Chair for Cognitive Systems
Department of Electrical and Computer Engineering
Technische Universität München

# RoboCup@Home Practical course

## Tutorials

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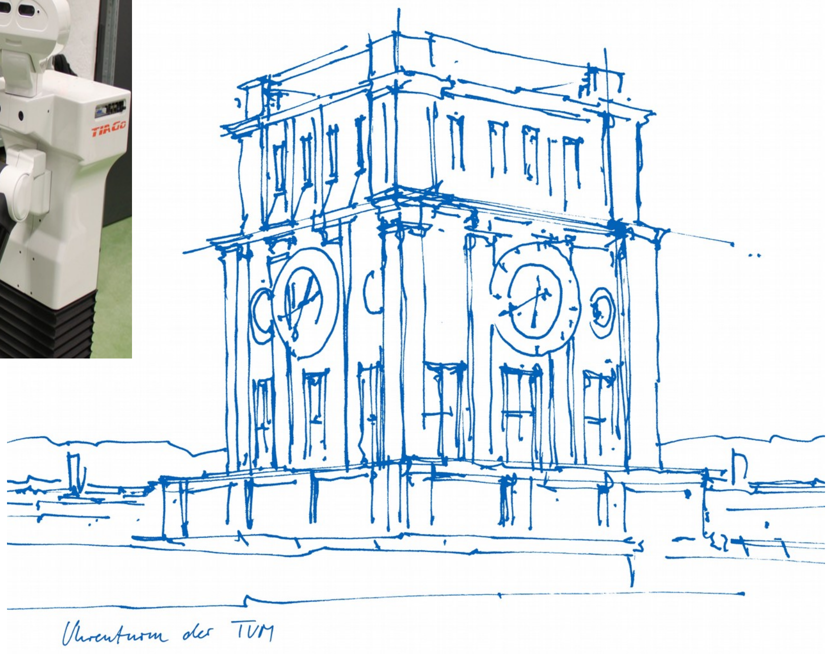

Technical University of Munich

Chair for Cognitive Systems

# Introduction

- Send the tutorials homework here:

**Email: robocup.atHome.ics@gmail.com**

Remember:
Individual laboratory assignments:30%

# Tutorial 1: ROS intermediate-level

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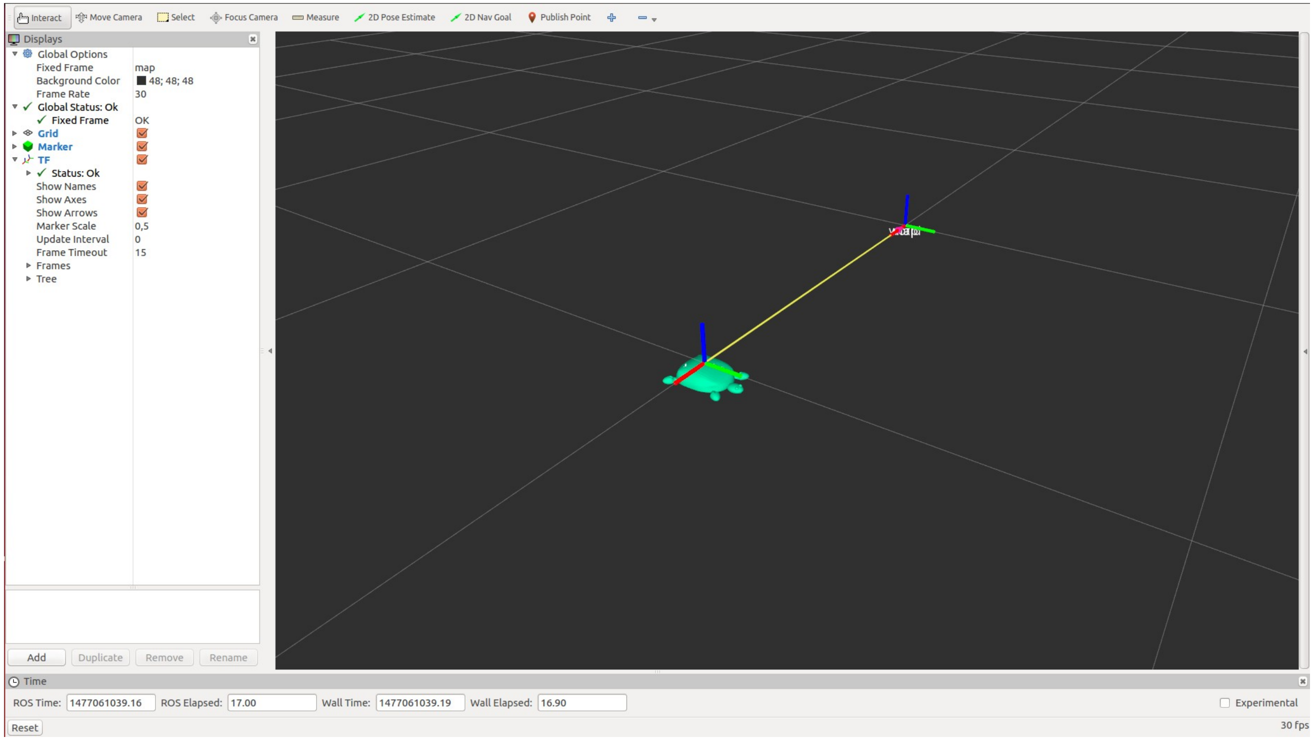
Goal: Move the position and orientation of one turtle to a desired position



Displays

- Global Options
  - Fixed Frame: map
  - Background Color: ■ 48; 48; 48
  - Frame Rate: 30
- ✓ Global Status: Ok
  - ✓ Fixed Frame: OK
- Grid ☑
- Marker ☑
- TF ☑
  - ✓ Status: Ok
  - Show Names ☑
  - Show Axes ☑
  - Show Arrows ☑
  - Marker Scale: 0,5
  - Update Interval: 0
  - Frame Timeout: 15
  - Frames
  - Tree

Time

ROS Time: 1477061039.16 ROS Elapsed: 17.00 Wall Time: 1477061039.19 Wall Elapsed: 16.90 □ Experimental

30 fps

You can use: roslaunch turtle_vis TurtleVis.launch

# Tutorial 1: ROS intermediate-level

## 1. Create a new ros workspace

```
$cd ~
$cd ros/workspace
$mkdir roboCupHome_tutorial_YOURNAME
$cd  roboCupHome_tutorial_YOURNAME
$mkdir src
$cd src
$catkin_init_workspace
```

## 2. Compile the new workspace

```
$cd ~/ros/workspace/roboCupHome_tutorial_YOURNAME
$catkin_make
```

## 3. Remember to source your new ros workspace

```
cd ~/ros/workspace/roboCupHome_tutorial_YOURNAME
cd source devel/setup.bash
```

# Tutorial 1: ROS intermediate-level

**1. -- Qtcreator -- Tools to Debug your code.**

```
$cd ~/ros/worspace/roboCupHome_tutorial_YOURNAME
$cd src
$mv CMakeLists.txt CMakeLists.txt.old
$cp CMakeLists.txt.old CMakeLists.txt
```

**2. Open your Code**

```
$cd ~/ros/worspace/roboCupHome_tutorial_YOURNAME/src
$qtcreator CMakeLists.txt
```

**3. Explore Qtcreator**

**4. Copy the template folder in your ros workspace and compile**

```
$cd ~/ros/worspace/roboCupHome_tutorial_YOURNAME/src/turtle_vis
```

# Tutorial 1: ROS intermediate-level

**5. Compile the template folder.**

```
$cd ~/ros/worspace/roboCupHome_tutorial_YOURNAME
$catkin_make
```

# Tutorial 1: ROS intermediate-level

**Exercise 1:** Fix the CMakeList.txt of the template project

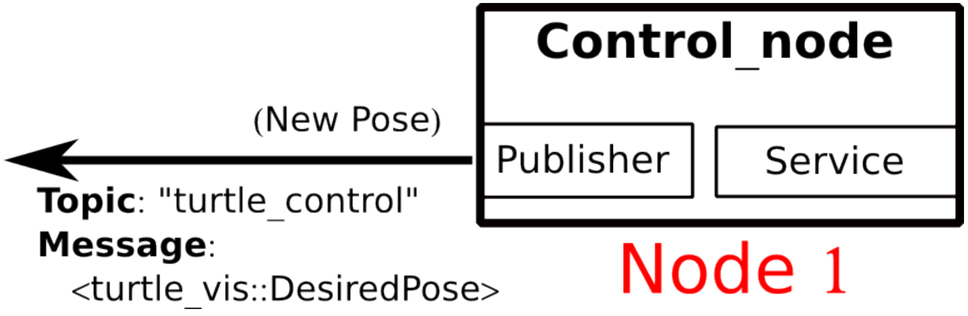
Hint: Look for the #>>>TODO inside the file

- Add the new defined messages
- Include the required service files
- Include the name of the new defined library on catkin_package
- Add the nodes that will be executed and create the proper target link.

Take a look at: http://wiki.ros.org/catkin/CMakeLists.txt

# Tutorial 1: ROS intermediate-level

**Exercise 2:** Create a node to compute the new turtle pose using a simple Kinematic Control.



Node 1: **Turtle_Control_node**

a) This node will provide:

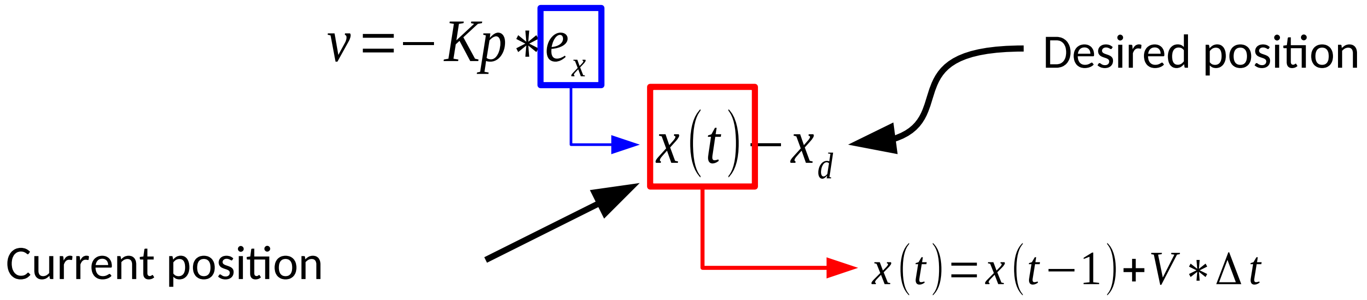
**a)Service**: this service is used to receive the desired turtle pose (x_d,y_d,theta_d).

**b)Publisher**: it will publish a topic “turtle_control” with the new turtle pose. This pose will be listened by Node 3.

# Tutorial 1: ROS intermediate-level

Inside the main loop of “turtle_control_node.cpp”:

- Obtain the desired pose ( $x_d$ ) from a class variable (see slide 22, definition of the class).
- Implement a P-control (Kinematic control) to move the turtle to a desired (d) position.



$$v = -Kp * \boxed{e_x}$$

$$\boxed{x(t)} - x_d$$

$$x(t) = x(t-1) + V * \Delta t$$

Desired position

Current position

- Publish the obtained turtle position to Node 3.

# Tutorial 1: ROS intermediate-level

Use the provided template “turtle_control_node.cpp” to create node 1, look for all #>>>TODO:

- To set the gain values for the controller (Kp), create a *.yaml file, which is usually in a new folder inside your package e.g. turtle_vis/configs.
- Modify the launch file to set the ros parameters from the yaml file (see the template in turtle_vis/launch).
- Define a message type to send the new position of the turtle through a publisher topic to Node 3 (see slide 9 for a message example).

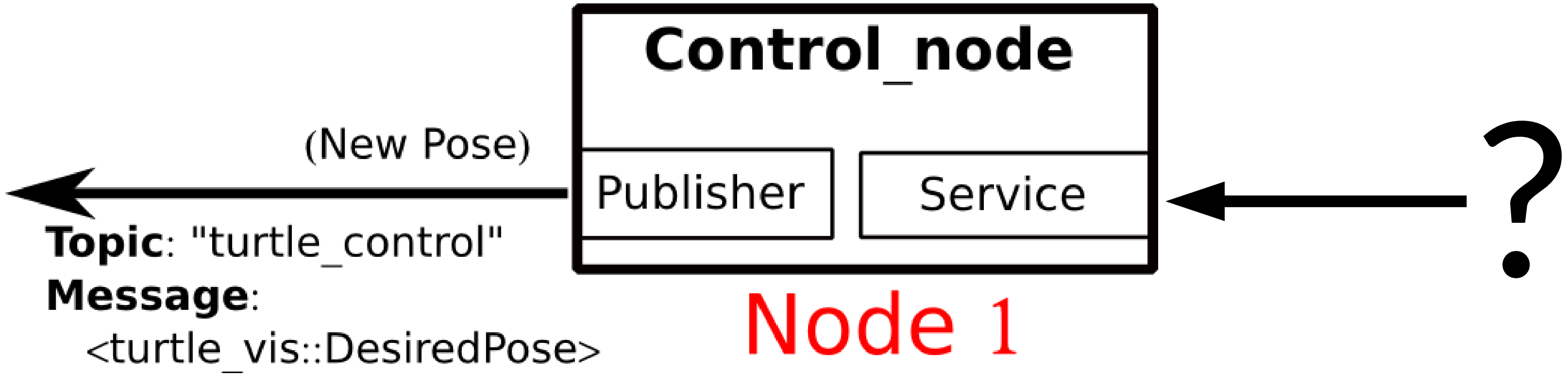
Take a look at: http://wiki.ros.org/rosparam

# Tutorial 1: ROS intermediate-level

**Exercise 3:** Answer the following questions:

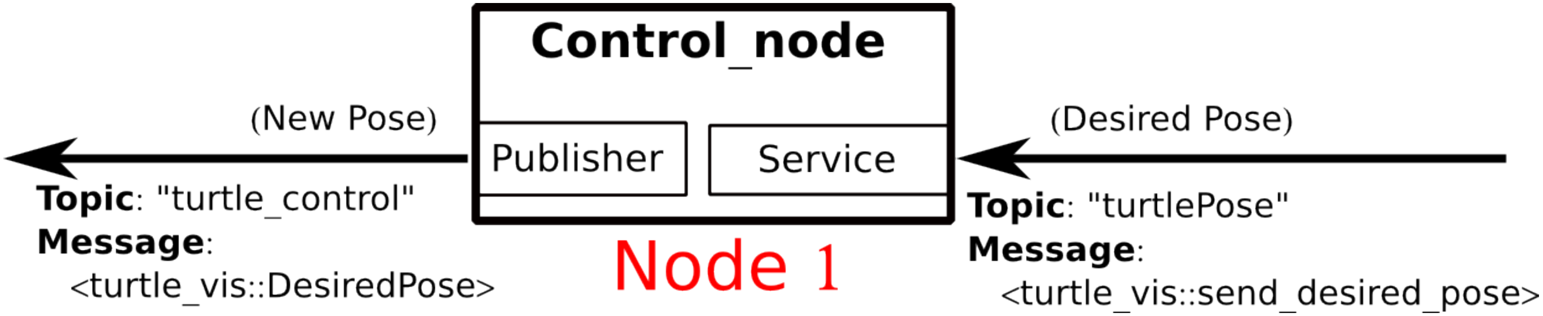
1) How can I send the new desired pose of the turtle (x_d, y_d, theta_d) to Node 1. Please, indicate the command that you will use and explain the reasons.

2)What is the main difference between a Publisher/Subscriber and Service/Client? For example, what would happen if I replace the Service for a Subscriber in Node 1?



# Tutorial 1: ROS intermediate-level

- Node 1 also has a service that will receive the desired position and orientation of the turtle.
- Define a new message type for the service of Node 1.
- Replace the "CALLBACKFUNCTION" from the template file (TurtleClass.h and TurtleClass.cpp) with the name of your function for the service, this function should be defined in your class (see slide 22).



# Tutorial 1: ROS intermediate-level

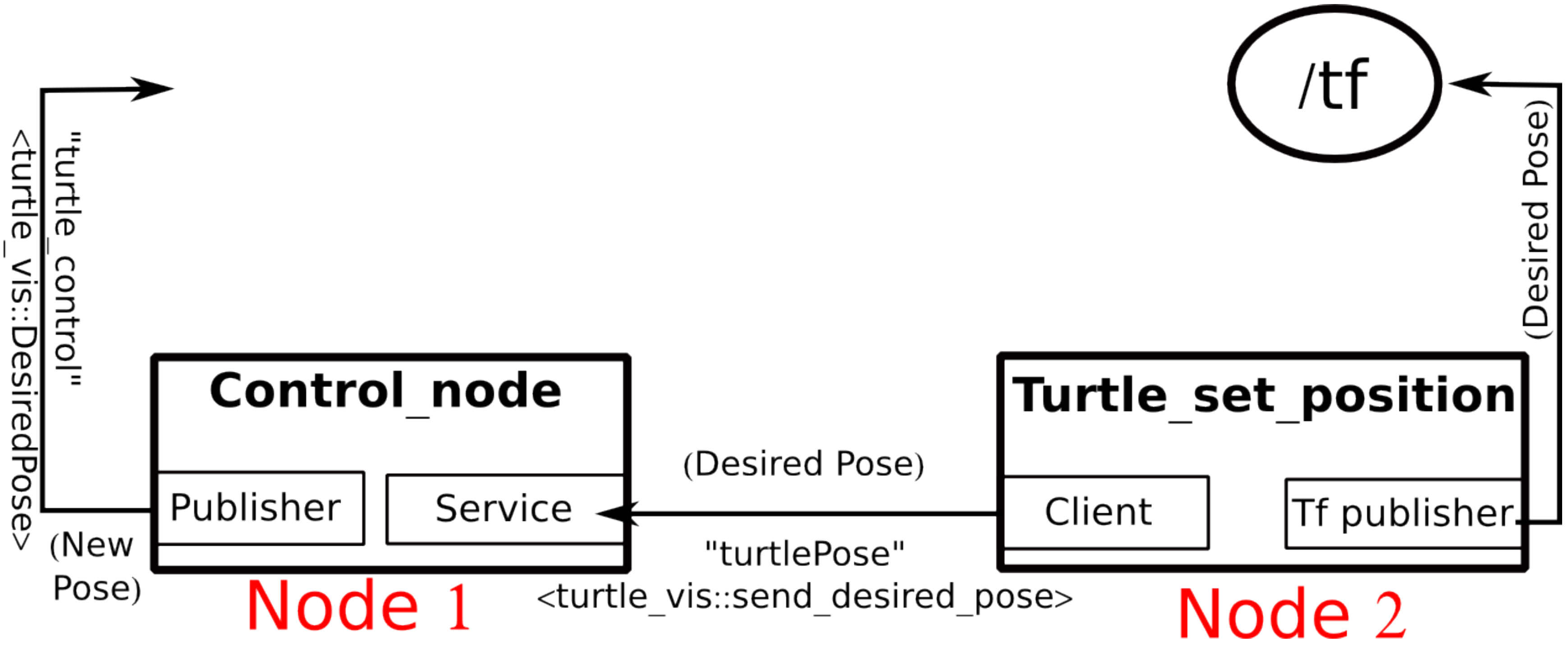
Hint: You can use the following command to debug the correct behavior of node 1, i.e. send the desired position of the turtle from the ros service terminal command, e.g.

```
rosservice call /TurtlePose "p:
          x: 0.0
          y: 0.0
          theta: 0.0"
```

Take a look at: http://wiki.ros.org/rosservice

# Tutorial 1: ROS intermediate-level

**Exercise 4:** Create node 2 to set the new desired pose of the turtle (x_d, y_d, theta_d) from a client to your defined service from node 1 .



# Tutorial 1: ROS intermediate-level

Node 2 has the name: **Turtle_set_position_node** and it contains:

- **Client:** will connect to the service provided by Node 1 and will send the desired turtle pose
- The desired pose should be acquired from the terminal (x_d, y_d and theta_d) in a continuous loop (this is a different terminal command than the one used in slide 14).
- **TF Publisher:** will publish the coordinate frame of the desired turtle pose to the /tf node.

You must define a custom message. This message will be used for the topic for the Service/Client definition (communication between Node 1 and Node 2), e.g. turtle_vis::send_desired_pose.

# Tutorial 1: ROS intermediate-level

**Exercise 5:** Create Node 3 that receives the new computed pose of the turtle from Node 1 and visualize the turtle with its new pose.

Node 3: **Turtle_vis_node**

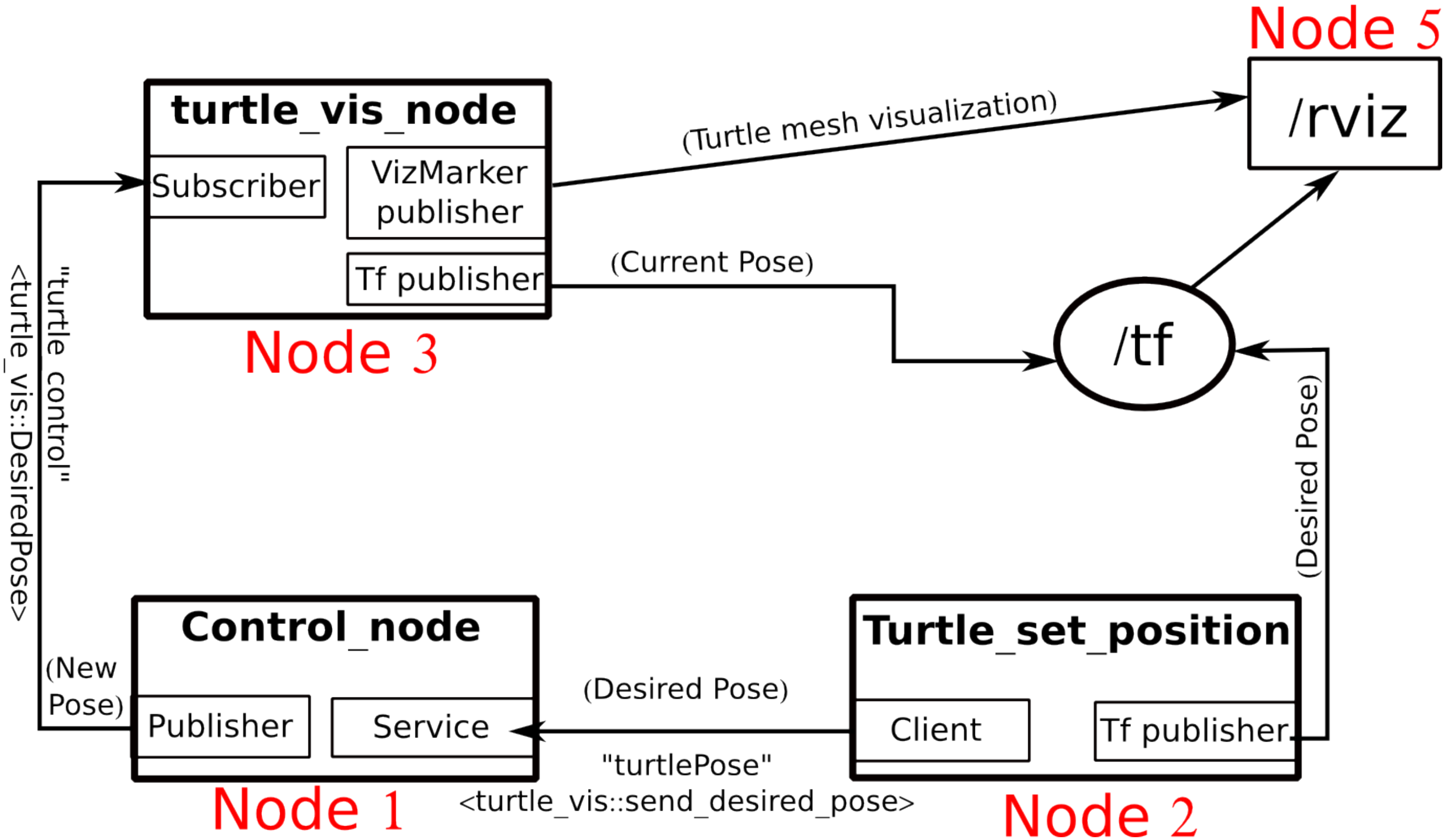
This node will provide:

a)**Subscriber:** will connect to the topic generated by Node 1 and will generate the coordinate frame for the current turtle position and the visualization of the turtle.

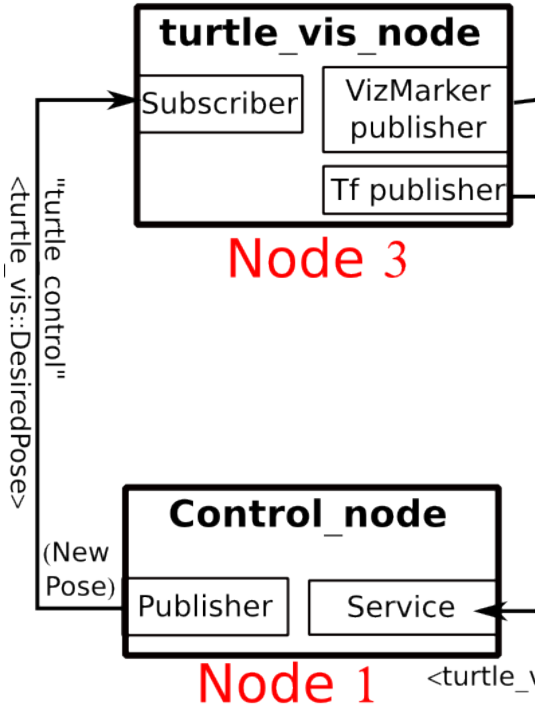
b)**TF Publisher:** to publish the coordinate frame for the current turtle pose.

c)**Visualization_Marker Publisher:** To visualize the turtle mesh in rviz.

# Tutorial 1: ROS intermediate-level



# Tutorial 1: ROS intermediate-level



You must define a custom message. This message will be used for the topic publisher/subscriber (communication between Node 1 and Node 3), e.g:

turtle_vis::DesiredPose

# Tutorial 1: ROS intermediate-level

As additional nodes, we have static transformations as well as rviz transformations using tf.

- **Node 4:** Static transformation

  This node will perform:

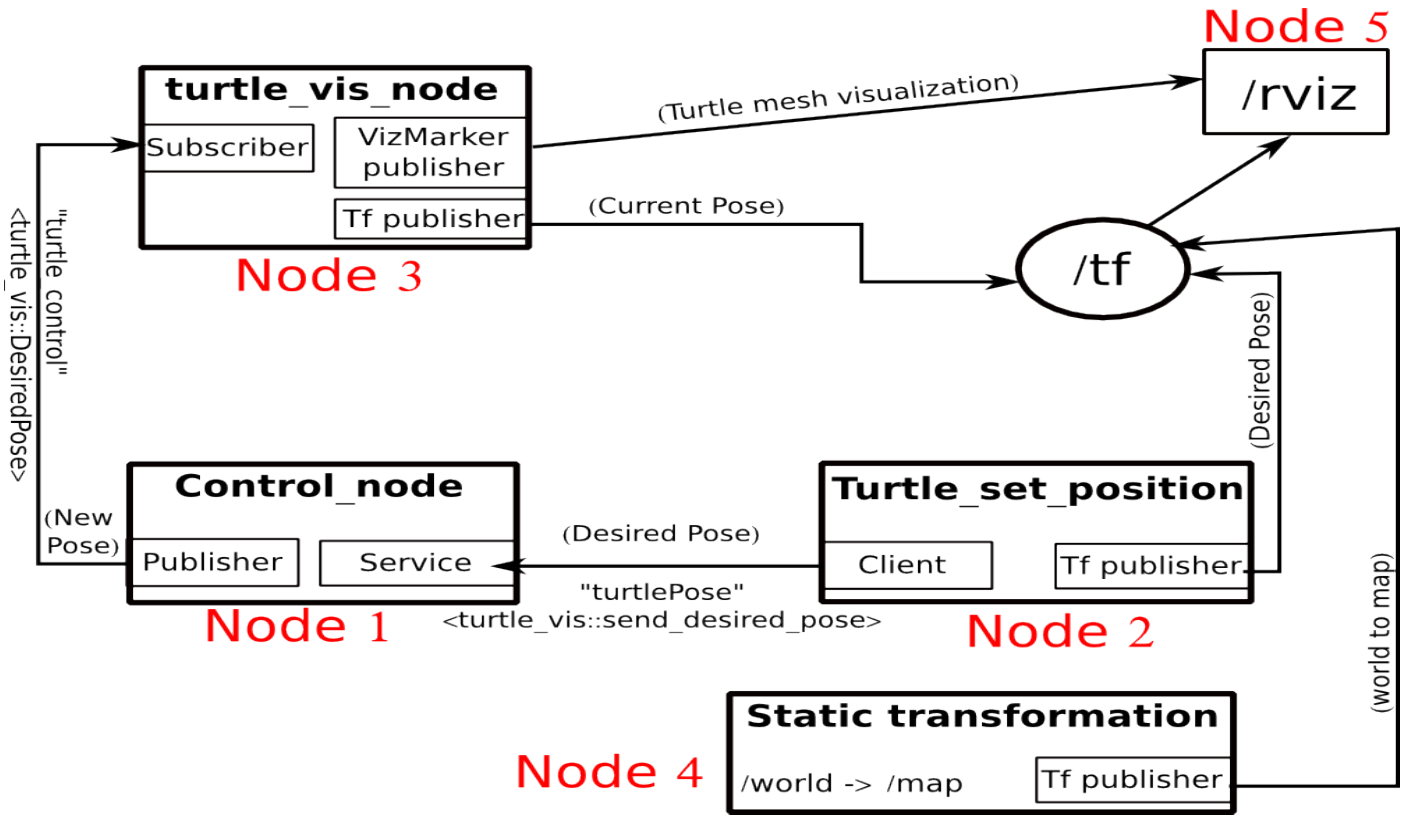
  a) A static transformation between the coordinate frames /map and /world. This tf will publish the rviz visualization.

- **Node 5**: rviz visualization

  a) Visualize the turtle mesh (marker), the world coordinate frame (tf), the turtle tf and the desired pose tf.

# Tutorial 1: ROS intermediate-level

The nodes should be connected as shown in the Figure:



# Tutorial 1: ROS intermediate-level

**Exercise 6:** The following sub-tasks should be considered.

Make your system modular, i.e. use a common object class for the subscriber (Node 3) and the client (Node 2) callback functions, i.e.
Look at the file: turtle_vis/src/solutions/myClass

- Create a callback function for the service in Node 1
- Create two methods for obtaining the turtle pose needed in Node 1
- Create a callback function for the subscriber of Node 3

**Important:** Create the header for the class in a separate file and place it in turtle_vis/include/turtle_vis/myClass

# Tutorial 1: ROS intermediate-level

Use the given template to complete the exercises.

You should deliver a compress file with your implementations using the instructions from the slides and the given template. Please include a readMe.txt file to indicate how to run your nodes and to answer the questions.

Please, name the compress file as follows:

**“Name_lastName_roboCupHome_tutorial1”**

# Tutorial 1: ROS intermediate-level

Example of the readMe.txt file:

```
 1) roslaunch turtle_vis TurtleVis.launch

 2) rosservice call /TurtlePose "p:
     x: 2.0
     y: 2.0
     theta: 1.57"

 3) rosrun turtle_vis turtle_set_position_node
(cm, cm, rad)
```

# Tutorial 1: ROS intermediate-level

Important links:

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

http://wiki.ros.org/Services

http://wiki.ros.org/roscpp/Overview/Publishers%20and%20Subscribers

Q & A about this homework on Friday @15:00 hrs.

Deadline to deliver this homework: next Tuesday @23:00 hrs