Introduction to ROS

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A middle-ware for robots

- Open-source, C++ and Python
- Framework
- Unified communication patterns
- Drivers, Hardware abstraction
- Contributors from all over the world

http://www.ros.org/

Tutorials: http://www.ros.org/wiki/ROS/Tutorials

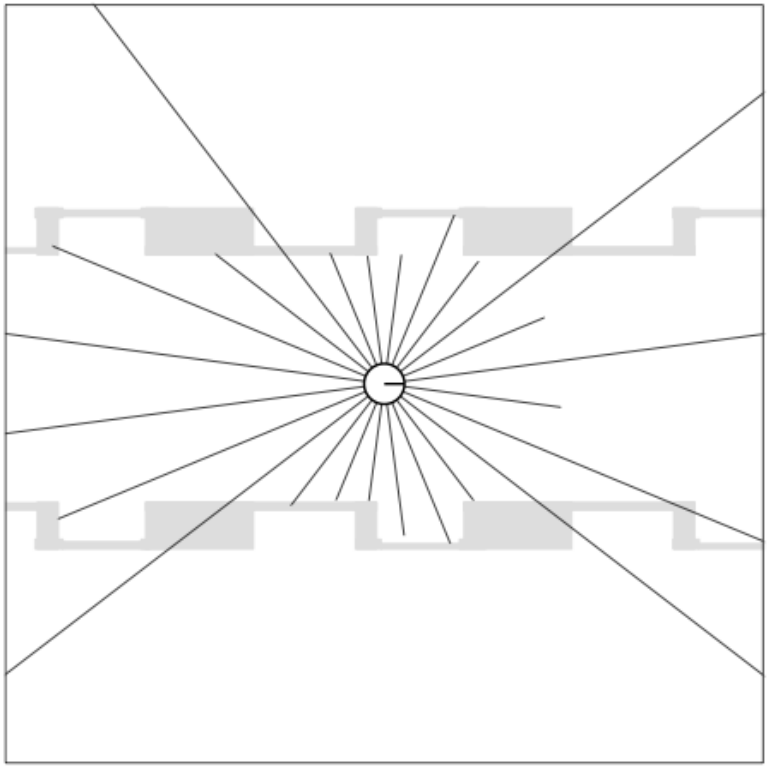
ROS: Topics

/openni/rgb/image_raw
/openni/depth/image_raw
...

/scan

/odom

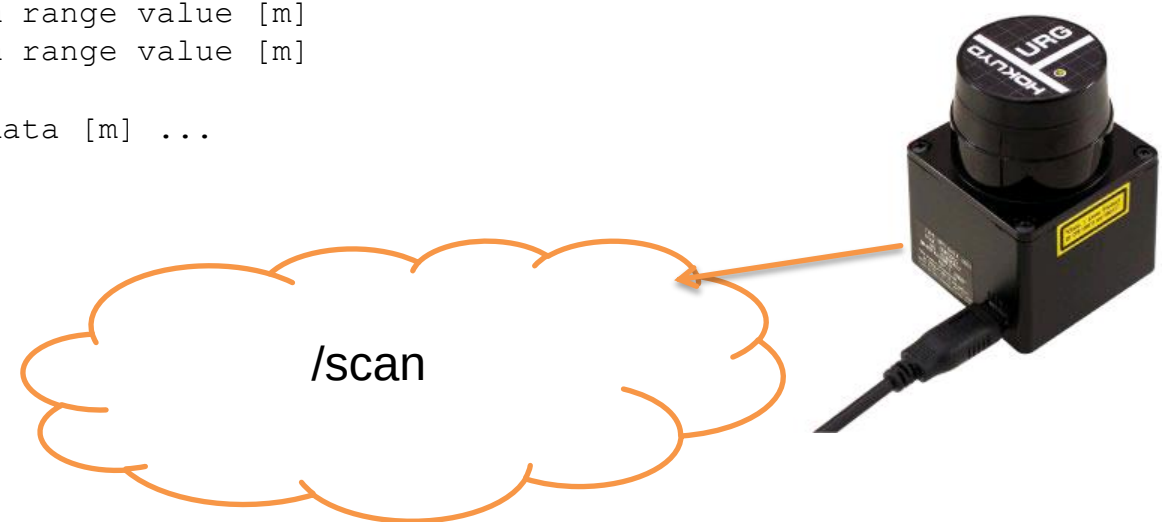
Example: Laser Scanner



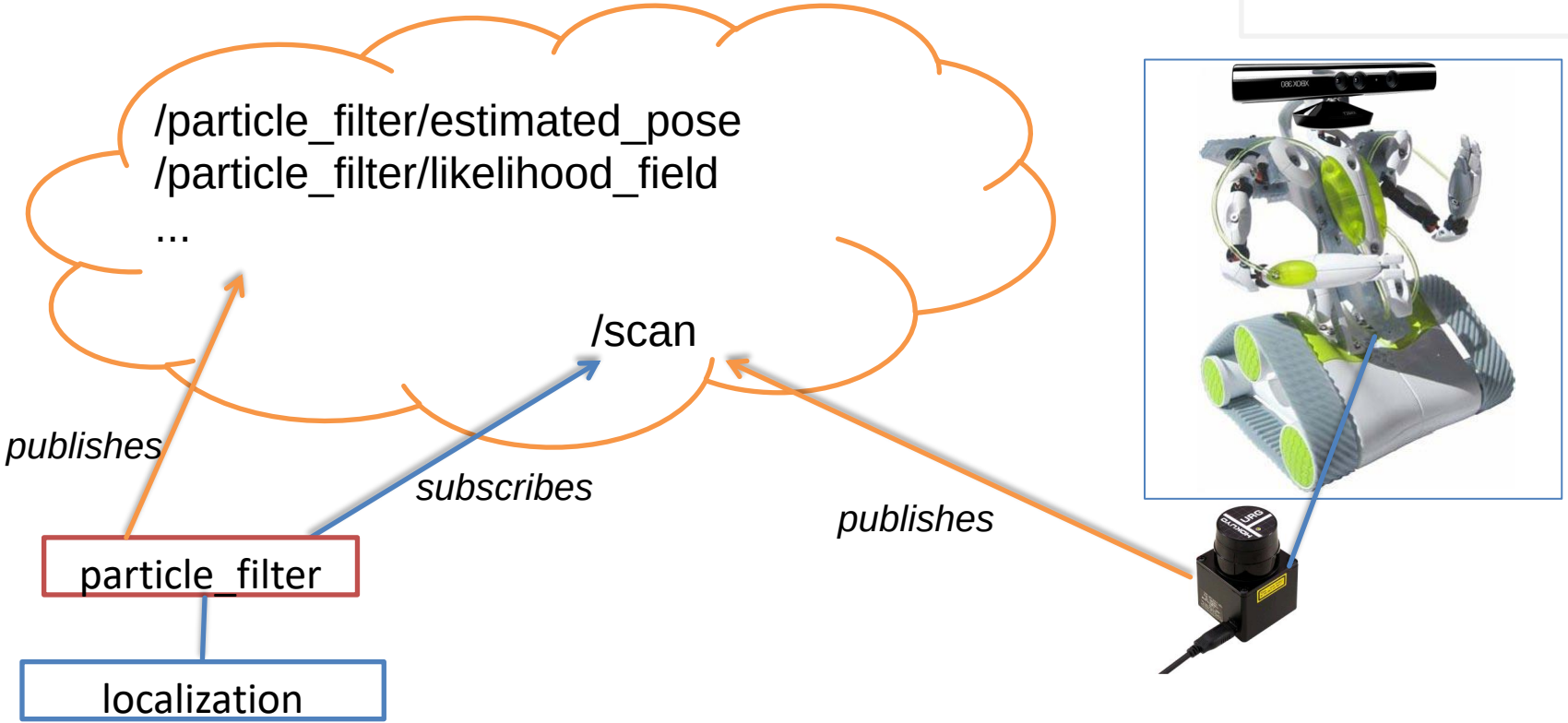
ROS: Messages

http://www.ros.org/doc/api/sensor_msgs/html/msg/LaserScan.html:

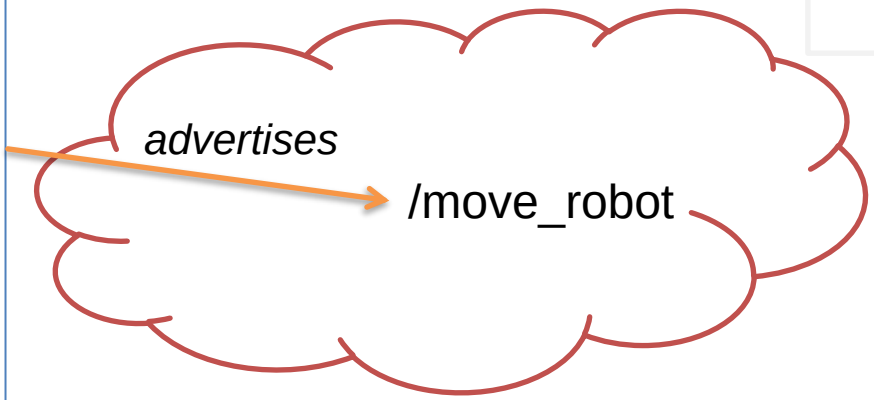
```
# ...
float32 angle_min        # start angle of the scan [rad]
float32 angle_max        # end angle of the scan [rad]
float32 angle_increment  # angular distance between
                                  # measurements [rad]

float32 range_min        # minimum range value [m]
float32 range_max        # maximum range value [m]

float32[] ranges         # range data [m] ...
```



ROS: Subscribing to Topics



ROS: Services

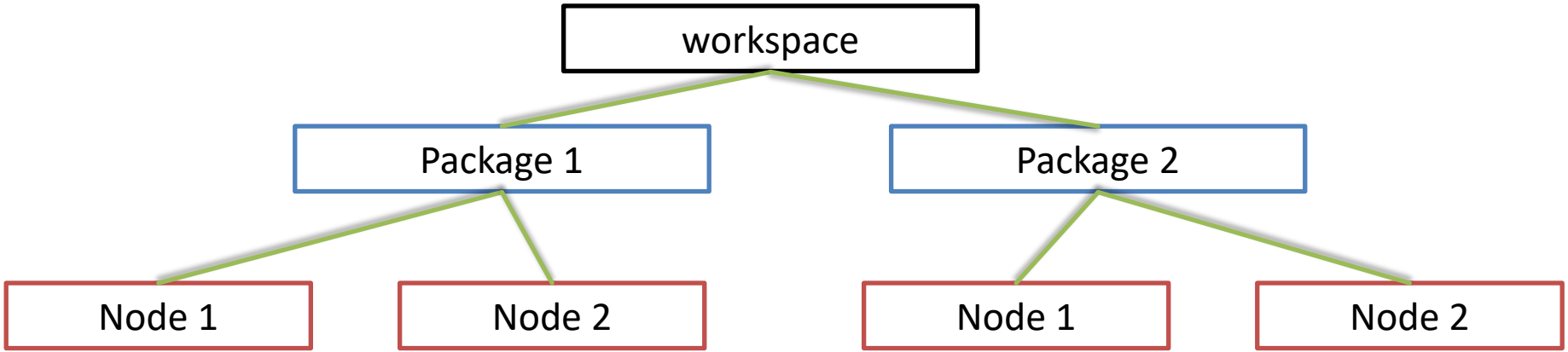



```
user@pc$:~/ rosservice call /move_robot 5.4 3.0
```

- Services are very similar to messages
- „Remote procedure call“: Services can have return values

ROS: Structural concepts

- A **package** contains **nodes**, **messages**, and **services**
- A **node** publishes+subscribes to topics, offers+calls services
- [A **workspace** contains packages (and meta-packages)]



Installing ROS on your computer

- Ubuntu 20.04.: http://wiki.ros.org/noetic/Installation
  - Option: desktop-full
- The Virtualbox image comes with ROS noetic preinstalled
- Installing addional packages:
  - `sudo apt-get update`
  - `sudo apt-get install ros-noetic-navigation ros-noetic-slam-gmapping ros-noetic-rviz ros-noetic-roslib libwxgtk3.0-de`

Using a ROS Workspace

- Get our ROS workspace from ISIS2 and unpack it locally (e.g. in `/home/user/ws_assignment4`)
- Setup your workspace with:
  - catkin_make

    (catkin is a wrapper for cmake)
- Setup your shell to use the workspace:
  - source devel/setup.sh

    (you can also append this to your ~/.bashrc)
- see also: http://www.ros.org/wiki/ROS/Tutorials/InstallingandConfiguringROSEnvironment
- Build all packages in your Workspace:
  - catkin_make

ROS Commands

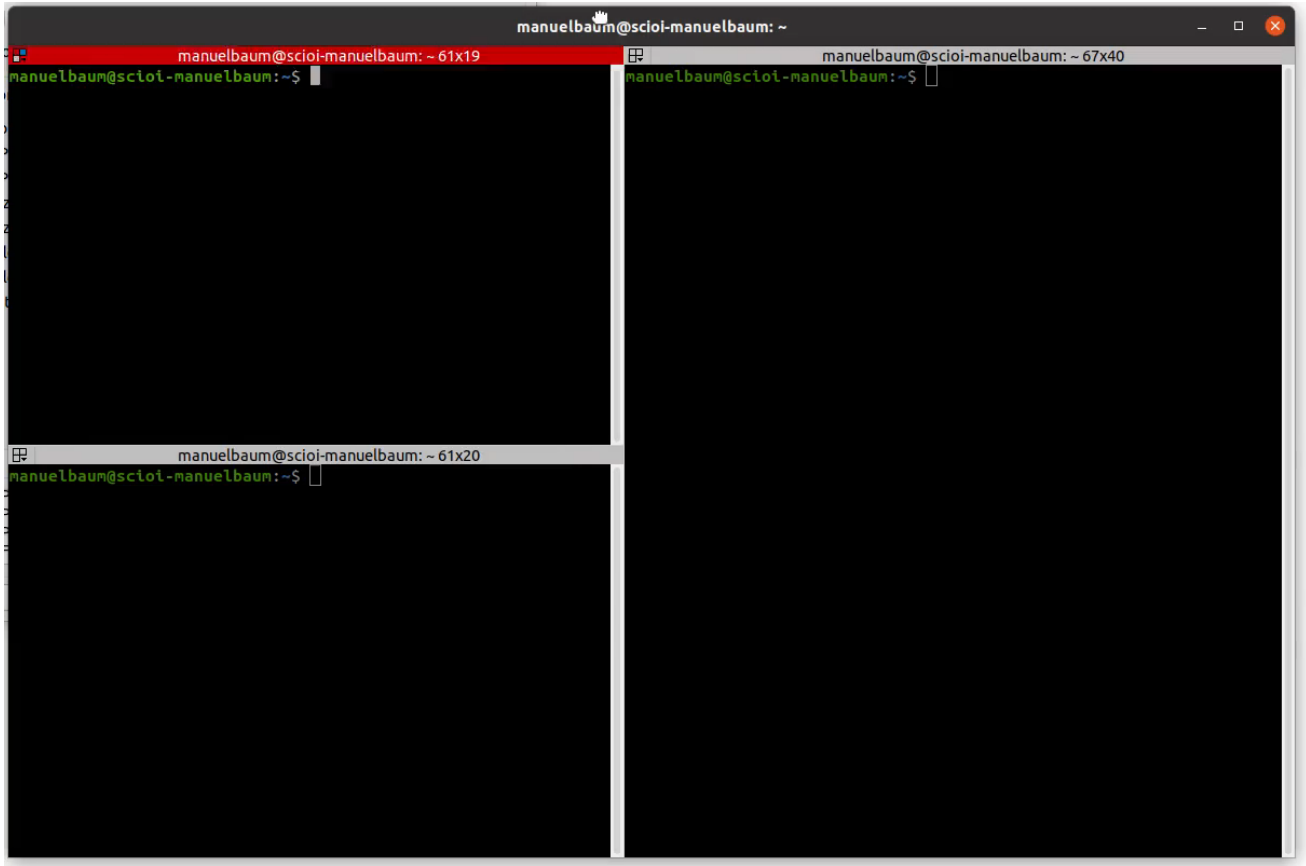
http://wiki.ros.org/

http://wiki.ros.org/ROS/Tutorials

How to start a ROS network

- Start server with **`roscore`**
- Nodes connect to the roscore at `$ROS_MASTER_URI`
  - Default: http://localhost:11311
  - But you can also connect multiple machines!
- **`rosrun`**: run a node (executable) from a certain package
- **`rosrun turtlesim turtlesim_node`**

ROS Commands Executed Part 1

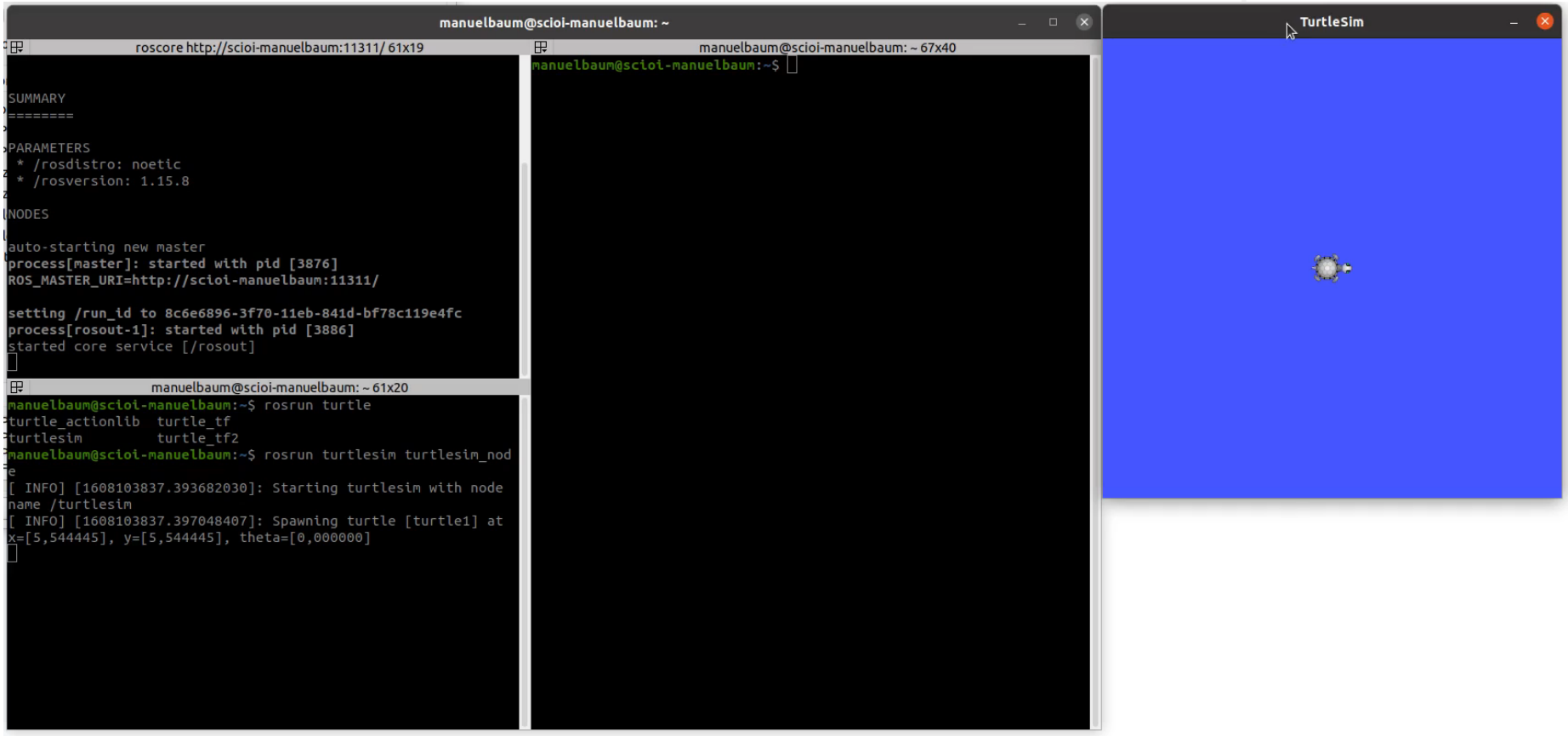


ROS Messages

- **`rostopic`**
  - list: Display a list of current topics
  - echo <topic-name> : Display messages
    - **`rostopic echo /turtle1/pose/`**
  - info <topic-name> : Display general information
    - **`rostopic info /turtle1/pose/`**

- **`rosmsg`**
  - show <msg-name> : Display a message definition
    - **`rosmsg show turtlesim/Pose`**

ROS Commands Executed Part 2



ROS Service

`rosservice`

(service counterpart to rostopic)

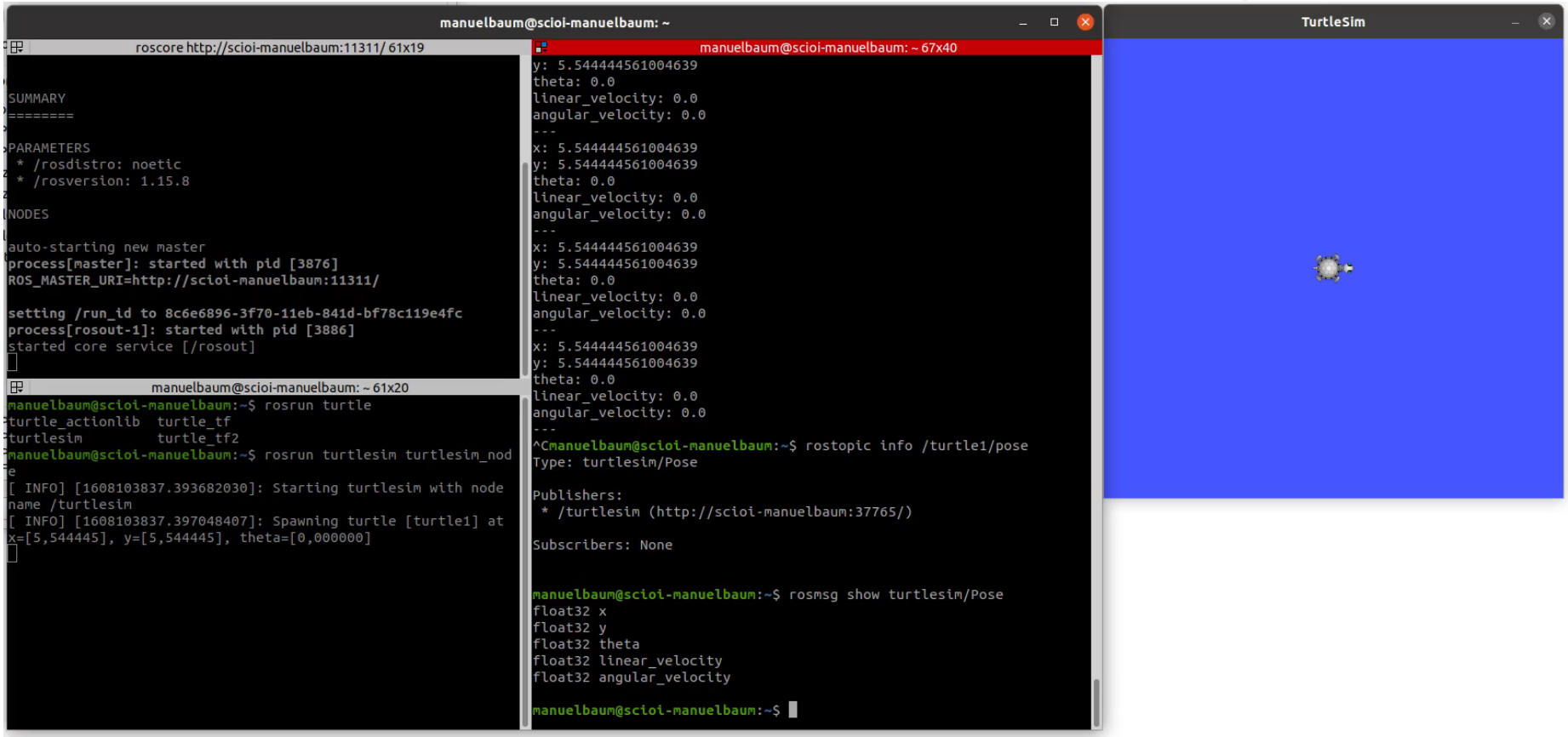
- list: Display a list of available services
- call <srv-name> <params>: Call a ROS service
  - **`rosservice call /turtle1/teleport_relative 3.0 1.0`**

`rossrv`

(service counterpart to rosmsg)

- show <srv-name>: Display a service definition
  - **`rossrv show turtlesim/TeleportRelative`**

ROS Commands Executed Part 3

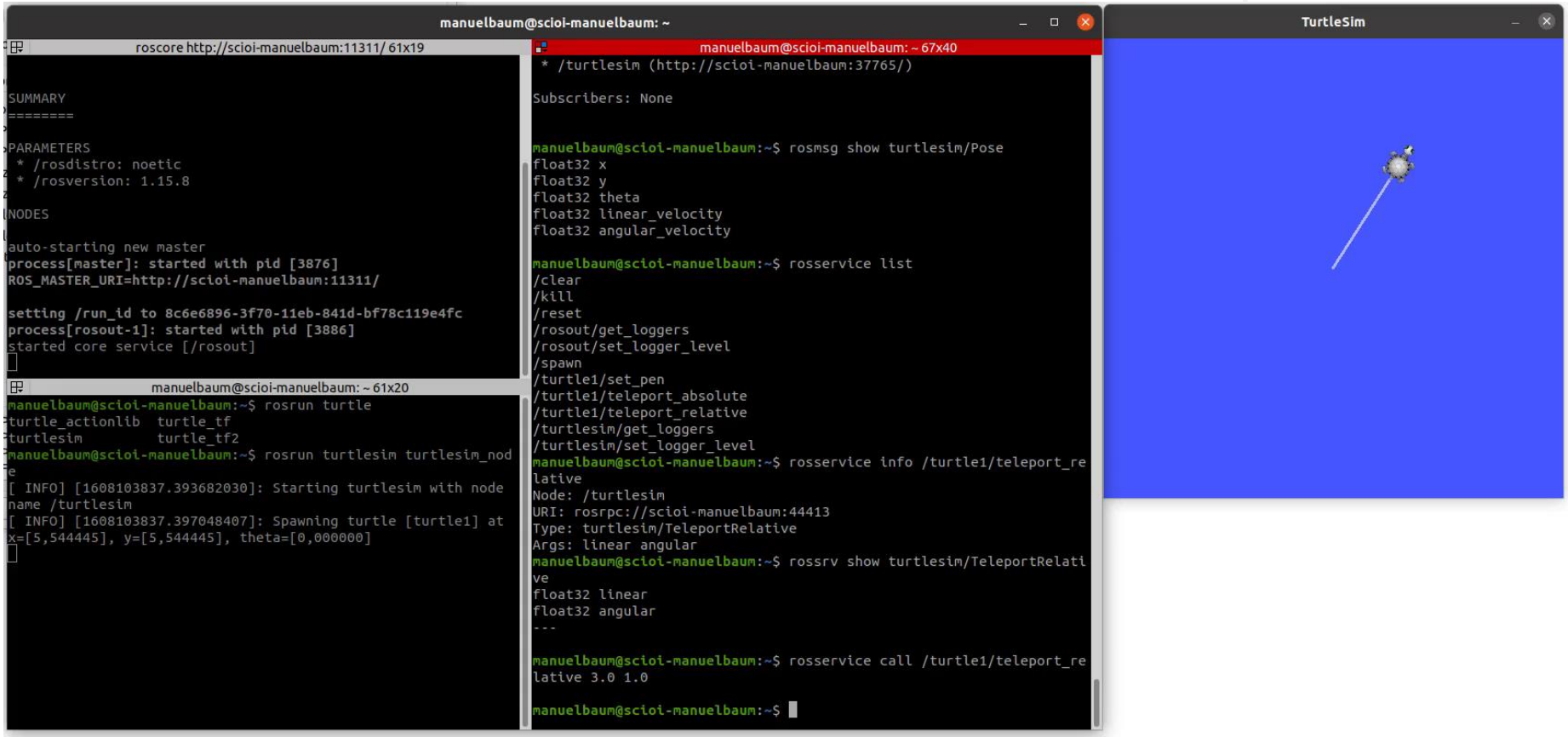


ROS File System Tools

- **`roscd`**
  - Jump immediately to a package/stack directory

```
roscd stack-or-package[/subdir]
```

ROS Commands Executed Part 4



ROS Tools

- **`roslaunch`**: launches a set of nodes
  - defined by an XML configuration file
    - **`roslaunch [<node>] <launch-file>`**
  - *roscore* is started automatically (if not yet running)

- **`catkin_make`**: is a tool aware of ros packages dependencies

- **`rosparam`**: enables getting and setting parameter server values

ROS logging

- Log files are called *bag files*

- **`rosbag play <file>`**
  - Pause playing with space key and stepping with s

- **`rosbag record <topic-names>`**
  - will generate a ".bag" file
  - Use option –a to record all topics

That’s it!

http://wiki.ros.org/

http://wiki.ros.org/ROS/Tutorials