Robot Operating System

Lab 1: Packages, launch files, parameters and topic remapping

1 Goals

In this lab we will see the main tools to analyze nodes and topics.

1.1 Using the terminals

In ROS, a lot of commands have to be run from the terminal. Each terminal should be configured either to run ROS 1 things, or ROS 2 things. A simple shortcut allows changing this:

```
ros1ws # type this to configure the terminal for ROS 1 (default)
ros2ws # type this to configure the terminal for ROS 2 (has to be done manually)
```

You can change the default behavior by updating the ros1ws line of your `.bashrc` file.
Each time a package is compiled, the corresponding command (ros1ws / ros2ws) should be run in order to refresh the package list.

1.2 Bring up Baxter

Even if you have a real Baxter robot it can be a good idea to test the lab in simulation first. In both cases, we want to have a RViz display, which is mandatory in simulation and quite handy on the real robot. RViz is run automatically in both cases.

1.2.1 On the real robot

Baxter is a ROS1-based robot. To work with ROS 2 we thus have to run a bridge that transforms all or some topics between ROS 1 and ROS 2.
A launch file is available in the `baxter_bridge` package to run both the bridge and RViz.
You have to connect to Baxter's ROSMASTER in the terminal where you run the bridge:

```
ros2ws
source ~/ros/baxter.sh # so that your ROSMASTER is Baxter
ros2 launch baxter_bridge baxter_bridge_launch.py
```

In you are in a lab on the real Baxter, remind the lab assistant to allow multiple publishers for this lab. It can be done from a ROS 1 terminal:

```
ros1ws
source ~/ros/baxter.sh # so that your ROSMASTER is Baxter
rosparam set allow_multiple true
```

1.2.2 In simulation (including virtual machine users)

The Baxter simulator behaves as the actual Baxter from the ROS 2 side, only with a very limited part of the same topics and services.
The baxter_bridge node should be run from a ROS 2 terminal:

```
ros2ws
ros2 launch baxter_simple_sim sim_launch.py
```

The launch file also runs RViz.

1.3 Initial state

Whether in simulation or on the robot, Baxter is not moving and is waiting for commands on any arm.
A few in/out topics exist and can be listed through:

```
rostopic list (ROS 1, if on the real robot)
ros2 topic list (ROS 2)
```

1.4 Compiling the package

The folder should be put in your ROS 2 workspace (~/ros2/src). Compilation is done by calling colcon from the root of the workspace:

```
ros2ws
cd ~/ros2
colbuild --packages-select move_joint
```

2 Running the control nodes

A basic control GUI can be run with:

```
ros2 launch move_joint slider_launch.py
```

It runs a node that sends the slider value on a topic (here setpoint).

The Baxter robot has 2×7 joints as shown in Fig. 1, the names of which are listed in the table.

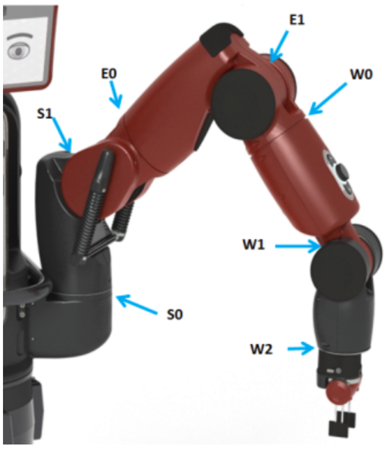
A special node called move_joint should be used to change the value published by the slider GUI, to the setpoint of a particular joint:

```
ros2 run move_joint move_joint
```

2.1 Initial state of the control nodes

Use ros2 node and ros2 topic to get the information on the nodes. There are currently two limitations:

- The move_joint node needs a parameter to tell which joint it should be controlling



joints (`left_` & `right_`)	`s0`	`s1`	`e0`	`e1`	`w0`	`w1`	`w2`

Figure 1: Baxter joints

- The slider publishes on `setpoint` while the `move_joint` node listens to `joint_setpoint`

Additionally, it would be nice to run the two nodes in the same lauch file.

2.2 Regroup all nodes in the same launch file

Open the `slider_launch.py` and add a line equivalent to calling `ros2 run move_joint move_joint`. Then, add a parameter to tell which joint should be controlled:
`parameters = {'joint_name': 'right_e0'}`

To run this launch file, you can go to its folder and type `ros2 launch ./slider_launch.py`. Display the graph (`rqt_graph`) to detect that the slider node and `move_joint` do not communicate, because they do not use the same topics.

2.3 Remapping

In this section we will remap the topic name of `move_joint` such that is uses `setpoint` instead of `joint_setpoint`.

Modify the launch file by adding this argument to the `move_joint` node:

```
remappings = {'joint_setpoint': 'setpoint'}.items()
```

Run the launch file again and you should be able to control the chosen joint.

3 Playing with launch files

3.1 Argument for joint name

Now that a launch file exists to control 1 joint from a slider, we will change the hard-coded joint name to an argument:

```
sl.declare_arg('name', 'right_e0')
```

This syntax tells the launch file that is now has a `name` argument, with default value `'right_e0'`.

Change the hard-coded value to the argument one `sl.arg('right_e0')` and check that the behavior is the same

Also, you can rename the slider GUI by giving an additional argument:

```
sl.node('slider_publisher', 'slider_publisher', name=sl.arg('name'), ...)
```

Then, run the launch file with another name, for instance:
`ros2 launch ./slider_launch.py name:=left_e0`
On another terminal, try to run the same launch file for another joint. What happens?

3.2 Including launch files in other launch files

In this last section we will write a new launch file that will include the previous one, for various joint names. In order to avoid node / topic duplicates, each nodes relative to a specific joint will be in their own namespace.
The syntax to include a launch file in another one is as follow:

```
sl.include('move_joint', 'slider_launch.py', launch_arguments = [('name', 'right_e0')])
```

It should be called from a namespace block, with this syntax:

```
with sl.group(ns = 'right_e0'):
  sl.include('move_joint', 'slider_launch.py', launch_arguments = [('name', 'right_e0')])
```

Check that the behavior is similar to the previous one. Then, write a for loop to run this code for many joint names:

```
joints = ('right_e0', 'right_e1', ...)
for joint in joints:
    with sl.group(ns = joint):
        sl.include(...)
```