3.2.1 Mapping Theory

Mohamed Baioumy

Map of the environment

A **map** is mandatory for navigation

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How to get a map?

1. Use a pre-existing map

Amsterdam metro map

Source: https://thingstodoinamsterdam.com/transport/amsterdam-public-transport/

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Source: : https://www.behance.net/gallery/36209277/Metro-Map-Amsterdam

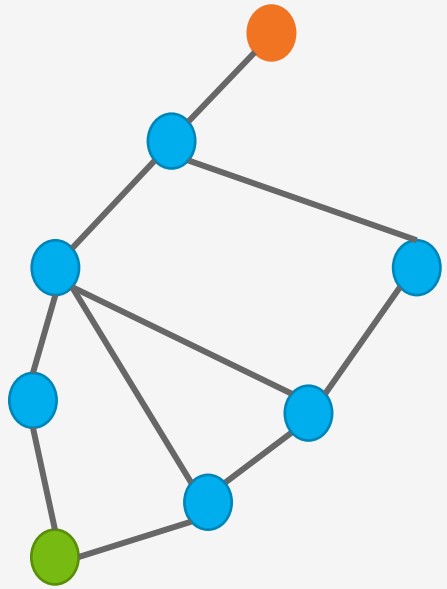
Topological representation

Topological representation

The map consists of ‘stations’

Lines represent a direct connection

Geometric scale is not accurate



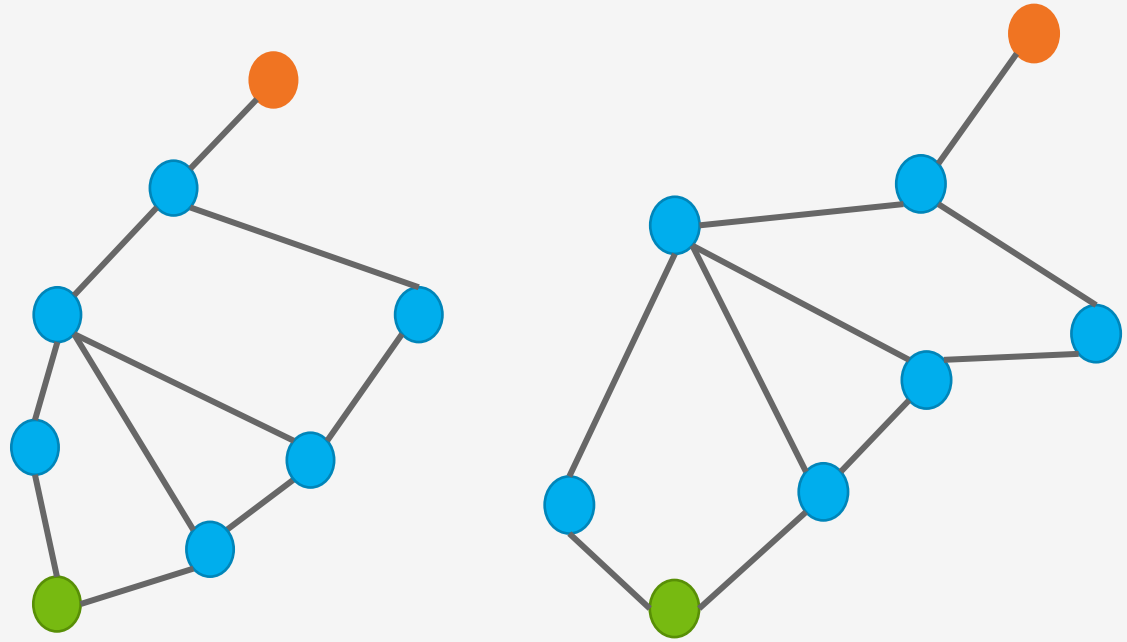
Topological representation

Topological representation

The **graph** consists of ‘stations’

Lines represent a direct connection

Geometric scale is not accurate



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Topological representation

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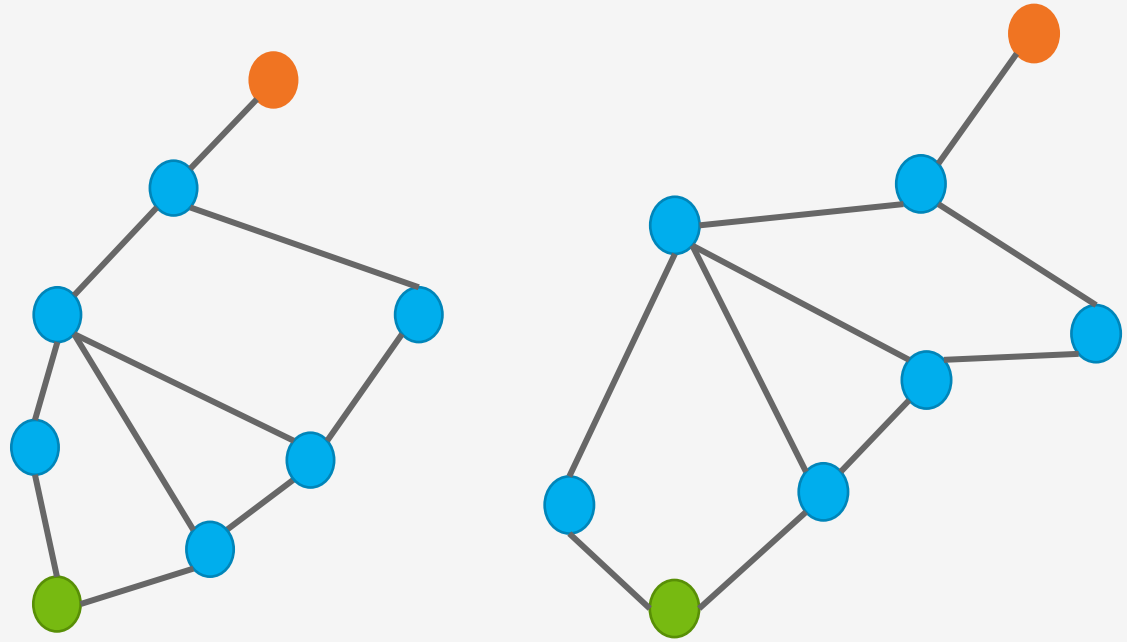
Lightweight

Useful for path planning



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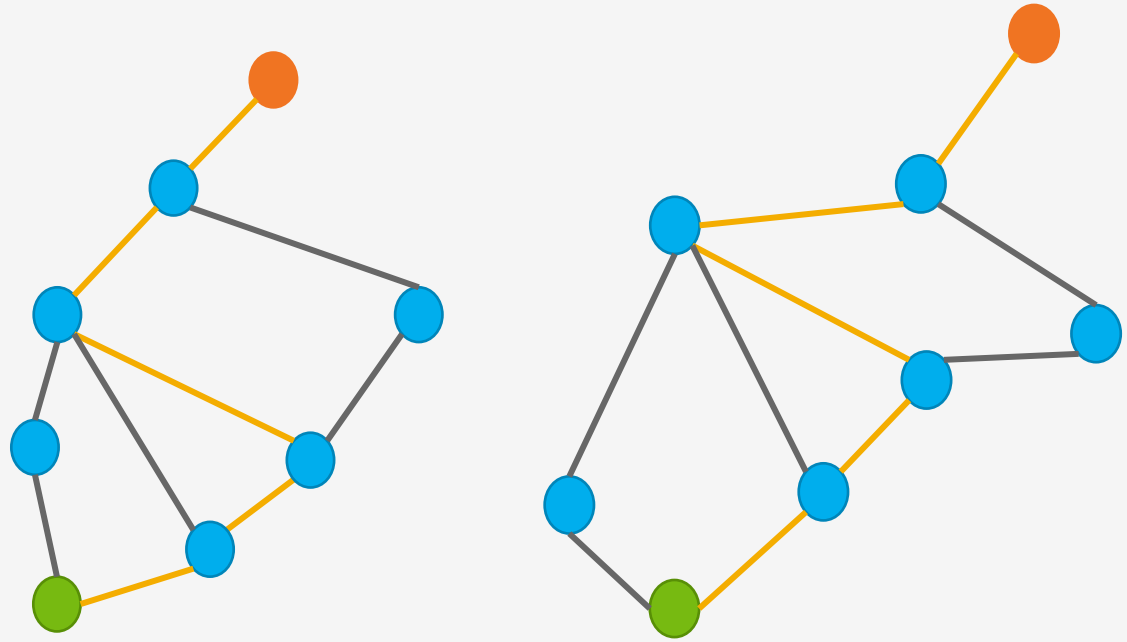


Optimal path

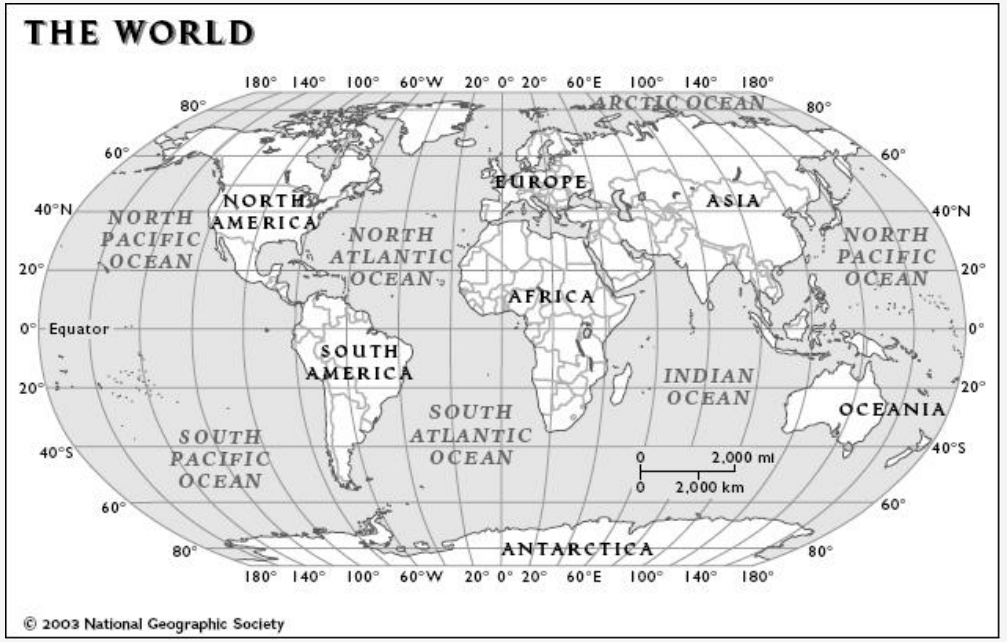
Metric representation

Metric representation

Represented with precise coordinates

Sensitive to noise

Very useful for path planning



Source: https://googleearthgeographywebquest.wikispaces.com/

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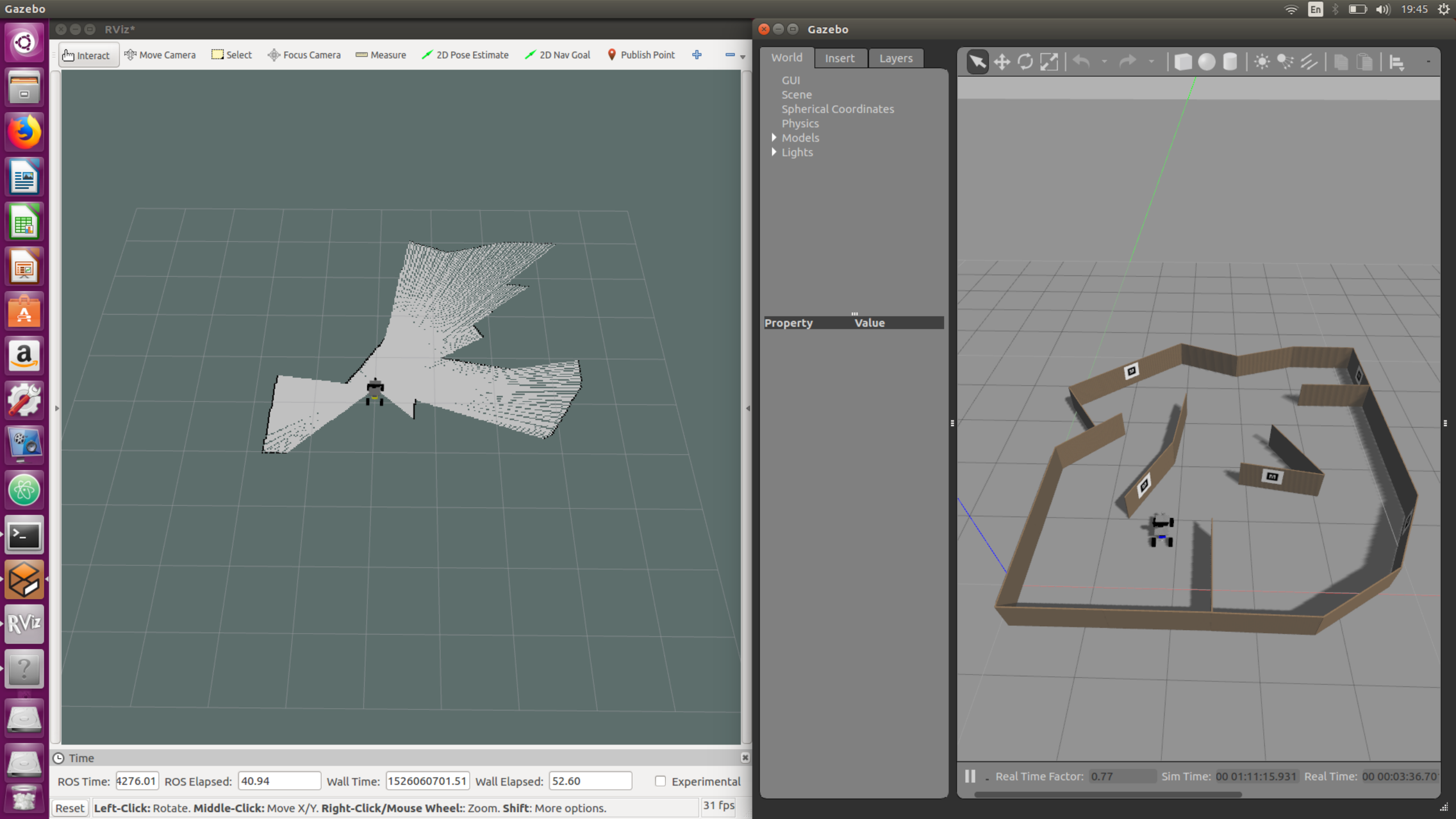
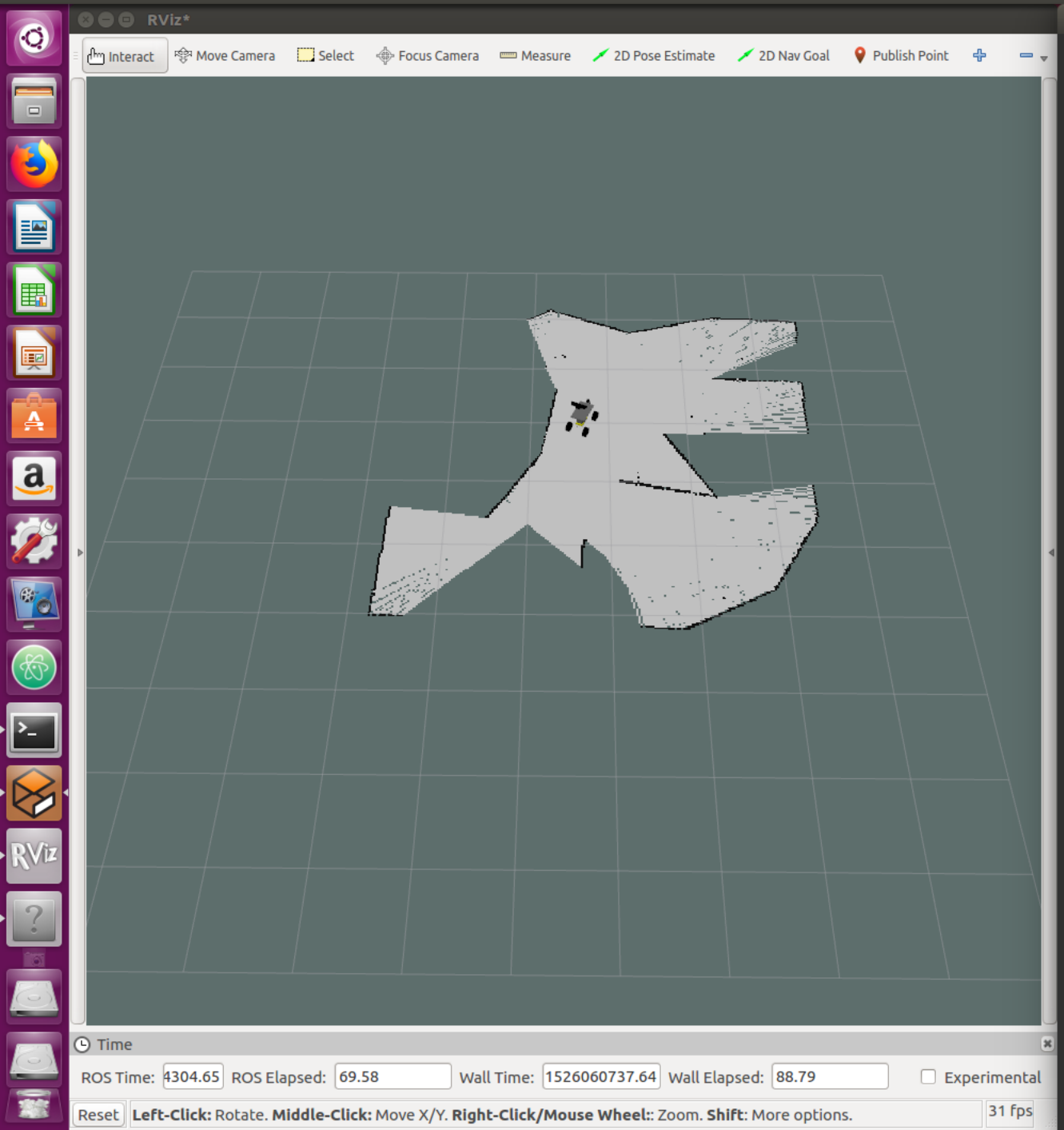
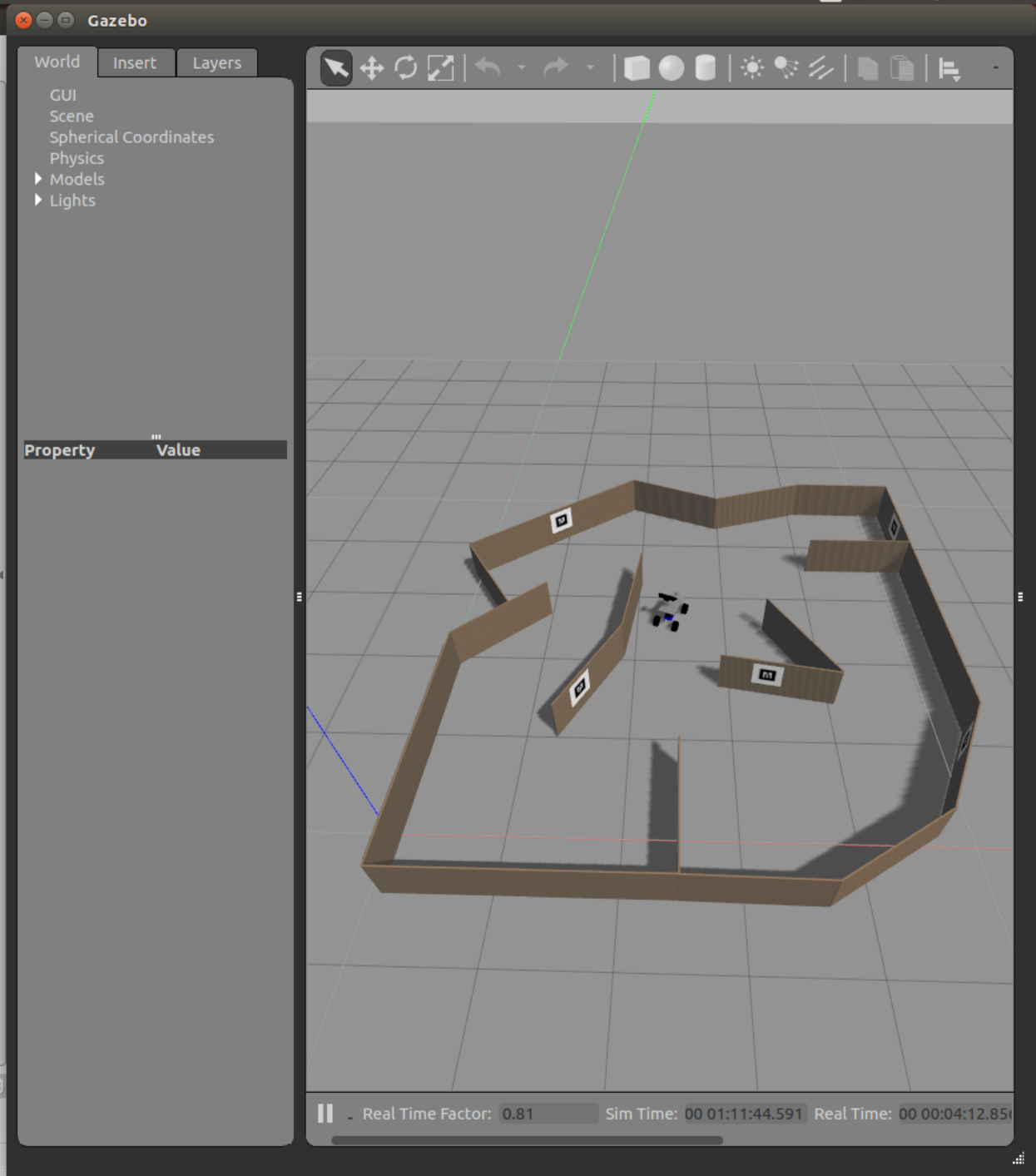
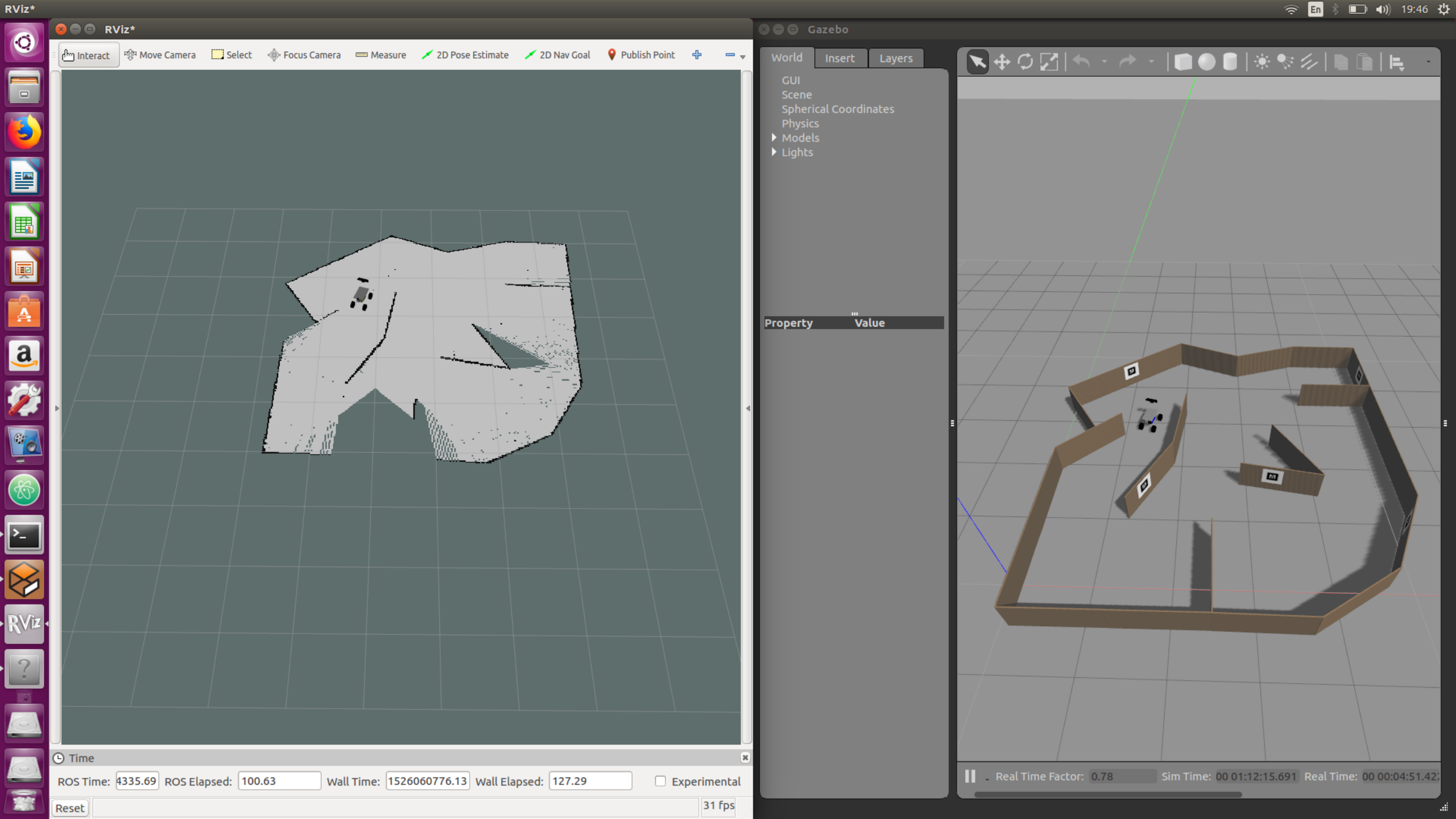
How to get a map?

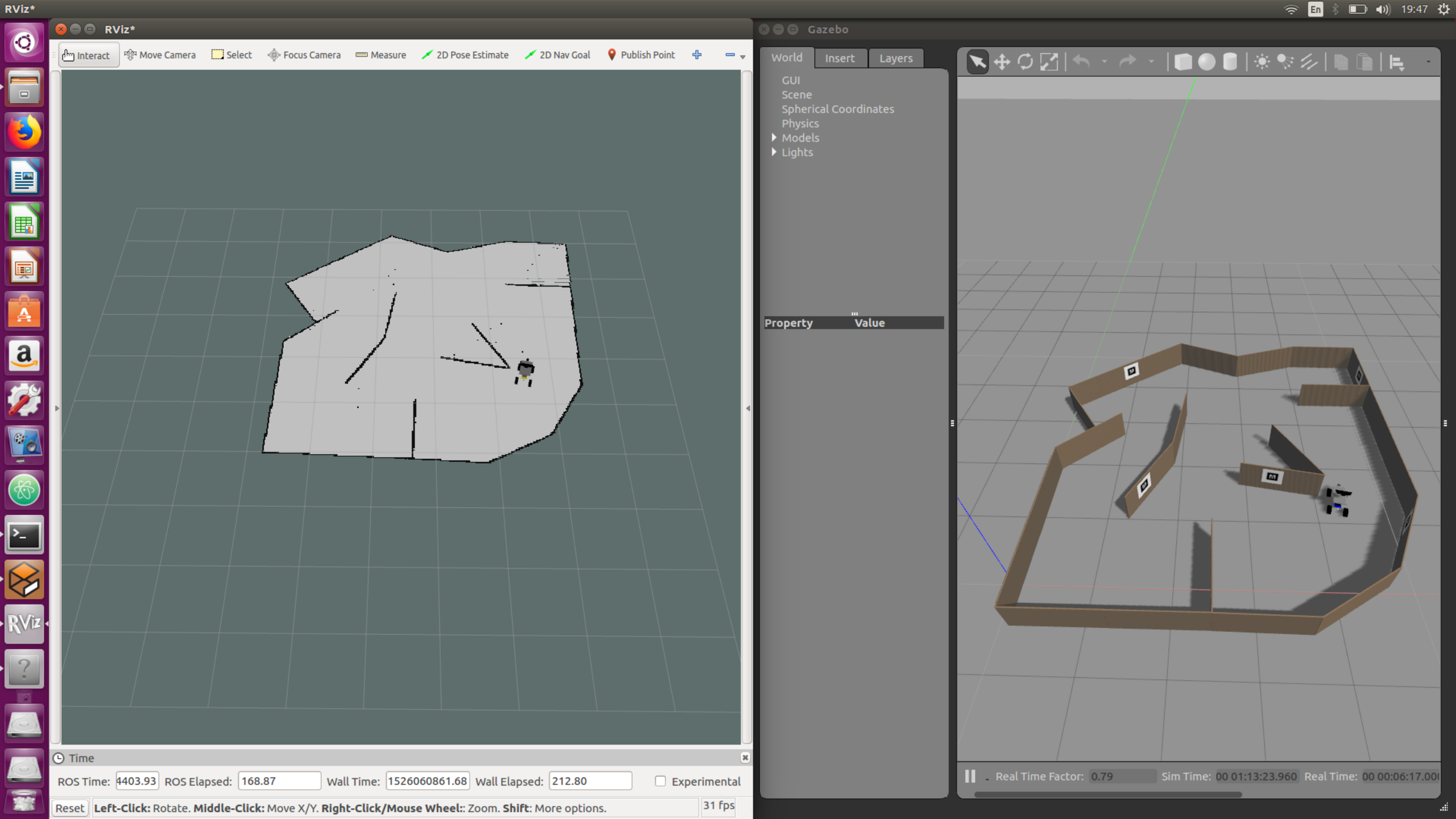
1. Use a pre-existing map
2. Built by the robot itself during a mapping process


Gazebo
RViz*
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Time
ROS Time: 4276.01
ROS Elapsed: 40.94
Wall Time: 1526060701.51
Wall Elapsed: 52.60
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps
Gazebo
World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Models
Lights
Property
Value
Real Time Factor: 0.77
Sim Time: 00 01:11:15.931
Real Time: 00 00:03:36.70


RViz*
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Time
ROS Time: 4304.65
ROS Elapsed: 69.58
Wall Time: 1526060737.64
Wall Elapsed: 88.79
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps


Gazebo
World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Models
Lights
Property
Value
Real Time Factor: 0.81
Sim Time: 00 01:11:44.591
Real Time: 00 00:04:12.85


RViz*
19:46
RViz*
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Time
ROS Time: 4335.69
ROS Elapsed: 100.63
Wall Time: 1526060776.13
Wall Elapsed: 127.29
Experimental
Reset
31 fps
Gazebo
World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Models
Lights
Property
Value
Real Time Factor: 0.78
Sim Time: 00 01:12:15.691
Real Time: 00 00:04:51.42


RViz*
19:47
RViz*
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Time
ROS Time: 4403.93
ROS Elapsed: 168.87
Wall Time: 1526060861.68
Wall Elapsed: 212.80
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps
Gazebo
World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Models
Lights
Property
Value
Real Time Factor: 0.79
Sim Time: 00 01:13:23.960
Real Time: 00 00:06:17.00

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How to get a map?

1. Use a pre-existing map
2. Built by the robot itself during a mapping process
    - This process is called **SLAM**:
    - Simultaneous Localization and Mapping