IE Perspectives

MAGAZINE

Research and Leadership Insights from Informatics Europe

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IE Perspectives

Research and Leadership Insights from Informatics Europe

IE Perspectives is the flagship magazine of Informatics Europe and a platform where the community's **impact, visibility and shared resources** come together. Published twice a year, it brings together strategic reflections, forward-looking analyses, research insights and leading practices. By stimulating informed debate and collective empowerment, IE Perspectives strengthens the discipline and its societal impact in Europe.

IE is the collective voice of Informatics research and education in Europe. Uniting over 200 university departments, research labs and national associations, it empowers its community to create *impact* through shared positions and evidence-based policy engagement, strengthen *visibility* through a coherent European presence, and build *resources* through collaboration, peer exchange and shared knowledge.

Together, we turn shared challenges into collective progress, reinforcing Informatics as a core scientific discipline and contributing to Europe's technical and societal development.

Call for Contributions

IE Perspectives invites contributions from across the Informatics Europe community. We particularly invite articles that align with one of the magazine's core sections: *Trends, Research Advances, Leading Practices and Voices.*

Submission deadline is the end of April for the June issue and the end of October for the January issue. Please refer to the full contribution guidelines as stated on the Informatics Europe website.

Advertising

IE Perspectives offers targeted advertising opportunities for organisations seeking to reach academic leaders in Informatics across Europe. For further information, contact us.

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Introducing IE Perspectives: The Flagship Magazine of Informatics Europe

As President of Informatics Europe, I am thrilled to present the inaugural edition of *IE Perspectives*, a testament to the vibrant community we have fostered over two decades. This magazine is conceived as a platform to showcase the diverse voices, leading practices and groundbreaking research from across our community.

Informatics Europe has been instrumental in uniting and elevating the European Informatics research and education community through collaboration and advocacy. Our long-standing engagement strengthens the standing of Informatics as a distinct scientific discipline, promotes its recognition in curricula at all levels of teaching, supports data-driven decision-making, and advocates for responsible practices within our field.

By highlighting trends, showcasing ongoing research projects, and celebrating initiatives that have significantly enhanced the pedagogical experience of students pursuing Informatics studies, *IE Perspectives* aims to catalyse further development and collaboration within the community.

This debut issue draws extensively on contributions connected to the 2025 European Informatics Leaders Summit (ECSS), our flagship annual event. These articles offer timely insights into pressing and forward-looking topics: how to anticipate and respond to novel computing paradigms such as Quantum Software Engineering; how to foster more inclusive academic cultures and software development practices; how open science strengthens transparency, collaboration and public confidence in scientific knowledge; and finally, how to better support and leverage on the potential of aspiring researchers seeking to make a difference through Informatics.

You will also find comprehensive reports on two innovative projects. "Graph Deep Learning for Time Series Forecasting", authored by the winner of the 2025 Informatics Europe Best PhD Dissertation Award, and an article on a genomic surveillance software platform developed by one of our member institutions.

As we continue on our journey, *IE Perspectives* will serve as a cornerstone of our efforts to amplify the voices within our community and nurture an environment where collaboration drives collective progress and innovation. We warmly invite your feedback and contributions, helping to ensure that Informatics Europe members remain at the forefront of research and education as well as societal progress.

Together, let us celebrate our achievements and continue shaping the future of Informatics in Europe!

Jean-Marc Jézéquel
President, Informatics Europe
Editor-in-Chief, *IE Perspectives*

*Contribution by Manuel Wimmer, ECSS 2025 Keynote Speaker and colleagues from the [Department of Business Informatics](),
Johannes Kepler University Linz, Austria.*

Quantum Software Ante Portas: How to Prepare for a New Computing Paradigm?

Christoph Stein, Stefan Klikovits, Manuel Wimmer (Johannes Kepler University Linz, Austria)

Quantum computing has received considerable interest in recent years due to its potential to solve computational problems that are intractable for even the best classical supercomputers. Significant progress has been achieved not only at the hardware level [1], but also at the software level with the emergence of cloud-based services for quantum computers, dedicated simulators, and quantum programming languages [2]. The ability to execute software on a quantum computer, however, is not enough to drive innovation. Similar to the state of classical computing during the software crisis in the 1960s [3], in order to extend beyond the proof-of-concept and achieve industry adoption, we require new tools, processes, and programming languages for quantum computing, and all in all, a new generation of (quantum) software engineers. In this article, we seek to provide an overview of where we stand and where we need to go to prepare for this new computing paradigm.

The potential of quantum computing lies in its fundamentally different approach to information processing. While a classical computer operates in one of 2^N states at any given time (where N is the number of available bits), a quantum computer can represent a probability distribution across 2^N states simultaneously through the phenomenon of superposition. Quantum parallelism (the ability to operate on all of these states at once), combined with entanglement (the correlation between probability distributions of quantum bits, or qubits), brought forth quantum algorithms. They often achieve up to exponential speed-ups over their classical counterparts for specific problem classes (see [4] and [5] for well-known examples).

Realising this potential, however, is far from trivial [6,7].

The current state of the field – often referred to as the Noisy Intermediate-Scale Quantum (NISQ) era [8] – is characterised by systems with 50–1000 physical qubits that are error-prone, have short coherence times, and lack full error correction. These hardware constraints shape how quantum software must be engineered. In the NISQ era, quantum software must be carefully optimised for circuit depth, gate count, and hardware-specific compilation strategies. Furthermore, the quantum computing landscape is heterogeneous [2], with multiple competing hardware platforms based on different physical implementations, each with distinct operational characteristics, gate sets, and connectivity topologies. This hardware diversity creates significant challenges for software portability and increases the need for abstraction layers that can shield software engineers from low-level hardware details while still enabling performance optimisation.

Besides limitations directly induced by the hardware, applications increasingly demand hybrid classical-quantum architectures where quantum processing units serve as specialised co-processors within larger computational workflows [9]. Major technology providers, such as IBM, Microsoft, Google, and AWS, are extensively investing in quantum cloud infrastructures and development frameworks, recognising that accessible software tooling will be critical for widespread adoption of the technology. Still, current quantum programming mostly occurs at the quantum circuit level [10], an abstraction

comparable to assembly languages for classical computers. Despite significant progress in the required tools and languages, significant gaps remain in areas such as debugging, testing, verification, and integrated development environments [11]. In addition, software engineering research has achieved several abstraction layers for classical computing that bridge the gap between human-oriented programs and machine-oriented representations. This achievement has not yet been made for quantum software.

Manuel Wimmer presents a keynote on "Integrating Quantum Technologies into European Informatics Departments" at ECSS 2025.

The quantum software engineering community is actively working to tackle these challenges by developing new or adapting existing methodologies from classical software engineering. For instance, we are working on model-driven engineering approaches that provide higher-level abstractions, e.g., for circuit composition [12], and search-based engineering approaches for automatically synthesising or optimising quantum circuits for specific objectives [13]. Adopting such established engineering methodologies for quantum software is a major challenge, as it requires a new generation of quantum software researchers capable of working at the intersection of quantum physics, computer science, and potential application domains.

This brings us to the next major challenge: education. An ad-hoc search of global quantum computing programmes reveals a heterogeneous landscape of over 100 study programmes worldwide, predominantly at the Master's level and typically building upon either computer science or physics foundations. Industry partners such as IBM, Microsoft, Google, and AWS frequently collaborate with these programmes, which generally include quantum programming but rarely embed more advanced software engineering topics within broader quantum computing curricula. Notable exceptions include programmes at institutions such as KAIST[i], SDU[ii], and UTS[iii] that offer dedicated software engineering specialisations. However, a shared understanding of how to design comprehensive quantum software engineering curricula remains elusive. The European Commission's Quantum Europe Strategy[iv] explicitly identifies this gap, noting that shortages are "*most critical in applied fields, including quantum software engineering, system integration, and quantum cybersecurity, slowing the commercialisation path for EU-based start-ups and scale-ups.*" Building a diverse, world-leading workforce through coordinated education, training, and talent mobility across the EU is a strategic priority that will require sustainable investment and curricular innovation. Bridging the skill gap demands not only technical training in quantum physics and programming, but also interdisciplinary collaboration capabilities, systems thinking, and software engineering skills—competencies that traditional physics or more theoretical computer science programmes often only cover to a limited extent.

As quantum computing technology continues to mature along ambitious roadmaps[v], the need for high-quality quantum software and comprehensive engineering methods will only intensify. Successfully navigating the transition from current NISQ devices to fault-tolerant quantum computers will require advances across the entire software stack: from circuit synthesis and optimisation algorithms, through compiler technologies and runtime systems, to high-level programming abstractions and integrated development tools. Moreover, questions of how quantum components integrate into larger software systems, how development practices scale from current 10–100 qubit systems to future 1000+ qubit systems, and what organisational

changes are necessary within software teams remain largely unexplored. The innovations that will ultimately drive quantum computing's impact will be enabled by quantum software, making it essential that the computer science community tackles these challenges now, while the field is still taking shape.

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On Graph Deep Learning for Time Series Forecasting

Andrea Cini (Università della Svizzera italiana, Switzerland)

In modern cyber-physical systems, physical and virtual sensors continuously produce large amounts of data. Such pervasive sensor networks acquire partial heterogeneous observations at different rates and scales. The result is large collections of correlated, heterogeneous and irregular time series that learning systems should continuously integrate and process to make accurate predictions. Leveraging and modelling the spatiotemporal structure of the data is crucial to building models that can scale. Deep learning models have become fundamental tools in modern forecasting practice. The most successful approach consists of training a single deep network on collections of related time series while sharing parameters. Although this allows for training large (*global*) models on vast amounts of data, the resulting predictors process a time series at a time: they cannot leverage existing relationships among time series. My dissertation, *Graph Deep Learning for Time Series Forecasting*, shows that graph deep learning (GDL) provides the appropriate framework and inductive biases to go beyond the limitations of the current state of the art in deep learning for time series forecasting. Within the proposed framework, dependencies are modelled in terms of pairwise relationships among time series in the collection. The resulting representation is a graph where each time series is associated with a node, and functional relationships among them are represented as edges.

Graph deep learning for time series forecasting

The thesis's **goal** is the introduction of a comprehensive methodological framework instrumental to designing GDL methods for time series forecasting, providing the necessary tools and theory. In particular, we introduced novel methods and techniques to build, understand and scale graph-based predictors, i.e. methods to process and forecast collections of correlated time series given graph-based input representations [Cini et al., 2025]. The thesis provides a formalisation of the problem settings, representations and predictors. Available design choices and their implications are discussed, together with guidelines and methodologies to address associated challenges. Results show that graph-based processing allows for building scalable predictors while taking structural dependencies among time series into account. A schematic outline of the project, its goal and challenges is provided in Figure 1. The following provides more details on the challenges we dealt with and our contribution in addressing them.

Challenge 1: Local effects.

Time series might be heterogeneous and characterised by specific dynamics (*local effects*). Specialising forecasting models to such dynamics can hinder transferability and scalability. We developed methodologies to address local effects by developing graph-based forecasting architectures with shared components and local processing blocks [Cini et al., 2023b]. Local components, i.e. modules with node-specific parameters, allow for tailoring the processing to the characteristics of each input time series. This research line addressed the implications of introducing such components in transductive and transfer learning scenarios and discussed the associated trade-offs.

Challenge 2: Missing data.

Missing data and intermittent observations (across both time and space) are inherent to any application involving a network of sensors. This makes the processing challenging, particularly in those applications characterised by extremely sparse observations. Within the thesis, we pioneered several state-of-the-art GDL methodologies for missing data imputation in collections of irregular time series and spatiotemporal data. The introduced methods rely on relational representations to reconstruct missing data by leveraging observations at the target time series and neighbouring nodes [Cini et al., 2022; Marisca et al., 2022]. This work opened up a line of research–graph-based neural imputation–which is currently very active and represents the state of the art in several applications. In this context, we also explored applications of this approach to the virtual sensing problem [Cini et al., 2022; De Felice et al., 2024], i.e. to the problem of reconstructing observations at locations where no physical sensor is available.
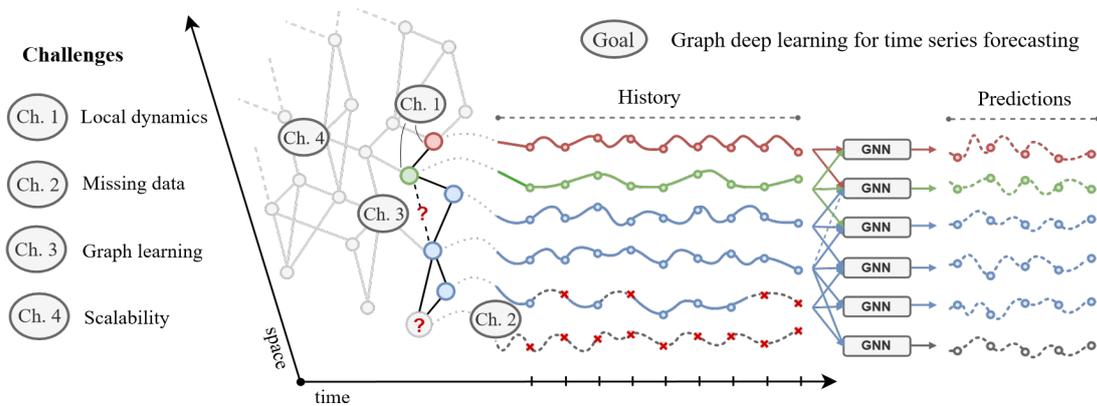

Figure 1: Outline of the nominee's dissertation highlighting the research goal and related challenges.

Challenge 3: Latent graph learning.

Available relational information can be inaccurate, inadequate, or completely missing. Exploiting relational architectures in such a setting requires extracting relationships from data. To address this challenge, the thesis studied the problem of learning latent graph structures directly from time series in an end-to-end fashion **(Challenge 3)** [Cini et al., 2023c]. Specifically, the thesis introduces methodologies for learning distributions over graphs while maintaining sparsity and computational efficiency in downstream graph-based processing. This was achieved by proposing novel variance-reduced score-based gradient estimators. The resulting graph learning framework also enabled the development of state-space models in which inputs, outputs and states are all represented as graphs [Zambon et al., 2023].

Challenge 4: Scalability.

In real-world applications, processing observations over both time and space has a high computational cost. Effectively exploiting the available spatiotemporal dependencies can then be extremely challenging and requires ad-hoc scalable operators. In the thesis, we propose scalable forecasting architectures by combining graph processing and deep randomised recurrent neural networks [Cini et al., 2023a]. The introduced architectures extract spatiotemporal representations without requiring any training; representations can be precomputed and then mapped to predictions by a decoder, which is the only trainable component of the architecture. Precomputation makes the cost of a training step independent of graph size and sequence length. The associated paper won the Best Paper Award at the Temporal Graph Learning workshop at NeurIPS 2022, one of the most prominent workshops in learning from dynamic relational data.

Future directions

Besides addressing the identified challenges, we also investigated graph-based models operating at adaptive spatial resolution. In particular, the thesis introduces a methodology unifying graph-based forecasting with hierarchical time series processing. The resulting framework enables the modelling of higher-order spatiotemporal structures. I am currently following up on this work funded by a Swiss National Science Foundation Postdoc Fellowship at the University of Oxford.

Dissemination, impact and applications

Most of the methodologies designed within the thesis have been published together with open-source implementations. Furthermore, we developed and open-sourced *Torch Spatiotemporal*[i], a software library for prototyping spatiotemporal graph neural networks and processing time series collections. The methods developed in the thesis have found several practical real-world applications, e.g. in smart grid and load forecasting applications, in collaboration with Siemens (Zurich) and DXT Commodities (Lugano). More recently, we applied the graph-based imputation approaches to process biomedical signals and, in particular, to reconstruct atrial fibrillation dynamics in collaboration with Imperial College London.

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i https://torch-spatiotemporal.readthedocs.io/en/latest/

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ConvMut: An Italian Software Platform to Predict SARS-CoV-2 Evolution Through Convergent Mutations

Tommaso Alfonsi, Anna Bernasconi, Emma Fanfoni (Politecnico di Milano, Italy); Cesare Ernesto Maria Gruber, Fabrizio Maggi (National Institute for Infectious Diseases Lazzaro Spallanzani. IRCCS, Rome, Italy); Daniele Focosi (Pisa University Hospital, Italy)

As SARS-CoV-2 continues to circulate globally across human and animal hosts, its evolutionary trajectory remains unpredictable and extraordinarily dynamic. In this complex scenario, anticipating which mutations and variants are likely to emerge is crucial for updating vaccines, designing robust monoclonal antibodies, and planning public health responses. A multidisciplinary Italian research team has developed **ConvMut**, a novel software tool capable of analysing viral genomic data and identifying patterns of convergent evolution—mutations that arise independently across different viral lineages because they provide a selective advantage.

Developed through a collaboration between the **Politecnico di Milano**, the **National Institute for Infectious Diseases Lazzaro Spallanzani (INMI)** in Rome, and the **Azienda Ospedaliero-Universitaria Pisana (AOUP)**, ConvMut has now been deployed within the **GISAID** Data Science Initiative, making it available to all registered users worldwide. The work, described in detail in [1], fills a major gap in existing SARS-CoV-2 bioinformatics resources: until now, convergent evolution had been monitored mostly manually by independent researchers.

Understanding the biological foundation: Convergent evolution

Convergent evolution refers to the independent acquisition of the same genetic change by multiple viral lineages. In SARS-CoV-2, convergent events have been observed extensively—particularly in the Spike protein—because the virus is under continuous selective pressure from infection-induced and vaccine-induced immunity. These pressures favour mutations that enhance immune escape, improve ACE2 binding or increase viral fitness.

The ConvMut team highlights that SARS-CoV-2 evolution remains unusually fast, with an estimated **28.4 substitutions per year**, roughly ten times higher than other long-established human RNA viruses. As documented in [1], over **5,300 SARS-CoV-2 sublineages** have been designated since 2019, with over **3,000** arising under the Omicron umbrella alone. This unprecedented granularity provides a unique opportunity: by examining how mutations repeatedly reappear across distinct branches of the phylogeny, researchers can detect which evolutionary paths are favoured by natural selection.

ConvMut's core innovation: Delta-based evolutionary analysis

The developers of ConvMut introduce a central concept: **deltas**, defined as sets of mutations acquired at a given node of the PANGO phylogenetic tree relative to its parent. These deltas—computed separately for nucleotide changes and amino acid substitutions—capture incremental evolutionary steps, enabling precise reconstruction of how each lineage diverged from its ancestors.

ConvMut processes daily-updated GISAID datasets and reconstructs the entire hierarchical lineage structure, including designated and recombinant lineages. Several specialised data structures are generated:

- **Parent-deltas**: mutations differentiating a lineage from its immediate ancestor.

- **Wild-type deltas**: all amino acid differences between each lineage and the Wuhan reference strain.

- **Inter-lineage deltas** for recombinants—calculated with special care due to the uncertainty in parental breakpoints.

This fine-grained representation enables ConvMut to count how many times a given mutation has arisen independently across the phylogenetic tree. The higher the count, the stronger the evidence of convergent evolution.

A powerful interactive web application

Built using the Streamlit framework and deployed as a Docker container, ConvMut offers a user-friendly interactive interface organised into three major analysis modules:

1. Convergence Analysis

This is the flagship feature of ConvMut, allowing users to:

- Select any SARS-CoV-2 protein (default: Spike).

- Choose a root lineage from which a phylogenetic subtree will be analysed (e.g. JN.1.11.1).

- Inspect a horizontal barplot showing how many lineages independently acquired mutations at each residue.

- Apply filtering thresholds to focus on the most convergent positions.

- Generate pie charts showing amino acid variability at selected positions.

- Automatically group lineages into **clusters** based on shared convergent mutations.

- Visualise an **interactive evolutionary graph** where nodes represent lineages and edges represent mutation-bearing evolutionary steps.

This dynamic graph enables users to trace evolutionary trajectories, including those of recombinant variants. For instance, the paper illustrates the path leading to the recombinant lineage **XFG**, highlighting successive acquisitions of R346T, S31N, T572I, and a final triplet of reversions and mutations (see Figure 1).

2. Codon Exploration

This tool allows exploration of mutational events at the codon level:

- Users select a protein, a root lineage, and a residue.

- ConvMut displays the wild-type codon, all alternative codons found in the subtree, and mutation counts per codon.

- It provides a list of all lineages exhibiting codon changes at that specific position.

This level of detail is essential for prospective design of monoclonal antibodies and structure-guided immunogen engineering.

3. Mutation Exploration

This module focuses on a single residue:

- It identifies all lineages within the selected subtree that exhibit a mutation at a given position.

- It generates a pruned phylogenetic tree where only relevant branches are retained.

- Mutation labels are colour-coded to highlight the diversity of amino acid changes.

This visualisation is particularly useful for residues under strong selective pressure—such as R346, F456, and L455, which have been repeatedly involved in Omicron immune-escape waves.
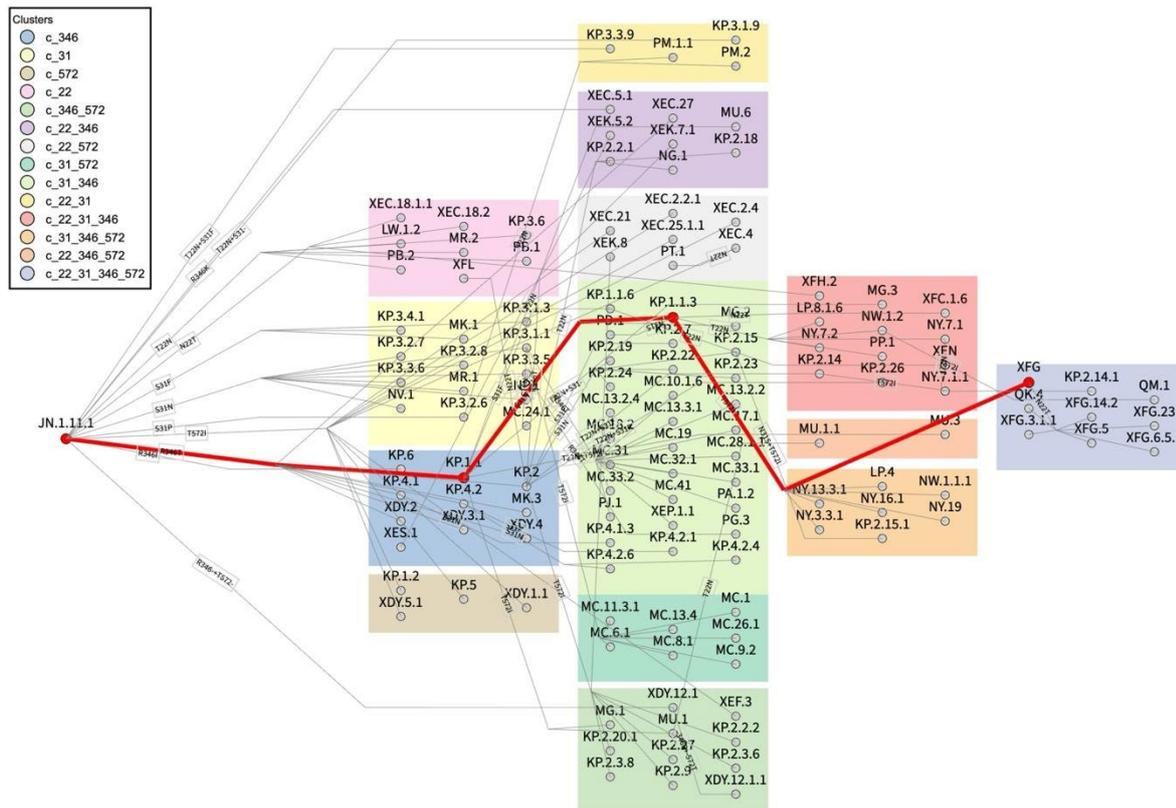
Figure 1. Example of convergence analysis in ConvMut.

Impact on vaccine and monoclonal antibody design

Unlike traditional surveillance tools, which document *what has already happened*, ConvMut aims to provide **foresight** into *what is likely to happen next*. By identifying mutations that repeatedly reappear across distinct lineages, ConvMut can help:

- Predict which Spike mutations may dominate future variants.

- Inform the selection of strains for next-generation COVID-19 vaccines.

- Guide companies in designing monoclonal antibodies resilient to convergent escape pathways.

- Reduce late-stage drug development failures, which have plagued the monoclonal antibody field as successive variants rendered existing therapies obsolete.

In the context of the growing use of **immunobridging**—a regulatory strategy that shortens vaccine approval timelines—forecasting tools like ConvMut become even more critical.

Limitations and future perspectives

The authors acknowledge several limitations:

- ConvMut depends on **PANGO lineage designations**, which have inherent subjectivity.

- Recombinant lineages introduce ambiguity in assigning mutations to specific parents.

- Ignoring undesignated intermediate nodes may lead to overestimated counts of convergent events.

Still, the tool's strengths are substantial: fully automated data ingestion, daily updates through GISAID, intuitive visualisations, and a set of analysis capabilities not available in any other existing SARS-CoV-2 platform.

The team envisions applying the same framework to other pathogens—such as influenza, RSV, or dengue—as soon as granular phylogenies become available.

Conclusion

ConvMut represents a major advancement in genomic surveillance, offering an automated, user-friendly, and scientifically rigorous platform to detect and interpret convergent evolution in SARS-CoV-2. By enabling researchers, clinicians, and biotech companies to anticipate viral evolutionary trends, it provides a crucial tool for staying ahead of future variants and improving preparedness in vaccine and therapeutic development. In an era where viruses evolve faster than global responses, ConvMut embodies a proactive approach—transforming massive genomic datasets into actionable intelligence for global health.

Reference

[1] Tommaso Alfonsi, Anna Bernasconi, Emma Fanfoni, Cesare Ernesto Maria Gruber, Fabrizio Maggi, Daniele Focosi, ConvMut: Exploration of viral convergent mutations along phylogenies, bioRxiv preprint doi: https://doi.org/10.1101/2024.12.16.628620; this version has been posted on October 9, 2025.

Contribution from the ECSS 2025 Diversity & Inclusion Workshop, supported by the IE Diversity & Inclusion Working Group.

Voices of Inclusion: Experiences and Initiatives

Simona Motogna (Babeş-Bolyai University, Romania), Letizia Jaccheri (NTNU, Norway), Matthew Grech-Sollars (University College London, UK), Malvina Latifaj (Mälardalen University, Sweden), Oana Andrei (University of Glasgow, UK), Lola Burgueño (University of Malaga, Spain)

Academic staff and institutional leaders from universities across Europe gathered at the Diversity and Inclusion Workshop held during the European Informatics Leaders Summit (ECSS 2025) in Rennes, France, on 29 October 2025. The Workshop was organised by three members of the Diversity and Inclusion Working Group: Simona Motogna (Babeş-Bolyai University, Romania), Lola Burgueño (University of Malaga, Spain), and Oana Andrei (University of Glasgow, UK).

As part of the Workshop, a panel was organised, in which invited speakers led an open discussion on enhancing inclusion within Informatics departments and fostering a more collaborative, welcoming academic environment. The panel focused particularly on cultural diversity within European universities and departments, with speakers exploring issues such as equitable access, representation in curricula, inclusive hiring practices, and the role of intercultural competence in shaping more open and resilient academic communities.

The panel was composed of the following 3 distinguished invited panellists:

Prof Letizia Jaccheri (NTNU, Norway) has long-standing experience in gender equality and broader diversity initiatives, which contributed to her and her team at NTNU receiving the 2025 Minerva Informatics Equality Award. She is now strongly motivated to address how AI may worsen exclusion. Together with collaborators, she just started a new NGO to support people facing various disadvantages, particularly in relation to AI. Her opening phrase at the Workshop,

"Yesterday is history. Tomorrow is a mystery. Today is a gift. That's why it's called a present.", raised awareness on the importance of getting involved every day.

Dr Matthew Grech-Sollars (UCL, UK) is an Associate Professor in the Department of Computer Science, where he co-leads a research group. He is the Chair of the UCL Department of Computer Science Gender Equality Group and the Chair of the UCL Department of Computer Science Mental Health Working Group, while also serving as Mental Health First Aider. He summarised the committee's working groups and key initiatives, including mentoring for underrepresented students, student-led collaborations, annual culture surveys, mindful-conversation seminars on challenging academic topics, and events celebrating cultural diversity. His focus is on structured actions that strengthen inclusion, community, and mental-health and gender-equality awareness.

Dr Malvina Latifaj (Mälardalen University, Sweden) is a postdoctoral researcher and represents the voice of the new generation, with an academic journey from Albania to Sweden that shows how an Erasmus+ mobility scholarship reshaped her career. She is an advocate of initiatives such as broad international mobility partnerships, a new gender-equality plan, efforts to attract women to IT, and participation in European Alliances. She believes that real progress depends on people whose commitment and collaboration drive inclusion forward.

Panel Discussion at the ECSS 2025 Diversity & Inclusion Workshop, featuring (from left to right) Letizia Jaccheri (NTNU), Malvina Latifaj (Mälardalen University), Matthew Grech-Sollars (UCL) and Simona Motogna (Babeș-Bolyai University).

The panel was guided by a set of questions designed to frame the discussion and encourage thoughtful reflection:

Question 1: *What support do you receive from the leadership of your university? Are you encouraged to engage in diversity and inclusion activities?*

Matthew Grech-Sollars explained that at UCL, there is strong institutional support, such as dedicated time, budgets, and formal career structures. The Head of Department attends EDI committee meetings when possible. EDI work is formally recognised in staff workload, and department funding is available for EDI events such as the Mindful Conversations Seminar series. Within UCL, EDI work is recognised as "Institutional Citizenship", one of the four pillars required for academic promotion.

Malvina Latifaj mentioned that in her department, the leaders who championed mobility and inclusion had done so for years without compensation, purely out of conviction. "They showed me what leadership looks like," she said. It taught her that lasting change depends not only on policy but also on people willing to carry the torch and to teach others to carry it after them.

Letizia Jaccheri offered a more seasoned perspective. Economic crises, the COVID-19 pandemic, and tight budgets have all affected EDI efforts. "Support is strong in good times," she said, "but when resources shrink, inclusion work is the first thing people forget." She expressed admiration for institutions where EDI roles are permanent, not expendable. "You can't fire inclusion," she said, "just because the times get hard."

Question 2: *Why do you think cultural diversity is important in higher education? And what unique value does it bring to our domain of computer science, both in terms of teaching and in terms of research?*

Letizia Jaccheri believes that technology is global, so the people building and teaching it cannot come from a single cultural perspective. She pointed out the absurdity of imagining Norwegian-born men designing tools meant for billions of users across continents. "Our technology travels the world," she said. "Our classrooms should reflect that world."

Malvina Latifaj pushed the argument further. Diversity, she argued, is not just a moral value, it is a technical necessity. It prevents blind spots. It exposes biases. It forces us to confront the reality that AI systems trained on narrow datasets are already reinforcing inequalities. "If we don't bring cultural diversity into AI," she warned, "we will build systems that discriminate, and people will trust them anyway, simply because most users don't understand how these systems are trained or how biased data directly shapes their outputs."

Matthew Grech-Sollars grounded the issue in personal experience. As a migrant himself, he spoke about how inclusion shapes a person's ability to thrive. "When people feel they belong, they contribute more," he said. "When they don't, the whole institution loses something." Diversity, for him, was not only about fair algorithms but also about human well-being.

Question 3: *What about language barriers: how do you stay open without losing your identity?*

Letizia Jaccheri explained that Norway faces the same tension as Estonia or other European countries. Many newcomers never learn the language, yet key communication still happens in Norwegian. "If universities stop using Norwegian," she said, "the language dies. But if we insist on Norwegian, newcomers feel shut out." It is, she admitted, "the one-million-dollar dilemma."

Malvina Latfaj described a similar challenge in Sweden. Most Master's programmes are taught in English, but Swedish still anchors identity and local life. For that reason, she noted, efforts to encourage staff to learn Swedish have increased in recent years. She recalled that, more recently, staff across the institution were made aware that learning Swedish was now expected. "In Sweden, nothing is mandatory, only recommended," she said with a smile. "But suddenly, this recommendation felt stronger than usual." She argued for a softer transition: connect language requirements to responsibilities, not edicts.

Matthew Grech-Sollars considered that inclusion work is inherently imperfect. "Every attempt to include someone risks excluding someone else," he said. Language is simply one of the clearest examples.

Question 4: *How do you handle learning disabilities in such demanding fields?*

Matthew Grech-Sollars admitted this is one of the hardest challenges. Accommodations like extra time are manageable, but some requirements, such as mathematical literacy in AI, cannot be removed. Disability inclusion, he said, remains the least developed area, partly because needs are so diverse.

Letizia Jaccheri offered a reframing: what if disability could be seen not as a limitation, but as a kind of superpower? She spoke of neurodivergent students who excel in statistics or testing but struggle with communication, skills that can beautifully complement those of other team members. "We don't all need to be good at everything," she said. "We need to be good together."

Malvina Latifaj linked the discussion to equity. Equality gives everyone the same help; equity gives people the help they actually need. She emphasised that universities must accept tailored support, especially in small institutions like hers, where exposure to disabilities varies. She also drew a parallel to gender initiatives: men sometimes might feel excluded, but only because they are experiencing, briefly, what women have faced for decades.

As the panel drew to a close, the speakers returned to a central theme that had surfaced repeatedly throughout the discussion: diversity and inclusion cannot be reduced to policy statements or isolated interventions. Instead, they emerge from a sustained, collective effort to understand and respond to the complex realities of academic communities.

Letizia Jaccheri noted that the panel had successfully foregrounded other forms of marginalisation, such as disability, migration, age, and cultural background, which complicate the notion of disadvantage. Progress, she argued, depends not only on implementing targeted

measures but also on communicating their rationale clearly enough that communities understand why differentiated support is essential for fairness.

Building on this idea, **Malvina Latifaj** reflected on the structural and cultural conditions necessary for inclusion to thrive. Formal roles, such as deans, EDI officers, or heads of division, are important, but insufficient on their own. Inclusion, in her view, is primarily enacted within the everyday spaces where students and staff interact: research groups, laboratories, classrooms, and informal mentoring relationships. She argued that responsibility for inclusion must therefore be distributed across all members of the academic ecosystem, not concentrated in a small number of designated leaders. Without this shared ownership, institutions cannot build genuine trust in their commitments.

Matthew Grech-Sollars argued that academic training often prioritises disciplinary expertise while neglecting the development of interpersonal and ethical competencies that underpin responsible citizenship within scholarly communities. To address this gap, his department has begun integrating content on microaggressions, inclusion, and intergroup dynamics into the curriculum. Teaching students how to recognise and navigate these issues, he suggested, is essential for cultivating a more reflective, compassionate academic culture.

Taken together, the panel's final thoughts reinforced a shared conclusion:

that diversity and inclusion are collective, evolving practices rather than fixed outcomes. They require not only structures and resources, but also ongoing dialogue, mutual accountability, and the willingness of individuals at all levels to engage with uncomfortable questions. The speakers' reflections positioned inclusion as both a systemic responsibility and a deeply human endeavour—one that must be nurtured through everyday interactions, continual learning, and a commitment to equitable participation within the academic community.

*Contribution by the Erasmus+ Inclusion4EU **project**, with Informatics Europe as one of the project partners.*

Inclusion4EU: Co-Design for Inclusion in Software Development Design

Inclusion4EU Consortium

The Inclusion4EU project (www.inclusion4eu.eu) has recently come to an end, and the partnership is delighted to share its achievements, outcomes, and resources developed to support Informatics lecturers and professionals across Europe.

Inclusion4EU is an Erasmus+ project involving Technological University Dublin (project lead), Télécom SudParis, Mälardalens University, Saint John of God Community Services, SAP, and Informatics Europe. The project ran for three years, starting in December 2023, bringing together higher education institutions, industry, and community organisations around a shared goal: making inclusive and universal design and co-design an integral part of how technology is taught, designed, and developed.

Why Inclusion4EU?

We began this project with a clear understanding of a paradox that defines our digital age. While the pace of technological innovation continues to accelerate, not all individuals and groups benefit equally from these advances. Some are left behind, not because technology cannot include them, but because it often isn't designed with them in mind.

People with disabilities, in particular, still lag in access to computers and digital services. Inclusive technology for people with disabilities requires a diversified and thoughtful approach that considers physical, cognitive, mental, and emotional interactions with technology, alongside ethical, privacy, and safety implications.

We firmly believed that co-design methodology could be used to make technology more accessible and equitable for all. Our strategy was to tackle the challenge from two complementary perspectives:

the classroom, where future technologists are educated, and the software development processes, supported by one of the world's largest IT multinationals, SAP.

Working Across Education and Industry

On the education side, we created a set of resources and activities aimed at supporting Informatics lecturers and upskilling staff in our partner institutions. These resources help educators apply co-design methodologies in their classrooms, fostering cohorts of graduates who are trained to listen to the lived experiences of people with disabilities and to understand their unique needs and preferences.

On the industry side, we collaborated closely with SAP to organise activities that helped staff better understand where and how inclusive design can be embedded within internal development processes. This dual approach allowed us to explore inclusive design not only as a pedagogical topic, but as a practical, organisational practice.

Research as a Starting Point

Our journey began with research. Our work began with research. In *The Dark Side of Design*, we examined how software systems and organisational practices can unintentionally become exclusionary, while *The Bright Side of Design* highlighted the benefits of inclusive design and showcased examples of good practice, demonstrating its value beyond ethical or legal compliance.

To understand how inclusive design is taught in Informatics programmes across Europe, we conducted a survey in early 2024 involving 35

universities from 22 countries. The results were revealing. While awareness of inclusive design is growing, its implementation remains uneven: half of the institutions surveyed had not integrated it into their curricula, citing barriers such as curriculum overload and lack of expertise. Even where it is taught, students often receive fewer than five hours of instruction per semester.

These findings are collected in three dedicated research reports, all available for consultation and download in the research section of our website.

From Research to Action: Co-Design at the Core

Having identified the gap, our response was clear: make universal design and co-design easier to understand, teach, and apply in practice. To achieve this, we developed a set of tools and resources grounded in co-design methodologies.

Through a series of co-design sessions with underrepresented groups, educators, students, and industry practitioners, we created resources that enable organisations and lecturers to meaningfully embed co-design in their work. Sessions involved older adults, Computer Science students and lecturers, academic staff, and industry professionals from SAP.

While each session brought different perspectives, they all reinforced the same message: inclusive design is most effective when people are genuinely involved in the process, not simply consulted.
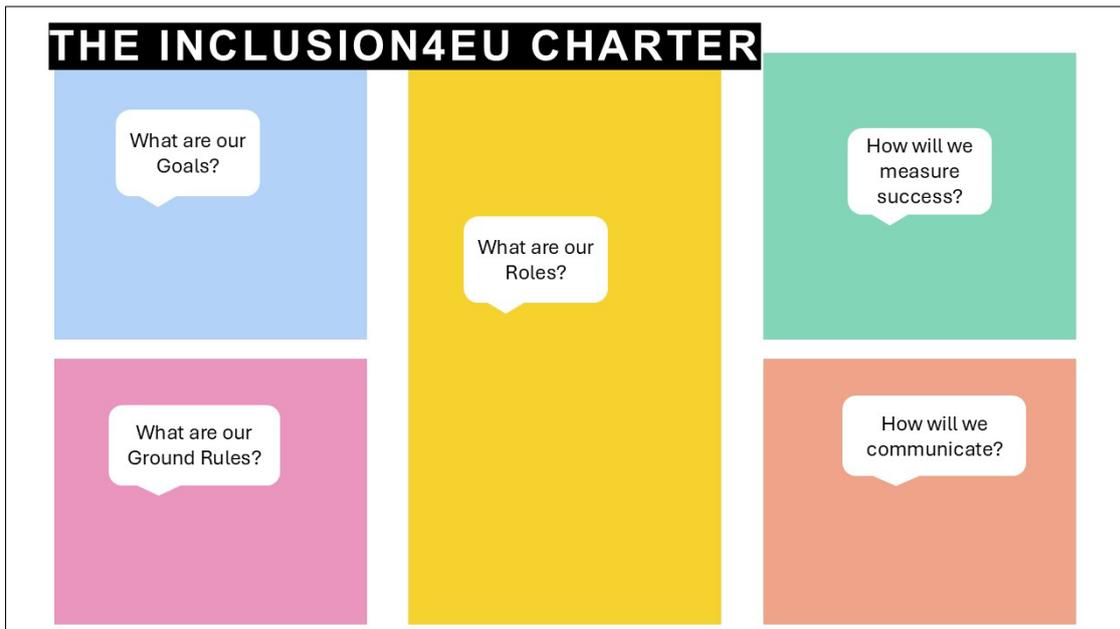

One of Inclusion4EU's Co-Design Sessions.

Resources and the Inclusion4EU Charter

All project resources are available for consultation and download in the resources section of our website. At the heart of these outputs is the Inclusion4EU Charter, the core resource developed through our investigation.

The Charter is a practical tool designed to support the planning and facilitation of co-design sessions. It functions as a comprehensive environment to collect outputs across all stages of co-design, from discovery and ideation to prototyping and evaluation.

A frame from the Inclusion4EU Charter.

Training and Capacity Building

We also delivered two training programmes to upskill academic staff in running co-design sessions. Asynchronous materials from this training will soon be available on the website. In addition, we ran a dedicated training programme for training professionals, involving co-designers from TU Dublin and Saint John of God Community Services.

Feedback from participants was overwhelmingly positive. One participant noted, "The Charter provided a very helpful map of what we were to work on, when to work on which piece, and in which order - it gave us a clear target." Another reflected, "I was surprised by how much more co-design can bring to both designers and co-designers. Even though I work with Universal Design, this is something special." Perhaps most tellingly, one participant shared, "I always thought of design as design-for, not design-with, and this changed my view."

That shift in perspective is, in many ways, the project's greatest success.

A photo from the 2025 training course.

Looking Ahead

Many people contributed to the success of Inclusion4EU, but above all, it was the sustained participation of co-designers throughout all stages of the project that made it truly inclusive and impactful. For this, we extend our deepest thanks to all co-designers involved.

The partnership plans to continue its work by implementing at least one co-design training session per year, so we encourage you to keep an eye on the website for upcoming events. More broadly, we hope you will use the Inclusion4EU website to stay informed, download resources, and—if you wish—upload your own.

You can contact us at any time or share your thoughts through our LinkedIn page. We hope our work will inspire you to bring co-design methodologies into your classes, institutions, organisations, and perhaps even into how you see technology in everyday life. After all, inclusion works best when everyone has a seat at the table and a say in how the chairs are designed.

Open Science in Theory and Practice

John Crowley (PHGD Group)

The idea of "open science" has become a central reference for science policy both globally and specifically in the European Union. It's hard to object to something being open when the alternative is for it to be in some sense "closed", especially when that alternative remains largely implicit. And yet, practical enthusiasm for open science doesn't always match its aspirational attractiveness, and scepticism is by no means limited to those with a vested economic interest in specific forms of closure, e.g. with respect to publications.

This suggests that open science practices, and the institutional frameworks within which they are set, deserve more detailed attention than they sometimes receive. This was the point of the recently completed Horizon Europe OPUS project (https://opusproject.eu/), which looked in detail at some of the issues in embedding open science within routine practices. A major focus of the project was on researcher assessment: if people are supposed to be engaging in open science, then how does their engagement (or lack of it) affect how they are assessed by the various institutions they relate to? In addition, a specific strand of work within OPUS was devoted to trust issues in open science, and specifically to trust barriers to open science engagement. This is the strand I was responsible for, working with Pierre Winicki, who's my business partner in PHGD Group affiliate TrustInside.

So, what is the "closed science" that needs to be opened up? In fairly general terms, this is quite easy to state. Science is "closed":

a. when it's separate from political, social and cultural dynamics, i.e. operates according to its own internal logic—science defined, run and assessed by scientists;

b. when within scientific communities it is closed by institutional barriers and habits of gatekeeping, broadly understood, incorporating preconditions for access to agenda-setting, to data, to publications, etc.

It will be noted that these characteristics aren't obviously "bad". In fact, they have been central to the definition and institutional organisation of science as a distinctive realm of social activity – to what makes science science.i Nonetheless, the view that opening up closed science is desirable builds on three considerations:

a. closed science entrenches inequalities in both access and benefit sharing, contrary to the aspiration expressed in article 27 of the Universal Declaration of Human Rights;

b. closed science hinders desirable epistemic transformations, e.g. towards transdisciplinarity;

c. closed science limits social responsiveness and responsibility, an issue given particular prominence by scandals or controversies in the 1980s and 90s stemming from the closure of technoscience (nuclear risk, HIV contamination in blood transfusion systems, bovine spongiform encephalopathy, genetically modified organisms, etc.). In a word, closed science creates specific trust issues.

This normative lineage is clearly visible in the definitions adopted in international instruments promoting open science. Thus, UNESCO's 2021 Recommendation on Open Science states:

Open science is about making sure not only that scientific knowledge is accessible but also that the production of that knowledge itself is inclusive, equitable and sustainable. (…) Open science has the potential of making the scientific process more transparent, inclusive and democratic.

Other versions of open science differ as to details, but the general thrust is the same.

Which leads to the question: do open science practices, in real-world conditions, produce the benefits to be expected from more open science? If not, what are the barriers, the unforeseen side effects, the structural biases? For the purposes of this brief overview, four specific questions deserve mention.

1. Does opening science increase trust?

The answer seems to be: not necessarily. Contemporary patterns of politicisation of science—of which climate science, virology, and many aspects of environmental science are exemplary—appear, in a specific political climate, to feed on openness. Perhaps this can be understood in terms of Bismarck's metaphor of the sausage factory: the more one knows about the processes by which science is produced, the less one can trust the product. At the very least, opening up scientific processes to lay examination depends on significant public understanding of why science is done the way it is.

The work done in OPUS also points to an additional issue. There are trust issues within science communities, exemplified by issues relating to data sharing as well as to concerns about misalignment between the various kinds of incentives embedded in assessment and evaluation.

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i A central topic in 20th century sociology of science, e.g. Pierre Bourdieu, *Science de la science et réflexivité* (Paris: Raisons d'agir, 2001), borrowing explicitly from Robert K. Merton, *The*

2. Does opening science increase social responsiveness and responsibility?

It's a fairly new agenda, so the evidence is inconclusive. But while increased stakeholder involvement in science probably does promote greater responsiveness to social demands, those demands may be highly biased in terms of an equitable assessment of social needs, which is what the human rights principle of benefit sharing logically demands. The connection between responsiveness and responsibility depends on a public culture of science that is compatible with openness, but not logically entailed by it.

3. Does open science limit political or corporate interference?

Hard to say on current evidence. Openness of protocols, data, review processes, etc., can, at least in highly politicised areas of science, have the effect of—or be weaponised towards—undermining scientific authority in its traditional forms, without replacing it by any functional alternative.

4. Does open science reduce scientific inequalities?

It's clearly too early to say. But there is a legitimate concern that more open science will tend to restrict participation in the scientific process while broadening the distribution of its benefits—by analogy with the way in which open access publishing, seen from developing countries, can make it easier to read and harder to publish.

In other words, no doubt unsurprisingly, there are still big gaps between the principles of open science and the practical mechanisms designed to achieve it.

Sociology of Science: Theoretical and Empirical Investigations (Chicago: University of Chicago Press, 1973).

Contribution by Dristi Yadav, PhD graduate of the [Faculty of Informatics](#), TU Wien (Austria), runner-up of the [IE Best Dissertation Award 2025](#).

Shaping Future Researchers: Lessons from My PhD Journey

Drishti Yadav (SnT, University of Luxembourg)

My PhD journey did not begin with a perfectly defined plan. It began with curiosity, a sense of purpose, and a willingness to leap into the unknown. Looking back, the most meaningful parts of my research experience were not the perfectly structured milestones but the unexpected moments that shaped me as a researcher and as a person.

My journey began in India, where I completed my Bachelor's degree in Electrical and Electronics Engineering at CSVTU, Bhilai, followed by a Master's in Control and Instrumentation Engineering at Dr B R Ambedkar National Institute of Technology, Jalandhar. Each academic step introduced me to new ideas—from control theory to automation—and I gradually found myself drawn toward the growing intersection of software, systems and safety. Moving from India to Europe to begin my PhD at TU Wien, Austria, was the biggest turning point. It was a 180-degree shift in every sense: culture, academic environment, research expectations, the rhythm of daily life, and even the food (yes!). I arrived in Vienna in October 2020 at the peak of the pandemic, a time when the world felt uncertain and strangely quiet. Navigating a new life during such an unusual time was challenging, but it also built resilience, independence and adaptability much faster than I expected. Every move—every new city, every new lab, every new cultural shift—added something meaningful. It shaped how I think as a researcher, how I collaborate, and how I build connections across different communities.

A few words about my PhD work. My focus was on improving how we test and verify safety-critical cyber-physical systems (CPS)—systems like autonomous vehicles and medical devices. These systems interact with the physical world and must operate safely in real time. My research combined software engineering and formal verification, exploring ways to diagnose faults early and design more effective fault-based testing techniques. In essence, I worked on methods that help uncover system failures before they manifest in the real world. What I loved about this topic was its intersection of theory and practice: it required both mathematical rigour and an understanding of real-world system behaviour. The more I engaged with this problem, the more I realised that safety in CPS is not just a technical objective. It directly affects human lives, which made the work deeply meaningful to me.

Looking back, one of the biggest reasons I was able to grow during my PhD was the mentorship and collaboration I received. I was fortunate to work with Prof. Ezio Bartocci (Professor, TU Wien, Austria), who was my PhD advisor, as well as Dr Dejan Nickovic (Senior Scientist, AIT Austrian Institute of Technology, Austria) and Prof. Leonardo Mariani (Professor, University of Milano-Bicocca, Italy). They encouraged my curiosity, supported me through difficult phases, and challenged me to refine my ideas. I also had the opportunity to spend three months at Prof. Mariani's lab in Milan, thanks to the KUWI Grant from TU Wien. This opportunity enriched my research, strengthened collaboration, and taught me the value of stepping into new environments to see ideas from different angles. The people you work with truly shape your PhD more than any

other factor, and I remain grateful to my supervisor and mentors every day.

Another essential part of my journey was the role of community. Networking and engagement with the broader research world shaped my PhD in ways I could not have imagined at the beginning. Conferences, workshops, and summer schools were never only about presenting a paper or volunteering. They were about meeting people, exchanging ideas, discovering how others approached similar problems, and building relationships that outlasted the event. Attending SRDS 2022, ISSRE 2022, ESEC/FSE 2022, ICST 2023, ISSTA 2024, and SCHIER 2024 gave me the chance to share my work, receive feedback that strengthened my thinking, and find people who inspired me. These experiences made me more confident, broadened my perspective, and helped me understand the global landscape of my research area. And beyond the academic side, one of the joys of being a researcher is everything that comes with travel: discovering new cities, learning new cultures, walking through unfamiliar streets, experiencing local traditions and tasting new cuisines. Those experiences made the journey richer, more memorable, and a lot more fun.

Drishti Yadav at the ECSS 2025 Leaders Workshop "Shaping Future Leaders: Lessons from Recent Doctorates", reflecting on extra-curricular experiences, including her participation in IE's Summer School on Informatics Education Research 2024.

Of course, no PhD journey moves in a straight line. The reality is often far from the idealised version we imagine at the beginning. One of the hardest moments for me was when my first paper was rejected after months of dedicated work. I was heartbroken. But with the support and encouragement of my mentors, I looked at the reviews, refined the work, and resubmitted it. Eventually, it was accepted. That moment taught me something I will carry throughout my career: *Rejections do not define you; they redirect you*. Ups and downs will come, but consistency and belief in your work make the difference. I also realised that persistence alone is not enough. What helped me just as much was communication. Talking openly with colleagues, friends, supervisor and mentors relieved the pressure and gave me clarity. Equally important was taking breaks and giving time to myself and the people I care about. Time with family and friends—even through phone calls in difficult moments—reminded me that research challenges are only one part of life. What matters is not avoiding obstacles but learning to move through them, one step at a time, trusting that the process will eventually make sense.

A PhD is not only about research. It is about personal growth. Over the years, I learned leadership skills, clearer communication, and even something I call "smart procrastination". Not every moment needs intense focus. Sometimes a small pause allows ideas to mature in the background. Stepping away from a problem often helps you see it from a new angle. These small resets prevent burnout and keep creativity alive. I also learned the importance of self-care and balance. For me, that came through painting, singing, hiking, and even skydiving—yes, really. Joy outside of research energised me to return to my work with new clarity. Whatever the activity may be, finding something that keeps you grounded and happy makes the PhD journey more sustainable.

If I could tell my first-year PhD self one thing, it would be this: *Trust the process and enjoy the journey*. Every setback is a setup for growth. Find mentors who lift you up. Build and nurture your network. Stay consistent and committed. Celebrate yourself, because you are your strongest ally. Research is filled with uncertainties, but it is also filled with moments of discovery, connection and transformation.

As I reflect on the years behind me, I see a path that was anything but smooth, but one that taught me more than I expected. I have learned that courage often looks like showing up again the next day a little wiser, a little steadier and a lot more determined. I am grateful to my mentors, colleagues, friends and family, as well as to everyone shaping the next generation of researchers. I am also grateful to myself for never giving up.

For enquiries and feedback about this publication,
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