Week 1: Course Overview

10.02.2016

Wednesdays 14:00 – 17:00, BM A5

Emre Ugur, ETA-36

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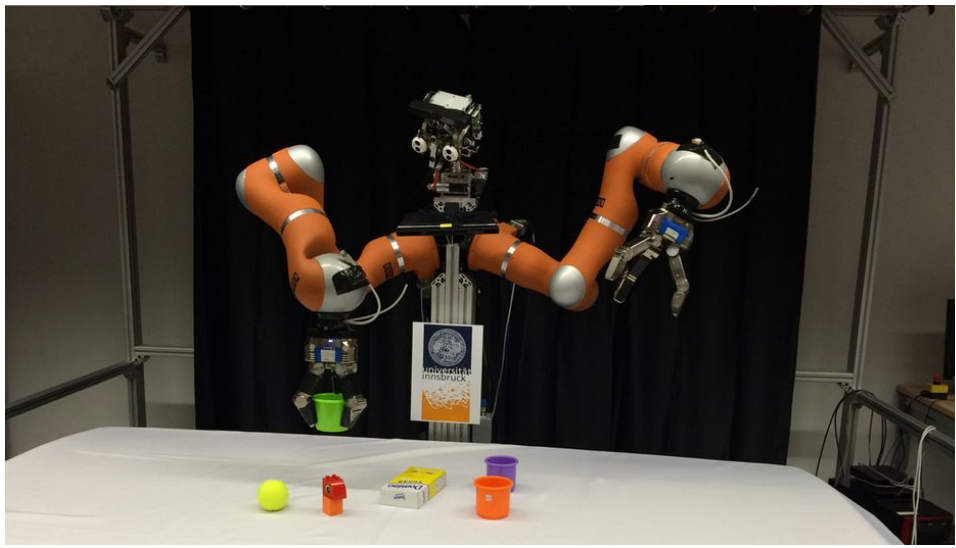
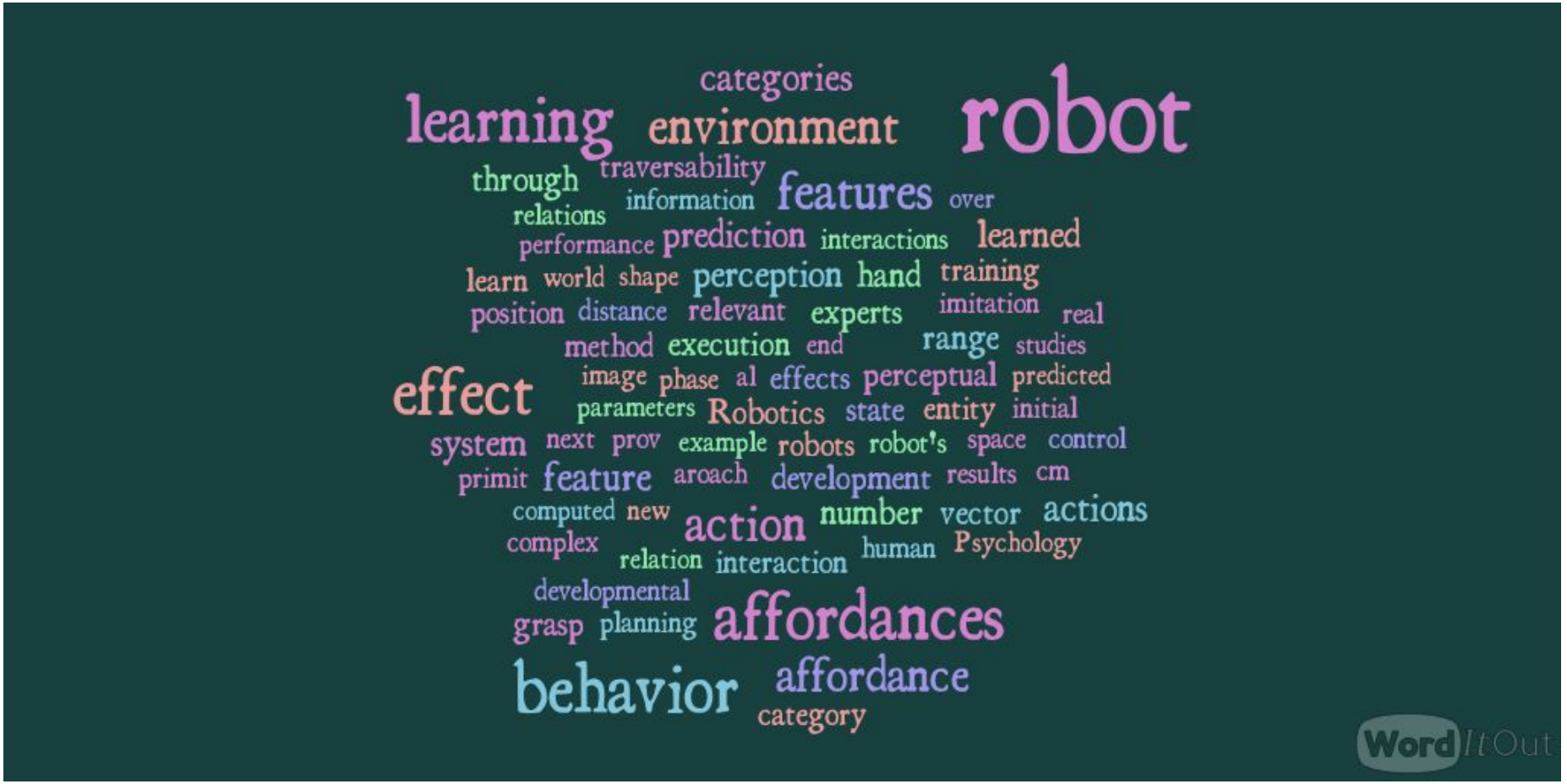
http://emreugur.net/courses/robot-learning.html

- Bogazici University

- Osaka University

- Innsbruck University




categories
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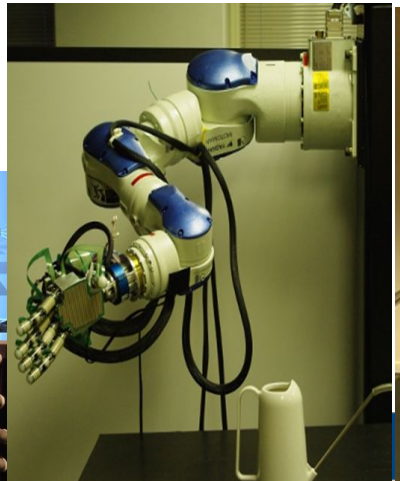
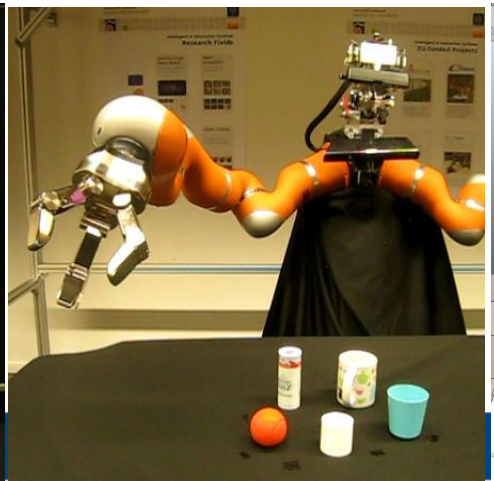
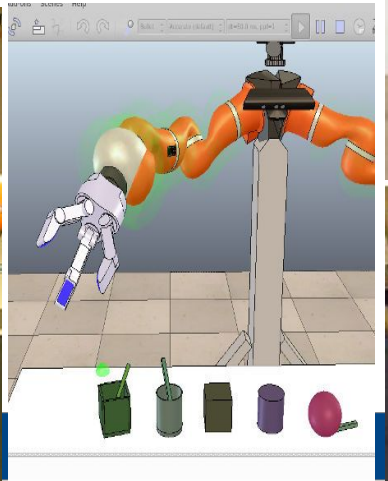
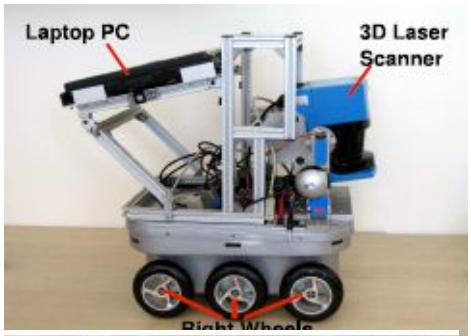
affordance
category
WordItOut

My topics

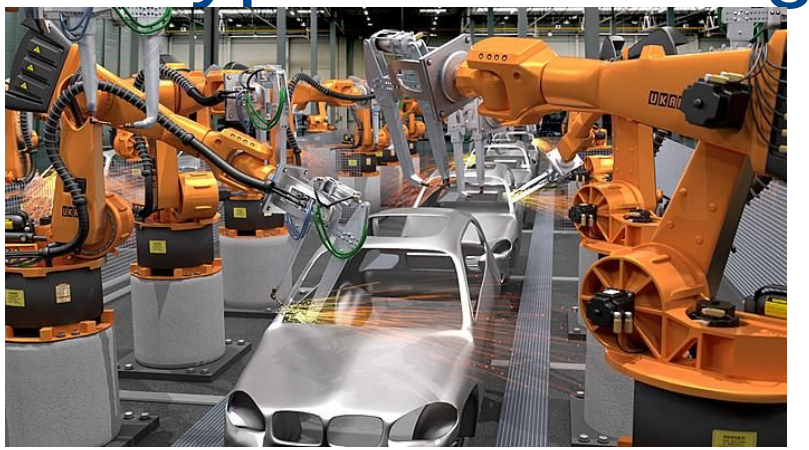







Laptop PC
3D Laser Scanner

Aim or why do we need learning
What type of learning



- High-level understanding
- Advanced sensorimotor skills

Aim

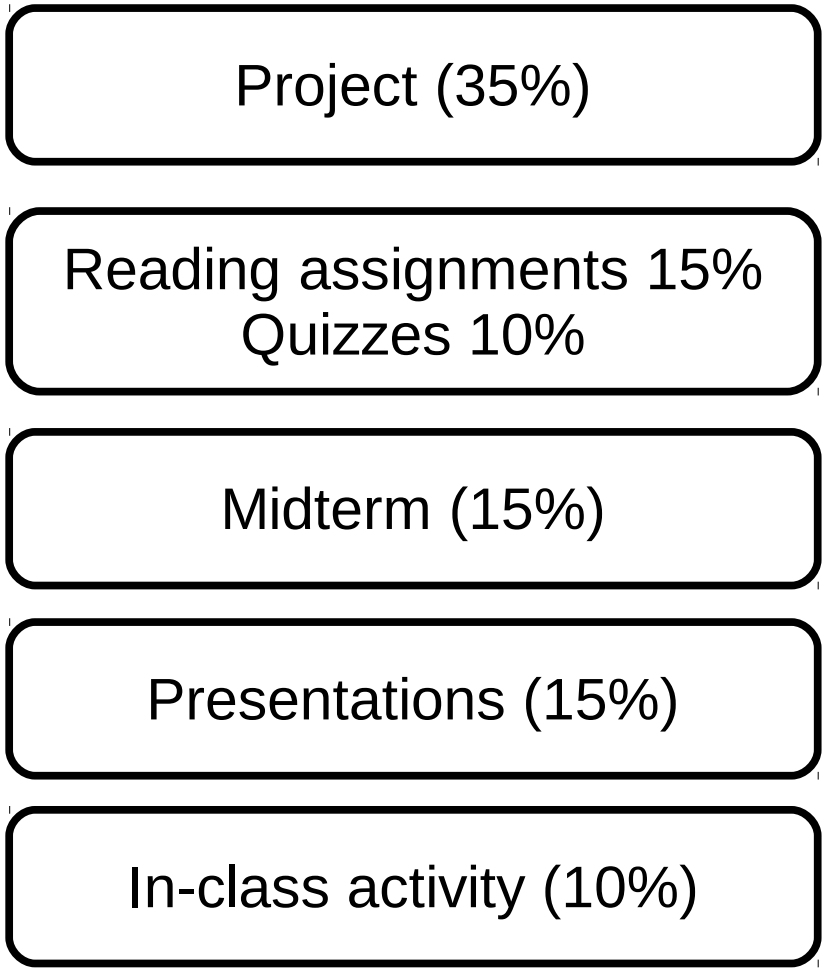
- For high-level understanding:
  - Learning like babies: Developmental robotics
  - Exploring smart: Intrinsic motivation
  - Learning from mistakes: Reinforcement learning
  - Acquiring higher-level abstractions: Symbol acquisition

- For advanced sensorimotor skills:
  - Learning by demonstration
  - Policy search
  - Grasping
  - Probabilistic modeling
  - Deep learning

Format

- Mixed lecture-seminar format, instructor leads
- Basics and concepts are introduced by the instructor.
- Research papers are presented by students.
  - One participant presents the paper & leads discussion
  - All students write a report on each paper
- Project implementation
  - Suggest a completely novel approach or choose replicating and extending one high-impact paper
  - A final project report written in conference/workshop paper format is expected.
  - The topics are not limited to the ones discussed in the lectures as long as they are related to robot learning.

Assessment


Project (35%)
Reading assignments 15%
Quizzes 10%
Midterm (15%)
Presentations (15%)
In-class activity (10%)

Project

- Propose a completely novel approach or choose from existing papers.
  - Implementation in a simulator.
    - e.g. learning from demonstration without a real robot.
    - e.g. learning probabilistic relationships between concepts obtained from robots
  - Depending on difficulty, replicate or extend.
  - Final report in conference paper format (TORK?, RSS 2017 workshops?)
- Better to start soon. Discuss all steps together.
- Deadlines for proposals and progress reports: TBA

Reading Assignments

Please read the papers before the class and submit an **outline** of paper (via email) prior to the class in PDF format. 1 page

- The addressed problem.
- Main contributions.
- Brief technical details.
- The relation to prior-work and state-of-the-art.
- The most important experimental results
- Do conclusions follow the experimental results?

Quizzes

- In the beginning of each lecture, a 5-10 min quiz
- Simple questions about the paper
  - Trivial to reply if you have read the paper
  - Please bring your **outline**

Paper presentations

- Papers will be selected **at least one week** prior to the presentation.
- Aim for 30 minutes presentation, 15 minutes discussion time
  - Who are the authors?
  - What are the problems?
  - Why are the problems important, interesting, and/or hard?
  - Who did what before?
  - What are the key contributions?
  - How did they do it? - algorithmic and technical details
  - How does it perform?
  - What are/might be the limitations?
  - What is next?
- Do not limit yourself with the selected paper, do/present some background, works of other groups, etc.
- Any ideas to have stimulating discussions?

Midterm

- Responsible from the material covered in the class

In-class activity

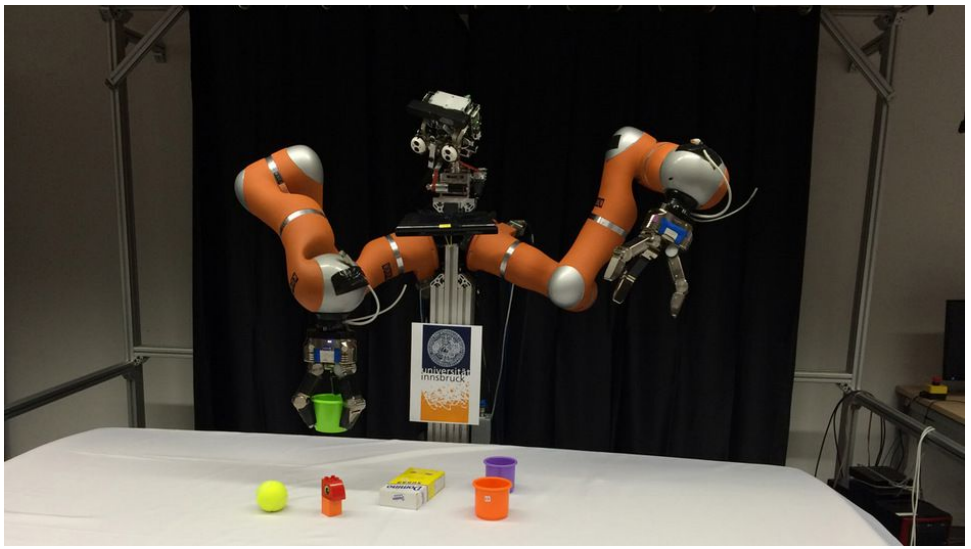
- Active participation to the discussions in the class
- Evaluation of the presentations

Bonus

EU FP7-ICT-STREP, 2014-2018

SQUIRREL

Clearing Clutter Bit by Bit



Topics (tentative) – new course new topics

1	10.02	Developmental Robotics, Intrinsic Motivation, Perceptual Learning	I.
2	17.02	Motor Learning, Affordances in Psychology, Neuroscience and Robotics	I.
	24.02	No class	
3	02.03	Reinforcement Learning, MDP, Value Iteration, TD Learning	I.
4	09.03	Reinforcement Learning, Policy Search	I. + S. (2)
5	16.03	Learning from Demonstration – Trajectory & Probabilistic	S.
6	23.03	Learning from Demonstration – Trajectory & Probabilistic	G.+ S.(1) + I.
7	30.03	Grasping and grasp learning	S. (3)
8	06.04	Introduction to Probabilistic Approaches	I. + S. (2)
9	13.04	Probabilistic Approaches (HMMs, MRFs, DBNs)	S. (3)
	20.04	Spring break	
10	27.04	Human-in-the-loop learning / Deep learning	G. + S. (2)
11	04.05	Skill/symbol acquisition	S. (3)
12	11.05	Final project presentations	S.

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5		ctory & Probabilistic	
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7			
8		nes	
9		RFs, DBNs)	S.
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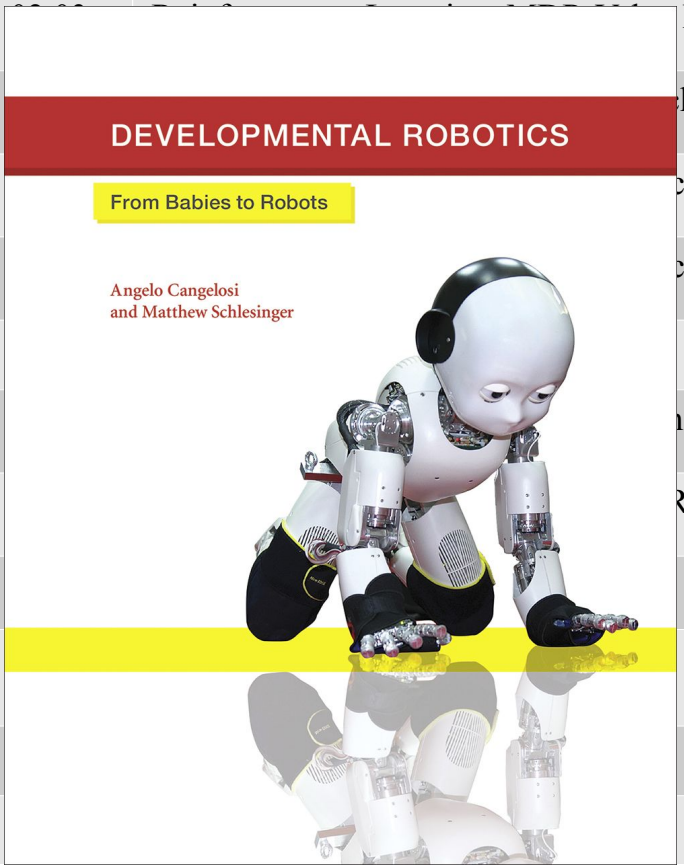

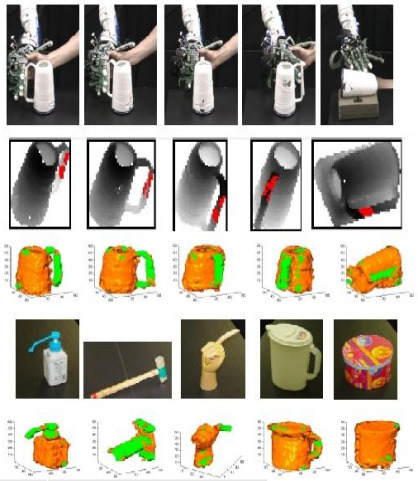

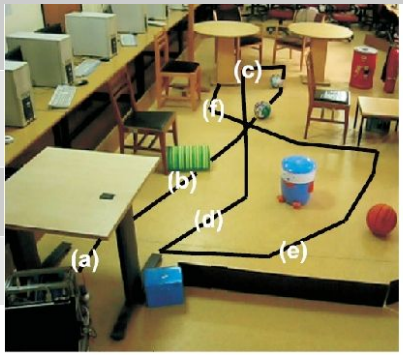

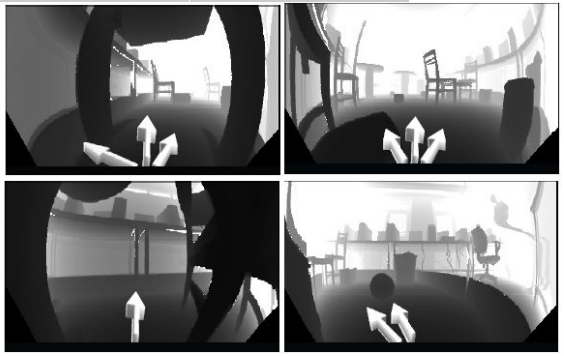

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8		Approaches	
9		MMs, MRFs, DBNs)	
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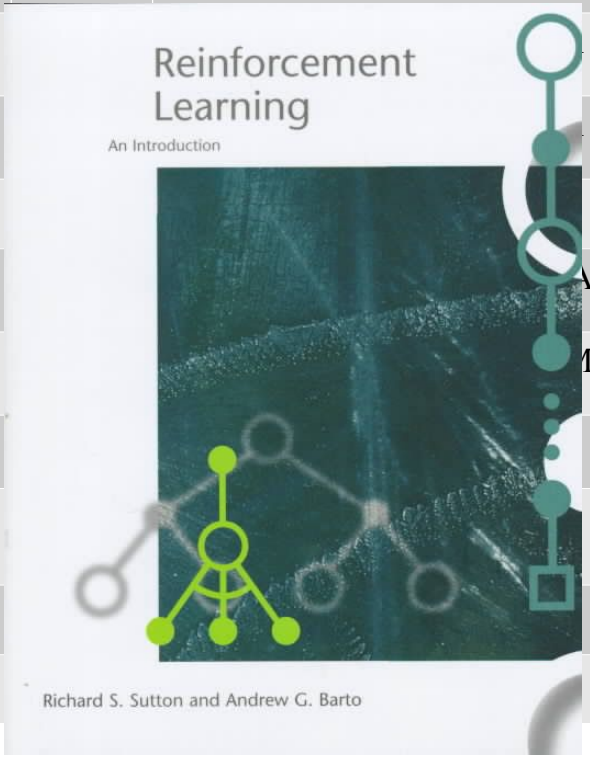

G.D. Konidaris, S.R. Kuindersma, R.A. Grupen and A.G. Barto. Autonomous Skill Acquisition on a Mobile Manipulator. In Proceedings of the Twenty-Fifth Conference on Artificial Intelligence, pages 1468-1473, August 2011.

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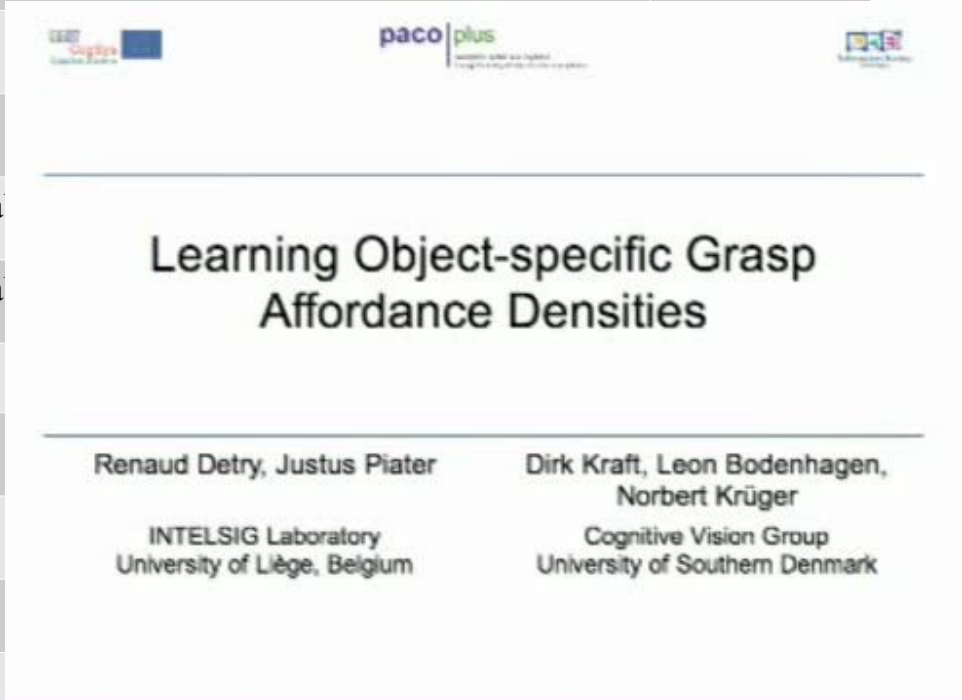

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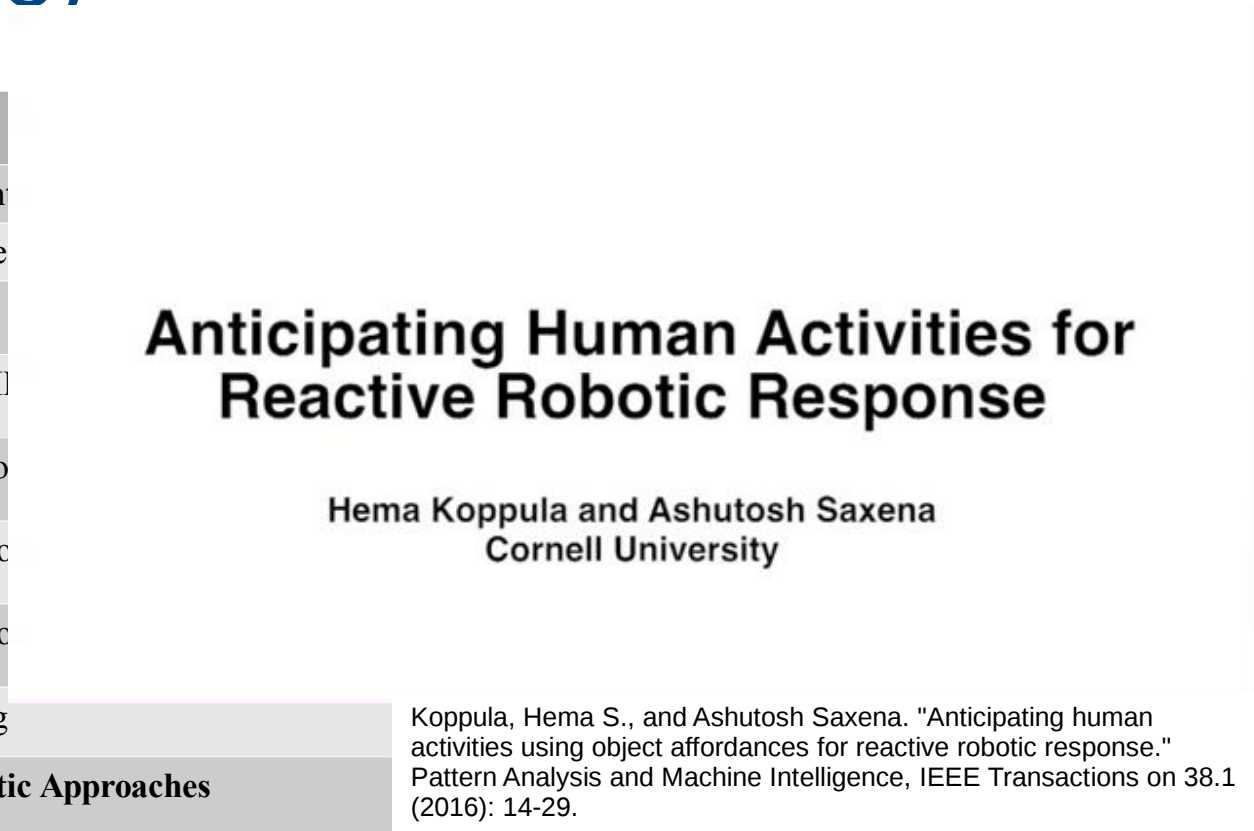

Koppula, Hema S., and Ashutosh Saxena. "Anticipating human activities using object affordances for reactive robotic response." Pattern Analysis and Machine Intelligence, IEEE Transactions on 38.1 (2016): 14-29.

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Pinto, Lerrel, and Abhinav Gupta. "Supersizing Self-supervision: Learning to Grasp from 50K Tries and 700 Robot Hours." arXiv preprint arXiv:1509.06825 (2015).

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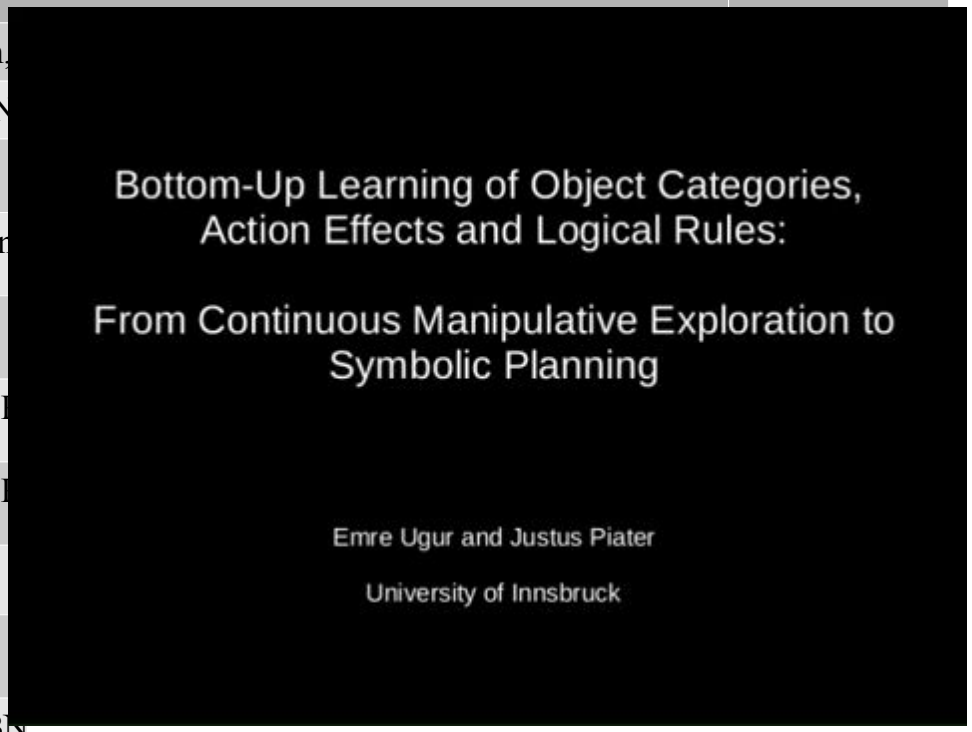

Ugur, Emre, and Justus Piater. "Bottom-up learning of object categories, action effects and logical rules: From continuous manipulative exploration to symbolic planning." Robotics and Automation (ICRA), 2015 IEEE International Conference on. IEEE, 2015.

Topics (tentative) ~ 2 papers per person

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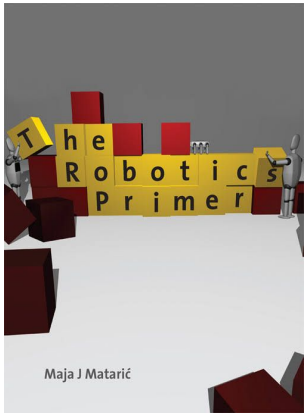
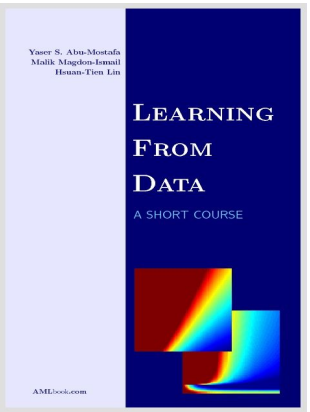
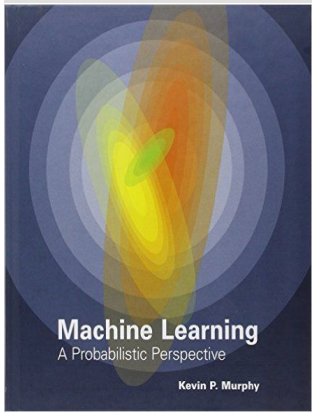
Basics







- Degrees of freedom
- Depth camera, point cloud
- Forward Kinematics, Inverse Kinematics
- Robot, world state
- Clustering / classification
- Supervised learning, unsupervised learning
- Reinforcement learning, Markov Decision Process
- Support Vector Machine (SVM), Maximum Margin Classifier
- Bayesian Inference, Bayesian Networks
- Feed-forward networks, back-prop algorithm

Opinions?

- Expertise
- I will need feedback