ROBOTIC OPERATING SYSTEMS AND ROBOT SIMULATIONS

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● Download and install the turtlesim package

○ Open a terminal and start the roscore

roscore

○ Open another terminal and type
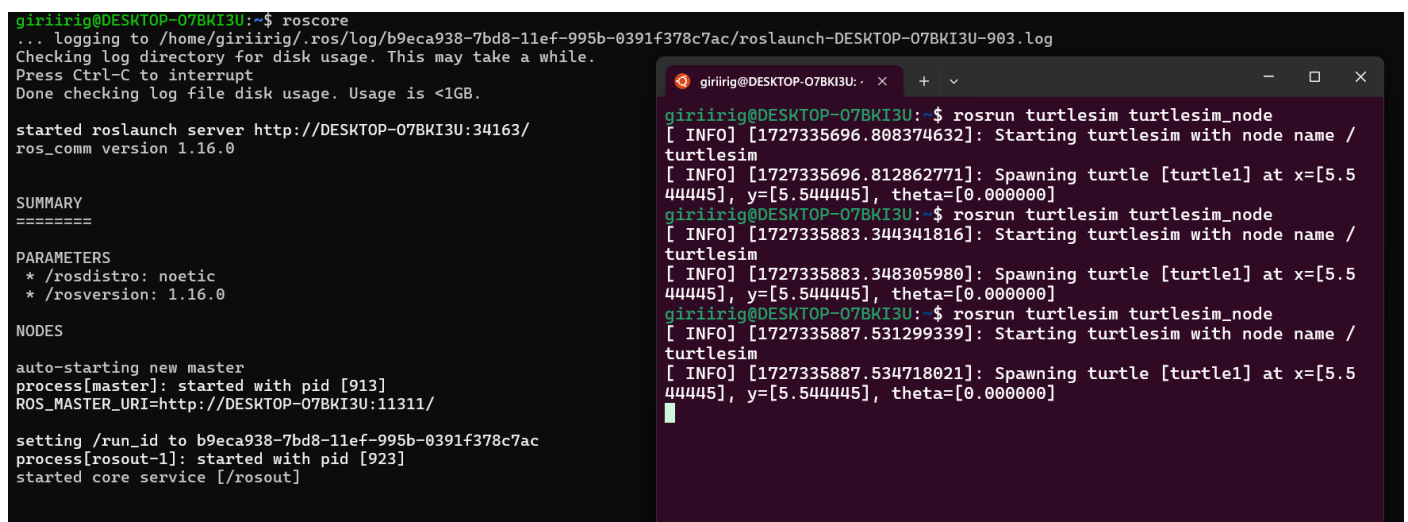
sudo apt-get install ros-$(rosversion -d)-turtlesim

○ Run turtlesim

rosrun turtlesim turtlesim_node

○ Open another terminal and type

rosrun turtlesim turtle_teleop_key

➢ Use the keypad arrow keys to move the turtle around and

check how the data is getting published in **/cmd_vel** topic

```
giriirig@DESKTOP-O7BKI3U:~$ roscore
... logging to /home/giriirig/.ros/log/b9eca938-7bd8-11ef-995b-0391f378c7ac/roslaunch-DESKTOP-O7BKI3U-903.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://DESKTOP-O7BKI3U:34163/
ros_comm version 1.16.0


SUMMARY
========

PARAMETERS
 * /rosdistro: noetic
 * /rosversion: 1.16.0

NODES

auto-starting new master
process[master]: started with pid [913]
ROS_MASTER_URI=http://DESKTOP-O7BKI3U:11311/

setting /run_id to b9eca938-7bd8-11ef-995b-0391f378c7ac
process[rosout-1]: started with pid [923]
started core service [/rosout]
```

```
giriirig@DESKTOP-O7BKI3U:~
giriirig@DESKTOP-O7BKI3U:~$ rosrun turtlesim turtlesim_node
[ INFO] [1727335696.808374632]: Starting turtlesim with node name /turtlesim
[ INFO] [1727335696.812862771]: Spawning turtle [turtle1] at x=[5.544445], y=[5.544445], theta=[0.000000]
giriirig@DESKTOP-O7BKI3U:~$ rosrun turtlesim turtlesim_node
[ INFO] [1727335883.344341816]: Starting turtlesim with node name /turtlesim
[ INFO] [1727335883.348305980]: Spawning turtle [turtle1] at x=[5.544445], y=[5.544445], theta=[0.000000]
giriirig@DESKTOP-O7BKI3U:~$ rosrun turtlesim turtlesim_node
[ INFO] [1727335887.531299339]: Starting turtlesim with node name /turtlesim
[ INFO] [1727335887.534718021]: Spawning turtle [turtle1] at x=[5.544445], y=[5.544445], theta=[0.000000]
```

Catkin workspace setup + publisher and subscriber :

```
giriirig@DESKTOP-O7BKI3U:~$ source /opt/ros/noetic/setup.bash
giriirig@DESKTOP-O7BKI3U:~$ mkdir -p ~/catkin_ws/src
giriirig@DESKTOP-O7BKI3U:~$ cd ~/catkin_ws
giriirig@DESKTOP-O7BKI3U:~/catkin_ws$ catkin_init_workspace src
File "/home/giriirig/catkin_ws/src/CMakeLists.txt" already existsgiriirig@DESKTOP-O7BKI3U:~/catkin_ws$ catkin_make
Base path: /home/giriirig/catkin_ws
Source space: /home/giriirig/catkin_ws/src
Build space: /home/giriirig/catkin_ws/build
Devel space: /home/giriirig/catkin_ws/devel
Install space: /home/giriirig/catkin_ws/install
```

```
giriirig@DESKTOP-O7BKI3U:~/catkin_ws$ gedit ~/.bashrc

(gedit:974): Tepl-WARNING **: 13:14:32.380: GVfs metadata is not supported. Fallback to TeplMetadataManager. Eithe
 is not correctly installed or GVfs metadata are not supported on this platform. In the latter case, you should co
e Tepl with --disable-gvfs-metadata.
giriirig@DESKTOP-O7BKI3U:~/catkin_ws$ cd ~/catkin_ws/src
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src$ catkin_create_pkg lab_1 std_msgs rospy roscpp
usage: catkin_create_pkg [-h] [--meta] [-s [SYS_DEPS [SYS_DEPS ...]]] [-b [BOOST_COMPS [BOOST_COMPS ...]]]
                         [-V PKG_VERSION] [-D DESCRIPTION] [-l LICENSE] [-a AUTHOR] [-m MAINTAINER]
                         [--rosdistro ROSDISTRO]
                         name [dependencies [dependencies ...]]
catkin_create_pkg: error: File exists: /home/giriirig/catkin_ws/src/lab_1/package.xml
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src$ cd lab_1
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1$ mkdir scripts
mkdir: cannot create directory 'scripts': File exists
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1$ cd scripts
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1/scripts$ touch subcriber.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1/scripts$ chmod +x subcriber.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1/scripts$ touch publisher.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1/scripts$ chmod +x publisher.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1/scripts$ sudo snap install code --classic
[sudo] password for giriirig:
```

publisher.py 2 ●   subcriber.py 2   publisher.py 2 ●   subcriber.py 2 ✕

Ubuntu-20.04 > home > giriirig > catkin_ws > src > lab_1 > scripts > publisher.py > ...

```python
#!/usr/bin/env python
# license removed for brevity
import rospy
from std_msgs.msg import String

def talker():
    pub = rospy.Publisher('chatter', String, queue_size=10)
    rospy.init_node('talker', anonymous=True)
    rate = rospy.Rate(10) # 10hz
    while not rospy.is_shutdown():
        hello_str = "hello world %s" % rospy.get_time()
        rospy.loginfo(hello_str)
        pub.publish(hello_str)
        rate.sleep()

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

```python
#!/usr/bin/env python
import rospy
from std_msgs.msg import String

def callback(data):
    rospy.loginfo(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()
```
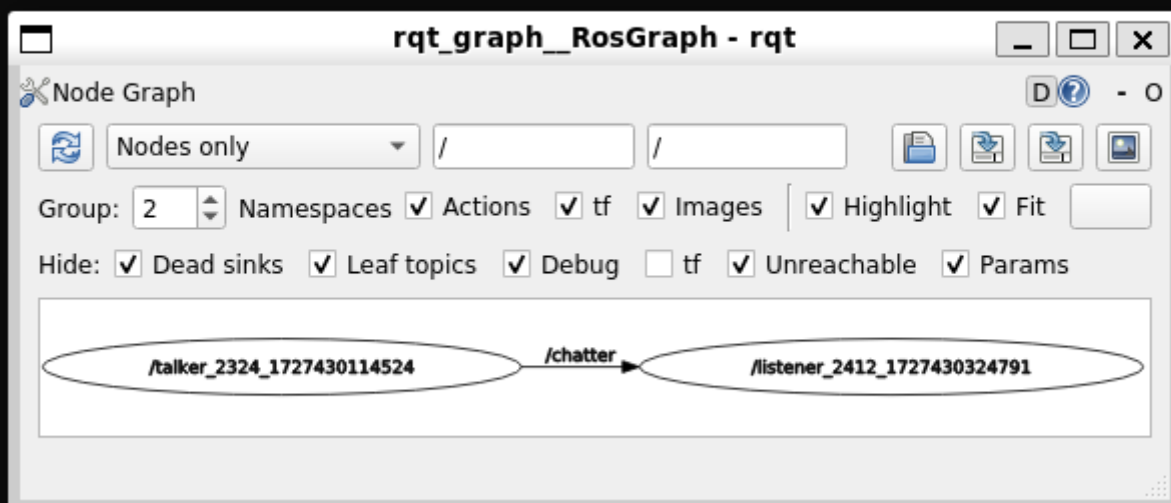
Output (publisher.py) :

```
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/lab_1$ rosrun lab_1 publiisher.py
[INFO] [1727430114.650255]: hello world 1727430114.6500766
[INFO] [1727430114.750740]: hello world 1727430114.7505226
[INFO] [1727430114.850730]: hello world 1727430114.8505065
[INFO] [1727430114.950745]: hello world 1727430114.9505234
[INFO] [1727430115.050693]: hello world 1727430115.0504742
[INFO] [1727430115.150822]: hello world 1727430115.1505907
[INFO] [1727430115.250885]: hello world 1727430115.250668
[INFO] [1727430115.351000]: hello world 1727430115.3507714
[INFO] [1727430115.451055]: hello world 1727430115.4507854
[INFO] [1727430115.550838]: hello world 1727430115.5505922
[INFO] [1727430115.650780]: hello world 1727430115.6505482
[INFO] [1727430115.750788]: hello world 1727430115.7505796
[INFO] [1727430115.850710]: hello world 1727430115.8504765
[INFO] [1727430115.950817]: hello world 1727430115.9505866
[INFO] [1727430116.051003]: hello world 1727430116.0507092
[INFO] [1727430116.150620]: hello world 1727430116.1504428
[INFO] [1727430116.250784]: hello world 1727430116.250566
[INFO] [1727430116.350904]: hello world 1727430116.3506742
[INFO] [1727430116.450917]: hello world 1727430116.4506993
[INFO] [1727430116.550734]: hello world 1727430116.5505474
[INFO] [1727430116.650820]: hello world 1727430116.6505642
[INFO] [1727430116.750916]: hello world 1727430116.7506797
[INFO] [1727430116.850837]: hello world 1727430116.8506038
[INFO] [1727430116.950982]: hello world 1727430116.9507504
[INFO] [1727430117.050848]: hello world 1727430117.0506265
[INFO] [1727430117.150653]: hello world 1727430117.1504893
[INFO] [1727430117.250708]: hello world 1727430117.2505093
[INFO] [1727430117.350742]: hello world 1727430117.3505518
[INFO] [1727430117.450625]: hello world 1727430117.450441
```

Output (publisher.py) :

```
giriirig@DESKTOP-O7BKI3U:~$ rosrun lab_1 subcriber.py
[INFO] [1727430324.953094]: /listener_2412_1727430324791I heard hello world 1727430324.9505093
[INFO] [1727430325.054847]: /listener_2412_1727430324791I heard hello world 1727430325.0504432
[INFO] [1727430325.154374]: /listener_2412_1727430324791I heard hello world 1727430325.1506941
[INFO] [1727430325.254668]: /listener_2412_1727430324791I heard hello world 1727430325.250528
[INFO] [1727430325.354677]: /listener_2412_1727430324791I heard hello world 1727430325.3505814
[INFO] [1727430325.453480]: /listener_2412_1727430324791I heard hello world 1727430325.4505336
[INFO] [1727430325.554574]: /listener_2412_1727430324791I heard hello world 1727430325.550617
[INFO] [1727430325.654690]: /listener_2412_1727430324791I heard hello world 1727430325.650555
[INFO] [1727430325.755158]: /listener_2412_1727430324791I heard hello world 1727430325.7509325
[INFO] [1727430325.854472]: /listener_2412_1727430324791I heard hello world 1727430325.8506532
[INFO] [1727430325.954346]: /listener_2412_1727430324791I heard hello world 1727430325.9506445
[INFO] [1727430326.054086]: /listener_2412_1727430324791I heard hello world 1727430326.0506055
[INFO] [1727430326.153249]: /listener_2412_1727430324791I heard hello world 1727430326.1506195
[INFO] [1727430326.254107]: /listener_2412_1727430324791I heard hello world 1727430326.2505074
[INFO] [1727430326.354980]: /listener_2412_1727430324791I heard hello world 1727430326.350632
[INFO] [1727430326.454030]: /listener_2412_1727430324791I heard hello world 1727430326.450826
[INFO] [1727430326.554675]: /listener_2412_1727430324791I heard hello world 1727430326.5506332
[INFO] [1727430326.654945]: /listener_2412_1727430324791I heard hello world 1727430326.6507523
[INFO] [1727430326.754470]: /listener_2412_1727430324791I heard hello world 1727430326.7506254
[INFO] [1727430326.854395]: /listener_2412_1727430324791I heard hello world 1727430326.8505816
[INFO] [1727430326.953631]: /listener_2412_1727430324791I heard hello world 1727430326.9505014
[INFO] [1727430327.054338]: /listener_2412_1727430324791I heard hello world 1727430327.0506577
[INFO] [1727430327.153450]: /listener_2412_1727430324791I heard hello world 1727430327.150625
[INFO] [1727430327.253845]: /listener_2412_1727430324791I heard hello world 1727430327.2504761
[INFO] [1727430327.353174]: /listener_2412_1727430324791I heard hello world 1727430327.3504477
[INFO] [1727430327.454190]: /listener_2412_1727430324791I heard hello world 1727430327.4506364
[INFO] [1727430327.553028]: /listener_2412_1727430324791I heard hello world 1727430327.5504906
[INFO] [1727430327.654853]: /listener_2412_1727430324791I heard hello world 1727430327.650611
[INFO] [1727430327.753789]: /listener_2412_1727430324791I heard hello world 1727430327.7508454
```

giriirig@DESKTOP-O7BKI3U:~$ rqt_graph

rqt_graph__RosGraph - rqt

Node Graph   D ? - O

Nodes only   /   /

Group: 2   Namespaces ✓ Actions ✓ tf ✓ Images   ✓ Highlight ✓ Fit

Hide: ✓ Dead sinks ✓ Leaf topics ✓ Debug   ☐ tf ✓ Unreachable ✓ Params

/talker_2324_1727430114524   /chatter ►   /listener_2412_1727430324791

● Create a package called **assignment_1** with dependencies **rospy** in your catkin workspace

```
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src$ catkin_create_pkg assignment_1 rospy
Created file assignment_1/package.xml
Created file assignment_1/CMakeLists.txt
Created folder assignment_1/src
Successfully created files in /home/giriirig/catkin_ws/src/assignment_1. Please adjust the values in package.xml.
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src$
```

● In the source folder of your package assignment_1 create a publisher python file **move_circle.py** which makes the turtlesim to execute a single circular(approximate) trajectory.

```
giriirig@DESKTOP-O7BKI3U:~$ cd catkin_ws/src/assignment_1/src
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ touch move_circle.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ code move_circle.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ chmod +x move_circle.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ rosrun assignment_1 move_circle.py
```
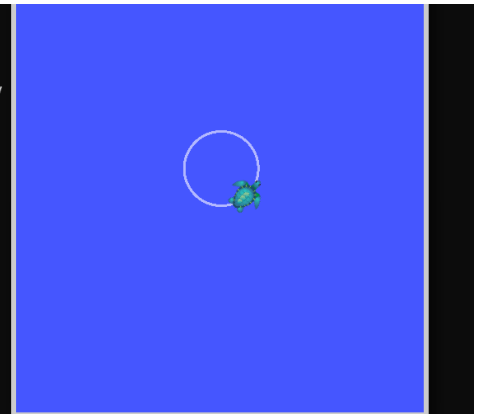
Code :

```python
#!/usr/bin/env python3

import rospy
from geometry_msgs.msg import Twist

def move_circle():
    # Initialize the ROS node
    rospy.init_node('move_circle', anonymous=True)

    # Create a publisher to the /turtle1/cmd_vel topic
    pub = rospy.Publisher('/turtle1/cmd_vel', Twist, queue_size=10)

    # Set the loop rate
    rate = rospy.Rate(10)  # 10 Hz

    # Create a Twist message for circular motion
    move_cmd = Twist()
    move_cmd.linear.x = 1.0    # Move forward with linear velocity
    move_cmd.angular.z = 1.0   # Rotate at a specific angular velocity

    # Loop to publish the message
    while not rospy.is_shutdown():
        pub.publish(move_cmd)
        rate.sleep()

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

● In the source folder of your package assignment_1 create a publisher python file **move_square.py** which makes the turtlesim to execute a single square(approximate) trajectory.

Code :

```python
#!/usr/bin/env python3
import rospy
from geometry_msgs.msg import Twist
import time
def move_square():
    rospy.init_node('move_square', anonymous=True)
    pub = rospy.Publisher('/turtle1/cmd_vel', Twist, queue_size=10)
    rate = rospy.Rate(10)
    move_cmd = Twist()
    side_length = 2.0
    move_duration = side_length / 1.0
    turn_duration = 1.57 / 1.0
    for _ in range(4):
        move_cmd.linear.x = 1.0
        move_cmd.angular.z = 0.0
        time_start = rospy.get_time()
        while rospy.get_time() - time_start < move_duration:
            pub.publish(move_cmd)
            rate.sleep()
        move_cmd.linear.x = 0.0
        pub.publish(move_cmd)
        rospy.sleep(1)
        move_cmd.linear.x = 0.0
        move_cmd.angular.z = 1.0
        time_start = rospy.get_time()
        while rospy.get_time() - time_start < turn_duration:
            pub.publish(move_cmd)
            rate.sleep()
        move_cmd.angular.z = 0.0
        pub.publish(move_cmd)
        rospy.sleep(1)
if __name__ == '__main__':
    try:
        move_square()
```

```
roscore http://DESKTOP-O7BK          giriirig@DESKTOP-O7BKI3U:

giriirig@DESKTOP-O7BKI3U:~$ rosrun turtlesim turtlesim_node
[ INFO] [1727431645.092660234]: Starting turtlesim with node name /turtlesim
[ INFO] [1727431645.104796964]: Spawning turtle [turtle1] at x=[5.544445], y=[5.544445], theta=[0.000000]
```

```
giriirig@DESKTOP-O7BKI3U:

giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ touch move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ code move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ rosrun assignment_1 move_square.py
[rosrun] Couldn't find executable named move_square.py below /home/giriirig/catkin_ws/src/assignment_1
[rosrun] Found the following, but they're either not files,
[rosrun] or not executable:
[rosrun]   /home/giriirig/catkin_ws/src/assignment_1/src/move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ ls
move_circle.py  move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ touch move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ code move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ chmod +x move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ rosrun assignment_1 move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$ rosrun assignment_1 move_square.py
giriirig@DESKTOP-O7BKI3U:~/catkin_ws/src/assignment_1/src$
```

TurtleSim