MASTER DEGREE IN COMPUTER ENGINEERING

a.y. 2021-2022

<COMPUTER ENGINEERING>@DEI:

The Whole Story

DIPARTIMENTO
DI INGEGNERIA
DELL'INFORMAZIONE

What will you become?

What are our secret ingredients?

How do we train a computer engineer?
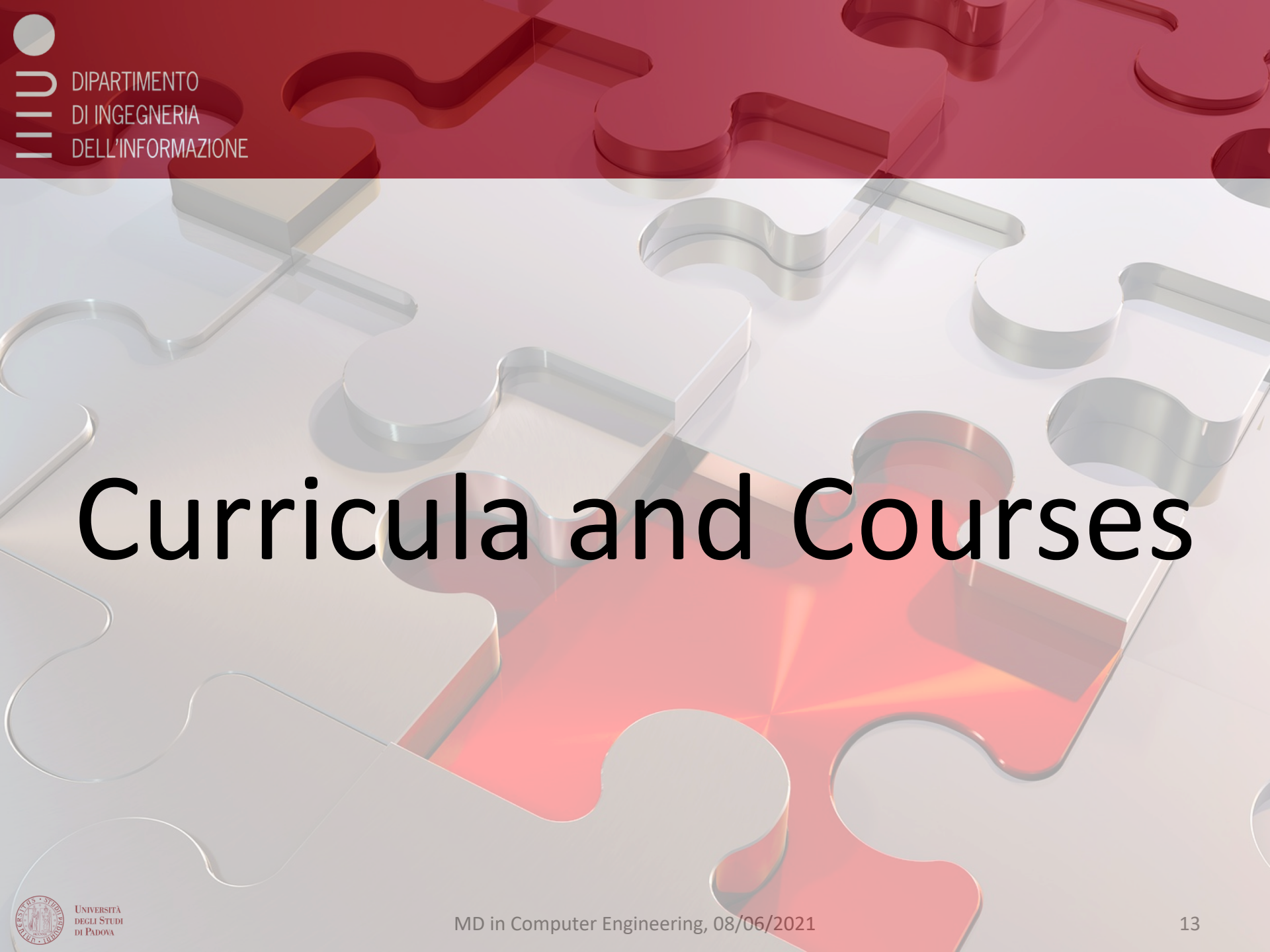
What are the curricula and courses?

What are you going to do?

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How Do We Train a Computer Engineer?

Soft Skills

Cooperation with stakeholders

Strong competencies in **math** and **physics**

Strong competencies in **basic engineering**

Computational Thinking

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Soft Skills

Cooperation
with
stakeholders

Advanced
Algorithmics

Strong
competencies
in **math** and
physics

Strong
competencies
in **basic**
engineering

Computational
Thinking

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Soft Skills

Cooperation with stakeholders

Artificial Intelligence

Strong competencies in **math** and **physics**

Strong competencies in **basic** engineering

Computational Thinking

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What Will You Become?

Great **attractiveness** on the **job** market

Ready for **research** and **development** in **industry** and academia

Strong and **wide-spectrum** competencies in computer engineering

Specialistic competencies in **emerging areas** of computer engineering

Ready for the **pervasiveness** of informatics in **society** and **industry**

Curricula and Courses

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Internship/Research
Training & Thesis

4 CURRICULA

Artificial Intelligence
and Robotics

Bioinformatics

High Performance and
Big Data Computing

Web Information and
Data Engineering

Core Competencies

Degree Structure

MANDATORY COURSES		
Course	CFU	Period
Automata, Languages and Computation	9	Y1.1
Machine Learning	6	Y1.1
Operations Research 1	9	Y1.1

COMMON TO ALL CURRICULA

MANDATORY COURSES
ELECTIVE COURSES: AT LEAST *X* CFU
OTHER CHOICES

CURRICULUM SPECIFIC

OTHER ACTIVITIES		
Activity	CFU	
English Language/Italian Language	3	
Internship/Research Training	9	Y2
Final Project	21	Y2

COMMON TO ALL CURRICULA

MANDATORY COURSES		
Course	CFU	Period
Automata, Languages and Computation	9	Y1.1
Machine Learning	6	Y1.1
Operations Research 1	9	Y1.1

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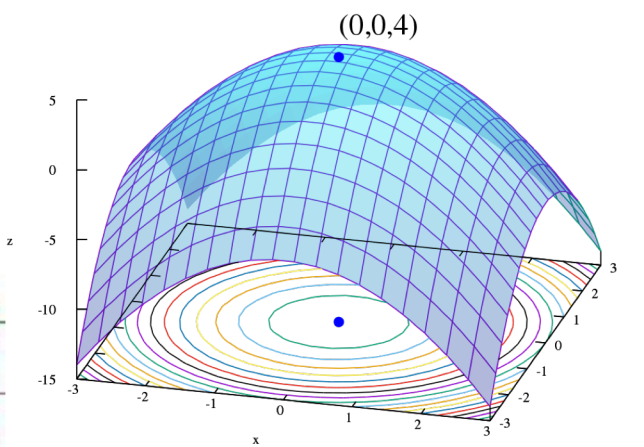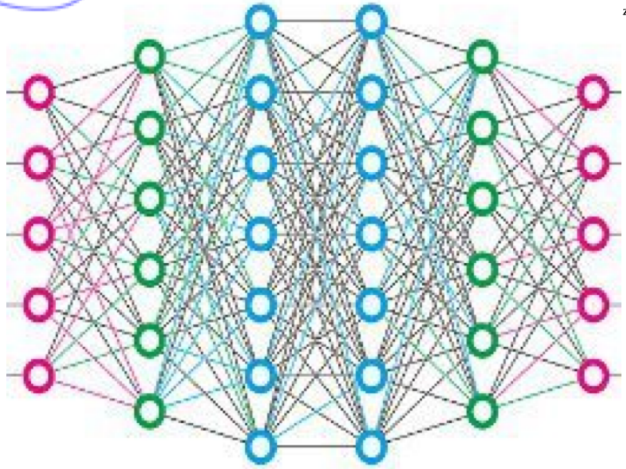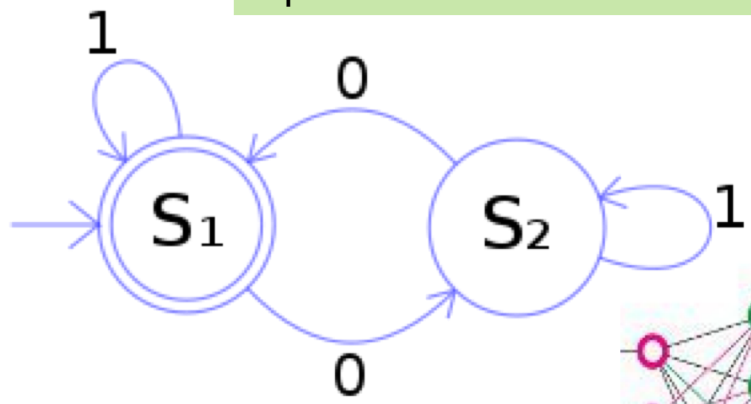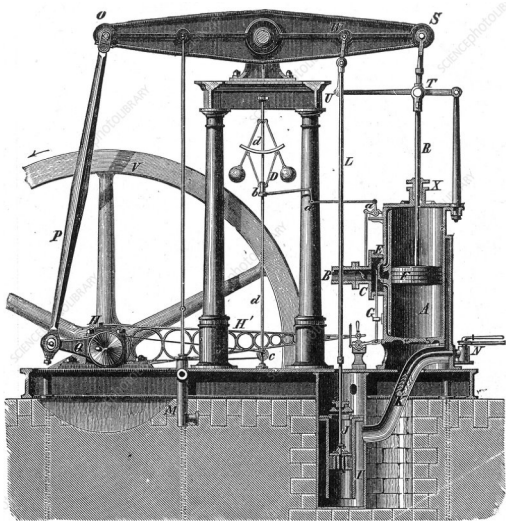
Like the steam-engine or electricity in the past…
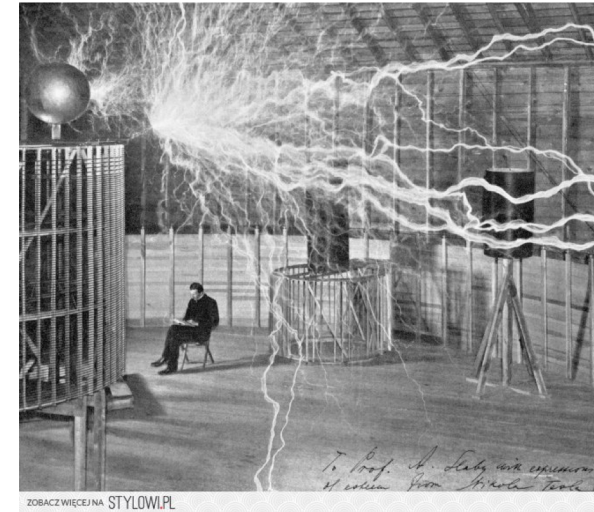
AI and Robotics

are transforming our world, our society and our industry
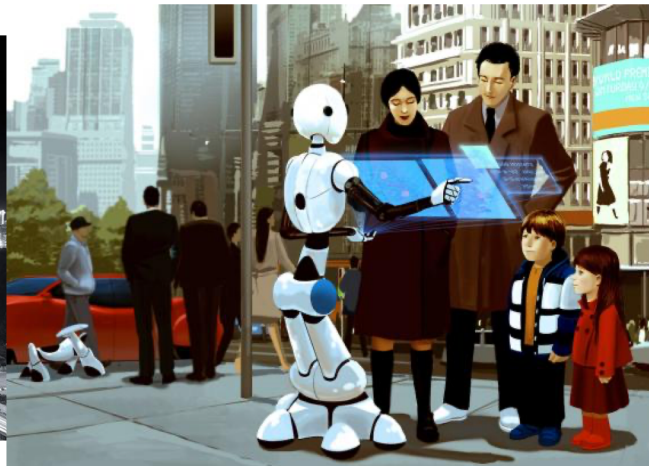
Artificial Intelligence and Robotics

MANDATORY COURSES		
Course	CFU	Period
Artificial Intelligence	6	Y1.2
Computer Vision	9	Y1.2
Intelligent Robotics	9	Y2.1

ELECTIVE COURSES: AT LEAST 27 CFU		
Course	CFU	Period
Deep Learning	6	Y1.2
Robotics and Control 1	9	Y1.2
Big Data Computing	6	Y1.2
Industrial Robotics	9	Y2.1
Learning from Networks	6	Y2.1
Natural Language Proc.	6	Y2.2
3D Data Processing	6	Y2.2

OTHER CHOICES		
Course	CFU	Period
Neurorobotics and Neurorehab.	6	Y1.1
Quality Engineering	6	Y1.1
Game Theory	6	Y2.1
Innovation, Entrepreneurship, …	9	Y2.2
Operation Research 2	6	Y2.2

Key characteristics:

Interdisciplinary topics because AI & Robotics is a multi-discipline science

Course choices:

? core competencies in computer engineering

? Complements from key disciplines: control theory, mechanics, economics, etc.

Hands-on experience with laboratories in AI, Robotics, Computer Vision, Industrial Robotics, etc.

Soft skills: team work, goal driven productivity, critical thinking, proactiveness, …

Motivation

- Large and complex modern biological and medical data sets require advanced computational skills

- The global bioinformatics market is expected to register substantial growth in the near future
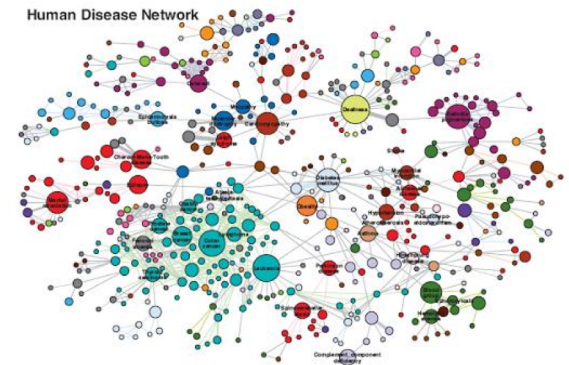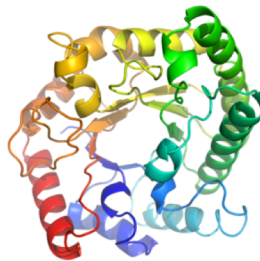
NB:

- No prerequisites in Biology/Chemistry/Medicine are needed!

- Techniques developed for biological data find applications in other areas

Bioinformatics

MANDATORY COURSES		
Course	CFU	Period
Inferential Statistics	6	Y1.1
Bioinformatics	9	Y1.2
Computational Genomics	6	Y2.1
Learning from Networks	6	Y2.1

ELECTIVE COURSES: AT LEAST 24 CFU (18 CFU FROM C.E.)		
Course	CFU	Period
Foundations of Databases	6	Y1.1
Artificial Intelligence	6	Y1.2
Big Data Computing	6	Y1.2
Web Applications	6	Y1.2
Distributed Systems	9	Y2.1
Advanced Algorithm Design	9	Y2.1
Operations Research 2	6	Y2.2

OTHER CHOICES		
Course	CFU	Period
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Genomics and NGS Data Analysis	9	Y2.2
Computers and Network Security	6	Y2.2

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MANDATORY COURSES		
Course	CFU	Period
Inferential Statistics	6	Y1.1
Bioinformatics	9	Y1.2
Computational Genomics	6	Y2.1
Learning from Networks	6	Y2.1

ELECTIVE COURSES: AT LEAST 24 CFU (18 CFU FROM C.E.)		
Course	CFU	Period
Foundations of Databases	6	Y1.1
Artificial Intelligence	6	Y1.2
Big Data Computing	6	Y1.2
Web Applications	6	Y1.2
Distributed Systems	9	Y2.1
Advanced Algorithm Design	9	Y2.1
Operations Research 2	6	Y2.2

OTHER CHOICES		
Course	CFU	Period
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Genomics and NGS Data Analysis	9	Y2.2
Computers and Network Security	6	Y2.2

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Bioinformatics

MANDATORY COURSES

Course	CFU	Period
Inferential Statistics	6	Y1.1
Bioinformatics	9	Y1.2
Computational Genomics	6	Y2.1
Learning from Networks	6	Y2.1

ELECTIVE COURSES: AT LEAST 24 CFU (18 CFU FROM C.E.)

Course	CFU	Period
Foundations of Databases	6	Y1.1
Artificial Intelligence	6	Y1.2
Big Data Computing	6	Y1.2
Web Applications	6	Y1.2
Distributed Systems	9	Y2.1
Advanced Algorithm Design	9	Y2.1
Operations Research 2	6	Y2.2

OTHER CHOICES

Course	CFU	Period
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Genomics and NGS Data Analysis	9	Y2.2
Computers and Network Security	6	Y2.2

Bioinformatics

MANDATORY COURSES

Course	CFU	Period
Inferential Statistics	6	Y1.1
Bioinformatics	9	Y1.2
Computational Genomics	6	Y2.1
Learning from Networks	6	Y2.1

ELECTIVE COURSES: AT LEAST 24 CFU (18 CFU FROM C.E.)

Course	CFU	Period
Foundations of Databases	6	Y1.1
Artificial Intelligence	6	Y1.2
Big Data Computing	6	Y1.2
Web Applications	6	Y1.2
Distributed Systems	9	Y2.1
Advanced Algorithm Design	9	Y2.1
Operations Research 2	6	Y2.2

OTHER CHOICES

Course	CFU	Period
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Genomics and NGS Data Analysis	9	Y2.2
Computers and Network Security	6	Y2.2

Key characteristics:

- Interdisciplinary themes
- Course choices:
    - core competencies in computer engineering
    - specific knowledge on processing biological data

- Hands-on experience on biological/biomedical data (projects or assignments)

- Soft Skills: communication, teamwork, problem solving, critical thinking

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Motivation

Data, data everywhere!

Extracting significant information

from data

We need:

Efficient and scalable algorithms

Advanced computing systems

High Performance and Big Data Computing

MANDATORY COURSES		
Course	CFU	Period
Inferential Statistics	6	Y1.1
Parallel Computing	9	Y1.2
Big Data Computing	6	Y1.2
Advanced Algorithm Design	9	Y2.1

ELECTIVE COURSES: AT LEAST 21 CFU		
Course	CFU	Period
Artificial Intelligence	6	Y1.2
Bioinformatics	9	Y1.2
Search Engines	9	Y1.2
Deep Learning	6	Y1.2
Distributed Systems	9	Y2.1
Learning from Networks	6	Y2.1

OTHER CHOICES		
Course	CFU	Period
Cryptography	6	Y1.1
Computational Genomics	6	Y2.1
Game Theory	6	Y2.1
Stochastic Processes	6	Y2.2
Operations Research 2	6	Y2.2

MANDATORY COURSES		
Course	CFU	Period
Inferential Statistics	6	Y1.1
Parallel Computing	9	Y1.2
Big Data Computing	6	Y1.2
Advanced Algorithm Design	9	Y2.1

ELECTIVE COURSES: AT LEAST 21 CFU		
Course	CFU	Period
Artificial Intelligence	6	Y1.2
Bioinformatics	9	Y1.2
Search Engines	9	Y1.2
Deep Learning	6	Y1.2
Distributed Systems	9	Y2.1
Learning from Networks	6	Y2.1

OTHER CHOICES		
Course	CFU	Period
Cryptography	6	Y1.1
Computational Genomics	6	Y2.1
Game Theory	6	Y2.1
Stochastic Processes	6	Y2.2
Operations Research 2	6	Y2.2

Key characteristics

Advanced algorithms for crunching data

Statistical methods for understanding data

Parallel computing systems for handling big data

Hands-on experience on parallel programming, cloud platforms, big data frameworks

Soft skills: problem solving, teamwork

Data is the new oil
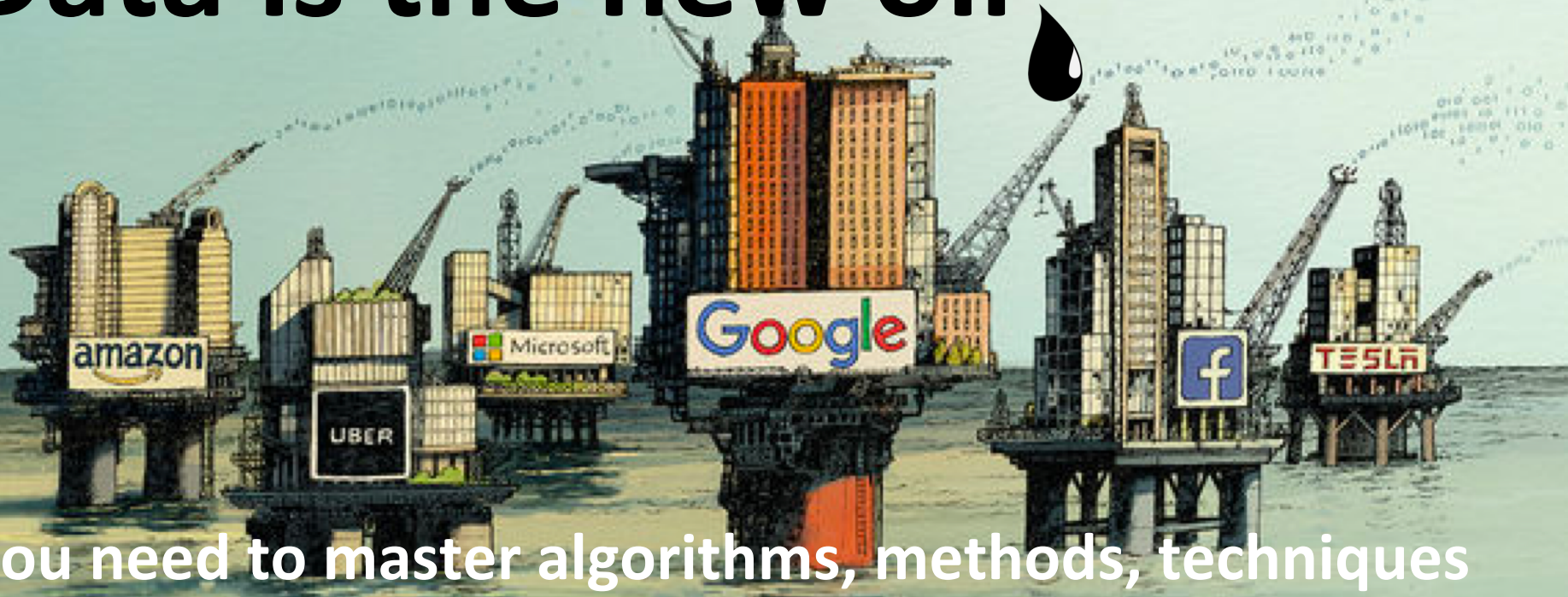
You need to master algorithms, methods, techniques and architectures to store, manage, access, search, recommend, link, and share both structured and unstructured data at Web scale

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MANDATORY COURSES		
Course	CFU	Period
Computer Networks	9	Y1.2
Search Engines	9	Y1.2
Web Applications	6	Y1.2
Database 2	9	Y2.1

OTHER CHOICES		
Course	CFU	Period
Inferential Statistics	6	Y1.1
Quality Engineering	6	Y1.1
Big Data Computing	6	Y1.2
Geographic Information Sys.	6	Y1.2
Information Security	6	Y2.1
Operations Research 2	6	Y2.2

ELECTIVE COURSES: AT LEAST 18 CFU		
Course	CFU	Period
Foundations of Databases	6	Y1.1
Software Platforms	6	Y1.1
Distributed Systems	9	Y2.1
Concurrent and Real Time Programming	6	Y2.1
Computers and Network Security	6	Y2.2
Computer Engineering for Music and Multimedia	6	Y2.2
Natural Language Processing	6	Y2.2

Key characteristics:

Wide-reaching competencies and skills in impacting domains (health, cultural heritage, intellectual property, multilingual and multimodal information access, social media, e-commerce, …)

Course choices:

? ***wide***-spectrum competencies in core computer engineering

? ***wide***-ranging knowledge in databases, Web applications, search engines, recommender systems, semantic technologies, distributed systems, and security

Widen your soft skills and hands-on experience on managing, accessing, sharing any kind of data (projects or assignments)

Thesis and Internship

@Companies

@UNIPD

English language (3 CFU)
Internship or Research Training: (9 CFU)
Thesis (21 CFU)

- Advanced computing paradigms and AI

Parallel hierarchical architectures

Artificial intelligence

Applications

Models

Algorithms
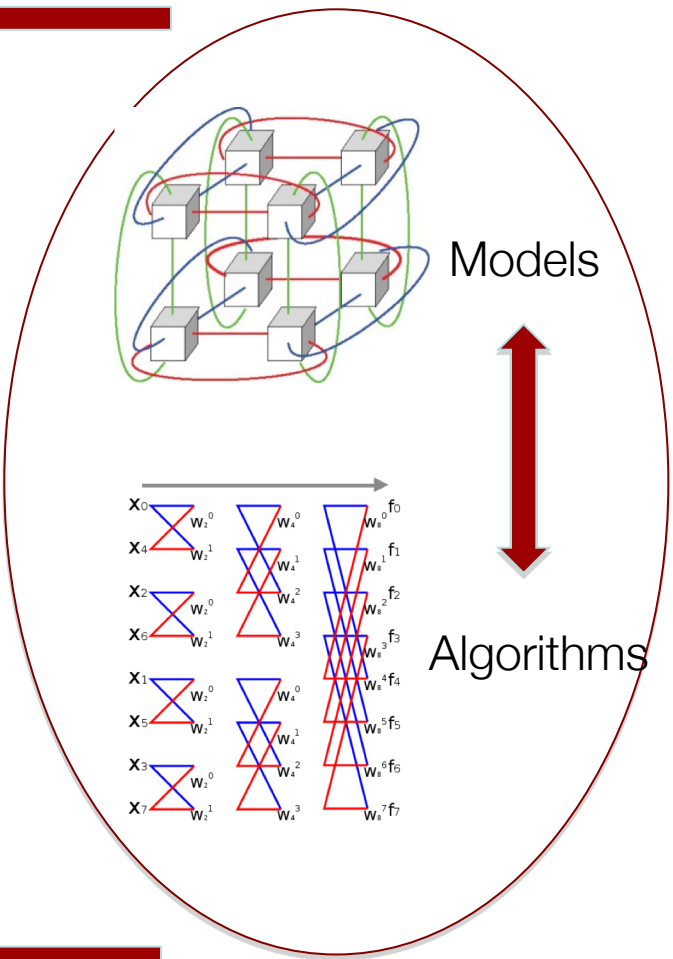
- ## Bioinformatics and Computational Biology
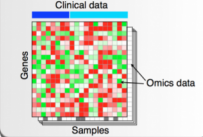
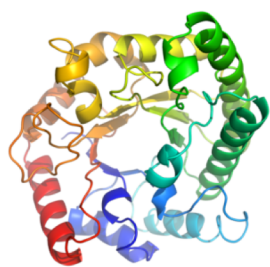ACCTTGTGACATCATGGT
AGGAACACTGTAGTACCA
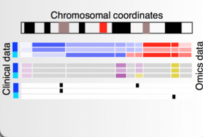
DNA
Strings on A,C,G,T

Proteins
3D structures
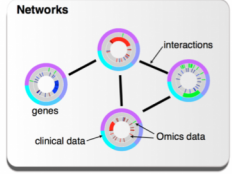
Relations
Graphs and networks

Mutation patterns
in disease

Protein-drug
interaction
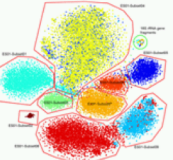
Community of species
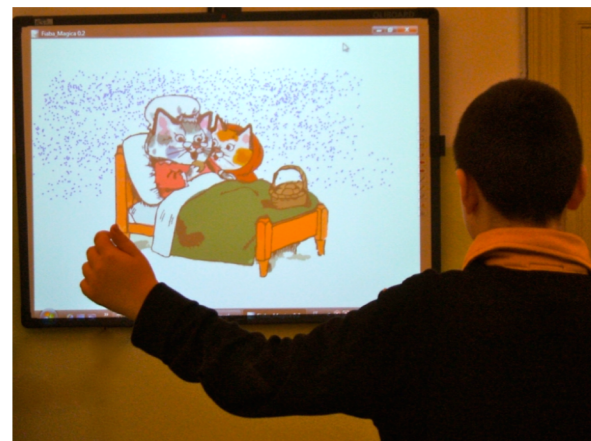
- ## Computer engineering for music and multimedia

Affective computing

Multimedia, interaction, augmented reality
for artistic production and rehabilitation

Musical cultural heritage

- Data mining and machine learning

Predictive models

Significant patterns

Data

Algorithms

Models

Biology/Medicine

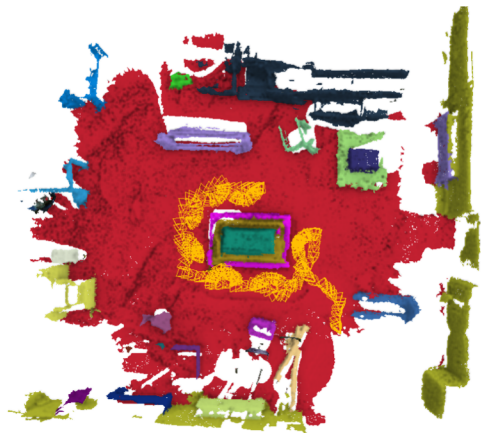Recommendation systems

Social network

- Information retrieval and databases

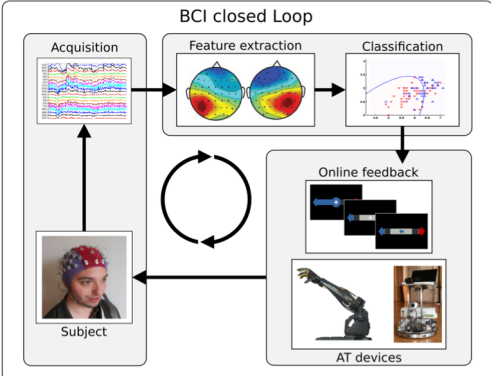- ## Intelligent robotics and autonomous systems

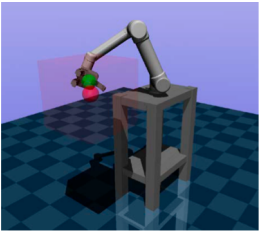Perception and action loop

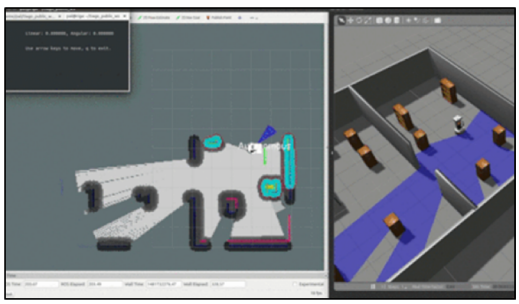3D environment reconstruction and segmentation

Robotics for Industry 4.0

Neurorobotics &
Brain-computer interface
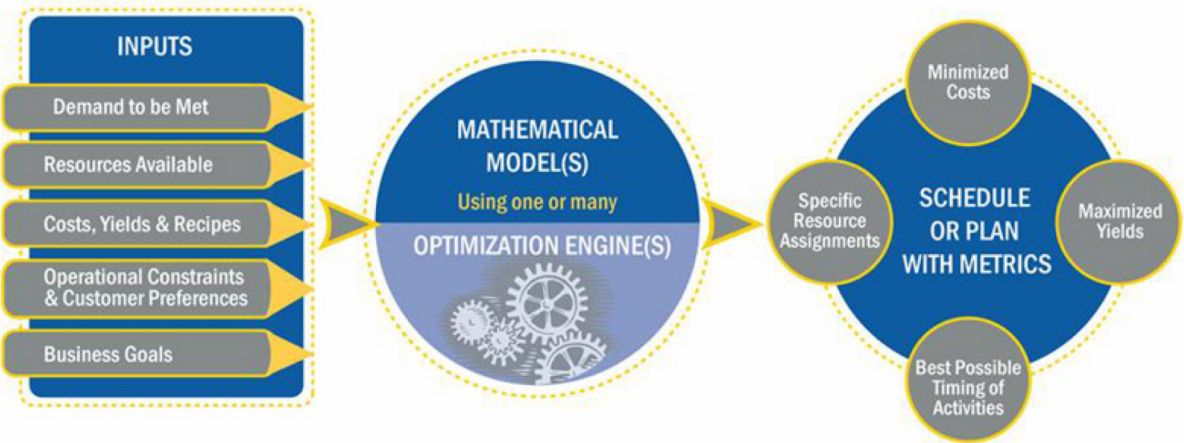

AI for Human-robot collaboration

Robot task
and motion planning

- Operation research

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Computing Systems for Smart Infrastructures

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degli Studi
di Padova
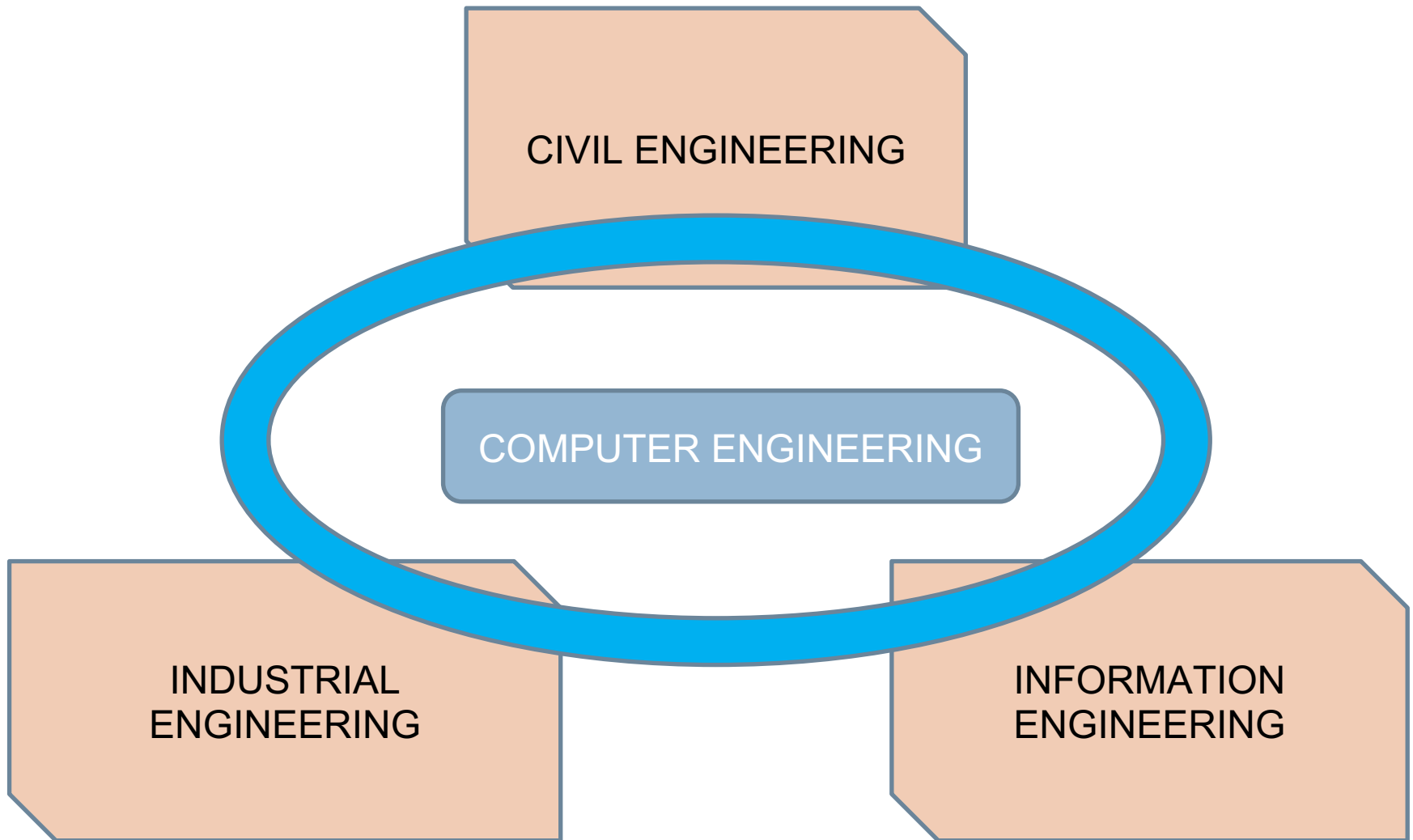
Open Badge on
«Expert in Smart Infrastructures»

COMMON MANDATORY COURSES		
Automata, Languages and Computation	9	Y1.1
Machine Learning	6	Y1.1
Operations Research 1	9	Y1.1

COMMON TO ALL CURRICULA

CURRICULUM SPECIFIC MANDATORY COURSES
ELECTIVE COURSES
OTHER CHOICES

CURRICULUM SPECIFIC

OTHER CHOICES FROM OTHER DEGREE (12 CFU)

OTHER ACTIVITIES		
English Language/Italian Language	3	
Internship/Research Training	9	Y2
Final Project	21	Y2

COMMON TO ALL CURRICULA

Computing Systems for Smart Infrastructures
(within High Performance and Big Data Computing)

CURRICULUM MANDATORY COURSES		
Course	CFU	Period
Inferential Statistics	6	Y1.1
Parallel Computing	9	Y1.2
Big Data Computing	6	Y1.2
Advanced Algorithm Design	9	Y2.1
Artificial Intelligence	6	Y1.2
Operations Research 2	6	Y2.2

ELECTIVE COURSES: AT LEAST 21 CFU		
Course	CFU	Period
Bioinformatics	9	Y1.2
Search Engines	9	Y1.2
Deep Learning	6	Y1.2
Distributed Systems	9	Y2.1
Learning from Networks	6	Y2.1

OTHER CHOICES		
Course	CFU	Period
Cryptography	6	Y1.1
Computational Genomics	6	Y2.1
Game Theory	6	Y2.1
Stochastic Processes	6	Y2.2

Computing Systems for Smart Infrastractures

ELECTIVE COURSES @ OTHER MASTER DEGREE: 12 CFU		
Course	CFU	
Circular Economy	6	
Land surveying and geographical information systems	9	
Material flow systems and logistic networks	9	
Safety and security in transport and strategic infrastructure	6	
Smart Grids	6	
Structural and geotechnical control and monitoring	9	
…more….		

Job Market