Lab 1 Questions

RBE 3002 Unified Robotics IV: Navigation

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1. Define the following concepts:

   - Catkin workspace:
     This is the whole workspace where a project is created. Anything inside this workspace is accessible to each other. This can be useful to share code between nodes or robots.

   - Package:
     A package pertains to the specific group of nodes focused on a certain task. You can use this as a way to group different projects apart from one another within the same catkin workspace so you can share code while distinguishing the difference between projects

   - Node:
     Represents a specific part of a robot and is responsible for publishing and subscribing to different topics to keep sensor data available and obtain any other needed data to operate.

   - Message:
     A message is a piece of data that is published to a topic. This can be senors data posted to a sensor or a position topic.

   - Topic:
     A topic represents a stream of data going to and from other nodes. Topics are labeled, distinguishing one topic from another and can be used to send data or receive data.

2. What is the purpose of the ROS Master?

   ROS Master, or I believe ROS core, is an infrastructure that handles all nodes topics messages publisher and subscribers. It is where information gets passed through and allows ROS to create it own paradigm. Without it ROS will not run because it has no core terminal to support the background work that is needed for topics and services to run.

3. How would you run a node that has the following file structure:
    a. Package: `HelloWorld`
    b. Filename: `say_hello.py`

rosrun HelloWorld say_hello.py

4. What do you have to run to make a Python script executable (also to run the file using the bash command `rosrun`)?

chmod +x _____.py

5. What does the command `source devel/setup.bash` do?

It is used to set the environment variables used by ROS and Gazebo

6. What are the terminal commands that must be run after a Python file is created so it can be run at the root of the package? (assume you're inside your package and the file is already executable)

catkin_make

7. What is the purpose of a launch file?

To create a file that will launch all required nodes and programs for a project automatically and properly. This allows you to launch one file at the beginning and be ready to work instead of manually starting every node and program.

8. Break down the `Pose` message into its fields and subfields.

geometry_msgs/Point.msg

float64 x
float64 y
float64 z

geometry_msgs/Quaternion.msg
float64 x
float64 y
float64 z
float64 w

9. What does it mean when a ROS message name ends with `Stamped` (e.g., `msgnameStamped`)? Give an example.

A stamped message is a message with a header which contains a timestamp. For instance, above used Pose.msg, but there is also a PoseStamped.msg which is exactly like above, but with the std_msgs/Header.msg pasted on before it.

10. What is a quaternion? Explain what it is mathematically and describe the structure of the ROS message.

geometry_msgs/Quaternion.msg
float64 x
float64 y
float64 z
float64 w

As stated above a quaternion message consists of 4 float64's for x, y, z, and w. Just like how Euler angles can gives us an absolute orientation of an object, quaternions can as well. Quaternions are a 4 dimentional system for orientating points which used 1 real axis, w, and 3 inaginary axis or parts called the vector part, x, y, z. This system is increasingly useful because mathmatically it prevents gymbal lock.

11. Using the `rostopic info` command, list the message types, publishers, and subscribers of the
    - Gazebo Simulator
        - `roslaunch turtlebot3_fake turtlebot3_fake.launch`
            - `Publishers`
                - `* /joint_states [sensor_msgs/JointState]`
                - `* /odom [nav_msgs/Odometry]`
                - `* /rosout [rosgraph_msgs/Log]`
                - `* /tf [tf2_msgs/TFMessage]`
            - `Subscribers`
                - `* /clock [rosgraph_msgs/Clock]`
                - `* /cmd_vel [geometry_msgs/Twist]`

        - `roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch`
            - `Publishers`
                - `* /cmd_vel [geometry_msgs/Twist]`
                - `* /rosout [rosgraph_msgs/Log]`
            - `Subscribers`
                - `* /clock [rosgraph_msgs/Clock]`

        - roslaunch turtlebot3_gazebo turtlebot3_empty_world.launch
            - /clock
            - /cmd_vel
            - /gazebo/link_states
            - /gazebo/model_states
            - /gazebo/parameter_descriptions
            - /gazebo/parameter_updates
            - /gazebo/set_link_state
            - /gazebo/set_model_state
            - /imu
            - /joint_states
            - /odom
            - /rosout
            - /rosout_agg
            - /scan
            - /tf

    - Topic /cmd_vel
        - Type: ***geometry_msgs/Twist***
        - Subscribers: ***/turtlesim***
        - Publishers: ***/teleop_turtle***

12. What command can be used to diagnose a problem in ROS?

printenv | grep ROS

echo $ROS_IP