<COMPUTER ENGINEERING>@DEI:

The Whole Story

What Are We Going to Talk About?

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?

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

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

How Do We Train a Computer Engineer?

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Soft Skills

Cooperation with stakeholders

Advanced Algorithmics

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

Strong competencies in **basic engineering**

Computational Thinking

How Do We Train a Computer Engineer?

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Soft Skills

Cooperation with stakeholders

High Performance Computing

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

Strong competencies in **basic engineering**

Computational Thinking

How Do We Train a Computer Engineer?

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DELL'INFORMAZIONE

Soft Skills

Cooperation with stakeholders

Artificial Intelligence

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

Strong competencies in **basic** engineering

Computational Thinking

Soft Skills

Cooperation with stakeholders

Autonomous Robotics

Strong competencies in **math** and physics

Strong competencies in **basic** engineering

Computational Thinking

How Do We Train a Computer Engineer?

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Soft Skills

Cooperation with stakeholders

Bioinformatics

Strong competencies in math and physics

Strong competencies in basic engineering

Computational Thinking

How Do We Train a Computer Engineer?

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Soft Skills

Cooperation with stakeholders

Databases, Search, and Web

Strong competencies in **math** and physics

Strong competencies in **basic** engineering

Computational Thinking

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Soft Skills

Cooperation
with
stakeholders

Networks,
Systems, and
Security

Strong
competencies
in **math** and
physics

Strong
competencies
in **basic**
engineering

Computational
Thinking

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
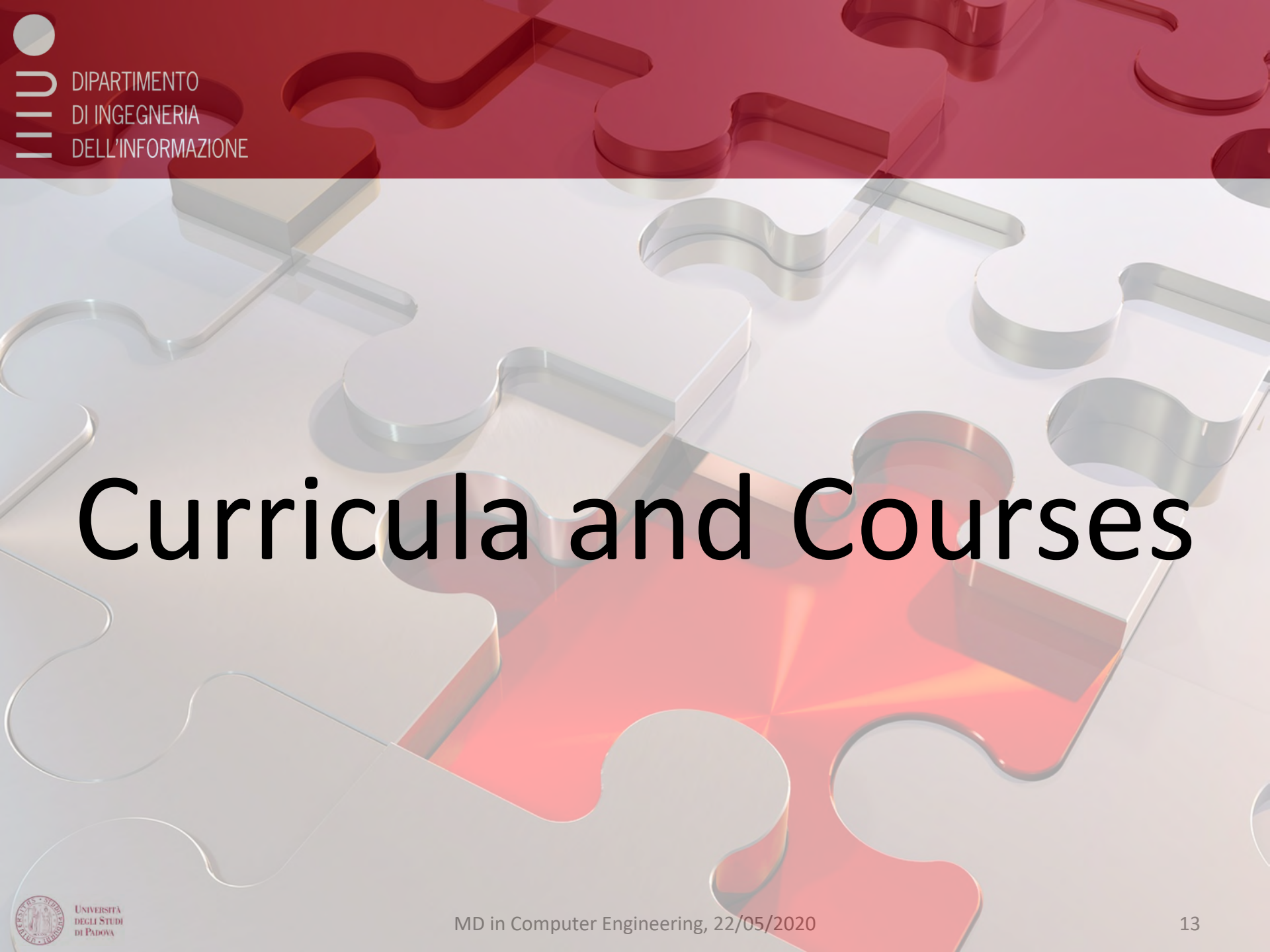
Curricula and Courses

Core Competencies

MANDATORY COURSES		
Course	CFU	Period
Automata, Languages and computation	9	Y1.1
Machine learning	9	Y1.1
Operations Research 1	9	Y1.1

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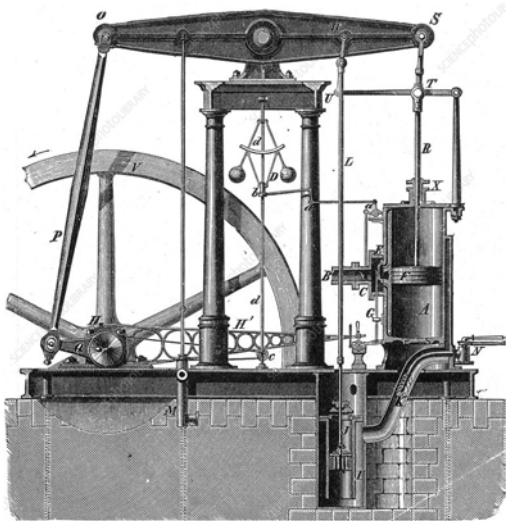
Like the steam-engine or electricity in the past…

AI and Robotics
are transforming our world, our society and our

Artificial Intelligence and Robotics

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

ELECTIVE COURSES: AT LEAST 24 CFU		
Course	CFU	Period
Deep Learning	6	Y1.2
Robotics and Control 1	9	Y1.2
Big Data Computing	6	Y1.2
Distributed Systems	9	Y2.1
Industrial Robotics	6	Y2.1 (F)
3D Data Processing	6	Y2.2 (F)
Natural Language Proc.	9	Y2.2 (F)
Learning from Networks	6	Y2.1 (F)

(*F*): Available from the 2021/2022 academic year

OTHER CHOICES		
Course	CFU	Period
Neurorobotics and Neurorehab.	6	Y2.1
Quality Engineering	6	Y1.1
Innovation, entrepreneurship, …	6	Y2.2
Internet of Things and Smart Cities	6	Y2.2
Game Theory	2	Y2.1

Artificial Intelligence and Robotics

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

Human Disease Network
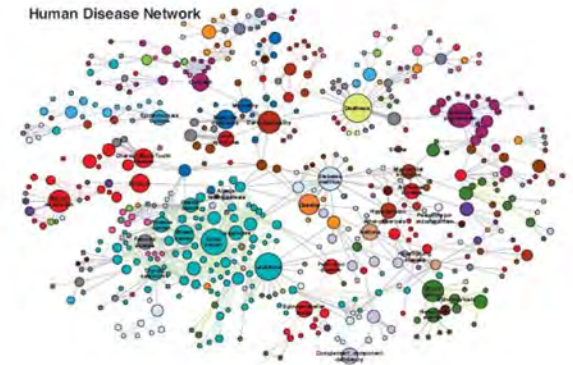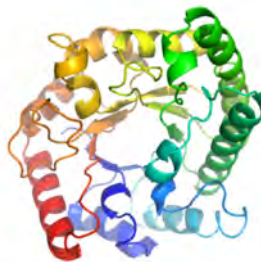
Techniques developed for biological data ꜰing applications in other areas

Bioinformatics

MANDATORY COURSES

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

ELECTIVE COURSES: AT LEAST 24 CFU

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 (*F*)
Advanced Algorithm Design	9	Y2.1 (*F*)
Computers and network security	6	Y2.2 (*F*)

OTHER CHOICES

Course	CFU	Period
Human Data Analytics	6	Y1.2
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Operations Research 2	6	Y2.2 (*F*)
Genomics and NGS data analysis	9	Y2 (*F*)

(*F*): Available from the 2021/2022 academic year

Bioinformatics

MANDATORY COURSES

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

ELECTIVE COURSES: AT LEAST 24 CFU

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 (*F*)
Advanced Algorithm Design	9	Y2.1 (*F*)
Computers and network security	6	Y2.2 (*F*)

OTHER CHOICES

Course	CFU	Period
Human Data Analytics	6	Y1.2
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Operations Research 2	6	Y2.2 (*F*)
Genomics and NGS data analysis	9	Y2 (*F*)

(*F*): Available from the 2021/2022 academic year

Bioinformatics

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

ELECTIVE COURSES: AT LEAST 24 CFU		
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 (*F*)
Advanced Algorithm Design	9	Y2.1 (*F*)
Computers and network security	6	Y2.2 (*F*)

OTHER CHOICES		
Course	CFU	Period
Human Data Analytics	6	Y1.2
Imaging for Neuroscience	9	Y1.2
Structural Bioinformatics	6	Y1.2
Operations Research 2	6	Y2.2 (*F*)
Genomics and NGS data analysis	9	Y2 (*F*)

(*F*): Available from the 2021/2022 academic year

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Key characteristics:

Interdisciplinary themes

Course choices:

core competencies in computer engineering
key disciplines in life and physical sciences, and medicine

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 analytics

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 (*F*)

ELECTIVE COURSES: AT LEAST 24 CFU

Course	CFU	Period
Foundations of databases	6	Y1.1
Artificial Intelligence	6	Y1.2
Bioinformatics	9	Y1.2
Search Engines	9	Y1.2
Deep Learning	6	Y1.2
Distributed Systems	9	Y2.1 (*F*)
Learning from Networks	6	Y2.1 (*F*)

OTHER CHOICES

Course	CFU	Period
Cryptography	6	Y1.1
Computational Genomics	6	Y2.1 (F)
Game theory	6	Y2.1 (F)
Natural Language Processing	6	Y2.2 (*F*)
Stochastic Processes	6	Y2.2 (*F*)
Operations Research 2	6	Y2.2 (F)

(*F*): Available from the 2021/2022 academic year

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 (*F*)

(*F*): Available from the 2021/2022 academic year

High Performance and Big Data Computing

ELECTIVE COURSES: AT LEAST 24 CFU		
Course	CFU	Period
Foundations of databases	6	Y1.1
Artificial Intelligence	6	Y1.2
Bioinformatics	9	Y1.2
Search Engines	9	Y1.2
Deep Learning	6	Y1.2
Distributed Systems	9	Y2.1 (*F*)
Learning from Networks	6	Y2.1 (*F*)

OTHER CHOICES		
Course	CFU	Period
Cryptography	6	Y1.1
Computational Genomics	6	Y2.1 (F)
Game theory	6	Y2.1 (F)
Natural Language Processing	6	Y2.2 (*F*)
Stochastic Processes	6	Y2.2 (*F*)
Operations Research 2	6	Y2.2 (F)

(*F*): Available from the 2021/2022 academic year

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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

David Parkins

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 (*F*)

OTHER CHOICES		
Course	CFU	Period
Cryptography	6	Y1.1
Digital Forensics	6	Y1.1
Quality Engineering	6	Y1.1
Wireless Networks	6	Y1.1
Information security	6	Y2.1 (*F*)
Operations Research 2	6	Y2.2 (*F*)

ELECTIVE COURSES: AT LEAST 18 CFU		
Course	CFU	Period
Foundations of databases	6	Y1.1
Software platforms	6	Y1.1
Inferential Statistics	6	Y1.1
Big Data Computing	6	Y1.2
Distributed Systems	9	Y2.1 (*F*)
Concurrent and Real Time Programming	6	Y2.1 (*F*)
Computers and Network Security	6	Y2.2 (*F*)
Computer Engineering for Music and Multimedia	6	Y2.2 (*F*)
Natural Language Processing	6	Y2.2 (*F*

(*F*): Available from the 2021/2022 academic year

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)

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- Advanced computing paradigms and AI

Parallel hierarchical architectures

Artificial intelligence

Applications

Models

Algorithms

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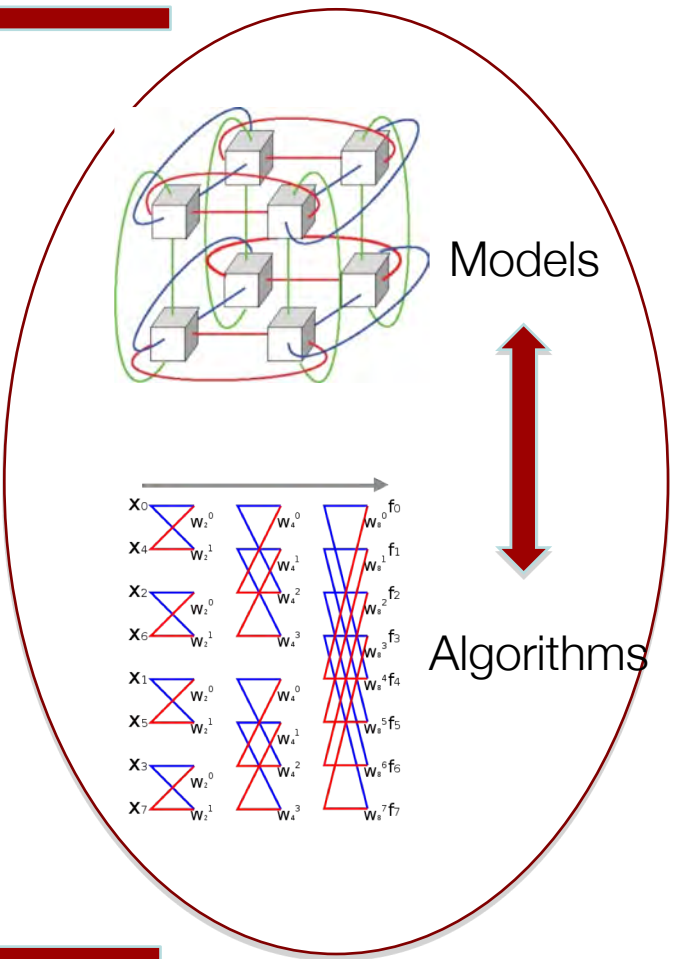
- ## Bioinformatics and Computational Biology

ACCTTGTGACATCATGGT
AGGAACACTGTAGTACCA

DNA
Strings on A,C,G,T
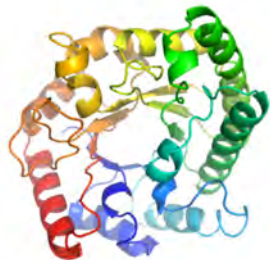
Proteins
3D structures
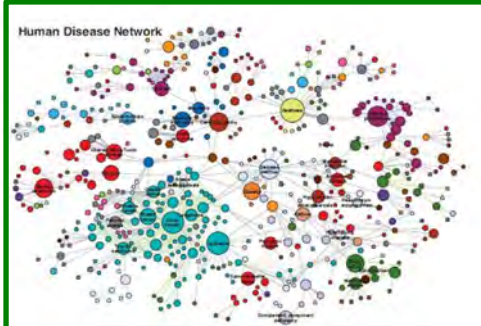
Relations
Graphs and networks

Protein-drug interaction
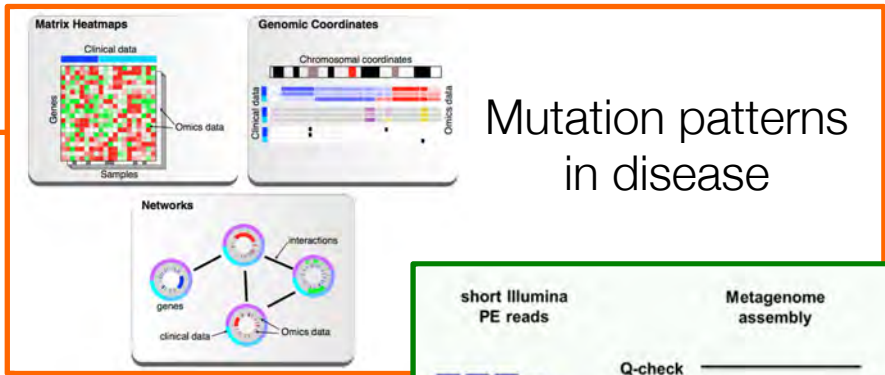
Mutation patterns in disease
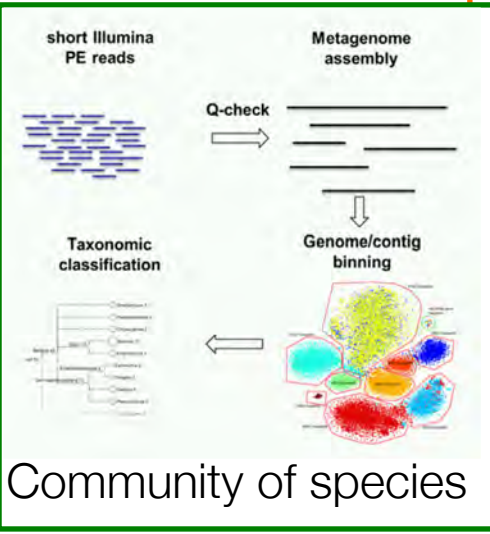
Community of species

- ## Computer engineering for music and

Affective computing

Multimedia, interaction, augmented reality
for artistic production and rehabilitation
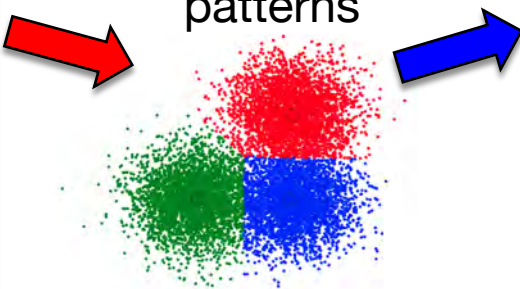

Musical cultural heritage

- Data mining and machine learning

Predictive models

Data

Algorithms

MACHINE LEARNING

Models
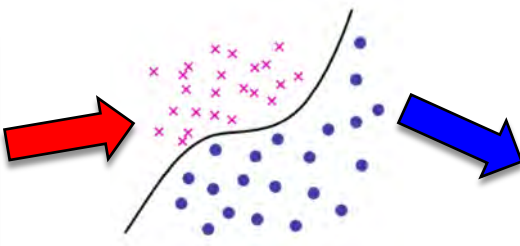
Significant patterns

Biology/Medicine

Recommendation systems

NETFLIX

Social network

- Information retrieval and
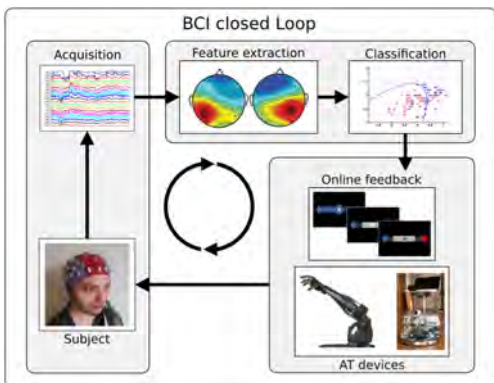
- ## Intelligent robotics and autonomous systems
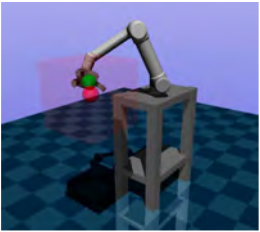

Perception and action loop

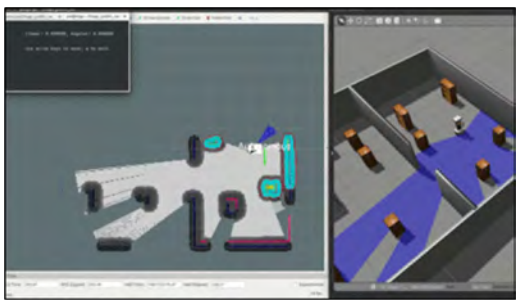3D environment reconstruction and segmentation

Robotics for Industry 4.0

Neurorobotics &
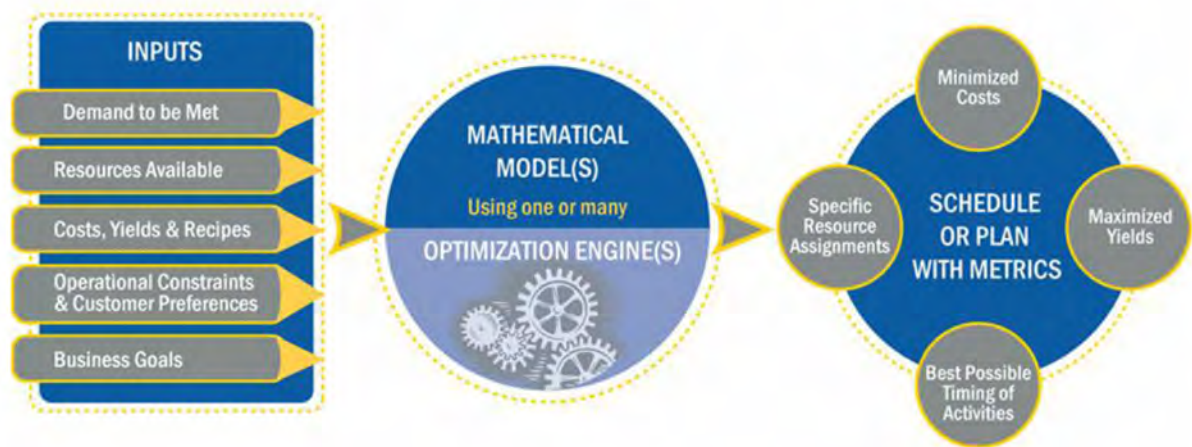Brain-computer interface

AI for Human-robot collaboration

Robot task
and motion planning

- Operation research

Job Market

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