



EKUMEN

Accelerating robotics development through simulation

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



- 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.



A little about Ignacio Davila

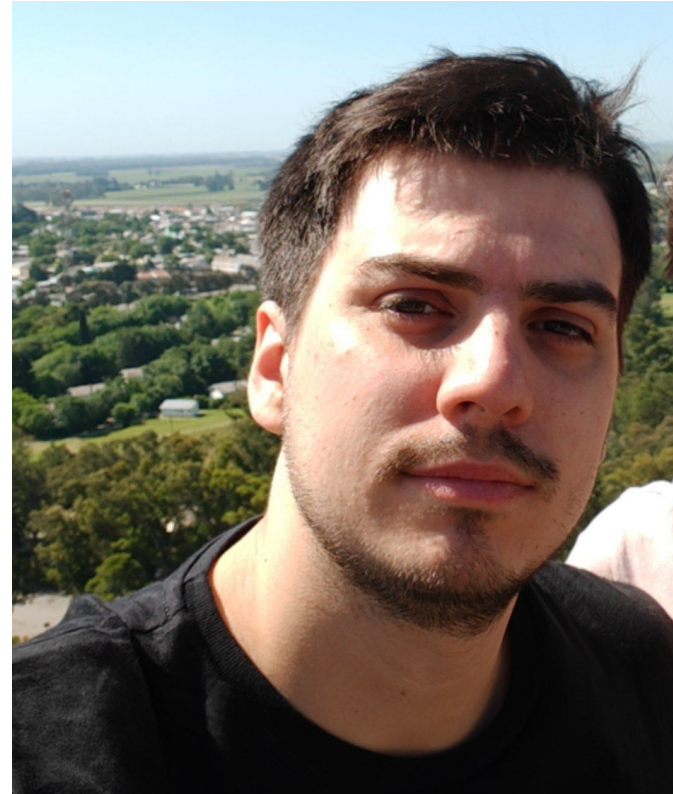


- Roboticist at Ekumen
- Simulations Operations head @ Ekumen
- Electronics Engineering graduate
- Based in Buenos Aires, Argentina 🍷
- Hobbies: 🎸 🖥️ ⚽

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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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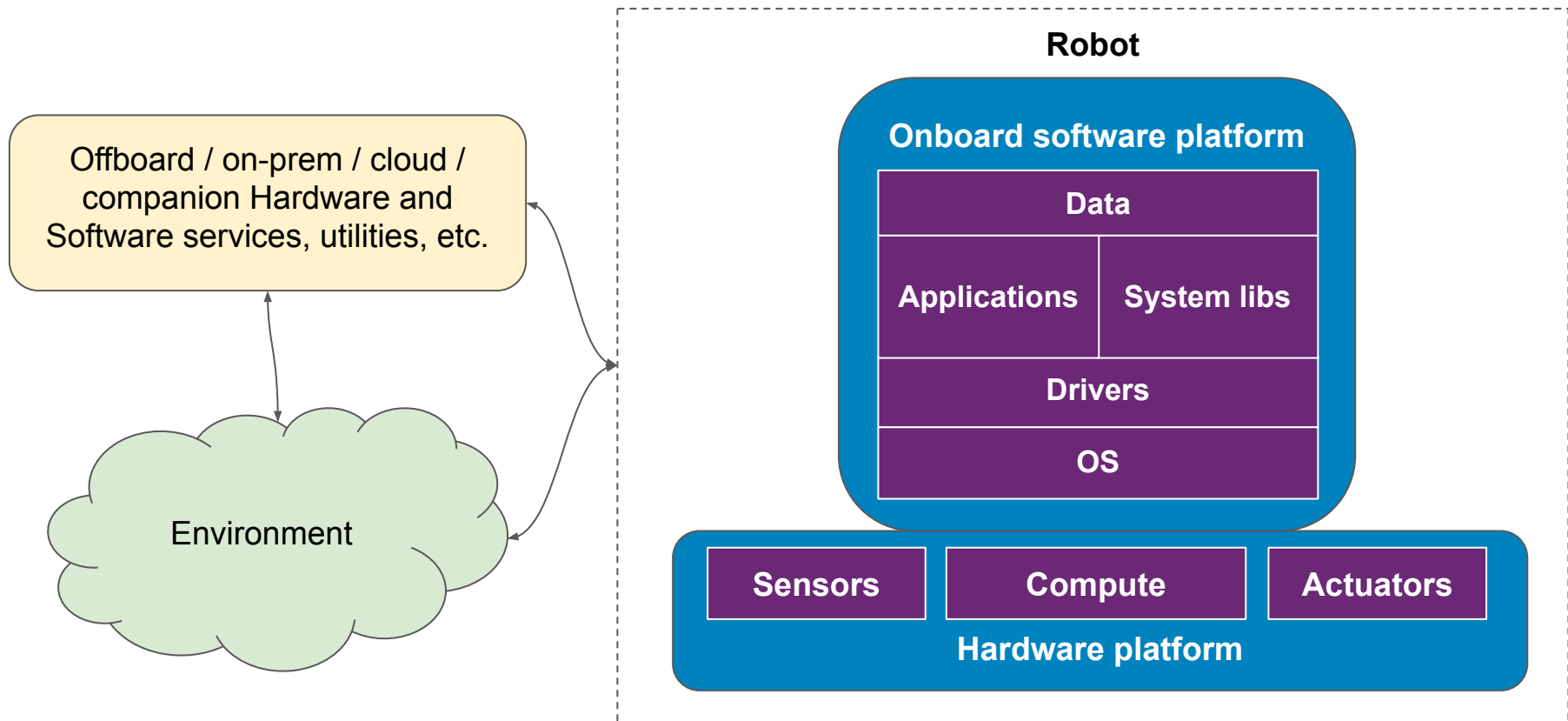




- Robots and Simulators
 - What is a *robotic* system?
 - What is a *robotic* simulator?
 - What can I *do* with a robotic simulator?
- Picking the right tool for the job
 - How to pick a robotic simulator?
 - One robot, many simulators
 - Gazebo
 - Webots
 - O3DE
 - MuJoCo
 - Flatland
- Discussion and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

Robots and Simulators

What is a *robotic* system?





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.

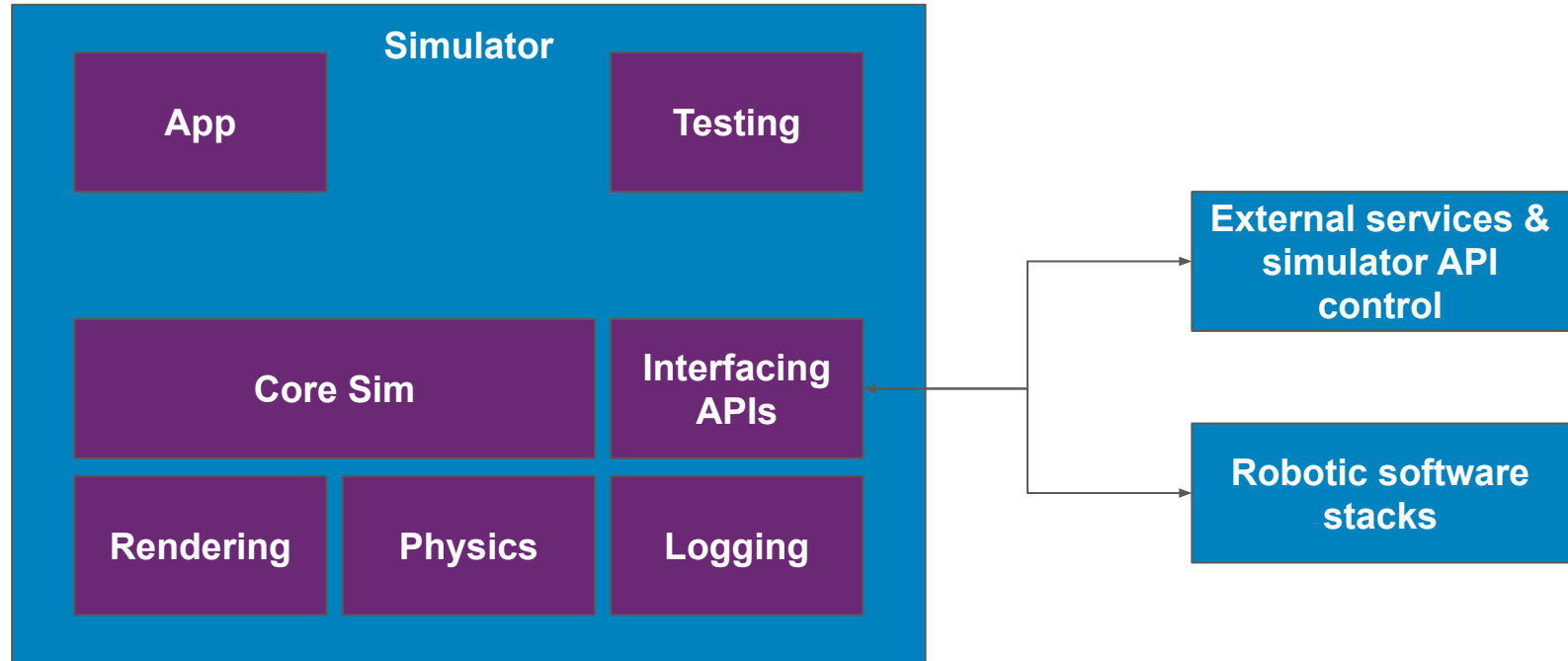


A robotic simulator is an application which allows to model scenarios with robotic systems.

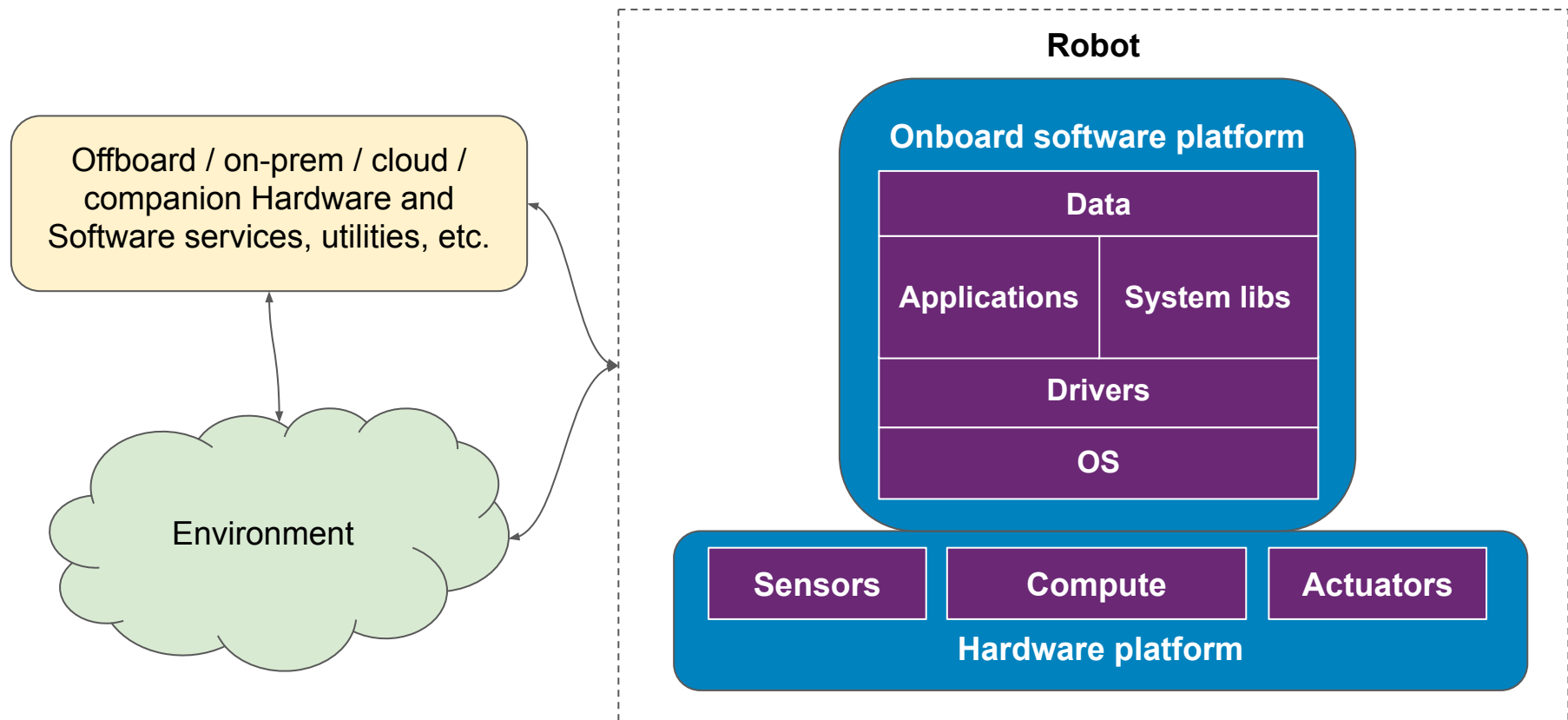
What is a *robotic* simulator?



Architecture



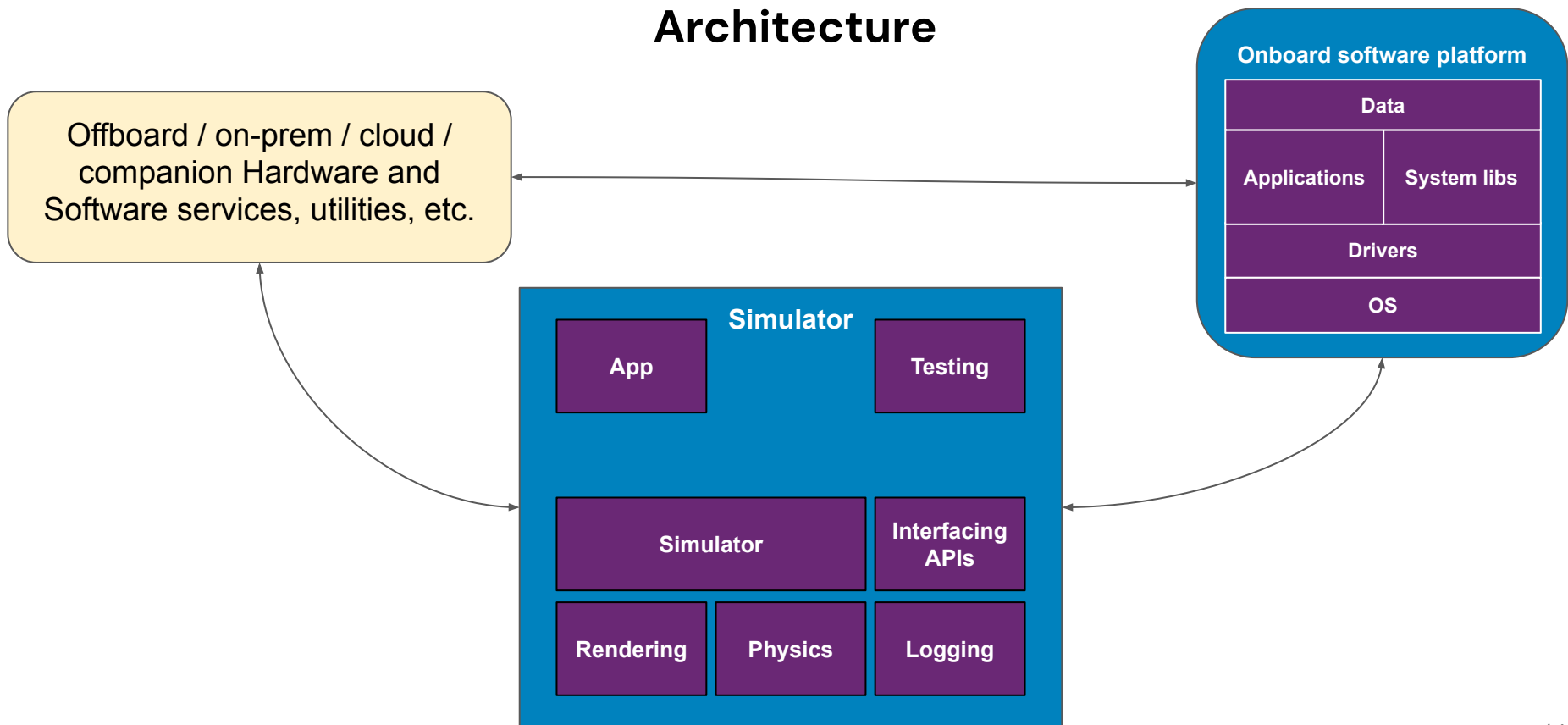
What is a *robotic* simulator?



What is a *robotic* simulator?



Architecture



What can I *do* with a robotic simulator?



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

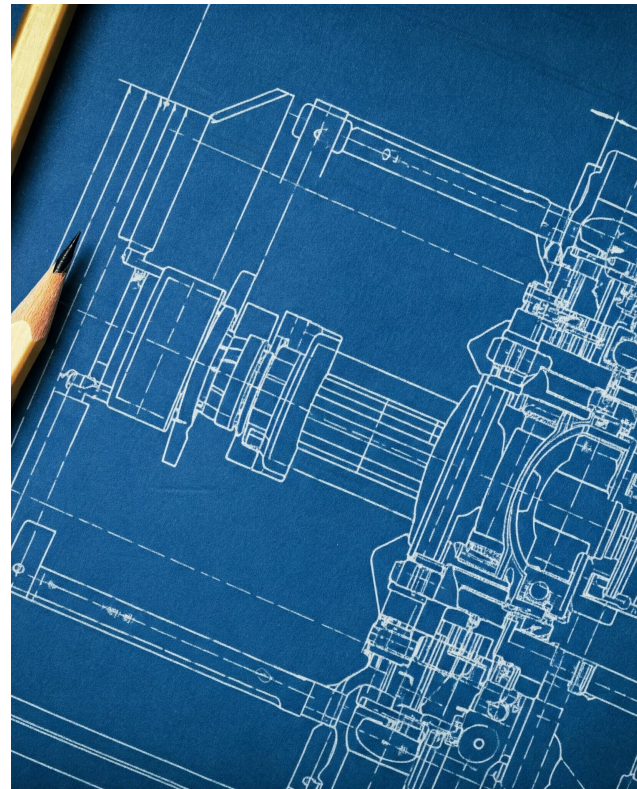


Picking the right tool for the job



Just another blueprint

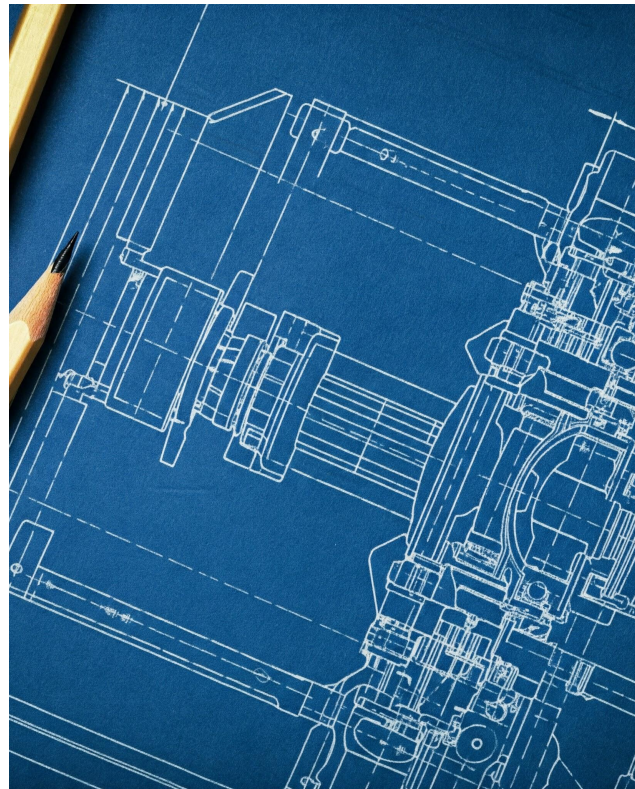
- Identify use cases
 - *Is it a testing tool?*
 - *Is it a validation tool?*
 - *Is it a development tool?*
 - *Is it data gathering tool?*
 - *Do you need a hardware-in-the-loop system?*
- Identify the type of robotic system
 - *Ground / Aerial / Maritime vehicles?*
 - *Robotic arm or mobile robot 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?*





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?*



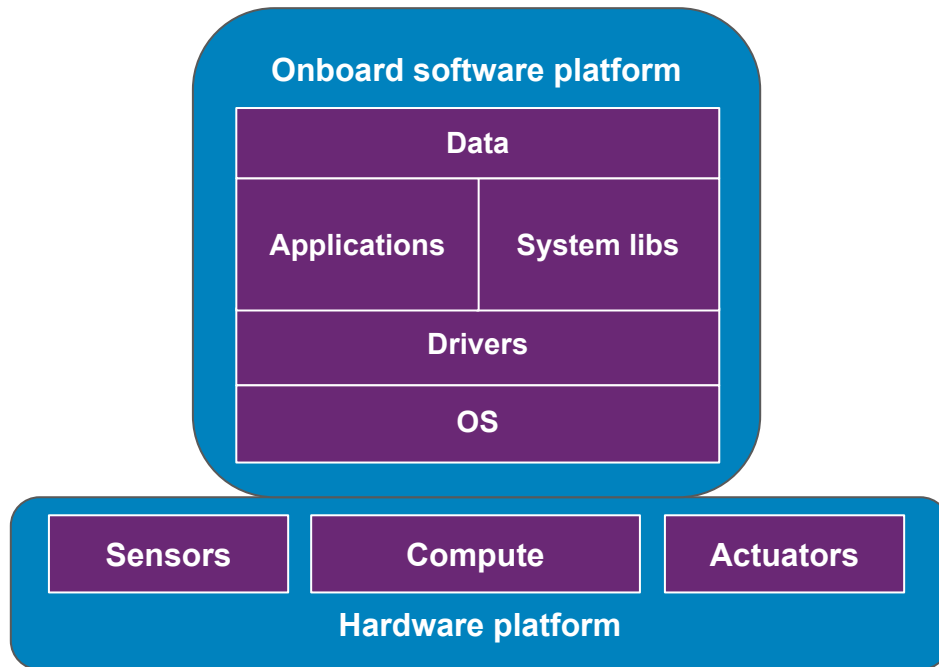


Model your robot



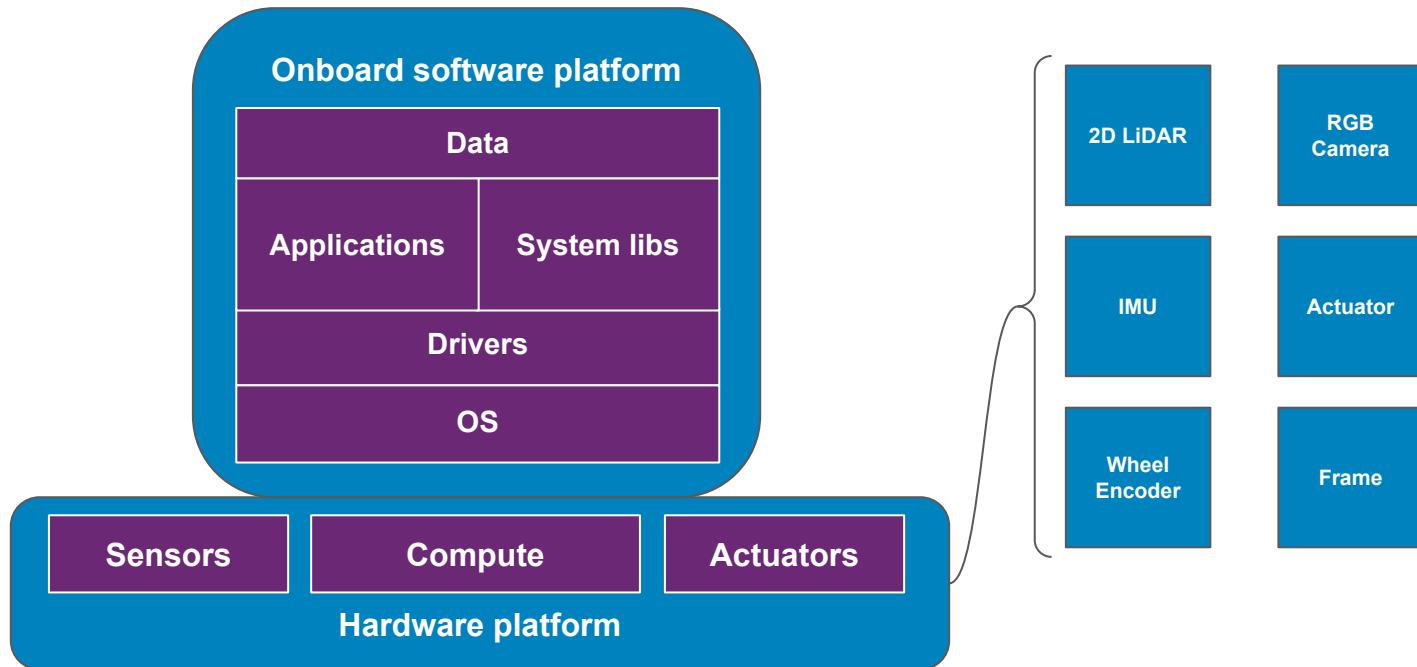


Model your robot





Model your robot



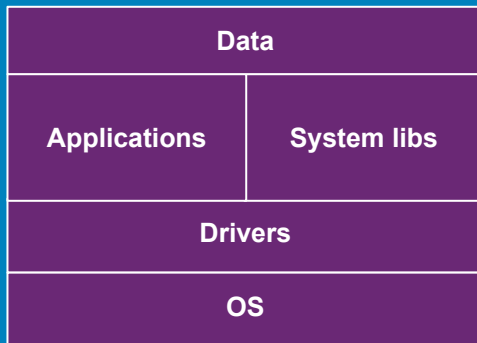
One robot, many simulators



Build your simulated model for each simulator & benchmark it!



Onboard software platform



Simulated robot model



GAZEBO



MuJoCo

Flatland





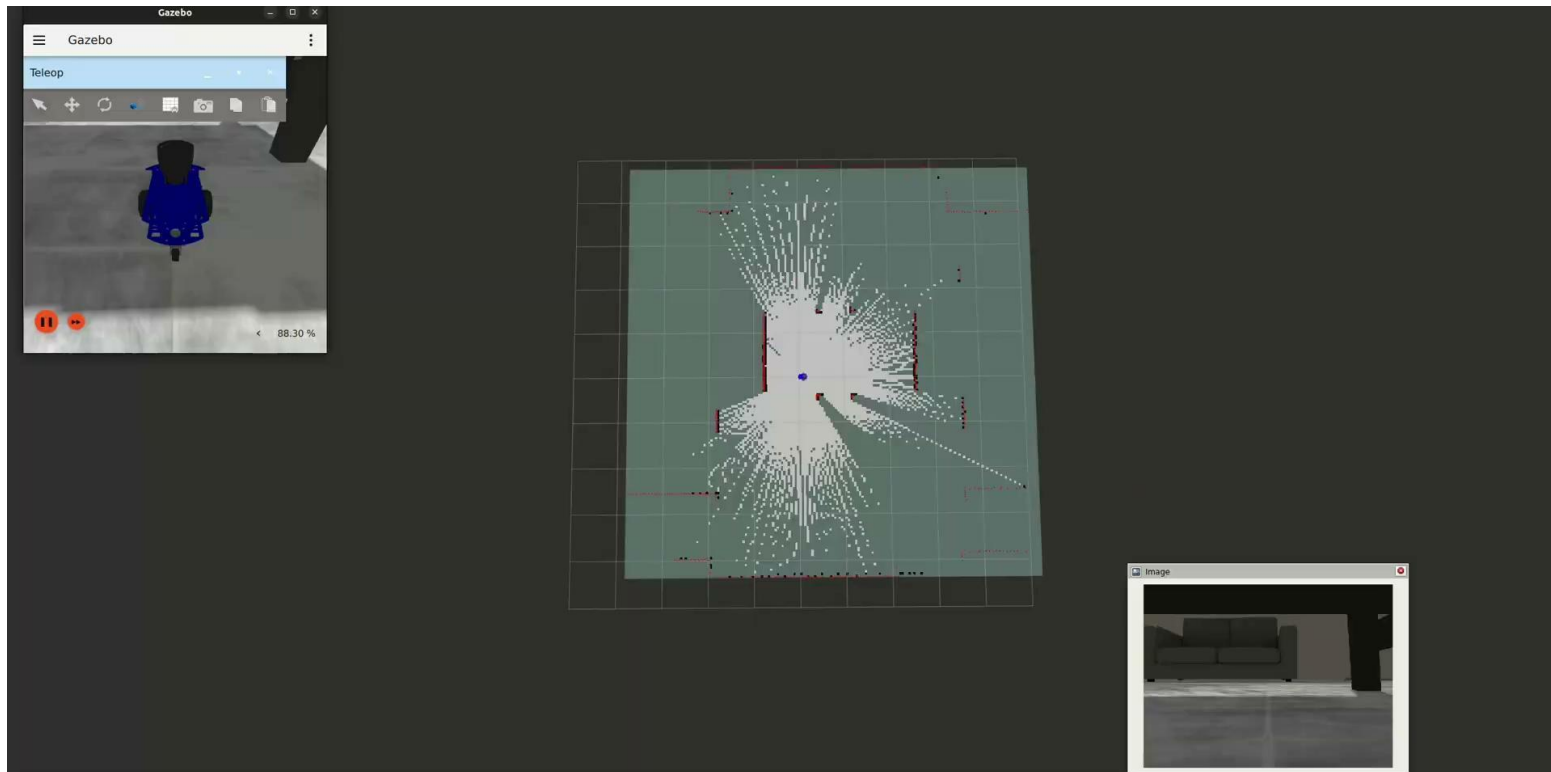
Show me the code!



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 ;)



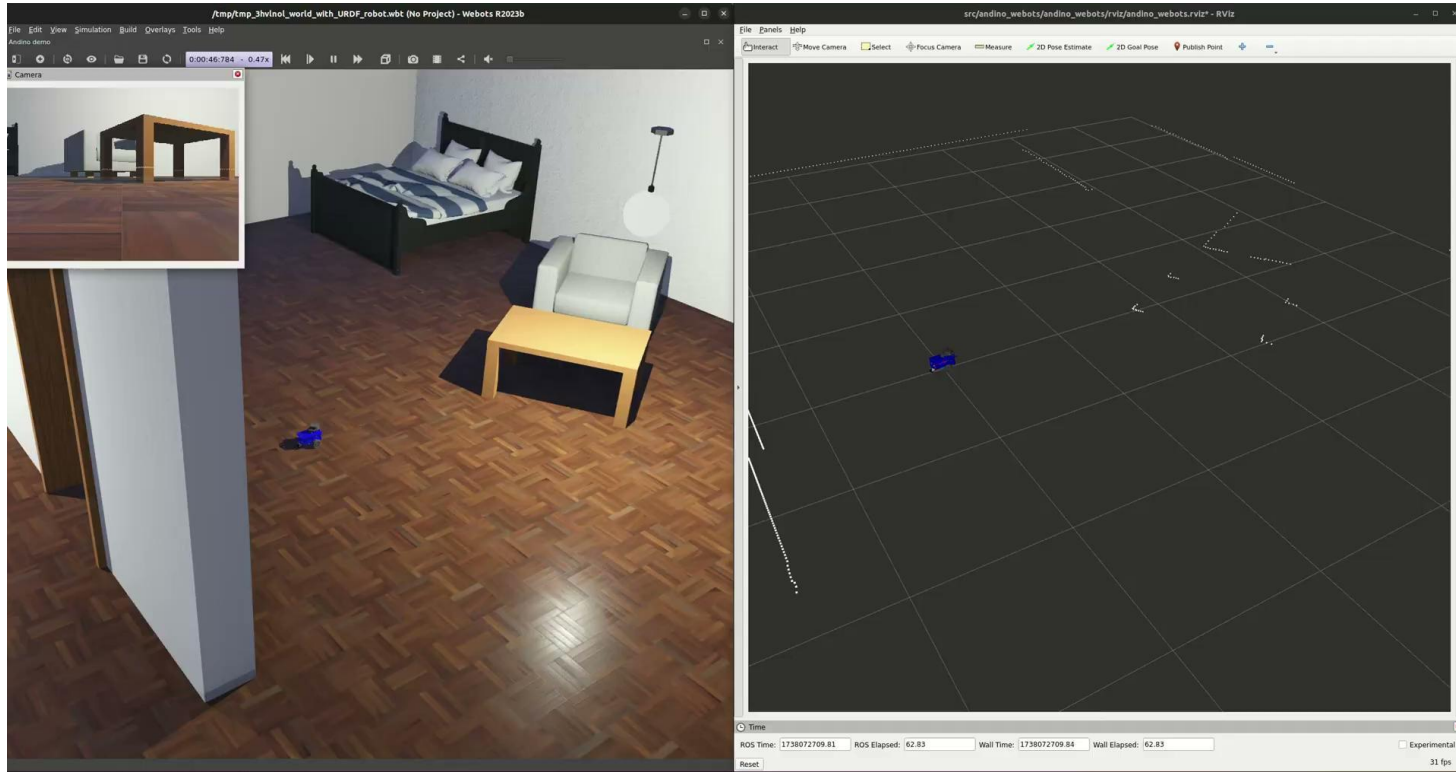
Gazebo



One robot, many simulators

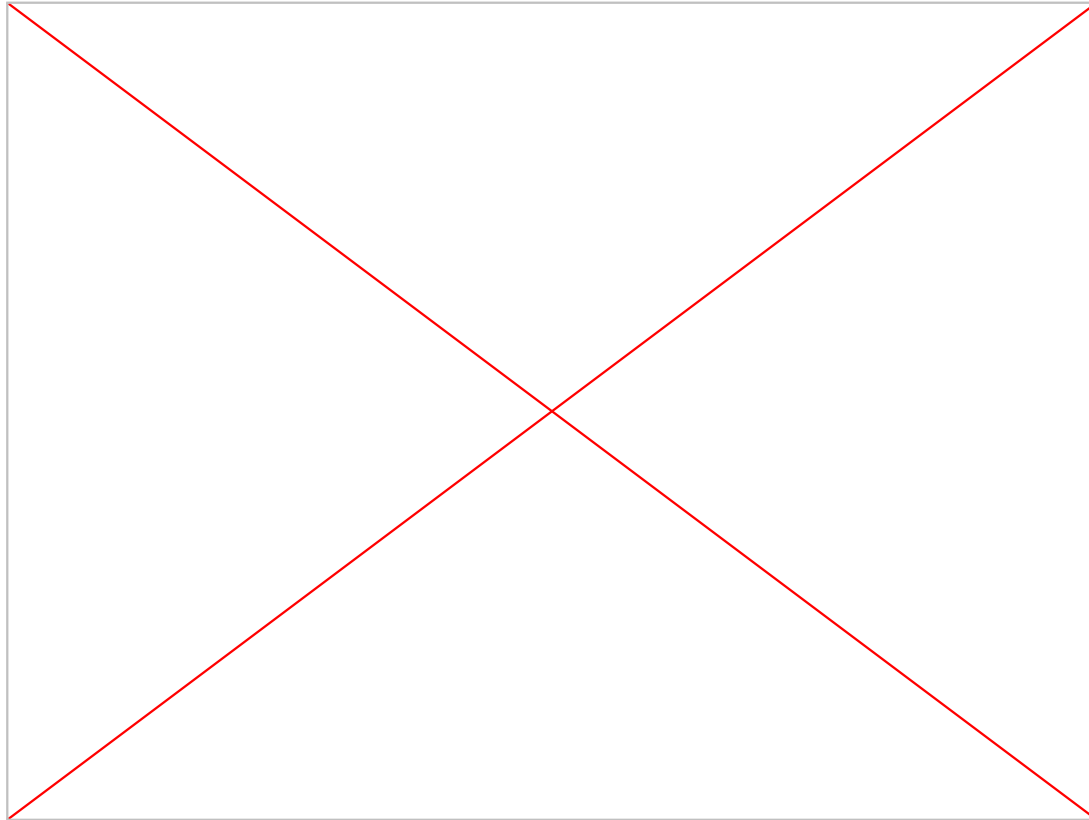


Webots





O3DE



One robot, many simulators



MuJoCo

The screenshot displays the MuJoCo Andino simulator interface. The main window shows a 3D scene with a wooden table and a small blue robot on a blue checkered floor. The interface includes a menu on the left, a central 3D view, and several data plots on the right.

File: Save xml, Save mjcb, Print model, Print data, Quit, Screenshot

Option: Help, Info, Profiler, Sensor, Pause update, Fullscreen, Vertical Sync, Busy Wait, Spacing, Tight, Color, Default, Font, 100 %

Simulation: Pause, Run, Reset, Reload, Align, Copy pose, Key, 0, Load key, Save key, Noise scale, 0, Noise rate, 0, History, 0

Watch: Field, gpos, Index, 0, Value, 0.795006

Physics: Rendering, Visualization, Group enable

Counts: Solver iteration (0 to 20), total, active, changed, evals, updates

Convergence (log 10): Solver iteration (0 to 20), improvement, gradient, lineslope

Dimensions: Video frame (-200 to 0), dot, body, constraint, sqrt(nnz), contact, iteration

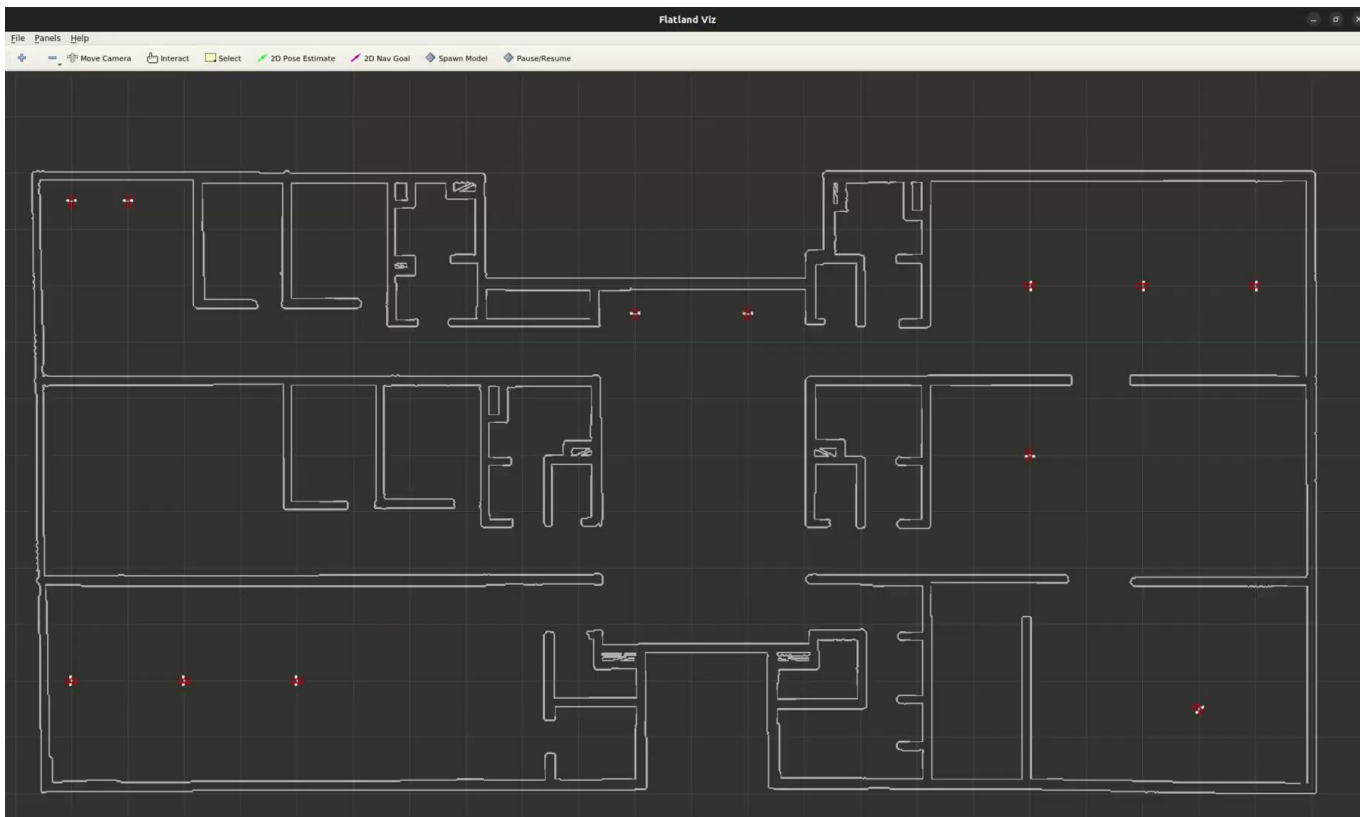
CPU time (msec): Video frame (-200 to 0), total, collision, prepare, solve, other

Joint: right_wheel_joi, 5.25e+05, left_wheel_joi, 1.87e+05, caster_base_t, -4.92, caster_wheel_, 8.07e+02

Control: Clear all, right-motor, 0, left-motor, 0



Flatland



Discussion and questions



Thank you!