

The
Construct

BROCHURE



Robotics Developer

MASTER CLASS 2023

Learn to Develop
Intelligent Robots from Zero

STARTS ON

March 6, 2023

ESTIMATED TIME

6-Month Course + 3-
Month Internship

FORMAT

Online

theconstructsim.com/robotics-developer/

Robotics Needs Developers

Overview

Robots are gradually becoming an essential part of our world. As a result, there is a massive demand for robotics developers to create solutions to everyday problems.

The challenge is that - robotics engineering is a multidisciplinary field and difficult to learn. That's why we've built the **Robotics Developer Master Class - to help you master robotics development from scratch and get you 100% job-ready to work at any robotics company.**

Learning timetable

The syllabus for the Robotics Developer Master Class will comprise a 6-month course and a 3-month internship.

The 6-month course requires a weekly commitment of 40 hours of study time. However, you can schedule and complete the program at your own pace over 12 months.

Assessment

During the program, students must complete the exercises and projects in each phase. In the final project, they must apply all knowledge learned and present it to all tutors. Students who pass the final project will receive a certificate.

Students have two opportunities to submit a final project (at the end of 6 months or 12 months). If the student doesn't pass within 12 months, a new enrollment will be required.

FUTURE-READY

Robotics Developer

MASTER - CLASS 2023



Course starts on: March 6, 2023



Estimated completion time:
6-Month Course + 3-Month Internship



Final project presentation time:
September 11, 2023 or March 4, 2024



Places: 50 places.



Format: Online



Language: English



Prerequisite:

- **Linux knowledge.** Linux is the base for most professional robotics systems. For that reason, Linux knowledge is a must. [Take this free course](#) to learn Linux essentials for robotics.
- **Python 3.** Python allows you to create quick prototypes and test your ideas before going into a production solution. [Take this free course](#) to learn Python essentials for robotics.
- **Basic maths.** A minimum high school level math equivalent is a requirement to understand basic robotics concepts. [Check out this course](#) to learn essential math concepts for robotics.

CLASS HIGHLIGHTS

Key Takeaways



Learn to **build robot apps** in a real integrated development environment



Gain **in-demand robotics skills** in a Fast-growing industry



Practice with both **simulated & real robots**



All courses are based on **hands-on exercises & projects**



Walk away with a **robotics portfolio** project to share with potential employers



Internship opportunities in robotics companies to apply what you have learned in the real world

ACCOMPLISHMENTS

Learn, Practice, Get Certified.

Get recognized! This program is graded as pass or fail; students will receive a certificate of completion issued by The Construct after completing the final project and passing the final exam.



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100% Practical

NO videos. NO slides.
Learn by DOING with
simulated & real robots.



Prerequisites:

Linux, Python, and
basic maths. Beginner-
Welcome



Personal Mentor

Experienced-in-robotics
mentors provide 1-on-1
coaching to guide you.

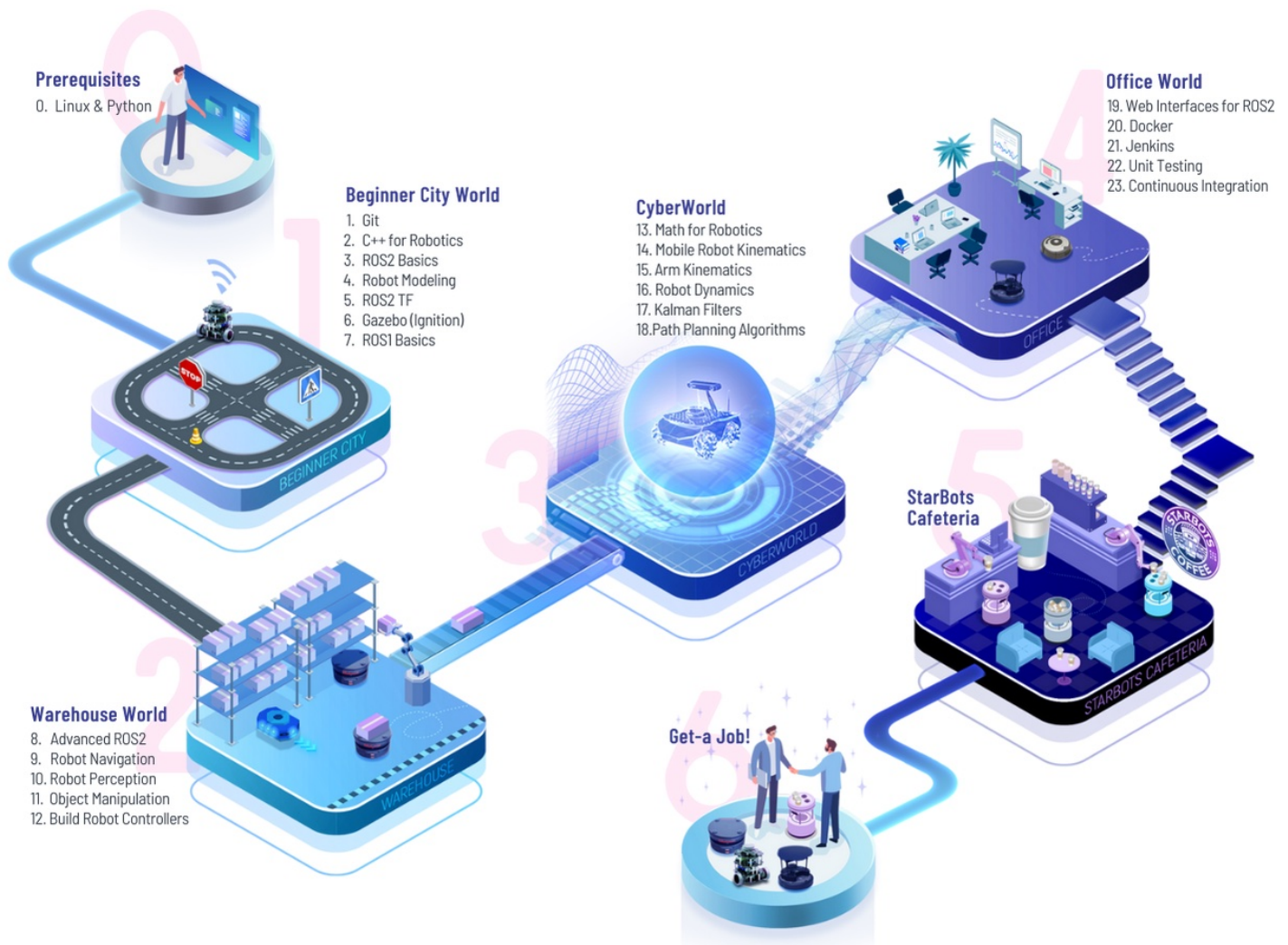


Flexible Learning

Self-paced, learn on
the schedule that
works best for you

WE HAVE THE PLAN

Kickstart Your Career in RobDev



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FOLLOW A LEARNING PATH

Program Schedule

Phase 1- Robotics Developer Novice

5 weeks

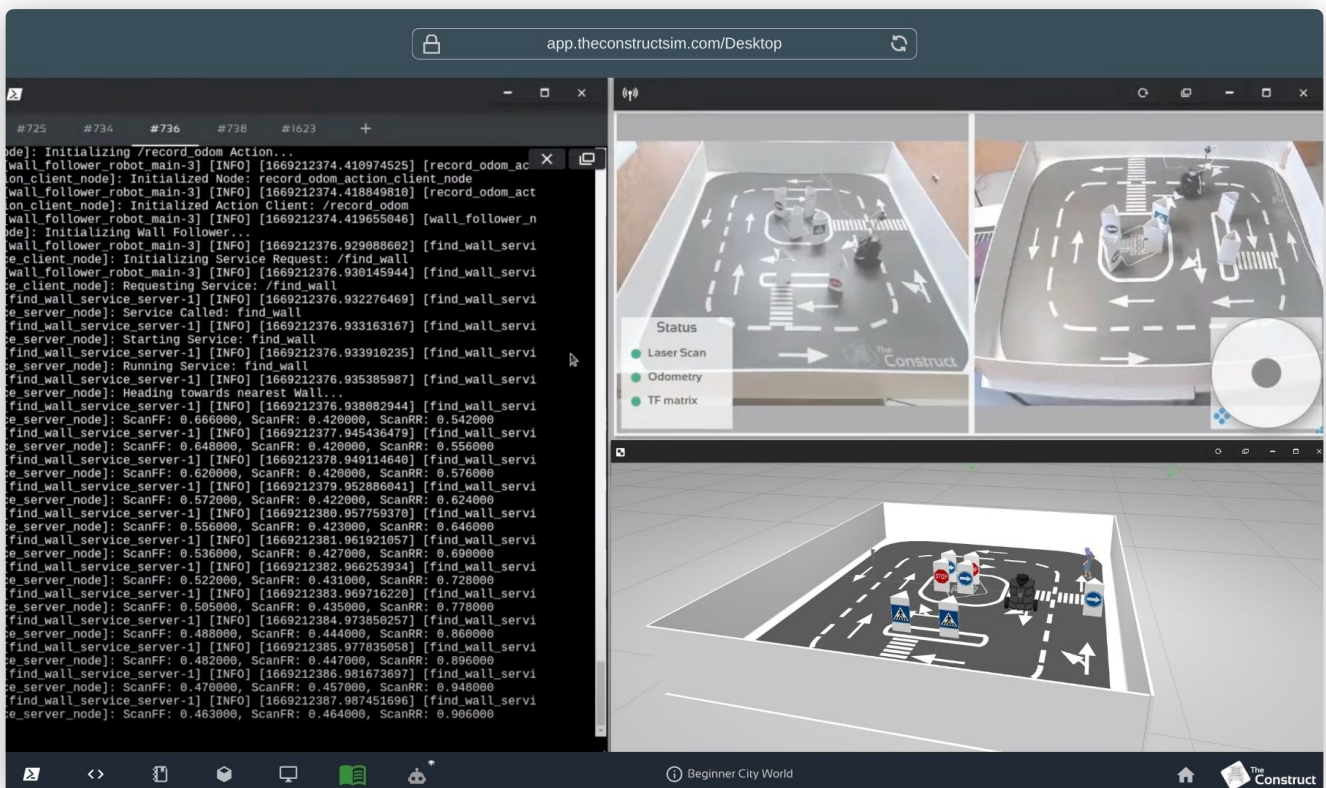
Build the robot programming foundation and get started with ROS.

Acquired Skills:

- Collaborative software development with Git
- C++ programming skills for robotics
- ROS2 basics
- Robot modeling with URDF - ROS2
- Robot frame transformations with TF ROS2
- Create robot simulations with Gazebo (Ignition)
- ROS1 basics



Project of this phase: Apply ROS to the Beginners City Lab and get a real mobile robot - TurtleBot3 to perform specific tasks.



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WHAT YOU WILL LEARN IN THIS PHASE

TIME

1 Git and GitHub Basics	<ul style="list-style-type: none">• Git Basics• Git Branches• Git and GitHub for Team Collaboration	10 hours
2 C++ for Robotics	<ul style="list-style-type: none">• How to compile C++ programs• How to store data into Variables• How to operate with the data in the Variables• How to change behavior based on Conditions• How to create Functions that can be called from other places of the code• How to properly use arrays and pointers• How to encapsulate the code into Classes so you can have clean and robust code	18 hours
3 Advanced Modern C++ for Robotics	<ul style="list-style-type: none">• How to build C++ programs• How to create a library• Understand the Standard Template Library (STL) and how it can help you create better code• How to use C++ classes to optimize your code• Inheritance• Function overriding and function overloading• How to use pointers and references for optimal memory management• Templates and Lambda expressions• How to use threads to parallelize tasks in C++• How to deal with unexpected or exceptional errors in your code	40 hours
4 ROS2 Basics	<ul style="list-style-type: none">• Creation of ROS2 packages• Management of the new Colcon universal building system.• Topic Publishers and subscribers in ROS2 C++.• New Launch system based on python• Service servers and client generation for ROS2.• Basic use of ROS1-Bridge to communicate ROS2 systems with ROS1 systems.• Use of Debugging tools in ROS2.	30 hours
5 URDF for Robot Modeling in ROS2	<ul style="list-style-type: none">• How to build a visual robot model with URDF• How to add physical properties to a URDF Model (Collision, Frictions...)• How to use XACRO to clean up URDF files.• How to use URDF in Gazebo-ROS ecosystem.• How to use URDF-XACRO in ROS2 systems	15 hours

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WHAT YOU WILL LEARN IN THIS PHASE

TIME

6 TF ROS2

- How to Visualize TFs in ROS2
- How to Publish & Subscribe to TF data
- Understanding Transformations & Frames
- Common TF Command-line Tools (tf_echo, view_frames...)
- Understanding Static Transform Publisher

15 hours

7 Mastering Gazebo Simulator

- Gazebo GUI
- How to build a robot for Gazebo
- How to connect gazebo robots to ROS
- How to build custom Gazebo worlds
- How to write plugins for gazebo worlds and models

20 hours

8 ROS1 Basics

- Understand key ROS concepts
- Understand and create your own ROS programs
- How to debug your ROS programs
- How to apply theory into real Robotics Challenge and Projects.

23 hours

Phase 2- Robotics Developer Beginner

5 weeks

Understand how to program mobile manipulator skills, including navigation, perception of the environment, and manipulation of objects.

Acquired Skills:

- Advanced ROS2 concepts
- Robot navigation with ROS2
- Robot perception with ROS2
- Object manipulation with ROS2
- Build robot controllers with ROS2

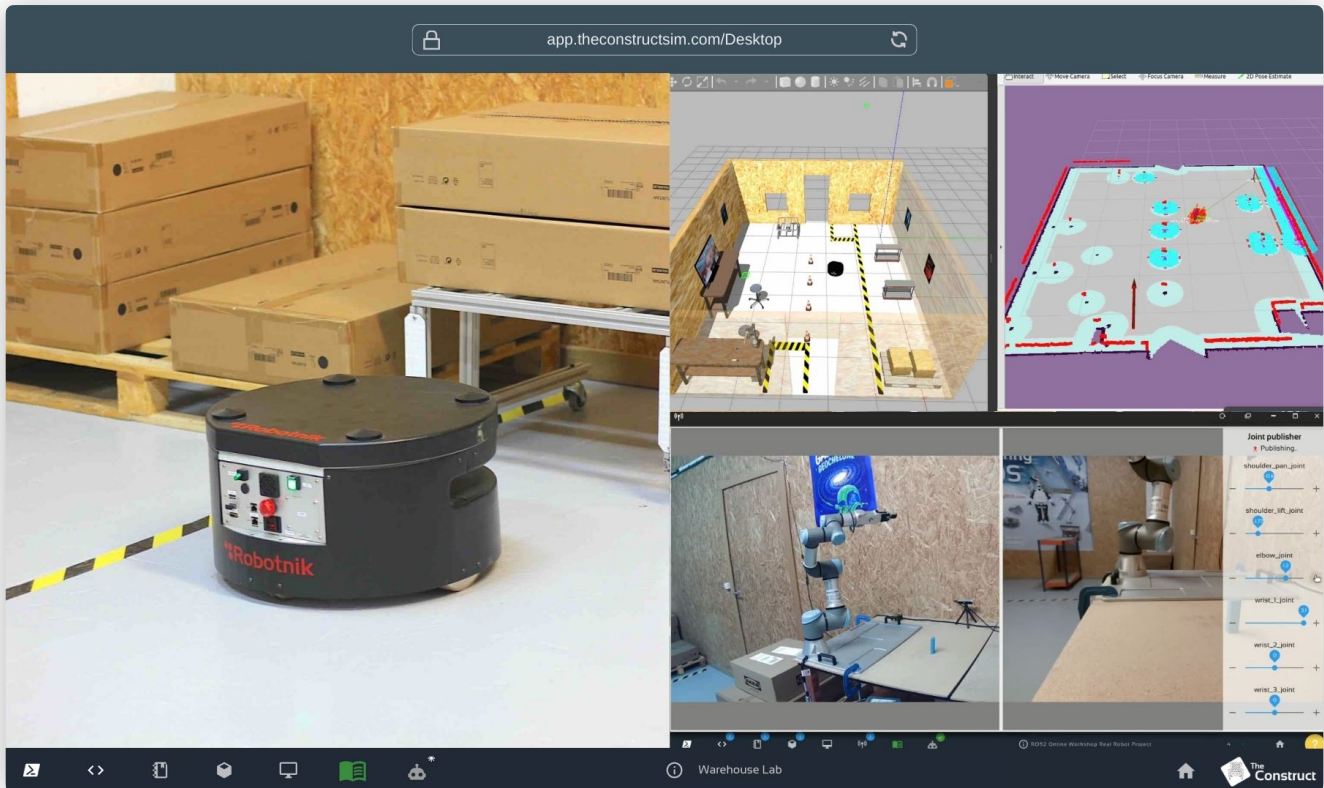


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Project of this phase: Apply what you have learned to the Warehouse Lab and create an entire pick-and-place task with real warehouse collaborative robots: RB1-Base and UR3e Arm.



WHAT YOU WILL LEARN IN THIS PHASE

TIME

9 Intermediate ROS2

- How to create different types of launch files in ROS2
- How to work with parameters in ROS2
- Threading in ROS2
- How to manage callbacks in ROS2
- Understand Quality of Service (QoS) in ROS2
- Understand DDS in ROS2
- Work with Managed Nodes in ROS2

12 hours

10 ROS2 Navigation

- How to build a map of the environment
- How to localize a robot in a map of the environment
- Path Planning from an initial position to the desired goal
- Obstacle avoidance using Costmaps
- Navigation Lifecycle Manager
- How Behavior Trees influence Nav2

18 hours

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WHAT YOU WILL LEARN IN THIS PHASE

TIME

11 Advanced ROS2 Navigation

- How to use the Simple Commander API
- How to use Costmap Filters
- An explanation of the BT Navigator
- How to create a custom behavior
- How to use Groot for visualizing behaviors
- How plugins are used in Nav2
- How to create custom plugins for Nav2
- The three main plugins of the controller server

12 hours

12 ROS2 Perception and Manipulation

- ROS2 Moveit
- ROS2 Object Detection
- ROS2 Programatical Motion Planning

22 hours

13 ROS2 Control Framework

- How to configure a `ros2_control` pipeline
- How to write a minimal custom interface for a hardware device
- Real-life implementation of a custom hardware interface
- Different controller types included with `ros2_control`
- Application of the course content to solve a robotics project based on a quadruped robot

12 hours

Phase 3 - Robotics Developer Experienced

5 weeks

Understand any robotic system's physics and mathematical principles, from simple kinematics to advanced planning and control algorithms.

Acquired Skills:

- Essential math for robotics
- Mobile robot kinematics
- Robot arm kinematics
- Robot dynamics
- Kalman filters
- Path planning algorithms



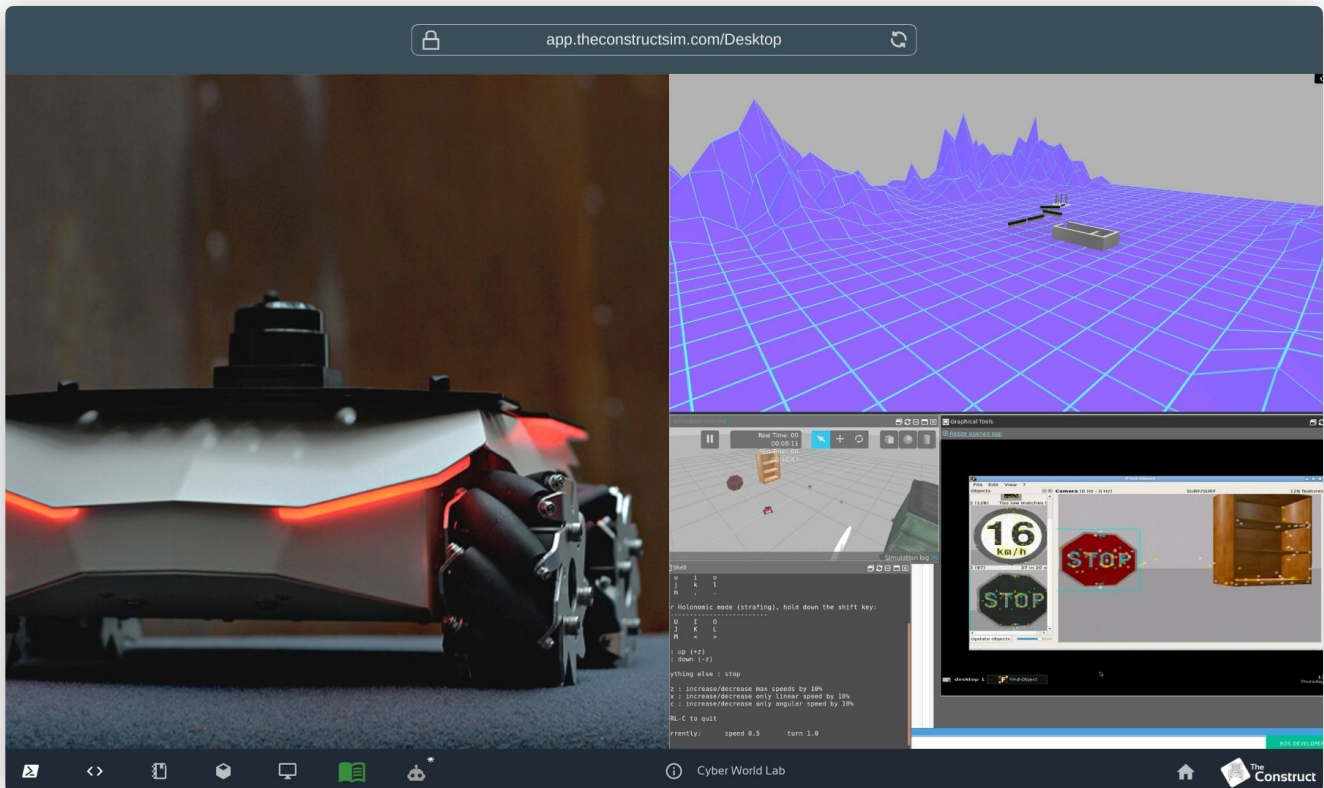
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Project of this phase: Apply what you have learned to the Cyber World Lab. Design and develop, from zero, the navigation algorithms for a wheeled mobile robot – ROSbot XL.



WHAT YOU WILL LEARN IN THIS PHASE

TIME

14 Basic Maths for Robotics

- Linear Algebra, where you'll learn about vectors and matrices
- Calculus, where you'll learn about functions, derivatives, and integrals
- Probability, where you'll learn about random variables and belief distributions

12 hours

15 Basic Kinematics of Mobile Robots

- Rigid-Body Motions
- Kinematics for Non-Holonomic Robots
- Kinematics for Holonomic Robots
- Kinematic Control

18 hours

16 Basic Arm Kinematics

- The basics of Rigid Body transformations
- The Denavit Hartenberg method for frames generation.
- Forwards kinematics
- Inverse Kinematics

10 hours

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WHAT YOU WILL LEARN IN THIS PHASE

TIME

17 Robot Dynamics and Control	<ul style="list-style-type: none">• How to solve the dynamics for the motion of rigid bodies in 3D space with the use of Newton's laws of motion• How to model the dynamics of a simple robotic system and how to derive its equations of motion• How to create a full state feedback controller to allow a robotic system to balance	12 hours
18 Kalman Filters	<ul style="list-style-type: none">• What is a Kalman Filter and why are required• Different types of Kalman Filters and when to apply each one.• Bayesian Filters• One-dimensional Kalman Filters• Multivariate Kalman Filters• Unscented Kalman Filters• Extended Kalman Filters• Particle Filters	10 hours
19 Path Planning Basics	<ul style="list-style-type: none">• Dijkstra algorithm• A* search algorithm• Rapidly-Exploring Random Tree (RRT)• Artificial Potential Fields	12 hours

Phase 4 - Robotics Developer **Competent**

5 weeks

Understand the development tools for robot programming in a corporate environment. Then, get prepared to bear the day-to-day work of a robotics developer.

Acquired Skills:

- Program web interfaces for ROS2
- Containerize your software with Docker
- Automate development tasks with Jenkins
- Check the integrity of the code with continuous integration (CI)

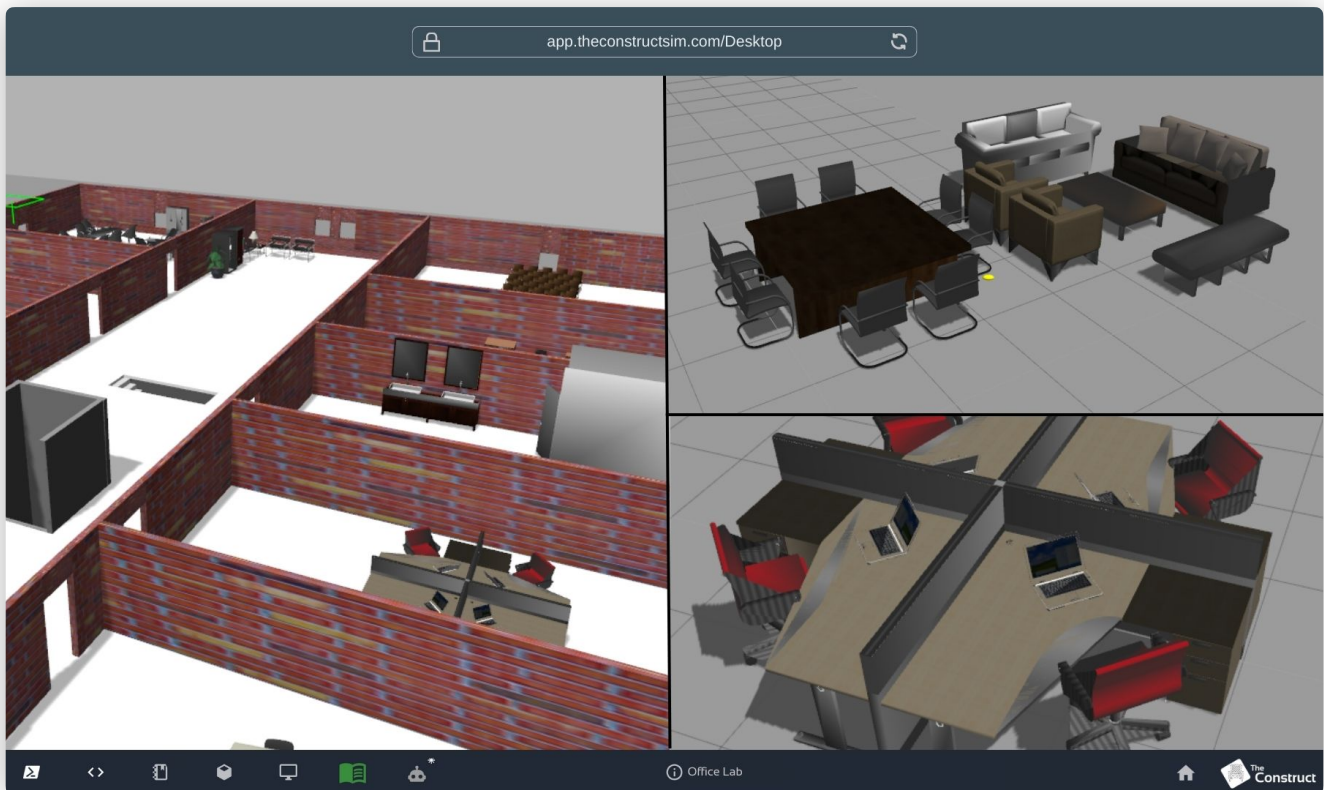


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Project of this phase: Apply what you have learned to the Office Lab. Develop a ROS-based web application from zero that provides a graphical interface to command a robot, in a containerized environment with continuous integration.



WHAT YOU WILL LEARN IN THIS PHASE

TIME

20 Web Development for Robotics

- Rosbridge: Use the Rosbridge to connect your web pages to ROS
- HTML5: Learn to build web pages containing the necessary elements to display your desired information. From simple titles and paragraphs to complex table data and forms to collect user's input and process that information
- CSS3: Learn to style your web pages to make them look great
- JavaScript: Learn basic instructions, types, arrays, and objects starting from programming logic.
- ReactJS: Learn to create scalable web applications by providing an organized folder structure and compiler for your web components

20 hours

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WHAT YOU WILL LEARN IN THIS PHASE

TIME

21 Developing Web Interfaces for ROS

- Understand how to make ROS data available to other environments
- Understand how to create simple but efficient web pages
- How to publish to topics and control robots from the web
- How to subscribe to topics and monitor ROS data from the web
- How to work with ROS params from the web
- How to consume ROS services and action servers from the web
- Create powerful interfaces that show: 3D models, maps and camera images

15 hours

22 Docker Basics for Robotics

- Introduction to Docker: How to pulling public images, run and inspect containers, basic commands, etc.
- Creating Docker Images: Create your own docker image, check its history, and work with Docker containers.
- Docker Network and Docker Compose: Launch multi containers using a single command and understand docker-compose files.
- Docker with ROS: Examples of using ROS with Docker.

12 hours

23 Jenkins Basics for Robotics

- Jenkins installation and initial setup
- Jenkins jobs
- Managing Users and Security
- Jenkins Pipelines
- Source Code Management Integration
- Test Integration
- Jenkins CLI

12 hours

24 Unit Testing with ROS

- How to create Python Unit Tests
- How to create ROS Unit Tests
- How to create ROS Integration Tests

12 hours

25 Continuous Integration

Integrate all the learned DevOps tools into a single practical project

8 hours

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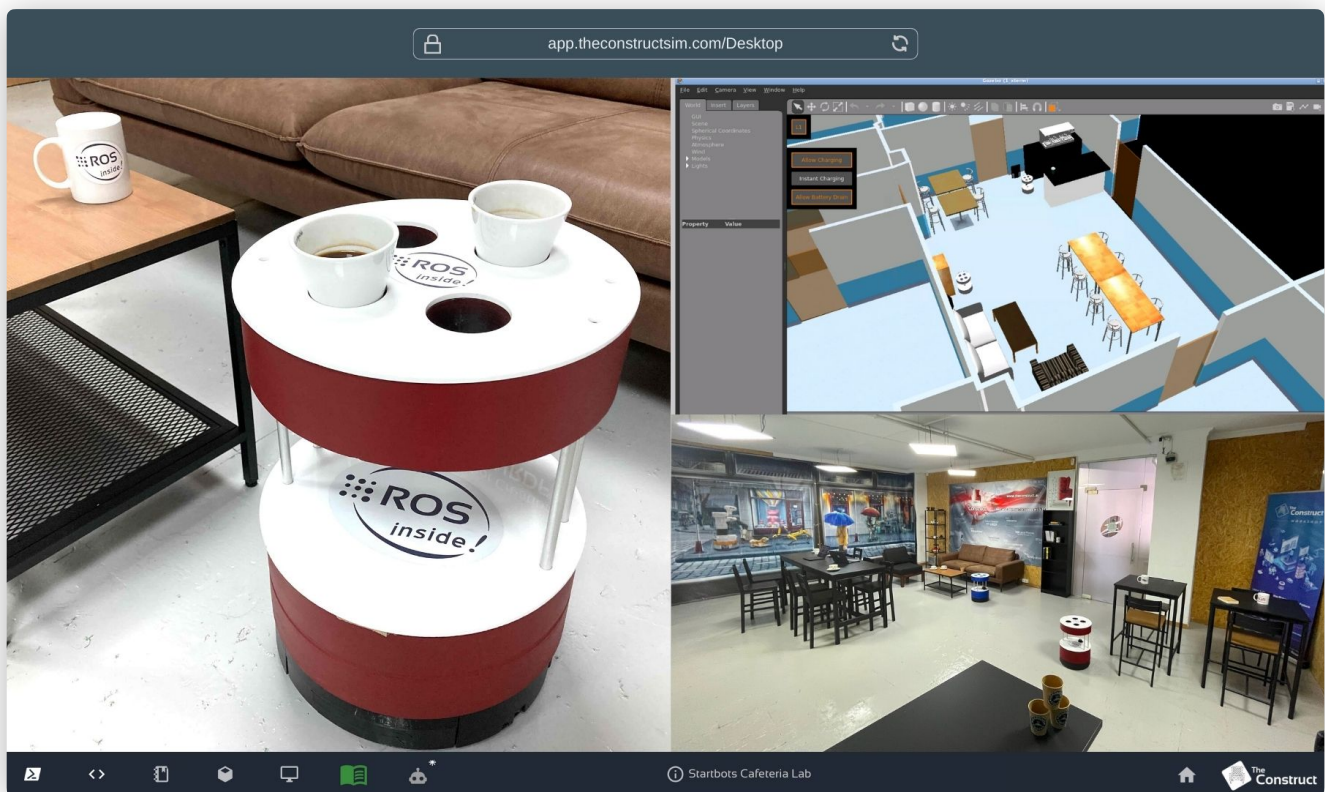


Phase 5 - Robotics Developer **Advanced**

4 weeks

Put all your skills and knowledge to the test in a real-world scenario.

Design, develop and present, from zero, a complete robotics project for the StarBots Cafeteria Lab - Get robots to prepare a coffee, deliver coffee to the tables, and clean the space while maintaining the battery level.



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Phase 6 - Robotics Developer

3 months internship

The Robotics Developer Master Class offers you a practical internship 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.



WORK PLACEMENTS

The Robotics Developer Master Class includes an external placement. The External Placement Programme (PPE) matches supply and demand for places to enable students to gain professional experience in the sector and put their knowledge of robotics development into practice.

The Construct has framework collaboration agreements in place with the following world's leading robotics companies to advance in the training of robotics professionals:

 **Robotnik**

PAL
ROBOTICS 

 **Karelis**

 **ROVER**
ROBOTICS

NEOBOTIX

 **ROBOTISE**

 **STOGL**
ROBOTICS


PERPETUUM PROGRESS

ROBOTEC 

ICRA
ISTITUTO COLUMBIANO DI ROBOTICA AVANZATA

 **orbital**
composites


KNIGHTSCOPE

 **HUSARION**

 **akara**

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REAL PRACTICES

Get Hands-on with Robots

Simulated Robots Used

BB-8



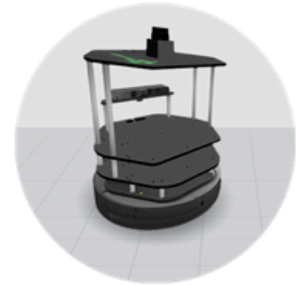
IRI Wam arm



Parrot A.R.



TurtleBot2



SUMMIT-XL



Husky



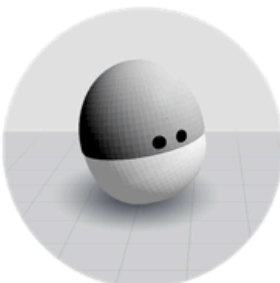
UR3



Fetch



Mira



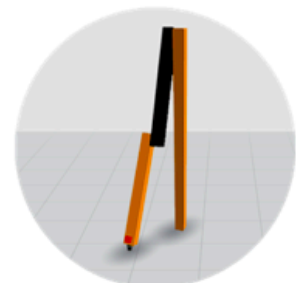
Phantom X



RB-KAIROS



RRBot



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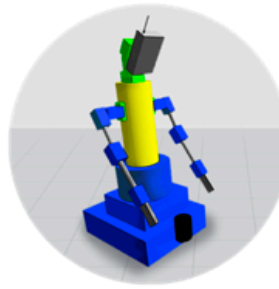
**Neobotix
MPO-500**



**3d Version of
the Classical
2D TurtleSim**



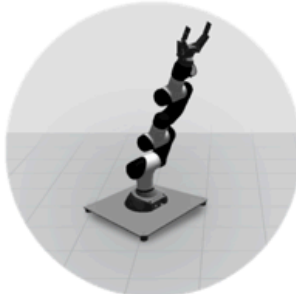
Pi robot



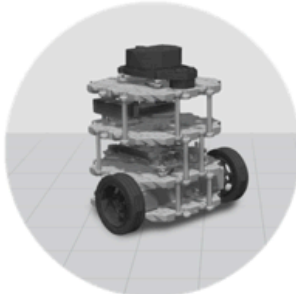
ROSbot 2.0



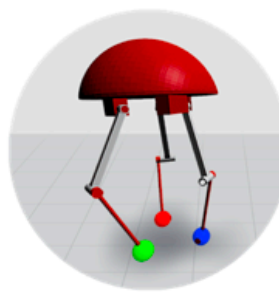
Mara



TurtleBot 3



Gurdy



JIBO



**Motoman
Sia10f
simulation**



**Clarkson Open
Manipulator**



PR2



Shadow hand



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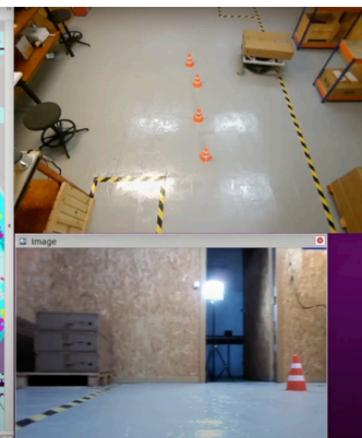
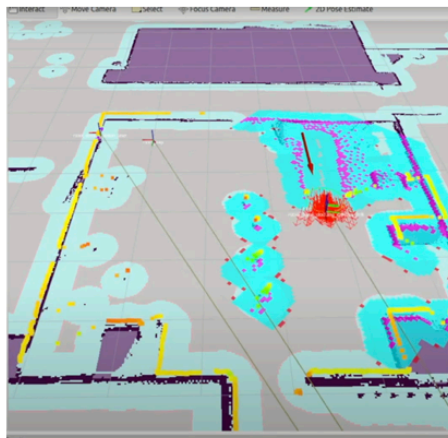
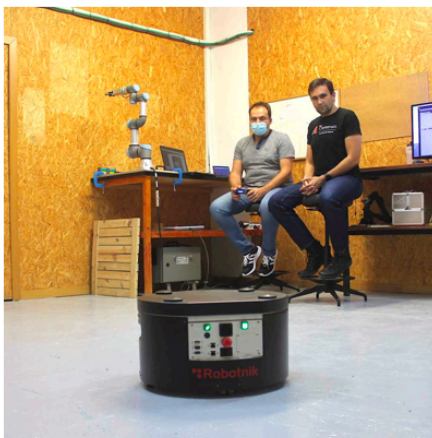
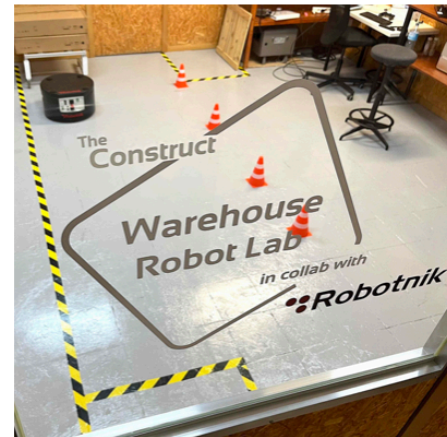
Real Robots Used

During the program, you will learn robotics and develop robotic apps by connecting remotely to the following real robots to practice:

RB-1 BASE mobile robot - Robotnik

RB-1 BASE is a mobile base robot able to move shelves from one location to another. With this robot, practice autonomous navigation; carrying cargo from one place to another; and recognize environments, like tags, people, or objects.

[See how it works \(video\).](#)



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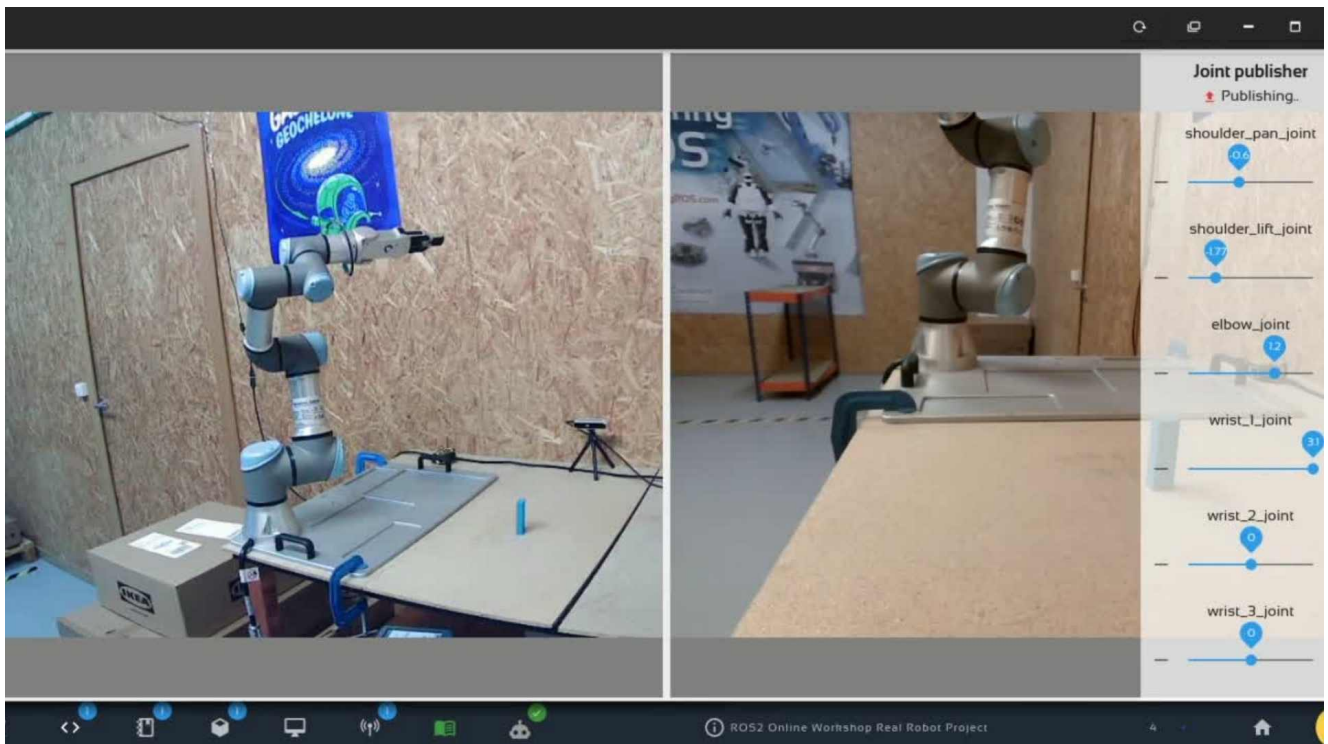
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UR3e robotic arm

This is a collaborative robotic arm with a gripper and a 3D sensor for perception. With this robot, you can practice manipulation, object detection, pick & place objects, and more.



ROSbot XL - Husarion

ROSbot XL is a 4x4 drive autonomous mobile robot platform equipped with LIDAR, RGB-D camera, IMU, encoders, etc. Powered by ROS / ROS2.



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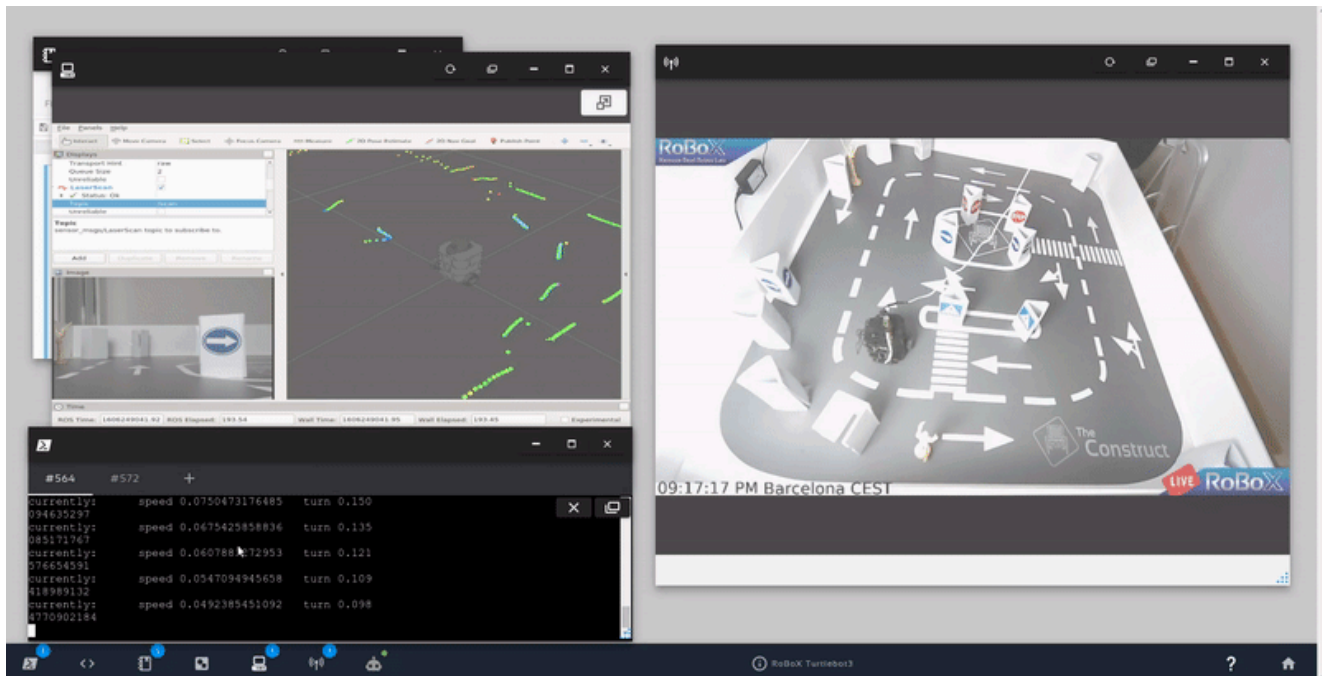
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TurtleBot3

TurtleBot3 is a wheeled robot with lidar and a camera.



Rick & Morty

Two robot baristas working in StarBots Cafeteria.



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Frequently Asked Questions

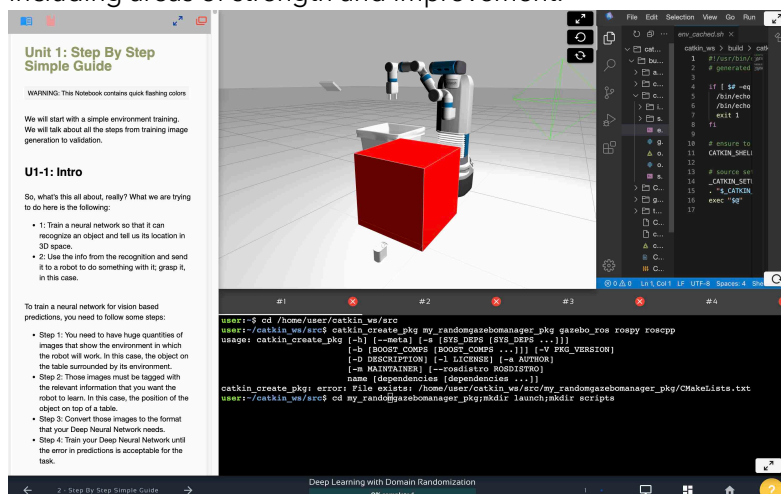
What is the difference between this Master Class and The Construct's existing course library?

- A personal mentor guides and supports your Robotics Programming learning development. We provide all you require to graduate from the Master Class as a subject expert.
- Access to exclusive courses:
 - Docker for Robotics
 - Advanced C++ for Robotics
 - Gazebo robot simulations
 - Web programming for robotics
 - Jenkins for robotics
- During the course, you will create several projects, which will be integrated into a shareable online robotics portfolio, showcasing your code and results to potential employers.
- You will practice what you learn in our Remote Real Robot Labs.
- You will intern at a leading robotics company.
- We will teach you how to use software development tools required for robotics programming jobs (i.e., Docker, Git, Jenkins, and more).
- The Master Class projects are entirely different, specialized, and more comprehensive. They take into account the whole MasterClass program. MasterClass students will also have exclusive access to our Remote Real Robot Labs.
- Attend seminars and talks by highly regarded external professionals.

Is this Master Class video-based?

NO. The courses are based on notebooks (as shown in the image below) which contain lectures, exercises, assignments, and exams that will guide you through the program. You can also access the notebooks for review at any time.

The courses are also based on regular meetings with your mentor. You will have a mentor assigned to follow your progress. In a monthly session, your mentor will provide feedback on your development, including areas of strength and improvement.



Robotics Developer

M A S T E R - C L A S S 2 0 2 3



Frequently Asked Questions

Can I complete the coursework at any time and at my own pace?

Yes, 6 months is the best time we recommend for completion, but you can complete the program at your own pace over 12 months.

Is the 3-month internship guaranteed upon completion?

The internship is 100% guaranteed for all the students who do the work, study hard, and pass the program. We take charge of providing you with an internship at a robotics company, but we want to send people who have taken the course seriously.

Where is the internship? Online or offline?

Internships are remote and in-person, depending on your location and other factors. You will discuss and agree on the internship details with your mentor.

Can I choose the internship location?

We will select the best internship opportunity based on your location, skills, and preferences. Then, you will discuss and agree on the internship details with your mentor.

Is there any contract we need to sign before enrolling in the Master Class?

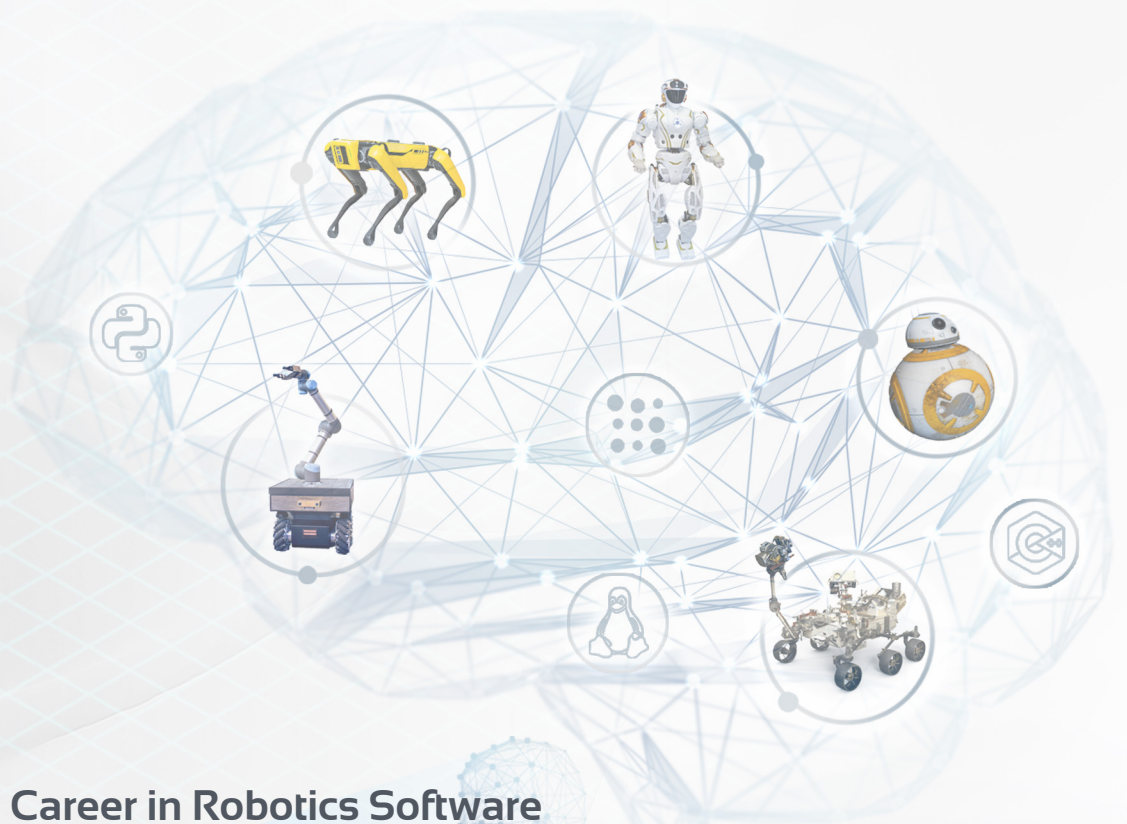
Yes, we will ask you to sign a simple contract explaining your rights and obligations.

Can I get a scholarship?

There is no scholarship available.

Can I pay in installments?

Yes. You can now register for the "Robotics Developer Master-Class" by paying in 12 installments. €700 EUR per month (The total tuition fee is €8400 EUR).



Kickstart Your Career in Robotics Software

Enroll Today

QUESTIONS?

Email: info@theconstructsim.com

Website: [https:// www.theconstructsim.com/robotics- developer/](https://www.theconstructsim.com/robotics-developer/)

What do the robots of the future look like?

...it all depends on **you**.