Week 6 Lab – Turtlebot Exploration

This lab will guide you through creating your submission for the second challenge, which is about autonomous exploration. **Your goal will be to get a robot to autonomously explore as much of its environment as possible within a time limit.** You will create a full package that can explore a simulated environment.

Make sure your packages work on the simulator, and **zip your workspace ready for next week's challenge.**

Challenge: Random Exploration

This exercise will provide you with a package that does Autonomous Exploration of both a Simulated and Real world. Currently, the package randomly selects a position and travels to it. Your challenge is to improve the performance (how fast 100% exploration is reached) as much as possible.

1. **Create a new workspace:** Your entry for this challenge is larger than a single launch file. Instead you will bring an entire package. This will be easier if it's in a seperate workspace, so create one named after your group (e.g. **group0_ws**). Refer back to exercise 2 of the Week 2 lab if you can't remember how to create a workspace (**HINT:** make the folder, run catkin_make, then source the new setup.bash in your ~/.bashrc file).
2. **Get the Package**: On SurreyLearn, download the "turtlebot_explorer.zip" file. This contains a "turtlebot_explorer" package. Uncompress and compile the package in the workspace you made above. **Note:** You must have the Turtlebot model set to burger in your .bashrc file! You should have done this in last week's lab by adding the following in your ~/.bashrc file:

   ```
   export TURTLEBOT3_MODEL=burger
   ```

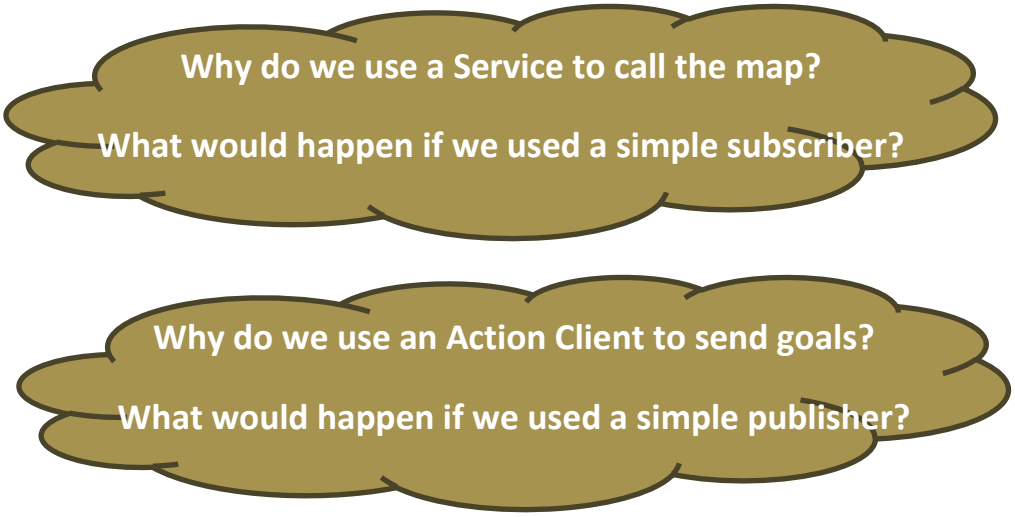
3. **Launch Explorer:** There are two main launch files on this package. "turtlebot_explorer.launch" and "turtlebot_explorer_sim.launch". These files will be used to run the challenge, so modify them at your own risk.
   Launch "turtlebot_explorer_sim.launch" (you may need to open a new terminal or to re-source the workspace). This launch file will:
   a. Start gazebo (in the background)
   b. Spawn a Turtlebot.
   c. Run the Navigation Stack
   d. Run a SLAM algorithm (gmapping)
   e. Run the Random Explorer
   f. Start RVIZ

   you should now see a Turtlebot slowly start to explore the environment. Look around the RVIZ visualisation and familiarise yourself with each of the Navigation Stack's costmaps and paths. If necessary, refer to the Lecture 9 slides. You can also read the Documentation (http://wiki.ros.org/turtlebot3_navigation). **Most importantly: ask questions or ask for help during labs.**

4. **Understand the System:** Look at the package you have downloaded. Try to figure out what is happening in the system. Pay particular attention to the "explore.launch" file. In this file, the Navigation Stack and the Random Explorer node are initialised. These are the two things

that will help you solve this challenge. **Note: Do NOT modify the resolution of the SLAM map (or it will not work on the real robot!)**

5. **Understand the Node:** Open the python scripts in the "nodes" folder. There are 2 different files "explorer.py" and "move_base_client.py". Understand how they work together to send goals to the Turtlebot.



6. **Understand the Goal Selection:** Try to understand *how* the node is selecting goals for the turtlebot. Pay attention to the function "`get_valid_cells`". Is there a better way of doing this?
7. **Have Fun:** Try to see how much you can improve the exploration. You have been provided with a Gazebo world, use it to try out your algorithms. Try creating more worlds if you want, but make sure they have a well defined border! (Hint: Use the "building editor" in gazebo!). The real challenge environment is likely to be smaller and more densely packed than this.

HINTS:

- How does the Random Pose get selected? What does "`get_valid_cells`" return?
- How does the Navigation Stack handle unexplored space? How does this correlate with the random pose?
- **Advanced**: How is the global path optimised? Could you do something better (distance vs. coverage)?

Submission: Once you and your team have agreed on a solution, prepare your workspace for submission:

1. Remove the "**build**" and "**devel**" folders from the workspace.
2. Compress your workspace into a zip file
3. Copy the zip file onto a usb stick .

- As an example, if your group was called “group0”, you would bring a zip file (e.g. “group0.zip”). The contents would be the “group0_ws” folder, with “src” inside. Your solution package “turtlebot_explorer” would be inside the “src” folder. In summary, the layout of your zip file should be as follows: