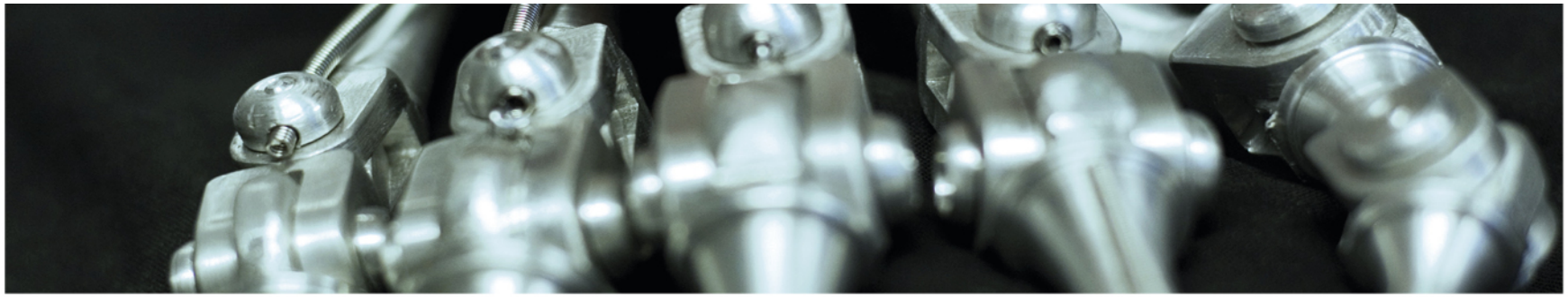


UiO : Department of Informatics
University of Oslo

INF3490/INF4490 - Biologically inspired computing

Lecture 1

2015

Jim Tørresen

INF3490/INF4490: Biologically Inspired Computing – Autumn 2015

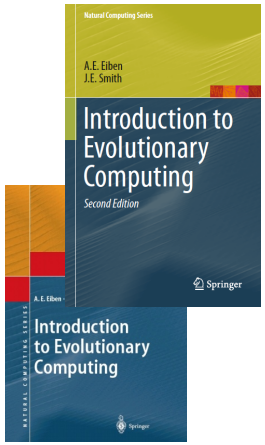
- **Lecturer:**
  - Jim Tørresen (jimtoer@ifi.uio.no)
  - Invited (Kyrre Glette and Arjun Chandra)
- **Lecture time:** Monday 10.15-12.00
- **Lecture room:** OJD 3437 Sem. room C
- **Group Lecture (starting this week):**
  - Group 2:Tuesday 14:15-16:00 (OJD 1454 Computer Room Sed)
  - Group 1: Friday 10:15-12:00 (OJD 1454 Computer Room Sed)
- **Course web page:** www.uio.no/studier/emner/matnat/ifi/INF3490

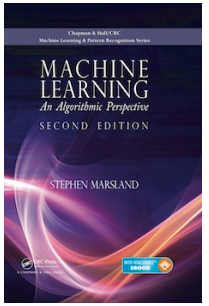
Group Teachers

Magnus Olden

Ole Herman Schumacher Elgesem

INF3490/INF4490





Syllabus:

- Selected parts of the following books (details on course web page):
  - A.E. Eiben and J.E. Smith: Introduction to Evolutionary Computing, Second Edition (ISBN 978-3-662-44873-1) **OR** 2nd printing, 2007 (ISBN: 978-3-540-40184-1). Springer.
  - S. Marsland: Machine learning: An Algorithmic Perspective. ISBN: 978-1466583283
  - On-line papers (on the course web page).
- The lecture notes.

Obligatory Exercises:

- Two exercises on evolutionary algorithms and machine learning.
- ***Students registered for INF4490 will be given additional tasks in the excercises.***

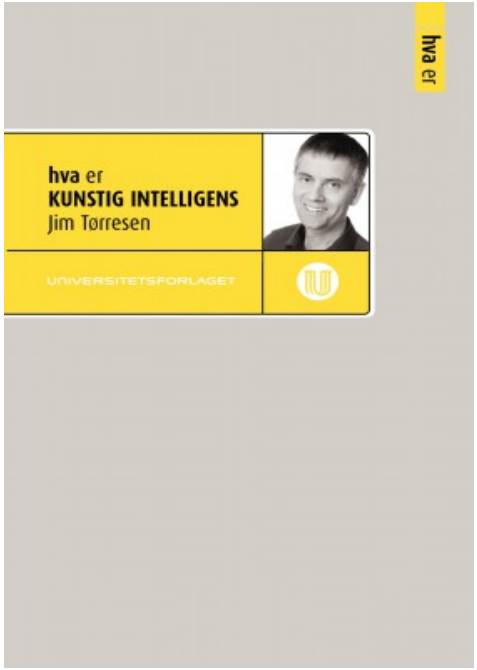
Supporting literature in Norwegian (not syllabus)

Jim Tørresen: hva er KUNSTIG INTELLIGENS

Universitetsforlaget Nov 2013, ISBN: 9788215020211

Topics:

- Kunstig intelligens og intelligente systemer
- Problemløsning med kunstig intelligens
- Evolusjon, utvikling og læring
- Sansing og oppfatning
- Bevegelse og robotikk
- Hvor intelligente kan og bør maskiner bli?



Username and Password Course Web Page

username: authorization

password: complete

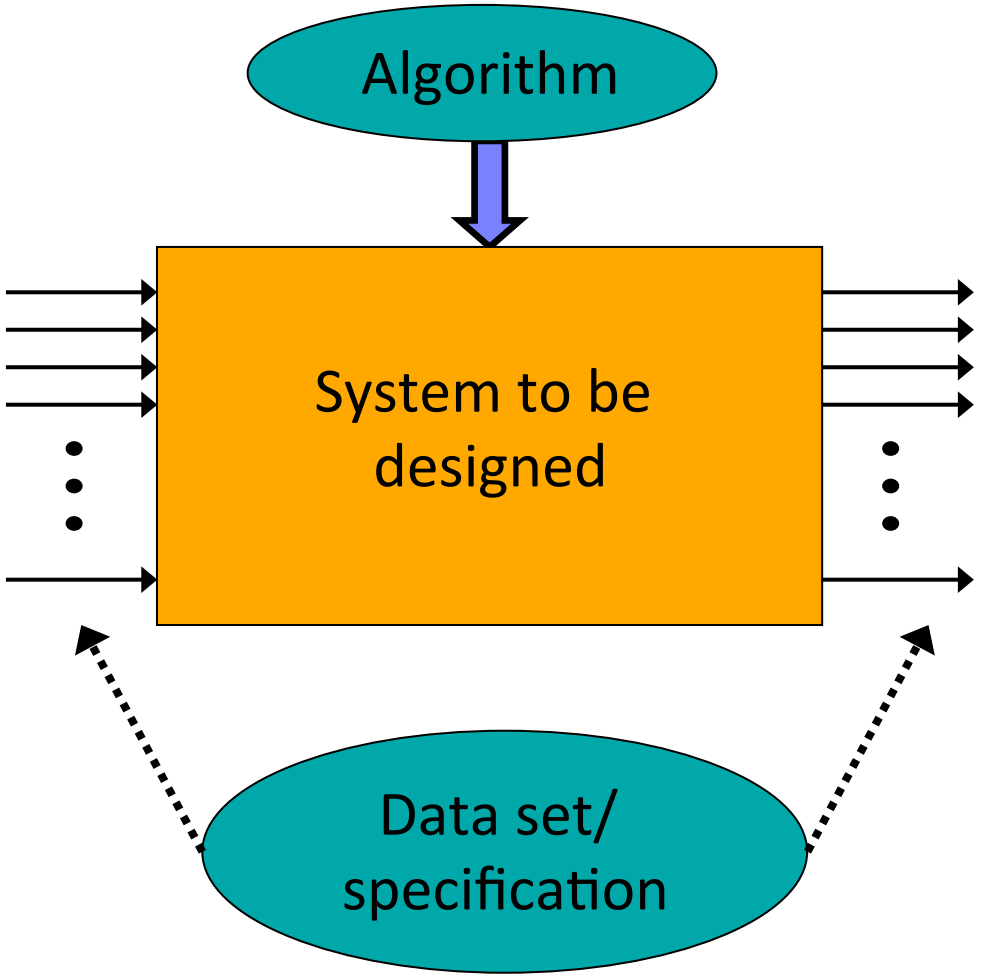
Lecture Plan Autumn 2015

Date	Topic	Syllabus
24.08.2015	Intro to the course. Optimization and search.	Marsland (chapter 9.1, 9.4-9.6)
31.08.2015	Evolutionary algorithms I: Introduction and representation.	Eiben & Smith (chapter 1-4, old book: 1-3)
07.09.2015	Evolutionary algorithms II: Population management and popular algorithms	Eiben & Smith (chapter 5-6, old book: 3-6) (+ Marsland 10.1-10.4)
14.09.2015	Evolutionary algorithms III: Multi-objective optimization. Hybrid algorithms. Working with evolutionary algorithms.	Eiben & Smith (chapter 9, 10, 12 (old book: 9, 10, 14)
21.09.2015	Intro to machine learning and classification. Single-layer neural networks.	Marsland (chapter 1 and 3)
28.09.2015	Break (no lecture)	
05.10.2015	Multi-layer neural networks. Backpropagation and practical issues	Marsland (chapter 4)
12.10.2015	Swarm Intelligence. Evolvable hardware.	TBA (On-line papers on the course web page)
19.10.2015	Support vector machines. Ensemble learning. Dimensionality reduction.	Marsland (chapter 8, 13, 6.2.)
26.10.2015	Unsupervised learning. K-means. Self-organizing maps.	Marsland (chapter 14)
02.11.2015	Reinforcement learning	Marsland (chapter 11)
09.11.2015	Bioinspired computing for robots and music. Future perspectives on Artificial Intelligence.	On-line papers on the course web page
16.11.2015	Summary. Questions	

What is the Course about?

- Artificial Intelligence
- Self-learning and adaptive systems
- Systems that can sense, reason (think) and/or respond
- Why bio-inspired?
- Increase intelligence in both single node and multiple node systems

Self learning/Machine learning (ex: evolutionary computation)



Learning by examples

Man/Woman vs Machine – Who are smartest?

- Machines are good at:
  - number crunching
  - storing data and searching in data
  - specific tasks (e.g. control systems in manufacturing)
- Humans are good at:
  - sensing (see, hear, smell etc and be able to recognize what we senses)
  - general thinking/reasoning
  - motion control (speaking, walking etc).

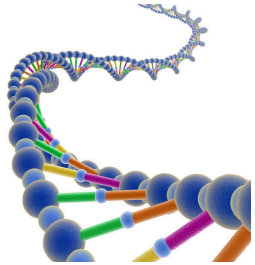
Turing Test (1956)

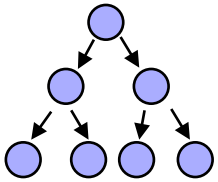
- A machines is intelligent when a human **communicating with text** is **unable to distinguish** the machine from a human.

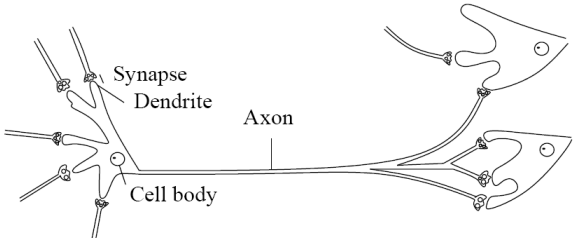
- Requirements:
  - recognize and generate ***natural language*** to communicate as a human
  - store the information for ***representing knowledge*** it has received or are receiving
  - ***reasoning*** based on stored information and draw new conclusions
  - be able to learn to ***adapt*** to new circumstances and extract patterns

Major Mechanisms in Nature

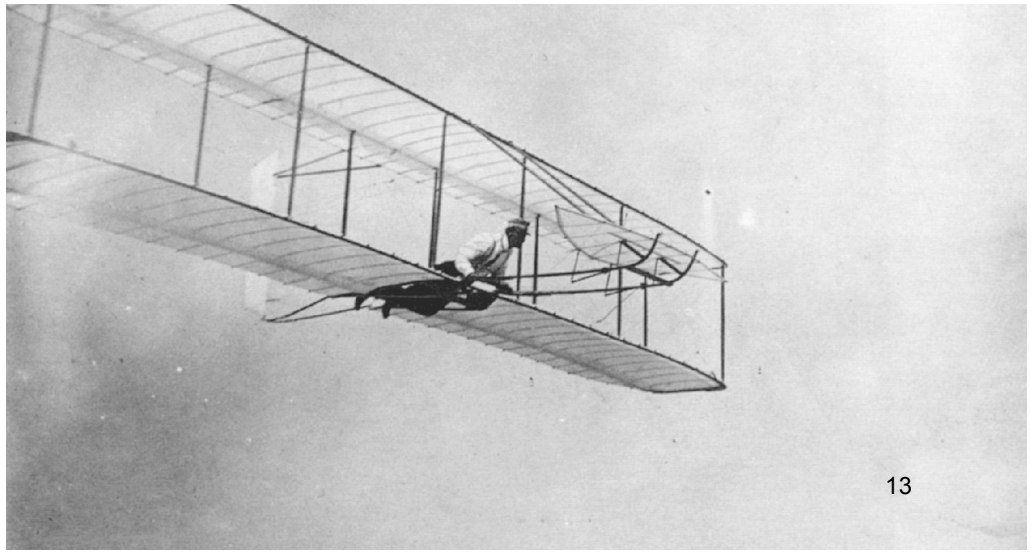
- **Evolution:** Biological systems develop and change during generations.
- **Development/growth:** By cell division a multi-cellular organism is developed.
- **Learning:** Individuals undergo learning through their lifetime.
- **Collective behavior:** Immune systems, flocks of birds, fishes etc





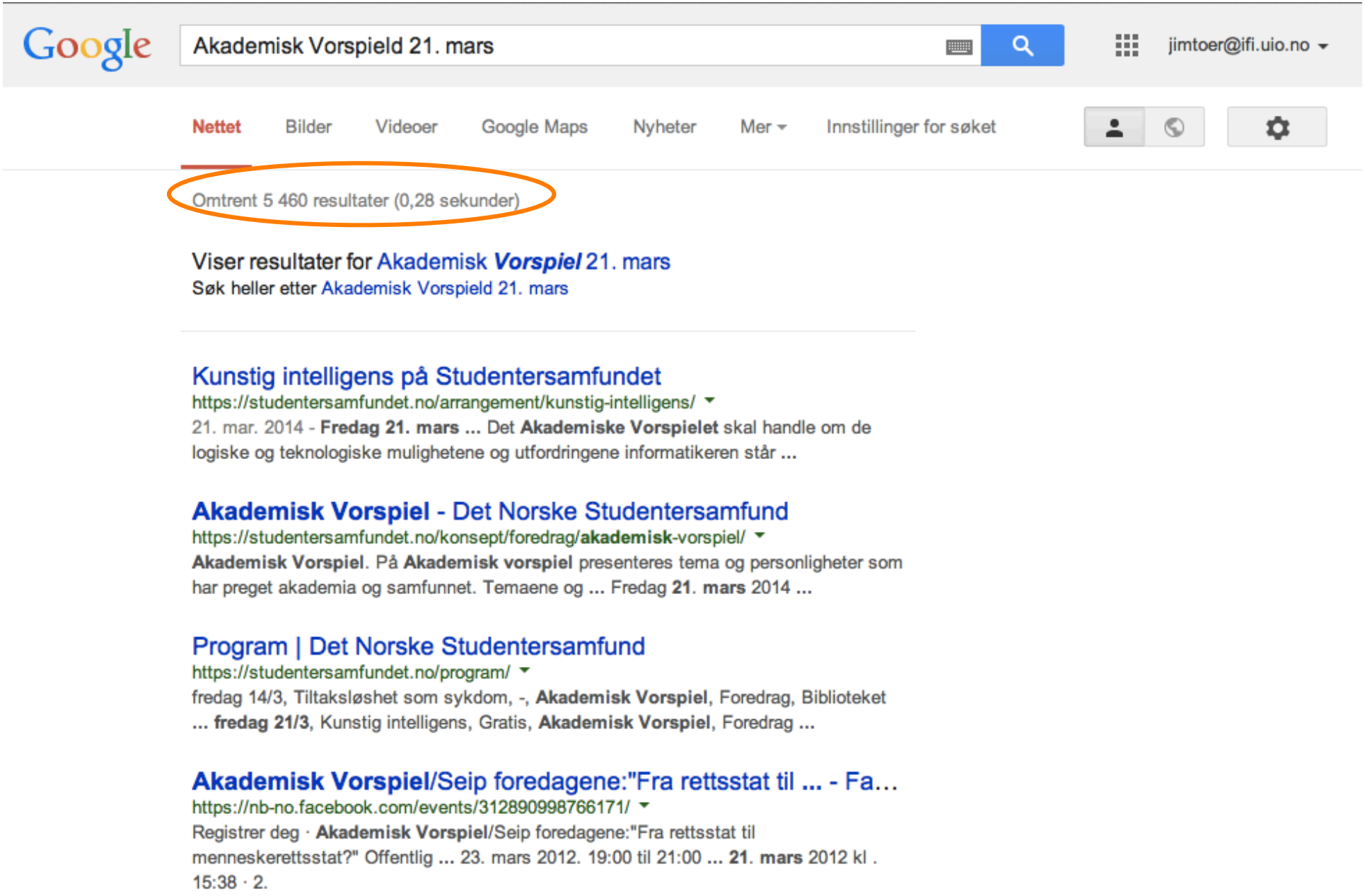


What methods are best?



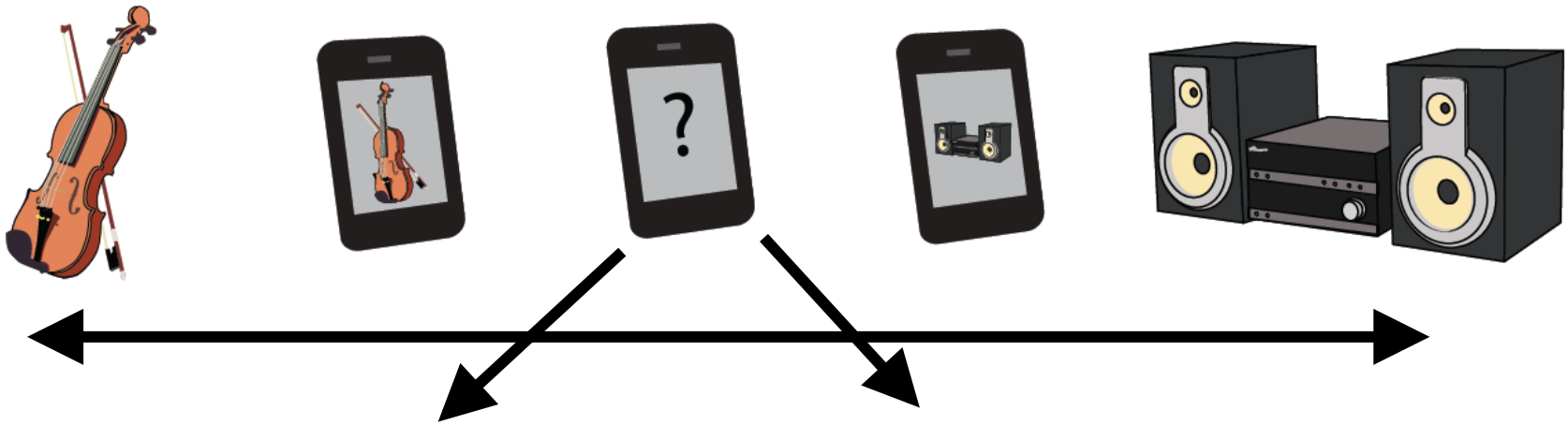
Artificial Intelligence Application

- Smartphone user adaptation
- Detecting faces/people smiling in cameras
- Design of physical shapes
- Web search
- Route planning
- Service robots
- Driverless cars
- Active music
- ??


Google
Akademisk Vorspield 21. mars
jimtoer@ifi.uio.no
Nettet
Bilder
Videoer
Google Maps
Nyheter
Mer
Innstillinger for søket
Omtrent 5 460 resultater (0,28 sekunder)
Viser resultater for Akademisk Vorspiel 21. mars
Søk heller etter Akademisk Vorspield 21. mars
Kunstig intelligens på Studentersamfundet
https://studentersamfundet.no/arrangement/kunstig-intelligens/
21. mar. 2014 - Fredag 21. mars ... Det Akademiske Vorspielet skal handle om de logiske og teknologiske mulighetene og utfordringene informatikeren står ...
Akademisk Vorspiel - Det Norske Studentersamfund
https://studentersamfundet.no/konsept/foredrag/akademisk-vorspiel/
Akademisk Vorspiel. På Akademisk vorspiel presenteres tema og personligheter som har preget akademia og samfunnet. Temaene og ... Fredag 21. mars 2014 ...
Program | Det Norske Studentersamfund
https://studentersamfundet.no/program/
fredag 14/3, Tiltaksløshet som sykdom, -, Akademisk Vorspiel, Foredrag, Biblioteket ... fredag 21/3, Kunstig intelligens, Gratis, Akademisk Vorspiel, Foredrag ...
Akademisk Vorspiel/Seip foredagene:"Fra rettsstat til ... - Fa...
https://nb-no.facebook.com/events/312890998766171/
Registrer deg · Akademisk Vorspiel/Seip foredagene:"Fra rettsstat til menneskerettsstat?" Offentlig ... 23. mars 2012. 19:00 til 21:00 ... 21. mars 2012 kl . 15:38 · 2.

Google driverless car

(Inter) Active Music



Direct Control

- Navigate within the song
- Control certain instruments (e.g. keep playing the chorus drumbeat in the verse)
- Change the tempo of the song

Indirect Control

- Use on-body sensors to adapt the music to the mood of the user
- Listen to music that pushes you to work out harder
- Fuse the musical preferences of multiple users into one song

Apple app: https://itunes.apple.com/us/app/pheromusic/id910100415?ls=1&mt=8

Ant Colony Optimization (ACO)

- Ants find shortest path to food source from nest.
- Ants deposit pheromone along traveled path which is used by other ants to follow the trail.
- This kind of indirect communication via the local environment is called stigmergy.


Funky Sole Music
Active music control by a sensor sole
nothing
ePICS
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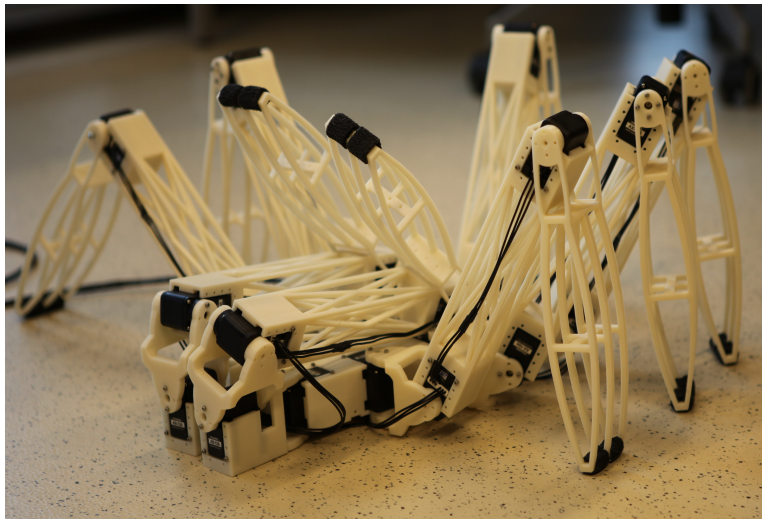
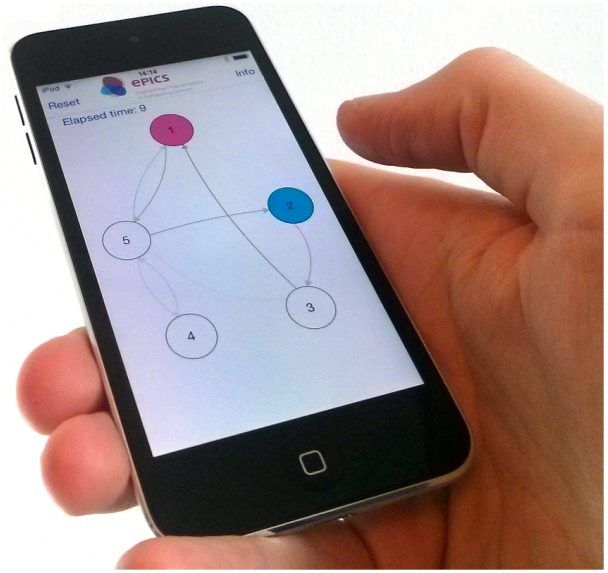
University of Oslo

EPEC: Prediction and Coordination for Robots and Interactive Music

2 PhDs + 1 post-doc 2015-2019





Goal: *Design, implement and evaluate multi-sensor systems that are able to sense, learn and predict future actions and events.*

Funding: *FRIPRO, Research Council of Norway*

Forskningsrådet

UiO : Department of Informatics
University of Oslo

MECS: Multi-sensor Elderly Care Systems

2 PhDs + 1 post-doc (2015-2019)

Goal: Create and evaluate multimodal mobile human supportive systems that are able to sense, learn and predict future events.

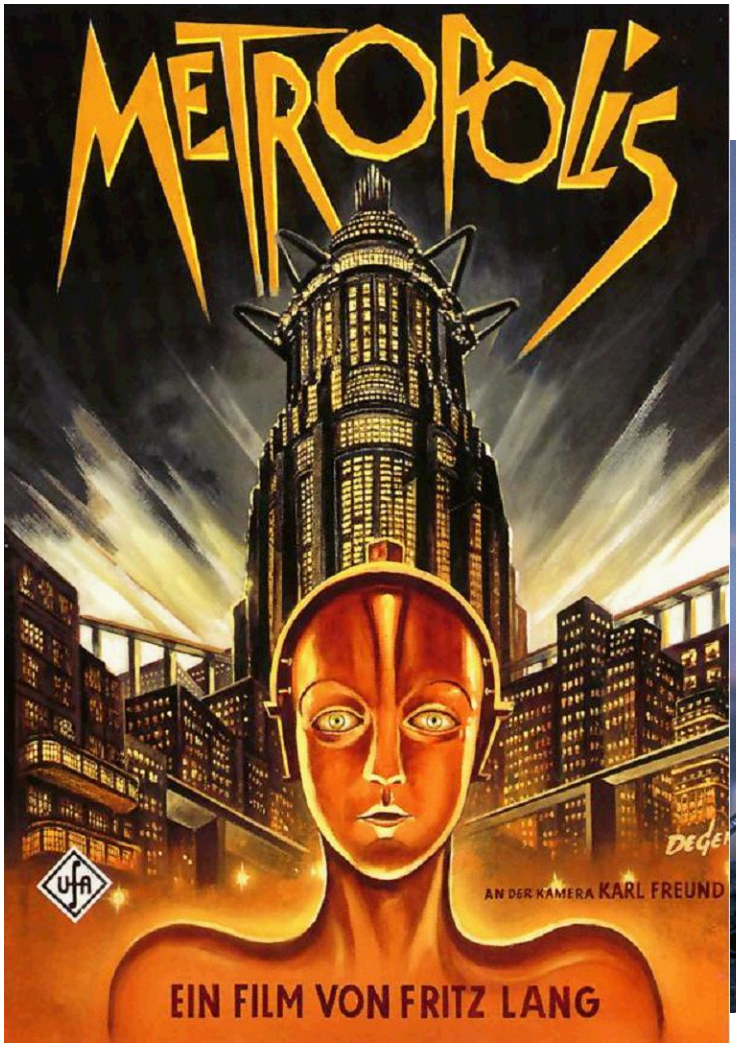
Project consortium:

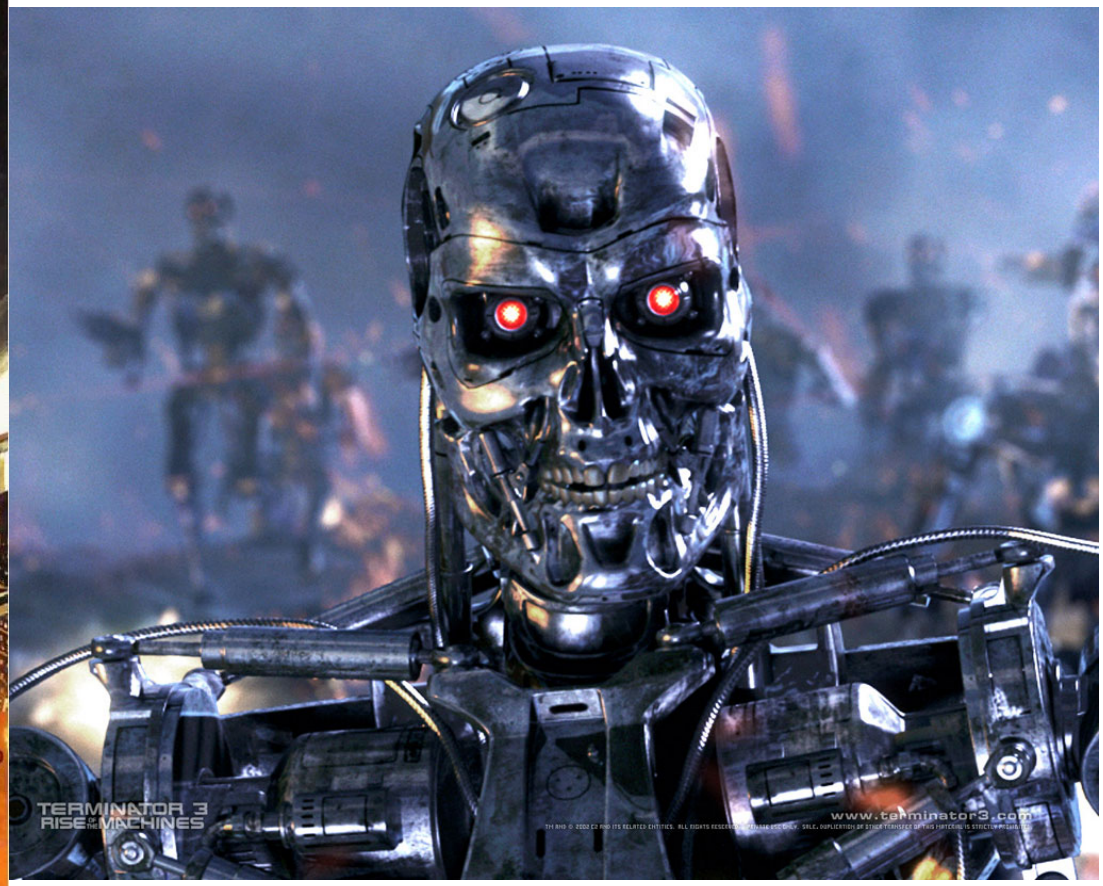
- Robotics and Intelligent Systems group (coordinator)
- DESIGN group (IFI)
- National:
  - Oslo Municipality (Oslo kommune, Gamle Oslo)
  - Norwegian Centre for Integrated Care and Telemedicine (Tromsø)
  - XCENTER AS (3D sensor)
  - Novelda AS (ultra wideband sensor)
- International:
  - University of Hertfordshire
  - University of Reading Whiteknights
  - Giraff Technologies AB

Funding: *IKTPLUSS, Research Council of Norway*

Forskningsrådet

Is terminator coming close?





Repetiton Questions

- What is machine learning?

- Give some examples of intelligent mechanisms in nature