The Construct

MASTER-CLASS
STUDENTS GUIDE

Robotics Developer

Learn to Develop
Intelligent Robots from Zero

· Student Guide ·

theconstructsim.com/**robotics-developer/**

INDEX

IMPORTANT DATES

EVENT	DATE
Master Class Opening Ceremony	**March 3rd**
The opening ceremony is a Live event where the essential points related to the MasterClass will be explained. Attendance is mandatory.	
Master Class Start	**March 6th**
The MasterClass program will officially start on March 6.	
Final Project Presentation (1st batch)	**September 4th – 8th**
The 1st batch of final project presentations will be made during this week. More information is available in the Final Project section.	
Closing Ceremony	**September 11th**
The closing ceremony is a Live event where the MasterClass certificates will be delivered to students who have successfully completed the program.	
Final Project Presentation (2nd batch)	**February 19th – 23rd (2024)**
The 2nd batch of final project presentations will be made during this week. More information is available in the Final Project section.	
2nd Closing Ceremony	**February 26th (2024)**
The closing ceremony is a Live event where the MasterClass certificates will be presented to students who have successfully completed the program.	

THE MENTORS

EXPERTS

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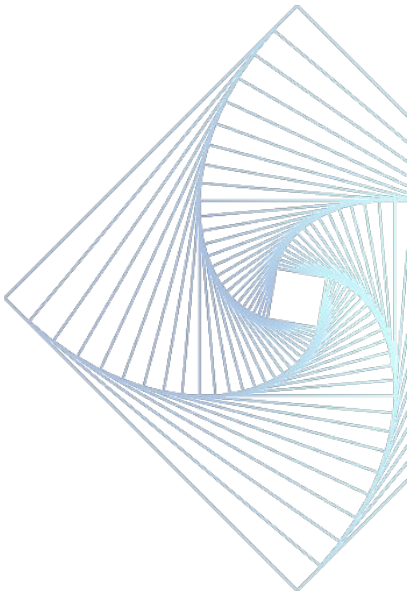
YOUR TUTOR

During the Master Class program you will have a tutor responsible for guiding you through the whole process.

Your tutor will assign you tasks, evaluate your progress and push you to complete the program successfully.

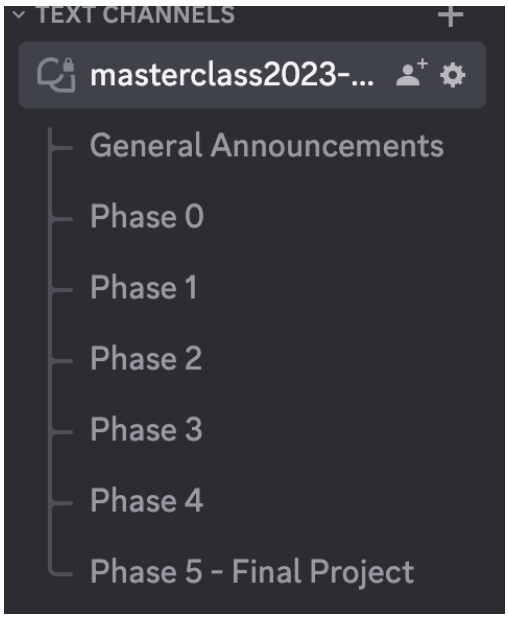
You will also have a weekly meeting with your tutor to discuss your weekly tasks and set the new ones. You will agree with your tutor on the best day/time to have this weekly meeting.



SUPPORT

All MasterClass students have access to a Discord server where they will be able to interact with other students and with the Experts.

The Discord server is organized in different categories:



Depending on the current Phase of the MasterClass you are in, you have to place your questions/comments in the corresponding Discord channel.

Discord will also be used as the main channel to establish communication with your tutor.

You will also find here general announcements (ie. special events, statements...) of the MasterClass.

STUDY PLAN

We recommended that you dedicate 35 hours per week to the Master Class. This is an average of 7 hours per day. Each day you should dedicate time to work on course material and projects (checkpoints).

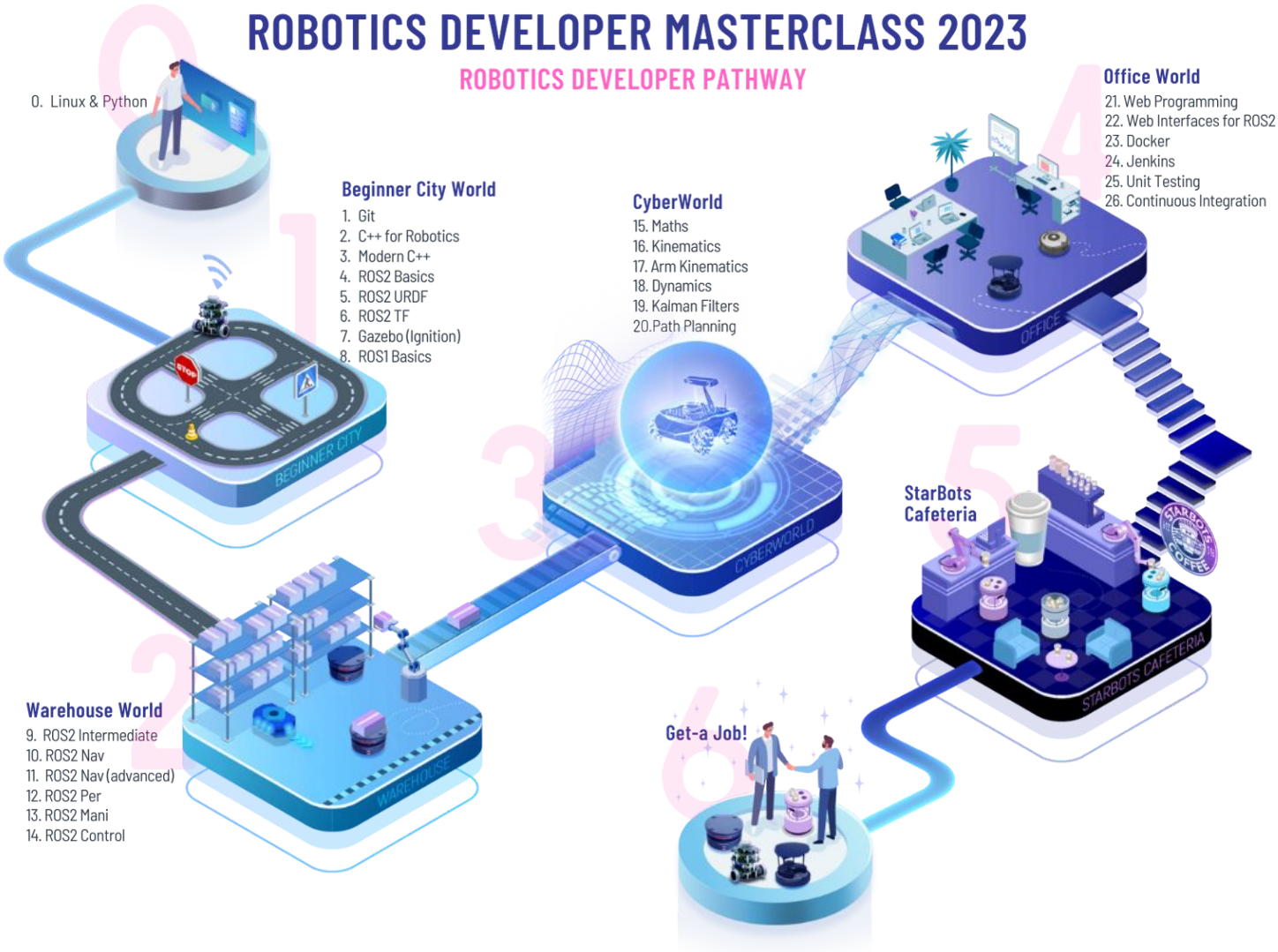
A recommended schedule for each day is shown below:

Time	Task
9h - 13h	Work on Course
13h 13:30h	Lunch Break
13:30 h - 16:30h	Work on Project

STEP-BY-STEP

MASTER CLASS PHASES

The Master Class program is divided into 7 phases, each one of them to develop different skills.



PHASE 0: Prerequisites Check

Learn the foundations to start programming. This phase will provide you with the minimum required knowledge in order to complete more complex courses.

Courses:
- Linux for Robotics
- Python3 for Robotics
- C++ for Robotics

Language: English

PHASE I
Learn the Fundamentals

Boost your robotics programming skills by practicing key robotics concepts such as autonomous navigation, manipulation or perception. Also, boost your ROS2 programming skills.

Courses:
- ROS1 Basics (C++)
- Git and GitHub Basics
- Advanced Modern C++
- ROS2 Basics (C++)
- URDF for ROS2
- TF for ROS2
- Gazebo Simulator

PHASE II
Build Robotics Programming Skills

Boost your robotics programming skills by practicing key robotics concepts such as autonomous navigation, manipulation or perception. Also, boost your ROS2 programming skills.

Courses:
- ROS2 Intermediate
- ROS2 Navigation
- ROS2 Manipulation & Perception
- ROS2 Control

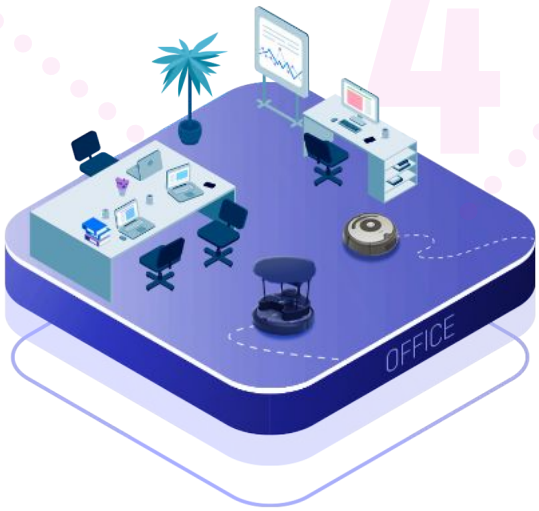
PHASE III

Robotics Theory

Strengthen your foundation by learning robotics theory. Understand the physics and mathematical principles behind any robotic system, from simple kinematics to advanced planning and control algorithms.

Courses:

- Basic Math / Probability
- Mobile Robotics Kinematics
- Arm Kinematics
- Robot Control
- Path Planning Algorithms



PHASE IV

DevOps for Robotics Projects

Learn to use and apply the most important tools and procedures for developing robotics projects. You will learn how to apply continuous integration techniques in real-world scenarios, so you're better prepared to bear the day-to-day work of a robotics developer.

Project: Develop a ROS-based web application from zero that provides a graphical interface to command a robot.

Courses:

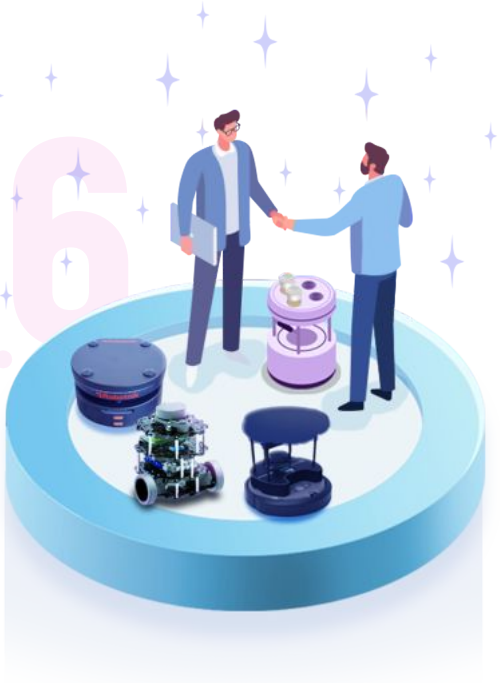
- Web Programming (HTML, CSS, JavaScript)
- Jenkins
- Docker
- Continuous Integration and Testing

PHASE V

Final Project

Put all your skills and knowledge to the test. Design, develop and present, from zero, a complete robotics project applying everything you have learned during the program.

This will lay the cornerstone for your career as a robotics developer.



PHASE VI

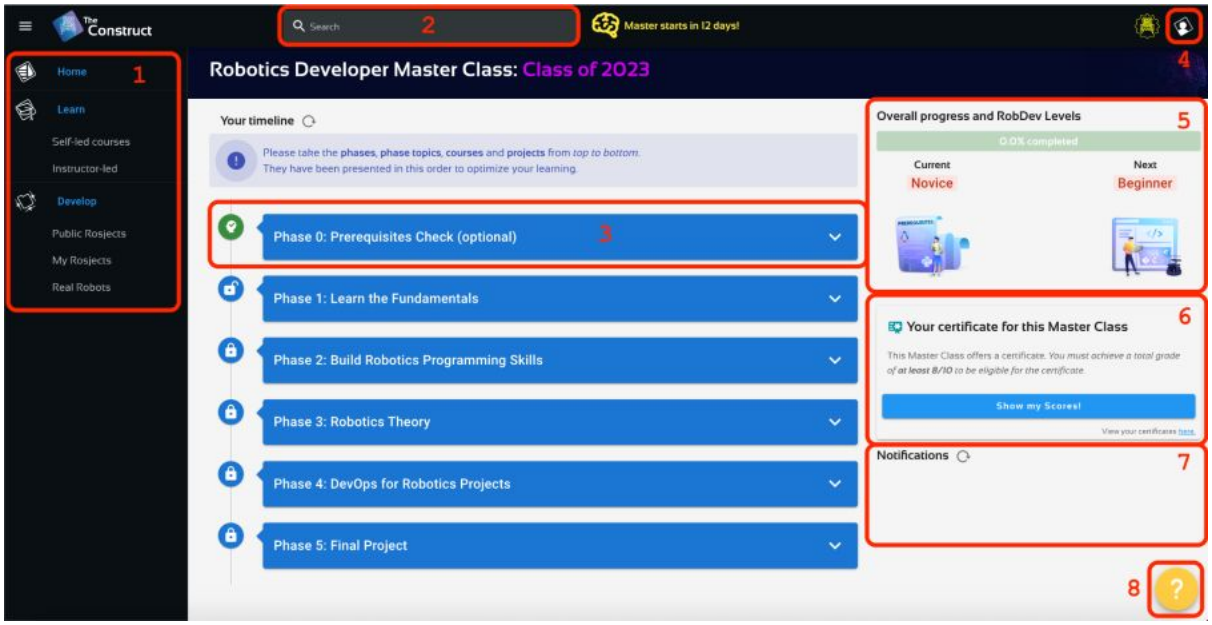
One Month Internship (optional)

The Robotics Developer Master Class offers you practical work in one of the world's leading robotics companies. You will learn from industry practitioners, and enhance your knowledge with relevant work assignments that can help you prepare for your future career as a real Robotics Developer.

THE CONSTRUCT

THE PLATFORM

The **HOME page** of The Construct's MasterClass provides you with direct access to all the areas of the platform.

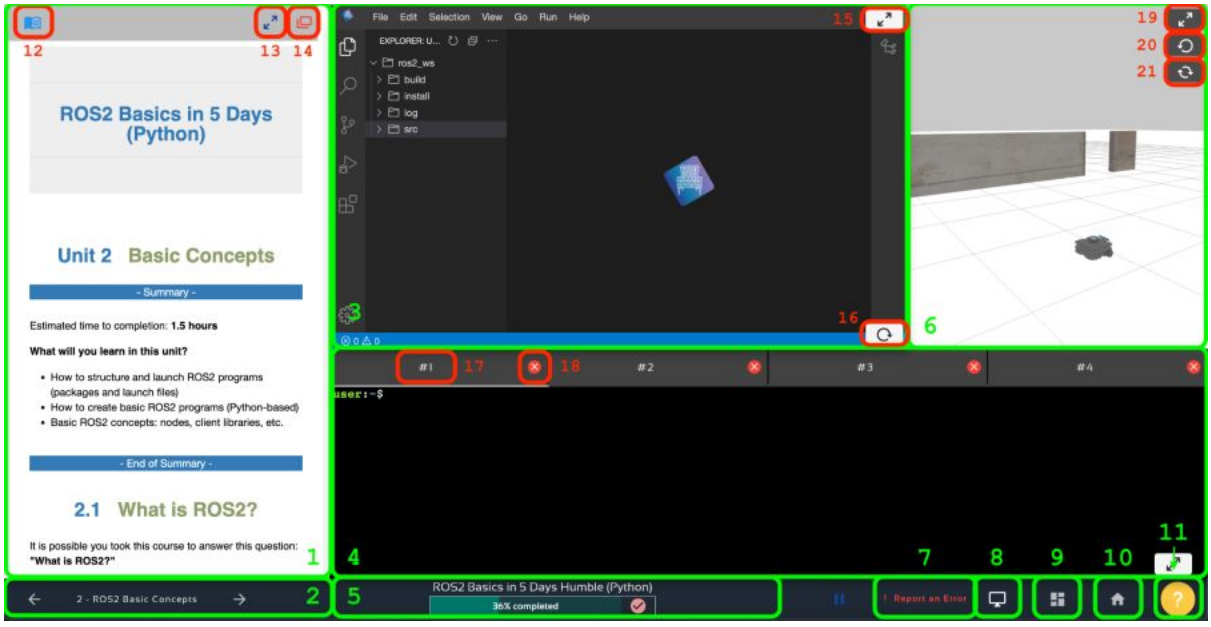


1. Left Menu:
    a. **Self-led courses:** Access to the courses and open classes
    b. **Instructor-led**: Access to special workshops and trainings
    c. **Public Rosjects**: Access to all the public rosjects
    d. **My Rosjects**: Access to your personal rosjects. Here you will have direct access to all the Checkpoints of the MasterClass

e. **Real Robots**: Access to the Real Robot Lab for practicing with real robots

2. Quick **Search** bar
3. **To-Do Courses**. In this section, you have direct access to all the courses and projects in the current MasterClass phase. More information in the section **Manage Your Work**
4. The **User Profile** area.
5. This area will show your **Progress** through the different phases of the MasterClass.
6. Check your current **Phase Scores**.
7. Check the **Notifications** for the MasterClass.

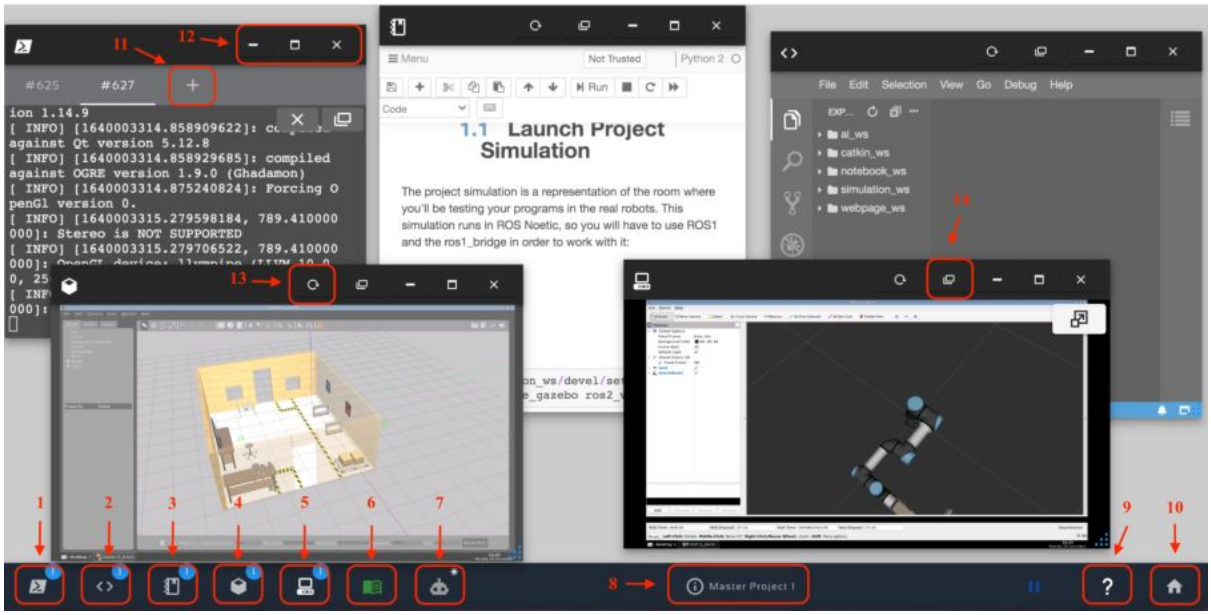
The **course page** will be shown every time you work on a course.



1. **Jupyter Notebook**: Here you will find instructions to follow to complete the courses.
2. **Unit Management**: Allows you to change between Units.
3. **IDE**: Development Environment to edit your programs in a graphical way.
4. **Web Shells**: Four different Linux shells to type commands.
5. **Progress Bar**: Visualize your progress throughout the course.
6. **Gazebo Simulation**: Simulated environment to interact with a robot.
7. **Report an Error**: Use this button to report an error in the platform.
8. **Graphical Tools**: Opens an extra window that allows you to visualize graphical applications such as RViz or rqt.
9. **Page configuration**: Allows to rearrange the main windows.
10. **Home Page**: Go back to the HOME page.
11. **Forum**: Access the course forum page.
12. **Notebook Pre Visualizer**: Allows you to pre-visualize other notebooks from the same course or other courses.
13. **Resize Notebook**: Allows you to maximize/minimize the notebook window.
14. **Detach notebook**: Opens the notebook in another browser tab.
15. **Resize IDE**: This allows you to maximize/minimize the notebook window.
16. **Reload IDE**: Reload the IDE application.
17. **Rename Shell**: This enables you to give a specific name to the Shell.
18. **Reload Shell**: Reloads the Shell.

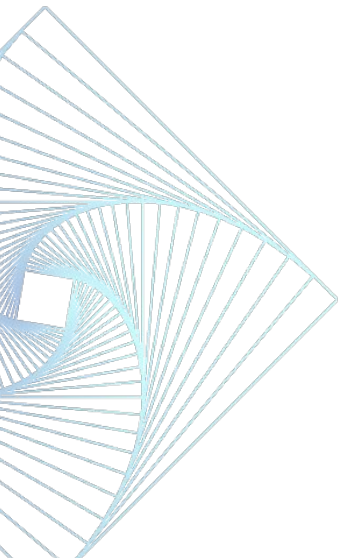
19. **Resize Simulation**: This allows you to maximize/minimize the notebook window.
20. **Reset Simulation**: Reset the model poses of the Gazebo simulation.
21. **Restart Simulation**: Restart the whole simulation.

The **rosject page** will be shown every time you work on a Project.



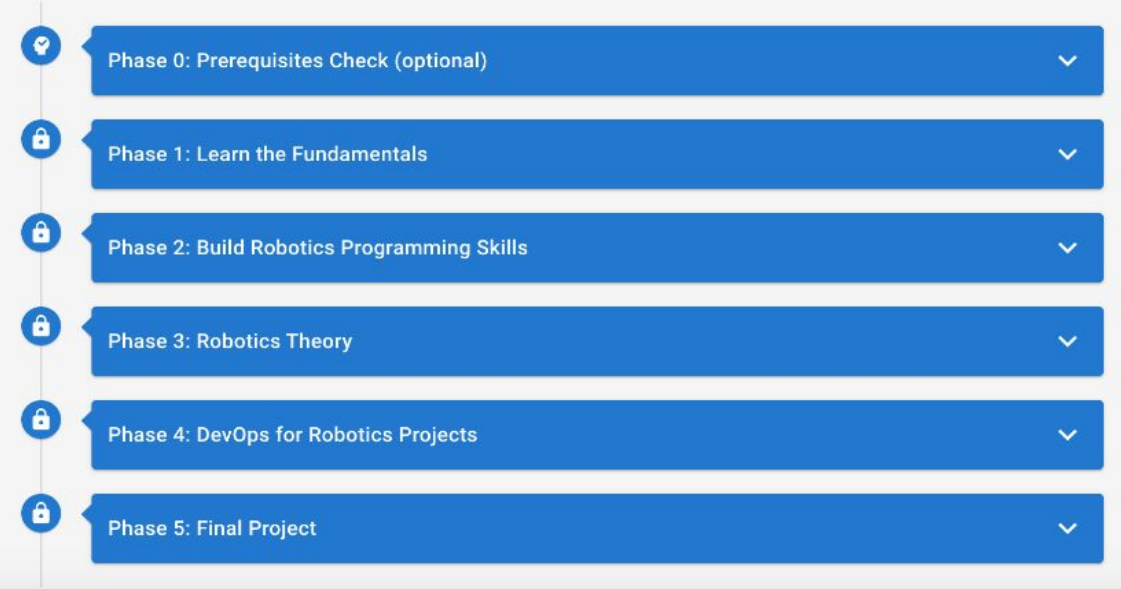
1. **Web Shell**: Open a new Web Shell.
2. **IDE**: Open the IDE.
3. **Jupyter Notebook**: Open the Jupyter Notebook.
4. **Gazebo**: Open the Gazebo window.
5. **Graphical Tools**: Open the Graphical Tools window.

6. **Notebook Pre Visualizer**: Open the notebook Pre Visualizer tool.
7. **Real Robot Connection**: Connect to a Real Robot.
8. **Rosject Data**: Main Rosject data. It contains the **Save Rosject** button.
9. **Forum**: Go to the forum page.
10. **Home**: Go back to the HOME page.
11. **New Web Shell**: Open an extra Web Shell.
12. **Minimize / Maximize / Close**: Minimize, Maximize or Close the window.
13. **Reload application**: Reloads the application.
14. **New tab**: Move the application to a different browser tab.



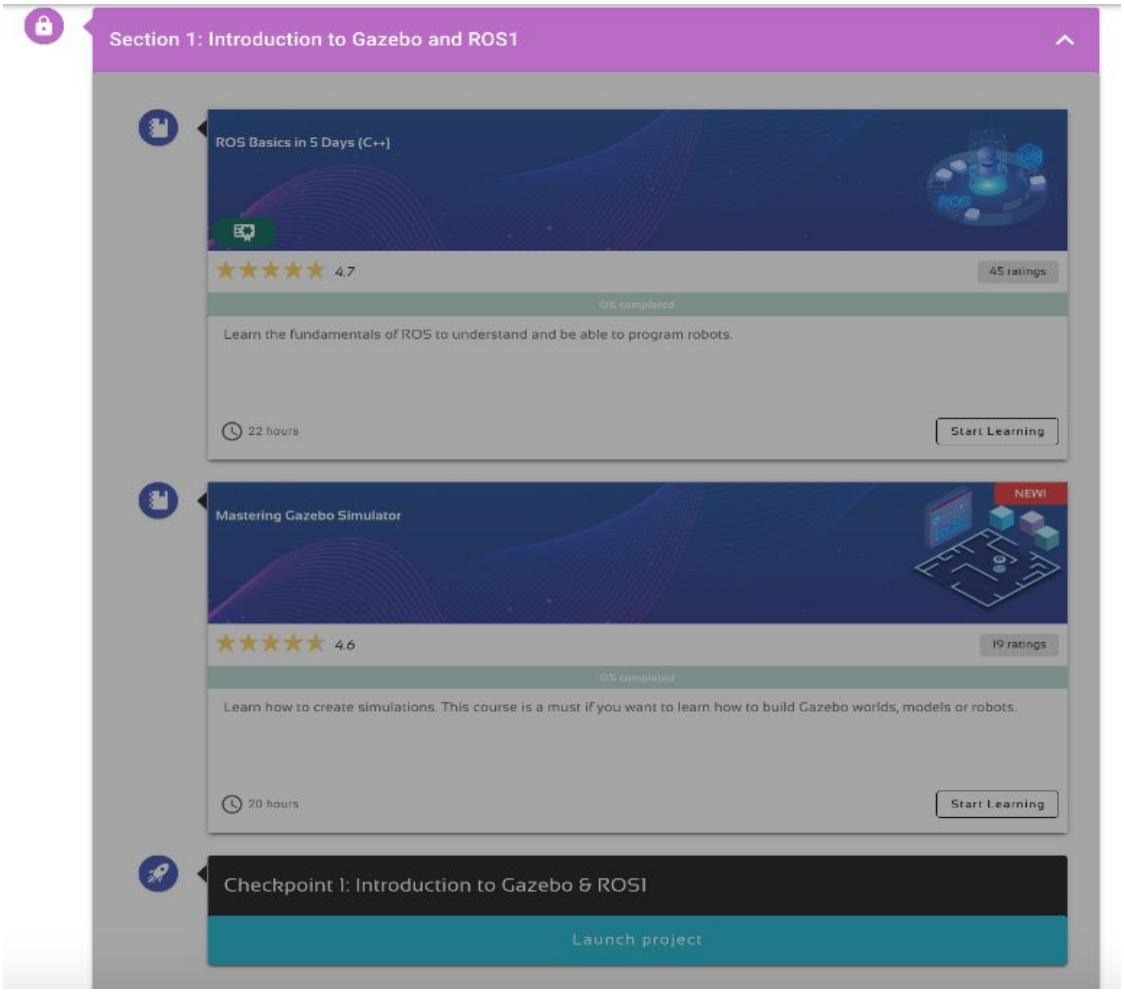
MANAGE YOUR WORK

In your homepage timeline, you will have direct access to all the ***Phases*** of the MasterClass.



Each Phase is composed of different ***Sections***.

Each Section is composed of 1 or more courses, and a ***Checkpoint***.



By default, Sections will be **LOCKED**. This means you won't be able to access the courses or checkpoint inside it. In order to unlock them, you have to complete them. As you complete each Section, the next one will be unlocked.

In order to complete a Section, you will have to successfully pass its corresponding Checkpoint.

When you complete all the Sections inside a Phase, the Phase will be considered as completed, and you will get a score for it.

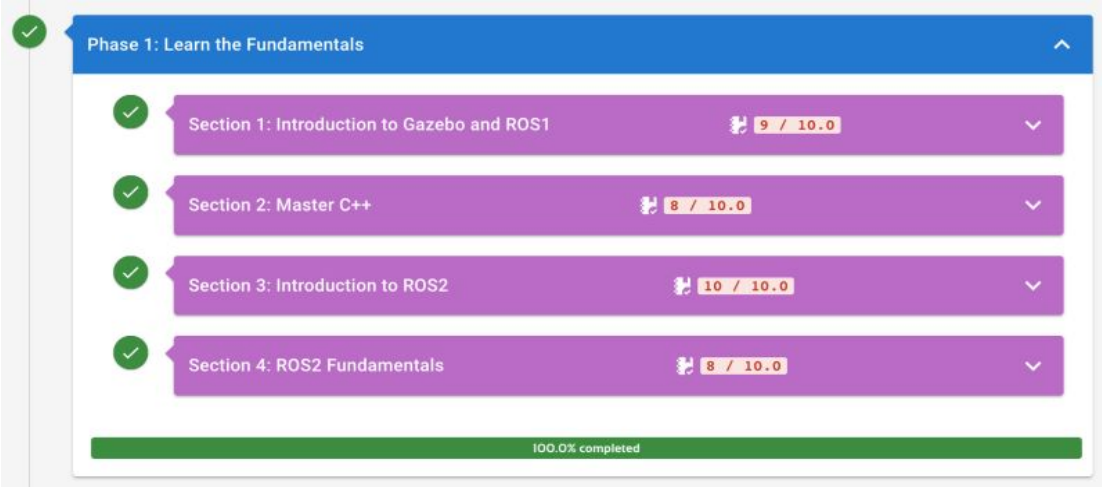
YOUR MARKS

Your final grade for the MasterClass will be computed based on the scores you get for each Phase. You can check your current Phase Scores in the Scores area:

Your scores for *Master Class: Class of 2023*

Phase	Grade Weight	Grade
Phase 1 (Learn the Fundamentals)	18.00%	8.75
Phase 2 (Build Robotics Programming Skills)	18.00%	0
Phase 3 (Robotics Theory)	18.00%	0
Phase 4 (DevOps for Robotics Projects)	18.00%	0
Phase 5 (Final Project)	28.00%	0
TOTAL Grade Achieved	**100.00%**	**1.57**

In order to get a Phase score, you need to complete all the Sections inside that Phase. The Phase score will be computed as an average of each Section score.



The score of a Section will be defined by the Checkpoint project. Checkpoints are small robotics project that will test everything you've learned during a specific Section. Inside a Checkpoint, you will be requested to complete different tasks.

Inside each Checkpoint you will find ***Grading Guides***.

- Grading Guide -

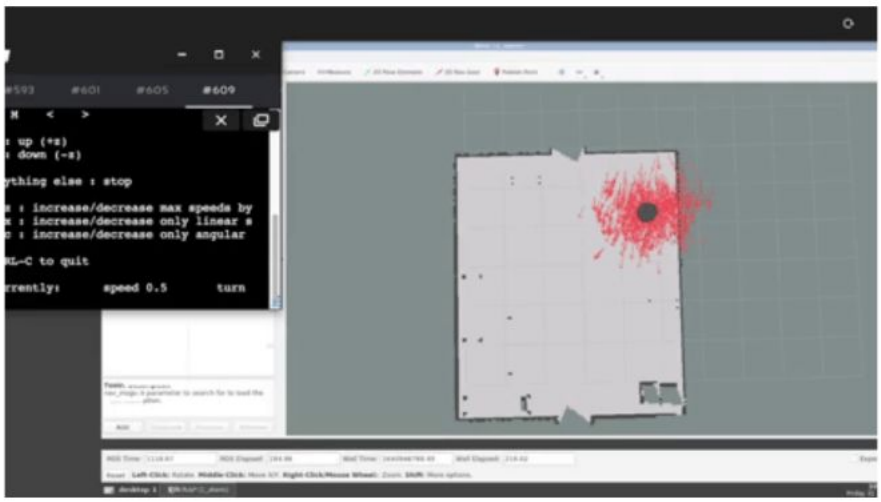
- When running the `localization.launch.py`, the robot is able to properly localize itself when moving around the warehouse - **1.5 points**

Execute in Terminal

```
In [ ]: ros2 launch localization_server localization.launch.py
```

Execute in Terminal

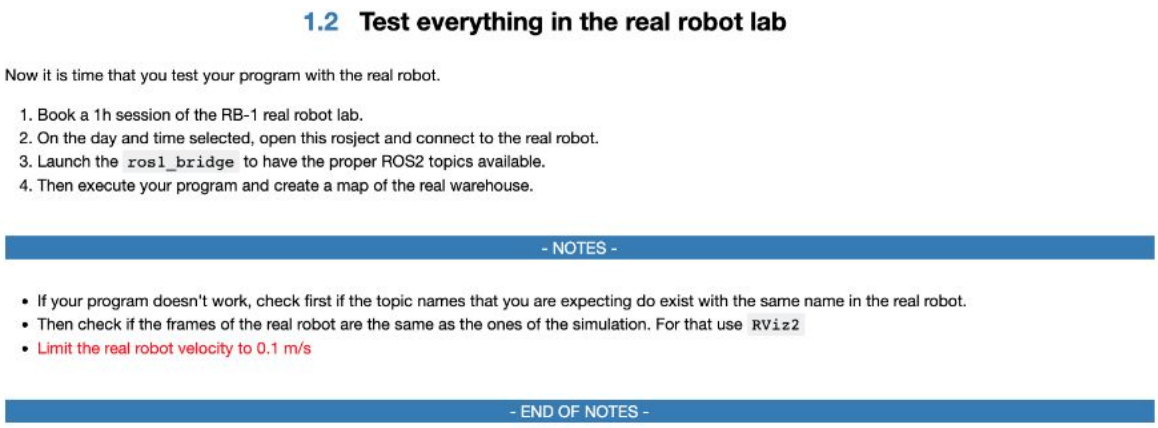
```
In [ ]: source /opt/ros/noetic/setup.bash
        rosrun teleop_twist_keyboard teleop_twist_keyboard.py cmd_vel:=/robot/cmd_vel
```



- End Grading Guide -

These ***Grading Guides*** indicate what is the expected result of an specific task, and how much points you will be granted if it's completed correctly.

In some Checkpoints, you will find sections like the following:



1.2 Test everything in the real robot lab

Now it is time that you test your program with the real robot.

1. Book a 1h session of the RB-1 real robot lab.
2. On the day and time selected, open this rosject and connect to the real robot.
3. Launch the `ros1_bridge` to have the proper ROS2 topics available.
4. Then execute your program and create a map of the real warehouse.

- NOTES -

- If your program doesn't work, check first if the topic names that you are expecting do exist with the same name in the real robot.
- Then check if the frames of the real robot are the same as the ones of the simulation. For that use `RViz2`
- Limit the real robot velocity to 0.1 m/s

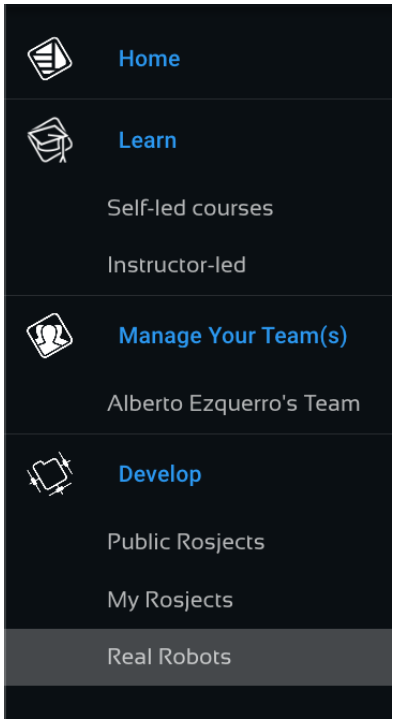
- END OF NOTES -

Whenever you find these sections inside a Checkpoint project, you will have to **test that your programs works in the real robot**. In fact, the evaluation of the Checkpoint will be made using the real robot, not the simulation. You can find more details about the Real Robot Labs in the following section.

When you are finished with a Checkpoint and it's ready to be evaluated, send a direct message to your tutor to let him know. Your tutor will evaluate it within the following 24 hours and provide you with a score.

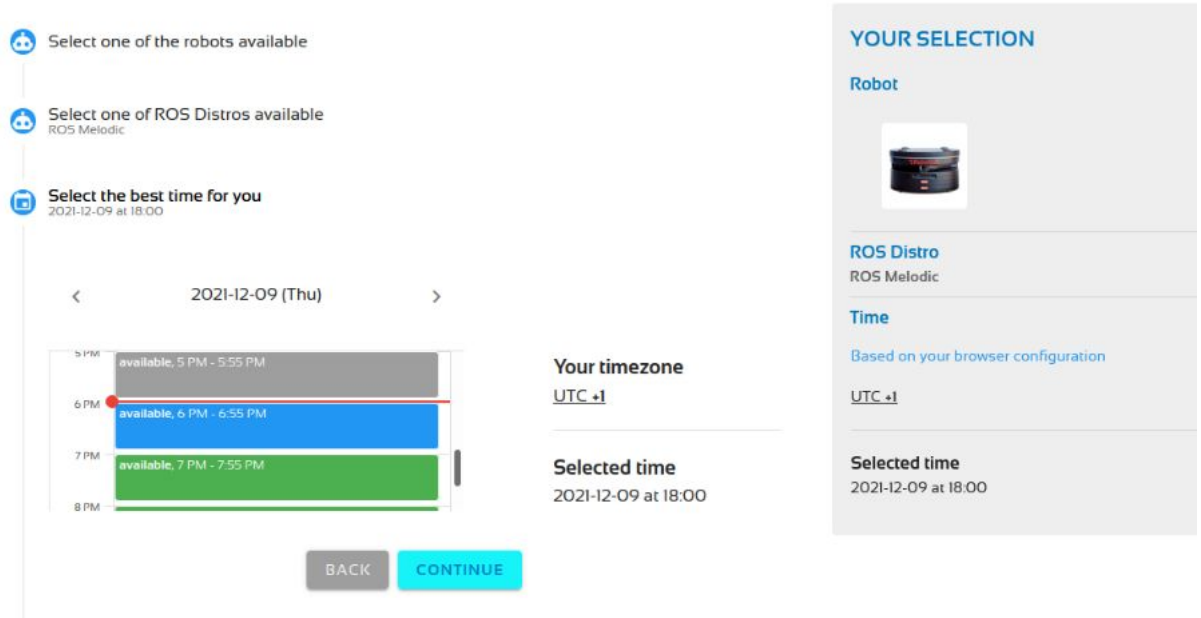
REAL ROBOT CONNECTION

In order to use the real robots, you need to first reserve a slot from the *Real Robots* tab in the home page:

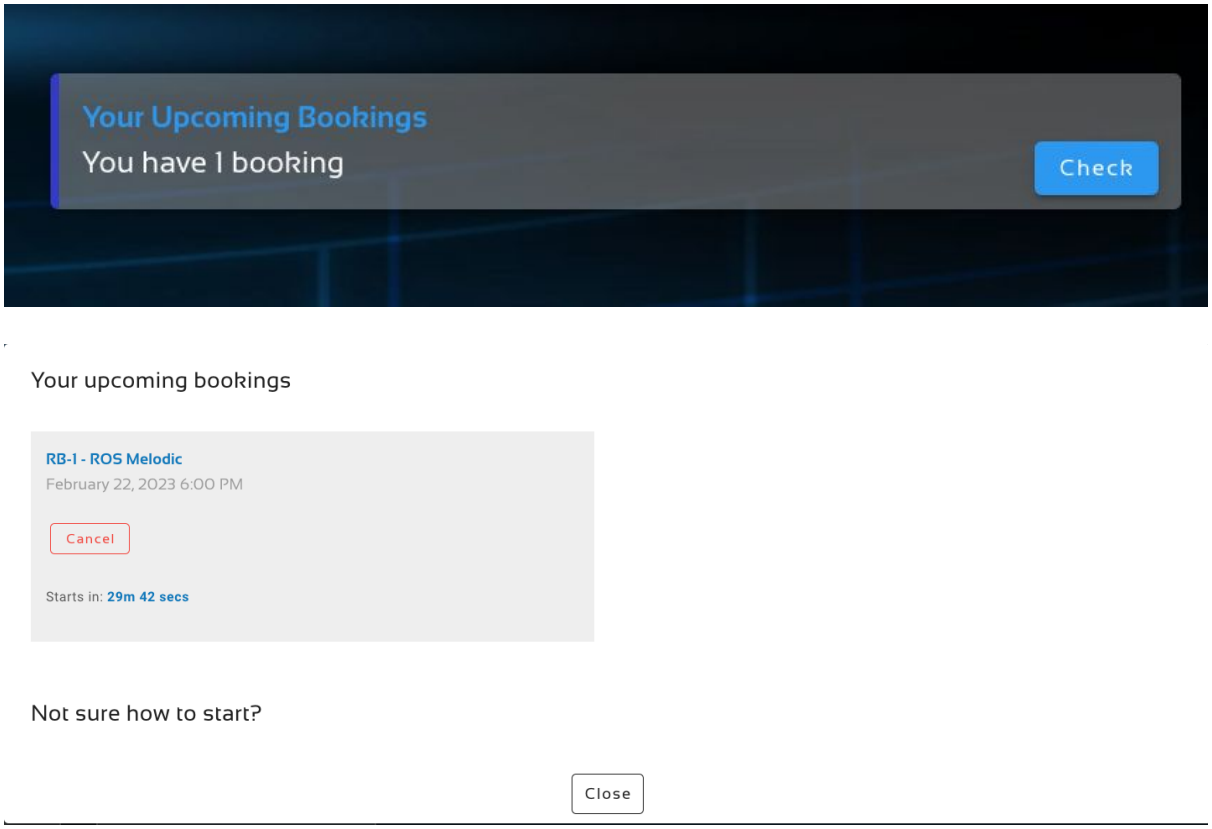


Here you will have access to all the available Real Robot Labs.

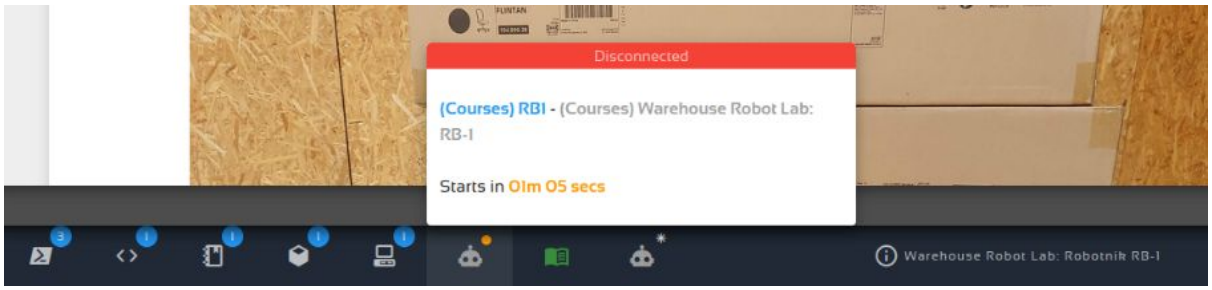
Just select the desired robot and book the time slot that suits you better.



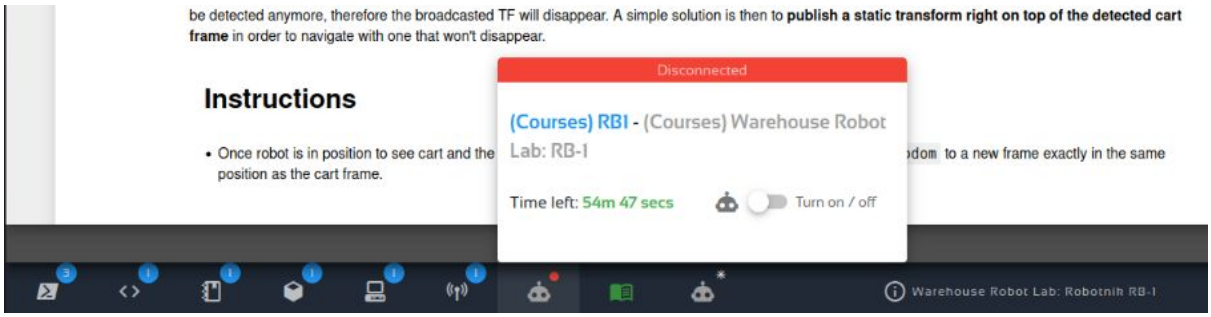
Once your booking has been registered, you will be able to check it in the *Upcoming Bookings* section:



To connect to the real robot you will have to be inside a rosject. When you are in a rosject, you can see how long until your reservation starts on the bottom panel:

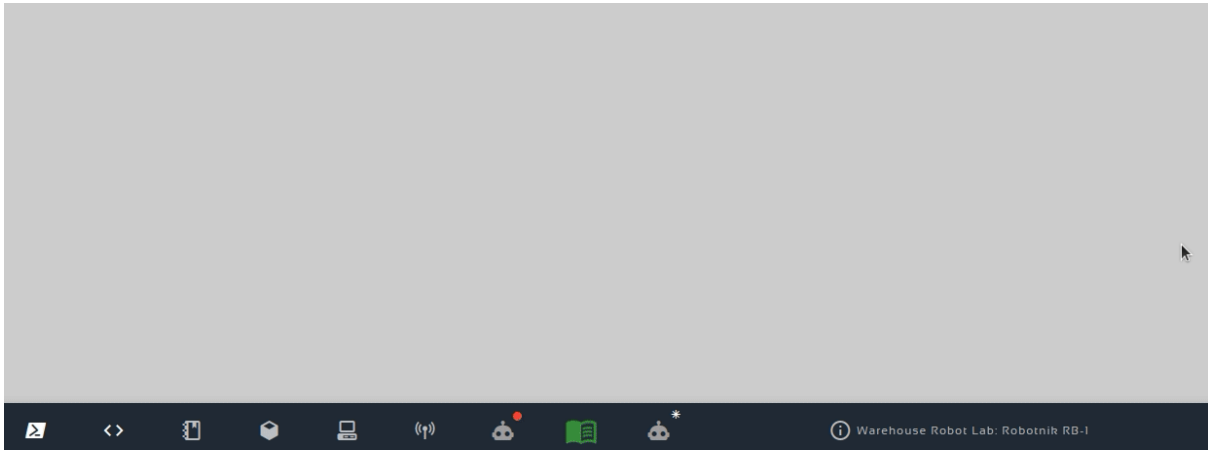


Once your time slot arrives, the dot above the robot icon will turn red, indicating that you can now connect:



Once you connect to the real robot, every shell that you have running will get killed. So don't worry if your nodes or simulation go away, this means that the terminals are pointing now to the real robot instead of the virtual machine.

Click on the turn on button, and wait until the connection is established. You will see the camera streams appear along with a virtual joystick. Wait a few seconds until the middle circle of the joystick turns gray and move it to see if the robot moves. If it does, it means you are connected! and are ready to get working.



FINAL PROJECT

- The Final Presentation of the project will be done on a **YouTube Live Stream**, with three experts of the team acting as evaluators:
  - 30 minutes for the presentation
  - 15 minutes for Q&A from the experts

- The Final Project will be discussed on the Starbots Coffee (an automated cafetería environment which involves different robots). Several Project options will be available to choose between them.

- The Final Project selected will be discussed and agreed upon between the student and the tutor.