

# ROS Workshop - Tutorial 4 - Create Package

## ME 4140 - Introduction to Robotics - Fall 2020

### Overview:

After completing *Tutorial 3 - Turtlesim*, You have begun learning ROS and you can are ready to create a custom C++ package. You can read more [here](#) on the wiki.

### System Requirements:

- **ROS+OS:** This tutorial is intended for a system with ROS Melodic installed on the Ubuntu 18.04 LTS operating system. Alternate versions of ROS (i.e. - Kinetic, Noetic, etc.) may work but have not been tested. Versions of ROS are tied to versions of Ubuntu.
- **ROS:** Your computer must be connected to the internet to proceed. Update the system before you begin.

### Disclaimer:

- **Backup the System:** If you are using a virtual machine, it is recommend to make a snapshot of your virtual machine before you start each module. In the event of an untraceable error, you can restore to a previous snapshot.
- **Workspace Setup:** In Part I you will setup a Catkin Workspace as your working directory for creating packages. This only needs to be done once.

### Important Note on Naming:

In this tutorial you will replace several <fields> with names of your choice. These are general guidelines for [naming in ROS](#).

- use descriptive names, very long or very short names are hard to read
- **do not** include the < > symbols
- **do not** use spaces, UPPER CASE letters, or special characters (@, \$, \*, etc.)
- the underscore \_ character **is** allowed

<workspace\_name> - name of your workspace

<package\_name> - name of your package

<node\_name> - name of your node

<user\_name> - ubuntu user name

**Part I - Setup the [Workspace](#):** ( Part I only needs to be done once Fall2020.)

Before building a custom ROS package you need to setup a *catkin workspace* as the working directory. Catkin is the program that manages the file system behind the scenes and compiles your .cpp code.

**Step 1:** Source the installation files needed to create a workspace. This requires ROS to be previously installed.

```
source /opt/ros/melodic/setup.bash
```

**Step 2:** Open a new terminal and navigate to the future location of your workspace.

```
cd ~          OR          cd /<user_name>/home
```

**Step 3:** Choose a workspace name and create a workspace and source directory with *mkdir*. This step determines the location of your new workspace.

```
mkdir -p ~/<workspace_name>/src
```

**Step 4:** Navigate to the top of your workspace directory and build your workspace.

```
cd ~/<workspace_name>
```

```
catkin_make
```

**Step 5:** Now add your workspace directory to .bashrc and source the script.

```
echo "source ~/<workspace_name>/devel/setup.bash" >> ~/.bashrc
```

```
source ~/.bashrc
```

Open the **.bashrc** file with the gedit text editor. You can see the lines you have added with **echo** » at the bottom of the file. Close the file.

```
gedit ~/.bashrc
```

**Part II - Create A [Publisher](#) Node:**

You can write custom nodes for your ROS system in C++, Python, or Lisp. These documents will support C++.

**Step 1:** [Create a new package](#) in your workspace for your new node to belong to. Make sure to do this in the correct parent directory .

```
cd ~/<workspace_name>/src
```

```
catkin_create_pkg <package_name> std_msgs roscpp
```

**Step 2:** Back out to the workspace directory then compile your package with [catkin\\_make](#)

```
cd ~/<workspace_name>          OR          cd ..
```

```
catkin_make
```

If you get here with no errors, your workspace is setup, and you are ready to write some code and test your new package!

**Step 3:** Create a new file for your C++ **publisher node** from the command line. The text editor *gedit* will create and open a new file named `<node_name>` in the current directory.

```
gedit ~/<workspace_name>/src/<package_name>/src/<node_name>.cpp
```

Copy the code below into the source file. .

```
#include "ros/ros.h"
#include "geometry_msgs/Twist.h"
#include <sstream>

int main(int argc, char **argv)
{
    ros::init(argc, argv, "replace_with_your_node_name");
    ros::NodeHandle n;
    ros::Publisher ttu_publisher =
        n.advertise<geometry_msgs::Twist>("/turtle1/cmd_vel", 1000);
    ros::Rate loop_rate(10);

    int count = 0;
    while (ros::ok())
    {
        geometry_msgs::Twist msg;
        msg.linear.x = 2+0.01*count;
        msg.angular.z = 2;
        ttu_publisher.publish(msg);
        ros::spinOnce();
        loop_rate.sleep();
        count++;
    }
}
```

Save and close the file. It must be saved as a `<node_name>.cpp` in the `src` directory of the package you created in previously in **Part I**

**Step 4:** Before we can compile the node we have to modify the file below.

```
gedit ~/<workspace_name>/src/<package_name>/CMakeLists.txt
```

Add the following lines to the bottom of the file and save.

```
add_executable(<node_name> src/<node_name>.cpp)
target_link_libraries(<node_name> ${catkin_LIBRARIES})
```

**Step 5:** Compile and test the new publisher node. This will compile and build your source code as well as check for errors in your entire workspace.

```
cd ~/<workspace_name>
```

```
catkin_make
```

Start a core

```
roscore
```

Turn on a turtle.

```
roslaunch turtlesim turtlesim_node
```

Start your new node

```
roslaunch <package_name> <node_name>
```

Use rostopic to view current topics.

```
rostopic list
```

Close your node and start it again with the cmd\_vel topic mapped to the turtle like we did previously.

```
roslaunch <package_name> <node_name> /cmd_vel:=/turtle1/cmd_vel
```

### Part III - Create A [Subscriber Node](#):

Now create a **subscriber node** in the same package as the previous node.

**Step 1:** Use the code below called `turtlesim_subscriber.cpp` to start.

---

```
#include "ros/ros.h"
#include "std_msgs/String.h"
#include "geometry_msgs/Twist.h"
/**
 * This tutorial demonstrates simple receipt of messages over the ROS
 * system.
 */
void dataCallback(const geometry_msgs::Twist::ConstPtr& msg)
{
    ROS_INFO("I heard: [%f]", msg->linear.x);
}
int main(int argc, char **argv)
{
    ros::init(argc, argv, "turtlesim_subscriber");
    ros::NodeHandle n;
    ros::Subscriber sub = n.subscribe("/cmd_vel", 1000, dataCallback);
    ros::spin();
    return 0;
}
```

---

**Step 2:** Modify the appropriate CMakeLists.txt file as you did previously.

**Step 3:** Compile the new subscriber node using catkin.

**Step 4:** Test the new node. Does it work? How do you know?

### Tutorial Complete:

After completing *Tutorial 4 - Create Package*, you are finally ready for a more advanced robot simulator.

**Bonus Exercise:** Install the [JoyStick Teleop Node](#) to drive the turtle with a USB joystick.