ROB - Basics of ROS

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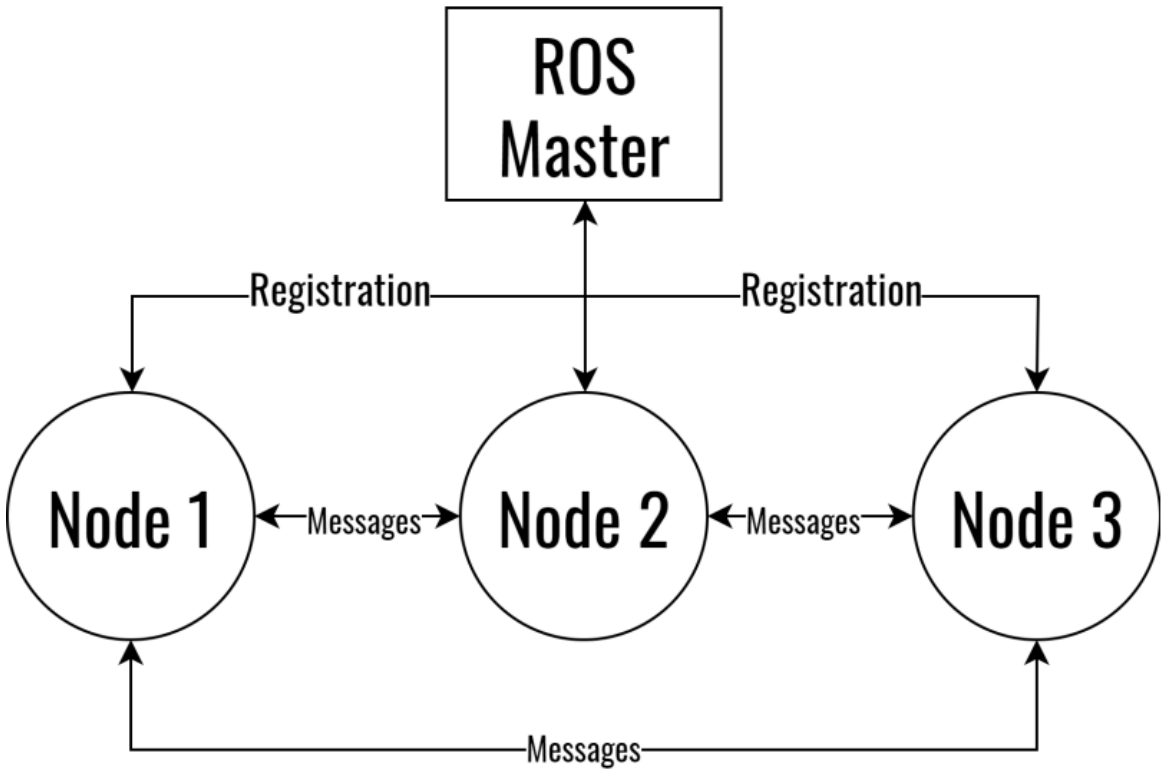
Today's lab will be focused on basics of ROS.

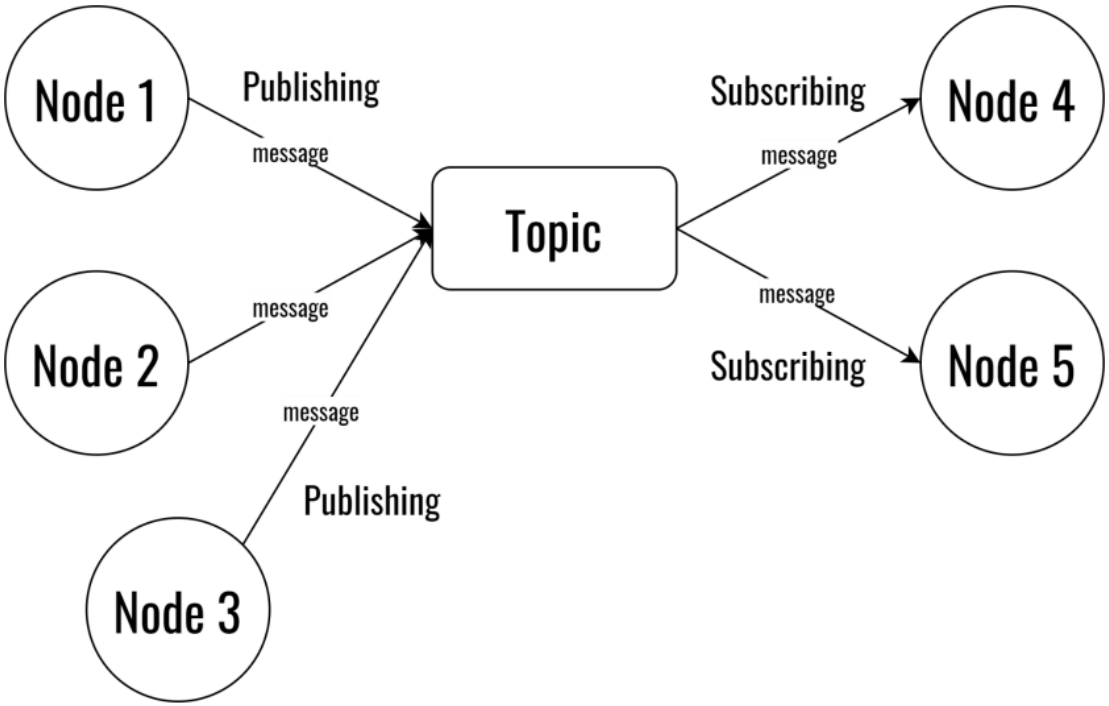
What is ROS

- The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications.
- It is used for prototyping and building robot applications
- Companies like Boston Dynamics or Kuka use ROS or ROS-derived tools

- Main parts of ROS architecture are: ROS master, Node, Topic, Message.
- Single instance of ROS master needs to run, created nodes are registered to ROS master



- Nodes exchange messages through topics
- Node can either publish or subscribe messages to/from topic



ROS offers command line tools for working/debugging in ROS environment:

- **roscore** - Starts ROS master. Run this command in one terminal window and keep it running until you finish your work.
- **rosrun** (package) (node) - Starts node. When starting node, package of the node must be specified.

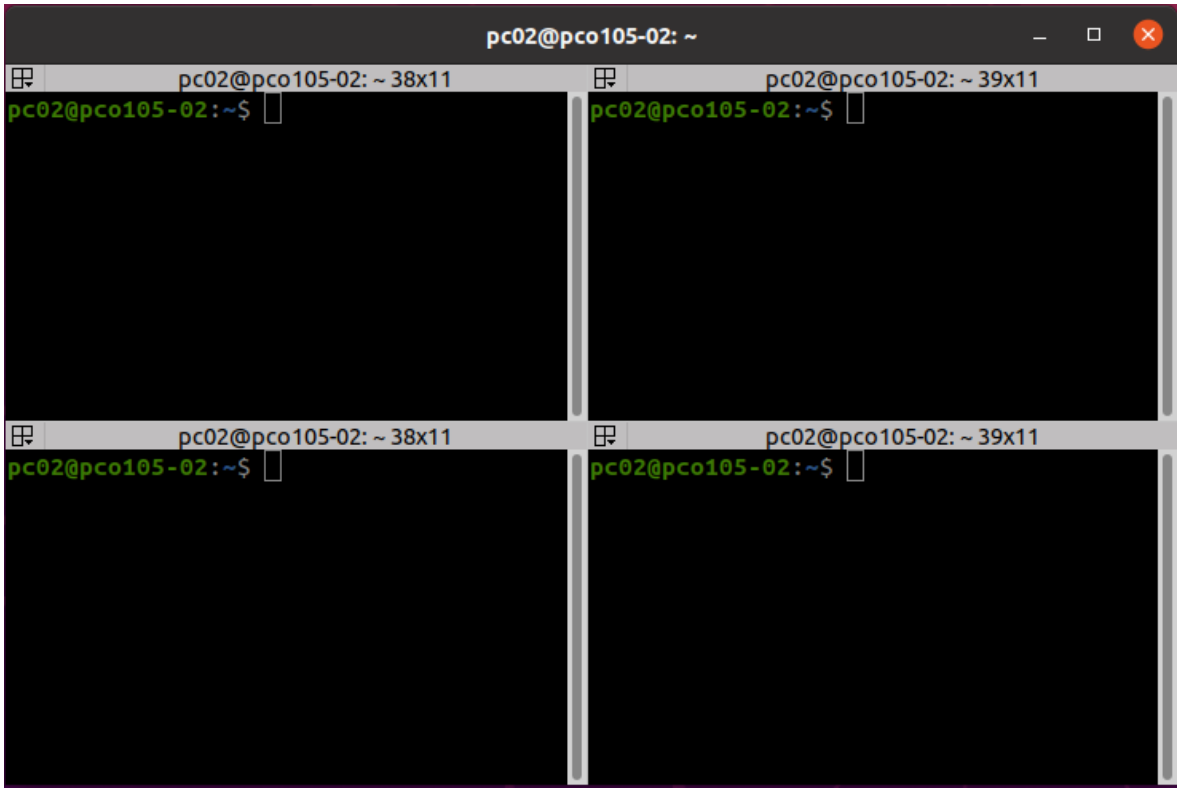
ROS debugging commands

Following commands can be used for displaying info about node/topic/message:

- **rqt_graph** - Opens new window where all Nodes and Topics are visualized.
- **rosnode** - command-line tool that displays information about ROS Nodes.
- **rostopic** - command-line tool that displays information about ROS topics.
- **rosmsg** - command-line tool that displays information about ROS messages.

Terminator

- It is good practice to have multiple terminal windows opened when working with ROS.
- This is the reason why application like Terminator where window can be split is good to use.



Running ROS master

- Open new terminal using **Terminator** app
- Split the terminal into 4 parts.
- Click onto top left terminal and run `roscore` command
- You should see last line of the message say: "`started core service [/rosout]`"
- Do not exit this terminal, let it run and use other terminal windows

Running simple ROS nodes

- Create publisher by running command: `rosrun rospy_tutorials talker`
- In another window, create subscriber by running command: `rosrun rospy_tutorials listener`
- Now, the publisher is sending messages and subscriber is listening to them
- Visualize this by running command: `rqt_graph`
- A new window should open where you can see visual representation of your running nodes

Getting info about ROS nodes

- Keep the talker and listener from last excercise running
- Run `rosnode list` to see running nodes
- Run `rosnode info /[node name]` where node name is name of one of the node listed by previous command (hint: you can use TAB to auto-complete node names)
- Run `rostopic list` to see active topics
- Run `rostopic info /chatter` to see type of message that this topic accepts and also publishers and subscribers that interact with this topic
- Run `rosmsg list` to see list of all message types
- Run `rosmsg show std_msgs/String` to see info about one message type

ROS and Python

- ROS offers a way to create custom nodes in c++ and Python
- In this lab ROS Python API will be used, called rospy

ROS-Python publisher

Simplest ROS publisher can be written in Python as following:

```
5   # Import everything important
6   import rospy
7   from std_msgs.msg import String
8
9   # Start of the program
10  if __name__ == '__main__':
11      # tell ROS name of this node
12      rospy.init_node('Basic_Publisher')
13
14      # Create publisher that sends messages to topic "/chatter" and message type is String
15      pub = rospy.Publisher('/chatter', String, queue_size=10)
16
17      # Set message speed to 2Hz
18      r = rospy.Rate(2)
19
20      # Infinite loop while ROS is running
21      while not rospy.is_shutdown():
22          # Send your own custom message
23          pub.publish("Your message here")
24          # Sleep for a given time
25          r.sleep()
```

Sometimes it is advantageous to write a publisher that sends only single message.

```
13  pub = rospy.Publisher('/chatter', String, queue_size=10)
14
15  while pub.get_num_connections() < 1:
16      pass
17
18  pub.publish("Your message here")
```

The simplest ROS subscriber can be written in Python as the following:

```
5   # Import everything important
6   import rospy
7   from std_msgs.msg import String
8
9
10  # Callback function that is called when subscriber gets data
11  def callback(data):
12      rospy.loginfo("Received data: %s", data.data)
13
14
15  # Start of the program
16  if __name__ == '__main__':
17      # tell ROS name of this node
18      rospy.init_node('Basic_Subscriber', anonymous=True)
19
20      # Create subscriber that subscribes messages from topic "/chatter" of type String
21      # callback function is called when message is received
22      rospy.Subscriber("/chatter", String, callback)
23      rospy.spin()
```

Create your own publisher that sends messages to topic /chatter

- If you have a talker running from the last exercise, kill it. Run only listener
- Open PyCharm by running command pycharm in terminal window
- Navigate to file **basic_publisher/src/publisher.py**
- Implement publisher that publishes String message to /chatter topic every 2 seconds.
- Run the node by running rosnode run XYZ
- Take a look at the listener - it should be receiving your messages

Create your own publisher that subscribes messages from topic /chatter

- If you have a listener running from the last exercise, kill it. Run only talker
- Open PyCharm by running command pycharm in terminal window (or keep it open from last exercise)
- Navigate to file **basic_subscriber/src/subscriber.py**
- Implement subscriber that subscribes String message from /chatter
- Run the node by running rosrun XYZ
- Take a look at the output from your code - it should be receiving messages

Create your own publisher that subscribes messages from topic /chatter

- If you have a listener running from the last exercise, kill it. Run only talker
- Open PyCharm by running command pycharm in terminal window (or keep it open from last exercise)
- Navigate to file **basic_subscriber/src/subscriber.py**
- Implement subscriber that subscribes String message from /chatter
- Run the node by running rosrun XYZ
- Take a look at the output from your code - it should be receiving messages

Thank You For Your Attention !