

# CSC398 Introduction to Autonomous Robots

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August 20, 2024

UNIVERSITY  
OF MIAMI



# Outline

- 1 RoboCanes Team UM
- 2 What are your expectations?
- 3 General Information



# Ubbo Visser

## Short introduction



### Research interest

- Artificial Intelligence with the focus on knowledge representation and reasoning.
- **Application areas:** Semantic Web and Multi-Agent Systems (Games, Robots, RoboCup).

### Position

- Associate Professor

### Stations

- Münster, Brisbane, Bremen
- Miami

### Contact information

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- Office Hours: by appointment

# May we know who you are?

## Short introduction

- You are an undergraduate student. What is your major? CS/ECE/MTH/Other?
- Why did you select this course?

*hmm, I am not sure;  
my advisor told me so;  
fascinating topic;  
this is what I want to specialize in;  
I see a big future ahead of this field; ...*

## Grading & general issues

- **Grading:**
  - 100% - Assignments/Quizzes based on the lectures in class
- **Class attendance and participation:** Class attendance is mandatory, and a lot of practical work is required. You cannot do the practical work on any machine. Most likely, you will use the machines here in this lab. Class participation is also important, active interest in lectures is the easiest way to learn.

## Always keep these in mind

- **Plagiarism:** The penalty for copied homework of any kind can be immediate failure in the course. Our policy on programs is as follows: There is no reason for two (or more) people handing in identical or nearly identical programs. We will regard such programs as either group-written or simply copied. If we have no hard evidence of copying, such programs will receive NO credit. More serious actions will be taken in cases where there is evidence of cheating.
- **Late programs:** Unless otherwise stated, programs will lose 20% of their value for each weekday (Monday through Friday that they are late, down to a minimum value of 20%. The due date of a program is the latest date on which it can be run to get full credit.

and also these ...

- **Dropping the course:** Dropping a course after the designated drop date will only be permitted in the case of extreme extenuating circumstances. Poor academic performance will never be an acceptable reason for a late drop.
- **Incompleteness:** An incomplete grade in this course will only be considered in cases of documented illness resulting in significant missed class and computer time. Therefore, please refrain from requesting an incomplete unless you have a compelling and valid reason.

## Content

### Part 1 (Introduction)

- 1 Introduction to autonomous systems, autonomous robots, RoboCup.
- 2 Overview of typical components of an autonomous robot.
- 3 Python and C/C++ Programming (if necessary)

### Part 2 (Isaac Sim World, ROS)

- 1 Building blocks of the simulator (navigation in the simulator, first robot in an empty world, in our lab world).
- 2 ROS essentials (Architecture, master, nodes, topics, commands, catkin ws, launch files, gazebo...).

### Part 3 (Control and motion)

- 1 PID-control, calibration of parameters.
- 2 Kinematics, controlling a wheeled robot, controlling joints.



## Content

### Part 4 (Localization, Path Planning and Navigation)

- 1 Recursive state estimation, Bayes filter, particle filter.
- 2 Self-localization.
- 3 Modeling path planning with A\* and RRT

### Part 5 (Perception)

- 1 Computer vision
- 2 Deep Learning for object detection

## More information ...

### ● Recommended books:

- Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza. *Introduction to Autonomous Mobile Robots*. MIT Press 2011, 2nd edition.
- Mark Spong, Seth Hutchinson, and M. Vidyasagar. *Robot Modeling and Control*. Wiley 2006.
- Sebastian Thrun, Wolfram Burgard, and Dieter Fox. *Probabilistic Robotics*. MIT Press, 2005.
- Richard S. Sutton and Andrew G. Barto. *Reinforcement Learning: An Introduction*. MIT Press, 2nd edition 2018.
- Stuart Russell and Peter Norvig. *Artificial Intelligence: A Modern Approach*. Prentice Hall, 4th edition, 2020.
- Herman Bruyninckx: Robot kinematics, and dynamics. Universiteit Leuven, Belgium, 2010.
- Joseph Lorenzetti and Marco Pavone: Principles of robot autonomy, lecture notes (MIT, Stanford), 2023.

## Do you know ... ?

- Linux/Docker
- C++/Python
- Debugging C++ in Linux
- Matlab
- Repositories (SVN, GIT)
- ROS
- Profiling
- LaTeX