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[www.theconstruct.ai](http://www.theconstruct.ai)

# How to Teach Robotics

**with Integrated Practice**

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CEO of The Construct

# Who is this webinar for?

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



**How to Teach Robotics with Integrated Practice**

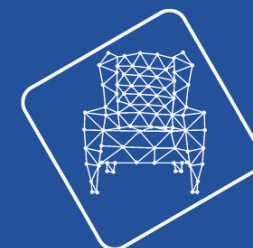


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# What are we going to learn?

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**



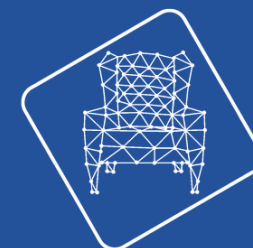
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# I saw many robotics courses curriculum:

- **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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- **Lesson 5:** ...



**What has all that  
to do with  
robotics?!?!**



# Start with the robot in mind

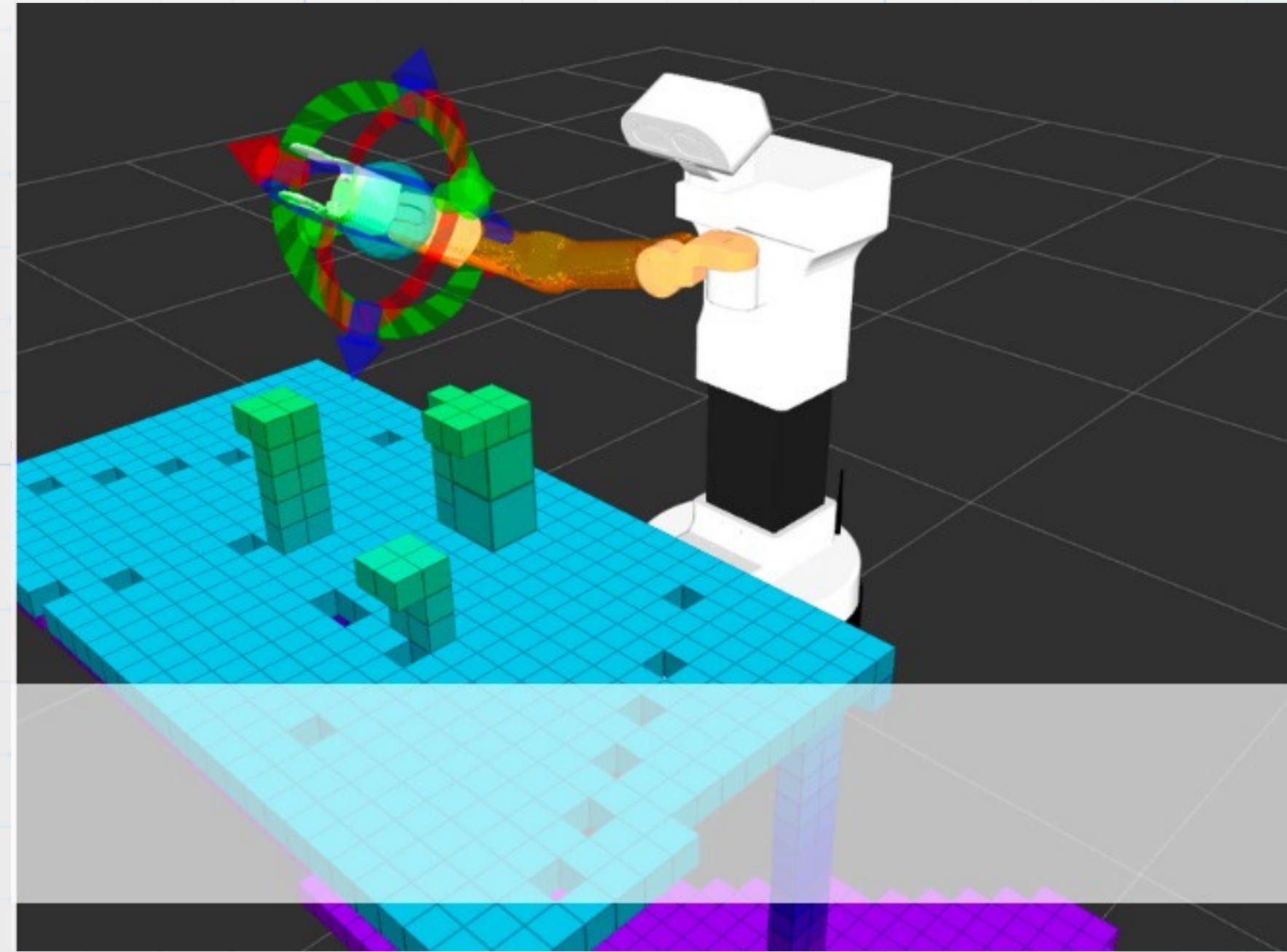
- Start with why!
  - **Why do we need this concept?**
- Show that necessity in the robot





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

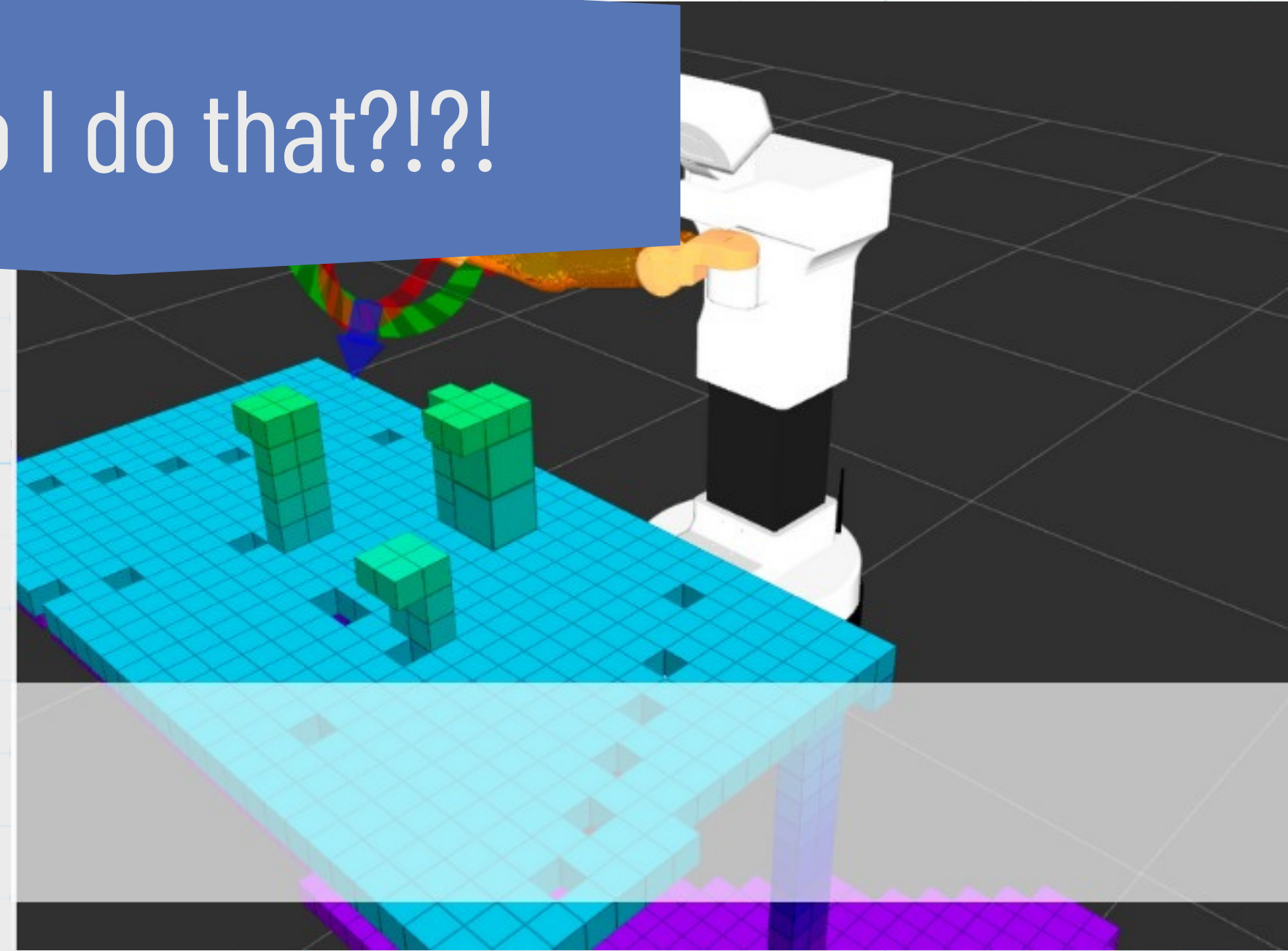
- **Compute gripper position** relative to center of robot
- **Compute object position** relative to center of robot
- **Compute the difference**



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

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How do I do that?!?!



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How do I do that?!?!?

I'm glad you asked!



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

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How do I do that?!?!

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...**



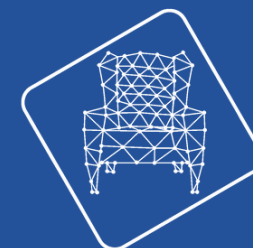
## What I mean...

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



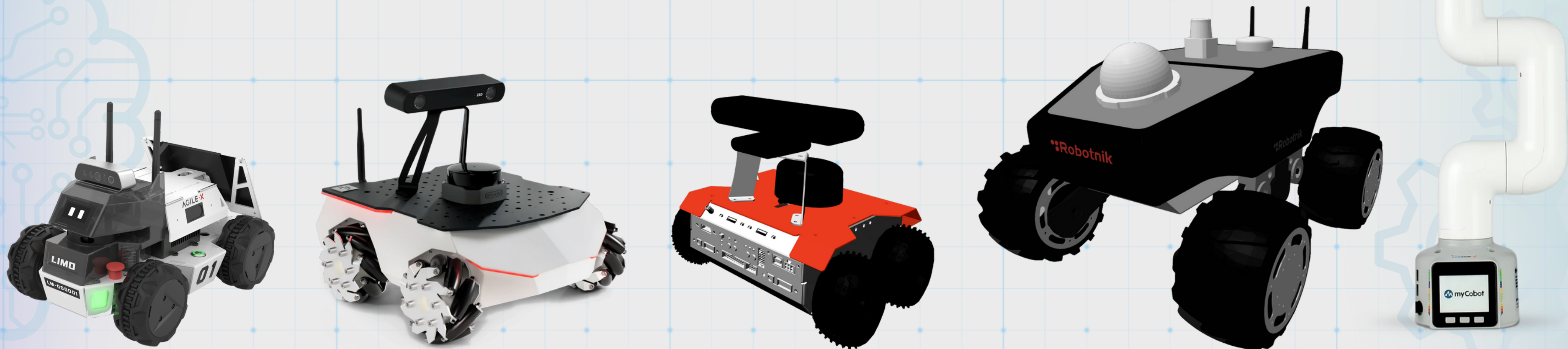
## What I mean...

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!



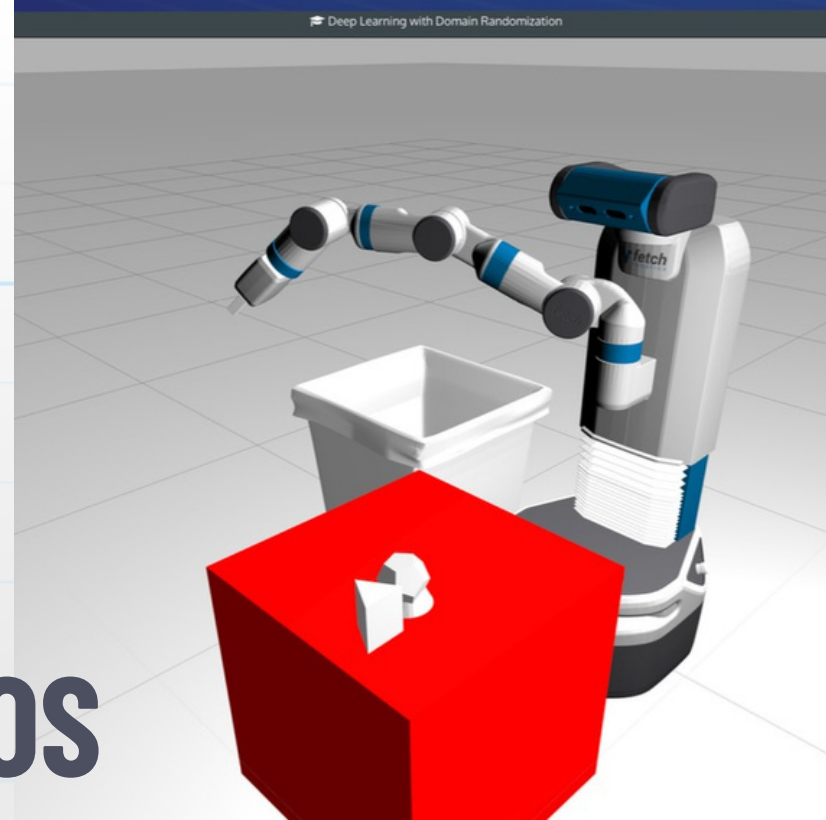
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# How to provide robots to students?

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



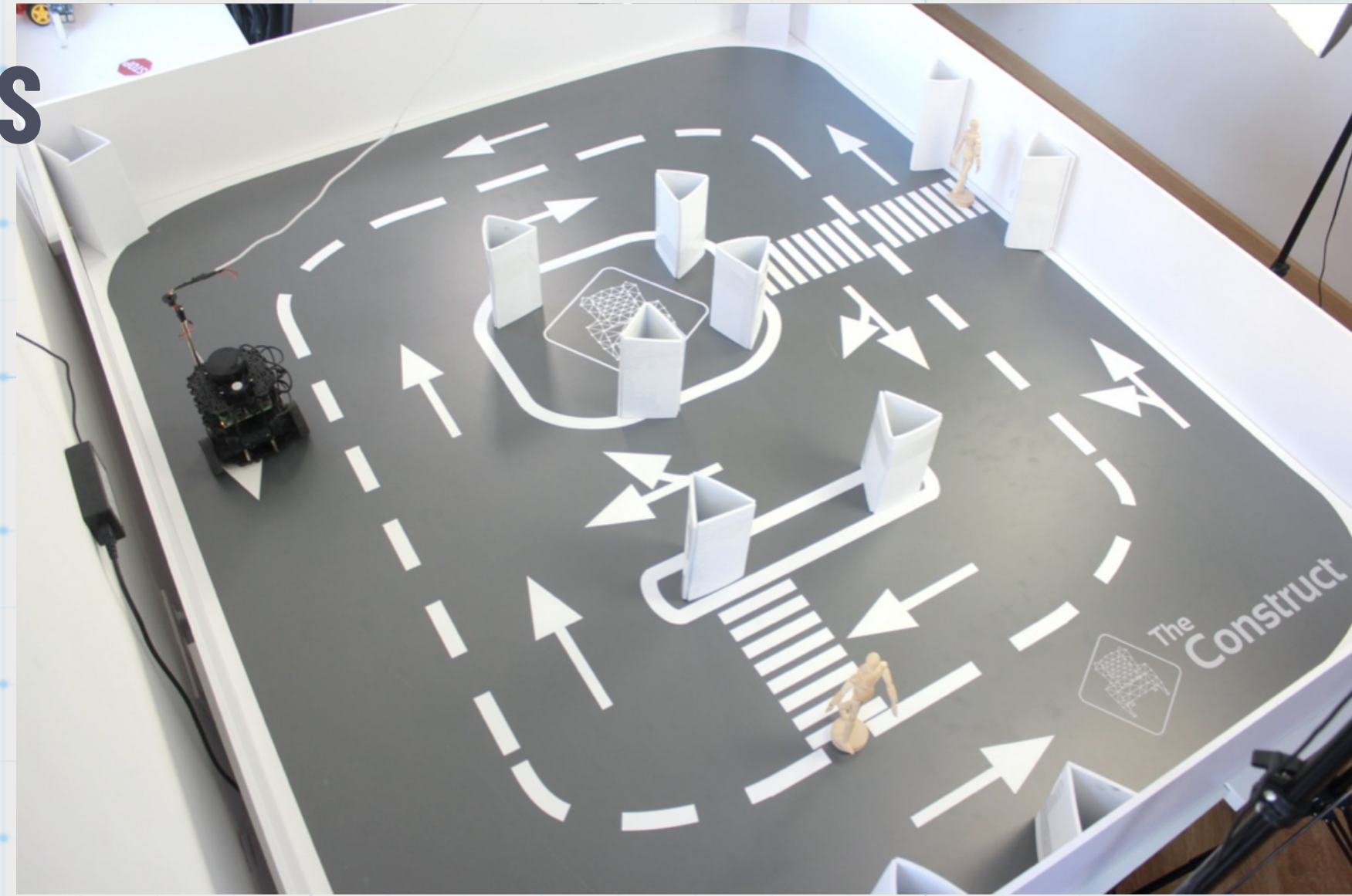
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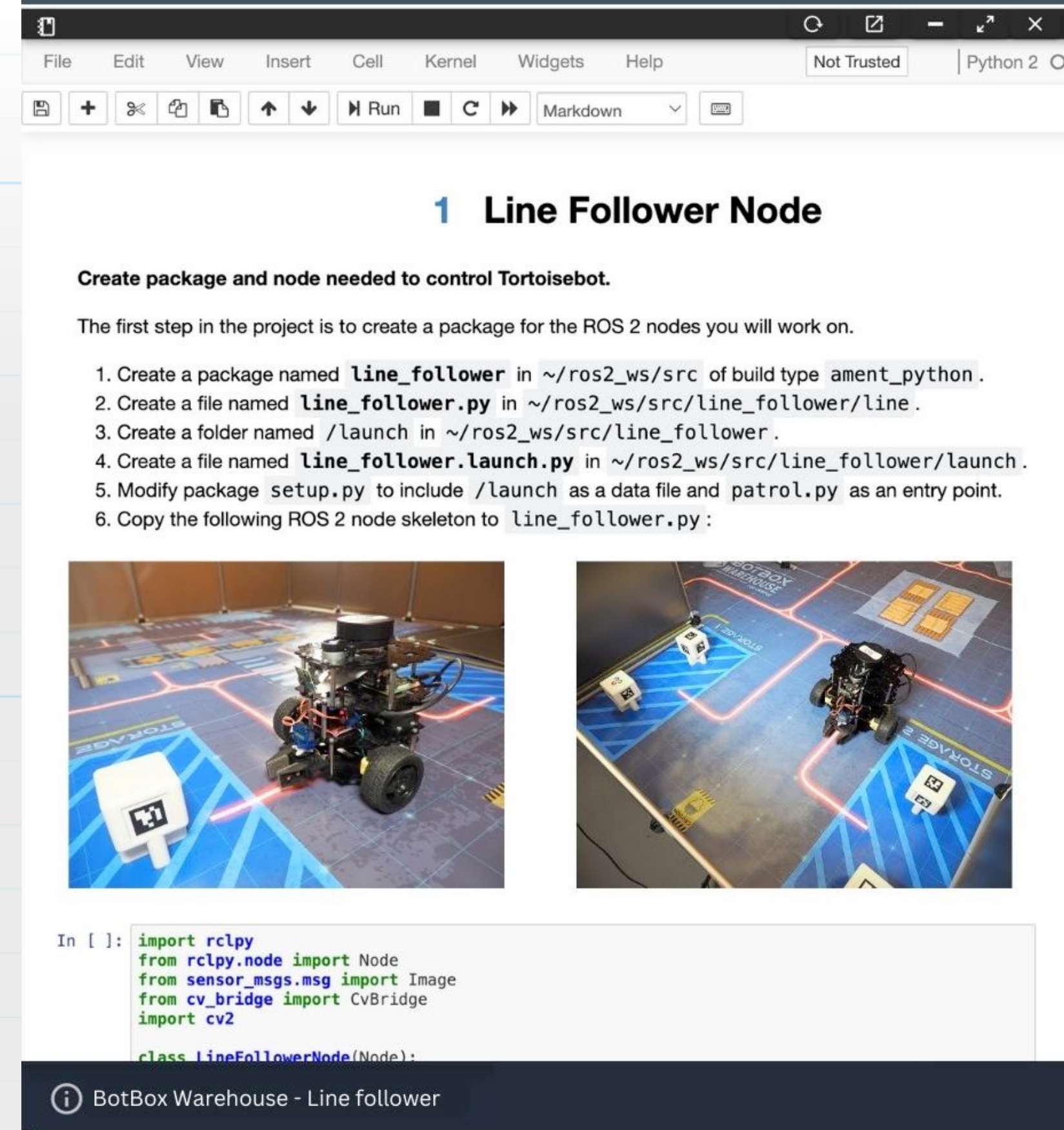
# How to provide robots to students?

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




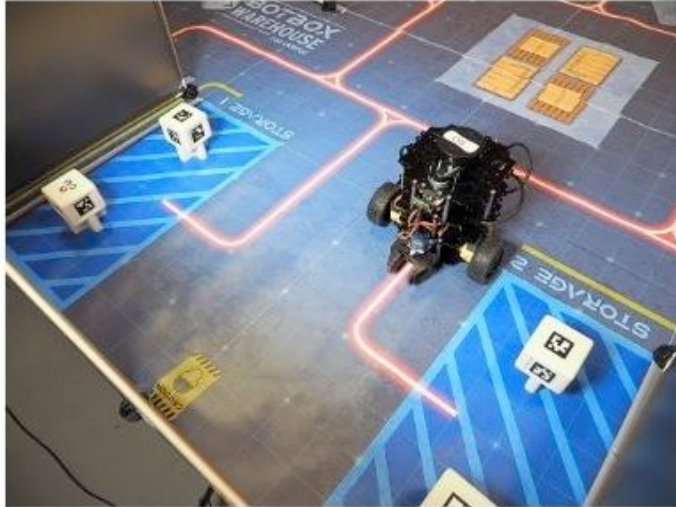
**1 Line Follower Node**

Create package and node needed to control Tortoisebot.

The first step in the project is to create a package for the ROS 2 nodes you will work on.

1. Create a package named `line_follower` in `~/ros2_ws/src` of build type `ament_python`.
2. Create a file named `line_follower.py` in `~/ros2_ws/src/line_follower/line`.
3. Create a folder named `/launch` in `~/ros2_ws/src/line_follower`.
4. Create a file named `line_follower.launch.py` in `~/ros2_ws/src/line_follower/launch`.
5. Modify package `setup.py` to include `/launch` as a data file and `patrol.py` as an entry point.
6. Copy the following ROS 2 node skeleton to `line_follower.py`:





```
In [ ]: import rclpy
        from rclpy.node import Node
        from sensor_msgs.msg import Image
        from cv_bridge import CvBridge
        import cv2

        class LineFollowerNode(Node):
```

BotBox Warehouse - Line follower

# 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

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**We simplified all this process....**

**rosject**

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

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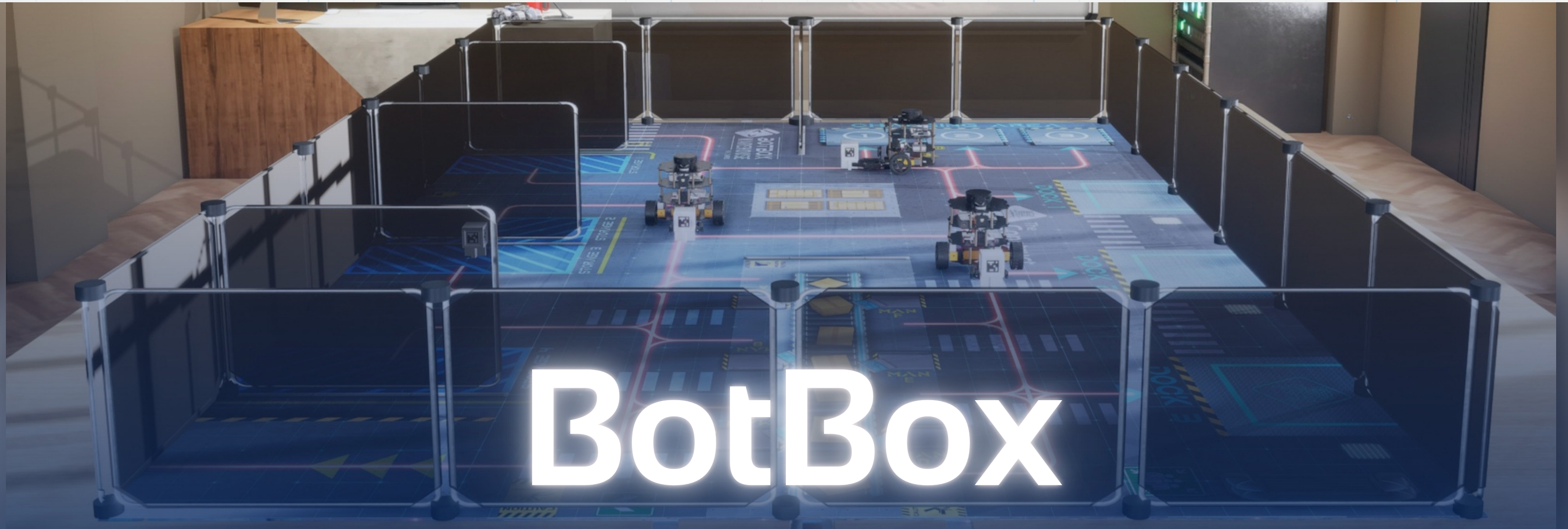


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**We provide an integrated REAL ROBOTS lab**



<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

✓ Select one of the robots available

✓ Select one of ROS Distro available  
ROS Melodic

3 Select the best time for you

< 2024-04-11 (Thu) >

15:00	available, 15:00 - 15:55
16:00	available, 16:00 - 16:55
17:00	busy, 17:00 - 17:55
18:00	

Your timezone  
UTC + 02:00


Selected time  
-----

4 Confirmation

BACK CONTINUE

**YOUR SELECTION**

Robot



ROS Distro  
ROS Melodic

Time  
Based on your browser configuration  
UTC + 02:00

Selected time  
-----

# Questions?

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