

How to teach Robotics & ROS remotely

... using Zoom



Who is this webinar for?

- Professors/Teachers/Teacher assistants of undergrads/graduate students of robotics
- You need to prepare robotics course for 2021
- You are searching for remote robotics teaching solution due to COVID-19



What do we mean by teaching robotics?

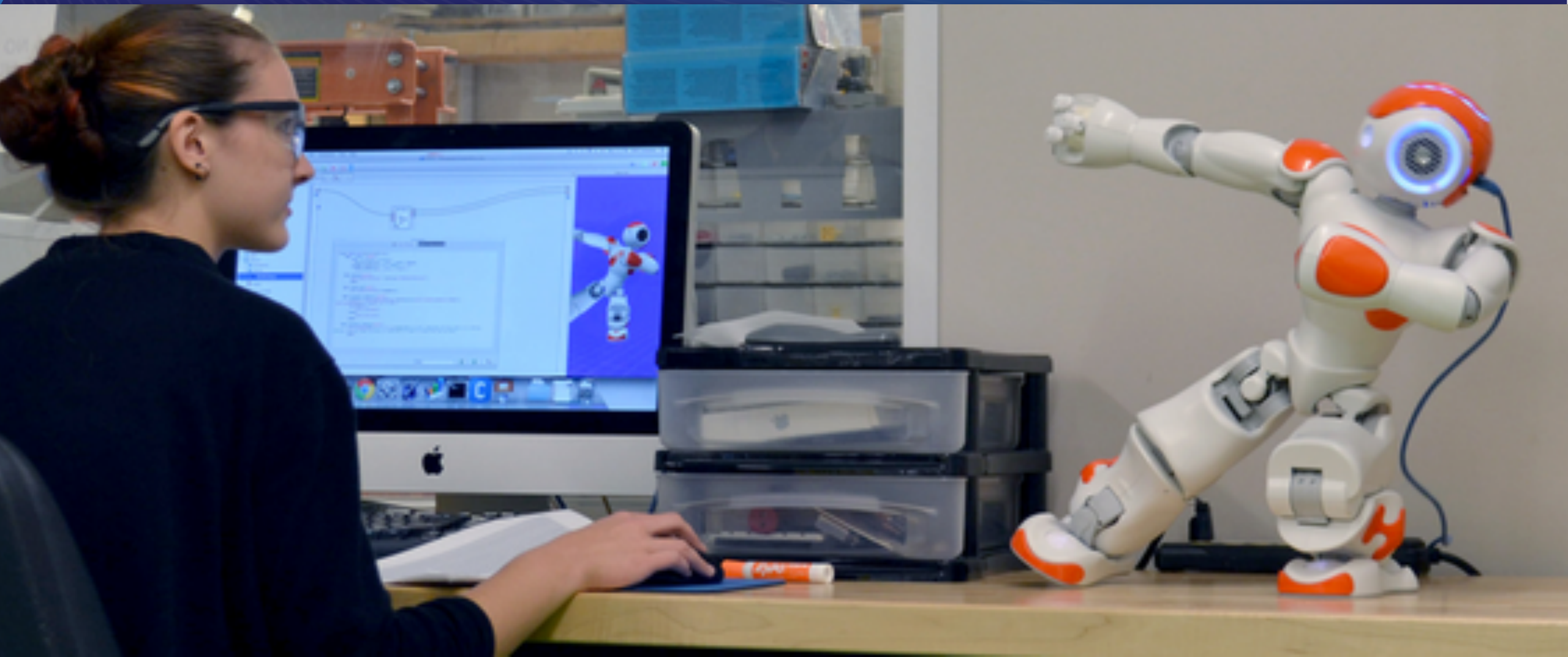
- Robot action and perception
- Arm Kinematics
- Mobile Robots Kinematics
- Robot Dynamics
- Motion Planning and Control
- Robot Navigation
- Computer Vision
- ROS



We do not mean



We do mean



About Us

- 5 years teaching on The Construct Youtube Channel
- Almost 1.000 videos uploaded
- 1 ROS Online Class every week (for 3 years)
- 3 ROS conferences online
- Tens of webinars (like this one)



Stay with us to take a full live teaching demo including remote real robots



- First, we'll see how to teach ROS & Robotics with zoom
- Provide solutions to problems
- Then we will do a class all together, including real robot lab



For teaching robotics remotely you need

- Prepare students for the class
- Deliver the theory
- Provide some practice
- Provide off-hours support
- Evaluate students
- Control students progress



Problems

1. Preparing curriculum is hard work
2. Make students practice is difficult
3. Students don't know Linux nor Python
4. Installing ROS in students' computer
5. Evaluate them remotely is difficult



Preparing the students



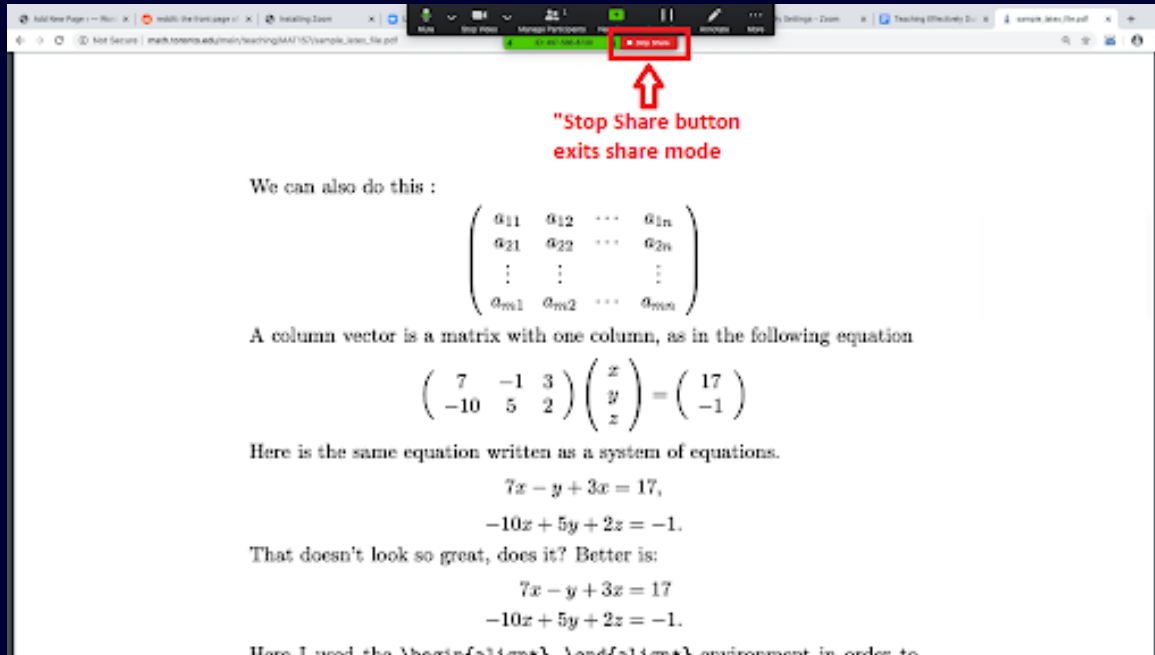
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For teaching theory remotely you need

- Your teaching material (slides)
- A platform to deliver and communicate with students in real time
 - Must allow:
 - Sharing Screen (teacher & student)
 - Live Chat (mic & written)



Example: Zoom



We can also do this :

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix}$$

A column vector is a matrix with one column, as in the following equation

$$\begin{pmatrix} 7 & -1 & 3 \\ -10 & 5 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 17 \\ -1 \end{pmatrix}$$

Here is the same equation written as a system of equations.

$$\begin{aligned} 7x - y + 3z &= 17, \\ -10x + 5y + 2z &= -1. \end{aligned}$$

That doesn't look so great, does it? Better is:

$$\begin{aligned} 7x - y + 3z &= 17 \\ -10x + 5y + 2z &= -1. \end{aligned}$$

Here I used the `\begin{aligned}` and `\end{aligned}` environment in order to



<https://youtu.be/JIRfIUH8ENw>

Pre-Requisites

- **Make students learn the requisites:**
 - Learn Linux
 - Learn Python
- **Make them take these online free courses:**
 - Linux for Robotics: <https://bit.ly/3gx6za7>
 - Python for Robotics: <https://bit.ly/36XldEs>
- **Take the exam and get evaluation for you.**



Simulated robots: use ROS + Gazebo

- Install ROS on students' computer <http://wiki.ros.org/ROS/Installation>

ROS Installation Options

There is more than one ROS distribution supported at a time. Some are older releases with long term support, making them more stable, while others are newer with shorter support life times, but with binaries for more recent platforms and more recent versions of the ROS packages that make them up. See the [Distributions](#) page for more details. We recommend one of the versions below:

ROS Kinetic Kame

Released May, 2016

LTS, supported until April, 2021

This version isn't recommended for new installs.



ROS Melodic Morenia

Released May, 2018

LTS, supported until May, 2023

Recommended for Ubuntu 18.04



ROS Noetic Ninjemys

Released May, 2020

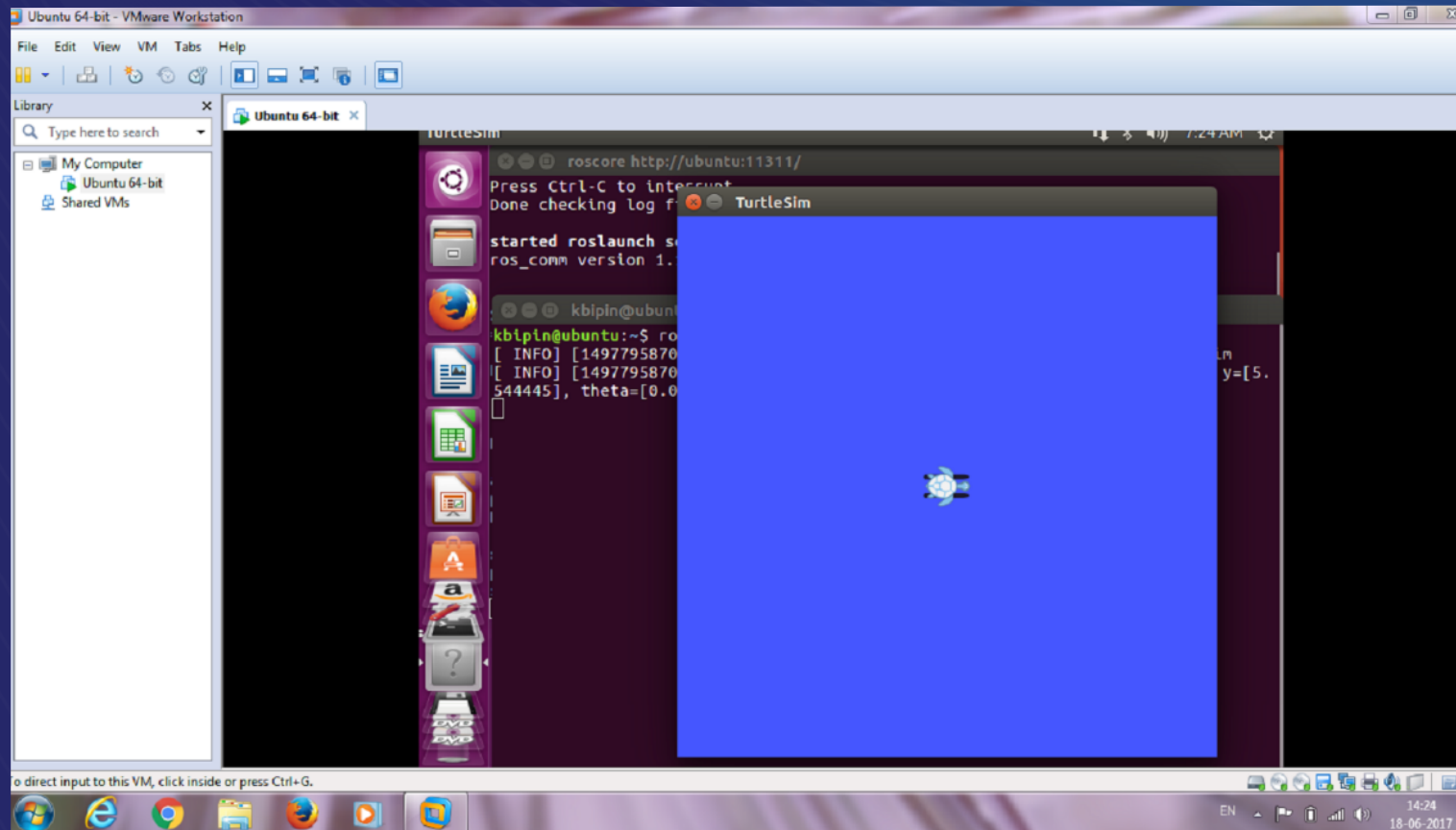
Latest LTS, supported until May, 2025

Recommended for Ubuntu 20.04



Simulated robots: use ROS + Gazebo

- Provide a Virtual Machine with ROS https://youtu.be/59F6Jake_48



Simulated robots: use ROS + Gazebo

- Provide a docker with ROS https://hub.docker.com/_/ros/



ros ☆

Docker Official Images

The Robot Operating System (ROS) is an open source

↓ 10M+

Container

Linux

ARM 64

x86-64

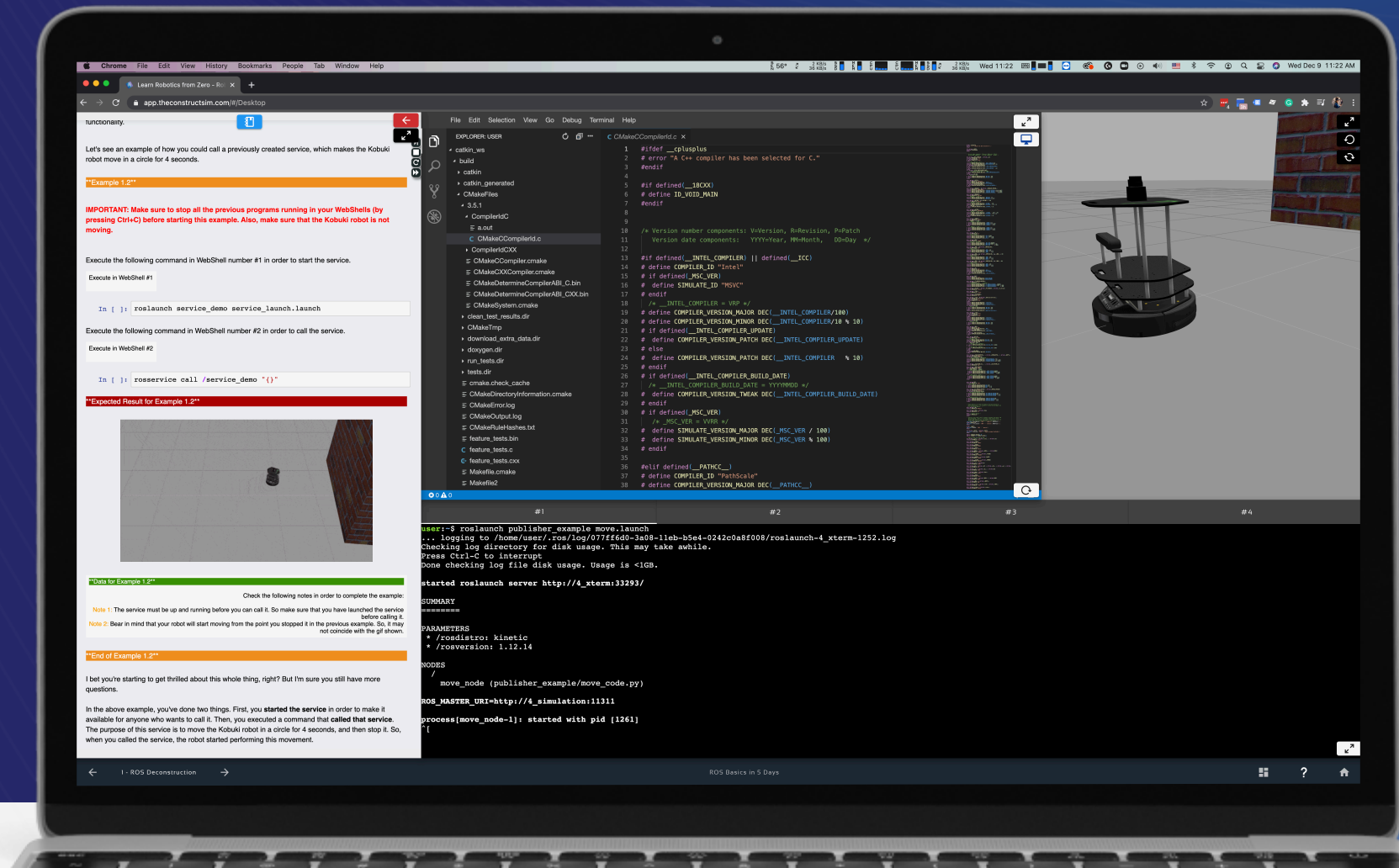
ARM

Operating Systems



Simulated robots: use ROS + Gazebo

- Use a web based environment <http://robotignite.academy>



Teaching the Theory



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If you are looking for

- **A fast method to create a ROS/robotics course based on slides...**
 - Just search over internet and get one of the trillions available
 - for example, this one by ETH Zurich: <https://bit.ly/35OqmLV>
 - Change the logo in the slides by your logo.
 - Done.

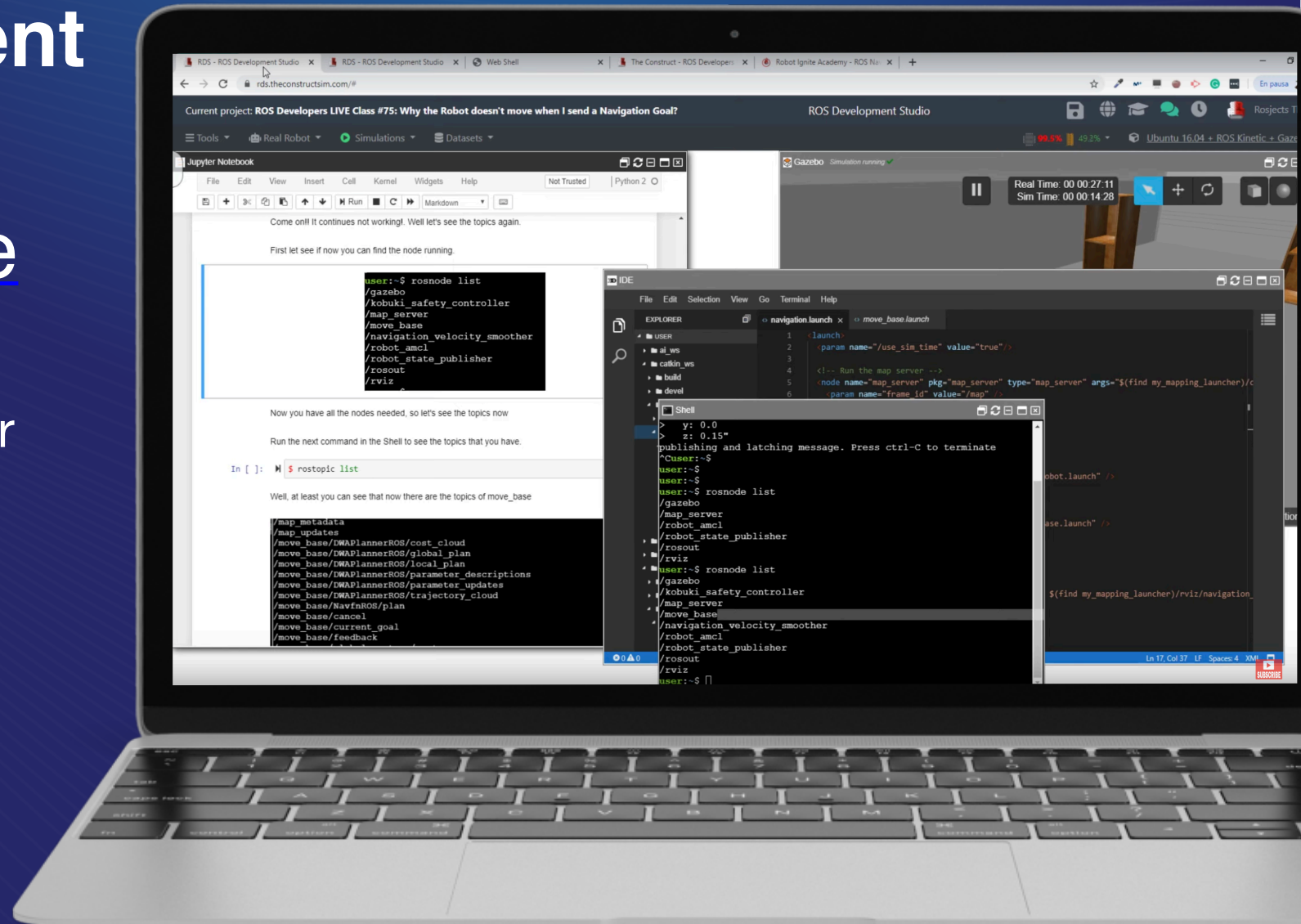


ROS Development Studio

<http://rosds.online>

A full ROS cloud environment in your browser

Create a free account

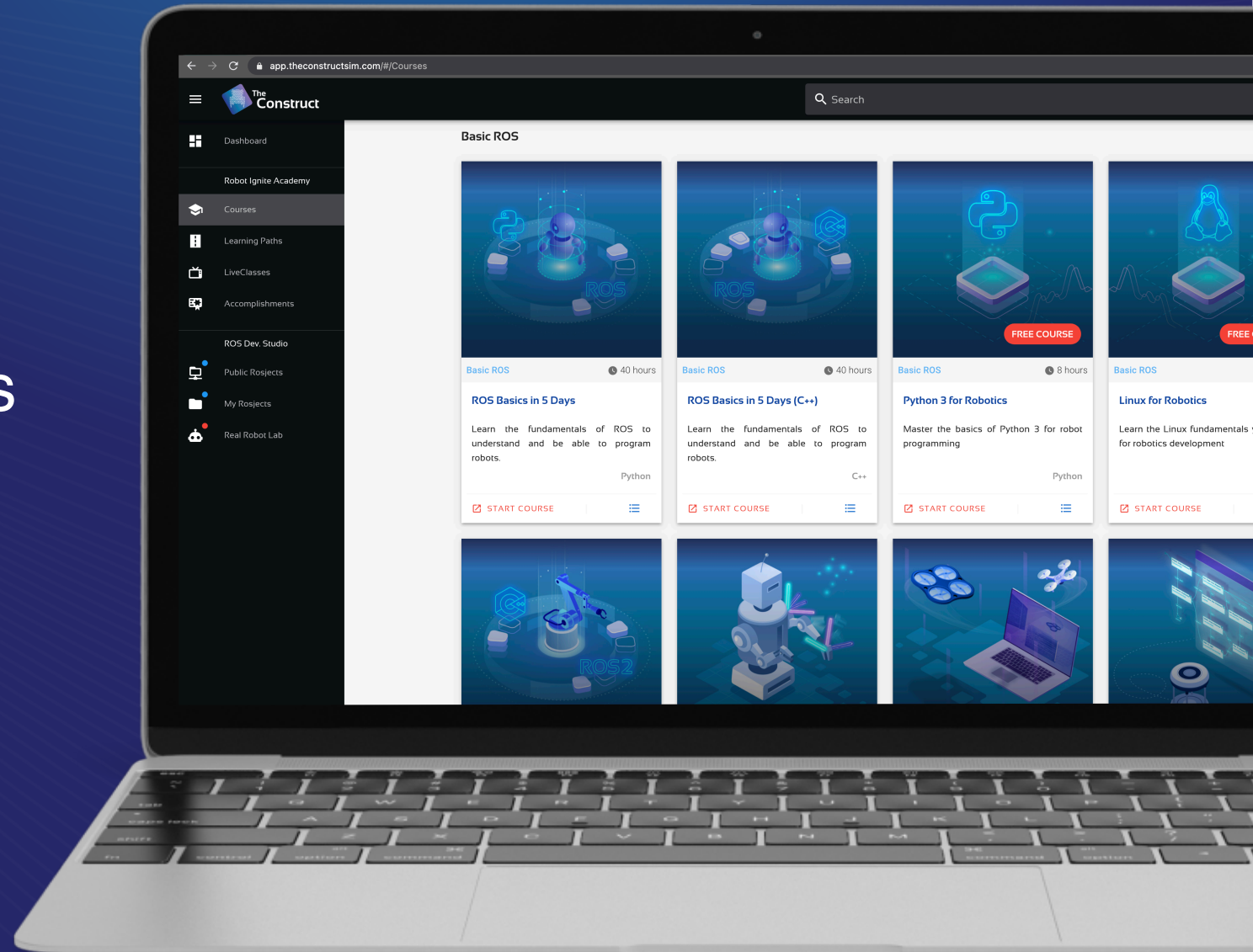


How to create your
curriculum with ROS
Development Studio:
[https://youtu.be/
q2Zg31pc-XM](https://youtu.be/q2Zg31pc-XM)



Get all content already created at Robot Ignite Academy

- * Mathematics for Robotics
- * Robot kinematics
- * Robot Dynamics
- * Kalman Filters
- * OpenCV for Robotics
- * ROS applied to Robotics
- * ...



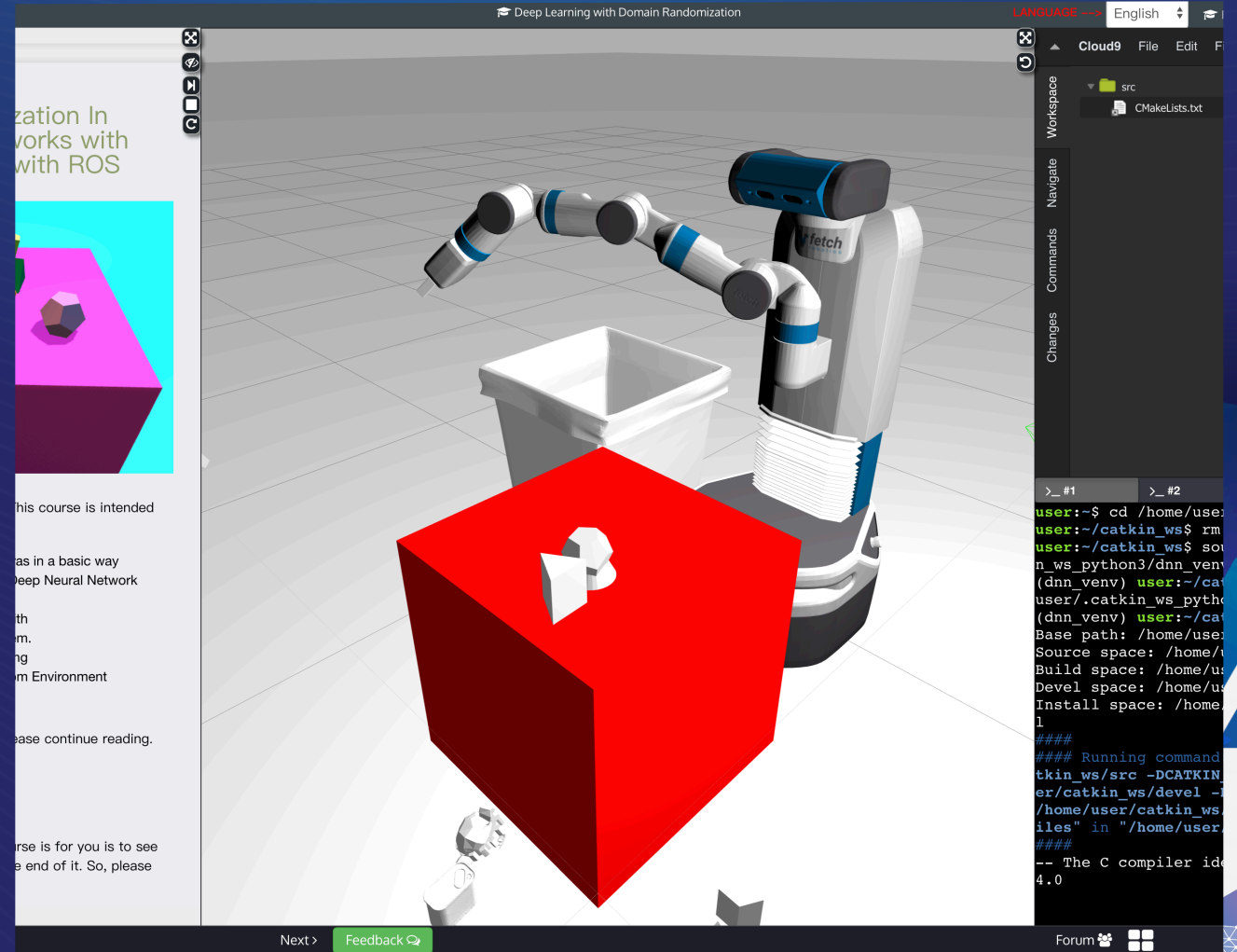
Provide Practice



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Simulated robots: use Gazebo/ROS robot sims

- Use the students ROS/
Gazebo environment
- Use the ROS
Development Studio
- Use Robot Ignite
Academy



Real robots: use ROS based robots

- Provide real robot to each student (around 200\$)
Base system (110\$) : <https://amzn.to/2DBpDov>
- Additions for Jetbot (110\$): <https://amzn.to/2XwJT1G>



Real robots: use ROS based robots

Provide remote robot lab

1. Have a robot with internet access
2. Install a server in the robot
3. Add external camera
4. Connect to it from ROSDS

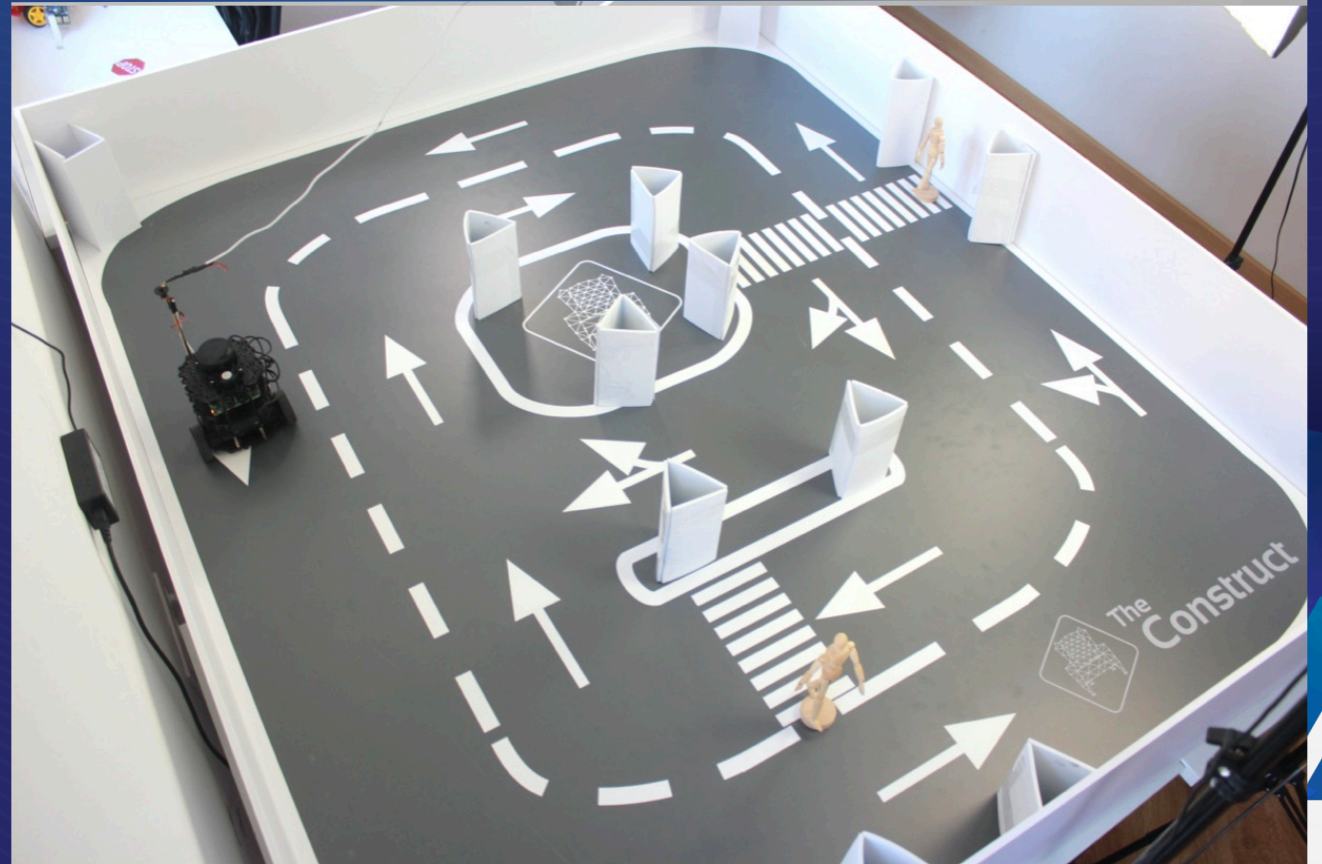
HOW TO SETUP:

<https://youtu.be/fzogfWRamDI>



Real robots: use RoboX Remote Real Robot Lab

- Provided by The Construct
- Everything already setup





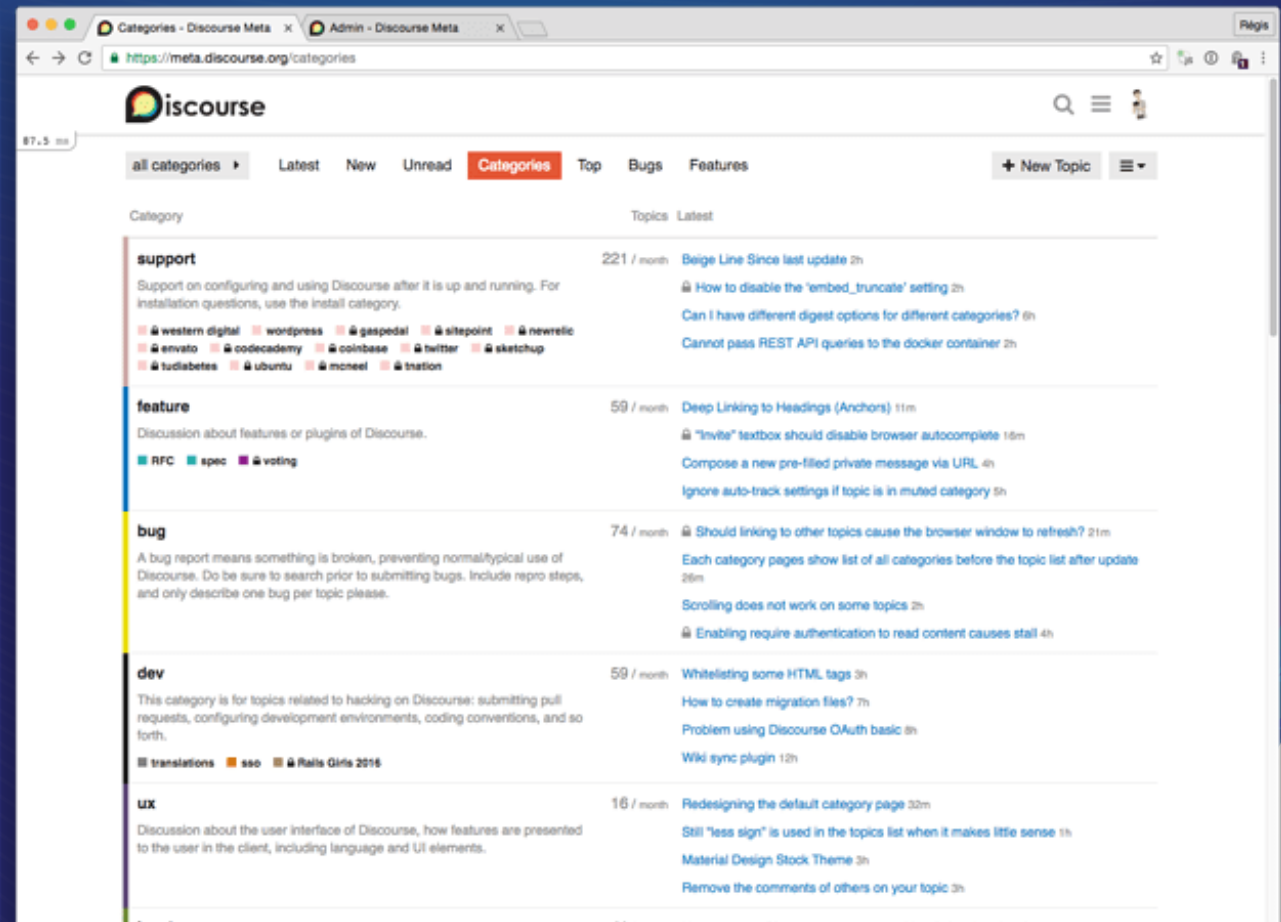
Provide off-hours support



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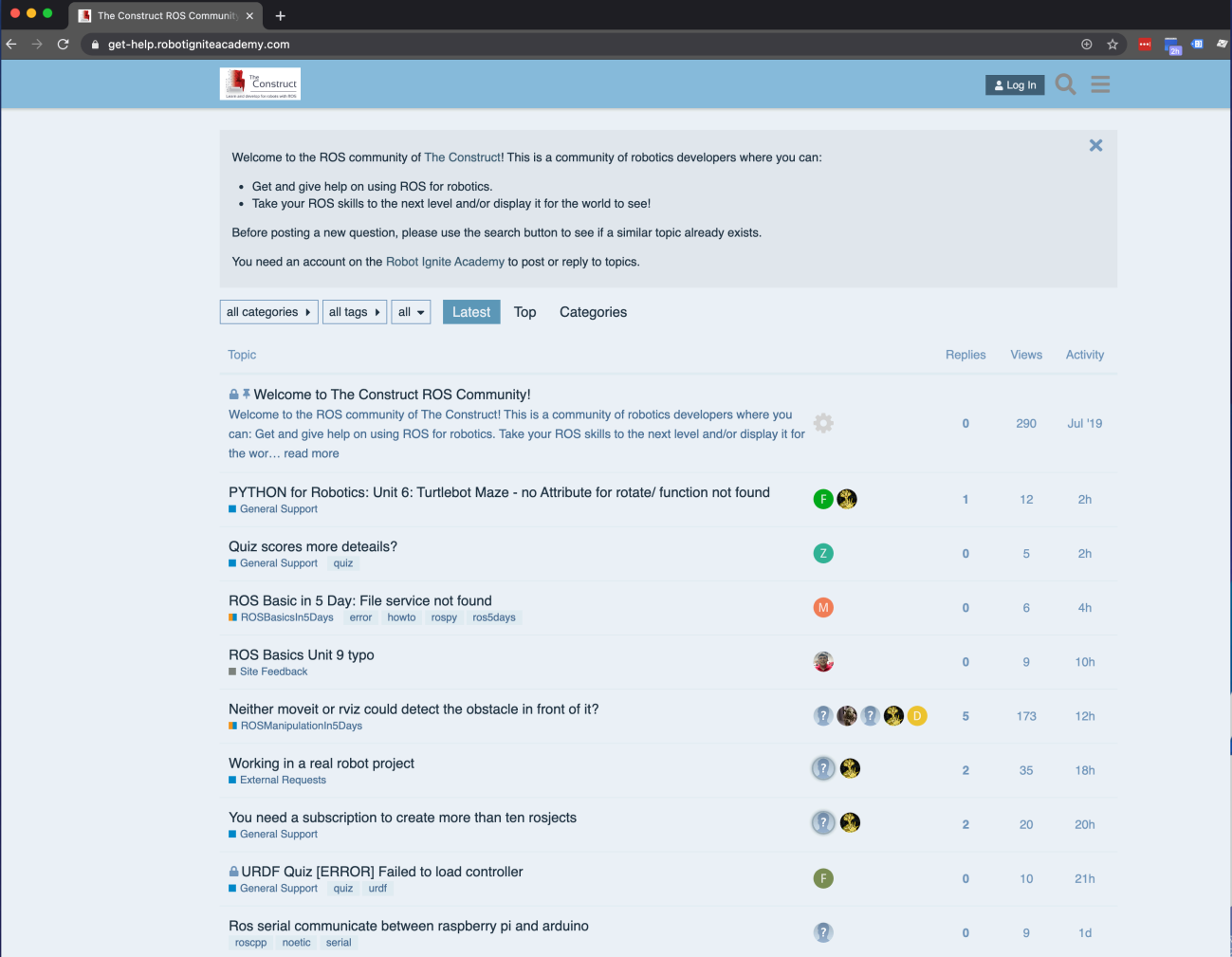
Provide a Forum for Q&A

- Use the one provided by the University
- Or install a Discourse: <https://bit.ly/2C7vuS2>



The Construct already provides one

- This Forum is answered by our team of ROS/Robotics experts.
- Answers typically in 24h on week days: <https://get-help.robotigniteacademy.com>



The screenshot shows a web browser window displaying the 'The Construct ROS Community' forum. The browser's address bar shows the URL 'get-help.robotigniteacademy.com'. The forum page has a light blue header with a 'Log In' button and a search icon. A welcome message box at the top states: 'Welcome to the ROS community of The Construct! This is a community of robotics developers where you can: Get and give help on using ROS for robotics. Take your ROS skills to the next level and/or display it for the world to see! Before posting a new question, please use the search button to see if a similar topic already exists. You need an account on the Robot Ignite Academy to post or reply to topics.' Below this, there are filters for 'all categories', 'all tags', and 'all', along with buttons for 'Latest', 'Top', and 'Categories'. The main content area is a table of forum topics with columns for 'Topic', 'Replies', 'Views', and 'Activity'. The topics listed include a welcome message, a Python error, a quiz question, a ROS error, a site feedback post, a question about obstacle detection, a question about working in a real robot project, a question about creating more than ten projects, a URDF error, and a question about serial communication between Raspberry Pi and Arduino.

| Topic | Replies | Views | Activity |
|--|---------|-------|----------|
| Welcome to The Construct ROS Community! Welcome to the ROS community of The Construct! This is a community of robotics developers where you can: Get and give help on using ROS for robotics. Take your ROS skills to the next level and/or display it for the wor... read more | 0 | 290 | Jul '19 |
| PYTHON for Robotics: Unit 6: Turtlebot Maze - no Attribute for rotate/ function not found General Support | 1 | 12 | 2h |
| Quiz scores more details? General Support quiz | 0 | 5 | 2h |
| ROS Basic in 5 Day: File service not found ROSBasicsIn5Days error howto rospy ros5days | 0 | 6 | 4h |
| ROS Basics Unit 9 typo Site Feedback | 0 | 9 | 10h |
| Neither moveit or rviz could detect the obstacle in front of it? ROSManipulationIn5Days | 5 | 173 | 12h |
| Working in a real robot project External Requests | 2 | 35 | 18h |
| You need a subscription to create more than ten projects General Support | 2 | 20 | 20h |
| URDF Quiz [ERROR] Failed to load controller General Support quiz urdf | 0 | 10 | 21h |
| Ros serial communicate between raspberry pi and arduino roscpp noetic serial | 0 | 9 | 1d |

Evaluate students



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Exams based on doing ROS code

- They must apply their knowledge
- Easy to detect when they copy



Use ROSjects to provide exams

- You create the rosject exam.
- You share with students
- They do the exam online
- Then they resend it to you
- You can see what they have done and reproduce their results
- Example:



Use Robot Ignite Academy Exams

- Exams already created
- Self-corrected
- Random exam to students to prevent copying (in preparation)

The screenshot displays the Robot Ignite Academy web interface. A modal window titled "Available exams" is centered, listing six exams with toggle switches. The first exam, "EXAM - Husky Robot Challenge of ROS Basics in 5 Days", is selected. The background interface shows the "University of LaSalle Barcelona" header, a navigation bar with an "Assigned" tab showing 3 items, and a table of students. The table has columns for "Full Name" and "Email". Two students are listed: Amalia Rodriguez (tellezatwork+03@gmail.com) and Ramon Sanpedro (tellezatwork+04@gmail.com). To the right, there is a section for "Enabled Exams (1)" with buttons for "EXPORT TO CSV" and "ADD MEMBER". Below this is a table with columns for "On", "Is manager?", "Details", and "Remove student?". The bottom of the interface shows a pagination bar indicating "1-2 of 2" rows.

Available exams

- ☒ EXAM - Husky Robot Challenge of ROS Basics in 5 Days
- ☐ EXAM - Navigate a Husky Robot autonomously in an Outdoor Environment of ROS Navigation in 5 Days
- ☐ Perception exam of ROS Perception in 5 Days
- ☐ EXAM - Husky Robot Challenge of ROS Basics in 5 Days (C++)
- ☐ EXAM - Ultimate Code Foundation Challenge of Python 3 for Robotics
- ☐ EXAM - Ultimate Code Foundation Challenge of Linux for Robotics

University of LaSalle Barcelona

Assigned 3

| Full Name | Email |
|------------------|---------------------------|
| Amalia Rodriguez | tellezatwork+03@gmail.com |
| Ramon Sanpedro | tellezatwork+04@gmail.com |

Enabled Exams (1)

EXPORT TO CSV ADD MEMBER

| On | Is manager? | Details | Remove student? |
|-----|--------------------------|---------|--------------------------|
| 12- | <input type="checkbox"/> | | <input type="checkbox"/> |
| 12- | <input type="checkbox"/> | | <input type="checkbox"/> |

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


























EXPORT TO CSV ADD MEMBER

Control students progress



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The Construct control panel

|  | Assigned | Remaining | Total | | | | | |
|---|------------------------|-------------|-----------------|---------------------|--|---|---|---|
| | 52 | 10 | 62 | | EXPORT TO CSV ADD MEMBER | | | |
| Full Name | Email | Total Hours | Exams Taken | Certificates | Added On | Is manager? | Details | Remove student? |
| Leeor Nehardea | lneharde@ucsd.edu | 22.57 hours | None taken yet. | - None earned yet - | 2020-07-30 |  |  |  |
| Haoru Xue | hxue@ucsd.edu | 1.02 hours | None taken yet. | - None earned yet - | 2020-07-31 |  |  |  |
| Jan Tengdyantono | jtengdya@ucsd.edu | 59.83 hours | None taken yet. | - None earned yet - | 2020-08-05 |  |  |  |
| Nathan Perkins | nperkins487@gmail.com | 42.89 hours | None taken yet. | - None earned yet - | 2020-08-05 |  |  |  |
| Lavita Zuo | x5zuo@ucsd.edu | 22.67 hours | None taken yet. | - None earned yet - | 2020-08-05 |  |  |  |
| Ryan Dunn | ryan.dunn729@gmail.com | 18.59 hours | None taken yet. | - None earned yet - | 2020-08-05 |  |  |  |
| Drew Britten | drewbrit10@gmail.com | 15.29 hours | None taken yet. | - None earned yet - | 2020-08-13 |  |  |  |
| Songyu Lu | sol009@ucsd.edu | 46.71 hours | None taken yet. | - None earned yet - | 2020-09-01 |  |  |  |
| Joshua Orozco | jorozco@ucsd.edu | 3.45 hours | None taken yet. | - None earned yet - | 2020-10-02 |  |  |  |
| Owen Cruise | ocruise@ucsd.edu | 3.53 hours | None taken yet. | - None earned yet - | 2020-10-07 |  |  |  |
| Ethan Lerner | elerner@ucsd.edu | 0.57 hours | None taken yet. | - None earned yet - | 2020-10-07 |  |  |  |
| Benjamin Crawford | bcrawfor@ucsd.edu | 0.18 hours | None taken yet. | - None earned yet - | 2020-10-07 |  |  |  |
| Udai Kandah | ukandah@ucsd.edu | 2.45 hours | None taken yet. | - None earned yet - | 2020-10-07 |  |  |  |
| Dominic Nightingale | djnighti@ucsd.edu | 16.20 hours | None taken yet. | - None earned yet - | 2020-10-07 |  |  |  |

The Construct control panel



Ramon Sanpedro
tellezatwork+04@gmail.com

Added on
2020-12-07

Last activity
December 07, 2020,
19:08

Total learning hours
0.06 hours

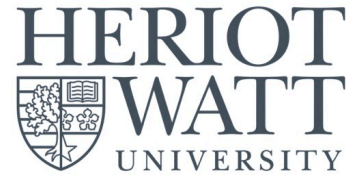
Exams taken | Score
None taken yet.


Certificates
- None earned yet -

| Lesson | Started on | Time spent |
|---|--------------------------|------------|
| URDF Introduction | December 07, 2020, 19:05 | 0:02:04 |
| Building the Visual Robot Model with URDF | December 07, 2020, 19:07 | 0:00:46 |
| Using URDF for Gazebo | December 07, 2020, 19:08 | 0:00:49 |

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Some Universities Using Our Solution





“With The Construct, our students can jump right into ROS without all the hardware and software setup problem. And the best: they can do this from everywhere”

Steffen Pfiffner

Lecturer at University of Weingarten



Advantages of Paid solution

1. Get all the material done ready to teach
 2. Get exams and correction of them
 3. Include LinkedIn certificate
 4. We provide support to your students
- Enjoy yourself teaching instead of wasting your time with the preparation



**Now let's do an
example of a
Zoom class!**





Book a Demo

Have all your students learning ROS in less than a day!

REQUEST A DEMO





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Who is this webinar for

**Which one is the best for launching
faster a better product?**

