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W E B I N A R

HOW TO TEACH ROS EFFECTIVELY WITH MINIMAL PREPARATION

Ricardo Téllez | CEO of The Construct

October 17th, 2019

WWW.THECONSTRUCT.AI

YOU WILL LEARN

- How to have a complete ROS course based on practice that makes students learn
- How to fully remove installation problems on Windows/Linux/Mac
- How to avoid problems of the students low level on programming

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MY GOAL

- The ONLY WAY to make students learn ROS is by **making them practice**
- The BEST WAY to make them practice is by using a **cloud robotics platform**

S P E A K E R

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"For ROS Developers"

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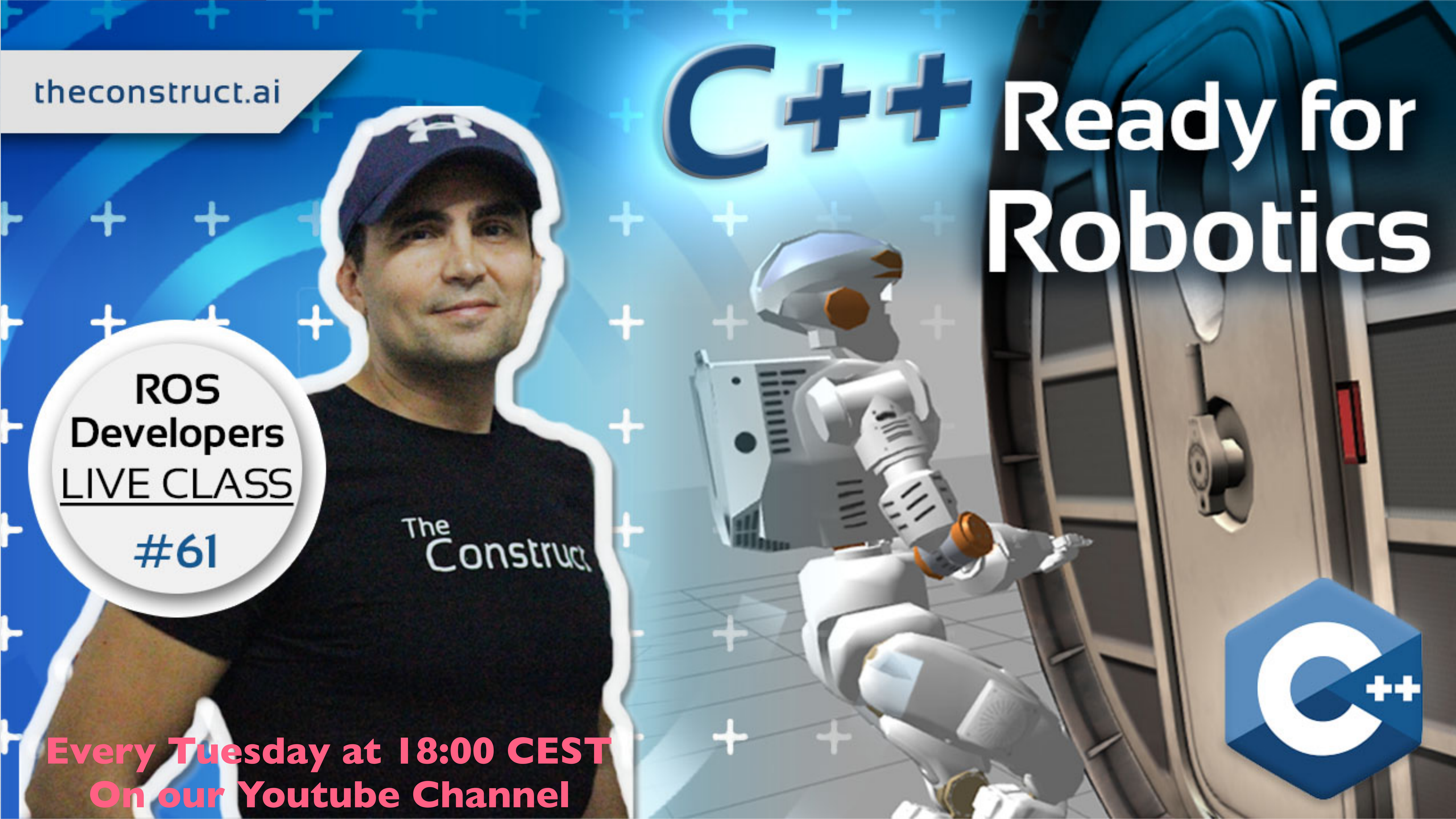
theconstruct.ai
C++ Ready for Robotics
ROS Developers
LIVE CLASS
#61
The Construct
Every Tuesday at 18:00 CEST
On our Youtube Channel

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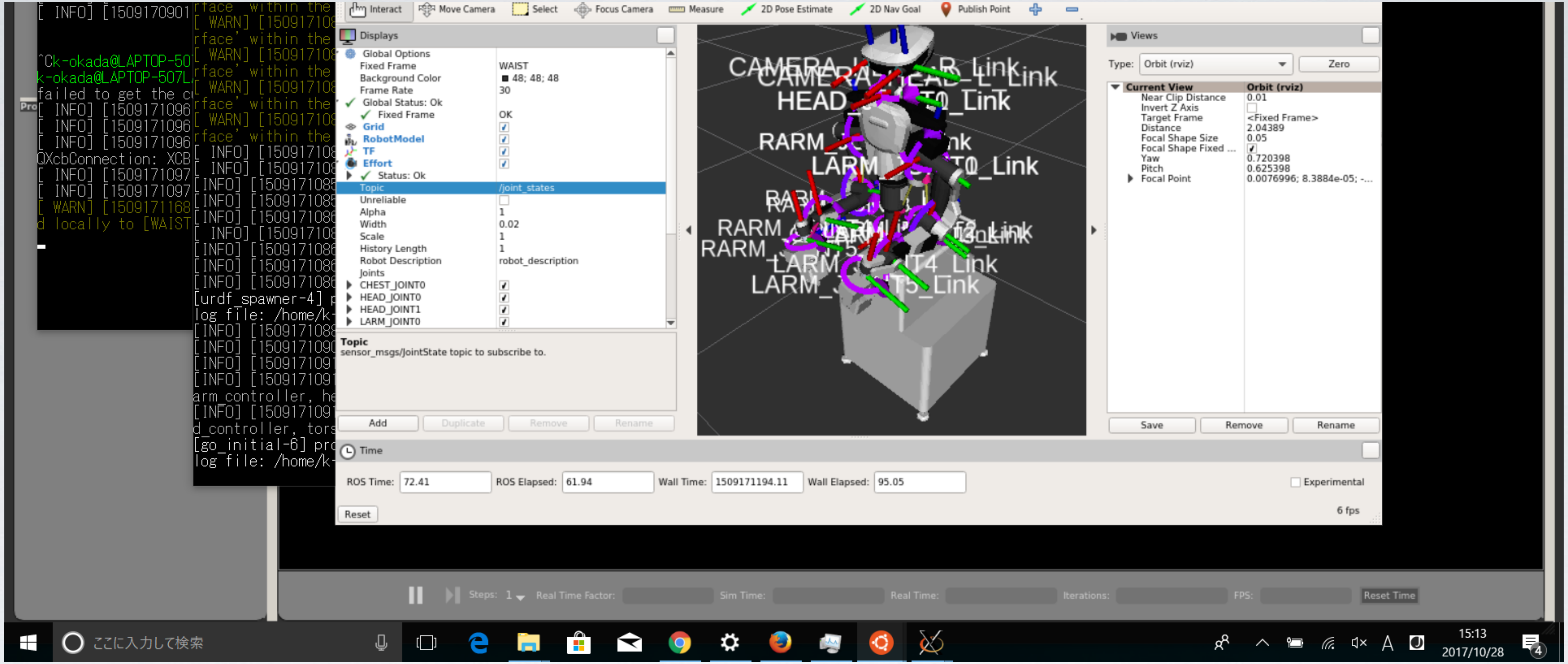
THE PAIN

TEACHING ROS TO STUDENTS

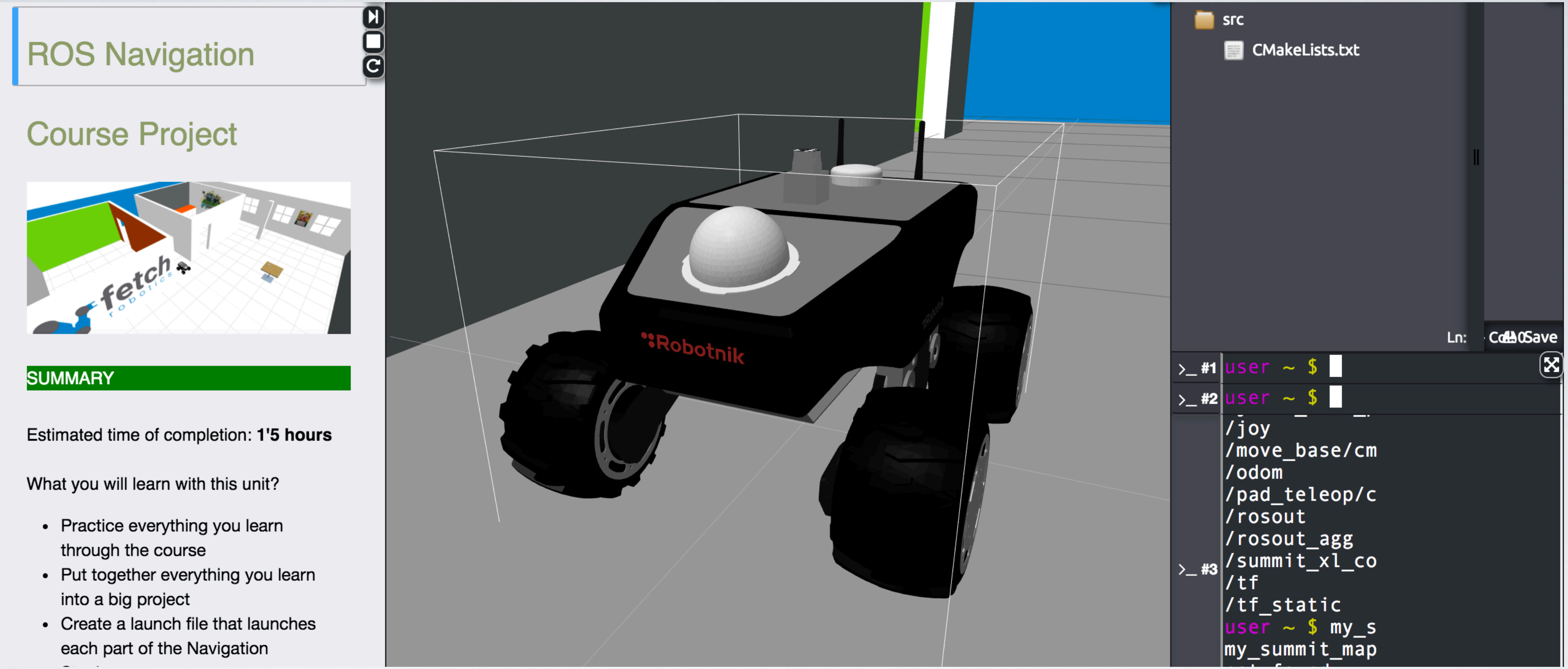
PROBLEM #1

STUDENTS DON'T KNOW LINUX NOR PYTHON /C++



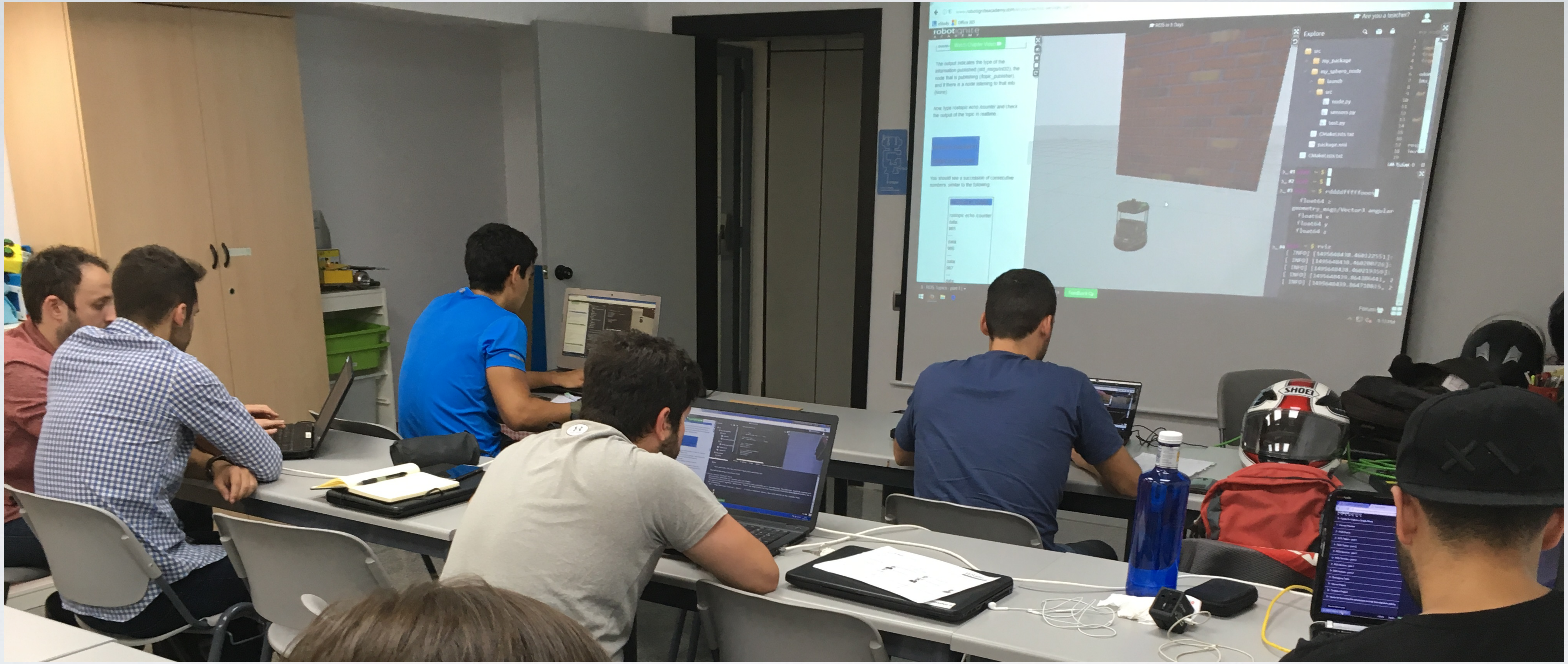
PROBLEM #2

INSTALL ROS IN STUDENTS' COMPUTERS IS DIFFICULT



PROBLEM #3

BUILD THE CURRICULUM IS A LOT OF WORK



PROBLEM #4

SHARE YOUR CODE WITH STUDENTS DOESN'T WORK

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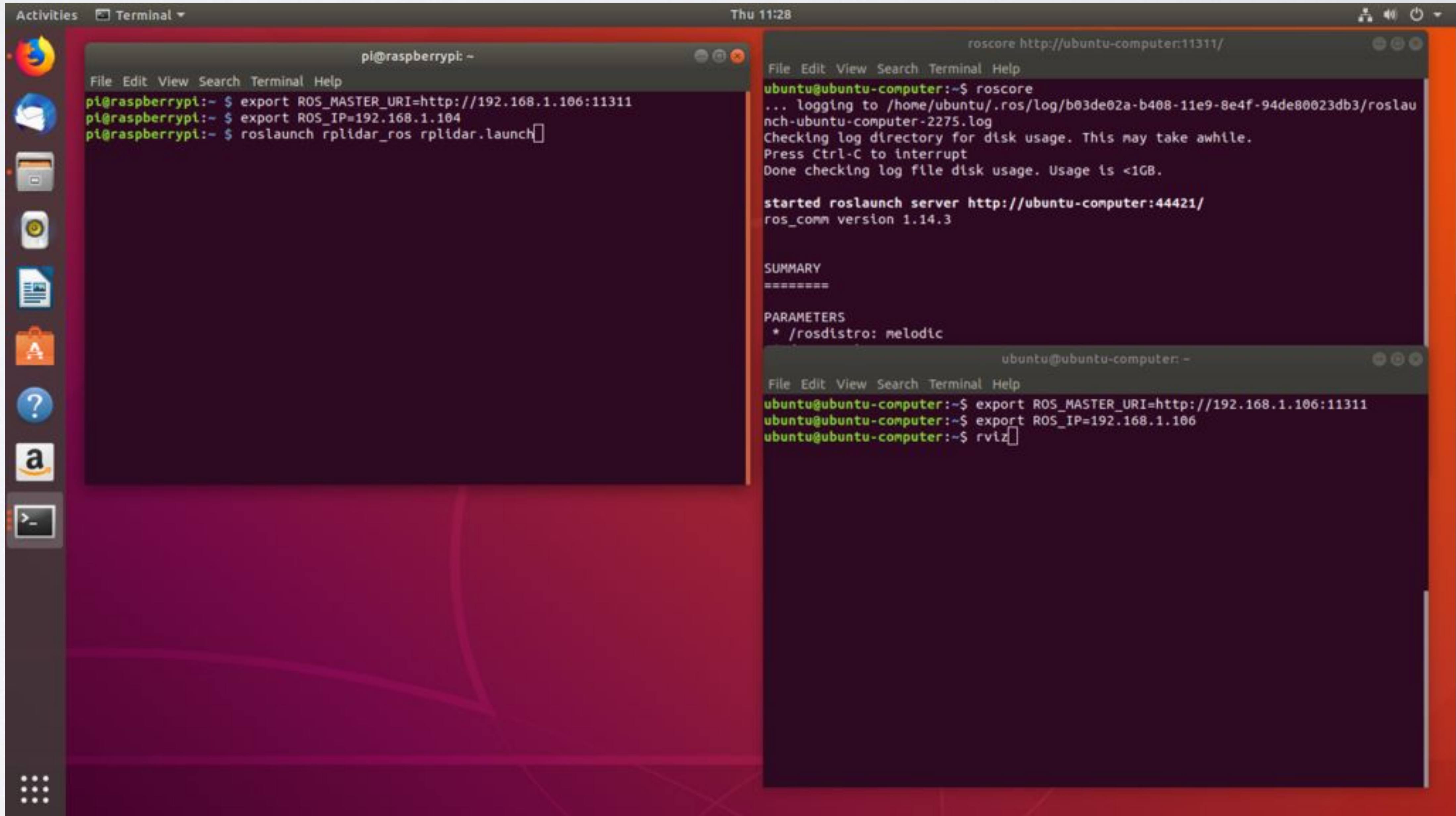
Step By Step Guide To

BUILD A ROS CURRICULUM (THAT MAKES STUDENTS LEARN)

I wanted students to learn ROS by making them practice

This means, install ROS in student's computer:

- Direct ROS install
- Virtual Machine install
- Docker install



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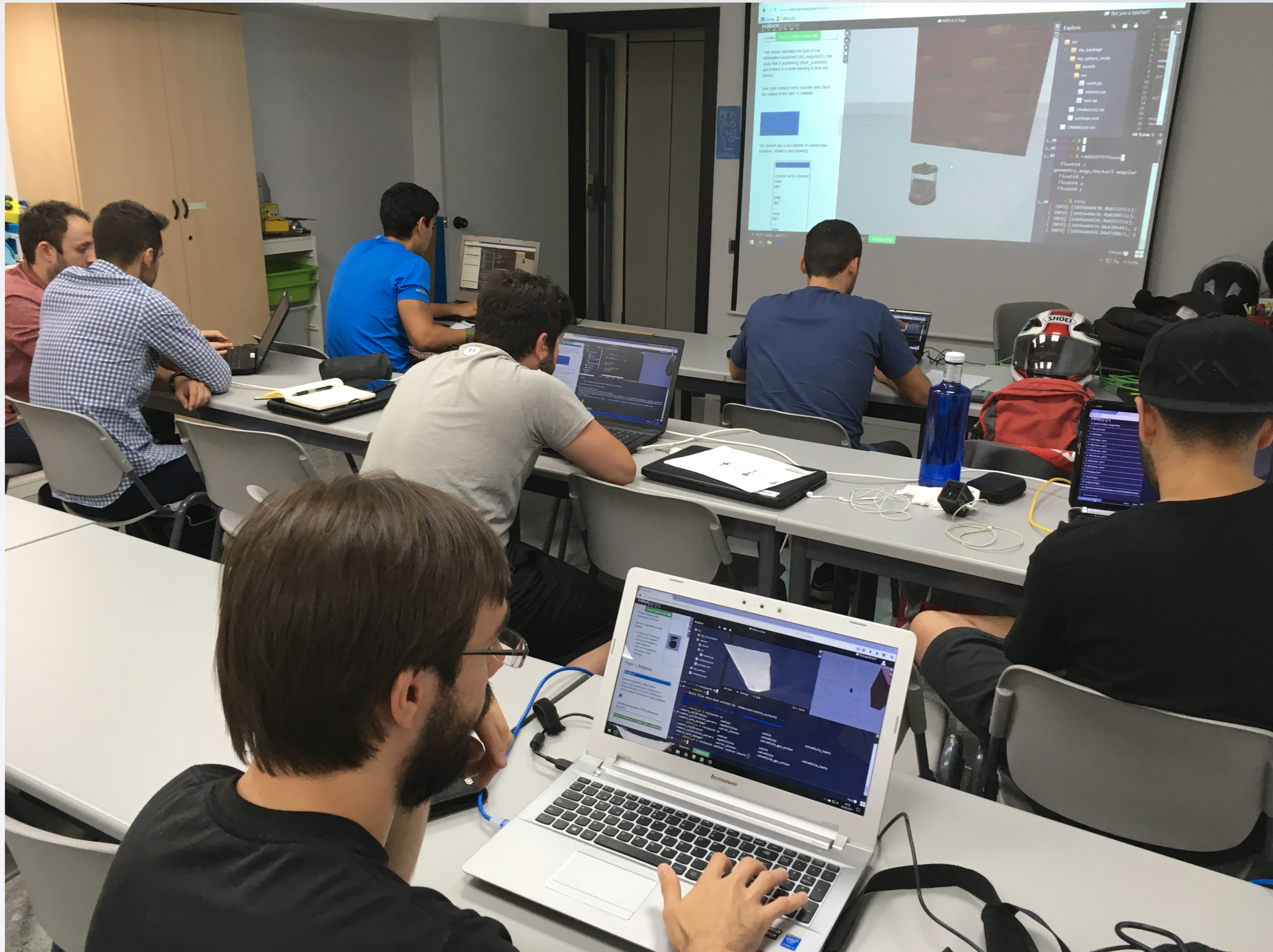
How to provide a ROS environment to the students that have?

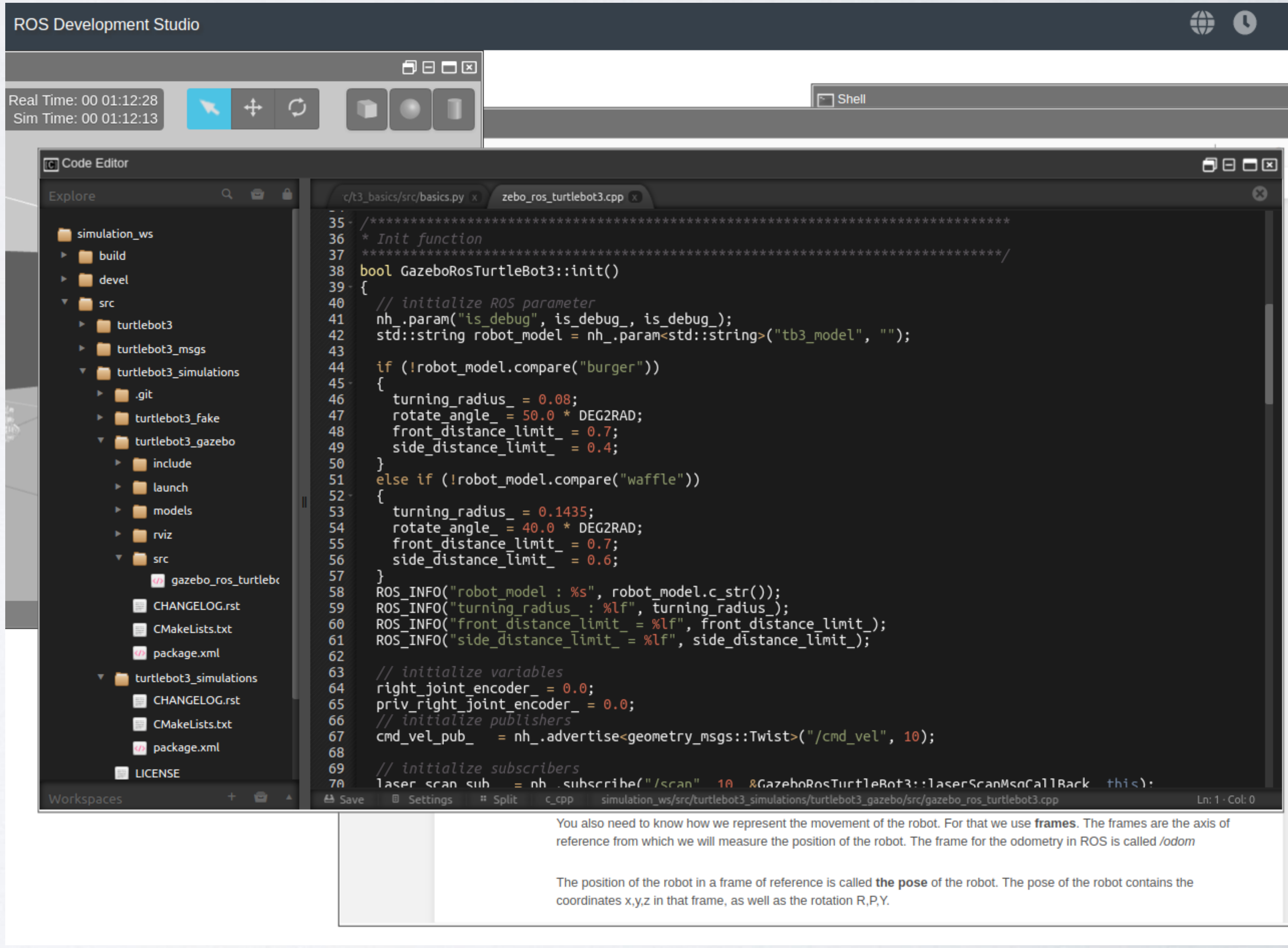
- **No knowledge of Linux**
- **Low programming knowledge** (Python or C++)
- **Windows machines** (mainly)



Let's use the cloud to avoid all the setup trouble!

I'm going to show two solutions:

1. One where **you build the curriculum** (it is free)
2. Another with the **full curriculum built** (has some cost)



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OUR METHOD

- Many Universities around the world using it:
  - Clarkson University, **USA**
  - University Reims, **France**
  - Tokyo University, **Japan**
  - University of Sydney, **Australia**
  - University of Luxembourg, **Luxembourg**
  - University of Michigan, **USA**
  - Heriot Watt, **Scotland**
  - FH Aachen, **Germany**
  - La Salle Barcelona, **Spain**

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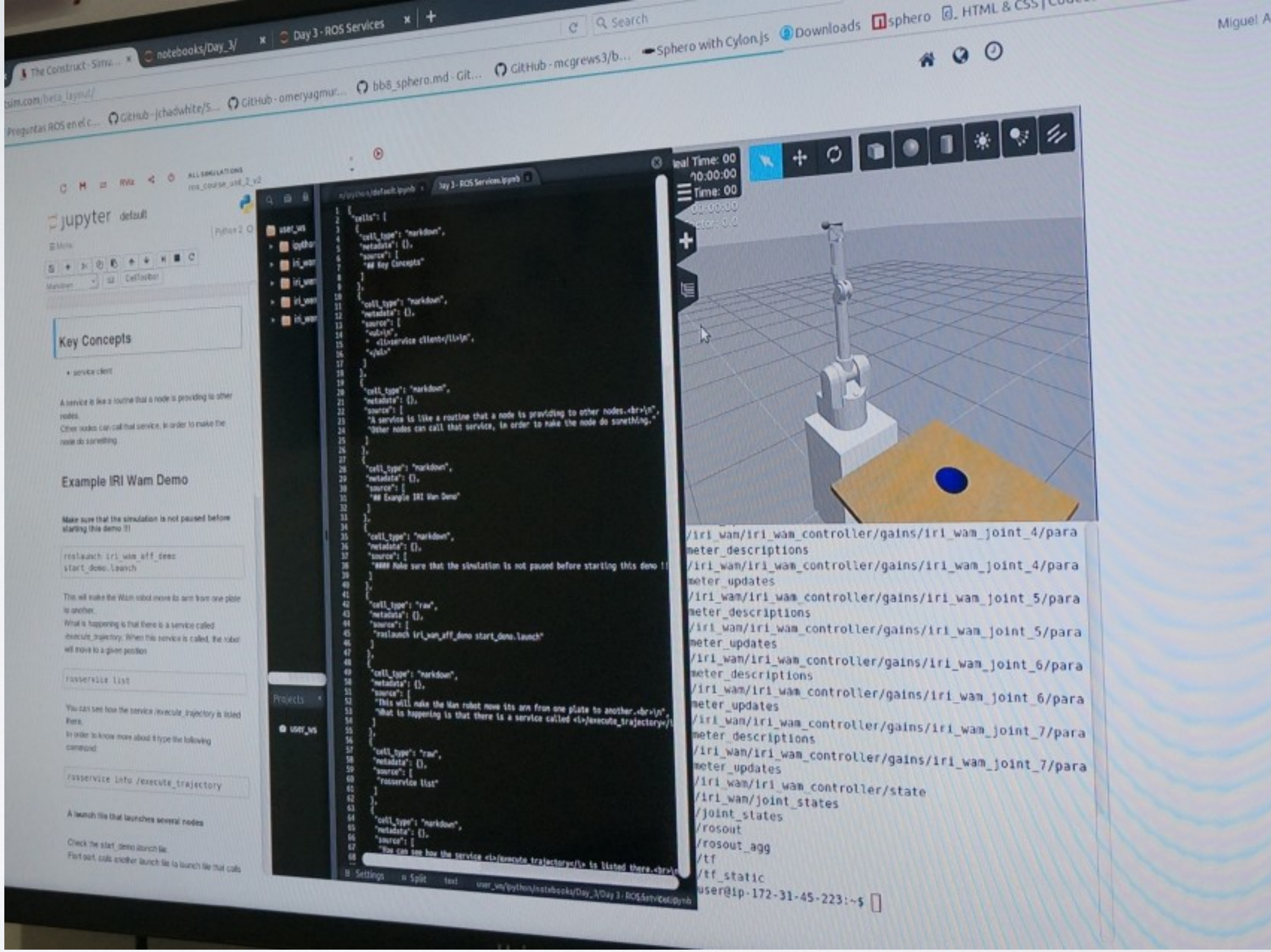
USING THE CLOUD TO

BUILD THE CURRICULUM

Completely Free solution

ROSDS

ROS DEVELOPMENT STUDIO



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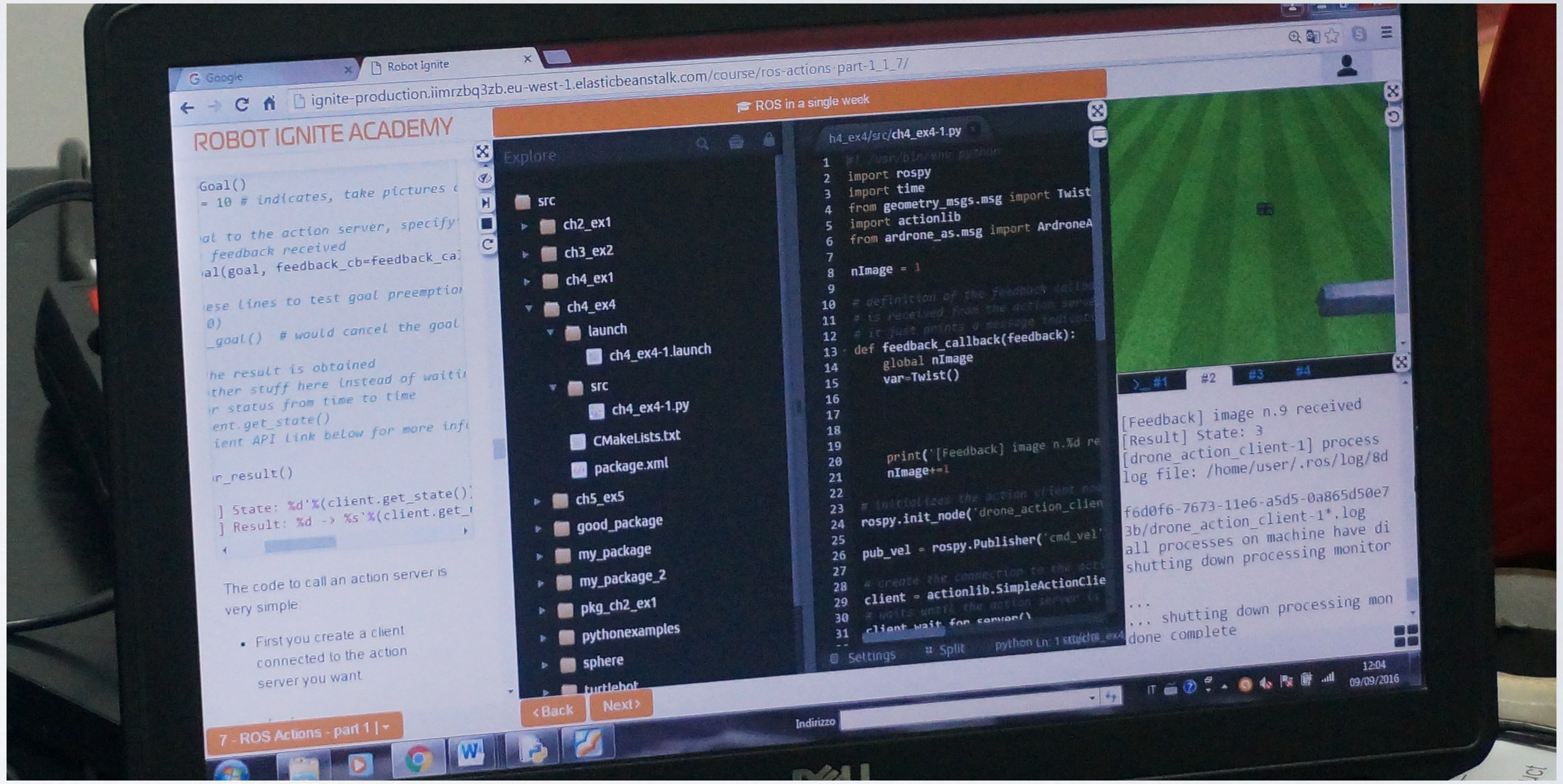
Create a free account at the ROSDS by visiting:
http://rosds.online

STEP 1: Decide Subject To Teach

- Decide a ROS Distribution
- Decide a robotics subject
- Decide a programming language



Let’s work on **ROS Kinetic**

Let's create a course about ***Robot Navigation with ROS***

Let's use **Python** for programming

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Six Units for Robot Navigation:

- **Unit 1**: Odometry Based Navigation
- **Unit 2**: Sensors For Robot Navigation
- **Unit 3**: SLAM Map Building
- **Unit 4**: Monte Carlo Localization
- **Unit 5**: Rapid Random Trees Path Plan
- **Unit 6:** Dynamic Window Approach
- **Project**: Patrol Robot

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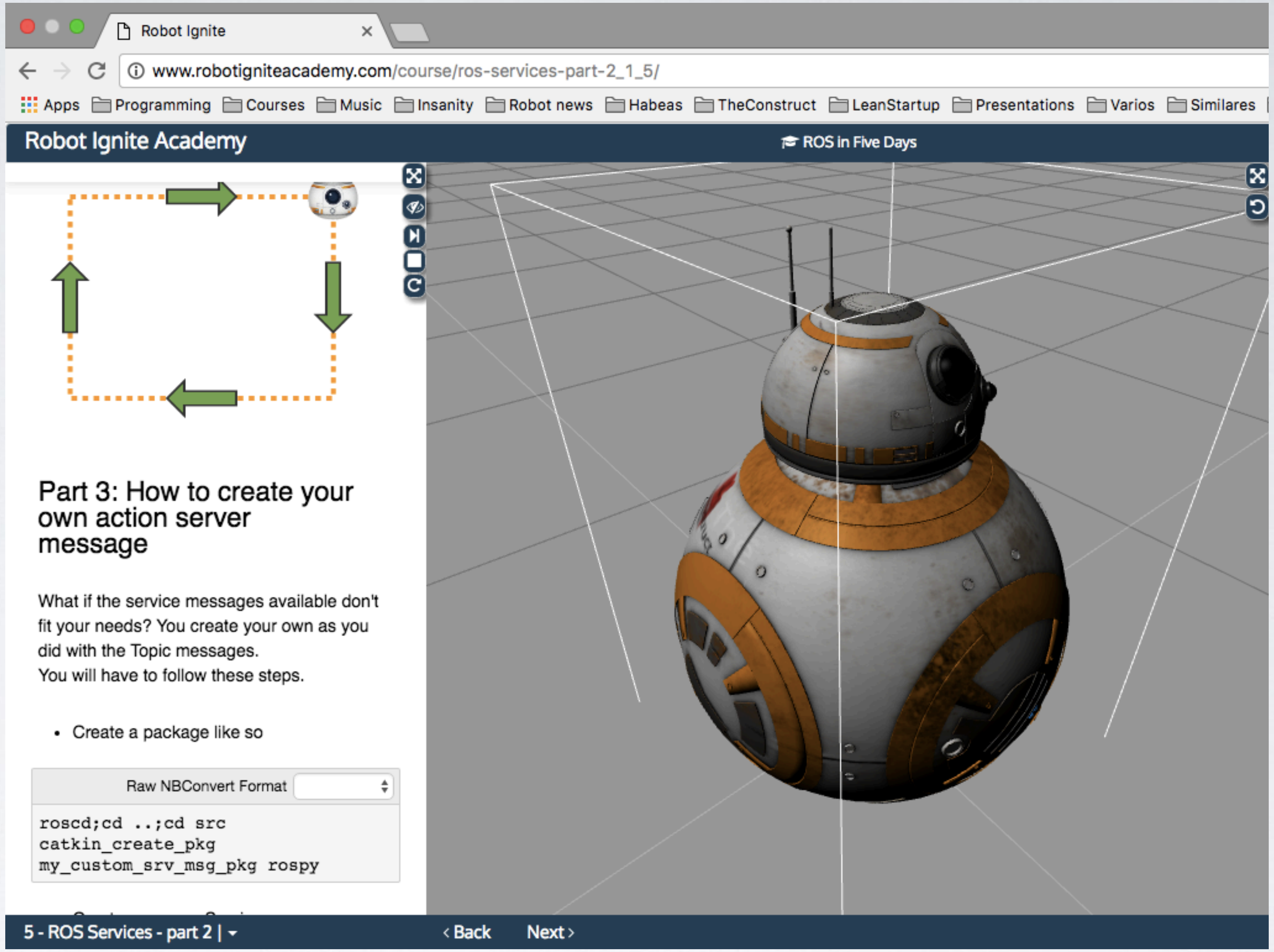

http://rosds.online

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Create a ROS project for first Unit

Unit Title: Unit1_Odometry_Based_Navigation

STEP 3: Decide Which Robots To Use

- Unit 1: **ROSBot** by Husarion
- Unit 2: **Husky** by Clearpath
- Unit 3: **Turtlebot 2** by OSRF
- Unit 4: **Jackal** by Clearpath
- Unit 5: **Summit XL** by Robotnik
- Unit 6: **RB-1** by Robotnik
- Project: **Turtlebot 2** by OSRF

- Need to use robot simulations to practice
- Selected robots must be suitable for the subject to teach
- Get simulations from repos or included in ROSDS
- The Construct simulations repo (for Kinetic or Melodic): https://bit.ly/2Gp601m

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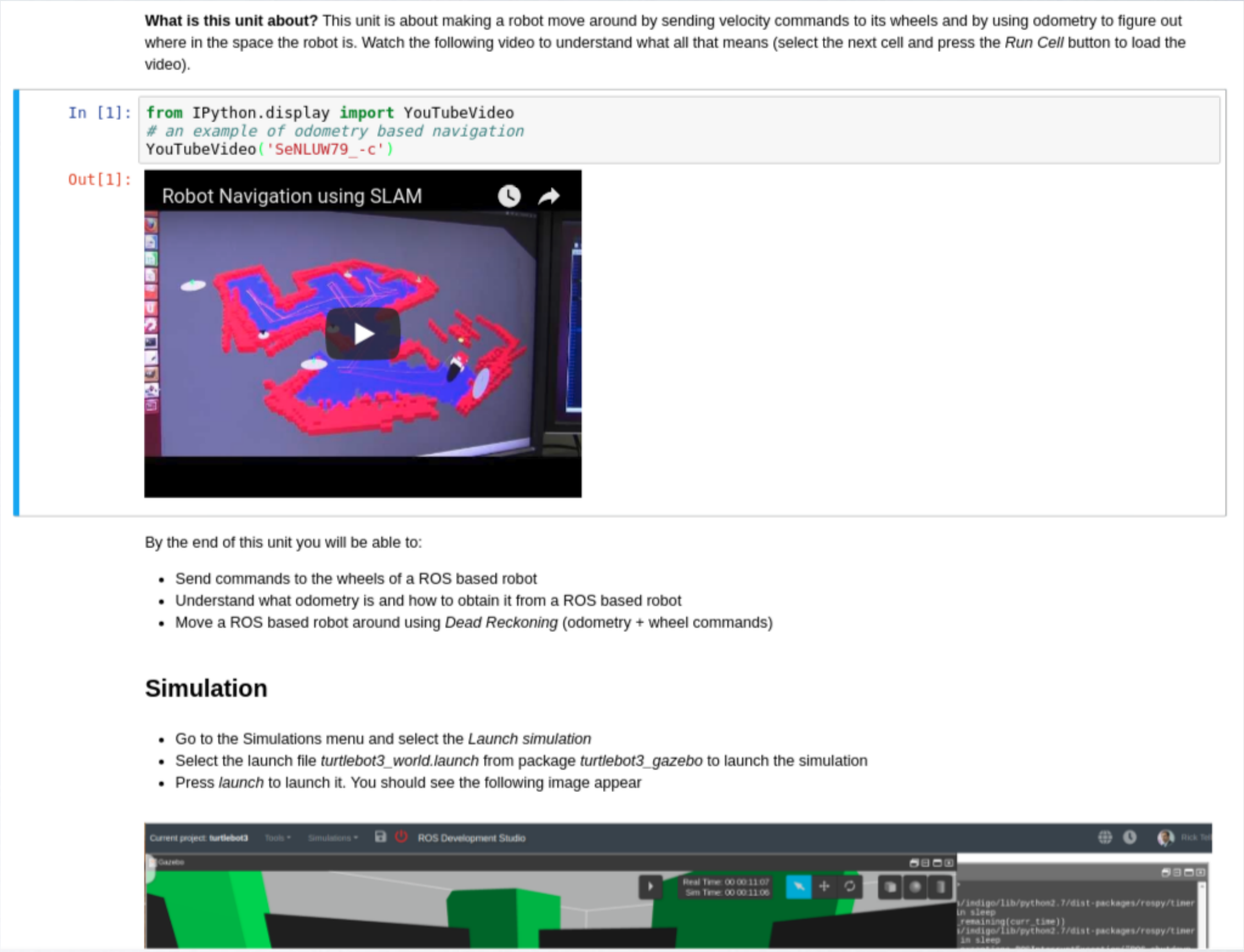
Using Jupyter Notebook

- Include text explanations
- Embed videos and pictures
- Embed Python code
- Interact with the robot directly from the notebook



What is this unit about? This unit is about making a robot move around by sending velocity commands to its wheels and by using odometry to figure out where in the space the robot is. Watch the following video to understand what all that means (select the next cell and press the *Run Cell* button to load the video).

In [1]:
```
from IPython.display import YouTubeVideo
# an example of odometry based navigation
YouTubeVideo('SeNLUW79_-c')
```

Out[1]:

By the end of this unit you will be able to:

- Send commands to the wheels of a ROS based robot
- Understand what odometry is and how to obtain it from a ROS based robot
- Move a ROS based robot around using *Dead Reckoning* (odometry + wheel commands)

Simulation

- Go to the Simulations menu and select the *Launch simulation*
- Select the launch file *turtlebot3_world.launch* from package *turtlebot3_gazebo* to launch the simulation
- Press *launch* to launch it. You should see the following image appear

STEP 5: Provide Example Code

- Add some code to the Unit so the student can use or modify.
- You can provide it as a template

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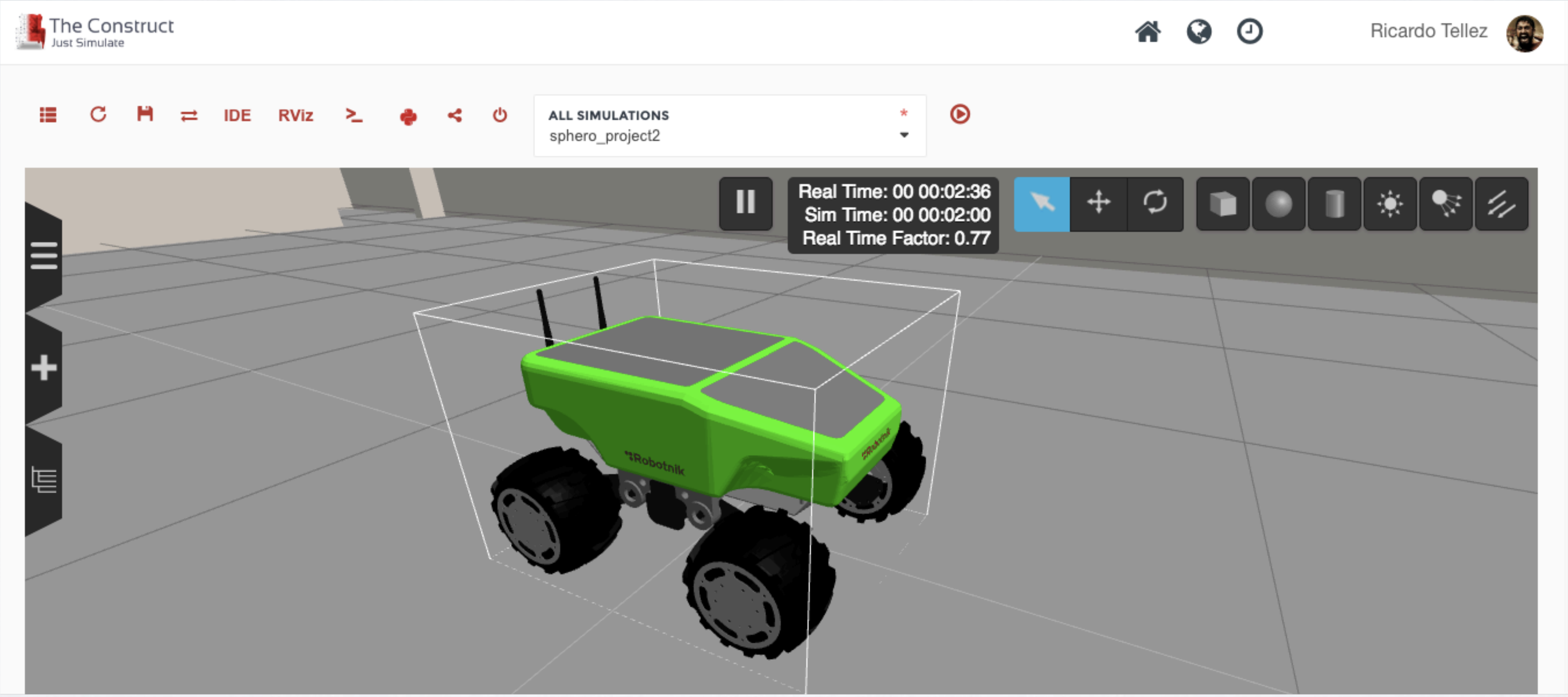
STEP 6: Continue With Next Unit



- Repeat the whole cycle for the rest of units

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STEP 7: ADD A PROJECT

- The project must contain an exercise that includes all the units knowledge
- Include if possible **connection with real robot**

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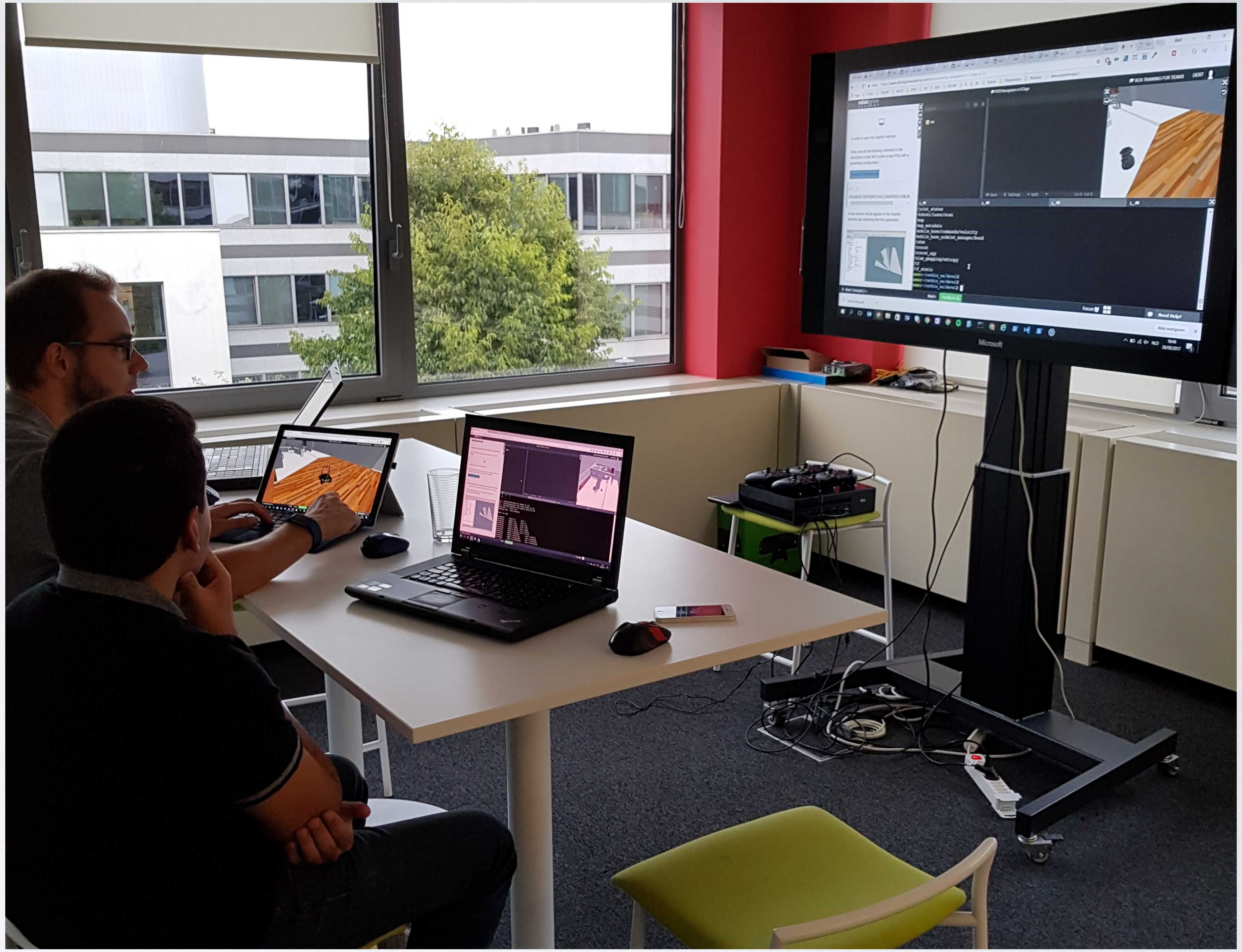
STEP 8: ADD AN EXAM

- **EXAM IS SUPER IMPORTANT!!!**
- Not only to evaluate, but also to make them learn

STEP 9: Share With Students

- Generate the rosject link and share with the students



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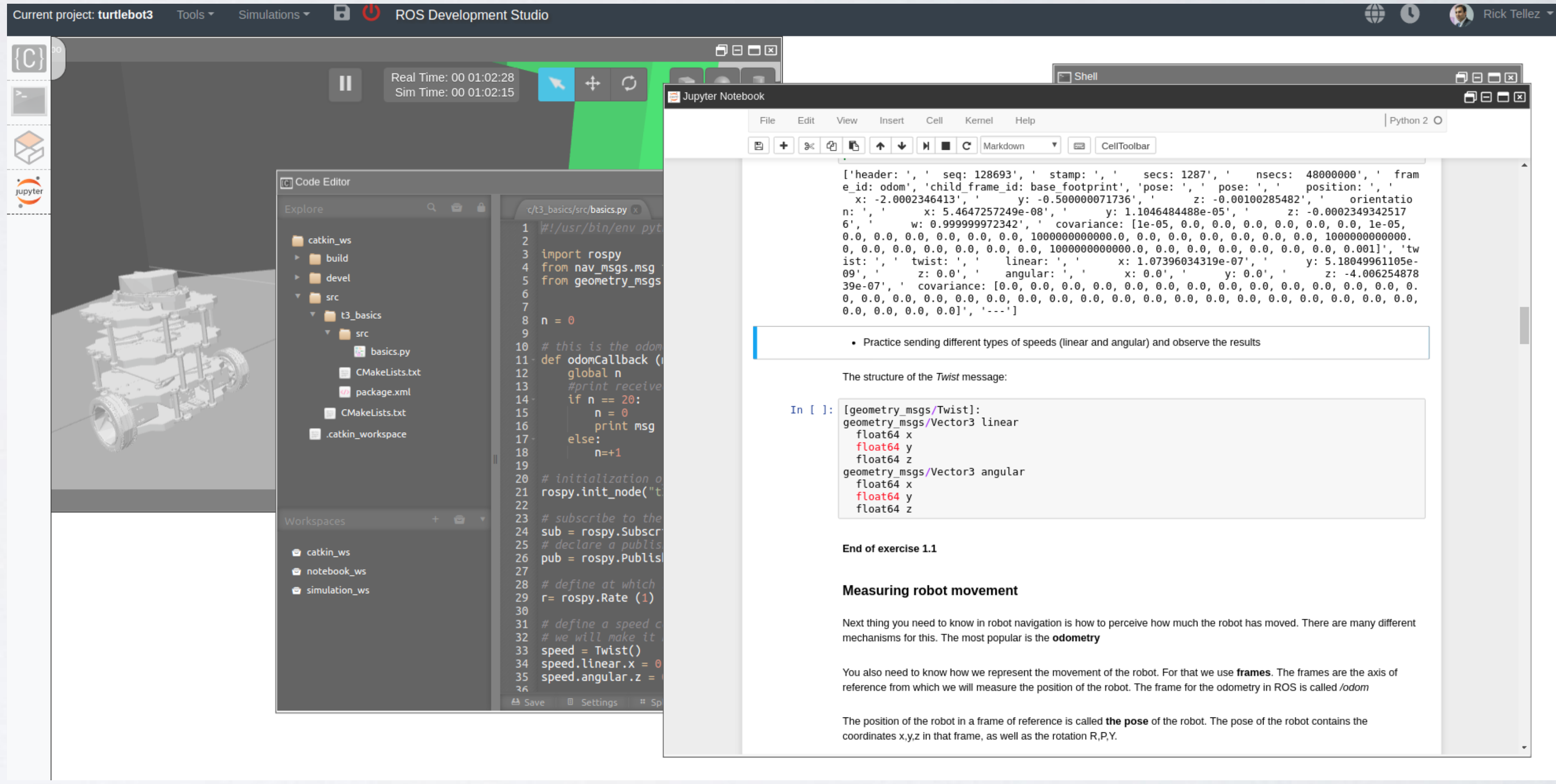
EXAMPLES ALREADY DONE

Unit 1: http://www.rosject.io/l/b5c1af3/

Project: https://bit.ly/2K1RCNq

Exam: http://www.rosject.io/l/b5e14b5/



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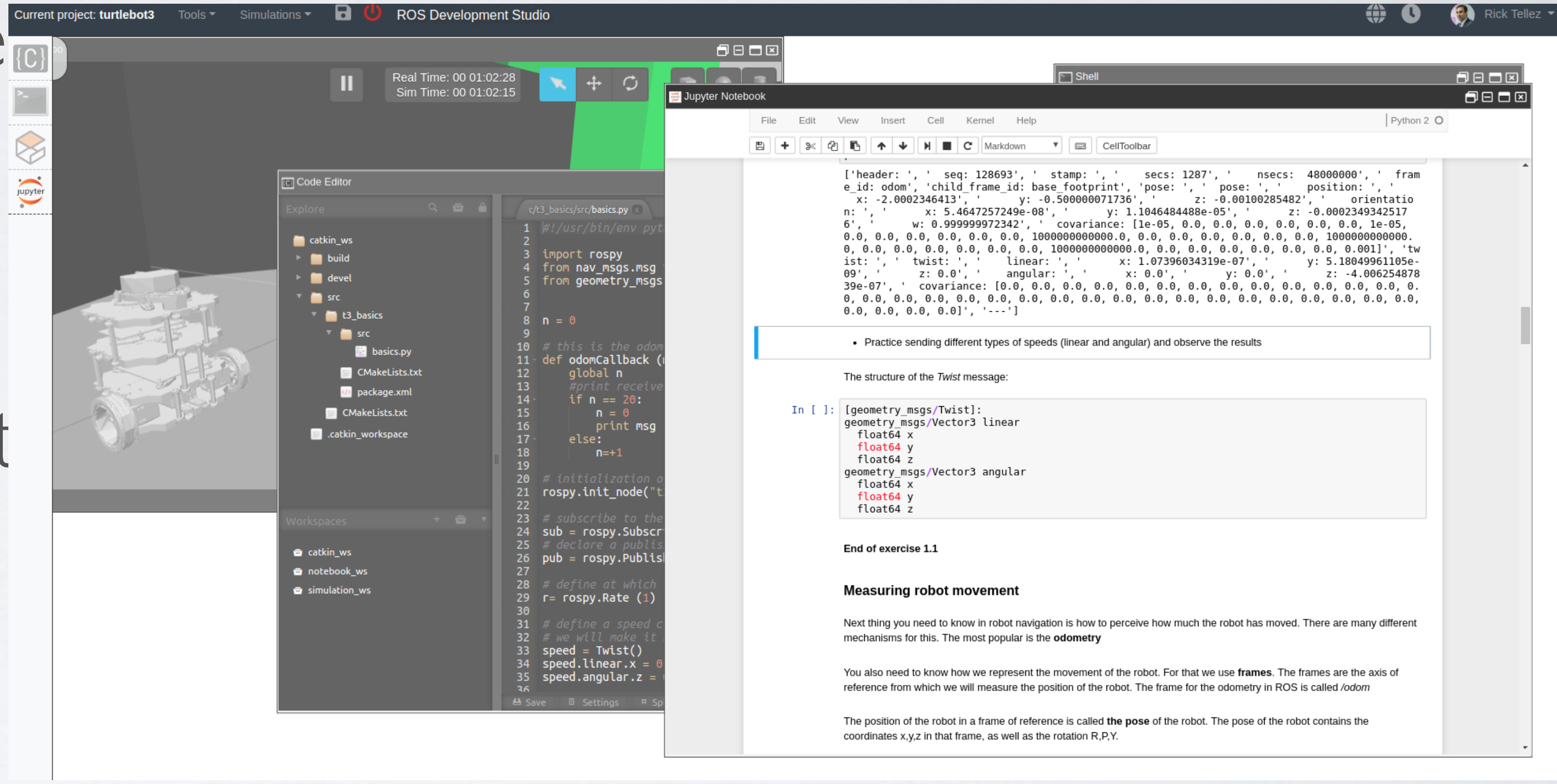
SUMMARY OF THE WHOLE PROCESS

1. Decide **subject** and **programming language**. Also, decide **units** of the course
2. Create a **rosject for each unit**
3. Get a **robot simulation** for each unit
4. Create a **Jupyter notebook** for each unit
5. Create some **sample code**
6. **Repeat** for each unit, project and exam
7. **Share** with students



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ATTENTION!

- Provide some previous training about:
  - **Linux**
  - **Python**

Free online courses:

Linux for robotics: https://tinyurl.com/yxuo5urh

Python for robotics: https://tinyurl.com/y2en8pl8

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ROS WEBINAR

QUESTIONS ?

Ricardo Téllez | CEO of The Construct

What our clients say

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

Steffen Pfiffner

Lecturer at University of Weingarten