ROS - Basic Mechanics and Use

ME 4140 - Introduction to Robotics - Fall 2018

I. Components The major building blocks of a ROS system

1. Master Node
   - *The ROS Master provides naming and registration services to the rest of the nodes in the ROS system.***
   - master node runs first `$ roscore`
   - core of the system or robot `$ ROS_MASTER_URI=http://12345`
2. Nodes
   - *A node is a process that performs computation.***
   - each 'program' or 'element' of the robot is a node
     examples:
     - sensor
     - hardware driver
     - navigation
     - keyboard or joystick
   - start or run node individually after master

     ```
     $ rosrun <packagename> <nodename> <options>
     ```
   - all nodes are registered to the master and communicate in different ways
     - topics - publishing and subscribing
     - parameter server - static data
     - services - subroutine call
3. Packages
   - *Software in ROS is organized in packages. A package might contain ROS nodes, a ROS-independent library, a dataset, configuration files, a third-party piece of software, or anything else that logically constitutes a useful module.***
   - a collection of related nodes, each node belongs to a package
   - pre-built packages available with ros installation `-desktop-full`
   - pre-built packages available for installation

     apt-get `$ sudo apt-get install ros-<distribution>-<packagename>`
     rosdep `$ rosdep install <packagename>`
   - update ubuntu before installing anything

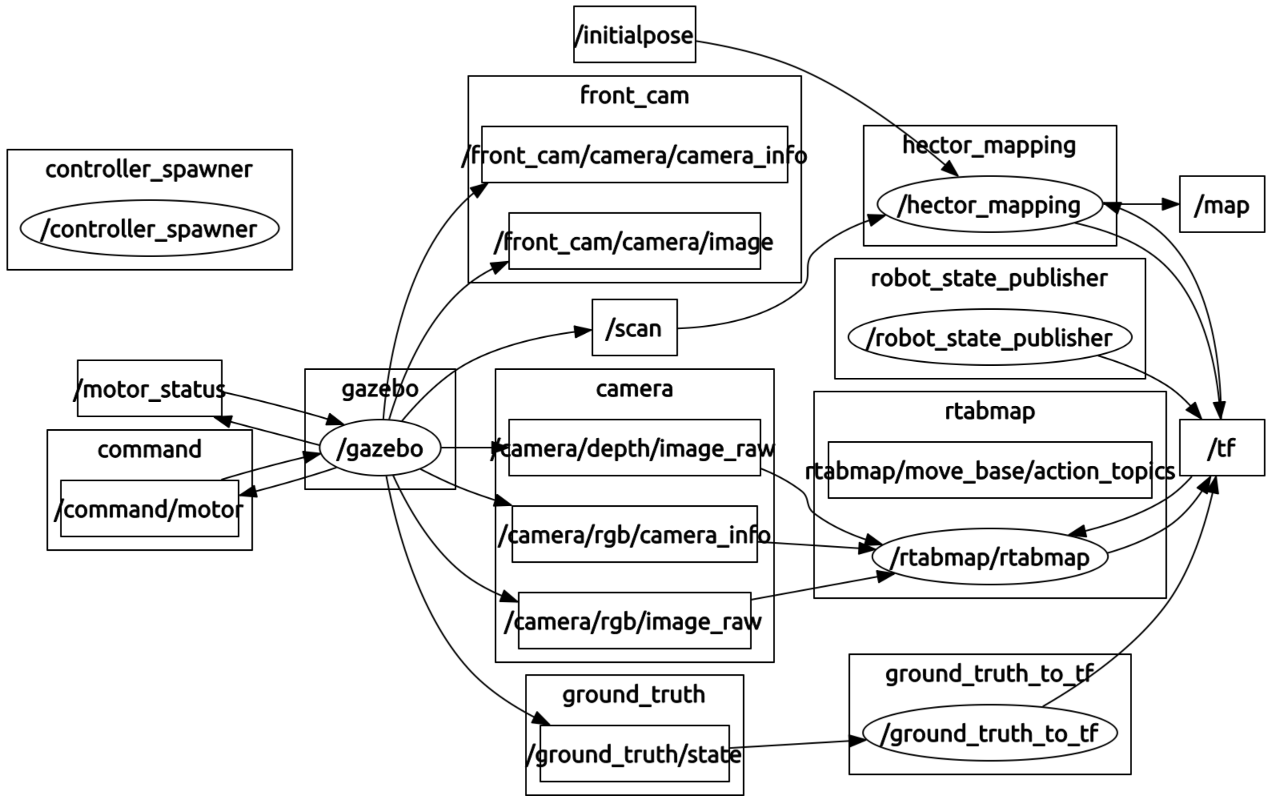
     ```
     $ sudo apt-get update
     $ sudo apt-get check
     ```

** from (ros.org)

II. The Graph of the System ROS works on a system of interconnected nodes. It is very useful to visualize this in a graph.

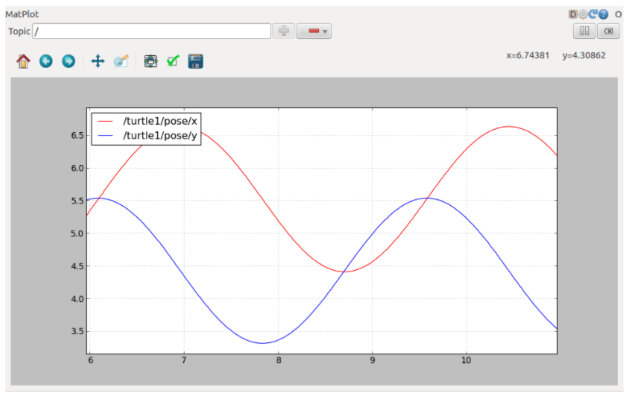
1. RQT Graph A very useful tool. A node *rqt_ graph* in a package *rqt_ graph*.

```
$ rosrun rqt_graph rqt_graph
```



2. RQT Plot A very useful tool. A node *rqt_ plot* in a package *rqt_ plot*.

```
$ rosrun rqt_plot rqt_plot
```



III. Topics, Publishers, and Subscribers The nodes in a ROS system communicate.

1. Topics
   - data available to nodes in the system
   - each topic has a name
   - data is stored and transferred in standard ros data types
   - generally data is streaming, but does not have to be
2. Publishers
   - data produced by a node can be shared with the system by publishing a topic
   - a node which outputs topic data is a publisher
   - a node may publish multiple topics
3. Subscribers
   - a registered node can access the data in a topic by subscribing to a topic
   - a node which gets topic data as input is a subscriber
   - a node may subscribe to multiple topics
4. rostopic
   - a very useful tool, a built in package
   - used differently than other packages, does not require rosrun
   - a set of different tools

     list `$ rostopic list`

     echo `$ rostopic echo /topicname`

     type `$ rostopic pub /topicname`

5. data types - topics are published in standard types called messages
   - `std_msgs/int32`
   - `std_msgs/float32`

   - `geometry_msgs/Point`
   - `geometry_msgs/Pose`

   - `nav_msgs/Odometry`
   - `nav_msgs/Path`

6. let show an example now!

IV. A Simple Robot Simulator :

1. Follow the basic tutorial for turtlesim.

   ```
   $ sudo apt-get update
   ```

   ```
   $ rosmake turtlesim
   ```

   ```
   $ roscore
   ```

2. Open a new terminal window.

   ```
   $ rosrun turtlesim turtlesim_node
   ```

   ```
   $ rostopic list
   ```

3. Now lets add a controller node.

   ```
   $ sudo apt-get install ros-kinetic-teleop-twist-keyboard
   ```

   ```
   $ rosrun teleop_twist_keyboard teleop_twist_keyboard.py
   ```

4. There is a problem, we need to make sure the nodes are talking. Add the following *options* to the end of the previous command and rerun the node.

   ```
   /cmd_vel:=/turtle1/cmd_vel
   ```