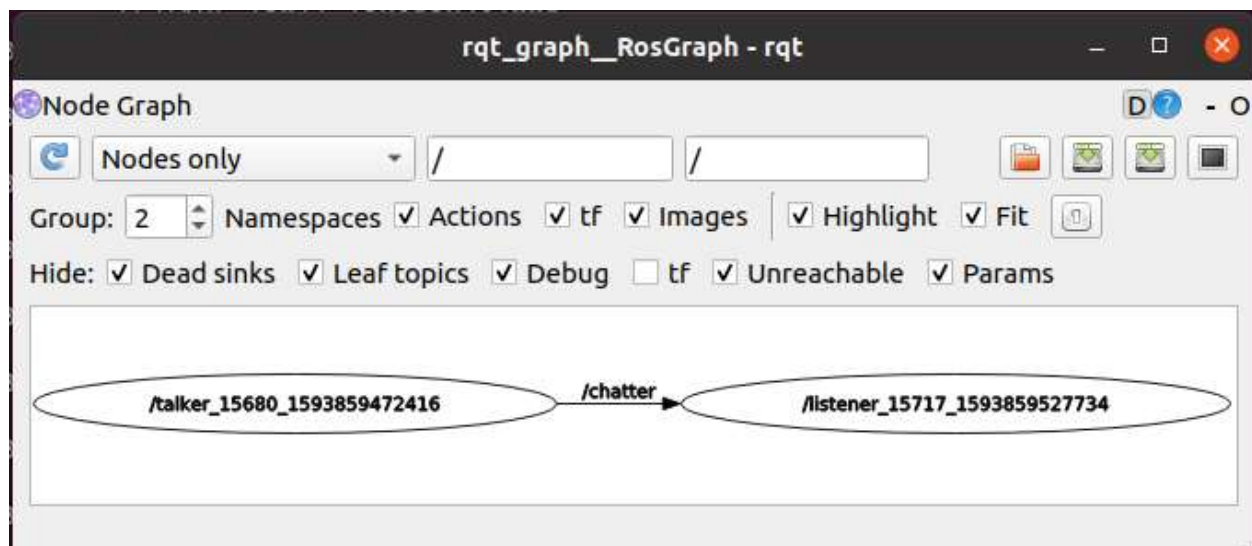
setting /run_id to db156a0a-bdd7-11ea-89a8-8d1aec8ad836
process[roscout-1]: started with pid [9081]
started core service [/roscout]
```



```
manal@ubuntu: ~/my_first_ws/src/my_first_package/scripts  Q  -  manal@ubuntu: ~/my_first_ws/src/my_first_packa...  Q  -  □  ✖
3861083.6747575 [INFO] [1593861082.575173]: hello world 1593861082.5750117
[INFO] [1593861083.777394]: /listener_15717_1593859527734I heard hello world [INFO] [1593861082.675504]: hello world 1593861082.6753697
3861083.7753644 [INFO] [1593861082.775525]: hello world 1593861082.7753894
[INFO] [1593861083.877072]: /listener_15717_1593859527734I heard hello world [INFO] [1593861082.874828]: hello world 1593861082.8746624
3861083.8749685 [INFO] [1593861082.975774]: hello world 1593861082.9755678
[INFO] [1593861083.977371]: /listener_15717_1593859527734I heard hello world [INFO] [1593861083.075806]: hello world 1593861083.0756028
3861083.975105 [INFO] [1593861083.175063]: hello world 1593861083.1749206
[INFO] [1593861084.077034]: /listener_15717_1593859527734I heard hello world [INFO] [1593861083.275310]: hello world 1593861083.2751687
3861084.075126 [INFO] [1593861083.375325]: hello world 1593861083.3751898
[INFO] [1593861084.176944]: /listener_15717_1593859527734I heard hello world [INFO] [1593861083.475154]: hello world 1593861083.4749653
3861084.175085 [INFO] [1593861083.575618]: hello world 1593861083.5753999
[INFO] [1593861084.276965]: /listener_15717_1593859527734I heard hello world [INFO] [1593861083.674930]: hello world 1593861083.6747575
3861084.2751849 [INFO] [1593861083.775577]: hello world 1593861083.7753644
[INFO] [1593861084.377278]: /listener_15717_1593859527734I heard hello world [INFO] [1593861083.875140]: hello world 1593861083.8749685
3861084.3752568 [INFO] [1593861083.975349]: hello world 1593861083.975105
[INFO] [1593861084.477850]: /listener_15717_1593859527734I heard hello world [INFO] [1593861084.075301]: hello world 1593861084.075126
3861084.4753373 [INFO] [1593861084.175234]: hello world 1593861084.175085
[INFO] [1593861084.620214]: /listener_15717_1593859527734I heard hello world [INFO] [1593861084.275355]: hello world 1593861084.2751849
3861084.580348 [INFO] [1593861084.375421]: hello world 1593861084.3752568
[INFO] [1593861084.686131]: /listener_15717_1593859527734I heard hello world [INFO] [1593861084.475675]: hello world 1593861084.4753373
3861084.6775706 [INFO] [1593861084.581343]: hello world 1593861084.580348
[INFO] [1593861084.780836]: /listener_15717_1593859527734I heard hello world [INFO] [1593861084.677852]: hello world 1593861084.6775706
3861084.7760997 [INFO] [1593861084.776617]: hello world 1593861084.7760997
```

Graphical view between the subscriber and publisher

```
manal@ubuntu: ~/my_first_ws
manal@ubuntu:~/my_first_ws$ rosnodet list
/listener_15717_1593859527734
/rosout
/talker_15611_1593859237668
/talker_15680_1593859472416
manal@ubuntu:~/my_first_ws$ rostopic list
/chatter
/rosout
/rosout_agg
manal@ubuntu:~/my_first_ws$ rosrund rqt_graph rqt_graph
```



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