

University of St Andrews School of Computer Science



Strategic Plan 2021—2026

The School of Computer Science is a world-class, collegial community of staff and students. We emphasise research-led teaching and interdisciplinary research, benefitting from the other world-class schools in the arts and sciences at St Andrews. Our teaching and research have an outstanding reputation: in 2021 we ranked first in our discipline in the National Student Survey (with a 96.6% satisfaction rate), as well as the Guardian and Times and Sunday Times Good University Guides.

We aspire to be the best place to study and conduct research in computer science. Our progress towards this goal is illustrated by our recent and sustained successes outlined above. Our plans to cement and further this progress over the coming years are presented below.

Community and Diversity

One of our distinctive features as a School is our strong sense of community. We have fostered a collegial, collaborative community of staff and students, where interaction and collaboration are actively encouraged at all levels. This is supported both by our physical estate, with research students' offices interleaved with those of staff and a single common area for students and staff, and our enthusiastic participation in schemes such as the hugely popular St Andrews Research Internship Scheme, which allows students at all levels to collaborate with staff in their research, and which the School supports directly by funding numerous internships in addition to those funded by the University.

Our staff are a diverse group of highly able individuals, and we have a diverse student body with one of the best gender balances (25–30% female) for computer science in the world. The School's commitment to advancing gender equality has been recognised by an Athena SWAN Bronze award. Following our action plan from this award we have introduced mechanisms to monitor staff recruitment and development, and support measures to counteract historical, unconscious or institutional biases. These include checks and adjustments in our recruitment processes, such as the language used in job advertisements; on duty allocation; before, during or after parental leave; and ahead of the annual promotion round. In planning our Distinguished Lecture Series and School seminars diversity is explicitly considered.

Our active outreach programme for schools spreads the excitement of computer science to a broader range of social groups. Its success is reflected in our relatively high number of SIMD Q1 and Q2 Scottish students. The programme includes several week-long summer residences where students attend research-based lectures, labs, and other activities. Examples include events with the Sutton Trust as part of the University's agenda for widening participation; Science Summer Schools organised as part of the University Summer Access Experience courses; and First Chances, where local school pupils are supported in their literacy, numeracy and IT skills throughout the academic year, culminating in a residential summer school. The School also hosts day visits from local schools themed around topics such as the development of computing technology or the connection between computer science and video games. Codefirst:girls is very popular, with many instructors from our student body. The School provides space, competition judges and prizes, and St Andrews was the first university to include this course on student transcripts. We supported the creation of a RoboGals chapter in St Andrews, providing advice, guidance and equipment.

Our priorities over the next five years are as follows:

- To preserve our diverse, collegial and collaborative community as our student body and staff complement grow.
- To strengthen our commitment to equality and diversity, and apply for an Athena SWAN Silver award.

- To continue our investment in the St Andrews Research Internship Scheme, fostering collaboration between students and staff.
- To expand our outreach programme to attract a wide range of students.

Teaching

The success of our taught programmes at both undergraduate and postgraduate level is very well recognised. We attract an amazing cohort of students every year, with intense competition for places: their ability and enthusiasm are one of our strongest assets.

Our programme ensures that students learn the principles of the areas they study, and have access to all the latest technologies and approaches in these areas, without the technology becoming dominant in itself. The goal is to provide a basis in theory and principle such that students can then learn *with* the technologies as they emerge, as well as being well-positioned to contribute to the future development of these technologies. We focus on the *practice* of computer science: all our teaching revolves around knowledge being made useful and applicable in building real systems.

Our students are also key to our research, with both undergraduate and postgraduate students engaged with the research of all our groups. Through our strong research culture, we are better able to maintain the freshness and relevance of our teaching programme while keeping it grounded in the core knowledge of computer science that remains relevant across changes in technology. Theory informs practice and *vice versa*, but we never teach one without maintaining a view to the other.

Our priorities over the next five years are as follows:

- To grow our student body carefully at both undergraduate and taught postgraduate levels, with a concomitant growth in our staff complement and estate.
- To maintain our engaged teaching approach, including extensive small-group and experiential lab-based teaching at sub-honours, and challenging practical exercises across the programme.
- To preserve our students' independence and the opportunities we afford them to engage in research, practical projects, and other activities.
- To strengthen the connection between our research and our teaching in order to ensure that our students are grounded in the latest developments in the field.

Research and Impact

Research excellence, for us, means both discovering new knowledge and refining the ways in which new knowledge is discovered – and then imparting both to our students and colleagues. We operate at the leading edge of computer science research and teaching, and seek to advance these boundaries both within the core of the discipline and in relation to other disciplines with whom we can collaborate. We are known for our world-leading research in several areas:

- **Artificial intelligence.** Computational algebra; computational argumentation; decision-making and optimisation via constraint programming and propositional satisfiability; intelligent intrusion detection in cybersecurity; image processing; responsible and legal AI
- **Computer systems.** Cloud computing; data analytics, integration, and linkage; middleware; networking, distributed and autonomic systems; software engineering; wireless and sensor networks
- **Health informatics.** AI in precision therapeutics; computational models of cancer treatment and infectious diseases; software for medical devices and data analytics.

- **Human-computer interaction.** Distributed learning environments; input and output technologies; intelligent interactive systems; natural language processing; pervasive and ubiquitous computing; privacy; visualization; virtual reality
- **Programming language technology.** Compiler technology; functional programming; parallel/concurrent systems; generative programming; language design; type systems
- **Research software engineering.** Software carpentry; researcher training; software citation; reproducible computational science.

Our research is supported by grants from a range of agencies, including at Scottish, UK, and EU levels, as well as from charities and direct commercial contracts. We have a strong cohort of PhD students working within St Andrews, and a growing cohort of EngD students working directly in industry under joint supervision. Our computational and storage facilities are upgraded on a rolling five-year cycle to ensure we can perform our research without technical constraints. These are augmented by specialist facilities including a next-generation IPv6 network test-bed, extensive arrangements for user testing, and most recently a small “fab lab” for prototyping and physical interfaces.

We recognise research in our field can have impact on the wider world through a variety of pathways. Software developed here has been incorporated in industrial practice and commercially-licensed products; we develop and maintain several open-source packages (including the world-leading computer algebra tool GAP); we have advised international standardisation bodies (IETF, ISO, RISC-V); and techniques developed here have been deployed in many public-facing contexts in Scotland and in wider world (in NHS hospitals, in museums and cultural centres). Our students have created multiple startups, and our staff have been involved with spin-outs.

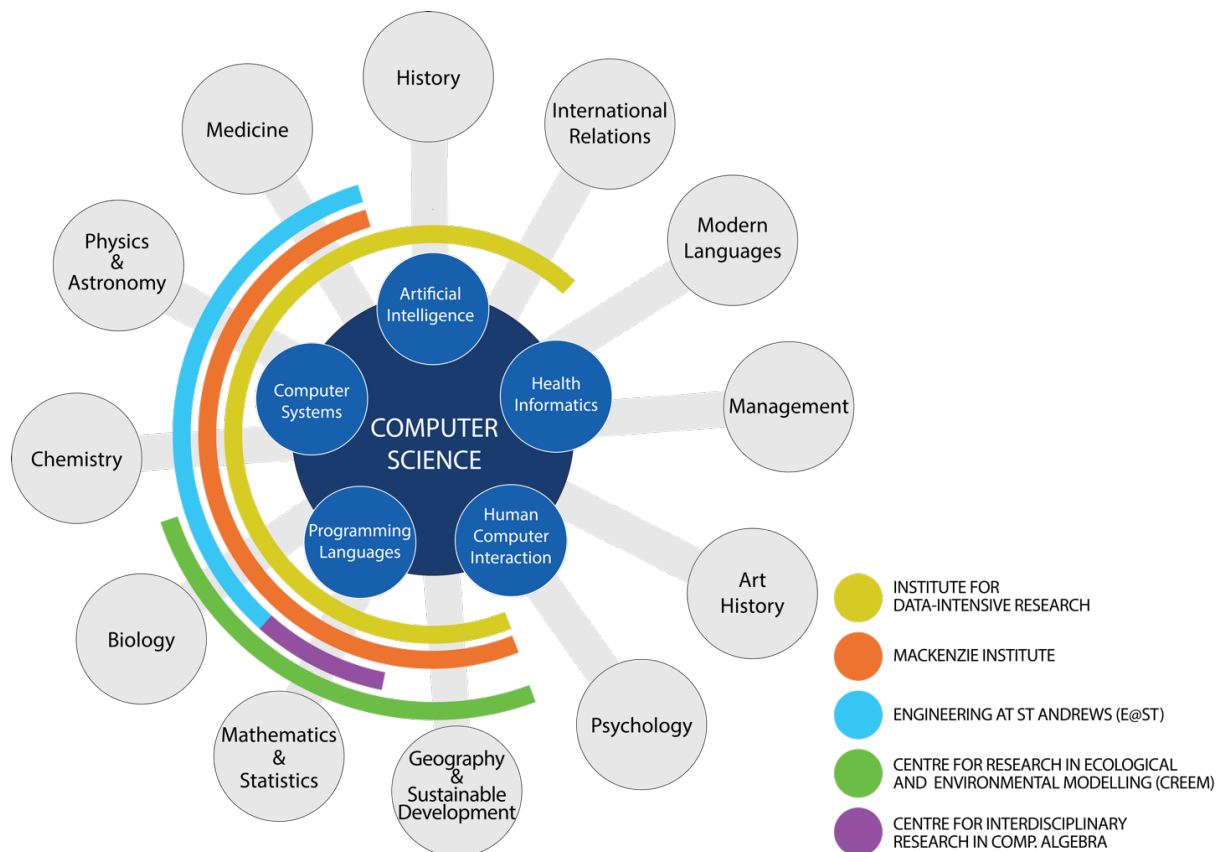
Our priorities over the next five years are as follows:

- To increase our grant income and to diversify our funding streams, for example by increasing the number of our staff holding personal fellowships.
- To pursue more “prestige” grants that have value well beyond their funding.
- To maintain our commitment to science, to the pursuit of curiosity-driven research, regardless of its funding potential or scale.
- To maintain our focus on the practice of computer science, where the vast majority of our research results in software embodying our ideas.
- To balance the recruitment of new staff into our existing areas of strength with an openness to appointing excellent new staff members from across the discipline, allowing us to exploit new or speculative opportunities as they arise.
- As our staff complement grows, to preserve our flat management and loose research group structure that minimises the tendency to “silo” staff.
- To grow our cohorts of PhD and EngD students to leverage the strengths that each brings to our activities.
- Aided by an increased grant income, to continue to invest in specialist facilities to support current trends in the work of both staff and students. For example, in provisioning GPU-accelerated compute facilities with high GPU core-counts and VRAM capacity, which are increasingly in demand in both student and staff work.
- To continue to support our staff and students in finding the best pathways to impact for their work.

Collaboration and Interdisciplinarity

We are engaged in the leadership of a number of University-wide inter-disciplinary initiatives:

- The Centre for Interdisciplinary Research in Computer Algebra (CIRCA), in which we maintain GAP, the world-leading software tool for computer-assisted group theory.
- The Centre for Research in Ecological and Environmental Modelling (CREEM), where we are working to develop machine learning techniques targeting ecological questions.
- The Mackenzie Institute for Early Diagnosis, to which we contribute expertise in imaging, machine learning, and care pathway modelling.
- Engineering at St Andrews (E@ST), where research software engineering is helping to improve the ways in which software is integrated into scientific instrumentation and the built environment.
- Eden campus, where we are helping develop the plans for prototyping and other large-scale facilities.



Each of these initiatives provides new research questions, new teaching opportunities, and new potential collaborations beyond the University. By adding our expertise to broader pools of strength we aim to leverage a broader network of contacts and routes to impact.

We collaborate internationally across the globe, with particular links within Europe and North America, and including with both academic and industrial partners. We act as members (and leaders) of research consortia, and as partners in study-abroad and co-tutelle arrangements that give our students the opportunity to gain an international perspective as part of their studies.

Our priorities over the next five years are as follows:

- To maintain and strengthen our existing inter-disciplinary links within St Andrews.
- To forge new interdisciplinary links across the University, particularly with the arts.
- To expand our international collaborations, both academic and with industrial partners.



Map of Academic (blue/circle) and Industrial (red/'i') Collaborators