# Introduction: Applications, Problems, Architecture

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# *Class overview*

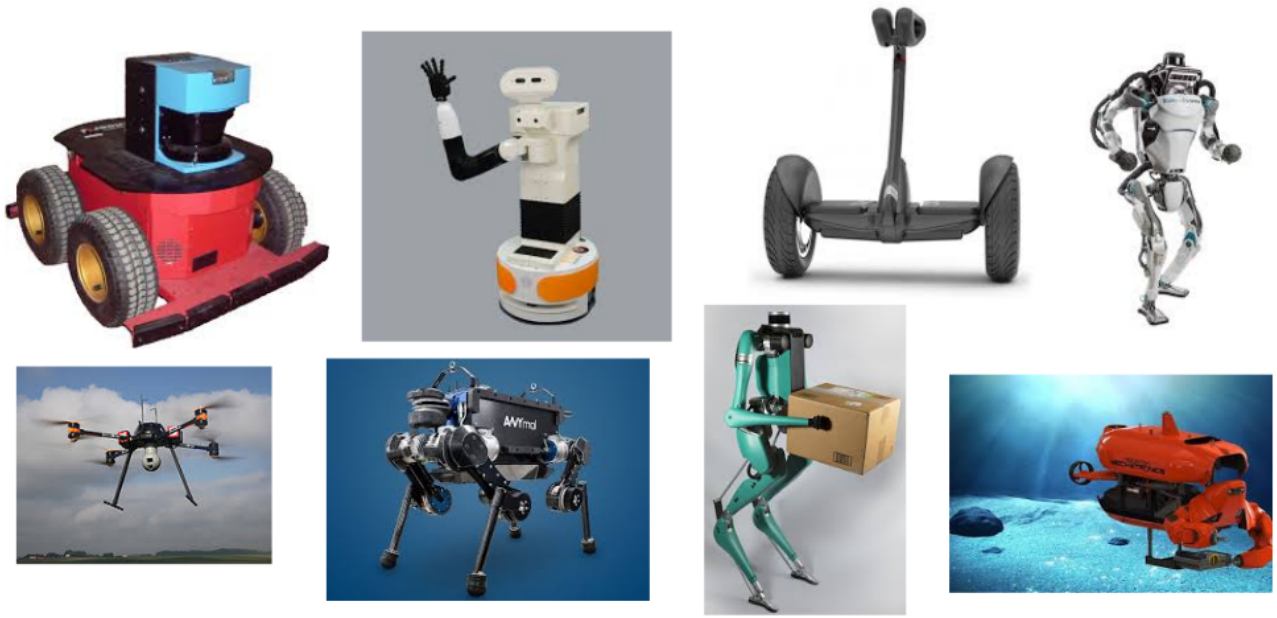
- Class schedule: Tuesday 1:00 pm - 2.50 pm & Thursday 1:00 pm - 3.50 pm
- Office hours: Tuesday 4:00 pm - 6 pm (by appointment only)
- Platforms used: Moodle (lectures, assignments) and Microsoft Teams (for Q& A, discussions)
- Grading: 35% labs + 35% project + 30% exam

# COVID

- MASKS are MANDATORY (you won't be allowed in class without a mask)
- Disinfect your desks, computers, robots first thing when you come in class, and last thing before leaving the class
- If you have been in contact with someone that tested positive DO NOT COME TO CLASS
- If you have any signs of Covid/cold DO NOT COME TO CLASS
- If you tested positive inform your close contacts and your instructor

# *Course objectives*

- To present the basic principles for basic localization and motion planning methods for achieving mobility and autonomy in mobile robots.
- ... in principle, everything mobile!



# *Motivation*

- Industrial fixed-base robots are fast and accurate in a limited, structured, known, static workspace
- To be useful in the outside world, robots must be able to move freely in large, unstructured, uncertain, dynamic environments



# *Applications of Mobile Robots: Structured Env.*

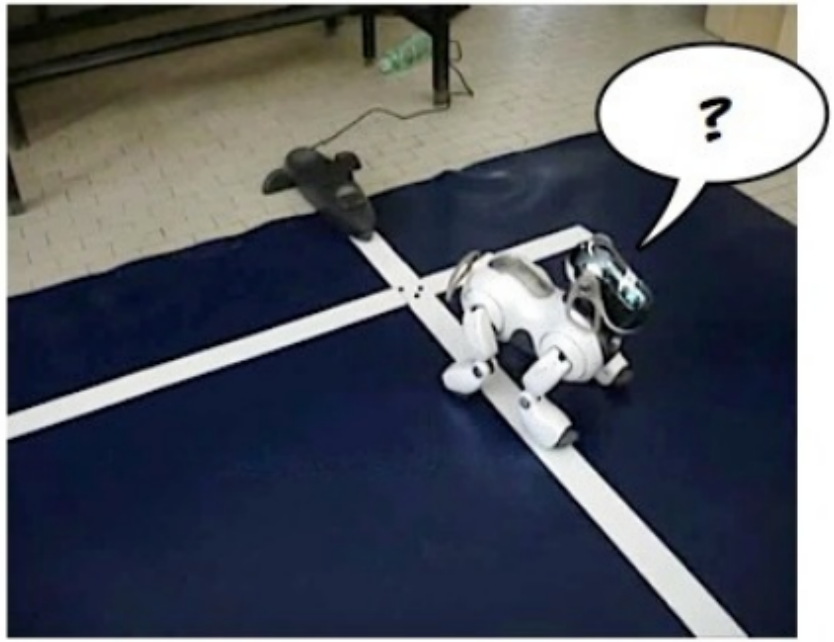
## Service Robots:

- transportation (industry, logistics)
- cleaning (homes and large buildings)
- customer assistance (museums, shops)
- surveillance
- entertainment

## Field Robots:

- exploration (sea, space)
- monitoring (sea, forests)
- rescue
- demining
- agriculture
- construction
- transportation
- military

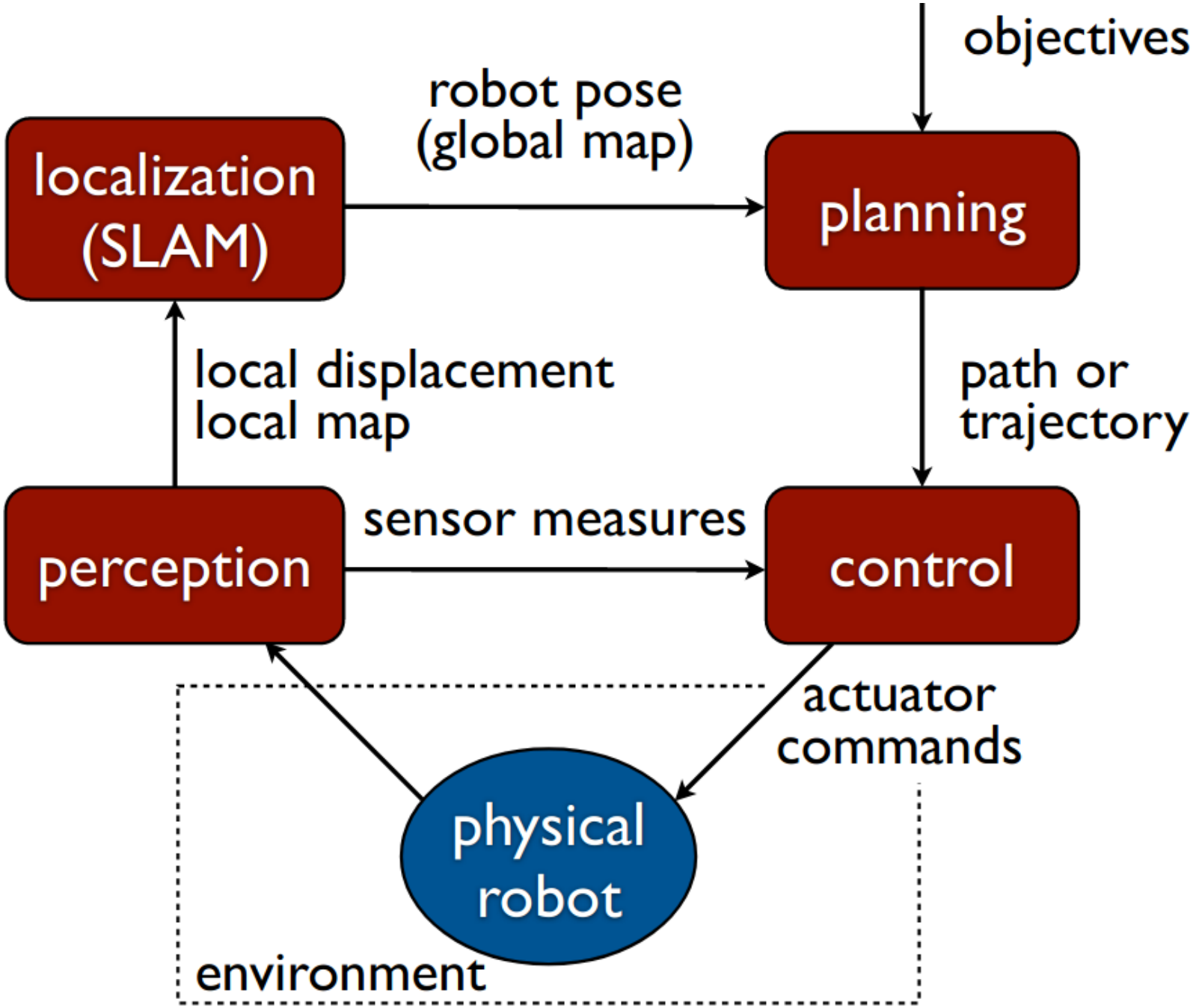
# *Key problems of Mobile Robots*




1. Where am I?
   Approach: Localization (with or without initial guess, map, ...)

2. How am I supposed to get to the goal?
   Approach: Path/trajectory/motion planning (respectively: only geometric motion, with time, among obstacles)

3. How do I actually move?
   Approach: motion control (feedback techniques)


objectives
robot pose
(global map)
localization
(SLAM)
planning
local displacement
local map
path or
trajectory
perception
sensor measures
control
actuator
commands
physical
robot
environment

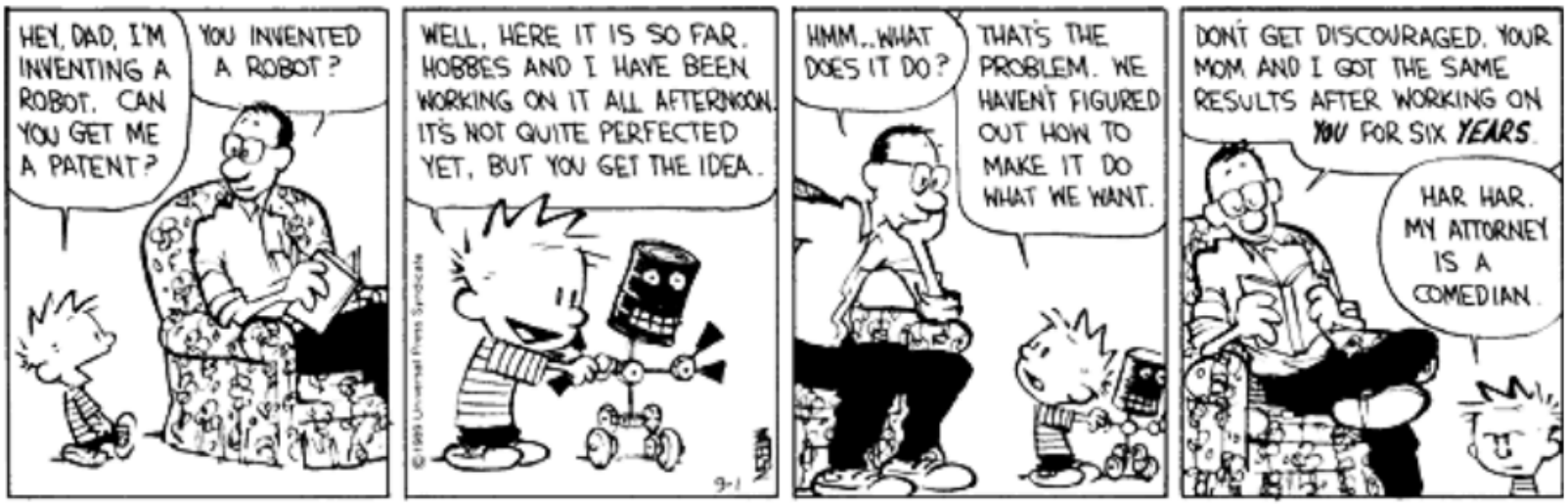
# *Course organization (tentative)*

1. Intro: Kinematics of non-holonomic robotics
2. Localization
   - Probabilistic Robotics
   - The Bayes Filter
   - Non-Parametric Filters
   - Gaussian Filters
   - EKF Map/Feature/Pose - based SLAM
3. Introduction to Path Planning

# *Bibliography*


- Sebastian Thrun, Wolfram Burgard and Dieter Fox, Probabilistic Robotics, The MIT-Press ISBN-10: 0-262-20162-3
- Yaakov Bar-Shalom and Xiao Rong Li, Estimation and Tracking: Principles, Techniques, and Software, ISBN 0-89006-643-4
- H. Choset et al. Principles of Robot Motion, MIT Press, 2005.
- R. Siegwart and I.R. Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2004.

# *Robotics is not only about building Robots!*



# *Questions?*