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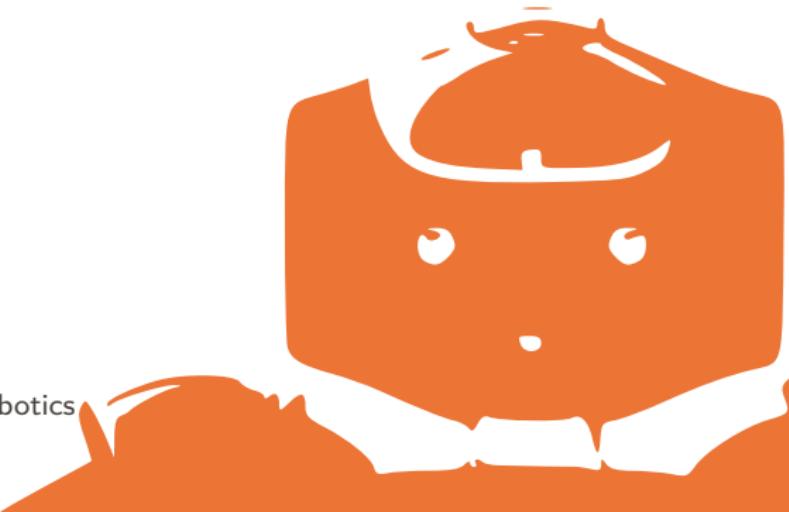
You can download the sources of this presentation here:
github.com/severin-lemaignan/module-mobile-and-humanoid-robots

ROBOTICS WITH PLYMOUTH UNIVERSITY

ROCO318
Mobile and Humanoid Robots
Part 1 – Introduction

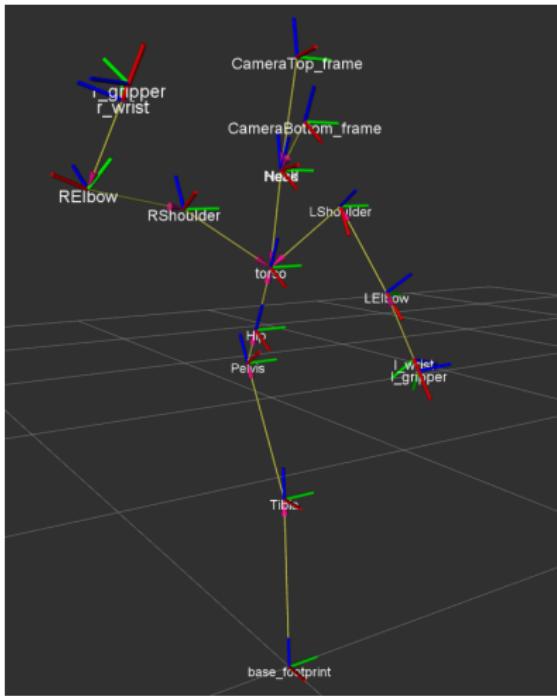
Séverin Lemaignan

Centre for Neural Systems and Robotics
Plymouth University



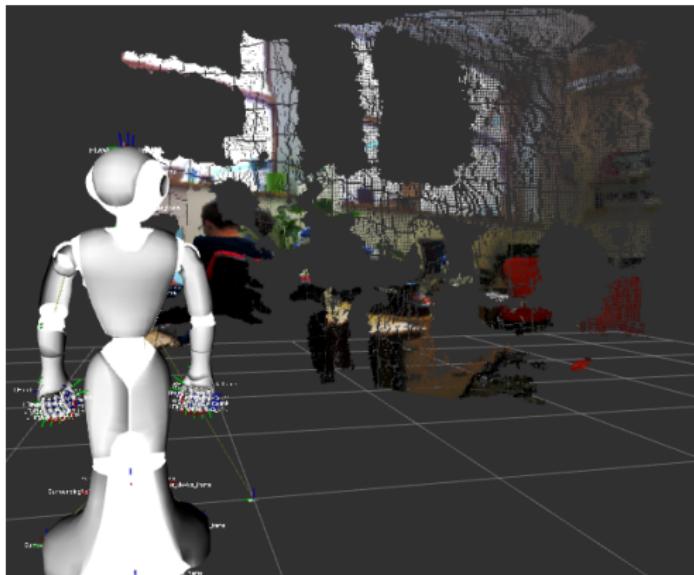


WHAT HAVE WE SEEN SO FAR?

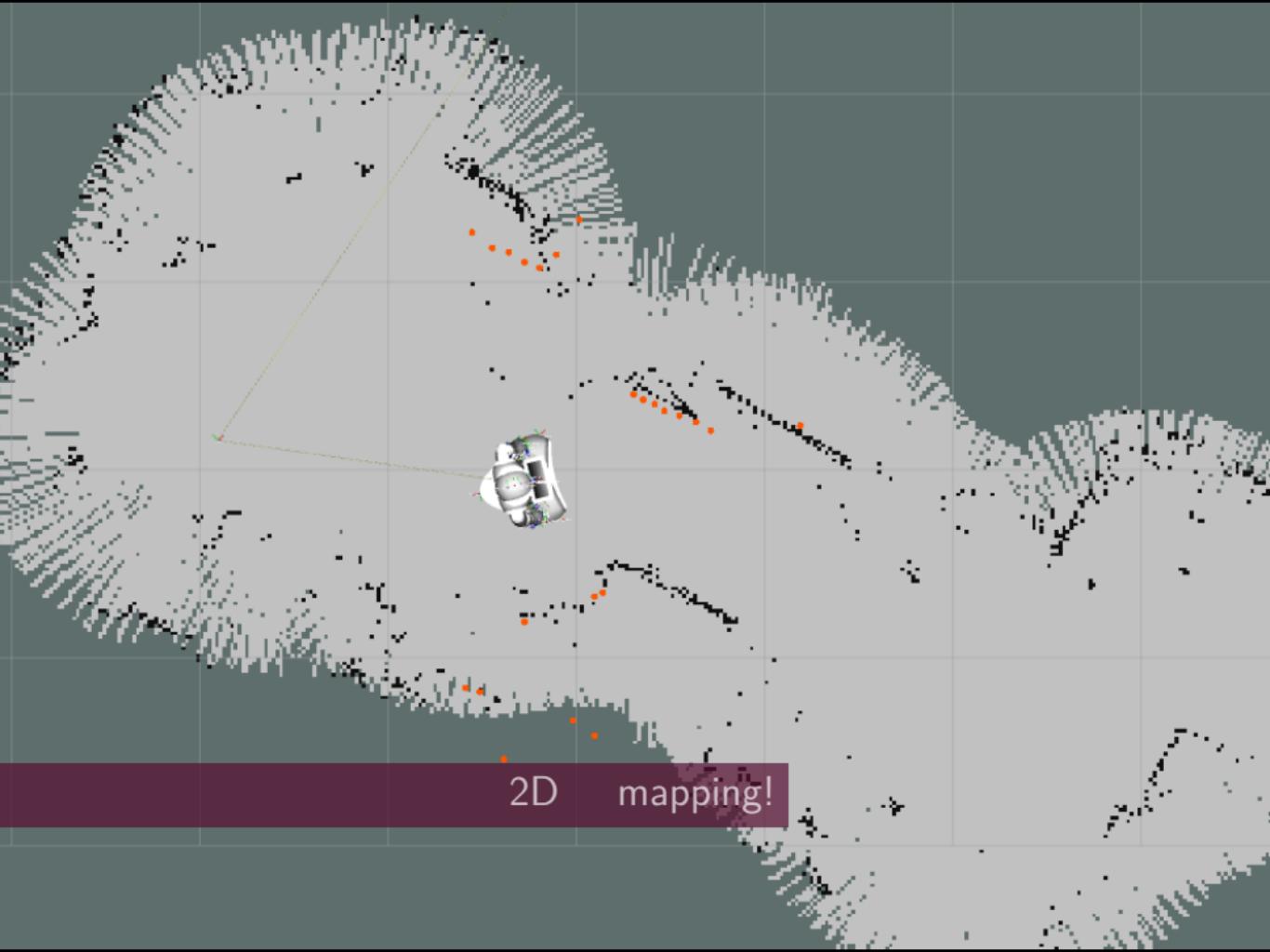


- **frames**
- **forward kinematics**
- **inverse kinematics**

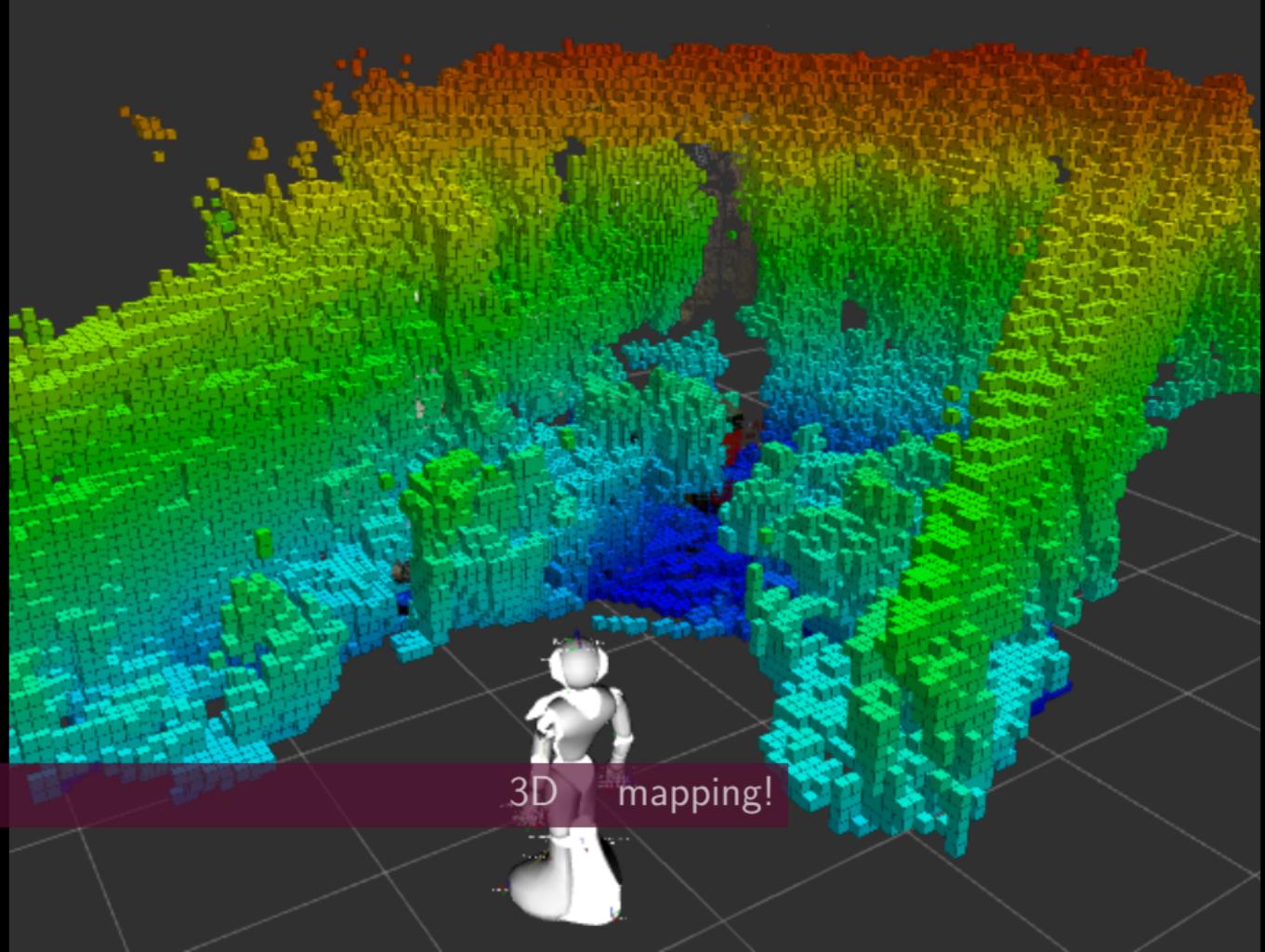
Lots of sensors!



- **RGB-D cameras**, color + depth registration
- **Laserscans**
- **Sonars**,...

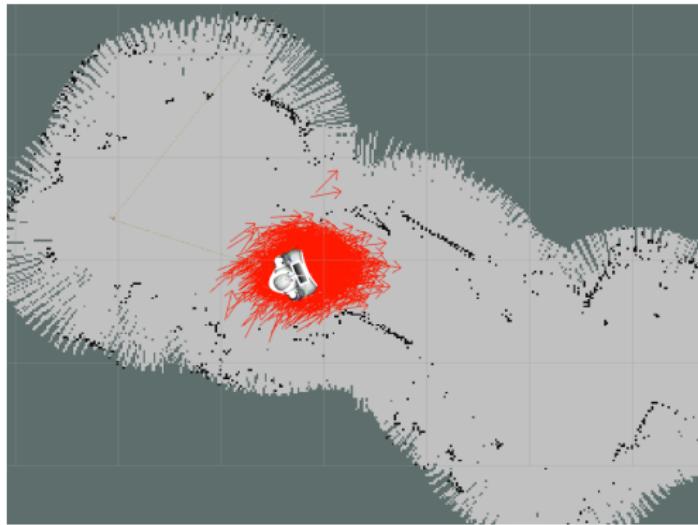


2D mapping!

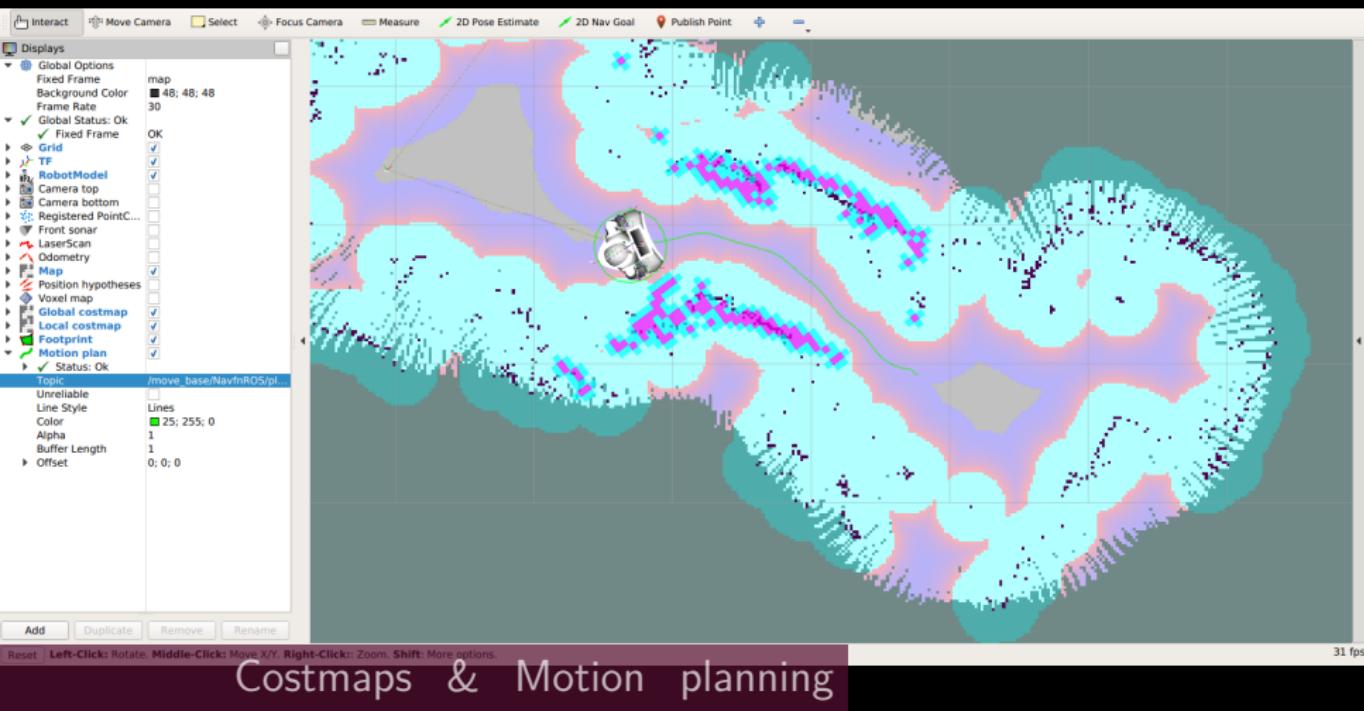


3D mapping!

Odometry is not good enough



- **SLAM** (Simultaneous Localization and Mapping)
- using **probabilistic reasoning** (Monte-Carlo localisation)



Costmaps & Motion planning

31 fps

Well, ROCO318 is over...

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(oh no, I forgot about the autonomous chairs...)



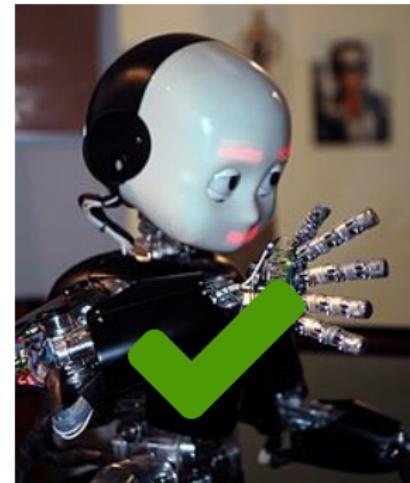
MODULE OVERVIEW

THIS MODULE

- Sensors for mobile and humanoid robots
- Computer vision
- Localisation
- Robot control
- Planning and navigation
- Bipedal robots

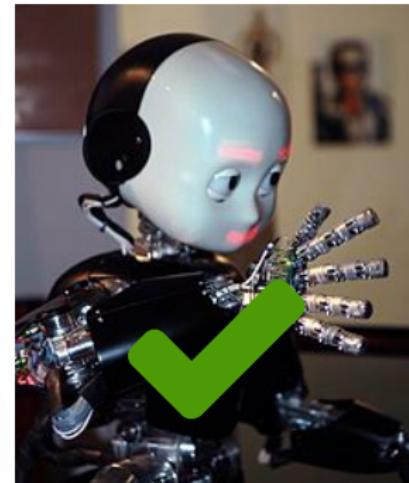
THIS MODULE

How to build intelligent mobile/humanoid robots?
≠ industrial automation!



THIS MODULE

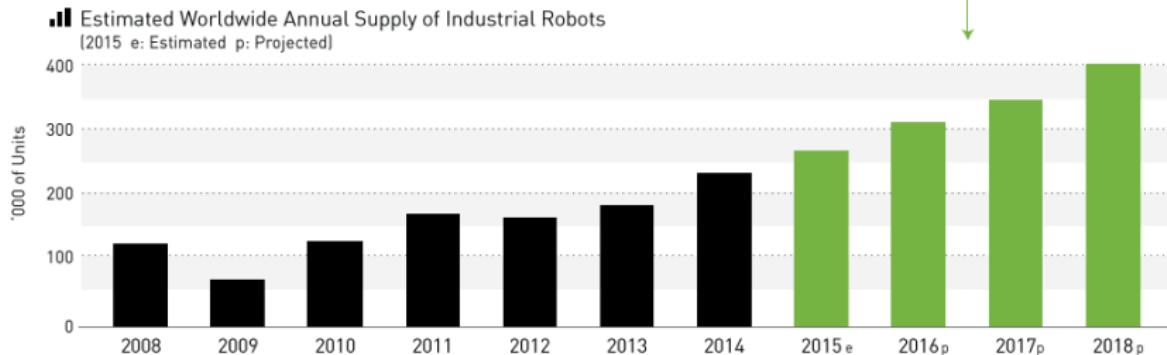
How to build intelligent mobile/humanoid robots?
≠ industrial automation!



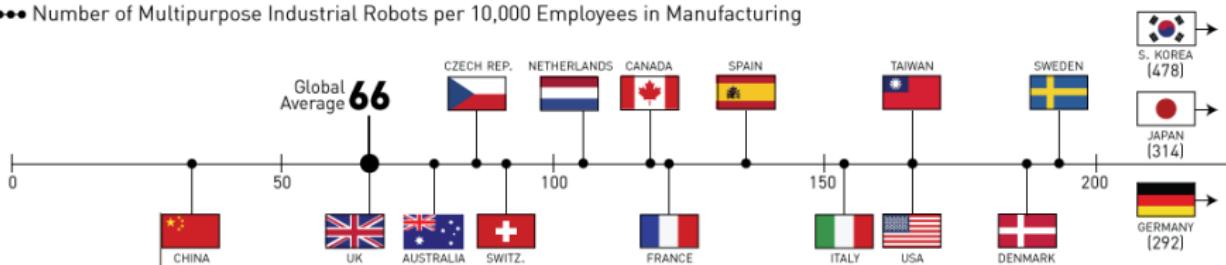
- **Hardware issues:** sensors, actuators, drive mechanisms, ...
- **Software issues:** robot control, computer vision, learning robots, ...

HOW WIDESPREAD?

The market for robot systems is growing at 15% pace, with 1.3 million new units installed by 2018



Number of Multipurpose Industrial Robots per 10,000 Employees in Manufacturing



China's robot density is just half of the global average.

Sales are rising fast. China will be home to one-third of the world's robots by 2018.

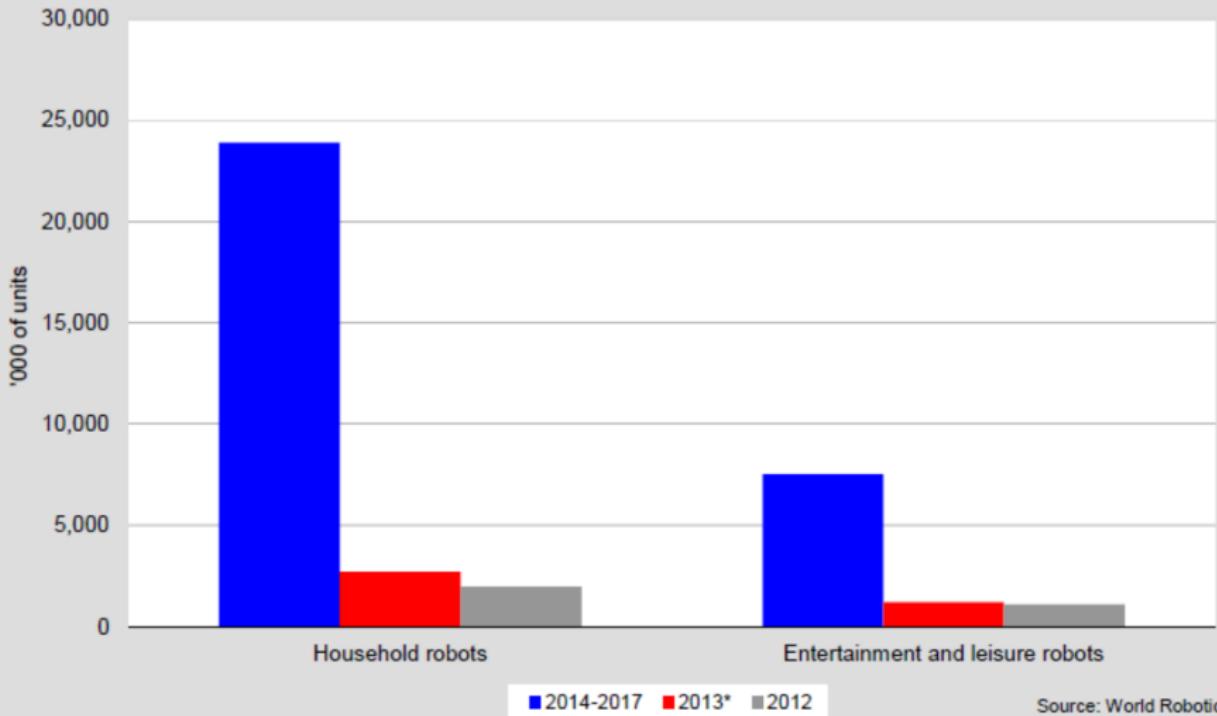
Source: World Robotics 2015

visualcapitalist.com



But...

**Service robots for personnel/domestic use.
Units sales Forecast 2014-2017, 2013 and 2012**



Source: World Robotics 2014

DOMAINS OF ROBOTICS

SERVICE/DOMESTIC ROBOTS

Service robots

- iRobot Roomba, 12M units sold.
- Samsung, LG, Dyson



Edutainment robots

- e.g. KeepOn,
- Lego Mindstorms (original, NXT, EV3),
- RoboSapiens



FLYING ROBOTS

Very popular research field and tremendous interest from the military, some civilian uses (e.g. aerial videoing).

Challenges: autonomy (control of flight parameters), localisation, energy autonomy, robustness.



- Raffaello D'Andrea's drone acrobatics
- U. Pennsylvania, Vijay Kumar's nano quadrotors (see also TED talk)
- EPFL's flying wing robot.

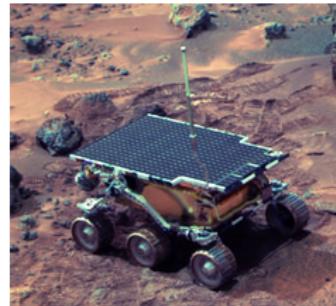
SPACE EXPLORATION

Three Mars rovers:

- **Sojourner** touched down in summer 1997
- **Spirit** and **Opportunity** landed in January 2004
- **Curiosity** touched down 5 August 2012

All are fully teleoperated from earth. However, the sensors and software allow for autonomous obstacle detection and navigation.

Have survived 30x longer than planned: marsrovers.nasa.gov



MILITARY ROBOTS

Best selling “professional service” robot: 6500 units in 2011, 6100 in 2012, 9500 in 2013.



Modular Advanced Armed Robotic System (MAARS)

Video: iRobot packbot

AUTONOMOUS CARS

2005: Darpa Grand Challenge; >200km race in Mojave/Nevada desert



Source: Wikipedia

AUTONOMOUS CARS

2007: Darpa Urban Challenge; 100km in urban environment, must obey all traffic regulations



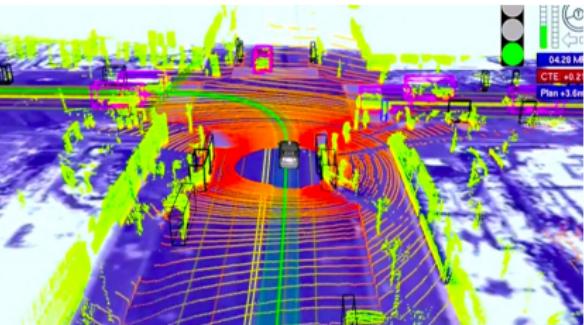
Source: Wikipedia



Source: Wikipedia

AUTONOMOUS CARS

Google Driverless cars



Source: *Engadget*

Source: *IEEE Spectrum*

24 Lexus + 34 'Google Cars'; between 2009 and August 2016,
autonomously driven \approx 2 000 000 miles

AUTONOMOUS CARS

Uber autonomous taxis



Source: Bloomberg

100 Volvo cars ...already driving in Pittsburg's streets! (with human supervision)

HUMANOIDS

Human-like robots.

Tremendously challenging:



- Power,
- actuations,
- artificial intelligence,
- perception,
- control,
- walking, ...
- Honda Asimo latest version
- Boston Dynamics Petman prototype and obstacle negotiation.
- DARPA Robotics challenge 2015 outtakes

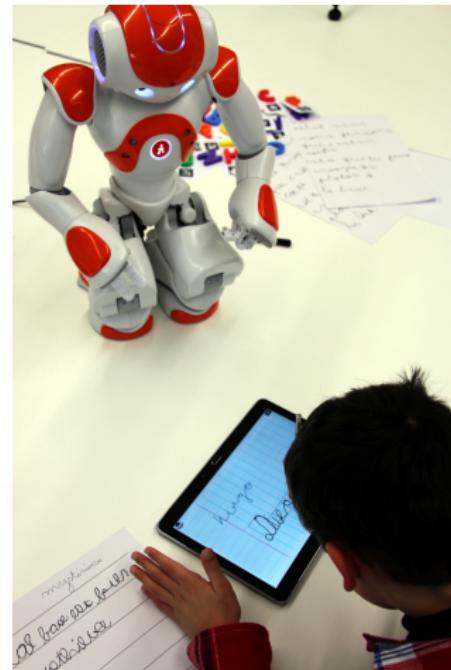
AND WHAT DO I DO?

Cognitive robotics

Building robots and their artificial intelligence inspired on natural systems, such as developing children

Human-Robot Interaction

Building robots that can work alongside people, using social cues that people use to communicate



That's all, folks!

See you on Friday, 13:00, for the first lab

Questions:

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Slides:

github.com/severin-lemaignan/module-mobile-and-humanoid-robots