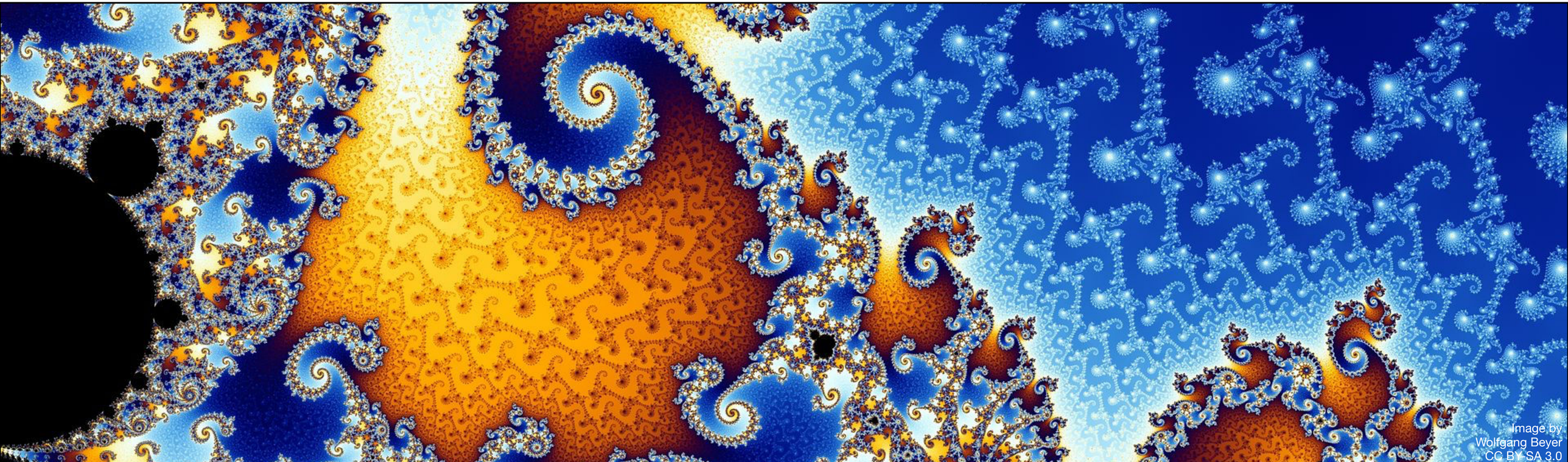
UNIVERSITÀ DEGLI STUDI DI TRIESTE

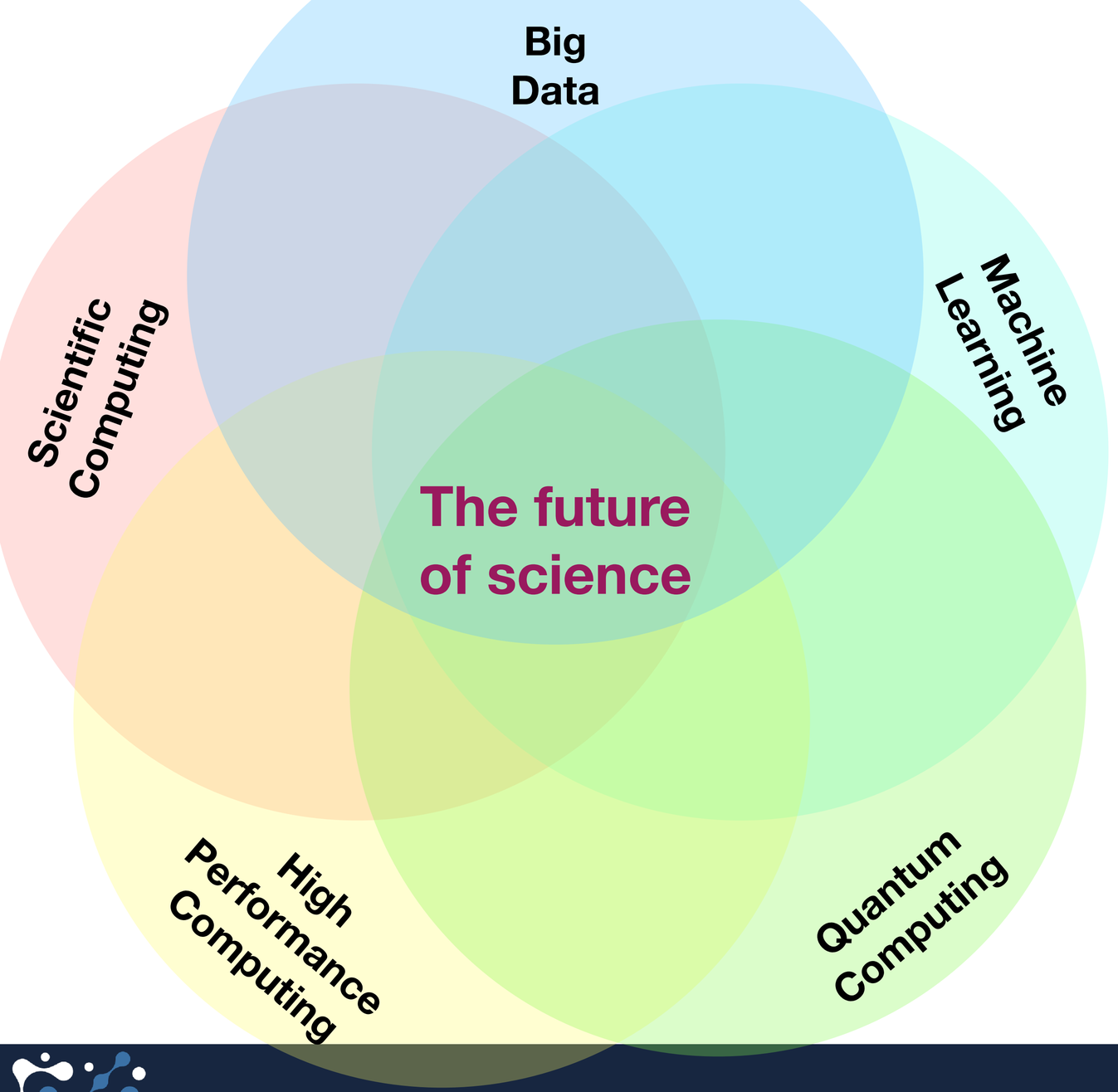
OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

AREA SCIENCE PARK

INAF ISTITUTO NAZIONALE DI ASTROFISICA

SCIENTIFIC & DATA-INTENSIVE COMPUTING





A Convergence of Many Factors

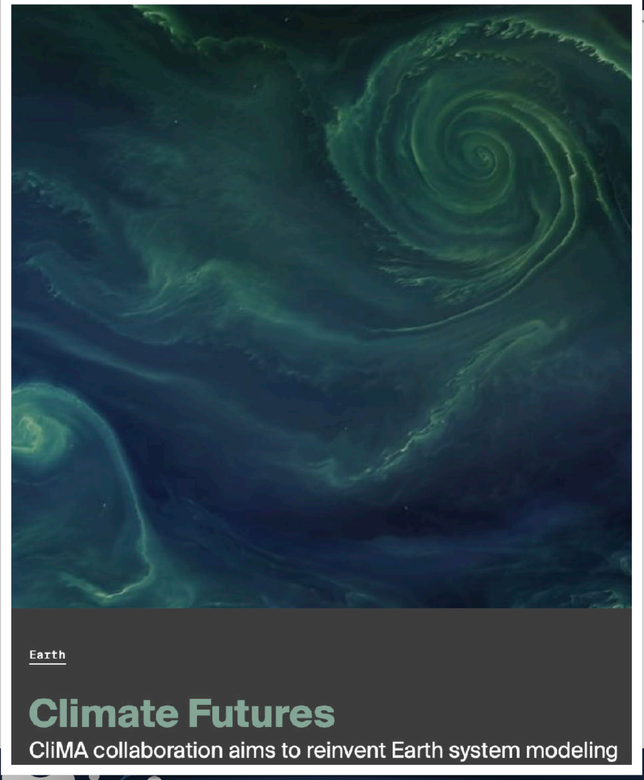
A new generation of experts is needed

Experts in Scientific and Data-Intensive Computing

What's next for science?

Parallel Supercomputing for Astronomy

Researchers use Julia on a NERSC supercomputer (650,000 cores) to speed astronomical image analysis 1,000x, catalog 188 million astronomical objects in 15 minutes and achieve peak performance of 1.5 petaflops



Science and Scientific Computing are Changing

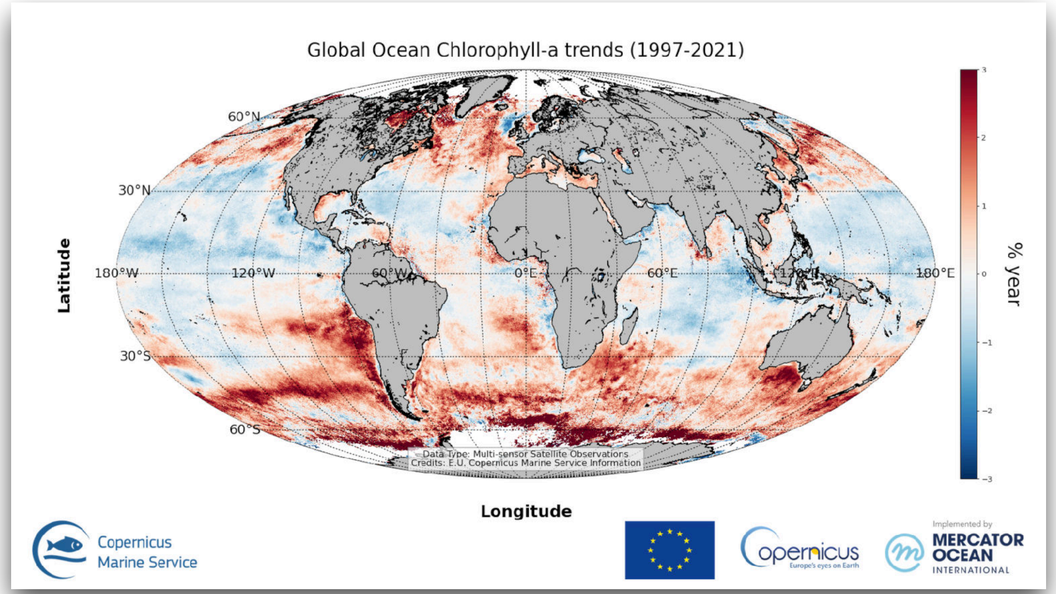
and they are changing **fast**

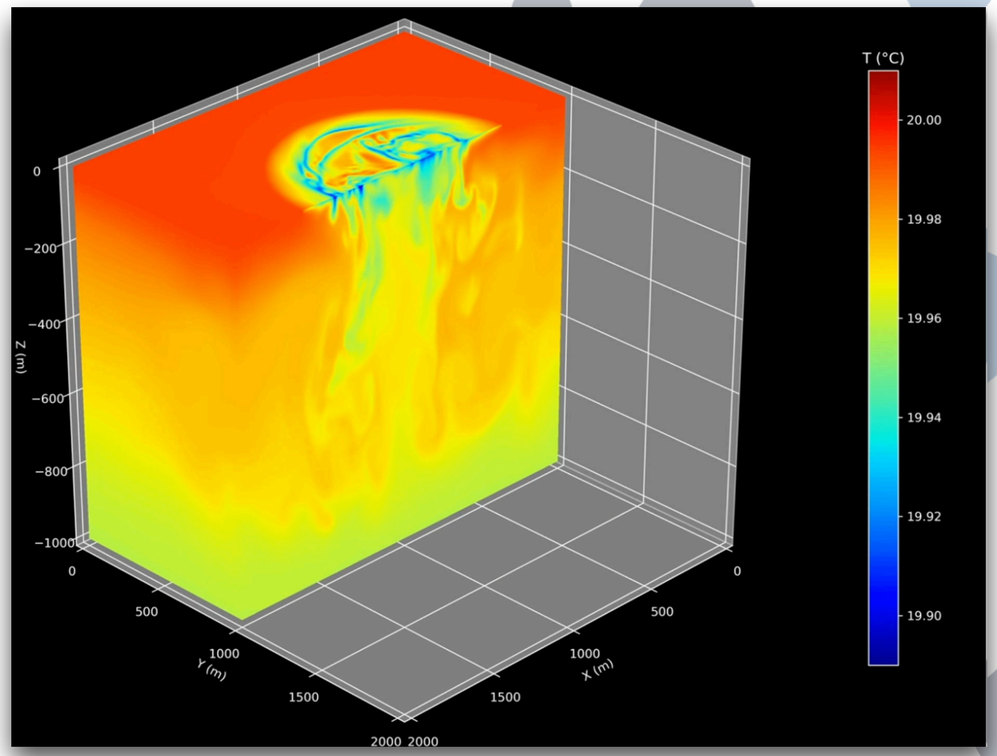
The role of differentiable programming in simulation-based science (SBS) and scientific machine learning (SciML)

kshop Report on Basic Resea
for Scientific Machine Learn

Report on the Department of Energy (DOE) Town Halls on Artificial Intelligence (AI) for Science

Scientific Computing





A computational scientist applies HPC to advance the state-of-the-art in science: physics, chemistry, biology, ecology, oceanography, engineering, …

High Performance Computing

1. Exascale Computing
2. HPC with AI and ML
3. Quantum computing
4. Portable performance and productivity
5. Cross-disciplinary collaboration

Quantum Computing

Quantum Computing is coming.
Will you be ready?

Press release | 4 October 2022 | Brussels

EU deploys first quantum technology in six sites across Europe

New Report Shows Quantum Technologies Thriving in Europe

BY JAMES DARGAN • FEBRUARY 10, 2023 • NATIONAL, QUANTUM COMPUTING BUSINESS

QUANTUM FLAGSHIP

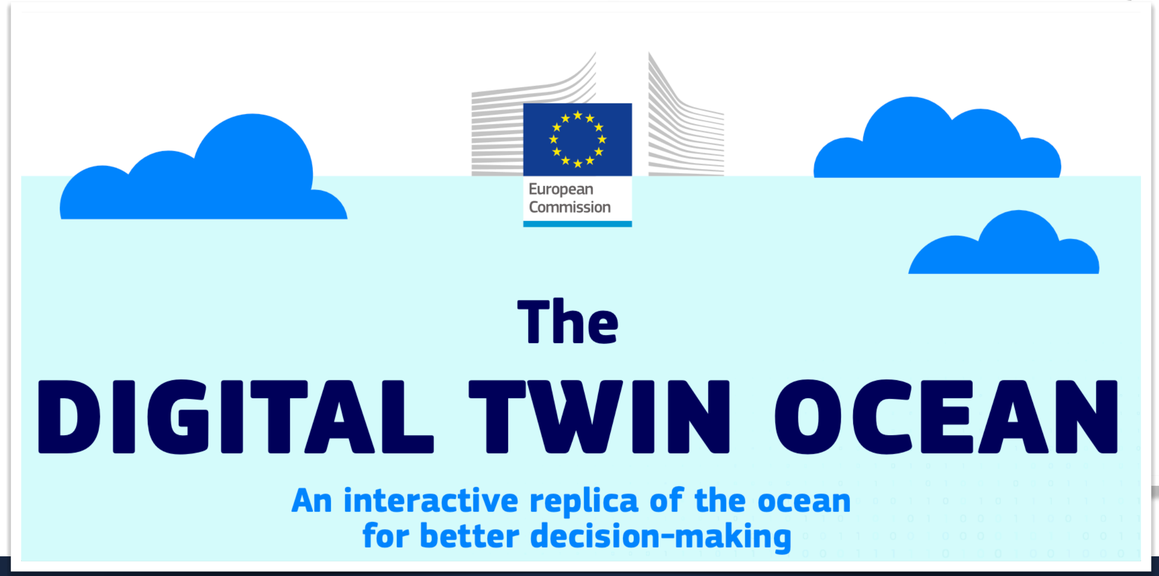
The future is Quantum.

The Second Quantum Revolution is unfolding now, exploiting the enormous advancements in our ability to detect and manipulate single quantum objects. The Quantum Flagship is driving this revolution in Europe.

Digital Twins

A digital twin is a digital representation of a real-world system

The digital twins can then be used as a replacement for practical purposes, such as simulation, integration, testing, monitoring, and maintenance



> “Digital twins are becoming a business imperative, covering the entire lifecycle of an asset...and forming the foundation for connected products and services. Companies that fail to respond will be left behind.
>
> Forbes 2018

~~Digital~~ Twins

DATA SCIENCE &
SCIENTIFIC COMPUTING

SCIENTIFIC &
DATA-INTENSIVE COMPUTING

DATA SCIENCE &
ARTIFICIAL INTELLIGENCE

Three Curricula

- **Computational Modeling and Digital Twins**
  With 5 sub-curricula with different focuses
- **High Performance Computing and Data Engineering**
  With 2 sub-curricula with focus on HPC or Data Engineering
- **Quantum Computing**

Advantages

Flexibility

Depending on your background you can select basic courses or skip to more advanced ones

Specialization

Many topic-specific courses to focus in the area you prefer

Computational Modeling and Digital Twins

Focus on:

- Industrial Computational Mechanics
- Ocean and Climate
- Computational Cosmology
- Computational Physics and Chemistry
- Discrete Modelling

Computational Modeling and Digital Twins

FIRST YEAR

Advanced programming, High Performance and Cloud Computing
or
Software Development Methods, High Performance and Cloud Computing

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Probability and Statistics for Scientific Computing

Numerical Analysis or **Stochastic Modelling and Simulation** or **Global and Multi-Objective Optimization**

Introduction to Machine Learning or **Probabilistic Machine Learning** or **Reinforcement Learning**

Deep Learning

Advanced Numerical Analysis or **Stochastic Modelling and Simulation**

Algorithms for Scientific Computing or **Advanced Algorithms for Scientific Computing**

High Performance Computing and Data Engineering

FIRST YEAR

Advanced programming, High Performance and Cloud Computing or
Software Development Methods, High Performance and Cloud Computing

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Probability and Statistics for Scientific Computing

Numerical Analysis or **Mathematical Optimization** or **Probabilistic Machine Learning**

Introduction to Machine Learning or **Unsupervised Learning**

Deep Learning

Mathematical Optimization or **Advanced High Performance Computing**

Algorithms for Scientific Computing or **Advanced Algorithms for Scientific Computing**

Data Management or **Advanced Data Managemen**

Quantum Computing

FIRST YEAR

Advanced programming, High Performance and Cloud Computing or
Software Development Methods, High Performance and Cloud Computing

Probability and Statistics for Scientific Computing

Introduction to Quantum Mechanics and Computing

Introduction to Machine Learning or **Information Theory**

Deep Learning

Algorithms for Scientific Computing or **Advanced Algorithms for Scientific Computing**

Probabilistic Machine Learning or **Stochastic Modelling and Simulation**

Introduction to Quantum Information Theory

Other Info on Study Plan

Elective courses
Essentially any course you seen before, plus few more (check official study plan).

Internship and Thesis
Internships (12 ECTS) and thesis (24 ECTS) in companies or research labs.
Can be combined together for a longer activity.

Where are the lectures?
At the university of Trieste - some 2nd year courses can be in partially in SISSA

Other Info

Requirements to Enroll
At least 60 ECTS on the topics of mathematics, computer sciences, computer/civil/industrial engineering, physics, statistics, economy and finance, chemistry, genetics and molecular biology, geophysics.
Of those at least 21 on mathematics or mathematics for economy and 6 in computer science or computer engineering

Positions Available
65 positions, 15 reserved for non EU students

Selection Procedure
Two application phases (April-May and July-August), evaluation of CV + interview (beginning of June / September). Applications together with Data Science & Artificial Intelligence, you need to specify your preference. Strict window to enroll, remaining position offered to following eligible but not admitted students.

Working students
3 or 4 year part time program available. Lectures are recorded and possibly streamed, exams in presence.

THANK YOU!

FIRST CALL IS OPEN
CLOSES ON MAY 22

sdic.units.it