Programming Project 0

New Attempt

Due Jan 25 by 11:59pm **Points** 10 **Submitting** a file upload **File Types** pdf

Welcome to the first programming project of CSE 571: Artificial Intelligence.

In this assignment, you will be setting up the platform that will be used for the majority of the programming assignments in this class. To complete this assignment, you will need to complete Step 1 (A or B) and Step 2. *Step 3 is optional, but give it a shot for extra credit!*

Step 1: Setting up the system [0 points]

In this step, we will be setting up the system and software to run the assignments. We will be using **ROS Melodic** and **Ubuntu 18.04 LTS**. Two options can be used to set up the system.

Option A (recommended option for most students):

Import the virtual machine (VM) for this platform using the instructions provided **here**. The VM provided contains all the necessary files already set up to perform Step 2 for this assignment.

Option B:

Use this option if you are confident about Linux installations and would like to install the platform on your own Linux machine.

Install Ubuntu 18.04, ROS, and other software on a virtual machine of your choice using the instructions provided **here**.

Note: All instructions here assume `~/catkin_ws` is the ROS workspace where the turtlebot3 is installed.

Loading a Gazebo environment

Once you have finished installing the required software (using either Option A or Option B), load a sample Turtlebot3 environment and drive the Turtlebot3 in this environment as follows.

`roslaunch` is a command that is used to launch Gazebo environments.

Usage: `roslaunch [options] [package] <filename> [arg_name:=value...]`

The `[package]` option refers to a compiled package like the one for Turtlebot3 (Users who chose option A can look at the last few slides of the option B instructions). The `<filename>` refers to a `.launch` file that we want to launch in the simulator.

Tip: `roslaunch` allows for tab completions. So you can use TAB to view all possible packages/files and also auto-complete the same.

We will use the `turtlebot3_gazebo` package and the `turtlebot3_empty_world.launch` file to test our installation. The package provides many different worlds in which the turtlebot3 may be placed. The `empty_world` launch file sets the turtlebot3 in an empty grid world.

Enter the following command in a new terminal.

```
$> roslaunch turtlebot3_gazebo turtlebot3_empty_world.launch
```

This will launch an environment in Gazebo, a 3D robotics simulator. Now, you can play with the robot by driving it around using *teleoperation*! This simulation captures the real-world dynamics of the robot. The command above only loads in the environment. We need to load the program that enables us to drive the robot.

If you run into an issue where the gazebo doesn't load, use the following commands and try the `roslaunch` command again:

```
$> killall gzserver
$> killall gzclient
$> pkill -f roscore
```

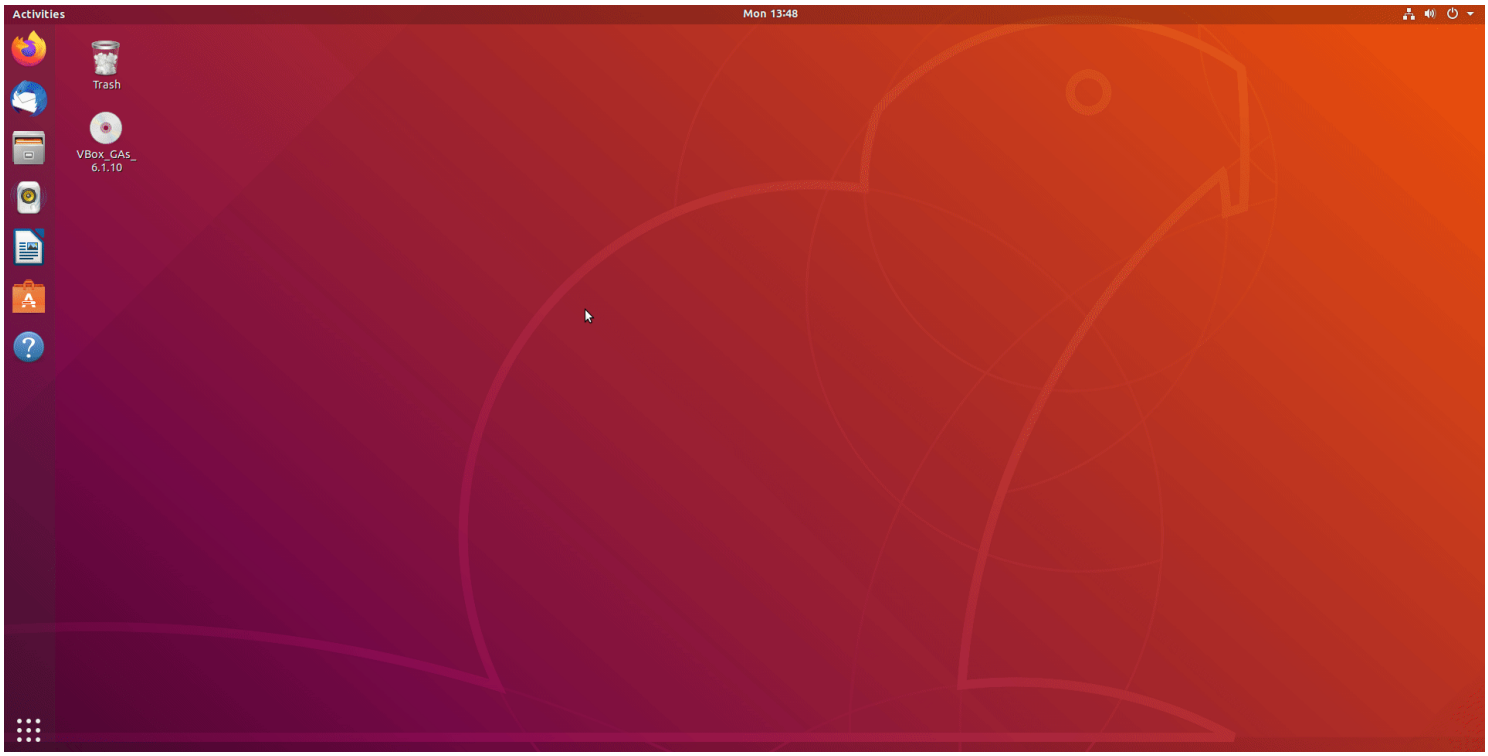
Enter the following command in a new terminal (do not close the earlier terminal).

```
$> roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch
```

Use the following instructions to drive the robot:

- Press "`w`"/"`x`" to increase/decrease the linear velocity of the robot.
- Press "`a`"/"`d`" to change the angular velocity of the robot.
- Press "`s`" to stop the robot.

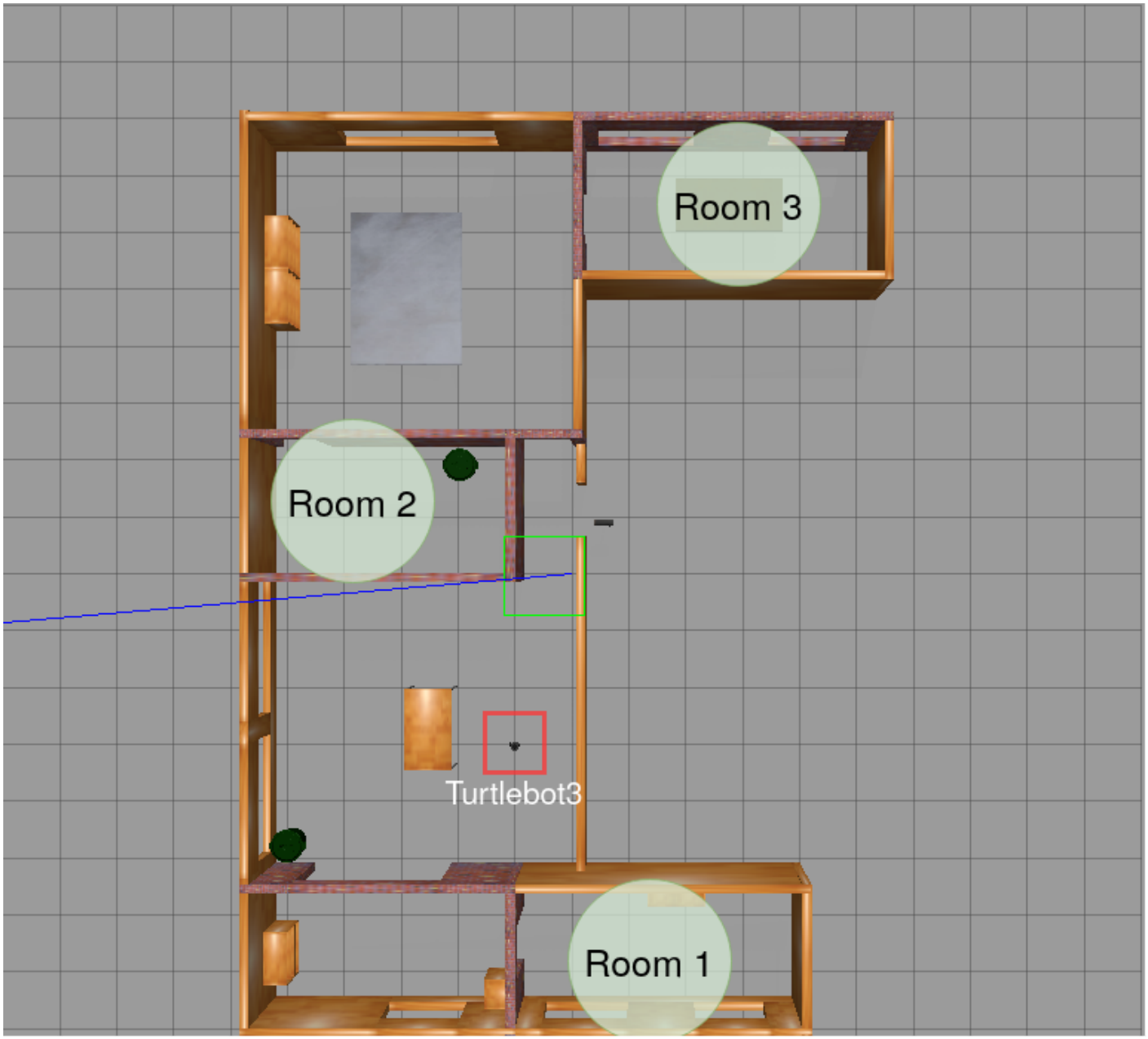
See the GIF below for an example of how this might look.



Step 2: Assignment question [10 points]

Load the **Turtlebot3 House** environment in Gazebo using the `roslaunch` command used earlier. The turtlebot3 house environment is a part of the `turtlebot3_gazebo` package and the launch file is present in the `~/catkin_ws/src/turtlebot3_simulations/turtlebot3_gazebo/launch/` directory. Launch this environment using the `roslaunch` command and teleoperate the turtlebot3 to your goal room!

Your goal room number is: `(x mod 3) + 1` where `x` is the last digit of your ASU ID. For example, if your ASU ID is 1235567894, the result of `(4 mod 3) + 1` is `2` and you would need to drive it to *Room 2*.



Step 3: Optional/Extra credit [5 points]

For extra credit, install a custom Gazebo world. Use the hints below, but since this is for extra credit, you may need to refer to Gazebo documentation!

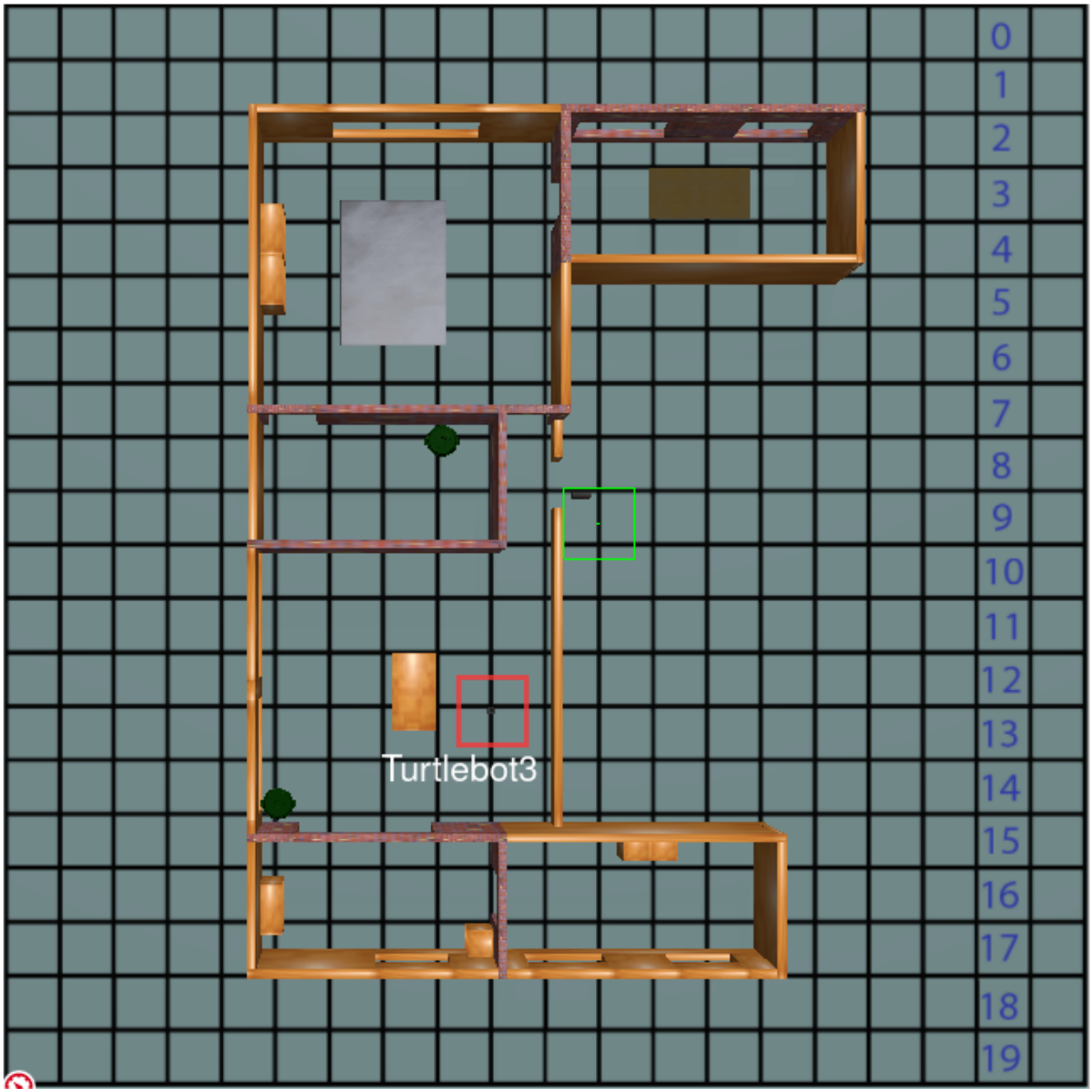
- Download the custom world files from **here (https://drive.google.com/file/d/1XNR54UoLeiFElGJbWysEAMao07K4pnf6/view?usp=sharing)** and unzip them.
- Place the `.world` file in `~/catkin_ws/src/turtlebot3_simulations/turtlebot3_gazebo/worlds/`.

- Place the `.launch` file in `~/catkin_ws/src/turtlebot3_simulations/turtlebot3_gazebo/launch/`.
- Add the custom `my_ground_plane` directory containing `materials` directory to `~/.gazebo/models/` (create the `models` directory if it doesn't exist).
- Launch the world in Gazebo using the `roslaunch` command.

Once the custom environment has loaded, use teleoperation to get the *turtlebot3* to the custom numbered location on the grid.

Use the last 2 digits of your ASU ID to determine which location you need to reach for your submission. E.g., suppose your ASU ID is 1234567890, then you need to reach the location to the right of the cell `9 + 0 = 9` in the last column of the grid (as shown in the image below). Note that the robot can be anywhere inside the destination grid cell.

NOTE: For the extra credit, you must load the given custom world which looks similar to the House world in your original assignment task. However, this custom world has explicit Grid markers and is annotated with location numbers that will be visible in Gazebo whereas those numbers will not be visible in the original House world.



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Submission Instructions

Submit a .pdf file with 5 top-view (zoom out) screenshots that show the intermediate (4 screenshots) as well as the final location (1 screenshot) of the *Turtlebot3*. Use the same .pdf file to submit the screenshots for the extra credit. Upload your submission file with the following naming convention: `firstname_lastname_asuid.pdf`.

You must submit your own work. **Penalties for plagiarism include a report to the Dean's office.** For the late submission policy, refer to the **syllabus (https://webapp4.asu.edu/bookstore/viewsyllabus/2221/35294)** .

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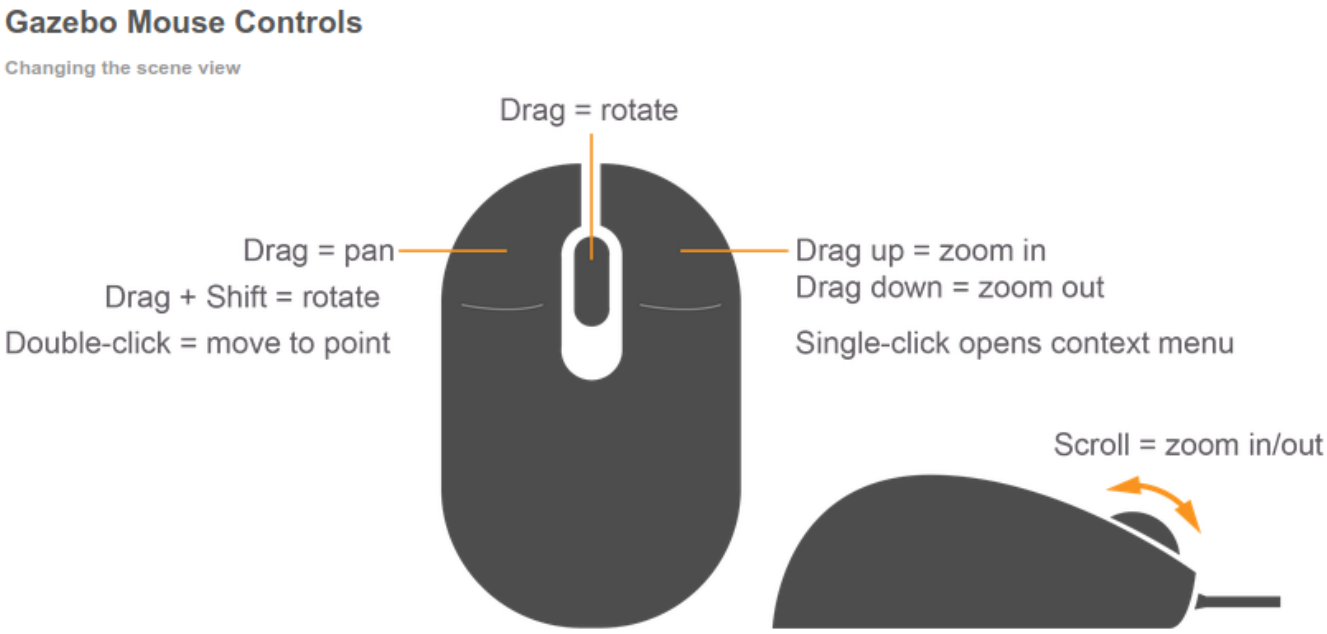
FAQs

- ***The environment is not loading/Gazebo opens with a blank screen.***
  On a VM, Gazebo can be slow to load some environments. Try waiting for a few minutes to see if it loads.

- ***It is hard to zoom in/out in Gazebo.***
  Zooming in Gazebo might be hard because you are using the middle mouse button to try zooming. Use the image below to try zooming with just the right mouse button. More info on such hotkeys can be found at **http://gazebosim.org/hotkeys (http://gazebosim.org/hotkeys)**.
  You can also refer to the image below:



- ***The robot cannot turn and move forward at the same time.***
  This is expected since the turtlebot3 is a diff drive robot. More information on this will be covered in the ROS tutorial class.