

# Introduction to Mobile Robotics

**Welcome**

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UTN

# Today

- This course
- Robotics in the past and today

# Organization

- Tue 9:00 – 12:00  
Lecture
- Thu 12:00 – 14:00  
Q&A, homework, practical exercises (Python)
- Course web page:  
<https://www.moodle.tum.de/course/view.php?id=84624>
- Exam: Oral or written

# People

## Teaching:

- Wolfram Burgard

## Teaching assistants:

- Reihaneh Mirjalili
- Michael Krawez



# Goal of this Course

- Provide an overview of problems and approaches in mobile robotics
- Probabilistic reasoning: Dealing with noisy data
- Hands-on experience

# Content of this Course

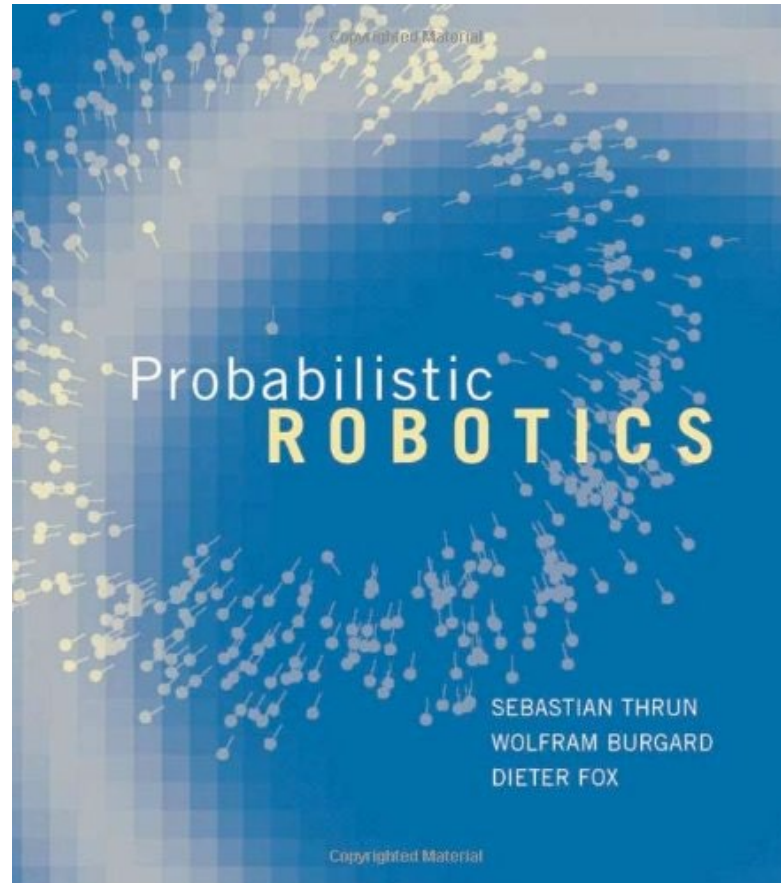
1. Linear Algebra
2. Wheeled Locomotion
3. Sensors
4. Probabilities and Bayes
5. Probabilistic Motion Models
6. Probabilistic Sensor Models
7. Mapping with Known Poses
8. The Kalman Filter
9. The Extended Kalman Filter
10. Discrete Filters
11. The Particle Filter, MCL
12. SLAM: Simultaneous Localization and Mapping
13. SLAM: Landmark-based FastSLAM
14. SLAM: Grid-based FastSLAM
15. SLAM: Graph-based SLAM
16. Techniques for 3D Mapping
17. Iterative Closest Points Algorithm
18. Path Planning and Collision Avoidance
19. Multi-Robot Exploration
20. Information-Driven Exploration
21. Summary

# Relevant other Courses

- Computer Vision II: Multi-View Geometry (IN2228) Computer Vision
- Robotics (IN2067)
- Robot Motion Planning (IN2138)
- Motion Planning for Autonomous Vehicles (IN2106, IN0012, IN4221)
- Mobile Robotics (IN2404)
- and many others.

# Reference Book

Thrun, Burgard, and Fox:  
“Probabilistic Robotics”



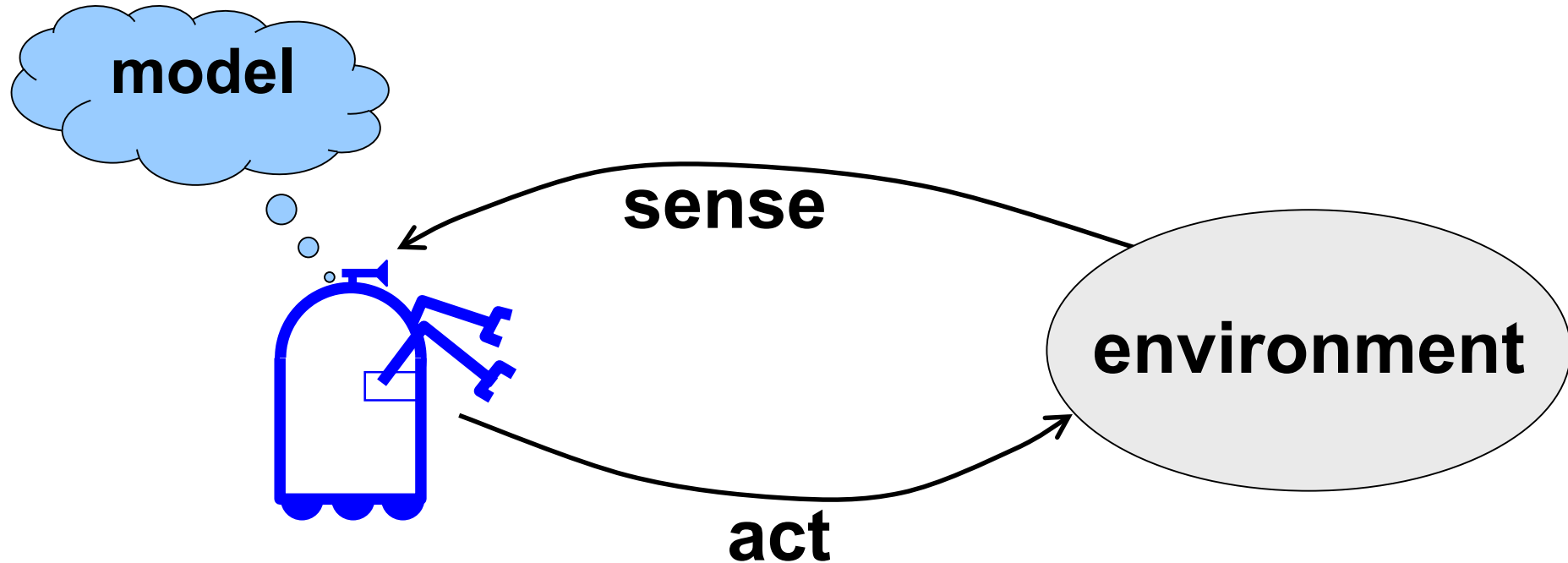


# Opportunities

- Projects
- Practical courses
- Seminars
- Theses
  
- ... your future!

# Autonomous Robot Systems

- perceive their environment and
- generate actions to achieve their goals.



# Tasks that Need to be Solved by Robots

- Navigation
- Perception
- Learning
- Cooperation
- Acting
- Interaction
- Manipulation
- Grasping
- Planning
- Reasoning
- ...

# Robotics Yesterday

- Highly repeatable tasks
- Robots bolted to the ground, often caged
- Limited to no perception
- Very little “AI”



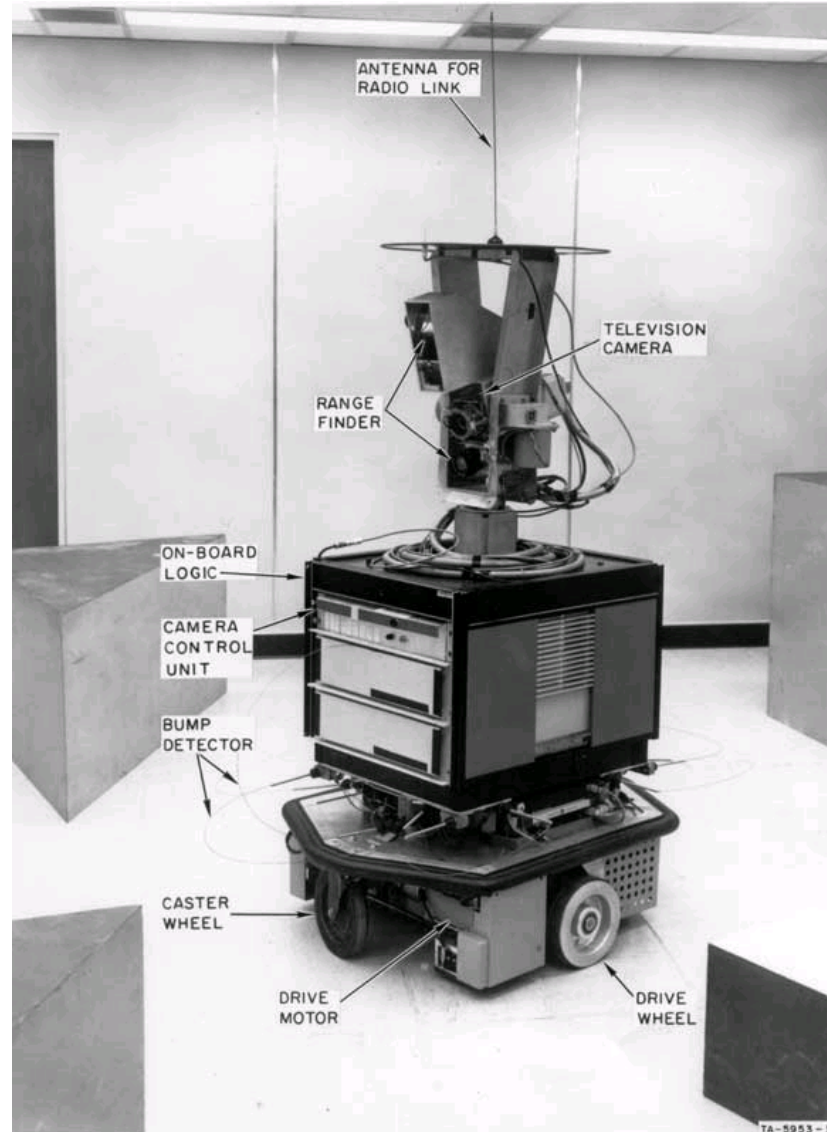
Picture: Bachmann, Kuka Roboter GmbH

# Current Trends in Robotics

Robots are (partly) moving away from factory floors...

- Entertainment, toys
- Personal services
- Medical, surgery
- Industrial automation
- Hazardous environments  
(mining, harvesting, space, underwater)
- Self-driving cars
- Robot learning
- ...

# Shakey the Robot (1966)





# Shakey the Robot (1966)



# The Helpmate System





# Autonomous Vacuum Cleaners





# Autonomous Lawn Mowers



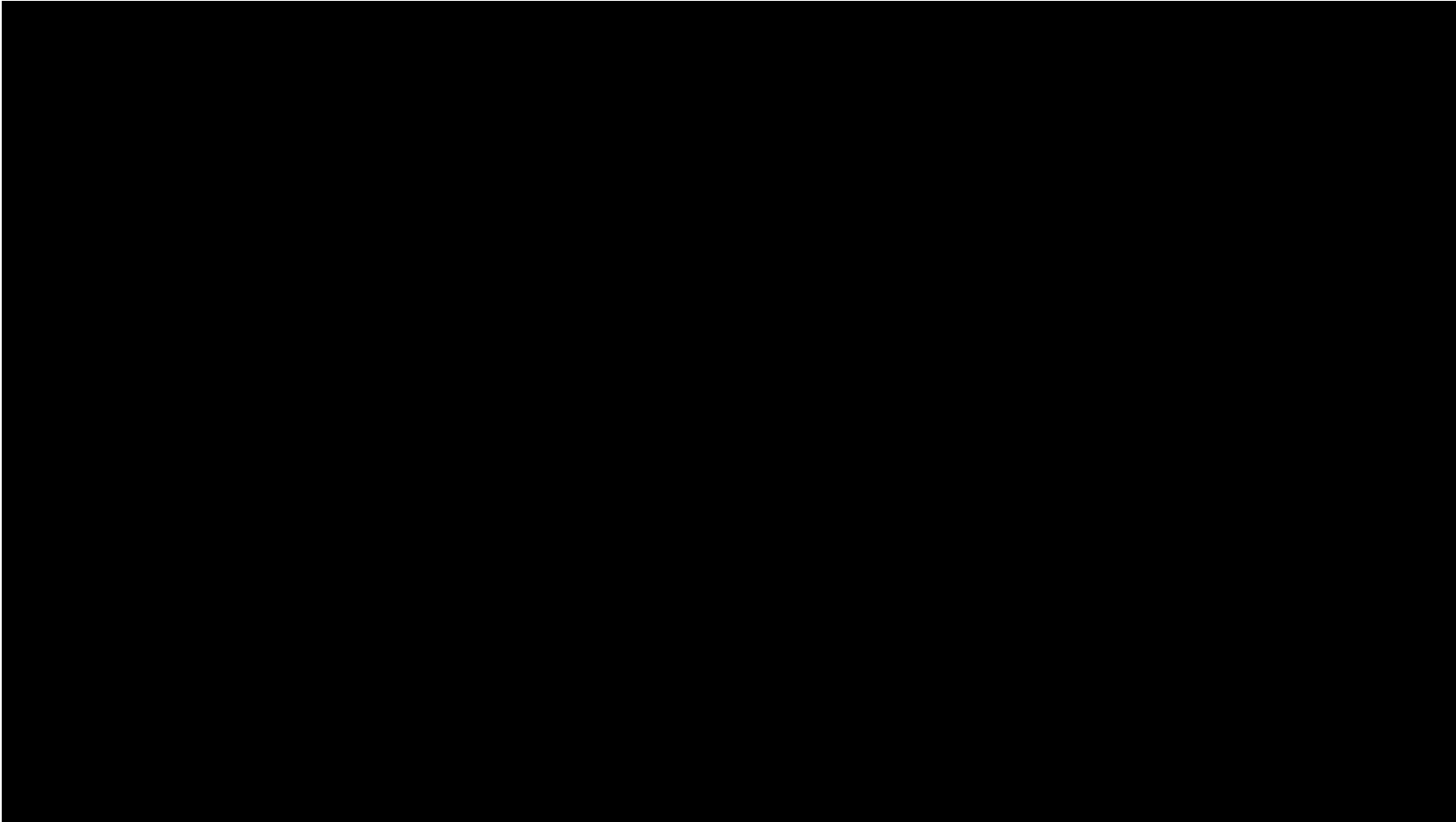


# Walking Robots



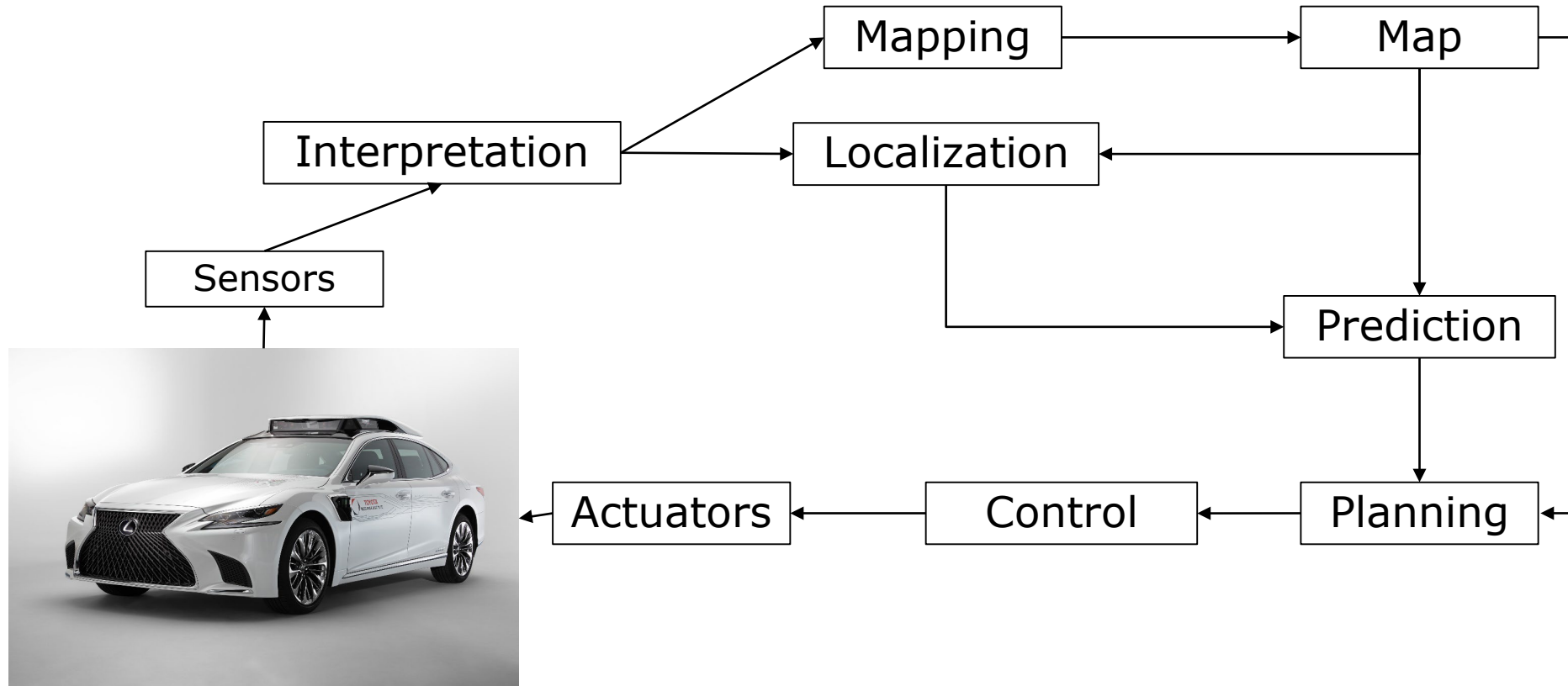
[Courtesy by Boston Dynamics]

# Driving in the Waymo Car



JJ Ricks in the Waymo Car #47

# Major Components of the Software-Stack of a Self-Driving Car



# Thank you

... and enjoy the course!