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Accelerating robotics development through simulation

FOSDEM 2025, Robotics and Simulation Devroom
2025/02/02

A little bit about Ekumen

- HQed in Buenos Aires, Argentina.
- Distributed team across Americas and Europe.
- Robotics, XR, DevOps and Web based services.
- OSRA members.
- ROS, Gazebo, Open-RMF and Infrastructure contributors.

Some Ekumen owned projects

A little about Ignacio Davila

- Roboticist at Ekumen
- Simulations Operations head @ Ekumen
- Electronics Engineering graduate
- Based in Buenos Aires, Argentina 🧉
- Hobbies: 🎸💻⚽

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IDavGal

A little about myself

- Regional Director for EMEA @ Ekumen
- Based in Munich, Germany.
- EE background.
- Statistics and Theory of Circuits undergrad teaching assistant.
- Working on robotic and AV simulation and validation since 2016.
- Hobbies: 🚴 ⚽ 🧉🍳💻

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Our journey today

- Robots and Simulators
  - What is a *robotic* system?
  - What is a *robotic* simulator?
  - What can I *do* with a robotic simulator?
- Picking the right tool for the job
  - How to pick a robotic simulator?
  - One robot, many simulators
    - Gazebo
    - Webots
    - O3DE
    - MuJoCo
    - Flatland
- Discussion and questions

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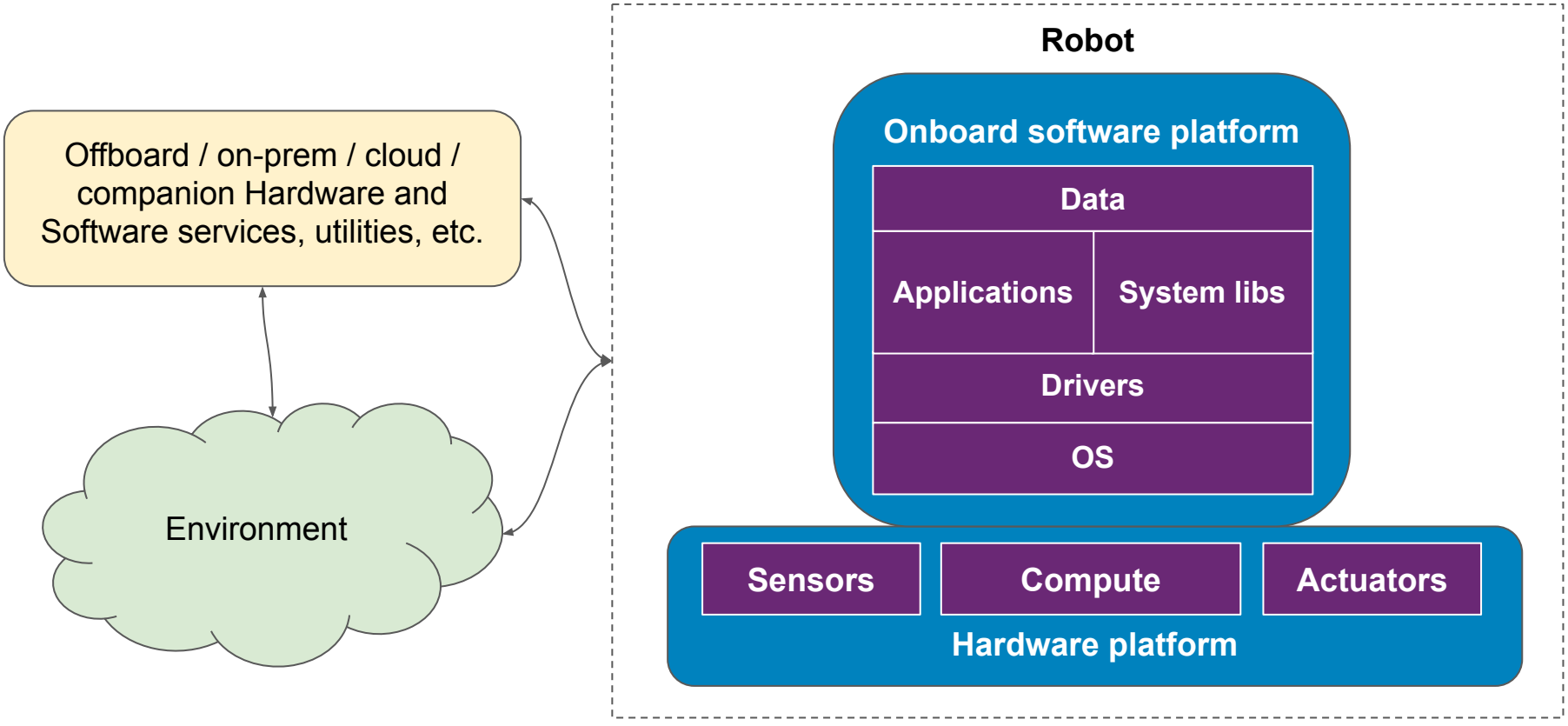
Robots and Simulators

What is a *robotic* system?



What is a *simulator*?

A **simulator** is an application that **models** a **scenario** with a given **model**.

A **scenario** is a **representation** of a **collection of systems** and their **environment** which **evolves** throughout **time**.

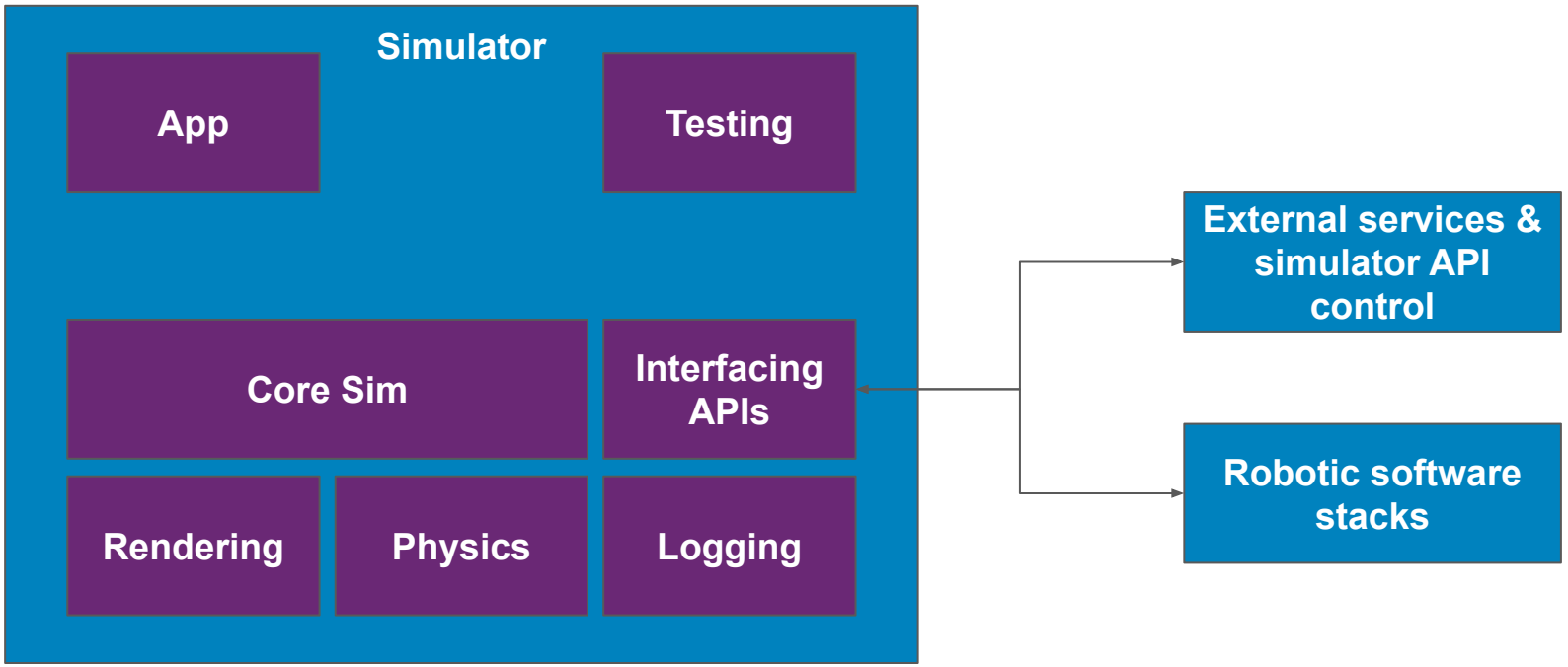
A **model** is a **representation** of the underlying rules of the **process** under evaluation.

What is a *robotic* simulator?

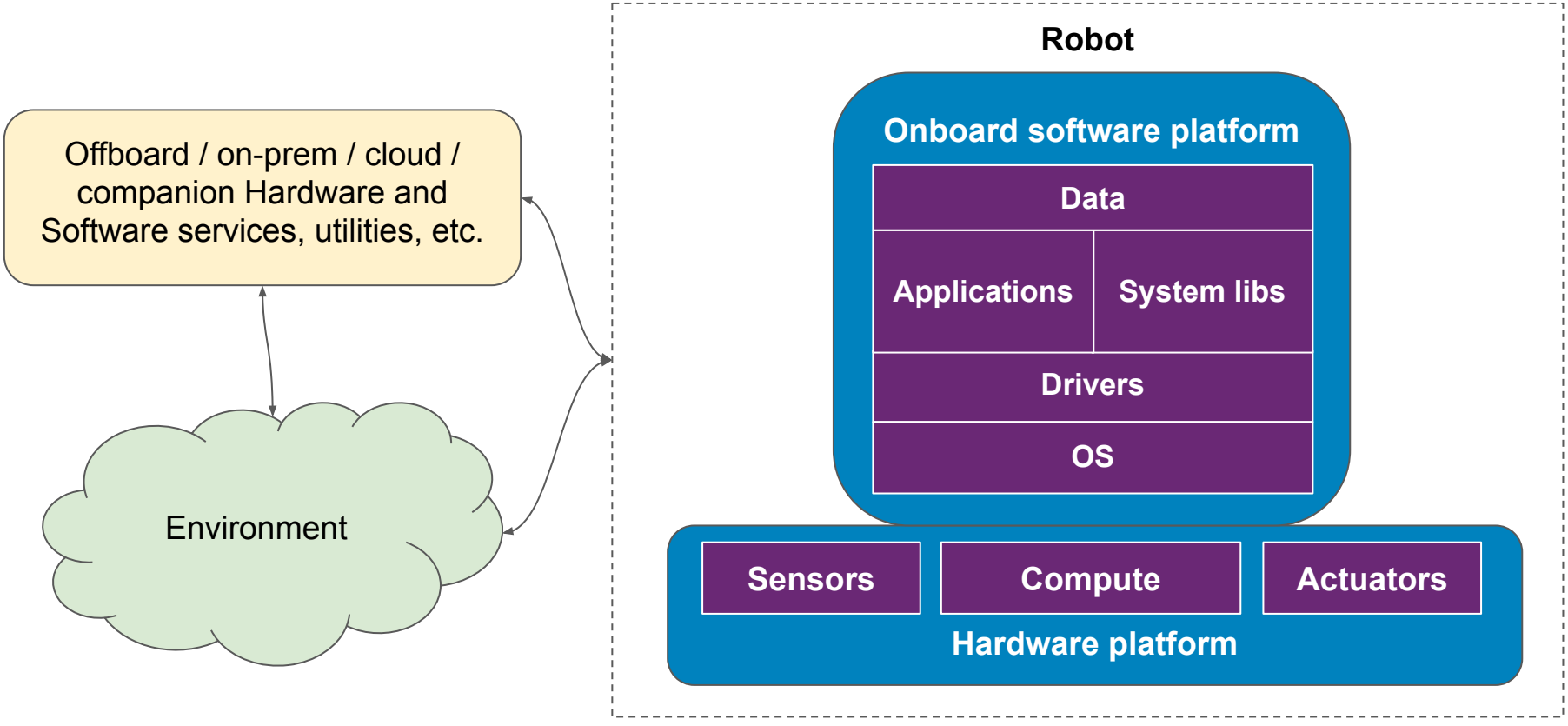
A robotic simulator is an application which allows to model scenarios with robotic systems.

What is a *robotic* simulator?

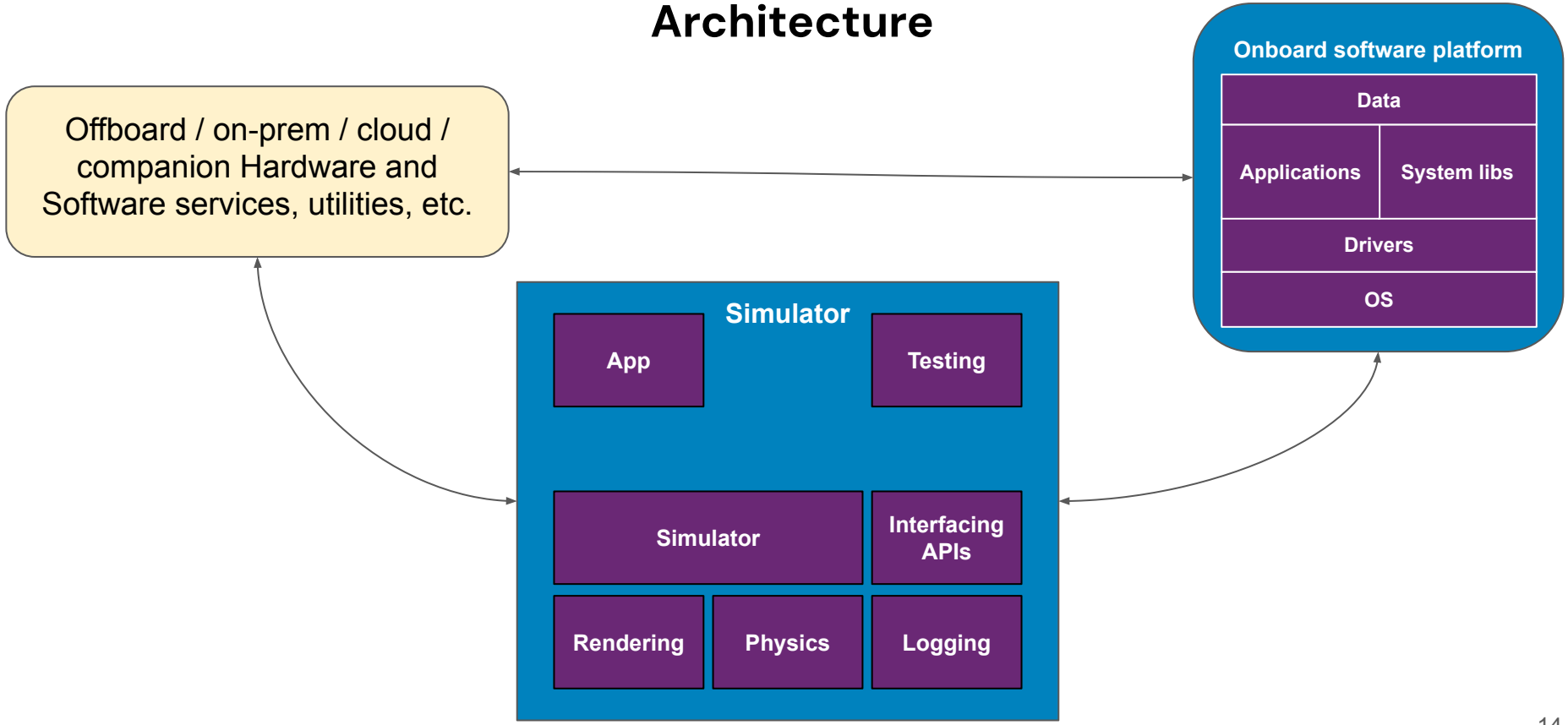
Architecture



What is a *robotic* simulator?

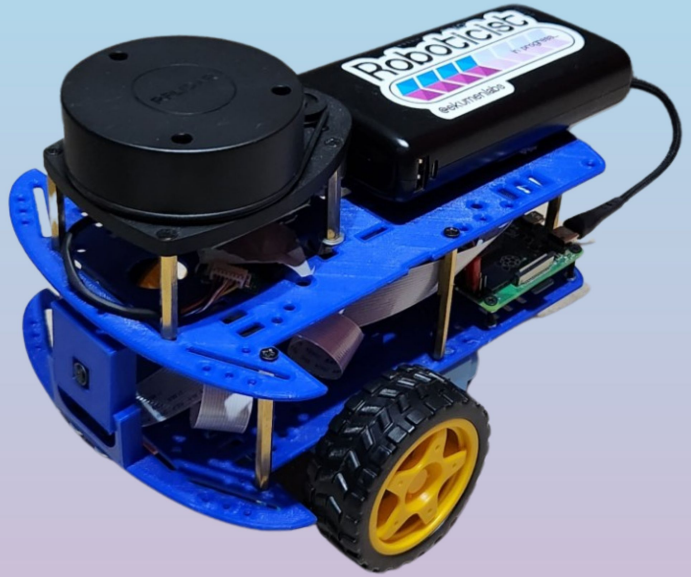


What is a *robotic* simulator?



What can I *do* with a robotic simulator?

- Model
- Test
- Validate
- Learn / tune parameters
- Generate data
- Train
- Sell
- …



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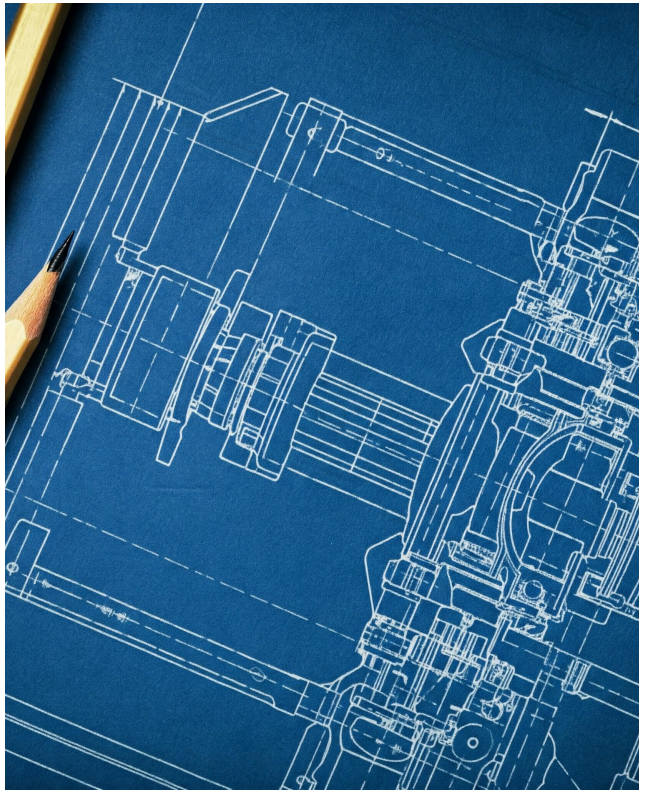
Picking the right tool for the job

How to *pick* a robotic simulator?

Just another blueprint

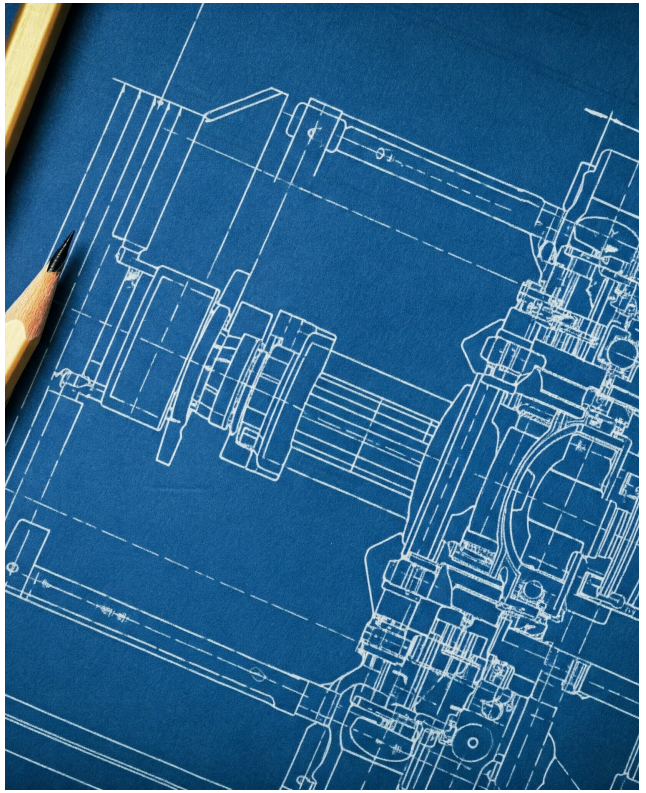
- Identify use cases
  - *Is it a testing tool?*
  - *Is it a validation tool?*
  - *Is it a development tool?*
  - *Is it data gathering tool?*
  - *Do you need a hardware-in-the-loop system?*
- Identify the type of robotic system
  - *Ground / Aerial / Maritime vehicles?*
  - *Robotic arm or mobile robot or custom mechanism?*
- Identify scenarios
  - *Indoor vs outdoor.*
  - *One vs multiple robots.*
  - *Do you have automatisms?*
  - *Do scenarios last long?*
  - *Do you need determinism?*
  - *Scene creation tools?*
  - *Digital asset library requirements?*



How to *pick* a robotic simulator?

And the list keeps growing...

- Identify physics requirements
  - *Kinematic vs dynamic vs complex dynamics?*
  - *Which are the required sensors and actuators?*
  - *Do you need soft bodies?*
- Identify rendering requirements
  - Do you need rendering at all?
  - Do you need photorealism?
  - Will it run on the CPU or do you have GPU?
- Identify the maintenance model
  - *Are you relying on the community?*
  - *Is your entire stack moving forward with your technology decision?*

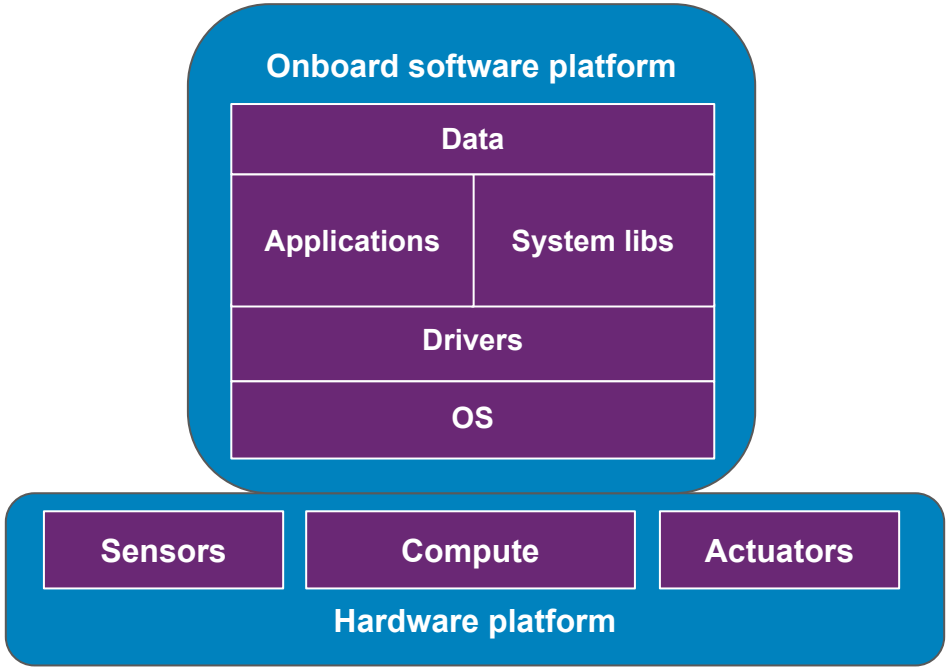


One robot, many simulators

Model your robot

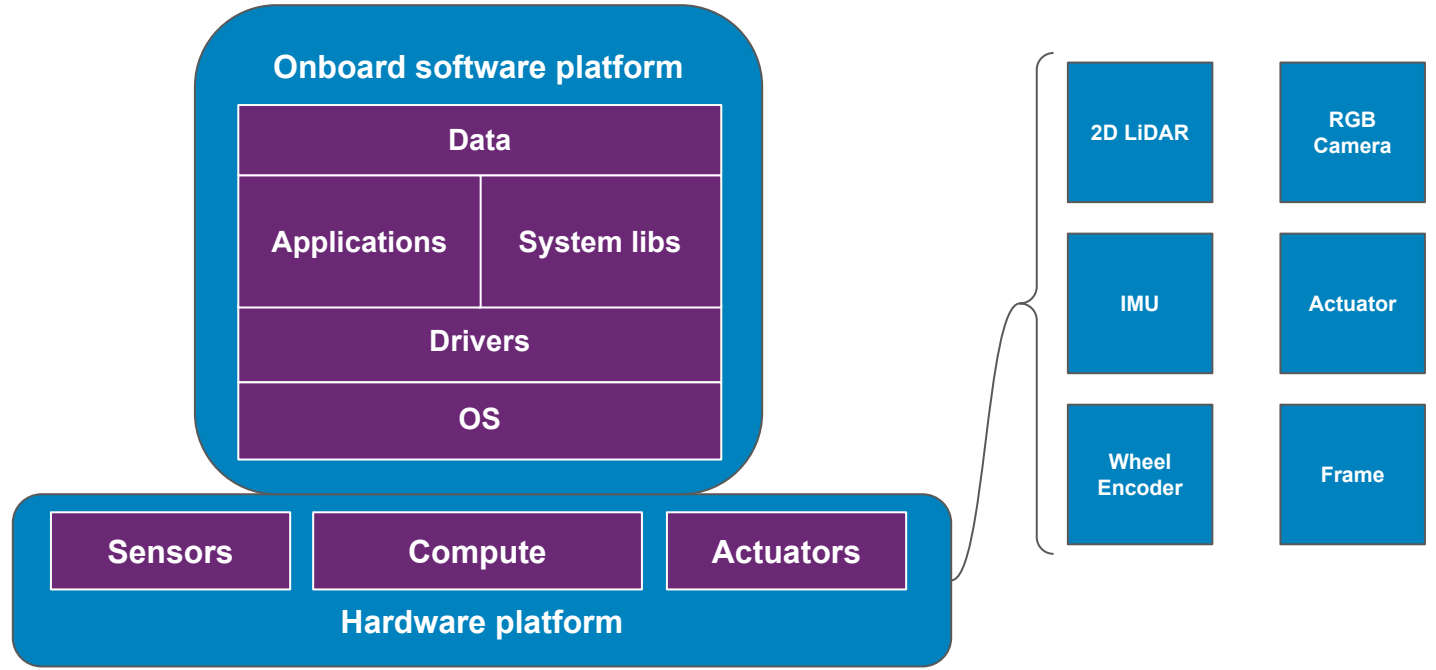
One robot, many simulators

Model your robot



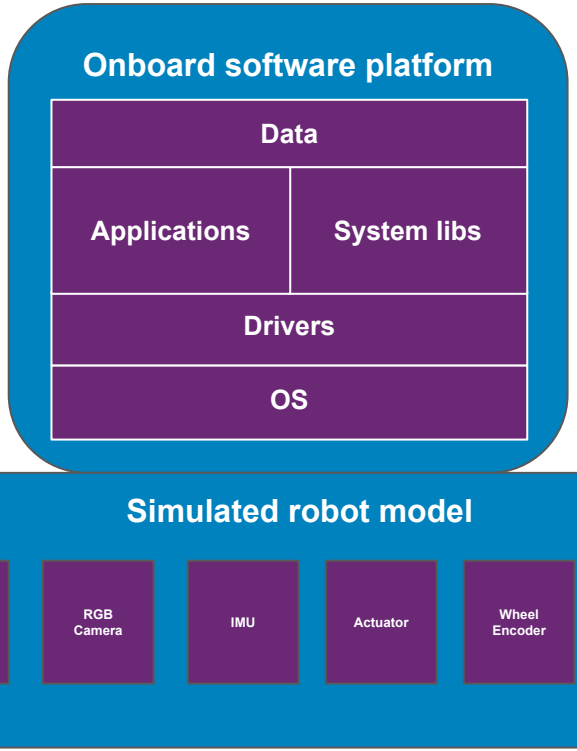
One robot, many simulators

Model your robot



One robot, many simulators

Build your simulated model for each simulator & benchmark it!



GAZEBO

O3DE
OPEN 3D ENGINE

MuJoCo

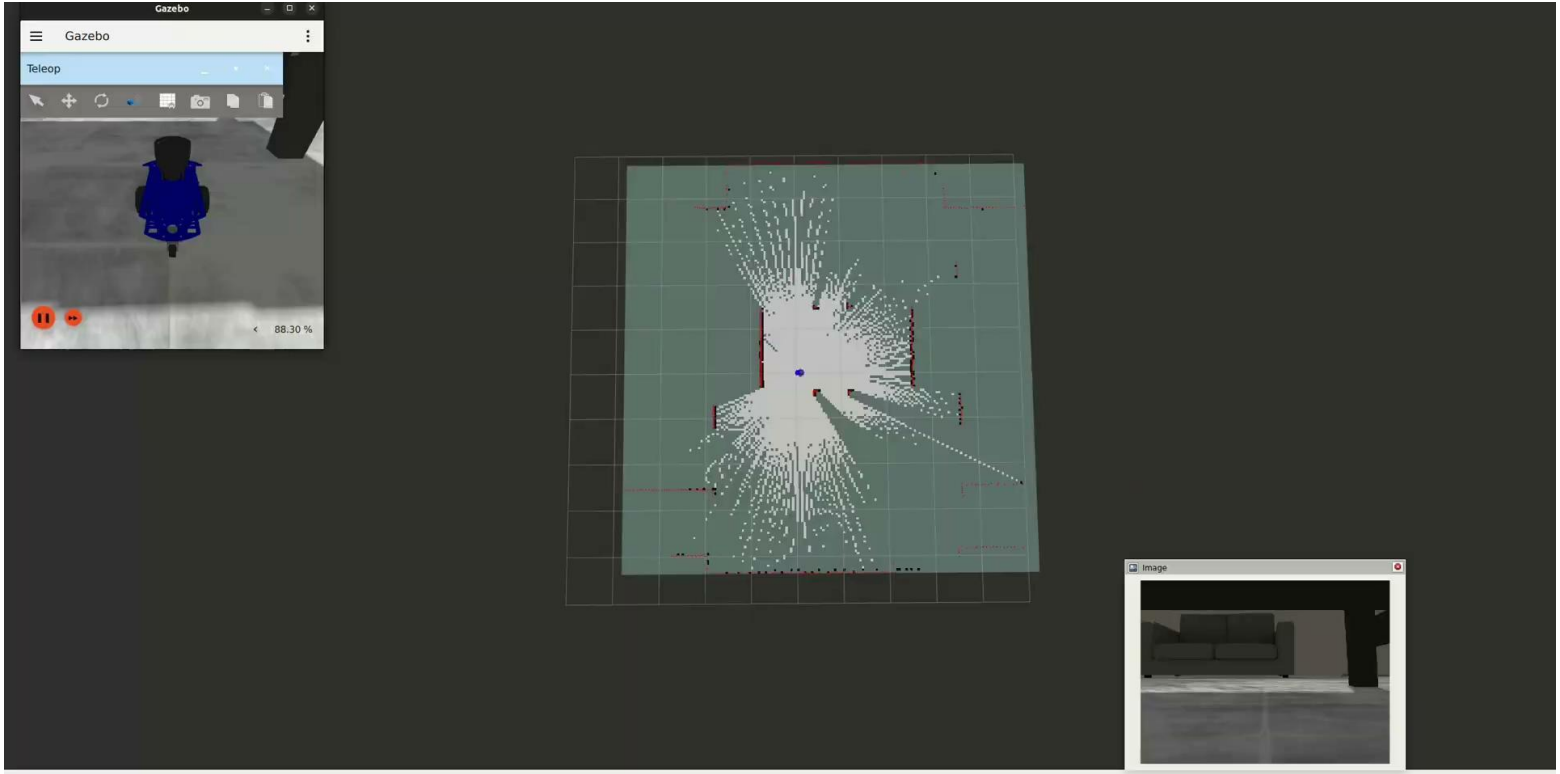
Flatland

Show me the code!

1. Scan me!
2. Click on “Open Source projects”
3. Ekumen-OS @ Github
   a. Andino ecosystem and all the simulator projects in the upcoming slides.
   b. Beluga
   c. Lambkin
4. ⭐ the projects ;)

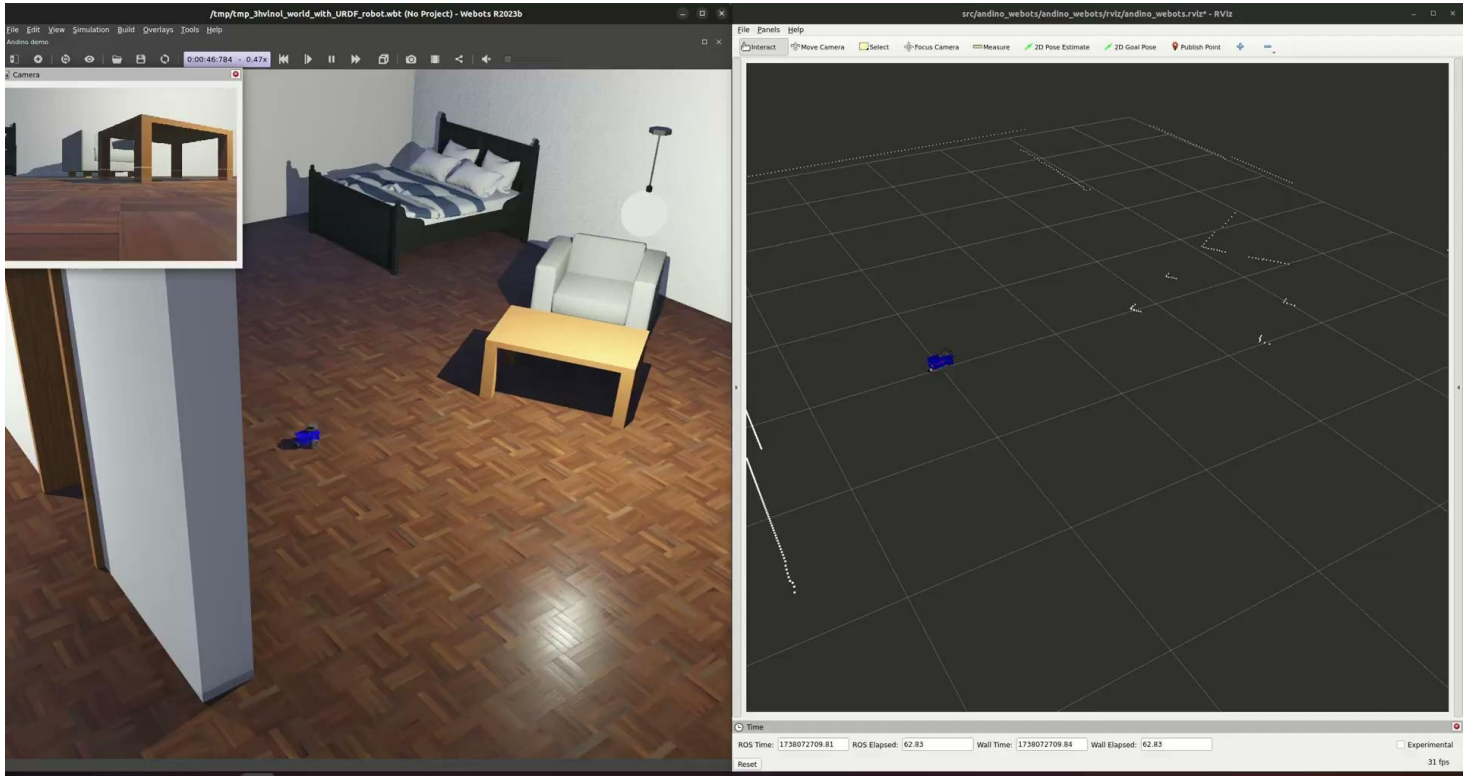
One robot, many simulators

Gazebo

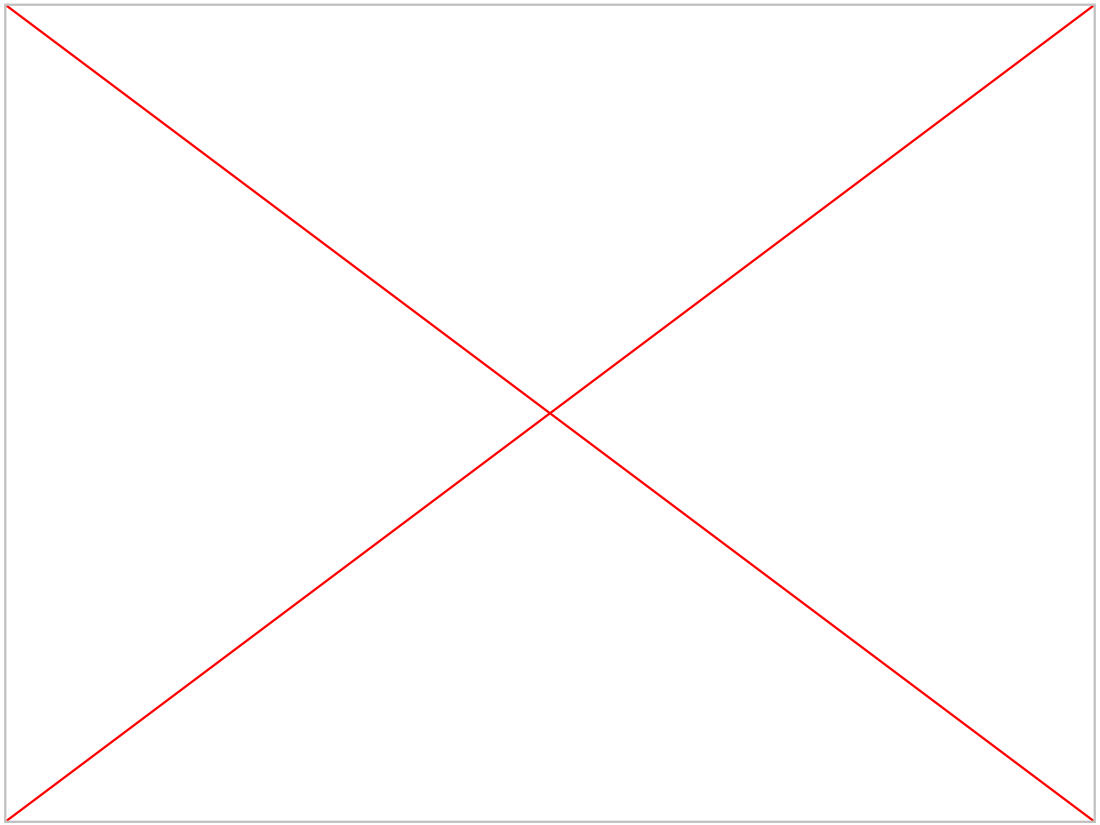


One robot, many simulators

Webots

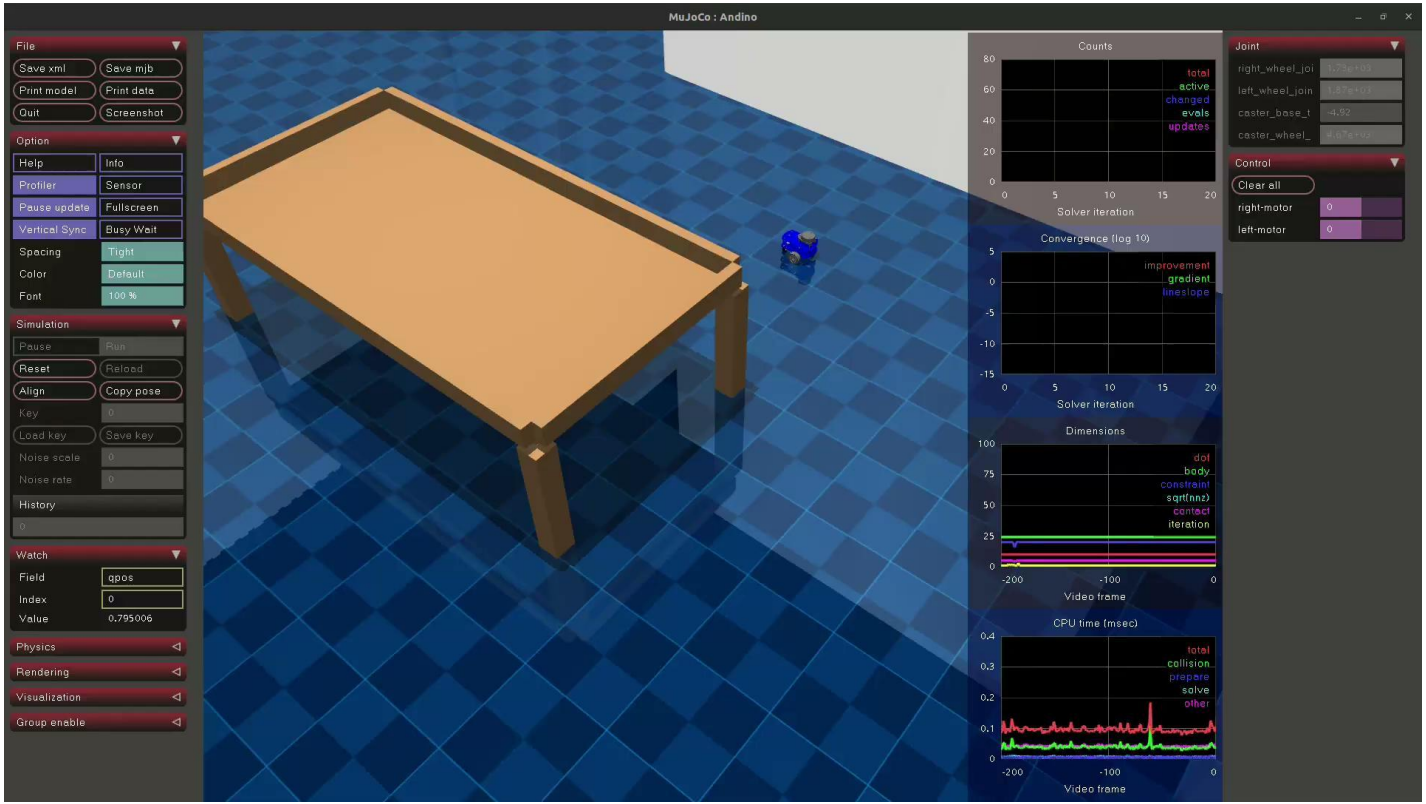


One robot, many simulators



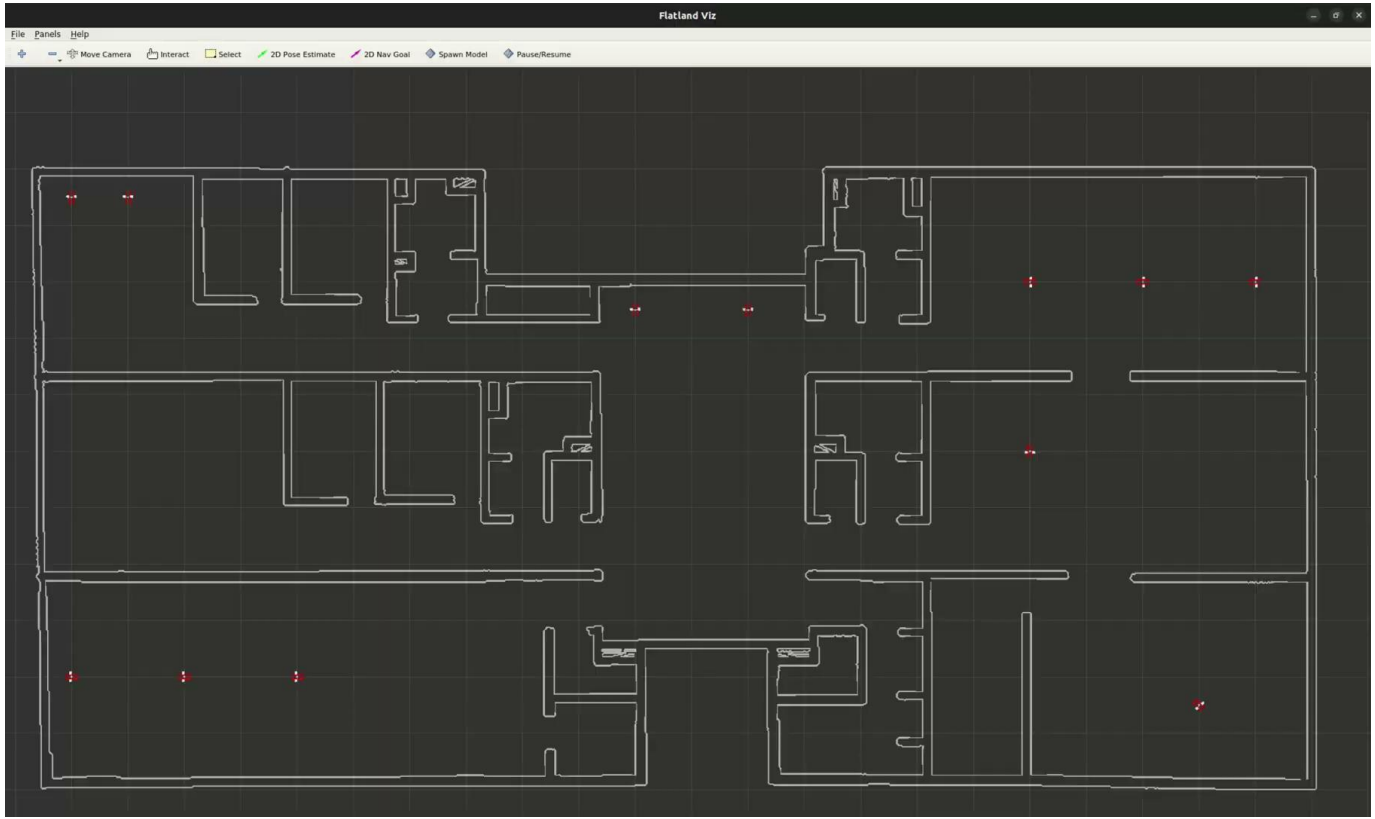
One robot, many simulators

MuJoCo



One robot, many simulators

Flatland



Discussion and questions

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Thank you!