Programming ROS nodes

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Overview (Review)

By now, you should know:

- What nodes, topics, messages are
- What a ROS package is, and how it's laid out, and how to create one
- How to use ROS tools: roscd, rosnode, rostopic, rosmsg, rxgraph

In this lecture

You will remind yourself how to program real robot nodes in Python and learn how to use launch files.

Running a simulated robot

- Get STDR Simulator from apt packages

```
$sudo apt-get install ros-$ROS_DISTRO-stdr-simulator
```

- Launch the simulation

```
$ roslaunch stdr_launchers
 server_with_map_and_gui_plus_robot.launch
```

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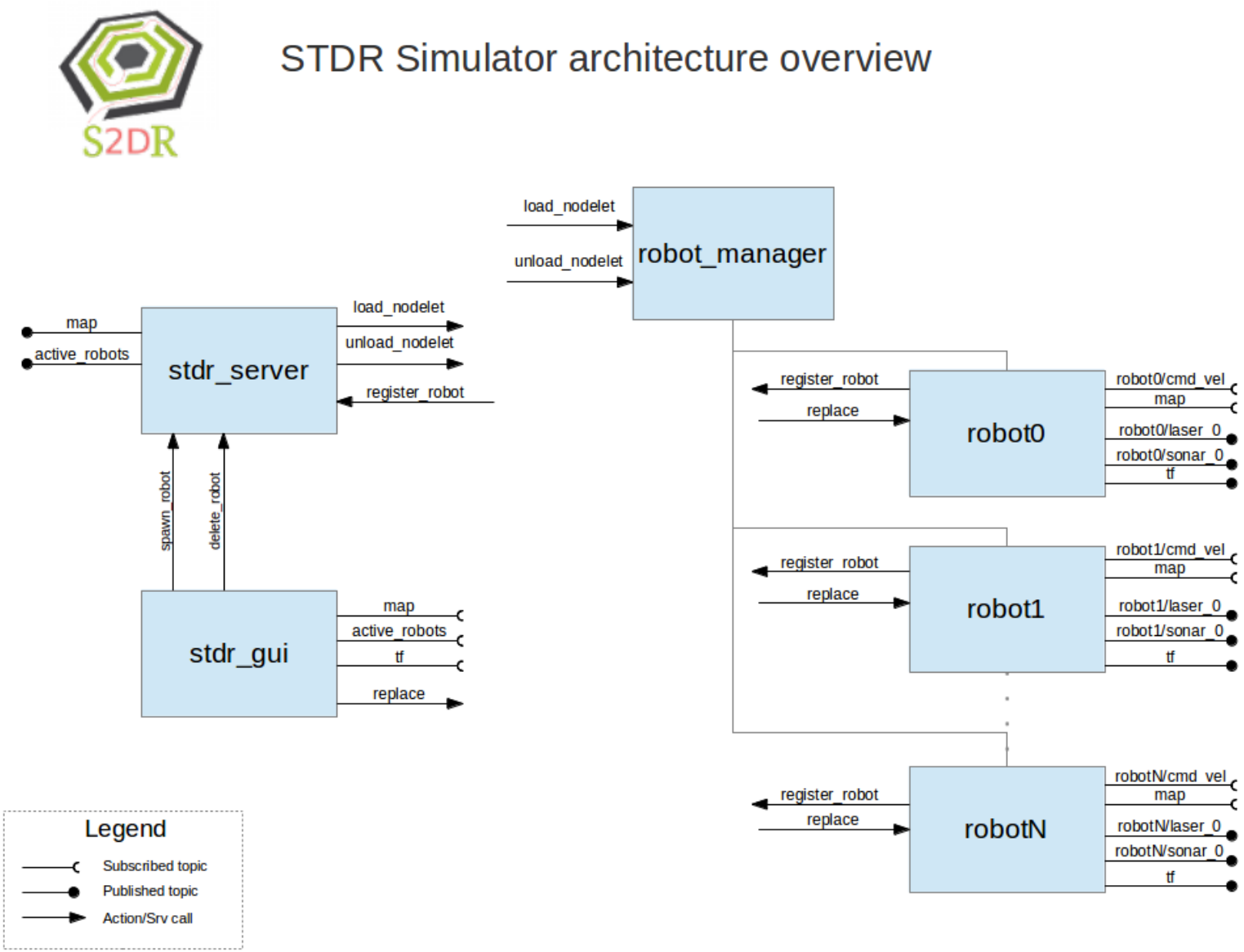
- Examine the ROS computational graph

```
$ rosrun rqt_graph rqt_graph &
$ rostopic list
$ rostopic info /cmd_vel
$ rosmsg info Twist
```

STDR Simulator architecture



STDR Simulator architecture

- server: Implements synchronization and coordination functionalities of STDR Simulator.
- robot: Provides robot, sensor implementation, using nodelets for server to load them.
- parser: Provides a library to STDR Simulator, to parse yaml and xml description files.
- gui: A gui in Qt for visualization purposes in STDR Simulator.
- msgs: Provides msgs, services and actions for STDR Simulator.

Publishing velocity commands (1/2)

- Create a package

```
$ catkin_create_pkg ros_liv_wander rospy geometry_msgs
sensor_msgs stage
$ mkdir ros_liv_wander/scripts
$ gedit ros_liv_wander/scripts/vel_pub.py
```

- Write the publisher code! Check publisher.py from turtlecontrol package :)

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- Write the publisher code! Check publisher.py from turtlecontrol package :)

```
#!/usr/bin/env python
import roslib
import rospy
from geometry_msgs.msg import Vector3, Twist

def publish_velocities(v, w):
  tw = Twist(Vector3(v,0,0), Vector3(0,0,w))
  pub.publish(tw)
  rospy.sleep(1.0)
```

Publishing velocity commands (2/2)

```
if __name__ == '__main__':

  pub = rospy.Publisher('cmd_vel', Twist)
  rospy.init_node('vel_pub')

  v = 0.5; w = 0.5
  try:
  while not rospy.is_shutdown():
    publish_velocities(v, w)
    except rospy.ROSInterruptException:
  pass
```

Running the velocity command publisher

```
$ chmod +x cmd_vel.py
$ rosrun ros_liv_wander cmd_vel.py
```

Assignment

Modify the code, so that velocities are passed to the node as command-line arguments. (Hint: You will need the argv object from the sys module)

Assignment

Modify the velocity command publisher, so that robot motion can be controlled from the keyboard. (Hint: The fastest way to do this is by utilizing turtle_teleop_key from turtlesim package.)

Launch files: running multiple nodes in one command

- Create a launch file

```
$ mkdir ros_liv_wander/launch
$ gedit ros_liv_wander/launch/server_with_map_and_gui_plus
_robot_with_keyboard.launch
```

```
<launch>
<launch><!-- standard XML blocks -->
<!-- We can start other launch files -->
<include file="$(find stdr_launchers)/launch/server_with_map_
and_gui_plus_robot.launch" />
<!-- We can start different nodes -->
<node type="turtle_teleop_key" pkg="turtlesim"
name="robot_teleop">
        <!-- remaping in launch files -->
        <remap from="turtle1/cmd_vel" to="robot0/cmd_vel"/>
</node>
</launch>
```

Namespace: the correct way of running multiple nodes

- turtle1 and robot0 are actually namespaces of robots
- Changing the namespace of a node is an easy mechanism for integrating code, as all names within the node (name, topics, etc) will be rescoped.
- For this feature to work properly, it's important that your program avoids using global names and instead uses relative and private names.

```
<!-- Turtlesim uses global name turtle1/cmd_vel -->
<node type="turtle_teleop_key" pkg="turtlesim"
name="robot_teleop" ns="robot0">
        <!-- because of global name we have to remap
        turtle1/cmd_vel to a private name cmd_vel-->
        <remap from="turtle1/cmd_vel" to="cmd_vel"/>
</node>
```

Listening to sensor data (1/2)

- Let's examine the topics published by our robot

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```
#!/usr/bin/env python
import roslib
import rospy
from sensor_msgs.msg import LaserScan

def scan_callback(scan):
  rospy.loginfo((len(scan.ranges), min(scan.ranges)))
def listener():
  rospy.init_node('laser_listener')
  rospy.Subscriber('scan', LaserScan, scan_callback)
  rospy.spin()

if __name__ == '__main__':
  listener()
```

Running the sensor data listener

- Let's run the listener

```
$ rosrun ros_liv_wander laser_listener.py
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- Are we getting the expected results? Hint: check rxgraph
- Topics are mapped by name!
- Run the listener with argument remapping

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$ rosrun ros_liv_wander laser_listener.py
scan:=laser_0
```

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- Do not use /laser_0 since / makes it global i.e. root

Running the sensor data listener (launch file)

```
<launch><!-- standard XML blocks -->
<!-- We can start other launch files -->
<include file="$(find stdr_launchers)/launch/server_with_map_
and_gui_plus_robot.launch" />
<!-- We can start different nodes -->
<node type="turtle_teleop_key" pkg="turtlesim" name=
"robot_teleop" ns="robot0">
        <!-- remaping in launch files -->
        <remap from="turtle1/cmd_vel" to="cmd_vel"/>
</node>
<node type="laser_listener.py" pkg="ros_liv_wander"
    name="laser_listener" ns="robot0" output="screen">
        <!-- output allows ROS_INFO in terminal -->
        <remap from="scan" to="laser_0"/>
</node>
</launch>
```

Letting the robot out to play :)

Assignment (Homework)

1. Write a launch file for your previous homework problem (hw3) so that it starts all the nodes necessary to play the game of turtlecatch.
2. Write a node that subscribes to topic laser_0 and drives the robot safely through the map (publishes on topic cmd_vel). The robot should use laser_0 data in order to figure out obstacles in front of it $min\_ahead = min(scan.ranges[left\_angle : right\_angle]) < min\_ahead\_tresh$. If *min_ahead* falls below threshold, the robot should steer left or right (you choose), otherwise it should drive straight. Figure out what parameters *left_angle*, *right_angle* and *min_ahead_tresh* work best for your robot.

Useful links

- http://www.ros.org/wiki/ROS/Tutorials/WritingPublisherSubscriber
- http://www.ros.org/wiki/geometry_msgs
- http://www.ros.org/wiki/sensor_msgs
  http://www.ros.org/wiki/gmapping
- http://www.ros.org/wiki/dynamic_reconfigure