Machine Learning

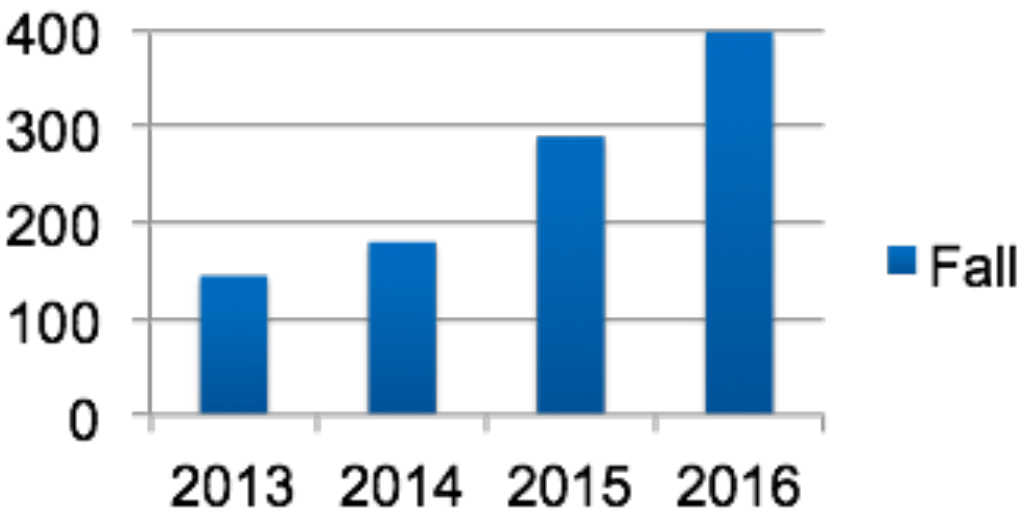
DD2421

Atsuto Maki, Giampiero Salvi, Örjan Ekeberg

Autumn, 2017

Welcome to DD2421 Machine Learning!

The number of students in the ML course:



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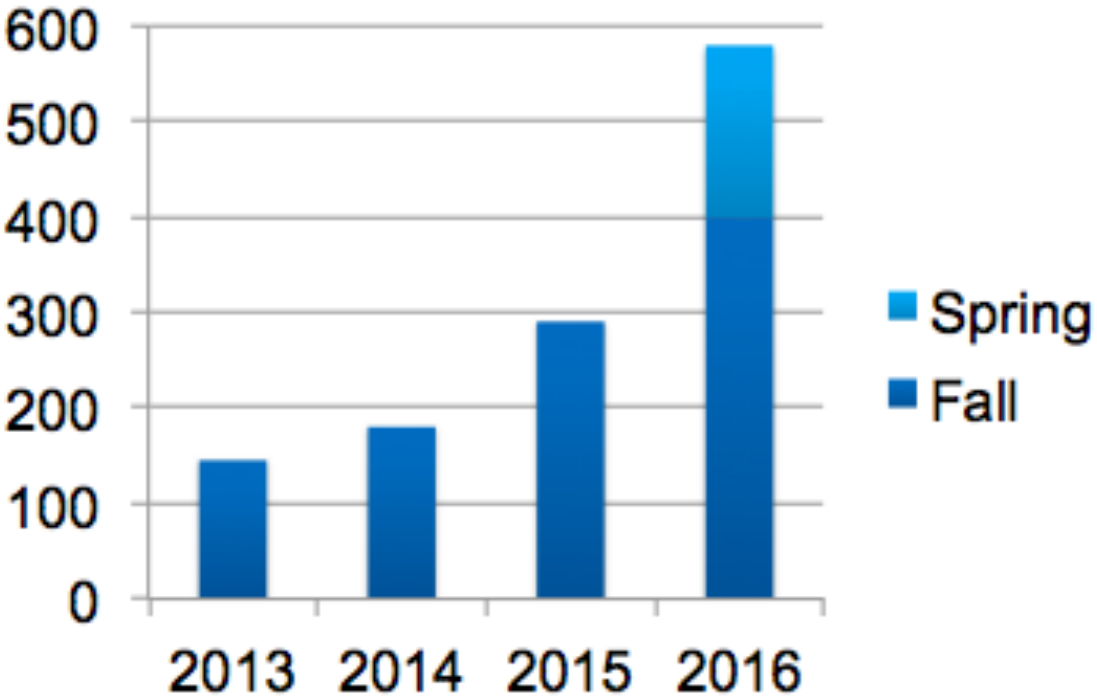

In 2017 it is given in P1, and will be then in P3.

1. About the course
   - Course Contents
   - Who are teaching?
   - Textbook
2. Logistics
   - Lectures
   - Labs
   - Examination
   - Miscellaneous
3. A brief overview of Machine Learning
   - Types of Learning
   - Supervised vs Unsupervised
   - Applications

Course Contents

Course registration needed:

Any questions regarding registration should be addressed to student office / CSC service center (Email:service@csc.kth.se).

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Course contents:

- Lectures 1–11
- Labs 1–3 (NB. there's a deadline for each)
- Industrial Guest Lecture (planned) on October 10, 17:00-18:00
- Lecture 12, A summary lecture
- Written exam, October 21

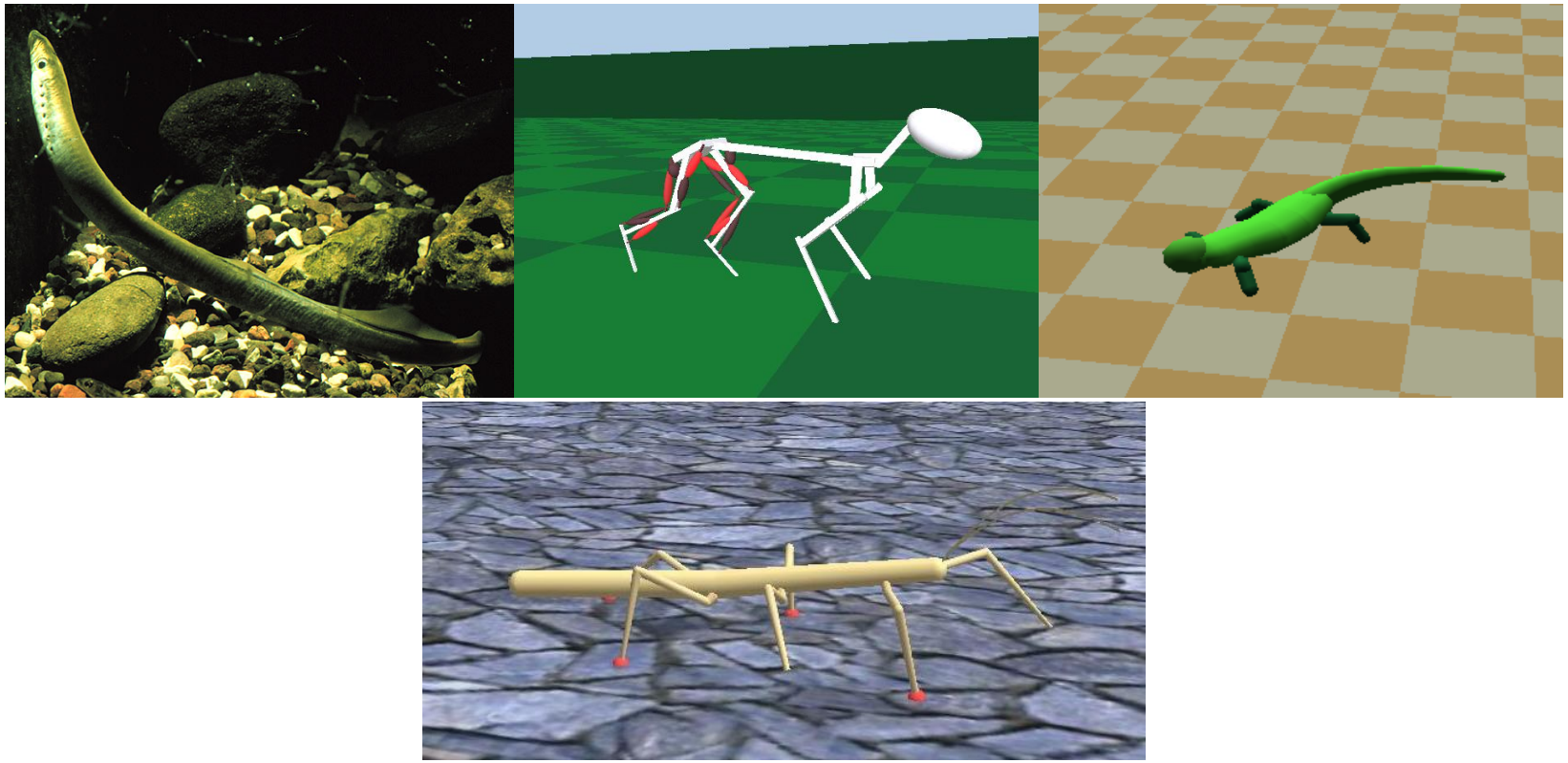
Who are teaching?

- **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

Örjan Ekeberg

My research

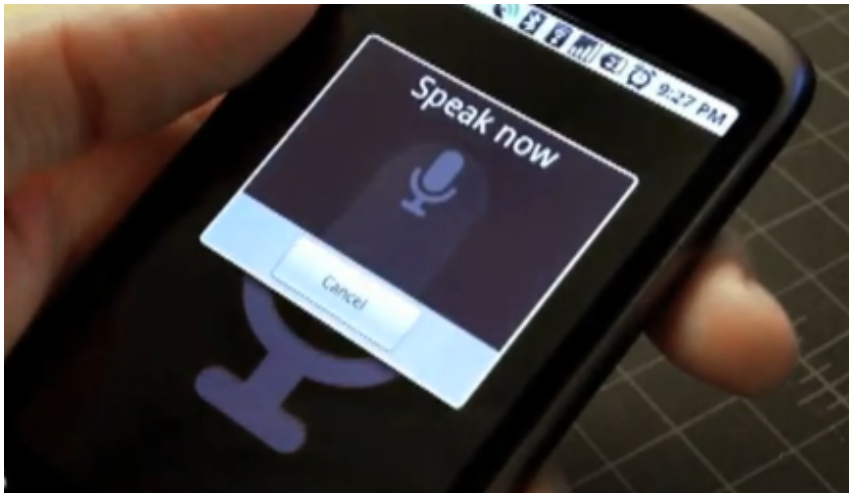
Simulation of the neural control of movements.

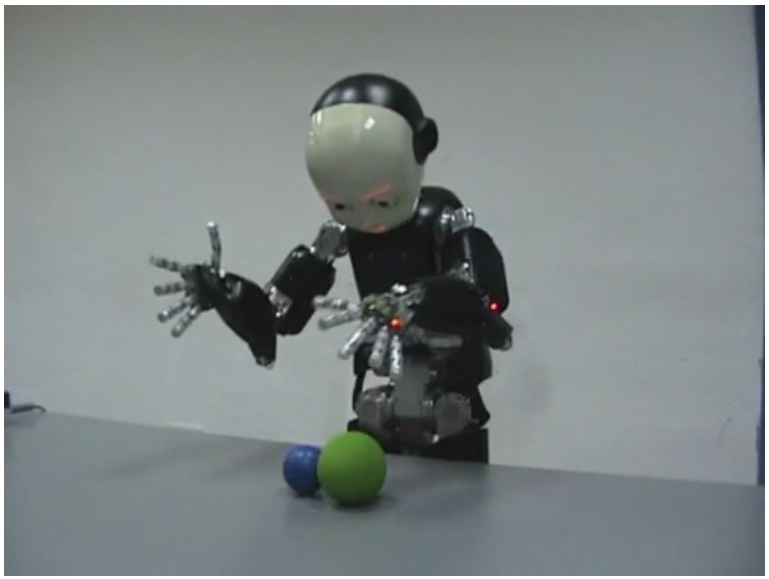


Giampiero Salvi

My research

Speech Technology, Biologically inspired learning



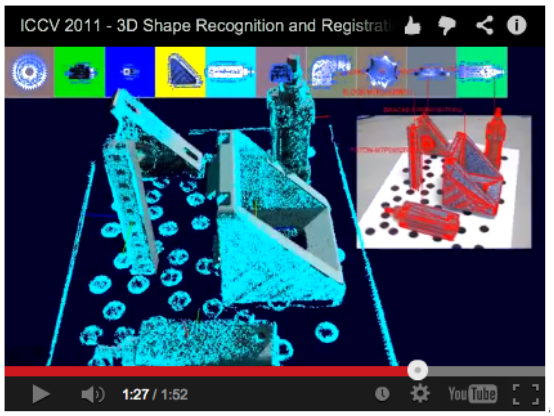


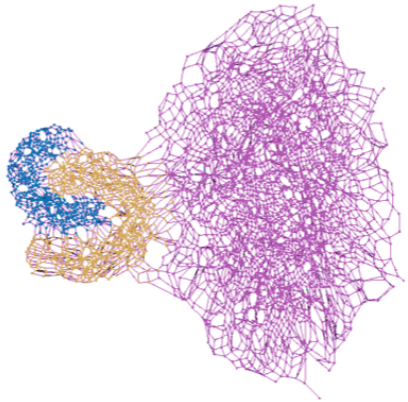
DT2119 Speech and Speaker Recognition, 4th period

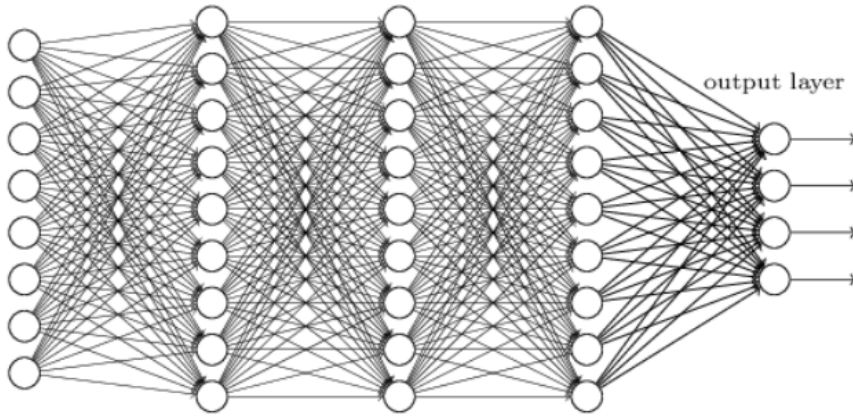
Atsuto Maki

My research

Machine/Deep Learning and Computer Vision







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

Recommended reading

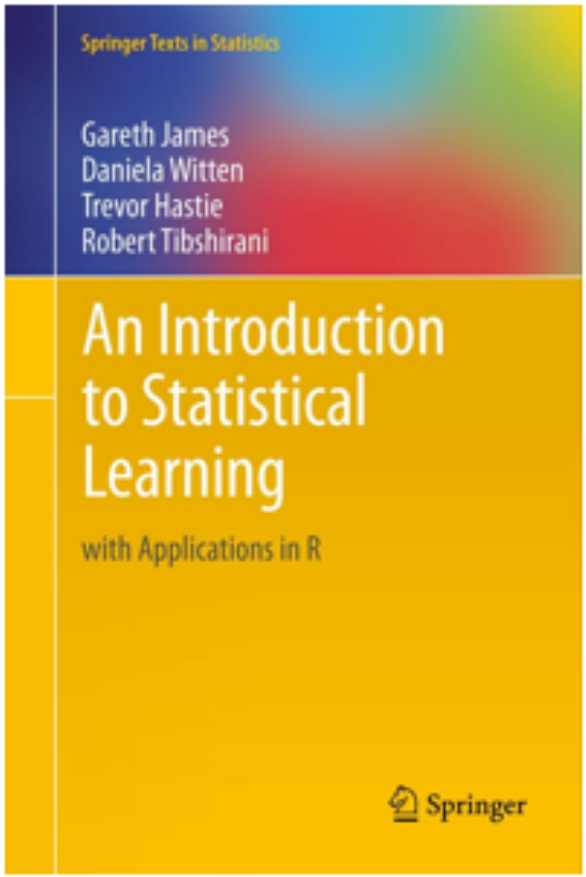
Gareth James, Daniela Witten,
Trevor Hastie and Robert Tibshirani

An Introduction to Statistical Learning

Springer, 2013

Available online:

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



Recommended reading

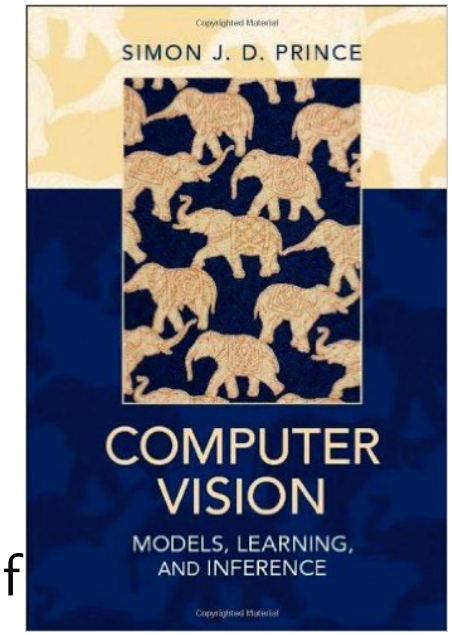
Simon Prince

Computer Vision: Models, Learning, and Inference

Cambridge University Press, 2012

Available online:

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



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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

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

Labs

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

Online booking of lab examination time-slots.

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

Labs are obligatory part for the course credits.

Written examination, October 21

Exam Registration 9/21 - 10/5

Instruction: https://www.kth.se/en/csc/utbildning/kurser/tentaanmalan-1.324242

A chance for re-exam in VT2018 (in P3 again).

Written examination, October 21

Exam Registration 9/21 - 10/5

Instruction: https://www.kth.se/en/csc/utbildning/kurser/tentaanmalan-1.324242

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 8/24 points needed for a pass

There are no bonus points.
A chance for re-exam in VT2018 (in P3 again).

FAQ

Q. Are course slides available?

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

Q. How is the course different from DD2431?

A. This is a 7.5 credit course with more materials and we go deeper on some topics whereas DD2431 was seen as "too easy" (students' feedback). Bonus not used, so it will be harder to get high grade.

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

A. Please consult student office/service center: service@csc.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 CSC (for PhD-students from other universities).

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

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Types of Learning

- **Supervised Learning** (covered)
- **Unsupervised Learning** (briefly covered)
- **Reinforcement Learning** (not covered)
- **Evolutionary Learning** (not covered)

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  - Well-defined problem. Battle-tested in industrial applications.
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  - Consider how a baby learns to walk for instance.
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- **Evolutionary Learning** (not covered)
  - General Purpose Optimization

Supervised vs Unsupervised learning paradigms

Conflates two different distinctions:

- **Supervised Learning**, a.k.a. predictive

- **Unsupervised Learning**, a.k.a. descriptive

Supervised vs Unsupervised learning paradigms

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- **Supervised Learning**, a.k.a. predictive
  - 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.)

Applications

Sample Applications

- Speech recognition and synthesis
- Image recognition
- 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