PUMASIMBOT

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PUMASIMBOT is a simulator system to test simple mobile robots behaviors developed by students in an introductory mobile robots course.

To use it follow the next instructions:

1. Using an Ubuntu-Linux operating system, unpack pumasimbot.zip in the user's directory.
2. Unpack data_pumasimbot in the user's directory.
3. Open an X terminal and go to the directory where the programs are, with the following command:

```
cd pumasimbot
```

Change the permitions of the file pumasimbot_make with the following command:

```
chmod 777 pumasimbot_make
```

Compile the source files with the following command:

```
./pumasimbot_make
```

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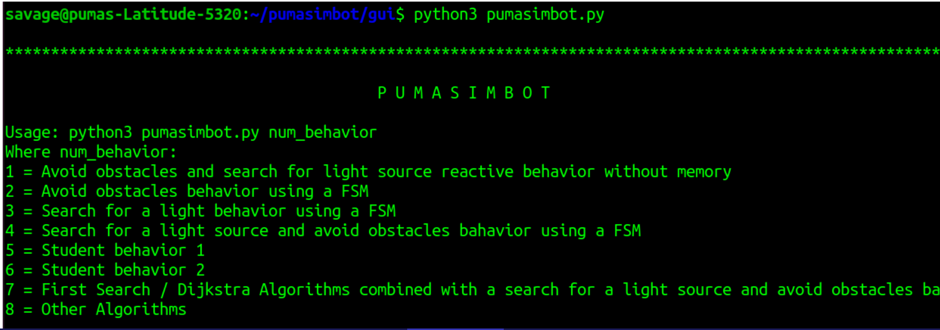
During compilation is possible that some warnings will appear.

4. GUI usage

If there were no critical compilation errors, go to directory gui and type the following command to see the system usage:

python3 pumasimbot.py



```
savage@pumas-Latitude-5320:~/pumasimbot/gui$ python3 pumasimbot.py

********************************************************************************************************

                                         P U M A S I M B O T

Usage: python3 pumasimbot.py num_behavior
Where num_behavior:
1 = Avoid obstacles and search for light source reactive behavior without memory
2 = Avoid obstacles behavior using a FSM
3 = Search for a light behavior using a FSM
4 = Search for a light source and avoid obstacles bahavior using a FSM
5 = Student behavior 1
6 = Student behavior 2
7 = First Search / Dijkstra Algorithms combined with a search for a light source and avoid obstacles ba
8 = Other Algorithms
```

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If there is an error because tkinter Python library is not installed in your computer do the following steps:

a) sudo apt-get update
b) sudo apt-get install python3-tk

There is a possibility that other Python3 libraries where not installed in your computer, thus repeat the previous procedure with the missing libraries. If the problem persist, consult with the course instructor how to solve the problem or try to find a solution in the WEB.

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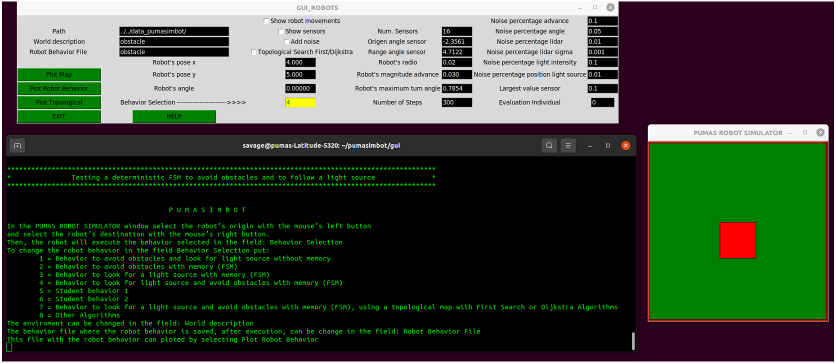
5. Select the type of behavior to be tested after the command python3 pumasimbot.py
For example to test "Search for a light source and avoid obstacles bahavior using a FSM", type the following command:

```
python3 pumasimbot.py 4
```



		□ Show robot movements				Noise percentage advance	0.1
Path	../../data_pumasimbot/	□ Show sensors		Num. Sensors	16	Noise percentage angle	0.05
World description	obstacle	□ Add noise		Origen angle sensor	-2.3561	Noise percentage lidar	0.01
Robot Behavior File	obstacle	□ Topological Search First/Dijkstra		Range angle sensor	4.7122	Noise percentage lidar sigma	0.001
	Robot's pose x	4.000		Robot's radio	0.02	Noise percentage light intensity	0.1
	Robot's pose y	5.000		Robot's magnitude advance	0.030	Noise percentage position light source	0.01
	Robot's angle	0.00000		Robot's maximum turn angle	0.7854	Largest value sensor	0.1
	Behavior Selection --------------------->>>>	4		Number of Steps	300	Evaluation Individual	0

savage@pumas-Latitude-5320: ~/pumasimbot/gui

```
*********************************************************************************************************
*               Testing a deterministic FSM to avoid obstacles and to follow a light source             *
*********************************************************************************************************


                                        P U M A S I M B O T

In the PUMAS ROBOT SIMULATOR window select the robot’s origin with the mouse’s left button
and select the robot’s destination with the mouse’s right button.
Then, the robot will execute the behavior selected in the field: Behavior Selection
To change the robot behavior in the field Behavior Selection put:
        1 = Behavior to avoid obstacles and look for light source without memory
        2 = Behavior to avoid obstacles with memory (FSM)
        3 = Behavior to look for a light source with memory (FSM)
        4 = Behavior to look for light source and avoid obstacles with memory (FSM)
        5 = Student behavior 1
        6 = Student behavior 2
        7 = Behavior to look for a light source and avoid obstacles with memory (FSM), using a topological map with First Search or Dijkstra Algorithms
        8 = Other Algorithms
The enviroment can be changed in the field: World description
The behavior file where the robot behavior is saved, after execution, can be change in the field: Robot Behavior File
This file with the robot behavior can ploted by selecting Plot Robot Behavior
```

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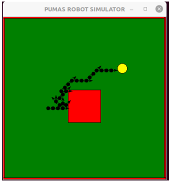
In the PUMAS ROBOT SIMULATOR window select the robot's origin with the mouse's left button, and select the robot's destination with the mouse's right button. Then the execution of the behavior it is shown in PUMAS ROBOT SIMULATOR window, as it is shown in the following figure:



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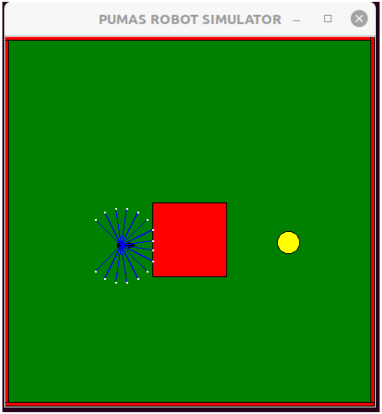
To display the robot sensors select the check button Show sensors in the GUI_ROBOTS window. In the following figure it is shown the sensors with the movement of the robot of one step, by setting in Number of Steps to 1.



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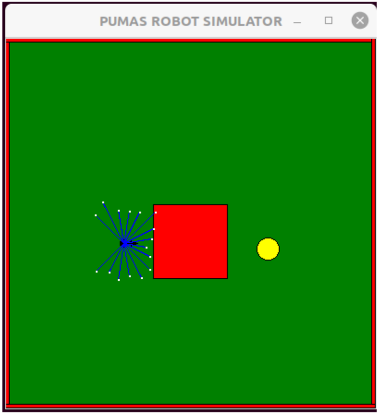
To add noise to the sensors and to the movement select the check button Add Noise. In the following figure is shown the effect of adding noise:



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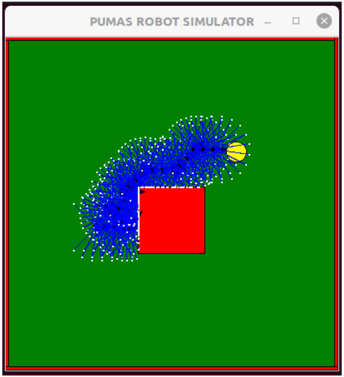
To display the movement of the robot step by step, select the check button Show robot movements.



To plot again the previous behavior of the robot, select the Plot Robot Behavior.

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Different behaviors can be selected in the Behavior Selection option. These behaviors are related to the C/C++ code in the directory pumasimbot/state_machines in the files *.h
The behaviors in these files are called in the file pumasimbot/motion_planner/GoTo_State_Machine.cpp that is executed any time a destination is selected in the PUMAS ROBOT SIMULATOR window.
When a behavior is modified or a new one is created it is necesary to compile again with pumasimbot/motion_planner/compile_motion_planner

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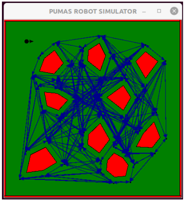
In the field World description can be selected the environment where the simulated robot operates, there are 15 environments: obstacle, random_1, random_2,..., random_14. When a new environment is selected push the Plot Map button to display it. A topological map of the environment can be plot pushing the Plot Topological button.



Selecting behavior 7, that looks for a light source and avoids obstacles with memory (FSM), using a topological map with First Search or Dijkstra Algorithms, these are selected in the check button Topological Search First/Dijkstra