TP2:

Controlling a Turtle (bis)

All the ROS environment is already setup into a the virtualbox image. To start it, enter the following command line:

Run the roscore and turtlesim node:

```
roscore &
rosrun turtlesim turtlesim_node &
```

Forward then turn

In this exercice you have to make the turtle do the following movements:

- go forward for 1 meter
- turn to reach pi/2 heading
- go forward for 2 meters
- turn to reach pi heading
- go forward for 2 meters
- go forward for 2 meters
- turn to reach 0 heading
- go forward for 1 meter

The turtle current pose (x, y, heading) is saved in the variable turtle_pose. The idea here is to get familiar with publisher, so we do not require that the turtle follow a perfect square.

To reset the turtle position (if required) you can use the rosservice /reset:

```
rosservice call /reset
```

1. Define a subscriber that will get the pose of the turtle and update the global variable
2. Publish the correct cmd message to control the turtle (you can use multiple while loop)

```
import rospy
from turtlesim.msg import Pose  # import the turtlesim Pose message type
from geometry_msgs.msg import Twist   # import the Twist message type
import math

turtle_pose = Pose()
def pose_callback(data):
    """
    a callback to save the current turtle pose into the global variable turtle_pose
    """
    global turtle_pose
    turtle_pose =    # <-- COMPLETE HERE
```

```
rospy.init_node( COMPLETE HERE )


#
turtle_pose_subscriber = rospy.Subscriber( COMPLETE_HERE )

cmd_publisher = rospy.Publisher(  COMPLETE HERE )
current_velocity_cmd = Twist()

rospy.sleep(0.2)
rospy.loginfo(turtle_pose)
init_turtle_pose = turtle_pose

# First movement
while turtle_pose.x  # <-- COMPLETE HERE
   # COMPLETE HERE (compute new command based on t)

# Second movement

# Third movements

# etc..
```

Go To (x,y)

Now you have to move the turtle to a position (X, Y).

Look then Move To

The easiest way to go to a position is to - rotate the robot to look to the target point - move to the point following a straight line

Define a function that will turn the robot until a specific angle is reached

You can use the following code:

```
def turn_to(robot_theta, target_theta, cmd_publisher):
  cmd_vel = Twist()
  # COMPLETE HERE : compute the right command

  # send the command to the robot
  cmd_publisher.publish( COMPLETE_HERE )
```

Define a function that will move the robot on a straight line based on a distance

```
def move_to(distance, cmd_publisher):
  cmd_vel = Twist()
  # COMPLETE HERE : compute the right velocity command

  # send the command to the robot
  cmd_publisher.publish( COMPLETE_HERE )
```

Use the two functions

Complete the following code to use the two previous functions.

```
import rospy
from turtlesim.msg import Pose  # import the turtlesim Pose message type
from geometry_msgs.msg import Twist   # import the Twist message type
import math

turtle_pose = Pose()
robot_current_orrientation = 0

def pose_callback(data):
    """
    a callback to save the current turtle pose into the global variable turtle_pose
    """
    global turtle_pose
    # COMPLETE HERE


rospy.init_node("TurtleEx4")
turtle_pose_subscriber = rospy.Subscriber(  COMPLETE HERE )
cmd_publisher = rospy.Publisher( COMPLETE HERE )

t = Twist()

target_X =  #<--COMPLETE HERE
target_Y =   # <-- Complte Here
rospy.sleep(0.2)
rospy.loginfo(turtle_pose)
init_turtle_pose = turtle_pose

target_theta =   # Complete here (simple trygonometry)

while not ( COMPLETE HERE ):  # <-- you need to check that the robot has not yet reached the
  turn_to( COMPLETE HERE)
```

```
while not (COMPLETE HERE):  # <-- you need to check that the robot has not yet reached the d
  move_to( COMPLETE HERE)

rospy.loginfo("destination reached !!!! YEAH !!")
```

Turn and move at the same time

Now you have to write a go to function that allows the turtle to go to a destination (X,Y) but doing the move and rotation at the same time.

You can use the following control law:

$$v = k_v * \sqrt{(X - cur_x)^2 + (Y - cur_y)^2}$$

$$\theta_{target} = tan^{-1}(y - cur_y)/(x - cur_x)$$

$$\theta_{velocity} = k_t * (\theta_{target} - \theta_{robot})$$

You can use different value for kv and kt, e.g kv=0.1, kt=1. You could also limit the min velocity that you send to the turtle, for instance a velocity bellow 0.1 meter/sec is maybee too slow.

For more information see : https://www.youtube.com/watch?v=Qh15Nol5htM&feature=youtu.be&list=PLSzYQGCXRW1HLWHdJ7ehZPA-nn7R9UKPa

```
import math

##############
#COMPLETE HERE

################

move_to(1, 1)
```

ROS TOOLS (RVIZ and Gazebo)

Use the last virtualbox image :

Or run the following command to install gazebo:

```
sudo apt install gazebo9 \
    ros-melodic-turtlesim \
    ros-melodic-gazebo-msgs \
    ros-melodic-gazebo-plugins \
    ros-melodic-gazebo-ros \
    ros-melodic-gazebo-ros-control \
    ros-melodic-rviz \
    ros-melodic-turtlebot3-gazebo
```

Launch the turtle bot in the gazebo simulator:

```
export TURTLEBOT3_MODEL=burger
roslaunch /opt/ros/melodic/share/turtlebot3_gazebo/launch/turtlebot3_world.launch
```

In an other terminal publish message on the correct topic to make the robot move forward.

In an other terminal launch rviz and in rviz display the different avaibles topics.

```
rosrun rviz rviz
```