The Construct

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How to Teach Robotics with Integrated Practice

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Who is this webinar for?

- Professors
- Teachers
- Teacher Assistants who need to deliver a robotics class

What are we going to learn?

How to prepare a robotics class that:

- Teaches a subject having the robots in mind
- Includes practice with simulated robots
- Provides practice with real robots
- Allows student evaluation

What do I mean by teaching robotics?

- Robot action and perception
- Arm Kinematics
- Mobile Robots Kinematics
- Robot Dynamics
- Motion Planning and Control
- Robot Navigation
- Computer Vision

What do I mean by Teaching With The Robots In Mind?

Concepts must come from **experiences with robots**

I saw many robotics courses curriculum:

- **Lesson 1:** Computational Linear Algebra
- **Lesson 2:** Linear equations and matrices
- **Lesson 3:** Matrix determinant
- **Lesson 4:** Triangular systems
- **Lesson 5:** ...

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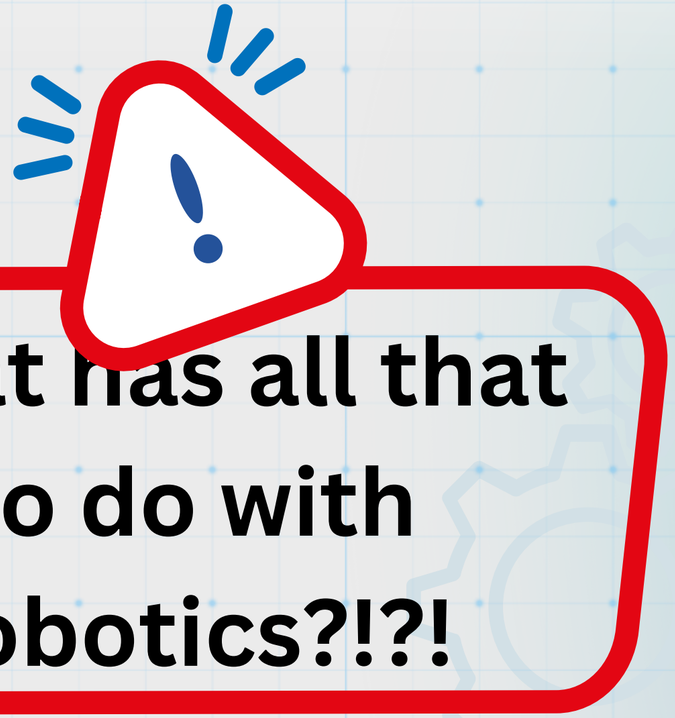


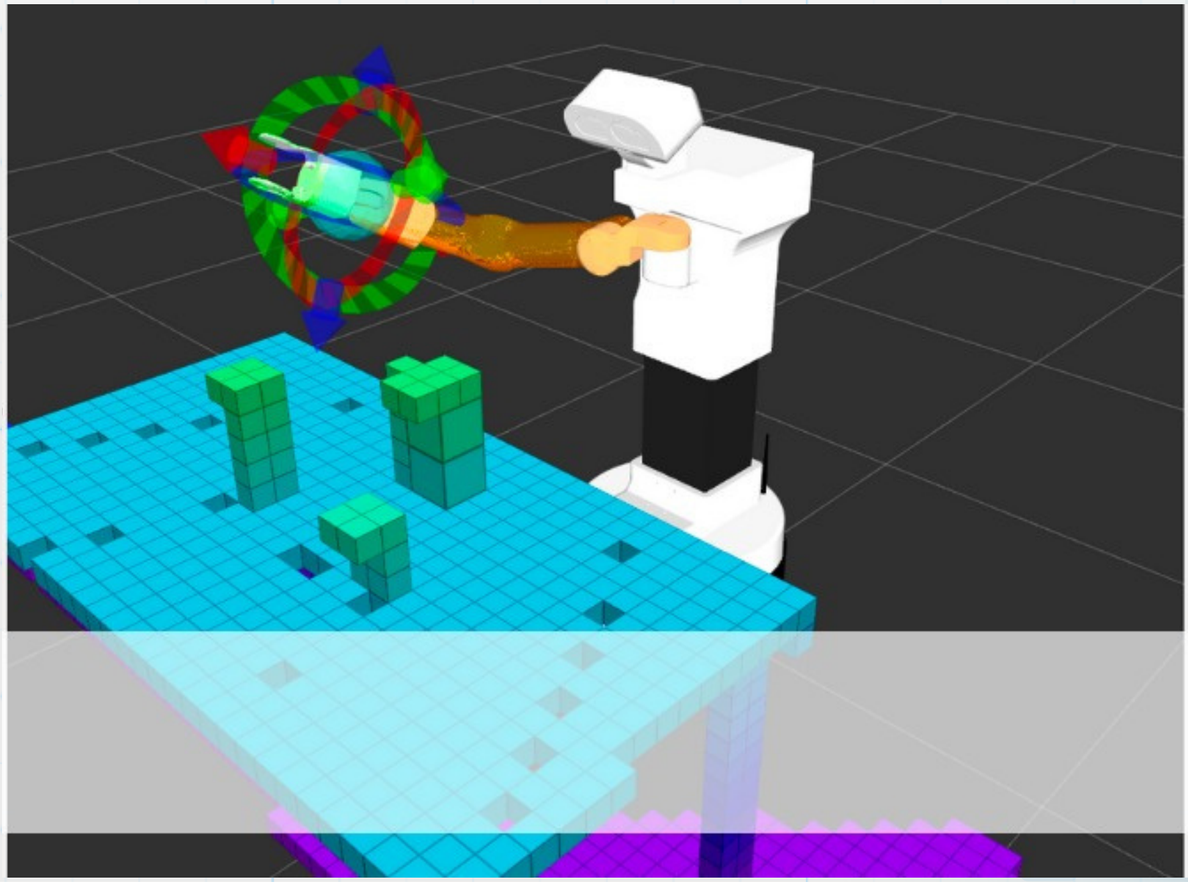
Start with the robot in mind

- Start with why!
  - **Why do we need this concept?**

- Show that necessity in the robot

Example: identify how far is the gripper from the object to grasp

- **Compute gripper position** relative to center of robot
- **Compute object position** relative to center of robot
- **Compute the difference**



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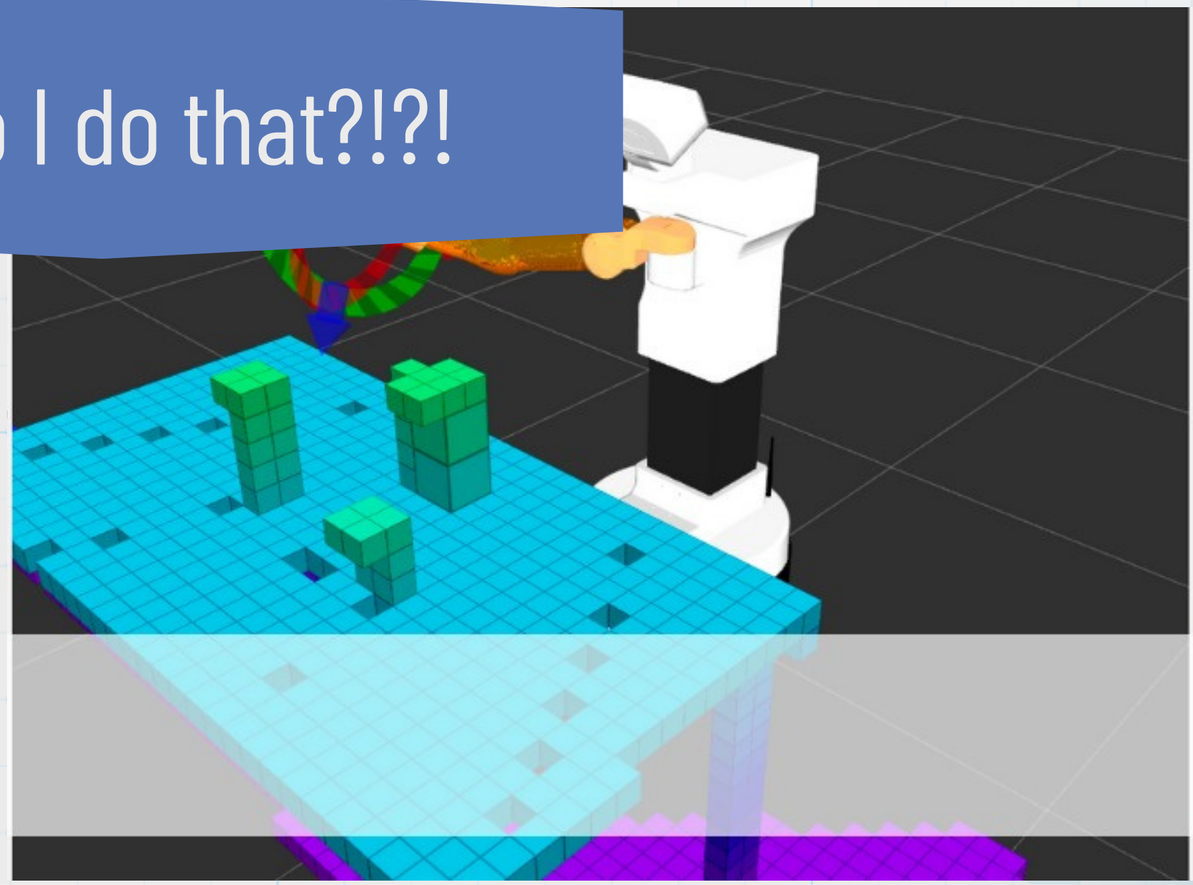

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I'm glad you asked!

Welcome to matrices world!

Key idea

I need the robot
to do **this** for **this**
and **that** reason

Key idea

I can solve that by using this **algorithm**, this **math**, this **technique**...

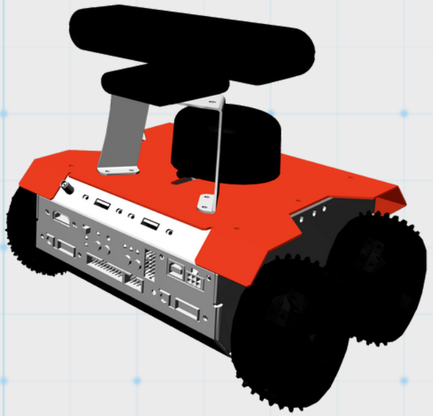
What I mean...

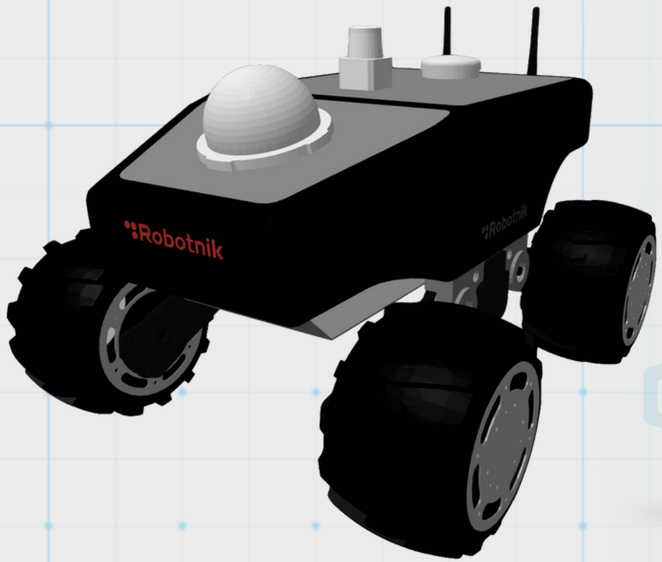
When we teach the matrices,
the goal for the students is
not to compute the matrix
but to grasp the object

What I mean...

Exercises and evaluation
shouldn't be done
on computing the matrices
but on **grasping the object!**

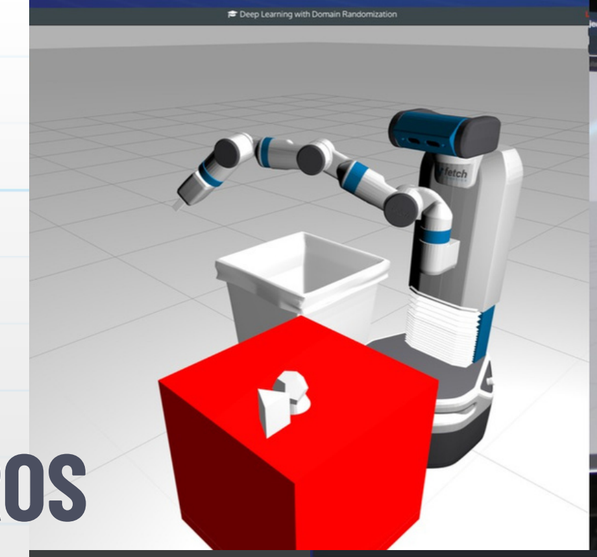
This approach to teaching doesn't work unless **we provide robots to students!**

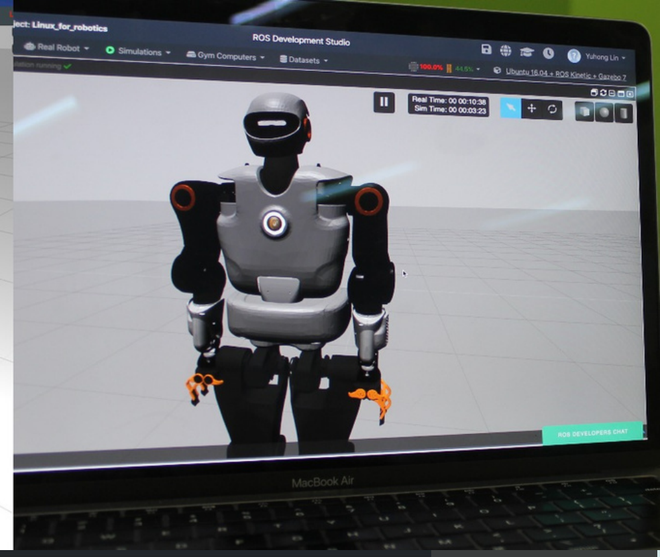




How to provide robots to students?

1. By using **Gazebo simulations** with **ROS**





How to provide robots to students?

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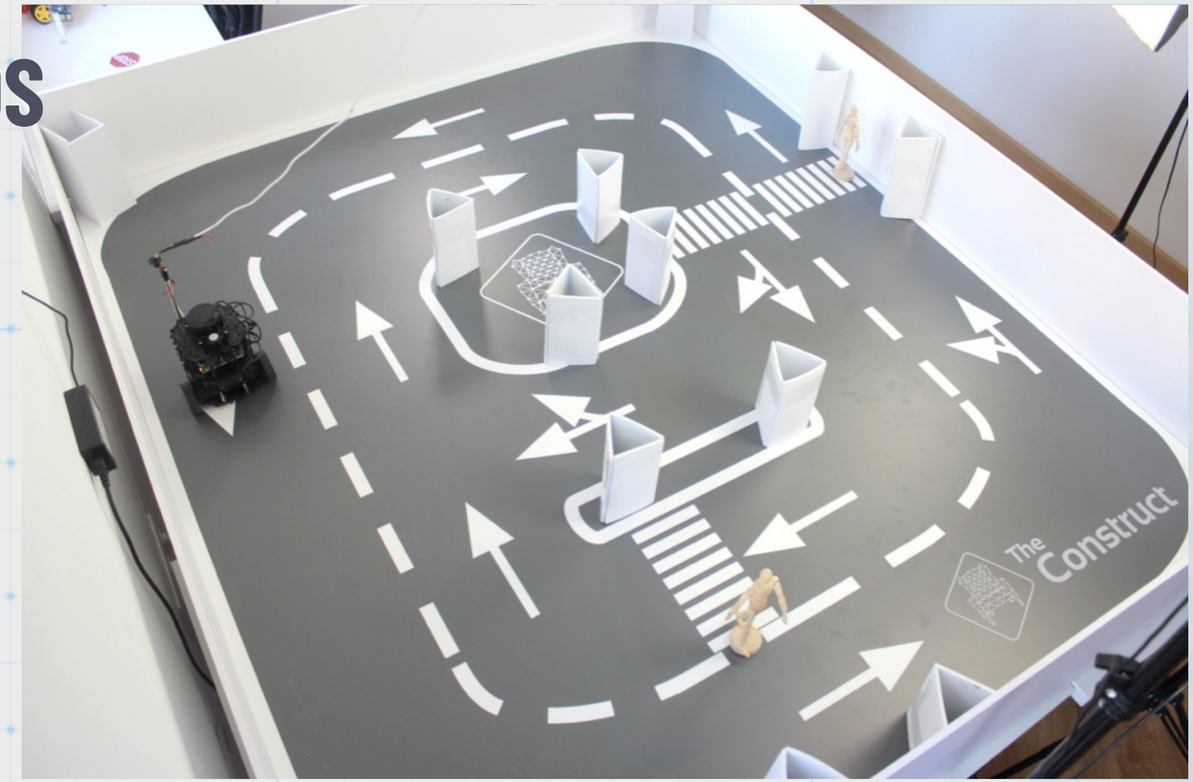
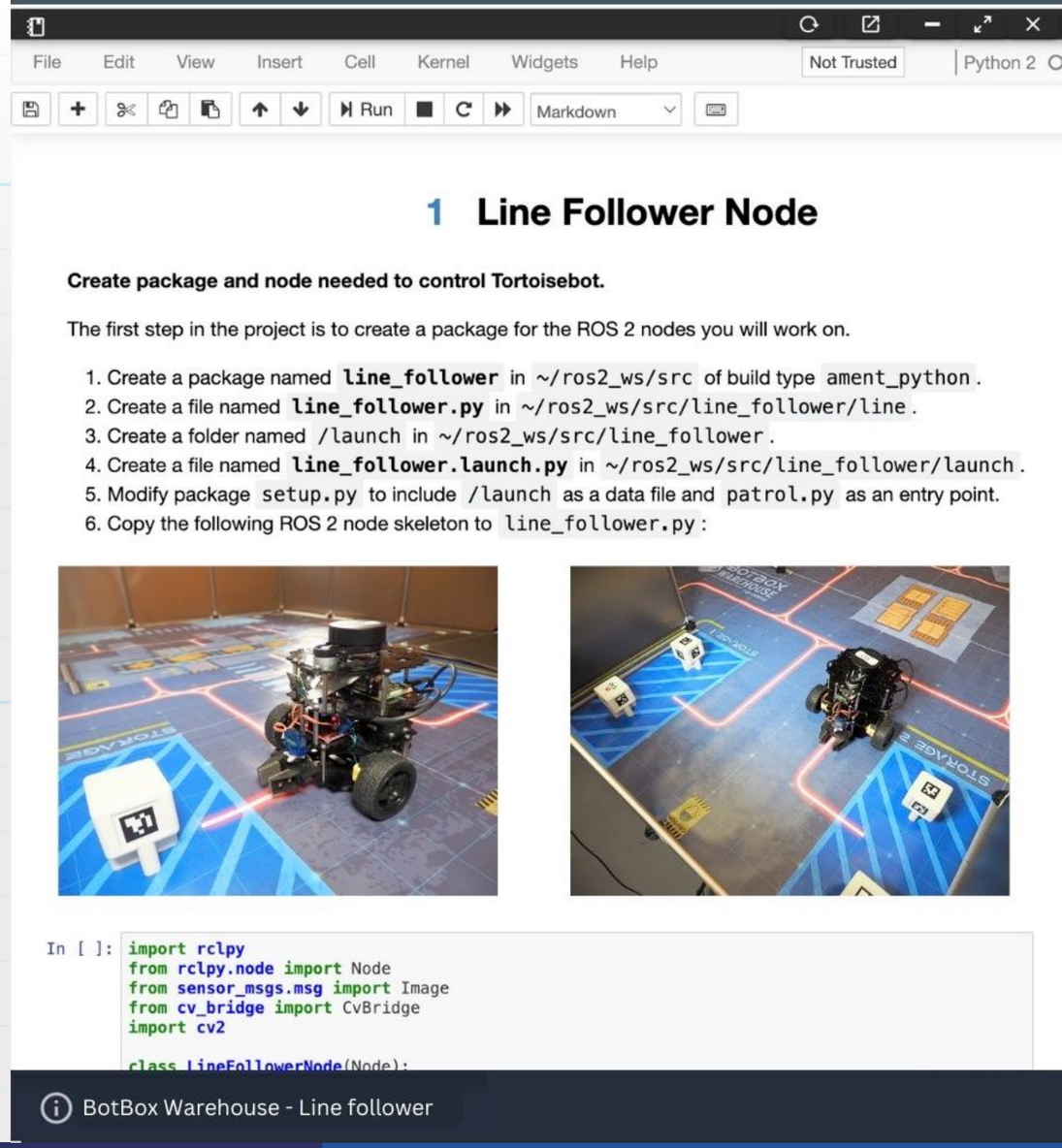
2. By adding a **lab with real robots**



How to provide robots to students?

1. By using **Gazebo simulations** with **ROS**
2. By adding a **lab with real robots**
3. The curriculum is prepared to make use of both



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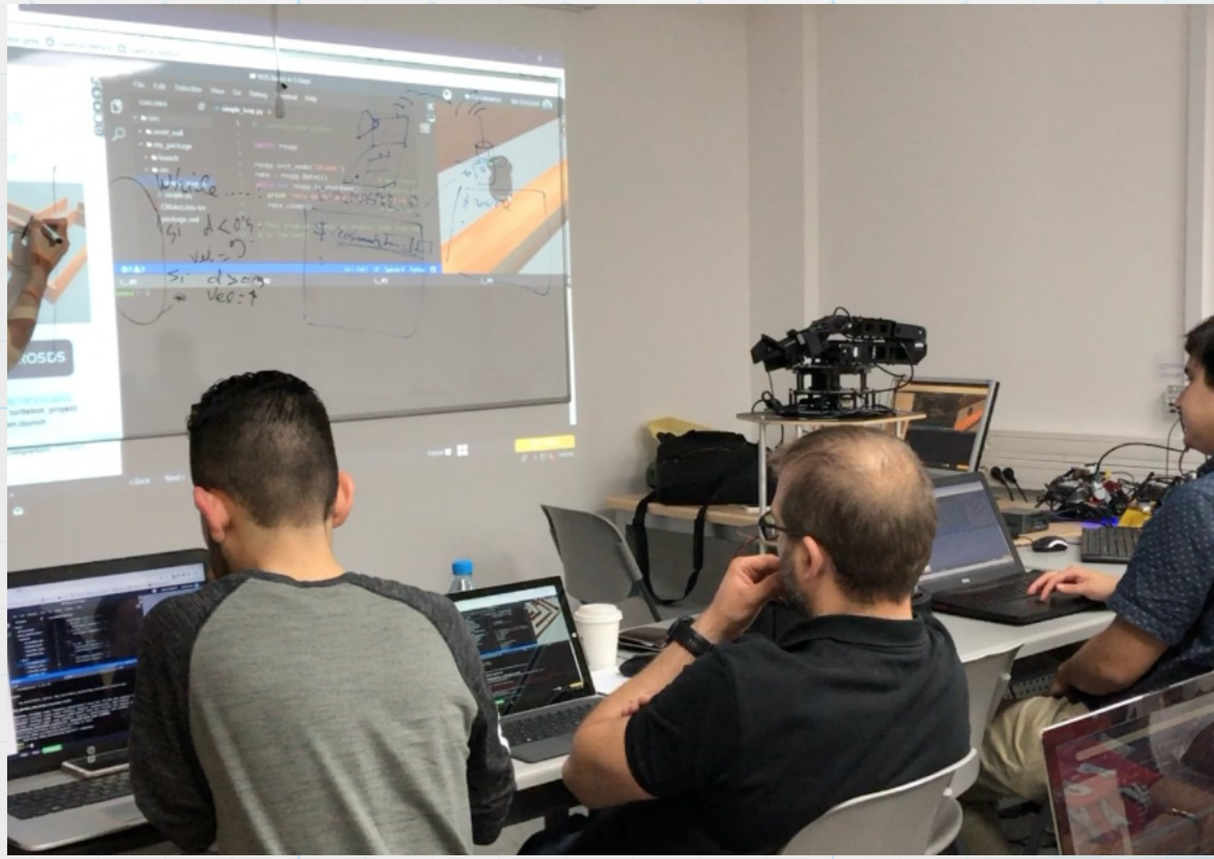
Let’s make a full example

- Let’s prepare the material for teaching the concept of **Coordinates and Transformations**



We need to prepare

1. The lesson learning material
2. The simulation to practice with
3. The exercises with the simulation
4. Homework
5. The evaluation with real robots

We will use the concept of

rosject

ROS environment
in the cloud

We simplified all this process....

rosject

Integrates:

- Robot Simulations
- Jupyter notebooks
- Code
- Real robot connection

We simplified all this process....

rosject

- Shareable
- No installation required
- Any computer
- **ARE FREE!!**

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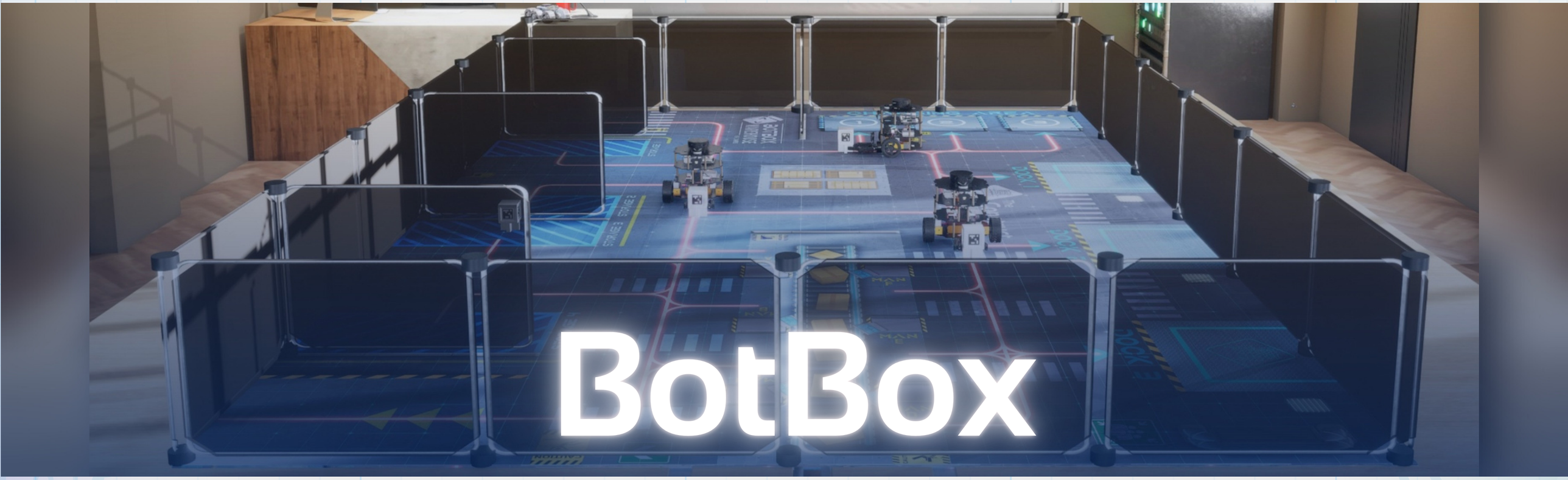
We provide an integrated REAL ROBOTS lab



https://www.theconstruct.ai/botbox-warehouse-lab

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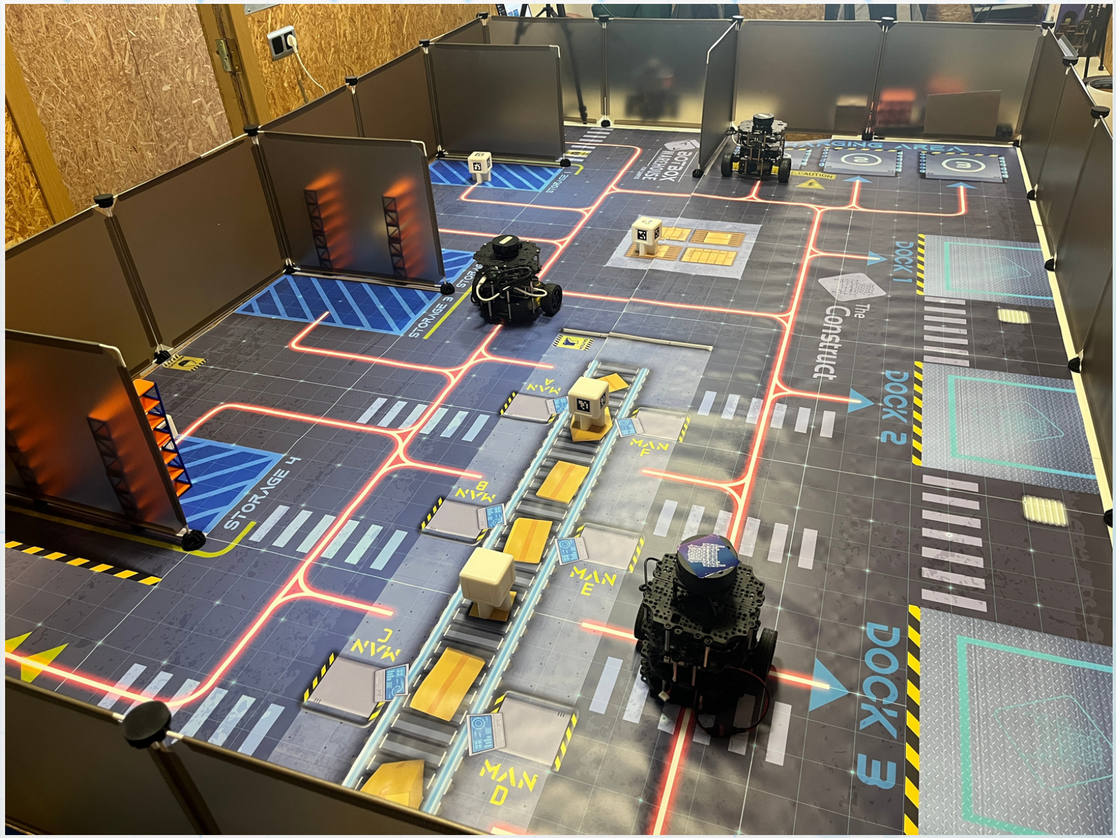
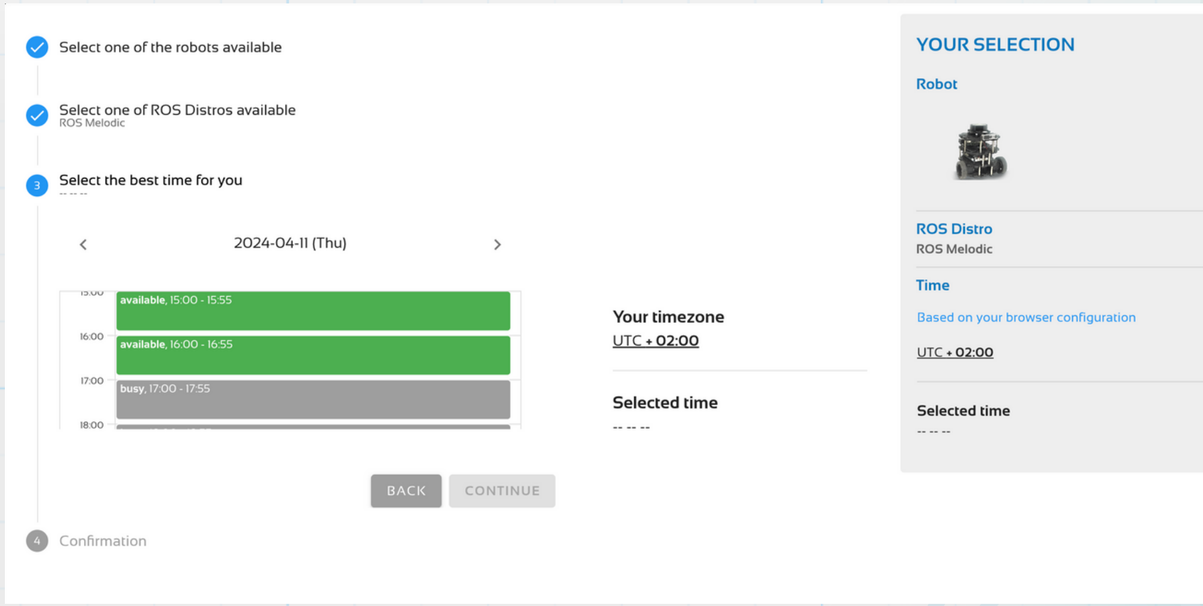
With BotBox

1. You have an already made lab
2. Includes simulation and projects
3. Does not depend on The Construct
4. You can integrate with The Construct for easier students' access



For the real robot practice you need:

- Have robots in an environment
- Have a planning agenda to allow students to access for practice
- Have a system to manage connection of students to robots



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Questions?