Robotics Project

Introduction & Logistics

Joaquin Rodriguez, ImViA - Univ. Bourgogne
MSc in Computer Vision, 2024

Presentations based on the work of Ralph Seulin

LOGISTICS & COURSE SCHEDULE

Team

- **Coordinator**: Joaquin Rodriguez
- **Instructors & Contacts**:
  - Joaquin Rodriguez — Joaquin-Jorge.Rodriguez@u-bourgogne.fr
  - Raphaël Duverne — Raphael.Duverne@u-bourgogne.fr

Logistics & Course Details

- There are no bad questions (respectful environment towards colleagues). **Please participate!**
- Course material: **shared on teams**.
- Courses and project done along 12 weeks! (17 September to 16 December).
- Every Monday (mornings and afternoons)
- Even if you have to work by yourself, without your professor, YOU MUST COME TO THE LAB !!

Robotics Project

Session 01 – Introduction Session

- Module Presentation
  - Objectives & Content / Planning
  - Evaluation
- Project
- Tools & Tips for Development

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Robotics Project

Course Goals:

1) Learn ROS, its philosophy and how to **implement algorithms in ROS (packaging)**

2) Develop and embed a large mobile robotics project with several perception and action submodules with a real robot (**and make it work!**).

3) After this course, students should also acquire good project management practices and be able to **develop and integrate ROS packages and deploy existing algorithms** into real robots.

Robotics Project

Module Content

➔ **Tutorials**

- Prerequisites – Ubuntu & Python
- ROS Basics
- Robots, Navigation & Perception

➔ **Projects Development**

- Groups of 2 Students

➔ **Defenses**

Module Planning

- **<u>Tutorials</u> for Hardware & Software (5 Weeks)**

  --> 17 Sep. until 21 Oct. 2024

- **<u>Projects Development</u> (6 Weeks)**

  --> 21 Oct. 2024 => 09 Dec. 2024

  --> Support & Project Review

- **<u>Defenses</u>: 16 Dec. 2024**

Module Evaluation

Progress (50 %)

- **Homework (20%)**

  --> Evaluate understanding during tutorial sessions.

- **Project Management (30%)**

  --> Project Review (every one or two weeks)

  --> Project Board :

  -Task management (on github)

  -Progress monitoring

Module Evaluation

Projects (50 %)

- Material (30%)

Examination board will evaluate the technical documentation and the quality of the associated delivered material (source code & medias).

- Oral Presentation & Demonstration (20%)

Examination board will evaluate the quality of the presentation, the commented demonstration and the questions answered by the students.

- Defenses 16 Dec. 2024

Robotics Lab Rules

Room Access

- **Granted only for students !**
- Opening Hours: 8:00 - 18:00
- ***Minimum 2 students***

- NO FOOD OR EATING IN THE LAB!

Academic Integrity

- You can discuss projects and exercises, but don’t share it.
- Don’t look up code from a friend (it is easy to catch :( ).
- **If you’re not sure if it’s allowed, ask to the staff.**
- Acknowledge any inspirations.
- If you get stuck, come talk to us!

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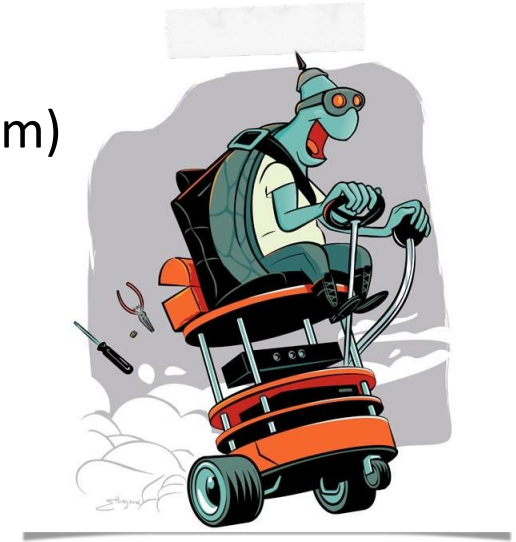
Project

To Demonstrate
a Ground Robot
performing Tasks
Autonomously
by Perception

Robotics Projects

Main Project Divided in Two Parts:

- Part I: Autonomous Driving (Basic algorithm)
- Part II: Autonomous Driving (Advanced algorithm)



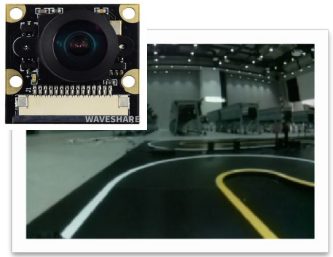
NOTE: The final grade will be computed as:

Final note = 0.5 * Part I + 0.5 * Part II

Project

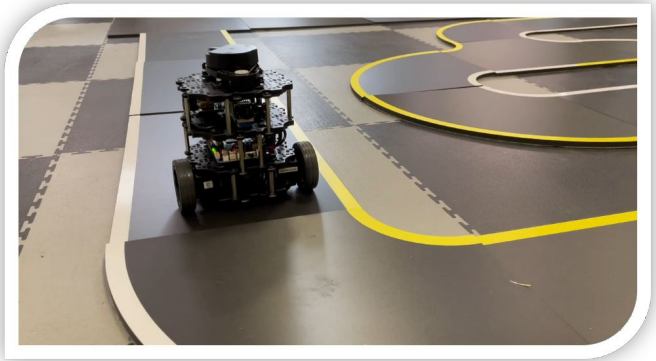
Part I: Autonomous Driving of a Ground Differential Robot by Perception

+



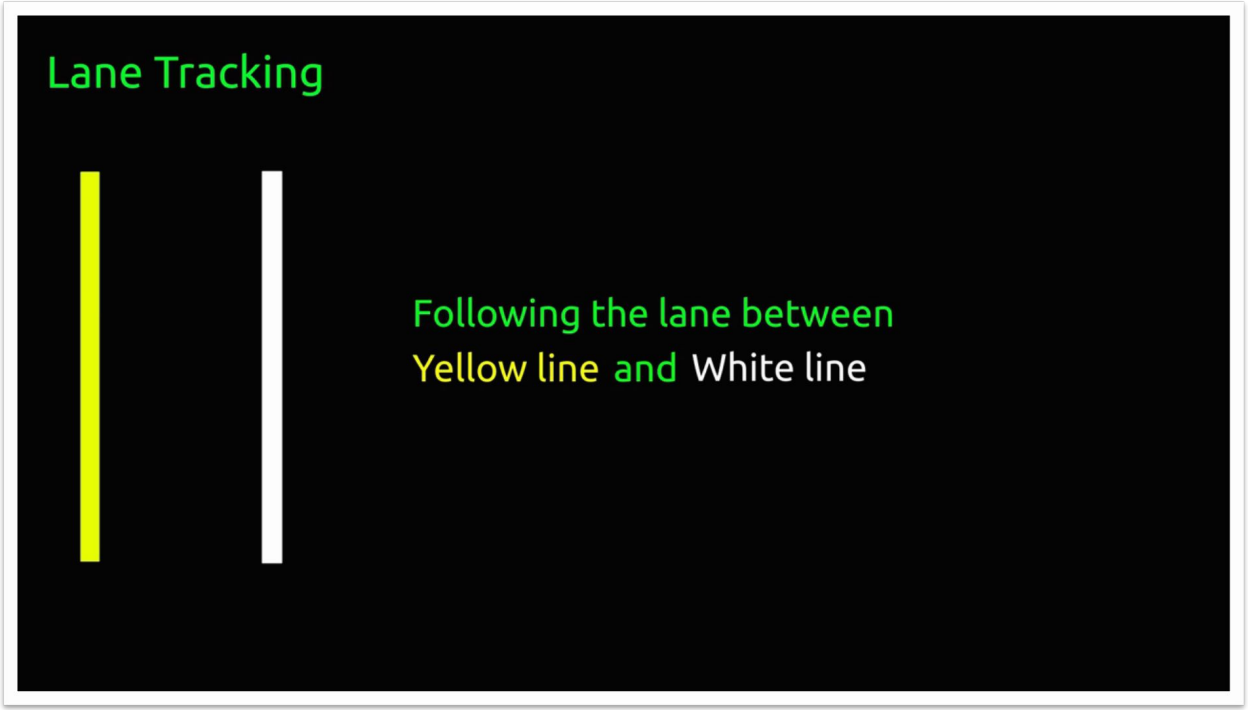
+ ROS

=



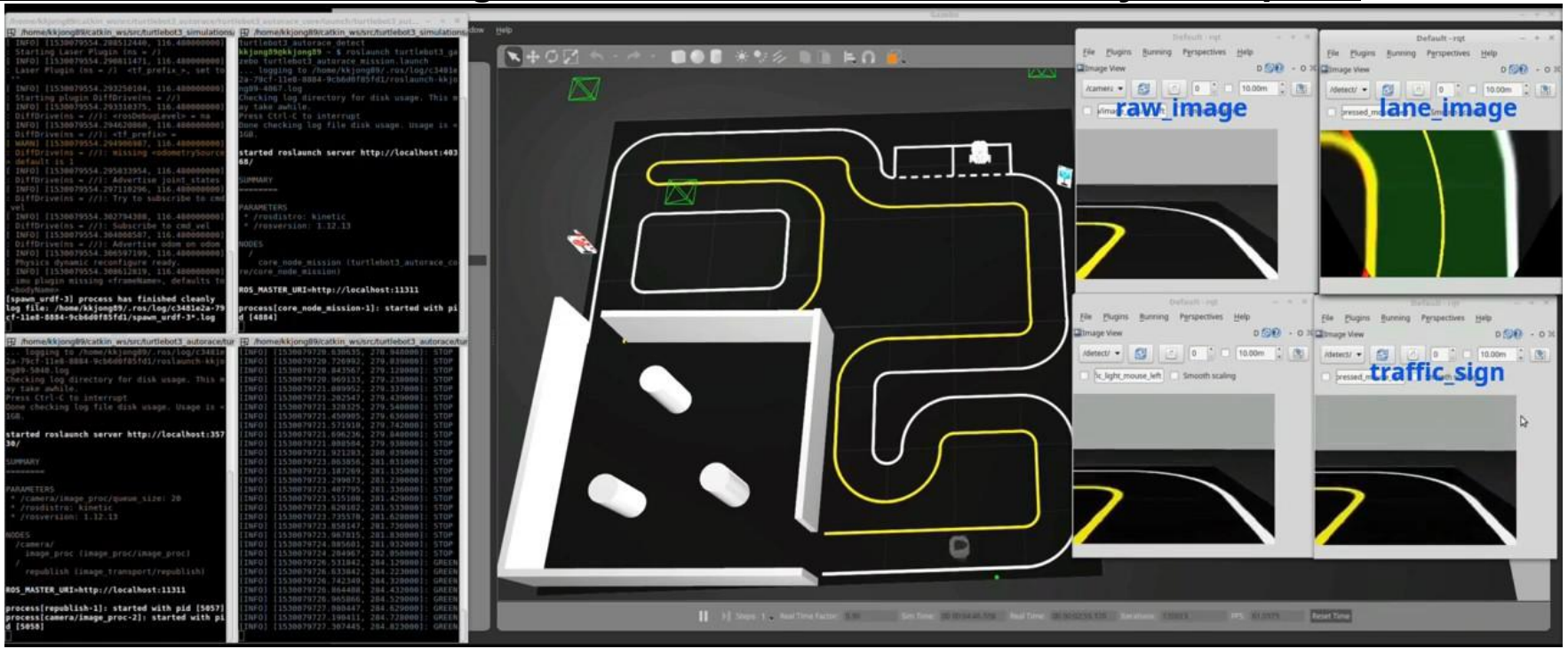
Project

Part I: Autonomous Driving of a Ground Differential Robot by Perception (HOW ?)



Project

Part I: Autonomous Driving of a Ground Differential Robot by Perception



Project Goal - Part I

ROBOTIS AutoRace Challenge

Website: https://emanual.robotis.com/docs/en/platform/turtlebot3/autonomous_driving/

Videos: ROBOTIS AutoRace Playlist

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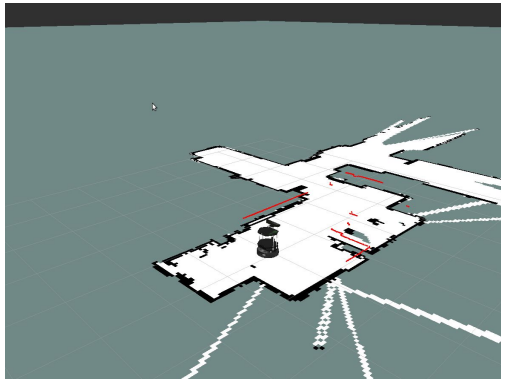
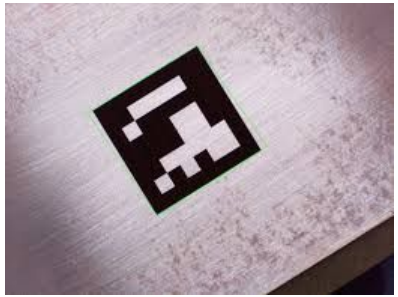
Part II - Tag Recognition & VSLAM

Part II: Doing autonomous driving by doing SLAM and create the autorace map



ROS



Part II - Tag Recognition & VSLAM

Part II: Doing autonomous driving by doing SLAM and create the autorace map

- Objective:
  - ⇒ Create a map of the autorace track by doing SLAM, and keep the robot inside the track all the time. Once the map done, using the path planning to move the robot in the track.
- Requirements:
  - ⇒ only use the vision sensors and encoders (No LiDAR).
  - ⇒ Use the race color lines as obstacles.
  - ⇒ Optionally, you can use at most 4 ArUco tags where you need.
  - ⇒ The first run, you will run an exploration run, then you will use the path planner to do continuous runs on the track.

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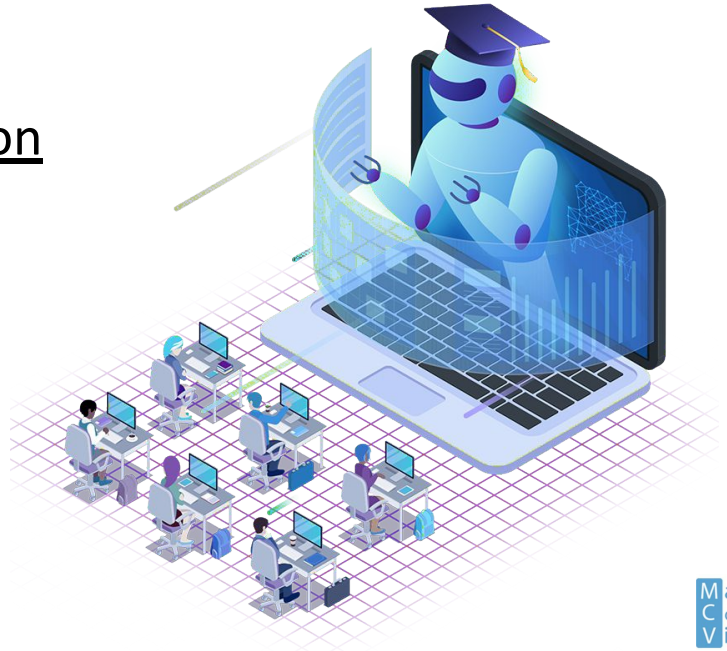
Platform

The Construct

- A Full ROS & Robotics Teaching Solution.
- Robotics Curriculum Designed for Remote & Classroom Learning.
- Courses with Practical Tutorials
- ROS Development w/ Robot Simulation

https://www.theconstructsim.com/

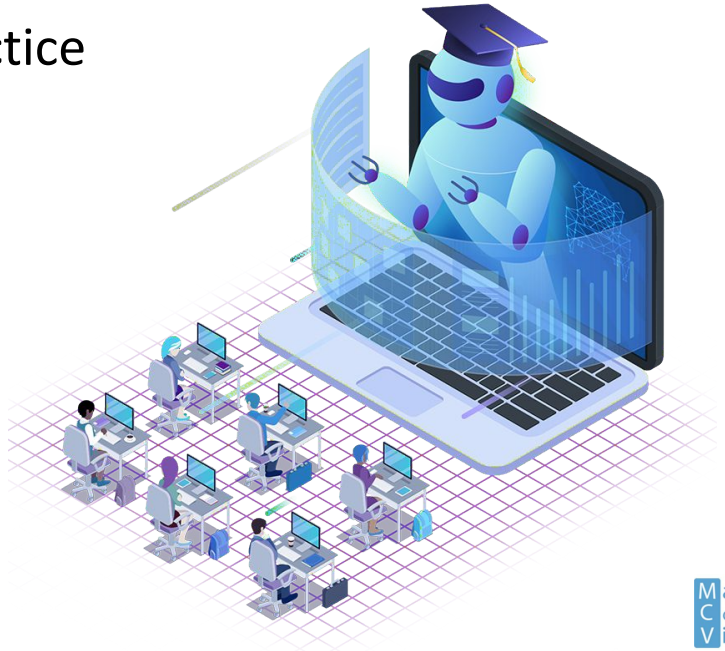


Platform

The Construct

- No Installation required -> Online
- Run ROS on Any Computer
- Learn Robotics & ROS based on Practice
- Dozens of Simulated & Real Robots.

https://www.theconstructsim.com/



Platform

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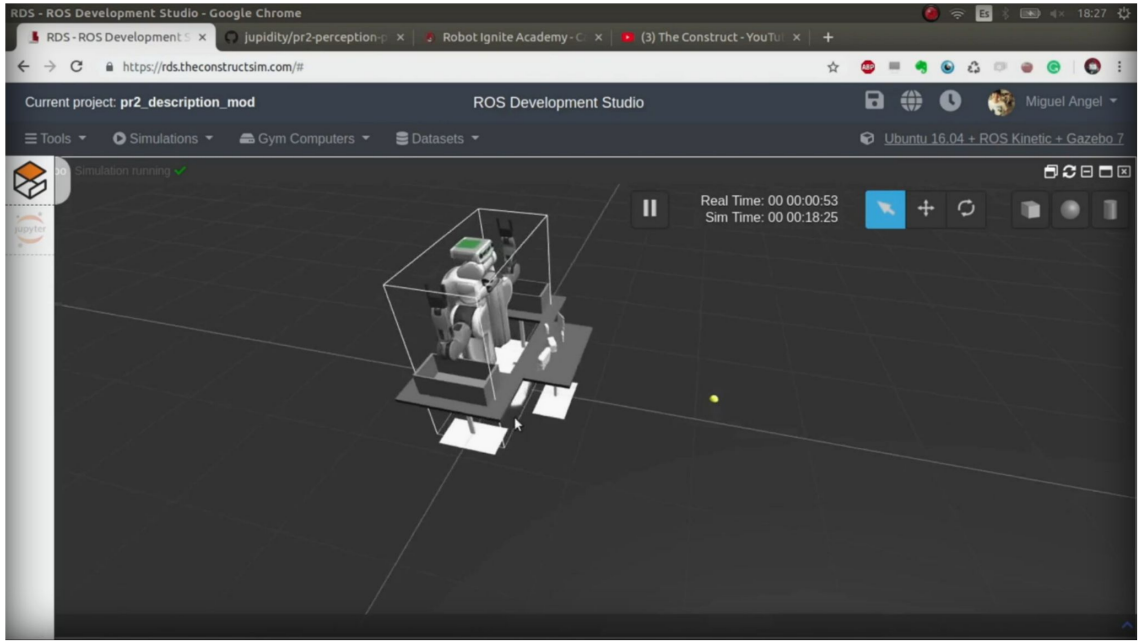


https://www.theconstructsim.com/

Platform

Certificate

End of Learning Path > Online Exam

https://www.theconstructsim.com/

Tutorials

Homework 01 - Linux for Robotics (today)

The Construct

Learn Linux Fundamentals

- How to navigate through a Linux **filesystem**
- How to interact with a Linux **filesystem**
- How to edit files using the **Shell** (vi editor)
- Manage access to files (**Permissions**)
- Create simple Linux programs (**Bash Scripts**)
- Manage execution of Linux programs (**Processes**)
- How to connect to the remote computer of a robot (**ssh**)
- ***Deadline (ONLINE EXAM): One week (27/09/2024)***

Free course : https://bit.ly/3fAlbUl

Live class video : https://www.youtube.com/watch?v=_YHvSl_yQDk

Tutorials

Session 02 - Python 3 for Robotics (23 / 09)

Master the basics of Python 3 for robot programming

- 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 encapsulate the code into **Classes** so you can have clean and robust code
- **Deadline: 10 days (04/10/2024)**

Free course : https://bit.ly/30qdsUb

Live class video : https://youtu.be/HqKpHj0_jtg

Tutorials

Session 03 - ROS Basics (30 / 09)

The Construct

Learn Fundamentals of ROS

- 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.
- ROS BASICS IN 5 DAYS – https://youtu.be/EnSpiaD4S1g?si=0ro-1js9GQcZmklJ
- **Deadline: 10 days (10/10/2024)**

Course : https://www.theconstructsim.com/..../ros-python-course/

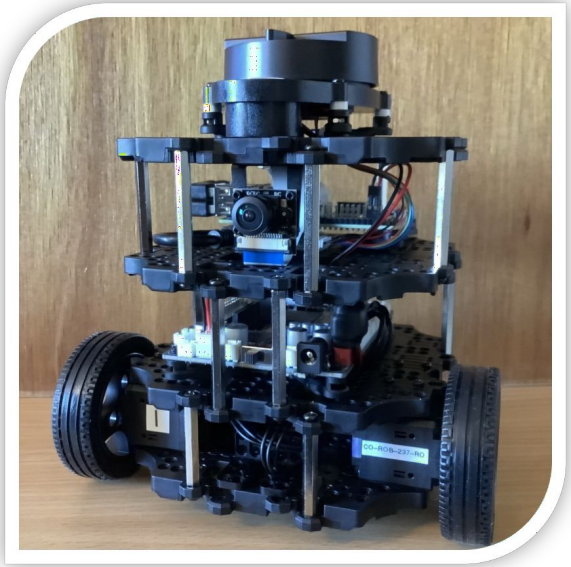
Video : Youtube Playlist - ROS BASICS IN 5 DAYS

Tutorials

Session 04 – TurtleBot 3 (07 / 10)

Learn How to “tame” your Robot

- Hardware
- Software
- Monitoring tools (RQt_Graph, RViz, ...)
- Simulation (Gazebo)



Turtlebot 3 manual : https://emanual.robotis.com/docs/en/platform/turtlebot3/overview

Additional Tutorials

Session 05 - ROS Perception (14 / 10)

- Learn how Visual Perception is Performed by Robots
  - Fundamentals of Computer Vision for Robotics
  - Vision Basics Blob Tracking
    - Track objects by its color blobs
  - Navigate following floor lines w/ RGB camera
    - Vision Basics Follow Line

Course : https://www.theconstructsim.com/.../ros-perception-in-5-days/

Video : Youtube Playlist - ROS PERCEPTION

Additional Tutorials

Mastering with ROS: Turtlebot3

Learn how to work with a Turtlebot3 robot

- Basic Usage and control of the Turtlebot3 robot
- How to perform Navigation with Turtlebot3
- Follow a line with Turtlebot3
- Object Recognition with Turtlebot3
- Motion Planning in Moveit with Turtlebot3

Course : https://www.theconstructsim.com/.../mastering-with-ros-turtlebot3/

Project : https://www.theconstructsim.com/.../ros-projects-turtlebot3/

Additional Tutorials

ROS Navigation in 5 Days

Make your Robot Navigate Autonomously w/ ROS Navigation Stack

- Setup ROS Navigation Stack on a Robot
- Building a map of the environment
- Perform Robot Localization
- Autonomous Path Planning
- Understanding Simultaneous Localization and Mapping (SLAM)
- Obstacle Avoidance

Course : https://www.theconstructsim.com/.../ros-courses-ros-navigation-in-5-days/

Video : Youtube Playlist - ROS NAVIGATION IN 5 DAYS

Additional Tutorials

OpenCV Basics for Robotics

Learn how to work with OpenCV in ROS

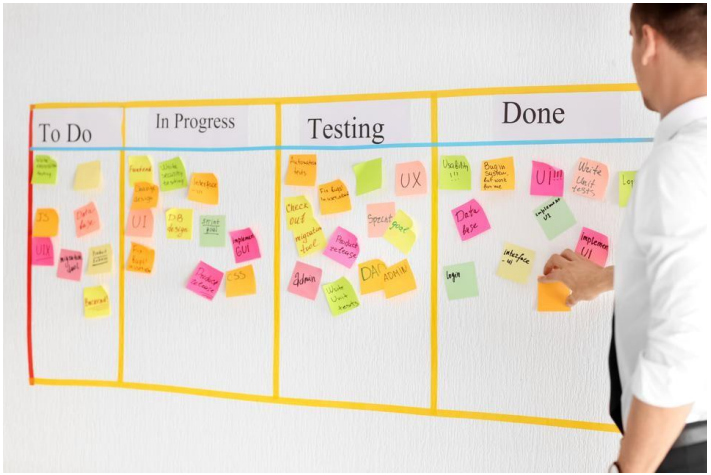
- Computer Vision Basics
- People related OpenCV functions
- Feature Matching
- ARTags (Augmented Reality)
- Course Project

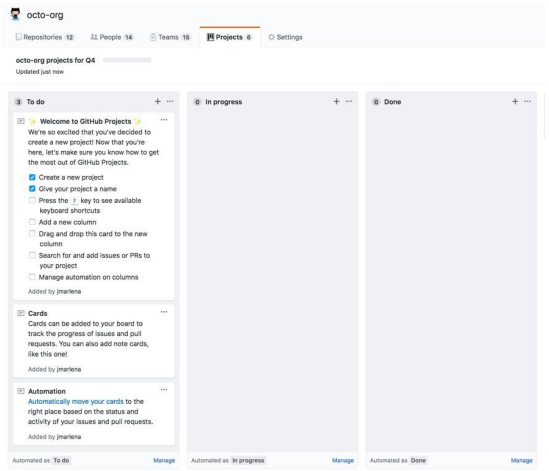
Course : https://www.theconstructsim.com/.../opencv-basics-for-robotics/

Video : Youtube Live Class OpenCV Basics

Project Management

- **GitHub Project Boards**
  - **Kanban Board to Track your tasks with :**
    To do / In progress / … / Done columns





GitHub : https://www.github.com/

MarkDown : https://guides.github.com/features/mastering-markdown/

Project Management

```
# WriteMe.md
### A simple, real-time Markdown editor with GitHub and Bitbucket
themes

---

To use it, simply:

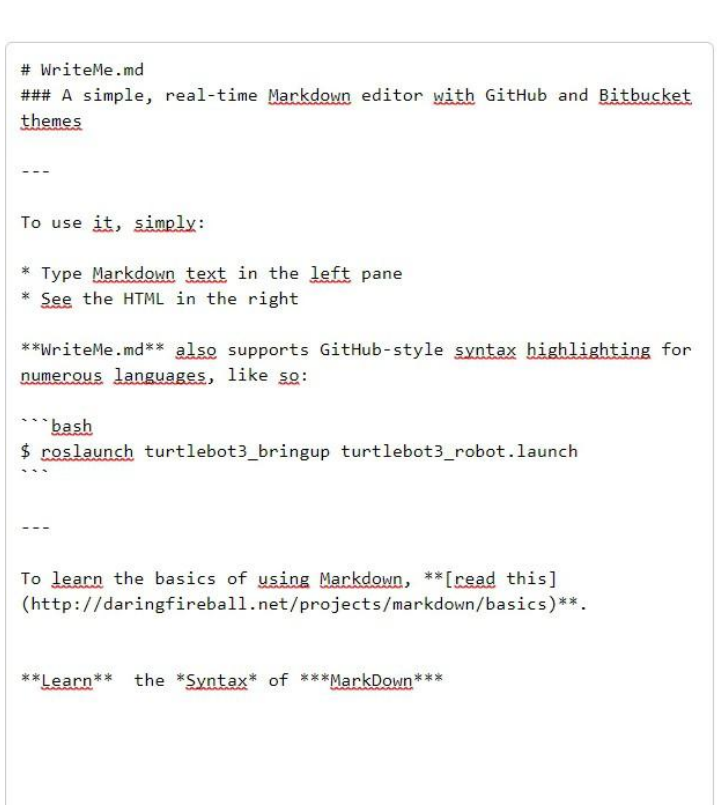
* Type Markdown text in the left pane
* See the HTML in the right

**WriteMe.md** also supports GitHub-style syntax highlighting for
numerous languages, like so:

```bash
$ roslaunch turtlebot3_bringup turtlebot3_robot.launch
```

To learn the basics of using Markdown, **[read this]
(http://daringfireball.net/projects/markdown/basics)**.

Learn the *Syntax* of ***MarkDown***
```



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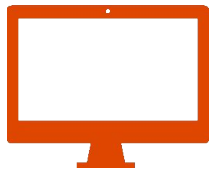
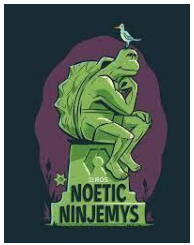
MarkDown highlighter: https://writeme.mattstow.com/

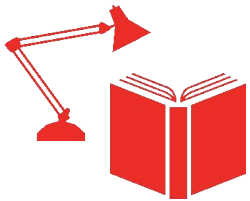
Project Management

- **Ubuntu**
  - Get familiar with the OS
  - Ubuntu 20.04.5 LTS (Focal Fossa)



- ROS
  - Tutorials + Read & practice
  - ROS Noetic





Project Management

Backup, Backup, Backup !

- Code + Proj. Management => GitHub
- Data => Cloud Storage
- Disaster => Recovery Plan

Project Management

Clock is ticking !

- ONLY 12 Weeks !
- Start ASAP !

Click me. I am awesome !

Thank you

We hope you will enjoy the course!

Thank you

Questions?

Robotics Project

Aside note

Joaquin Rodriguez, ImViA - Univ. Bourgogne
MSc in Computer Vision, 2023

Aside notes

Note 1: Deadlines

What is a deadline for you ?

NO EXCUSES (only justified medical issues)

Aside notes

Note 2: Cheating - Plagia

- You are here to learn, and you love to do it (You have chosen this course).
- In less than 4 months, you will be alone, in a company, doing robotics and computer vision.
- Copying and not saying who is the original author ? --> PLAGIA!
- As a researcher, it is THE WORST thing you can do (possibility of being banned).
- In robotics project it means you have a 0 in your work (no excuses).
- Copy to a friend in the course ? 0 to the author of that work too.

Aside notes

Note 3: We are here to guide you, not to guide ChatGPT

- Mainly answers to our problem can be obtained through AI-based sites.
- Besides the code you get is often of really bad quality, you might be able to use it, and maybe solve the task.
- In real life, the problems you will try to solve cannot be asked to these tools because they have not been solved yet.
- So, follow the course, take notes, think by yourself.

Piece of advice

You will only learn by deadline with problems. The content we will give you is just an excuse (I could teach you with 20 years old technology if I want to). The content will help you to develop your own skills, your critical thinking, and your problem-solving ability. Just practice, do the assignments, and ***do not use AI based solutions.***

Aside notes

Note 4: Your commitments

VIBOT - International Programme in Vision & Robotics
(BSc/Msc)
Edition 2018
Student Agreement

§1. The University of Burgundy (uB), established in Centre Universitaire Condorcet, 720 Avenue de l'Europe, 71200 Le Creusot, France.

Coordinating Institution of the VIBOT Programme in Computer Vision and Robotics, represented by Pr. David FOFI, **coordinator**, of the one part, and

Name: _____
First name: _____
Date of birth: _____
Place of birth: _____
Nationality: _____
the student, of the other part,

HAVE AGREED to the following terms and conditions.

§2. The student hereby commits him/herself on his or her honour to:

- attend compulsory lectures, courses, tutorials, examinations and other activities which form part of the programme. Absences will only be accepted for medical reasons. Supporting documents (medical certificate) are to be submitted to programme administration. Other absences must be agreed beforehand with the involved course director. Attendance records are required and consequently kept for grant providers.
- submit course work and other assignments by the specified deadlines. Any request for extension of deadline must be submitted in a timely manner to, and will be studied by the course director, and applies only for exceptional circumstances such as illness;
- reach the level of academic achievement required for your programme by the Academic Board;

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not commit any form of plagiarism. Plagiarism is an extremely serious academic offense and it will be severely penalized. If you have any questions or doubts about how to document the sources of your ideas refer to your instructor;