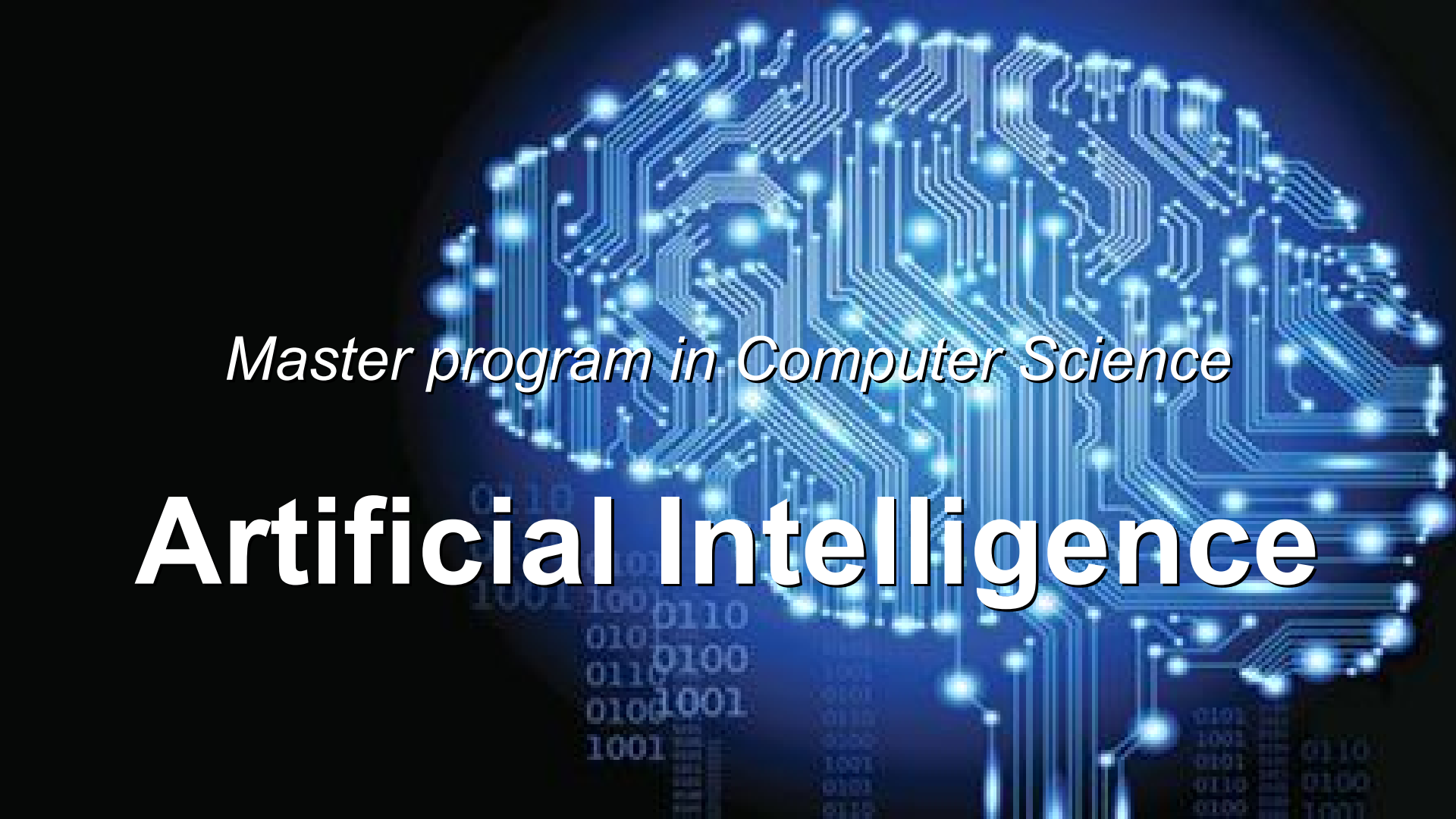
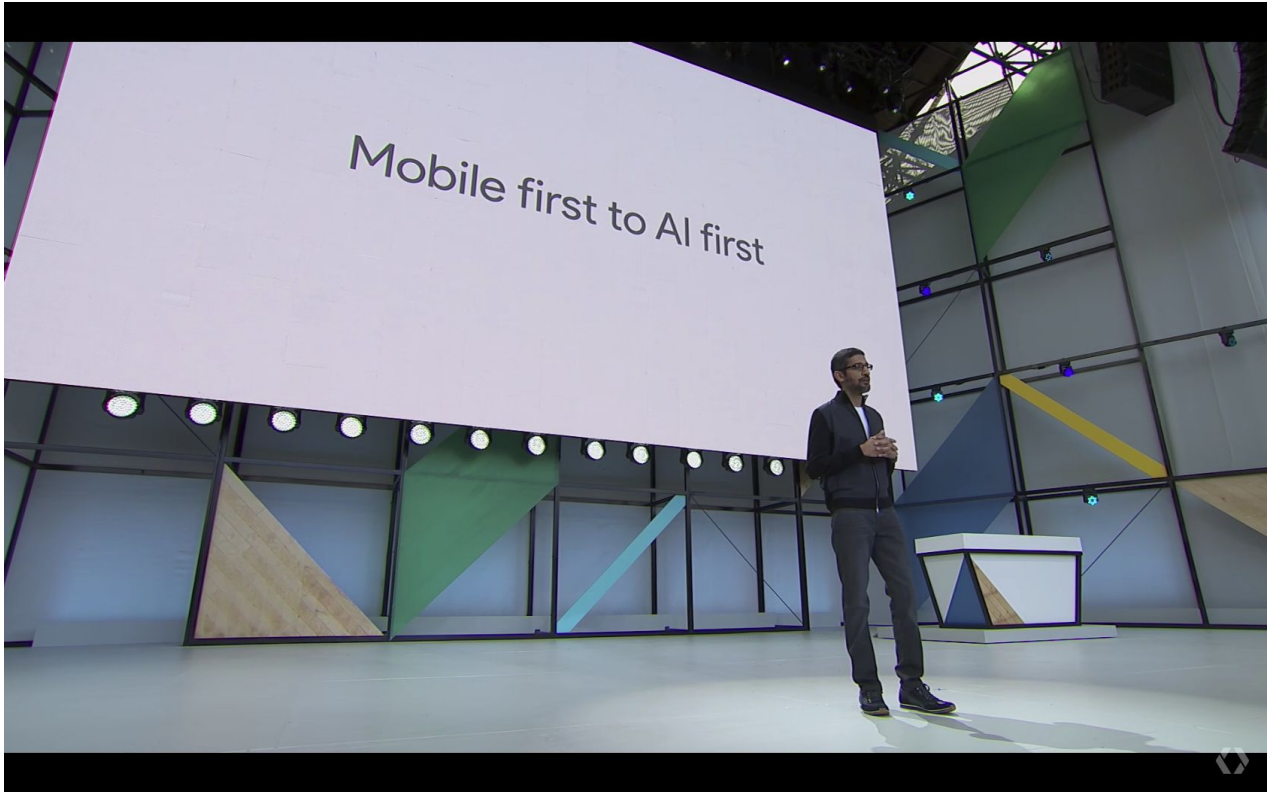

Master program in Computer Science
Artificial Intelligence

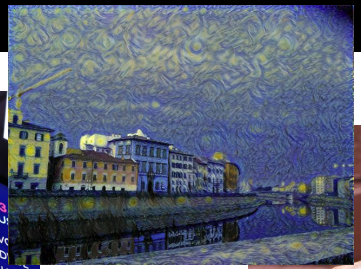
AI is taking over the world

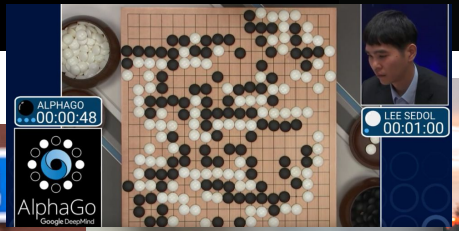


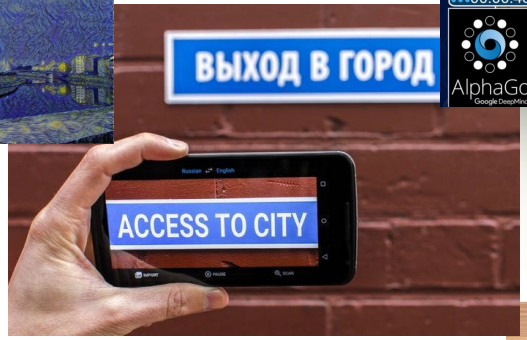
AI was the star at the latest Google I/O conference

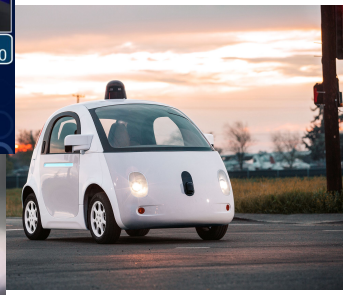
- 2 hrs of keynote talk
- almost *every* aspect of Google products and services relies on AI **today**

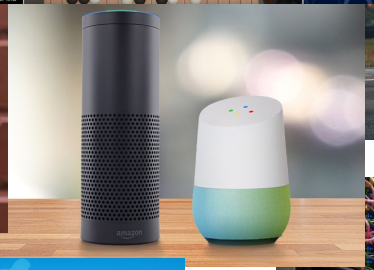
AI is taking over the world

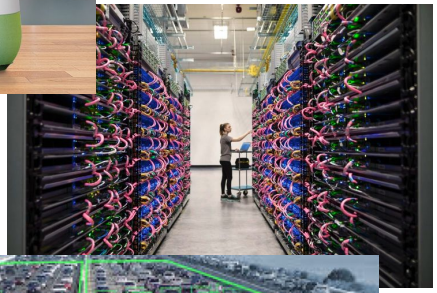


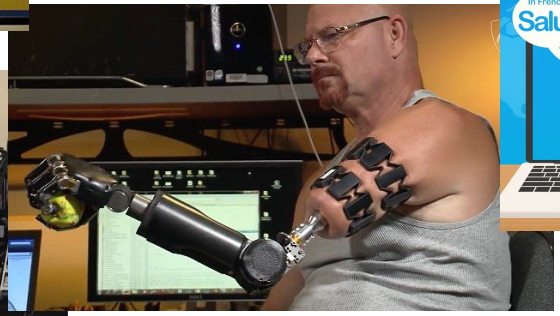


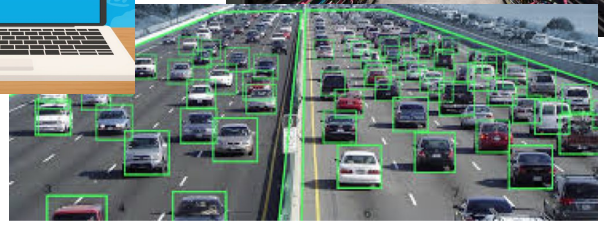




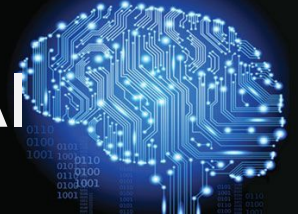








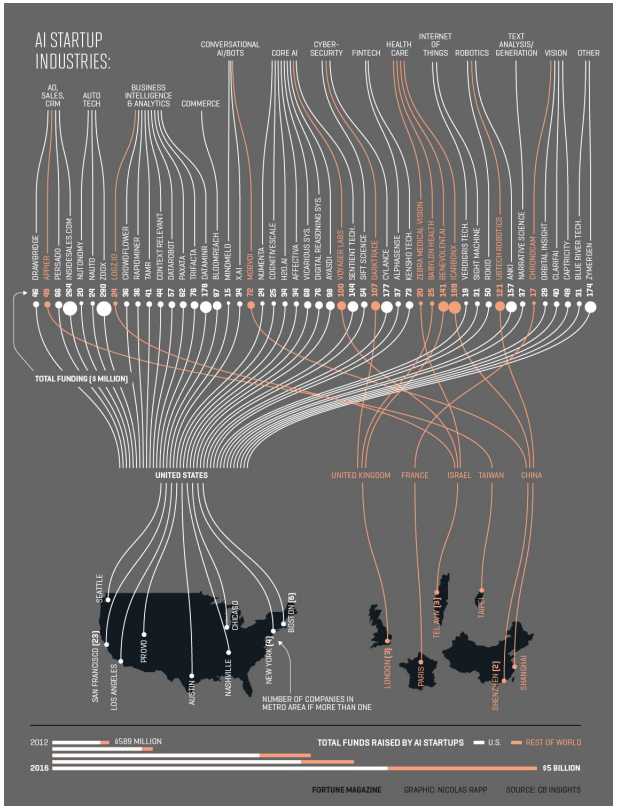
Big and small players alike are betting on AI



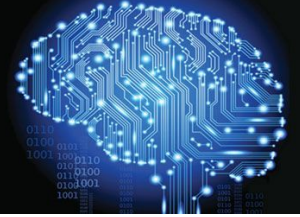
Google

Microsoft

amazon



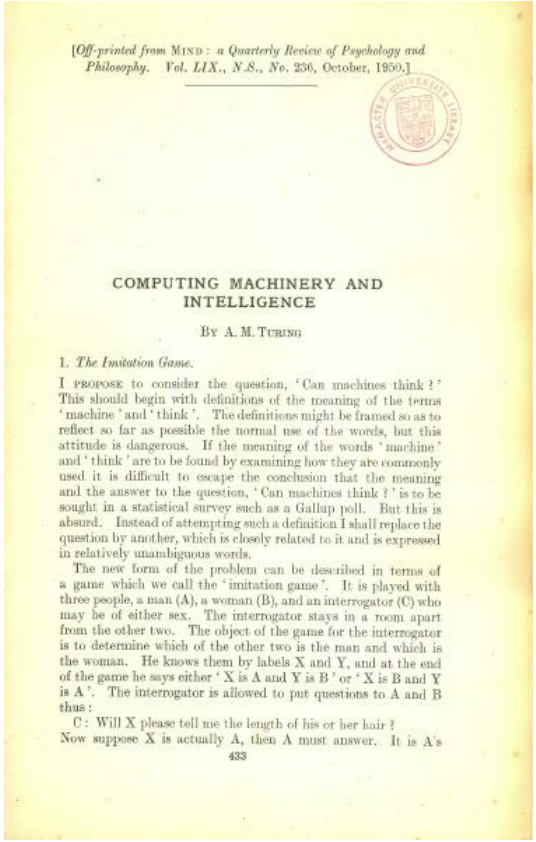
New branches from an old tree



1946: **John von Neuman**, ENIAC, *a giant brain*
1950: **Alan Turing** publishes the Turing Test
1955: **Arthur Samuel**, first *learning machine* (checkers)
1956: Dartmouth conference, birth of the term *Artificial Intelligence*
1958: **Frank Rosenblatt**, Perceptron, *artificial neural network*
1963: **J. Alan Robinson** implements *general deduction* on a computer
1966: **Joseph Weizenbaum**, ELIZA -- the first chatbot
1969: **Marvin Minsky**, **Seymour Papert**. Fundamental limits of Perceptron
1972: **Alain Colmerauer**, Prolog -- efficient computing by rules.

1970-1980: *AI Winter*. NN approaches discredited. Symbolic approaches do not deliver.

1980: Expert systems (rules+knowledge) deployed in a number of applications
1985: NNs rediscovered; backpropagation with hidden layers
1990: NNs out of fashion (hard limits on data and computing)
1995: Principled (statistical) approaches to Machine Learning
1997: IBM's *Deep Blue* beats Garry Kasparov at chess (brute force)
2015: Microsoft's *deep rectified model* exceeds human accuracy in classifying images
2016: Google's *AlphaGo* beats Lee Sedol at Go



[*Off-printed from* MIND : *a Quarterly Review of Psychology and Philosophy. Vol. LIX., N.S., No.* 236, October, 1950.]

COMPUTING MACHINERY AND INTELLIGENCE

BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

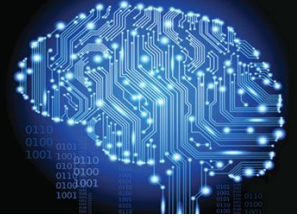
The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either 'X is A and Y is B' or 'X is B and Y is A'. The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?

Now suppose X is actually A, then A must answer. It is A's

433

Career opportunities



In **established companies** that are building the next generation of **intelligence** and **language understanding** for their products, for example:

- intelligent personal assistants
- opinion mining systems
- customer support system
- biomedical applications
- computer games
- smart adaptive devices
- robots
- smart planning systems

In **Research** and **Academy**, working on advancing fundamental theories and applications alike

In **your own startup**, a chance to create new product categories

- significant amounts of venture capital available
- unexplored market opportunities
- acquisition, merge, hiring, or growth

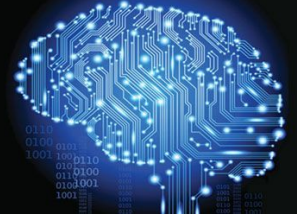
In **consulting** for companies or public bodies

- significant lack of in-house AI expertise
- AI will have a transformative impact on *any* type of business
- setting public policies, informing decision-making

In legal, economics, ethics, arts, humanities…

- think at the impact of mobile. It's like that.

The curriculum



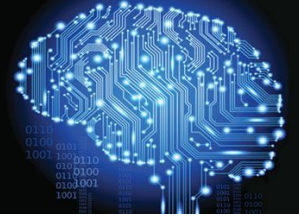
First year

Semester 1	C	Semester 2	C
Artificial intelligence fundamentals	6	Human language technologies	9
Computational mathematics for learning and data analysis	9	Parallel and distributed systems: paradigms and models	9
Machine learning	9	Intelligent Systems for pattern recognition	6
Elective	6	*Elective*	9

Second year

Semester 3	C	Semester 4	C
Smart applications	9	*Thesis*	24
Elective	9	*Elective*	6
Free choice	9		

The curriculum



First year

Semester 1	C		
Artificial intelligence fundamentals		tech	
Computational mathematics for learning and data analysis	9	Parallel a systems: models	
Machine learning	9	Intelligent S pattern recognition	
Elective	6	*Elective*	9

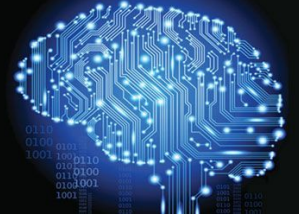
Second year

emester 4	C
	24
	6

Classical AI

- Symbolic approaches to AI
- Search, exploration, planning
- Constraint satisfaction systems
- Uncertain and probabilistic reasoning
  - non-standard logics
- Semantic networks and description logics
- Rules systems and their efficient implementation

The curriculum



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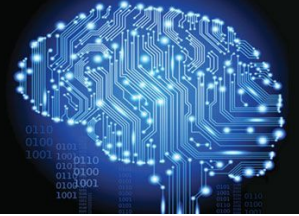
Second year

Semester 3	C	Semester 4	C
Smart applications	9	*Thesis*	24
			6

Mathematical concepts and tools for AI

- Numerical analysis and optimization
- Statistics, approximation, fitting
- Hands-on sessions
  - students will apply and test techniques and algorithms in lab setting
  - MATLAB and other software tools

The curriculum



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Machine learning		pattern re	
Elective	6	*Elective*	9

Second year

emester 4	C
	24
	6

Machines that learn

- Principles and paradigms in learning from data
- Building adaptive intelligent systems
- Developing predictive models
- Neural networks, in several flavours
- Probabilistic models
- Support Vector Machines and kernel-based models
- Statistical learning theory and model validation

The curriculum

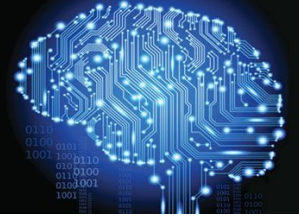
First year

Semester 1	C	Semester 2	
Artificial intelligence fundamentals	6	Human language technologies	
Computational mathematics for learning and data analysis	9	Parallel and distributed systems: paradigms and models	9
Machine learning	9	Intelligent Systems for pattern recognition	6
Elective	6	*Elective*	9

Machines that read, write, listen and speak

- Principles, models and state-of-the-art in natural language analysis
- Statistical ML, deep learning
- NL essentials: tokenization, morphology, POS-tagging, parsing, etc.
- Semantics: lexical, distributional
- Applications: entity recognition, linking, classification, summarization, opinion mining, sentiment analysis
- Question answering, language inference, dialogic interfaces, machine translation
- NLP libraries: NLP, Theano, Tensorflow

The curriculum



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Elective	6	*Elective*	9

Second year

Semest
Smart appli
Free choice

How to build and program those intelligent machines

- parallel and distributed architectures
- latency, service time, speedup, scalability
- models for parallel and distributed programming
- design patterns
- Fastflow, optimizations

The curriculum

Sentient AI: patterns, signal, and image processing

- Signal processing and time series
- Image processing, visual feature detectors
- Learning for machine vision
- Neural networks for non-vectorial data
  - physiological data, sensor streams, etc.
- Kernel and adaptive methods for relational data
- Applications
  - machine vision, bio-informatics, robotics, medical imaging
  - libraries and tools

First year

Semester 1	C		C
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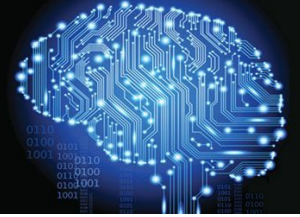
The curriculum



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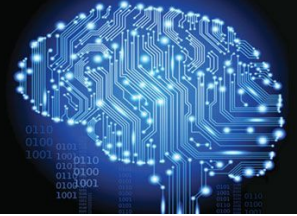
Putting it all together

- “Capstone project”
- Teamwork, joint design, development and testing of a complex AI-based application
  - sensors, IoT
  - mobile
  - natural interface
  - cloud-based AI
- End result: a user-ready application featuring intelligent interaction and behaviour

Second year

Semester 3	C	Semester 4	C
Smart applications	9	*Thesis*	24
Elective	9	*Elective*	6
Free choice	9		

The curriculum



First year

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Artificial inte fundamenta			
Computatio mathematic and data an			
Machine lear		pattern recognition	
Elective	6	*Elective*	9

Electives 9 CFU

- Algorithm engineering (KD)
- Data mining (KD)
- Mobile and cyber-physical systems (ICT)

Electives 6 CFU

- Information retrieval (KD)
- Computational neuroscience (ENG)
- Social and ethical issues in computer technology
- Robotics
- Semantic web

Second year

Semester 3	C	Semester 4	C
Smart applications	9	*Thesis*	24
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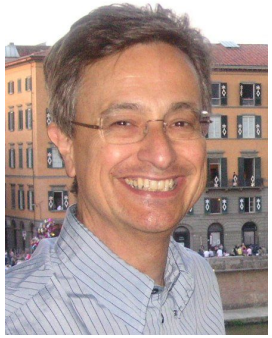
People



Maria Simi
Alessio Micheli
Davide Bacciu
Marco Danelutto
Antonio Frangioni & Federico Poloni
Giuseppe Attardi
Vincenzo Gervasi