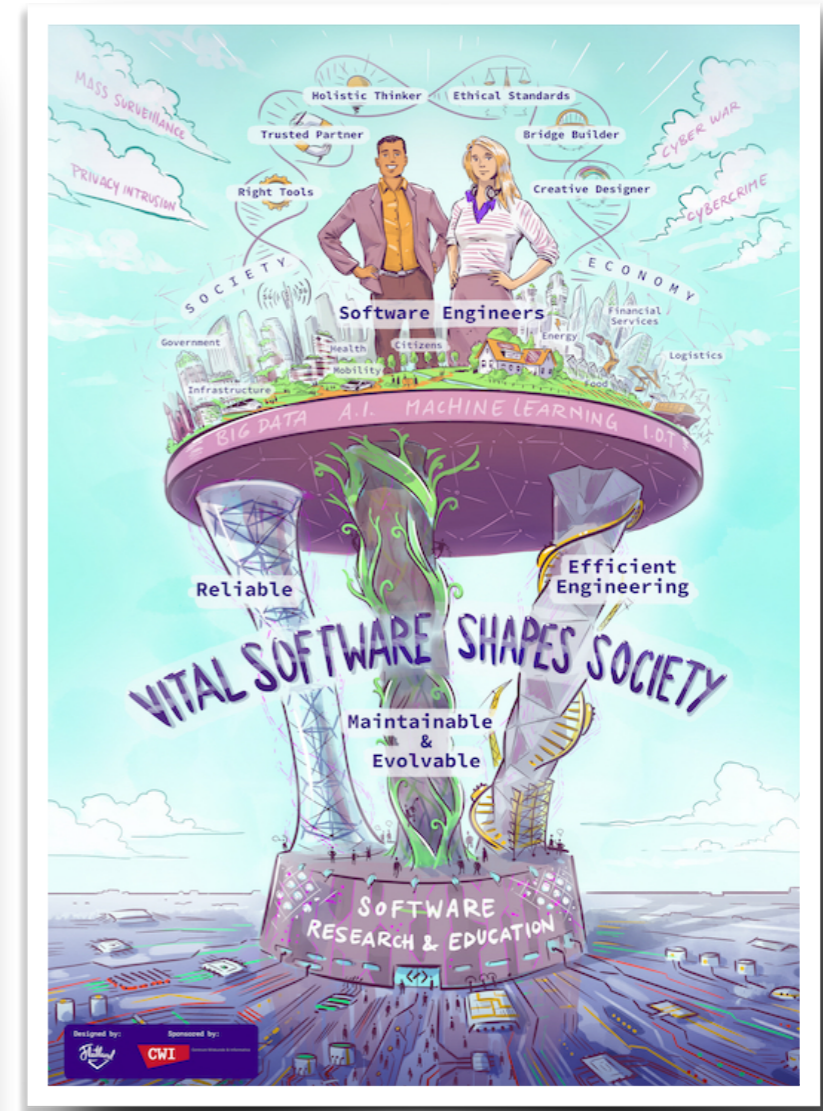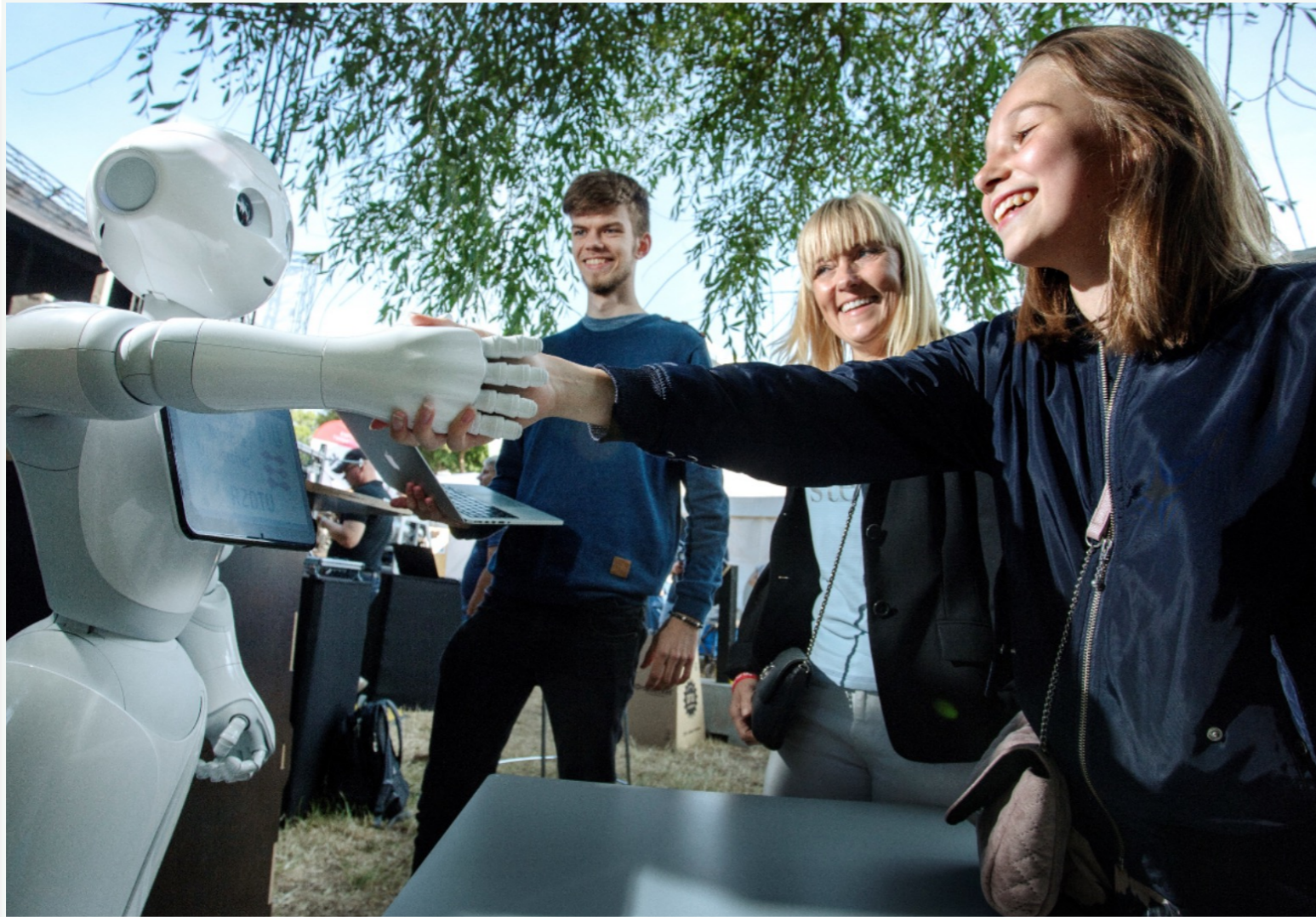# Software Systems Engineering

Alberto Lluch Lafuente
Head of Software Systems Engineering

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Software - a technology for people

Our section was created in 2022 to lead DTU's vision "technology for people" in what regards **software**.

We aim supporting society with foundations and methods to build and assess **high-quality** software systems.

Scientific Team

12
faculty

1 Full Professor
8 Associate Professors
3 Assistant Professors

14
non-faculty

10 PhDs
2 PostDocs
1 Research Assistant
1 Adjoint Professor

10
nationalities

20
alma mater

37
faculty avg. age
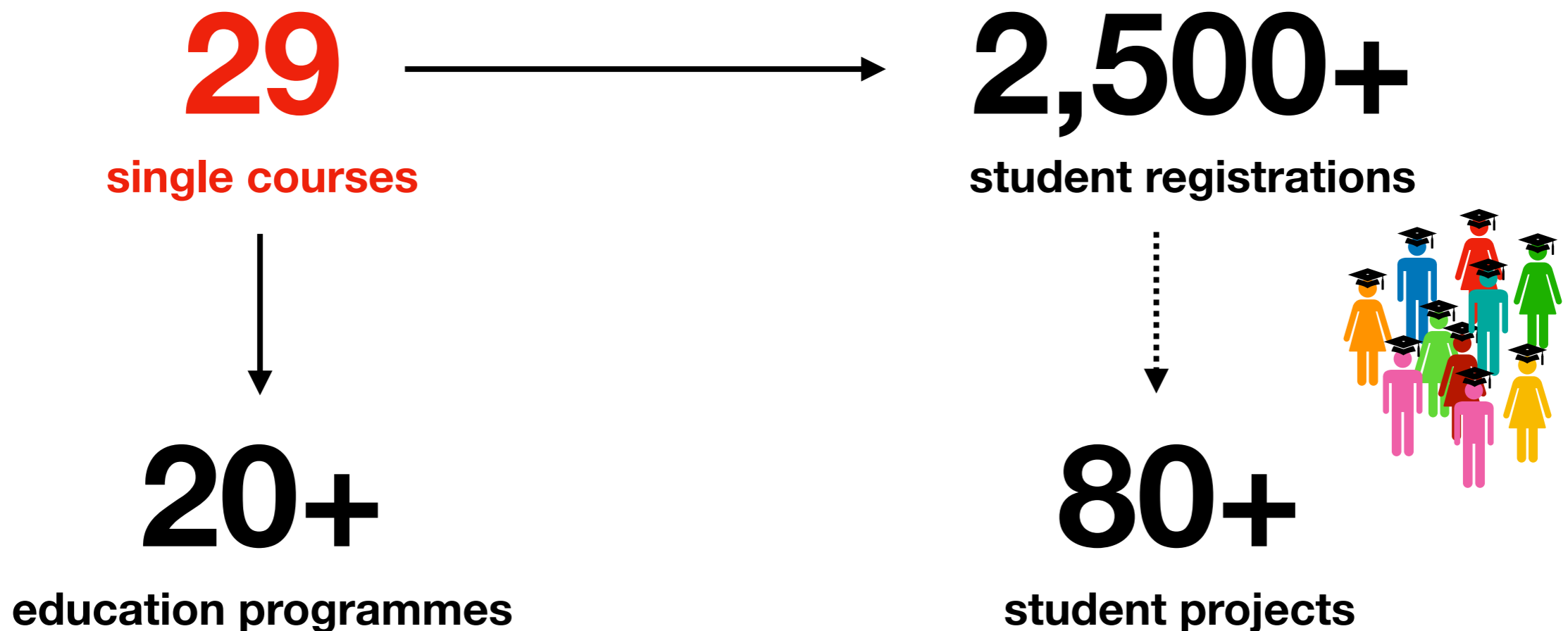
DTU Compute Research Areas

Data Driven vs Model Driven

Data Science

Computer Science

Virtual

Process Science

Programming Languages

Formal Methods

Mathematics

Security & Safety

vs

Data Engineering

Computer Engineering

Physical
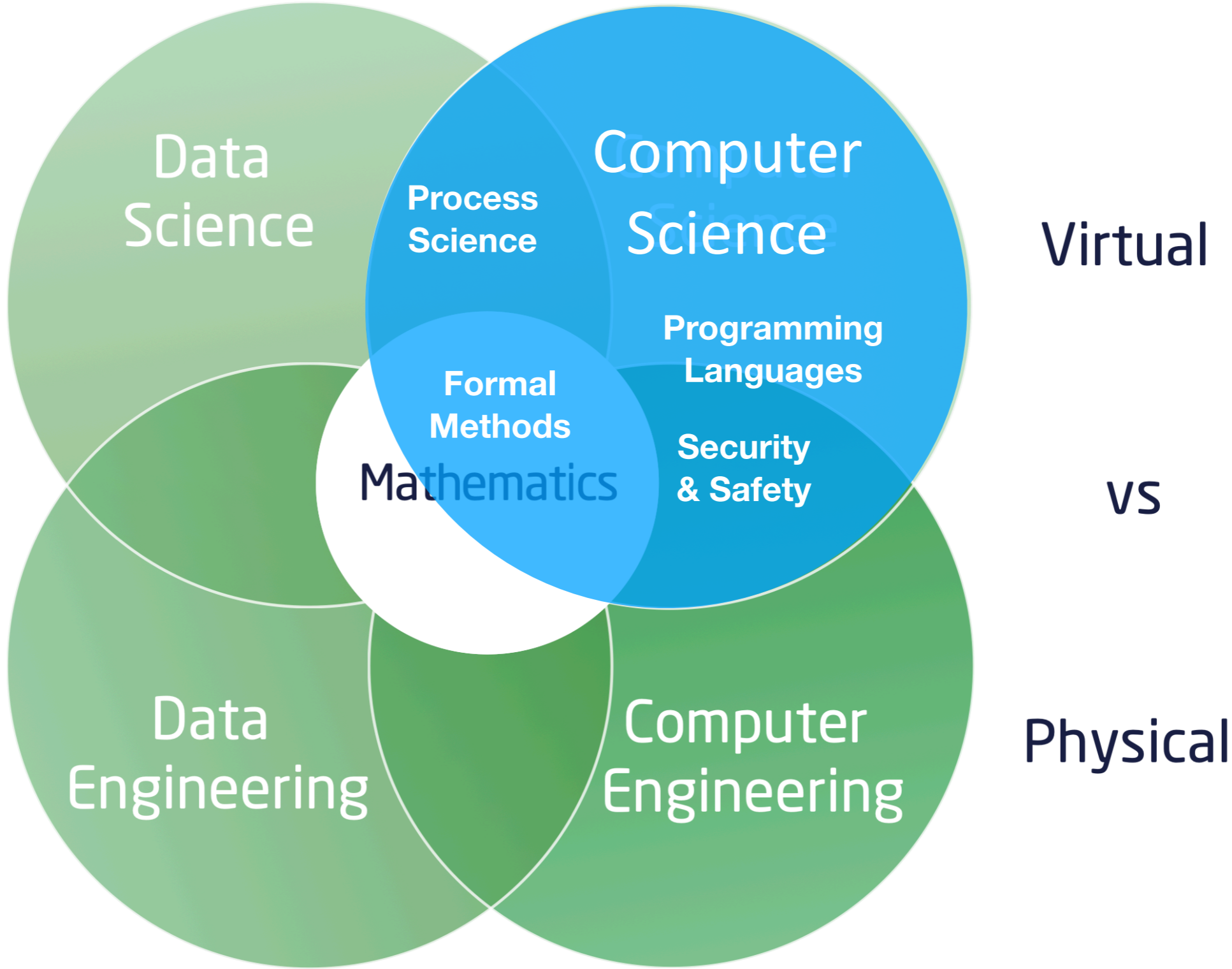
Contribution to Education
(academic year 2022/2023)

29
single courses

→

2,500+
student registrations

↓

↓

20+
education programmes

DTU Compute educations
- BSc Software Technology
- BSc General Engineering
- BEng Software Technology
- BEng IT & Economics
- BEng IT & Electronics
- MSc Computer Science & Engineering
- PhD DTU Compute
- …

but also other educations

80+
student projects

Key Courses in the BSc in Software Technology

COURSE NO.	TITLE
02141	Datalogisk modellering
02148	Introduktion til koordinering af fordelte applikationer
02160	Agil objektorienteret softwareudvikling
02161	Software Engineering 1
02162	Software Engineering 2
02170	Databasesystemer
02239	Datasikkerhed
02242	Programanalyse
02244	Logik for sikkerhed
02246	Model tjek
02247	Oversætterkonstruktion
02263	Formelle aspekter af software engineering
02267	Software-udvikling af Webtjenester
02268	Procesorienterede og event-drevne softwaresystemer

02269	Process Mining
02291	Systemintegration
02314	Indledende programmering
02318	Indledende programmering for diplom-E
02324	Videregående programmering
02327	Indledende databaser og database programmering
02332	Compilerteknik
02362	Projekt i software-udvikling
02363	Front end web teknologi
02369	Software processer og mønstre
02393	Programmering i C++
02913	Avancerede Analyseteknikker

https://www.compute.dtu.dk/english/research/research-sections/software-systems-engineering/courses

Suggestions to find a project

https://www.compute.dtu.dk/english/research/research-sections/software-systems-engineering

Software Systems Engineering

- › Employees
- › Projects
- › Why Formal Methods?
- › Courses
- ⌄ Looking for a thesis project?
- › Projects
- › Publications (findit)
- › Publications (orbit)
- › Current PhD projects

Statistics and Data Analysis

Visual Computing

Finding a Supervisor

The second step is to find a supervisor for your thesis project. The main supervisor must be a member of the scientific staff, with a permanent position at DTU. If the supervisor is an assistant professor, an associate professor, senior researcher, or professor must be connected as co-supervisor.

Here is the list of potential supervisors from our section with some of their areas of interest (dig deeper into their pages to learn more):

- **Alberto Lluch Lafuente**: formal methods, model checking, security
- **Alceste Scalas**: programming languages, compilers, concurrent/distrubuted systems
- **Andrea Burattin**: process mining, business process management, data-driven systems
- **Andrey Rivkin**: business process management, formal methods, artificial intelligence
- **Anne Haxhausen**: formal methods, formal verification, railway systems
- **Christoph Matheja**: programming languages, program verification, model checking
- **Christian Kalhauge**: programming languages, program analysis, automated testing
- **Ekkart Kindler**: software development, software engineering, software modelling
- **Hugo Andrés López**: business process management, distributed systems, formal methods
- **Hubert Baumeister**: software development, agile programming, domain-specific languages
- **Giovanni Meroni**: businesss process management, information systems, IoT monitoring
- **Sebastian Mödersheim**: formal methods, logic, security & privacy

Check main topics of interest, dig deeper into their personal webpages

Check the list of proposals

Case 1: you have a project idea that you would like to develop
Check the Research page of the section and/or the individual pages of the scientific staff of the section (see also the list above). The goal is to find one or more potential supervisors who work on the same or a similar research area. You can then contact the potential supervisor(s) by email. The email should contain:

1. A short description of who you are and of your academic studies
2. The list of courses you have attended with the related grades
3. A 1-2 pages description of your idea (problem, why the problem is relevant, how you plan to solve the problem)

Case 2: you don't have a project idea but you have a subject you like
Have a look at this list of proposals. Check the Research page of the section and/or the individual pages of the scientific staff of the section in order to find someone who work on that subject (see also the list above). You can then contact the potential supervisor(s) by email. The email should contain:

1. A short description of who you are and of your academic studies
2. The list of courses you have attended with the related grades
3. A short description of the subject you like
4. What kind of thesis project (theoretical, mostly practical, a combination) you would prefer to work on

Case 3: you have a project idea in collaboration with a company
Check the Research page of the section and/or the individual pages of the scientific staff of the section in order to find someone who does research or has expertise on to the subject of the project (see also the list above). You can then contact the potential supervisor(s) by email. The email should contain:

1. A short description of who you are and of your academic studies
2. The list of courses you have attended with the related grades
3. A 1-2 pages description of the project idea, including the details of the company and the name of the supervisor(s) from the company

Publications

Publications per year

2010 ▮▮▮▮▮▮▮▮▮ 2023

294	109	34	21	83
Article in proceedings	Journal article	Book chapter	Report	More

2023

A Calculus for Amortized Expected Runtimes

Batz, K., Kaminski, B. L., Katoen, J-P., Matheja, C. & Verscht, L., 2023, *Proceedings of the ACM on Programming Languages.* Association for Computing Machinery, 30 p. 67
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings › Research › peer-review

○ Expected Runtime ◗ Data Structure ◗ Dynamic Memory ◗ Reasoning ◖ Case Study

A Characterisation of Ambiguity in BPM

Franceschetti, M., Seiger, R., López-Acosta, H-A., Burattin, A., Garcia-Banuelos, L. & Weber, B., 2023, *Proceedings of the 42nd International Conference on Conceptual Modeling (ER).* Springer, Vol. 14320. p. 277–295
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings › Research › peer-review

○ Characterization ○ Ambiguity ○ Artifacts ◗ Taxonomies ◗ Taxonomy

A Decision Procedure for Alpha-Beta Privacy for a Bounded Number of Transitions

Fernet, L. P. K., Mödersheim, S. A. & Viganò, L., 2023, (Accepted/In press) *Proceedings of the 37th IEEE Computer Security Foundations Symposium (CSF 2024).* IEEE
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings › Research › peer-review

⌀ File

A Decision Procedure for Guarded Separation Logic: Complete Entailment Checking for Separation Logic with Inductive Definitions

Matheja, C., Pagel, J. & Zuleger, F., 2023, In: ACM Transactions on Computational Logic. 24, 1, 76 p., 1.
Research output: Contribution to journal › Journal article › Research › peer-review

🔓 Open Access ⌀ File

○ Decision Procedure ○ Inductive Definition ◖ Satisfiability Problem ◖ User ◖ Complexity

A Deductive Verification Infrastructure for Probabilistic Programs

Schröer, P., Batz, K., Kaminski, B. L., Katoen, J-P. & Matheja, C., 2023, In: Proceedings of the ACM on Programming Languages. 7, OOPSLA2, 31 p., 294.
Research output: Contribution to journal › Journal article › Research › peer-review

🔓 Open Access ⌀ File

A framework for modeling, executing, and monitoring hybrid multi-process specifications with bounded global–local memory

Alman, A., Maggi, F. M., Montali, M., Patrizi, F. & Rivkin, A., 2023, In: Information Systems. 119, 25 p., 102271.
Research output: Contribution to journal › Journal article › Research › peer-review

🔓 Open Access ⌀ File

You can also have a look at recent publications to find a supervisor working on topics you find interesting.

Skim through the publication titles, if something draws your attention skim through the paper and if you like what you see, contact the professor asking if they have a project on the topic.

https://orbit.dtu.dk/en/organisations/software-systems-engineering/publications/

Our Expertise in Detail

Process Science

Programming Languages

Process modelling, mining, monitoring & analysis

Type systems & run-time monitoring

Language design & implementation

AI-based analysis & verification

Formal Methods

Automated code testing & formal verification

Business process & socio-technical systems

Quantitative & probabilistic verification

Design & verification of security protocols

Specification & verification of safety-critical systems

Safety & Security

Current Research

Process Science

Process mining techniques for data-aware and data-intensive systems such as streams

Software engineering for Machine-Learning models and systems (MLOps)

Accessible formal methods via natural language processing and cognitive techniques

Specification, mining and analysis of object-centric processes

Applied AI techniques for improving Business Process Management

Expanding the scope of process mining to human behavior and to legislation

Programming Languages

Lightweight software verification methods, usable by non-specialised programmers

Automated software testing using language-based library fuzzing

Compositional reasoning of probabilistic programs

Invariant synthesis for the verification of probabilistic programs and stochastic games

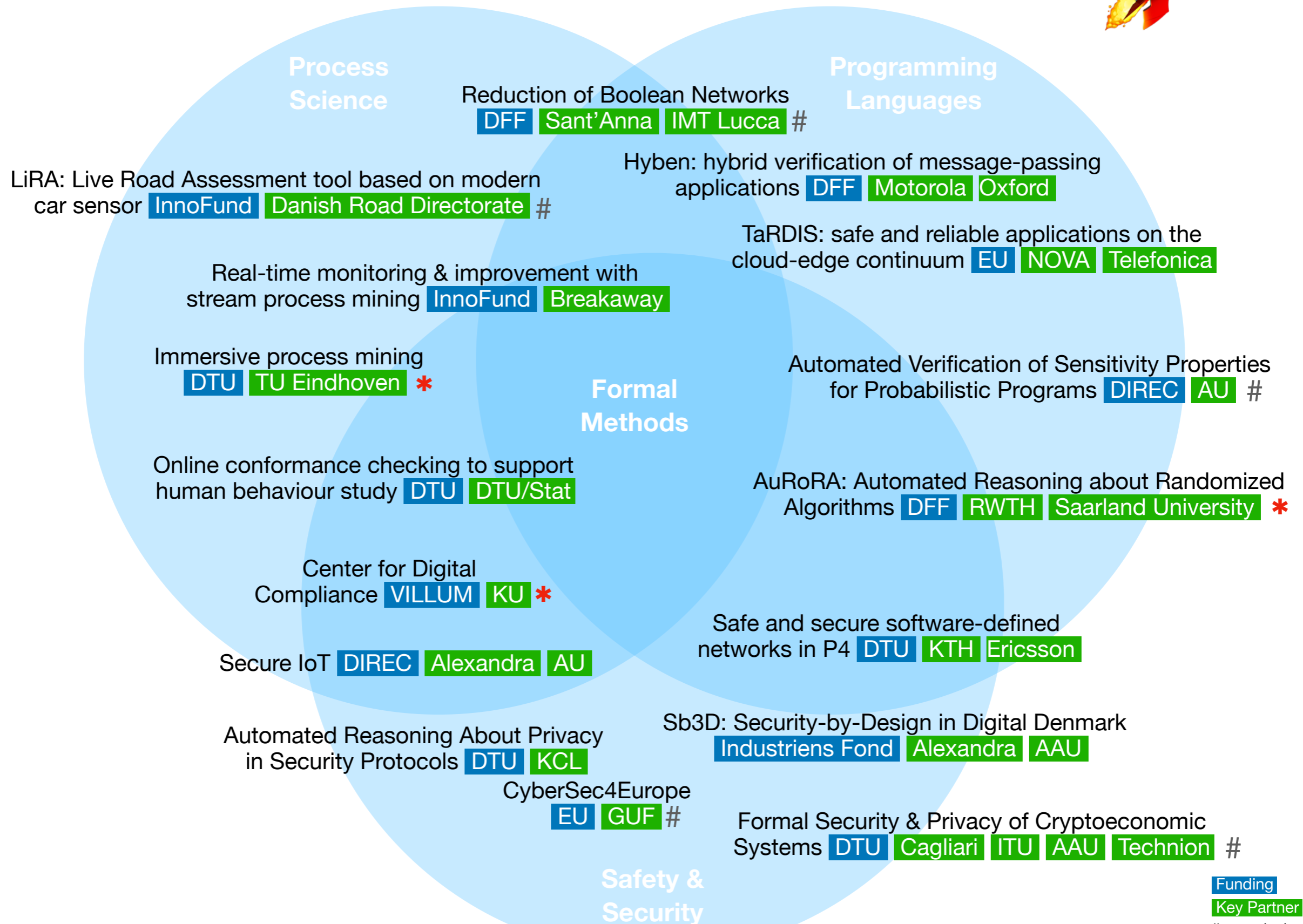Verification of programs with safe and unsafe code

Efficient verification of intelligent railway systems

Verification of post-compromise security guarantees and recovery mechanisms

Automated privacy verification for distributed systems

Safety & Security

Projects running in 2023 and onwards 🚀

Process Science

Programming Languages

Formal Methods

Safety & Security

Reduction of Boolean Networks
DFF Sant'Anna IMT Lucca #

LiRA: Live Road Assessment tool based on modern car sensor InnoFund Danish Road Directorate #

Hyben: hybrid verification of message-passing applications DFF Motorola Oxford

TaRDIS: safe and reliable applications on the cloud-edge continuum EU NOVA Telefonica

Real-time monitoring & improvement with stream process mining InnoFund Breakaway

Immersive process mining
DTU TU Eindhoven *

Automated Verification of Sensitivity Properties for Probabilistic Programs DIREC AU #

Online conformance checking to support human behaviour study DTU DTU/Stat

AuRoRA: Automated Reasoning about Randomized Algorithms DFF RWTH Saarland University *

Center for Digital Compliance VILLUM KU *

Safe and secure software-defined networks in P4 DTU KTH Ericsson

Secure IoT DIREC Alexandra AU

Sb3D: Security-by-Design in Digital Denmark Industriens Fond Alexandra AAU

Automated Reasoning About Privacy in Security Protocols DTU KCL

CyberSec4Europe
EU GUF #

Formal Security & Privacy of Cryptoeconomic Systems DTU Cagliari ITU AAU Technion #

Funding
Key Partner
concluded
* starting soon

Trending Topics

- LLMs
  - Process extraction from natural language descriptions (e.g. clinical guidelines) using LLMs.
  - LLMs to support data preparation for process mining.
  - Process-based understandability of LLMs.

- Digital Twins
  - Process mining for energy systems.
  - Control systems for railways

- AI/ML
  - Bringing Machine Learning Models Beyond the Experimental Stage with Explainable AI.
  - Reactive synthesis.
  - Safe and efficient future AI-aided railway systems.

- IoT
  - Streaming process mining.
  - Artifact-driven process monitoring with IoT data as first-class citizens.
  - Formal methods for Secure IoT: threat modelling and protocol verification.

- Blockchain
  - Blockchain for trusted process monitoring and on model-driven generation of smart contract code.
  - Formal models for Decentralised Finance applications.

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