Machine Learning

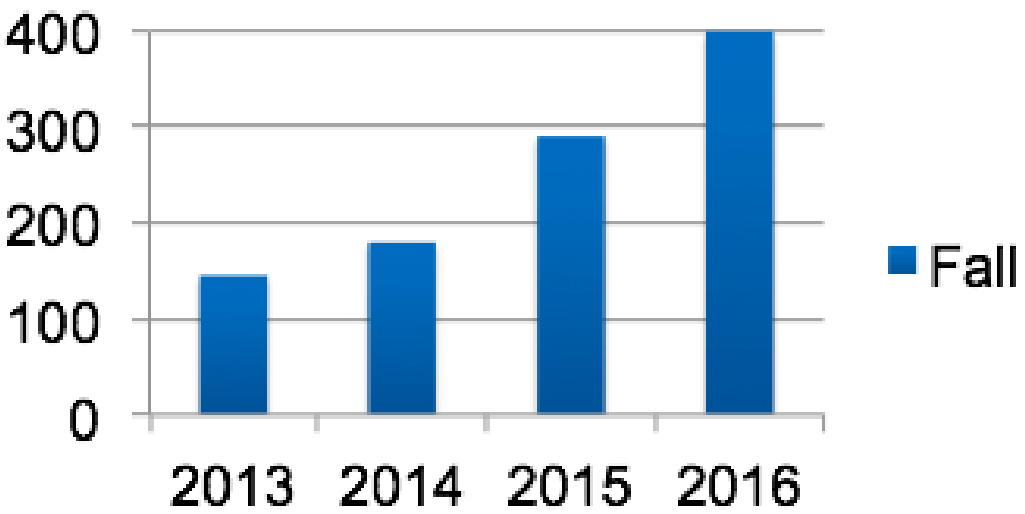
DD2421, 7.5 credits

Atsuto Maki, Giampiero Salvi, Örjan Ekeberg

Autumn, 2018

Welcome to DD2421 Machine Learning!

The number of students in the ML course:



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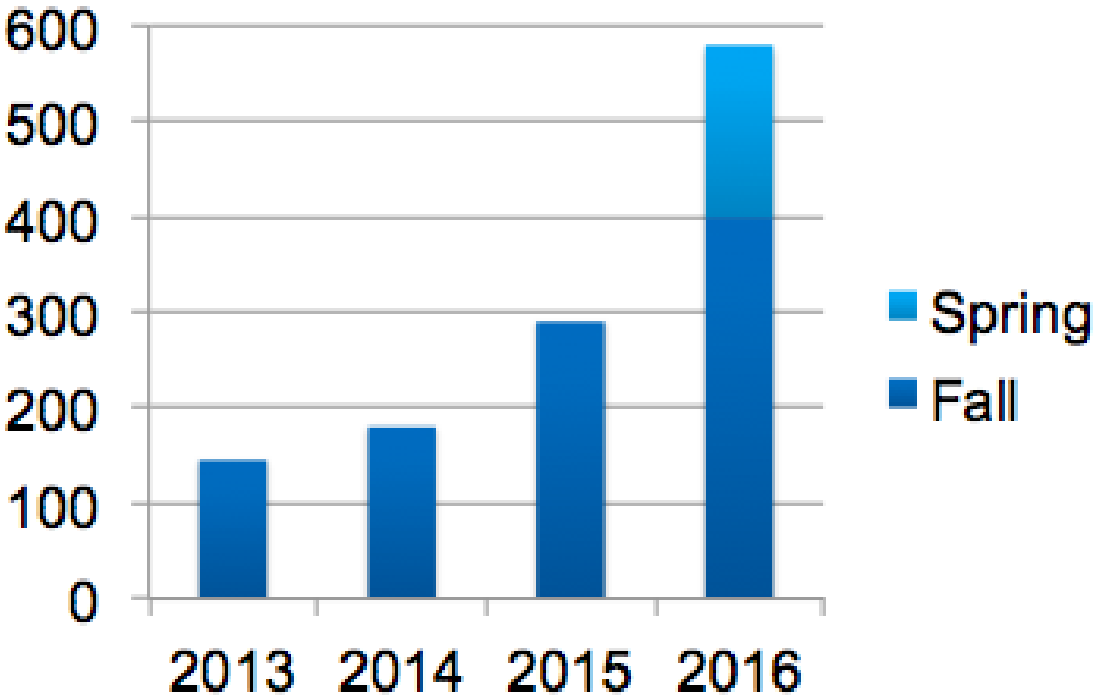

Since 2017 it is given in P1, and will be then in P3.

The aim of the course is provide:

- basic knowledge of the most important algorithms and theory that form the foundation of machine learning
- a practical knowledge of machine learning algorithms and methods

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Course contents:

- Lectures 1–11
- Lecture 12, A summary lecture
- Labs 1–3 (NB. there is a deadline for each)
- Written exam

Intended outcomes – students will be able to:

- explain the principles, advantages, limitations such as overfitting and possible applications of machine learning
- identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.

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DD2421 is:

- Compulsory for the Masters Programme in Machine Learning
- Prerequisite for DD2434 Machine Learning, Advanced Course

Who are teaching?

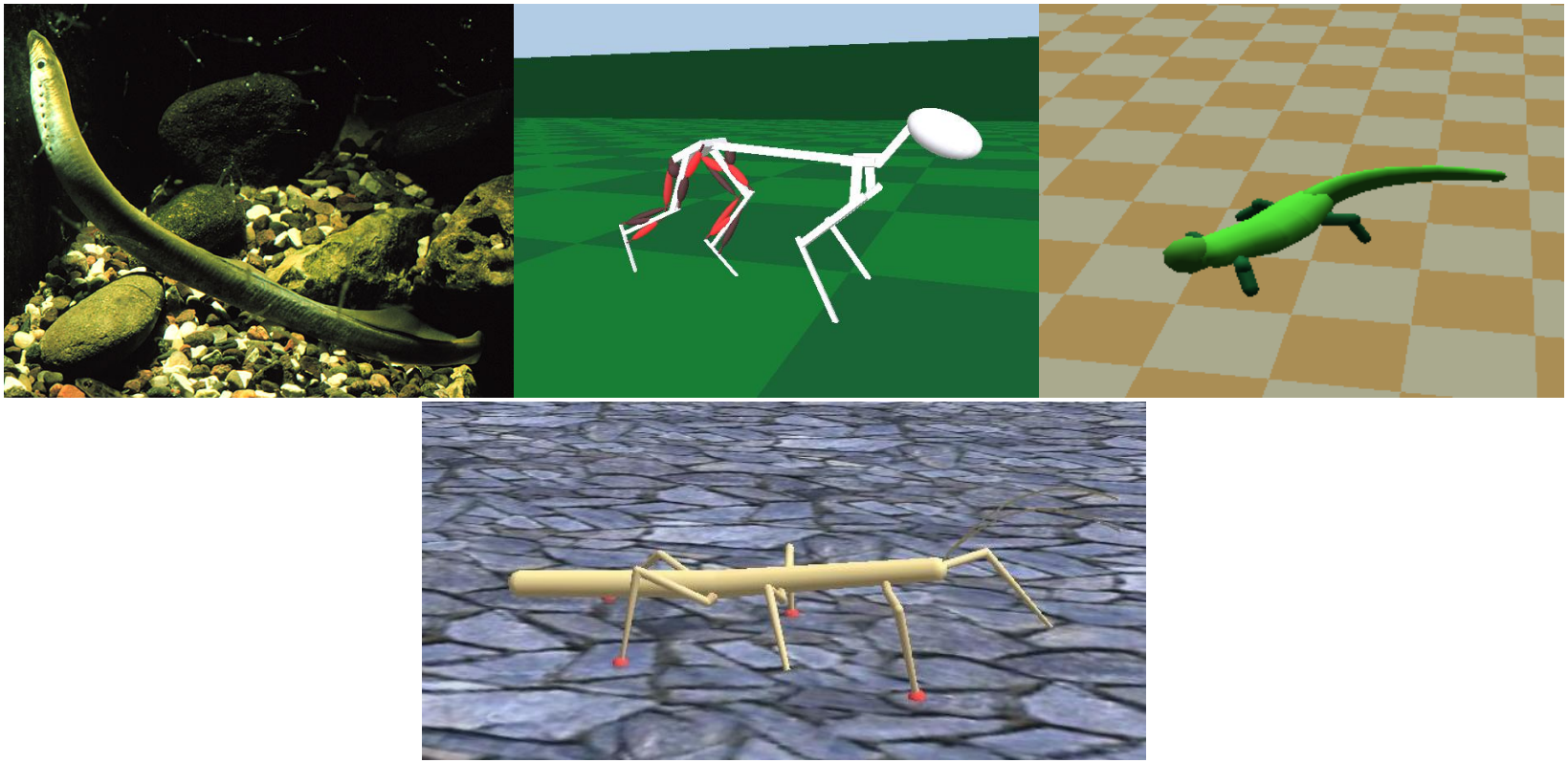
- **Atsuto Maki**
  Dept. Robotics, Perception, and Learning
- **Örjan Ekeberg**
  Dept. Computational Science and Technology
- **Giampiero Salvi**
  Dept. Speech, Music, and Hearing

- Course Assistant: **Alexander Kozlov**
  Dept. Computational Science and Technology
- 10+ teaching assistants (PhD students)

Örjan Ekeberg

My research

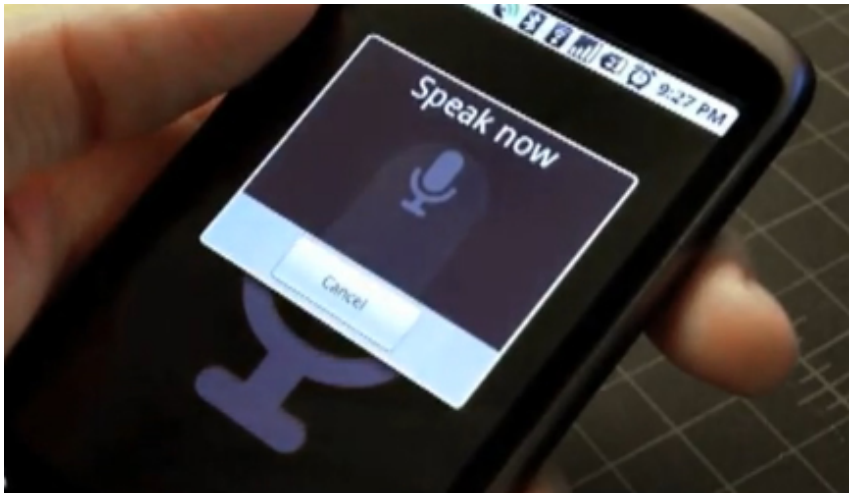
Simulation of the neural control of movements.

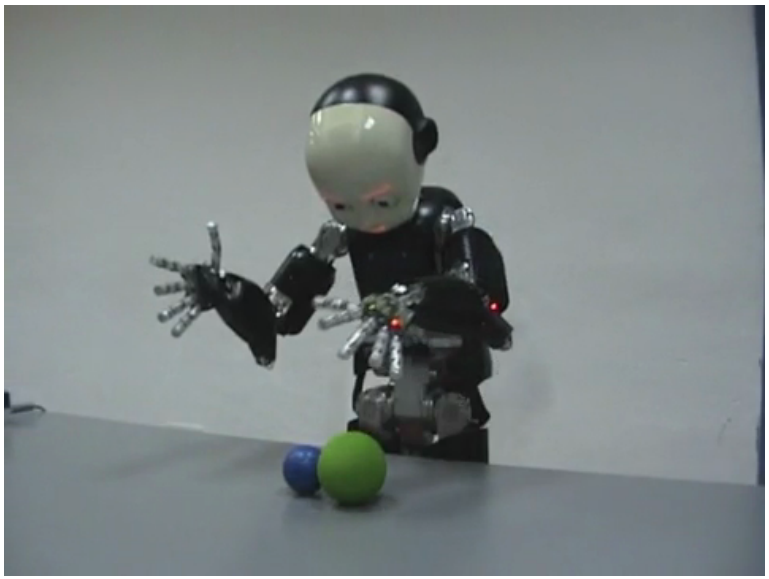


Giampiero Salvi

My research

Speech Technology, Biologically inspired learning



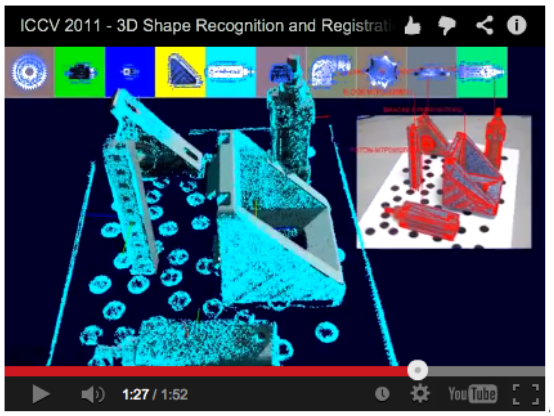


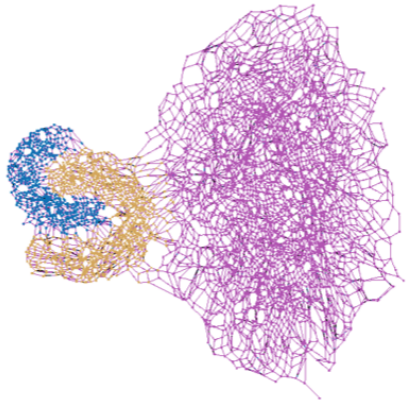
DT2119 Speech and Speaker Recognition, 4th period

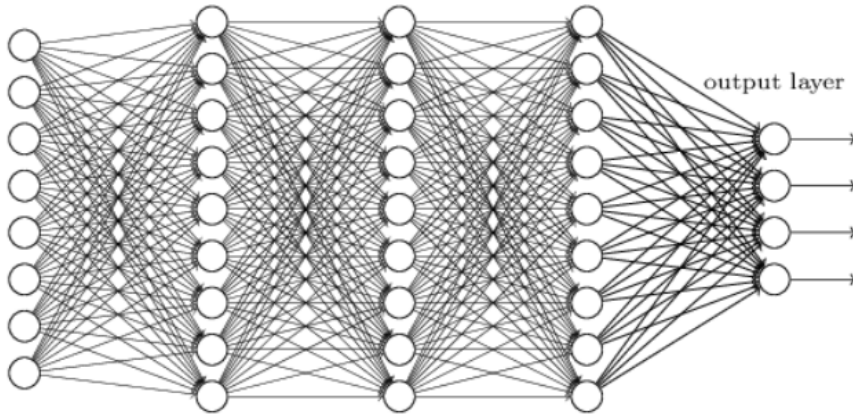
Atsuto Maki

My research

Computer Vision and Machine/Deep Learning







http://www.csc.kth.se/~atsuto/research.html

Recommended reading

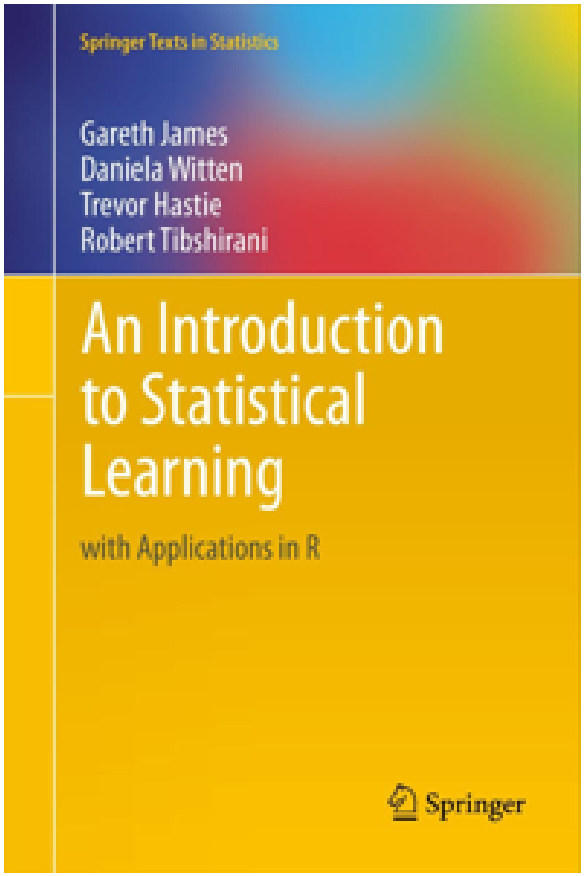
Gareth James, Daniela Witten,
Trevor Hastie and Robert Tibshirani

An Introduction to Statistical Learning

Springer, 2013

Available online:

http://www-bcf.usc.edu/~gareth/ISL/



Recommended reading

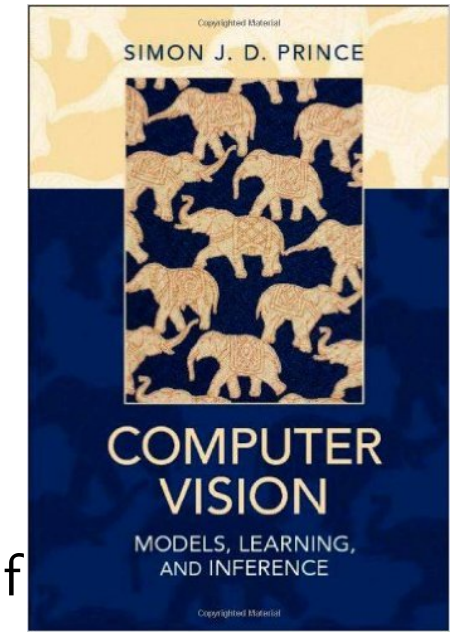
Simon Prince

Computer Vision: Models, Learning, and Inference

Cambridge University Press, 2012

Available online:

web4.cs.ucl.ac.uk/staff/s.prince/book/book.pdf



Course Information on KTH Social

`https://www.kth.se/social/course/DD2421/`
useful for the schedule

Course Information on Canvas

`https://kth.instructure.com/courses/4741`

Course registration needed! Any inquiries to student office / service center (Email:service@eecs.kth.se).

For administrative questions please consult this page: www.kth.se/en/eecs/studentsupport

Lectures

1. Nearest Neighbour Classifier (Memory-based)
2. Decision Trees (Logical inference)
3. Challenges in Machine Learning
4. Regression
5. Probabilistic Methods
6. Learning as Inference
7. Learning with Latent Variables
8. Support Vector Machines
9. Artificial Neural Networks
10. Ensemble Methods
11. Dimensionality Reduction

Labs (3.5 credits)

1. Decision Trees
2. Support Vector Machines
3. Bayes Classifier & Boosting

- labs are carried out by students and examined by teaching assistants
- use Canvas to book time slots for examination

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Examination:

- It is your task to convince the examiner that you have done the assignment and understood the results.
- Strongly encouraged to work+report by pairs of two students.
- 10 minutes
- No computer

Written examination (4 credits)

Date (HT2018): Mon 22 October 14:00-18:00

Exam Registration in advance!

https://www.kth.se/form/exams

Chance for re-exam in December, and again during VT2019 (in P3).

Written examination (4 credits)

Date (HT2018): Mon 22 October 14:00-18:00

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Exam in two sections with requirements (subject to change):

- A-part: Multiple choices at essential level, 7/8 points required
- B-part: Several questions, some 10/27 points needed for a pass

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FAQ

Q. Are course slides available?

A. Will be uploaded on the "Lectures" page on Canvas.

Q. Could we make a group of 3 students for the lab?

A. No – the slot is too short to examine three students.

Q. Can you register me to the course, please?

A. Please consult student office/service center: service@eecs.kth.se

Miscellaneous

Message board available on "Discussion" on KTH Canvas (but bear with us – teachers cannot promise to respond :-)).

A form to get a KTH-account available at the reception of EECS (for PhD-students from other universities).

Kursnämnd: It is a great pleasure to have students' course committee (so-called kursnämnd). Anyone volunteers, please?

Applications

Sample Applications

- Image recognition / Computer vision
- Speech recognition and synthesis
- Natural language processing
- Autonomous robots
- Spam-filter for e-mail
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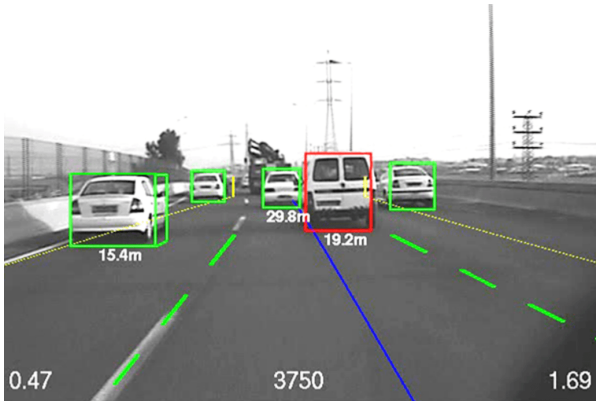
Where is machine learning useful?

A pattern exists

Data available for training

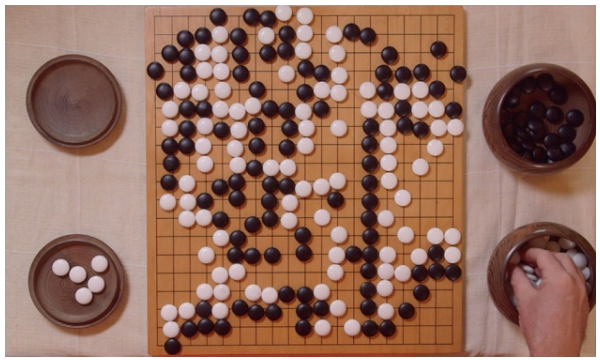
Hard/impossible to define rules mathematically

Driving assistants (Google, Toyota, Volvo, . . .)



Personal assistants (Apple Siri, Amazon Eco, . . .)

Board games (DeepMind AlphaGo)



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- **Unsupervised Learning** (briefly covered)
- **Reinforcement Learning** (not covered)
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  - General Purpose Optimization

Supervised vs Unsupervised learning paradigms

Conflates two different distinctions:

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  - Learning mappings from A to B.
    (Neutral mathematics.)
  - Learning from human supervision: B was provided by a human teacher, as in "This is a dog".
    (Not scalable and biologically implausible.)

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- **Unsupervised Learning**, a.k.a. descriptive
  - Analyzing unstructured raw data. There is no B, only A.
  - Learning without human supervision.
    (Scalable and biologically plausible.)