

Capability Statement

Cybersecurity, AI and ICT

The University of Wollongong (UOW) has an international reputation for the quality of our information communications and technology (ICT) education and research.

UOW has been a leader in cybersecurity and cryptology for almost 31 years and we are also developing innovative technologies and systems in big data and artificial intelligence (AI).

UOW's ICT research and education include: wireless networks; multimedia; cybersecurity; computer security; cryptography; machine learning; computer vision; multiagent systems; natural language processing; speech and audio processing; renewable energy; power system harmonics; pure mathematics; applied statistics; financial mathematics; community informatics; health informatics; social networks; virtual/augmented reality; and game software development.

While this expertise is concentrated in the Faculty of Engineering and Information Sciences, researchers across other faculties are also involved in leading ICT research from all disciplines.

The focus is on four main research themes: cybersecurity and cryptology; artificial intelligence and big data; health informatics; and software engineering.

The expertise, facilities and networks available at our Innovation Campus, combined with education and research at our Institute of Cybersecurity and Cryptology, the Cyber Academy, and the Centre for Artificial Intelligence positions the University as an ideal partner to develop advanced solutions in information communications and technology that will help shape the future of computing and foster skills in the cybersecurity and AI specialist workforce.

CYBERSECURITY AND CRYPTOLOGY

UOW is a nexus between government, industry and academia in the development, dissemination and application of innovative cybersecurity techniques. As a thought leader in the technical and regulatory fields of cybersecurity, UOW is well placed to provide leadership in helping to enhance cybersecurity systems across Australia.

The point of difference in UOW's cybersecurity education is that we have solid foundations in cryptology. This means we are uniquely providing a holistic delivery of education that combines cryptology and applied cybersecurity. Importantly, students gain hands-on experience in addition to theoretical learning.

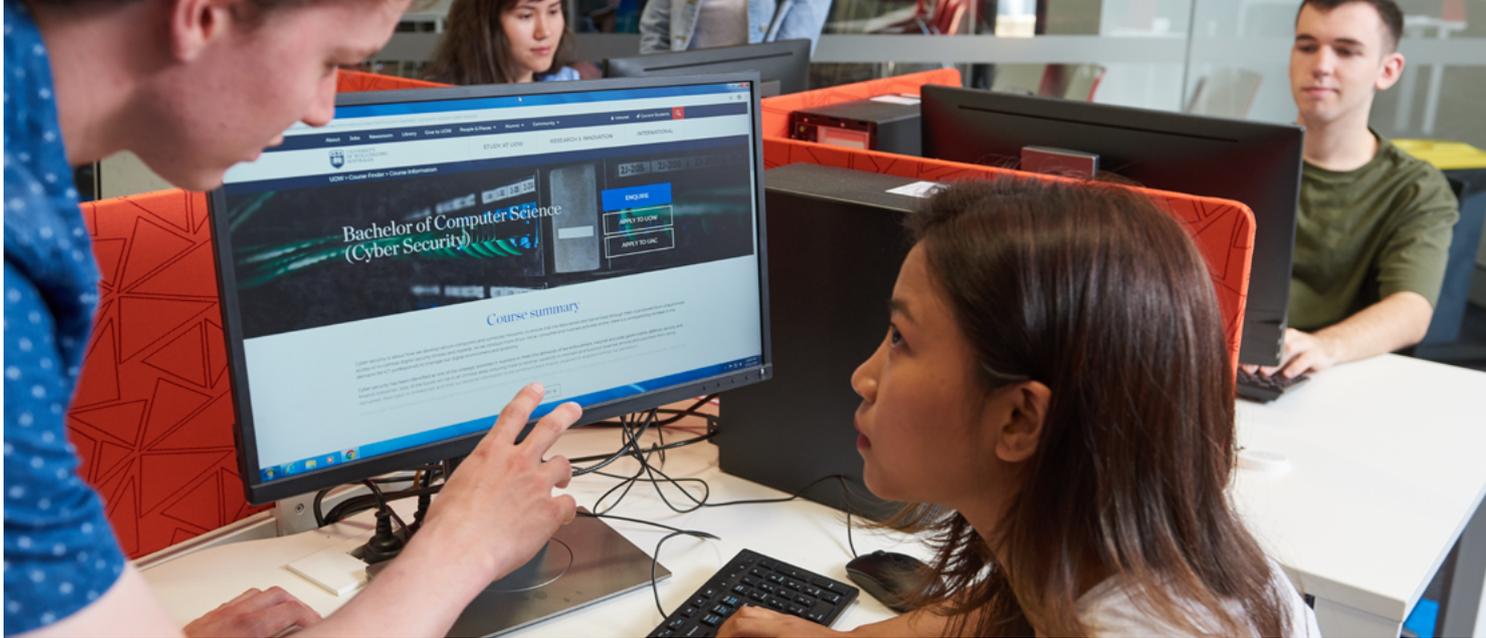
UOW's Institute of Cybersecurity and Cryptology (iC²) is one of the leading security research centres in Australia. The iC² – within UOW's School of Computing and Information Technology – specialises in teaching secure cloud technology, blockchain and IoT. The centre's staff and PhD students form a highly motivated team from diverse backgrounds with expertise in various aspects of cybersecurity and cryptology. In 2019 and 2022, the centre was named as the Field Leading Institution in Computer Security and Cryptography.

Research areas of the iC² include information security, cybersecurity, computer and network security, digital signature, encryption, anonymity, cloud and edge security, wireless and mobile security, cryptographic algorithms and protocols, blockchain, multimedia security, quantum cryptography, and post-quantum cryptography.

UOW is one of the founding universities of the NSW Cybersecurity Innovation Node and has worked closely with entities such as the Department of Prime Minister and Cabinet, the Australian Signals Directorate (ASD), the Defence Science and Technology Group (part of Australia's Department of Defence), and the Cybersecurity Growth Network (AustCyber). The University is engaged with Data61 (CSIRO) on projects that focus on IoT security, blockchain, post-quantum cryptography, and AI-driven cybersecurity to improve and extend Australia's cybersecurity capabilities.

Researchers at UOW are helping to enhance the cybersecurity and cryptology capabilities of the Australian Defence Force. Furthermore, they work collaboratively on several commercial research projects in the banking sectors and with small and medium-sized enterprises (SMEs).

UOW has been successful in gaining funding for the following projects to support state and federal government cybersecurity strategies: secure and dynamic access control



over encrypted data in the cloud; design and deployment of practical anonymous access systems; enabling anonymity and privacy for blockchain technology in a quantum world; and securing public cloud storage with protection against malicious senders.

CYBER TALENT PIPELINE

UOW is involved in an innovative new program that is paving the way for a new generation of cybersecurity professionals. The Cyber Academy is a partnership between UOW, Deloitte, TAFE NSW and Swinburne University of Technology. This program has been designed to help address Australia's critical cyber skills shortage by providing an opportunity for improved collaboration between industry and education to build a pipeline of skilled professionals for the future. It will fast track students' careers in the cybersecurity sector, by combining nationally recognised qualifications with on-the-job training and mentorship, and a three-year paid work placement. Students are placed in cyber roles with a broad range of government and private industry partners to ensure academic programs are fit-for-purpose and graduates gain the best skills and knowledge for the workforce.

Graduates will emerge with a Diploma of Information Technology (Cybersecurity) from TAFE NSW and a Bachelor of Computer Science (Cybersecurity) from UOW. UOW College Australia's Diploma of Technology is a pathway to our undergraduate programs in Computer Science, Data Science and Analytics and Information Technology.

RESEARCH AND COLLABORATION

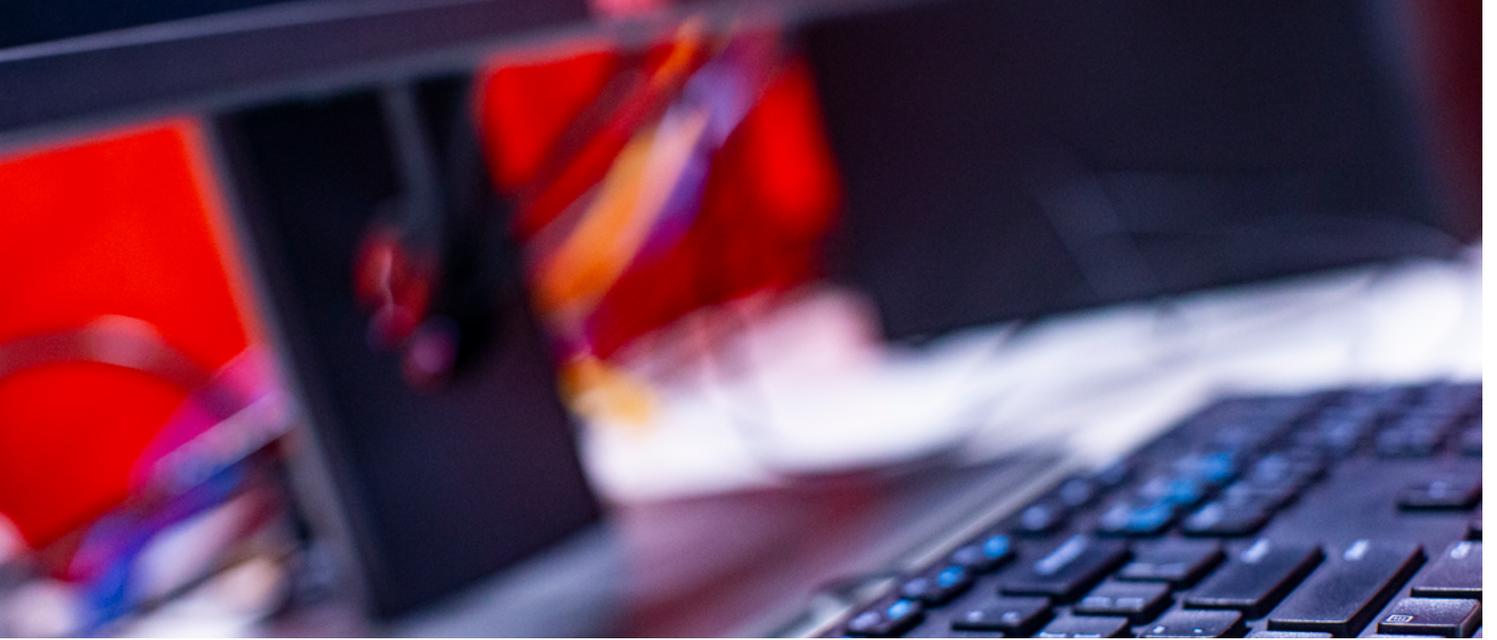
The iC² has been instrumental in contributing towards the world standard for encryption used to secure wireless technology and is the initiator of the prestigious annual International Conference on the Theory and Application of Cryptology and Information Security (Asiacrypt). Its results are widely cited and applied in practice, with continuous funding received from the Australian Research Council, the US National Institute of Standards and Technology (NIST) and industry partners such as DSD, DST Group and Microsoft.

The Director of the iC², Distinguished Professor Willy Susilo, is an internationally recognised research leader and expert in post-quantum cryptography and cybersecurity. Researchers engage with the Illawarra Shoalhaven Local Health District (using machine learning as a visual tool to assist cancer management), CSIRO's DATA 61 (transferring deep learning with applications to smart infrastructure and visual data; enhancing IoT security with blockchain technology), the NSW State Emergency Service, the NSW Defence Innovation Network, and the NSW Electoral Commission (on verifying iVote results), among others.

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Since 2012, research collaborations in quantum cybersecurity between Sorbonne University in France and UOW have focused on building cryptographic protocols and has led to a number of students from Sorbonne pursuing doctorates at UOW.

Researchers at the iC² also work with UOW's SMART Infrastructure Facility to help guide security within the IoT network, while working within UOW's Faculty of Engineering and Information Sciences to ensure ethical and societal implications of future technologies are considered.



ARTIFICIAL INTELLIGENCE

The Centre for Artificial Intelligence (CAI) at UOW conducts pioneering research to develop innovative theories and techniques for AI, transferring knowledge and technologies to industry and communities, and providing rigorous teaching and research training in contemporary AI to prepare the specialist workforce of Australia's future digital economy.

The expertise areas of the CAI include: machine learning; deep learning; computer vision; multimedia; natural language processing; autonomous agent and multiple agent systems; graph theory; big data analytics; and distributed artificial intelligence. The CAI has pioneered a number of AI technologies in recent years, including graph neural networks, new machine learning theory and methods, and 3D computer vision and multimedia.

Researchers at the CAI are well-recognised nationally and internationally in machine learning, computer vision and multimedia. Two members of the Centre were ranked among the top 2 per cent of highly-cited scientists in the world in 2022 and 2023 by Stanford University and one member was recognised as Australia's top researcher in multimedia by *The Australian* newspaper in 2022 and 2023. In the past three years, the CAI has won five national competitive grants and five industrial and commercial fundings. The Centre has established strong and sustained collaboration with industries and other leading research organisations, including Data61, Sydney University and Microsoft, in developing innovative AI solutions for the emerging market and services.

We provide a unique holistic delivery of education that combines **cryptology and applied cybersecurity with contemporary artificial intelligence and big data.**

The Centre collaborates closely with researchers from other disciplines such as health, future energy, manufacturing and mining in translating AI technologies into solutions to the emerging challenges in these disciplines through joint supervision of HDR students and industrial projects. In particular, the Centre provides AI consulting services to researchers and HDR students from non-computer science and/or data science disciplines, industries and communities. The CAI also offers an introductory lecture series on contemporary AI, machine learning and deep learning to improve the AI literacy of UOW's communities and to promote and assist industries in improving their products and services using AI.

The Decision Systems Laboratory (DSL) is an interdisciplinary group of academics, postdoctoral researchers and research students drawn from the School of Computing and Information Technology and the SMART Infrastructure Facility at UOW. Work here includes applied AI and significantly supports UOW's collaboration with the University of South Australia (UniSA) in boosting defence industry research. The DSL has pioneered a range of innovative AI applications across clinical, business, supply chain and Defence applications, with funding support from some of the largest global IT companies, including IBM, Xerox, Infosys and DXC, as well as funding bodies in the United States, Canada, Japan and the Australian Research Council.

Researchers at the Centre for Digital Transformation work to better understand and more effectively manage the IT-enabled transformation processes of human society. Key research areas include smart applications and innovation, e-learning and digital health. Meantime, expertise at the Centre for Persuasive Technology and Society extends across information system disciplines such as human-computer interaction. The centre's main research is on design, research and analysis of wearable and embedded systems that will assist individuals, organisations and society.

ICT EDUCATION

ICT degrees at UOW include Computer Science, Information Technology and Business Information Systems with specialisations in cybersecurity, digital systems security, big data, game and mobile development, software engineering, web design and development, network design and management, and business information systems.

All undergraduate ICT degrees are accredited with the Australian Computer Society (ACS). Students can study ICT degrees at UOW's Australian campuses in Wollongong and Liverpool in South Western Sydney, at UOW in Dubai, UOW Malaysia KDU, and with partner program providers at UOW College Hong Kong, Central China Normal University in Wuhan, China, and the Singapore Institute of Management (SIM).

Producing more than 1,000 ICT graduates every year, UOW offers ICT companies and organisations a critical advantage in tapping into future staff recruitment and research. UOW's Master of Information and Communication Technology Advanced is the only degree in Australia to receive the Advanced Professional Accreditation for an ICT course by the Australian Computer Society (ACS). Our on-campus business incubator and accelerator, the iAccelerate Centre, assists ICT students in their final year with industry-sponsored team projects and mentoring in start-ups.

DEFENCE CYBER SYSTEMS

Researchers from UOW's Decision Systems Lab are collaborating across seven research projects to inform Defence of the potential benefits and practical limitations of cyber technologies.

The Autonomic Cyber Resilience and Antifragility project (funded by the Next Generation Technologies Fund – NGTF – scheme) is researching and developing trusted autonomous systems to address the threats presented by ICT and vulnerabilities within cyber systems. The project is a collaboration between UOW, Swinburne University, and governmental and industry bodies, CSIRO Data61, and Defence Science and Technology Group (DSTG).

Another NGTF project - a collaboration between the DSL, the University of South Australia, the University of Adelaide, the Defence Science and Technology Group (DSTG) and CSIRO Data61 - addresses Rapid Situation Awareness using Network Knowledge and AI Reasoning. The outcomes will lead to fast real-time responses to cybersecurity threats.

A third NGTF project is a collaboration between DSL and UniSA and also looks at cybersecurity from a command-and-control (C2) perspective. A series of five major research contracts with DSTG are looking at various aspects of multi-agent systems and goal-reasoning applications in swarm coordination (many involving UxV swarms).

SOFTWARE ENGINEERING

The DSL solves problems in the areas of business process management (specifically process analytics), software analytics, software testing, requirements engineering, service-oriented computing, service science, industrial optimisation, database systems, formal knowledge representation and reasoning and agent technology.

The DSL has a significant profile in clinical informatics, focusing on data mining in radiation oncology and clinical process analytics. DSL Researchers work closely with some of the largest IT companies in the world, including IBM Research, Xerox Research, Infosys Labs and Samsung. DSL has also collaborated in the past with Telstra, SunCorp, BlueScope, Actenum Corp as well as government agencies such as the NSW State Emergency Service.

METAVESE ENERGY RESEARCH LAUNCHES

The School of Computing and Information Technology was recently awarded with an ARC Linkage Infrastructure, Equipment and Faculty (LIEF) grant to develop a secure and green metaverse environment. The project aims to establish a world-class facility for conducting research on metaverse technologies.

"The metaverse is widely anticipated as the next technological breakthrough that will revolutionise the way we interact, learn, work, shop and entertain in the new digital economy," explains Distinguished Professor Willy Susilo.

"However, metaverse technologies require a tremendous amount of computation and energy to serve millions of concurrent users. The proposed facility is expected to support the development of energy-efficient algorithms and systems for the metaverse."

The school was awarded funding under the ARC Linkage Projects scheme to develop encryption technology (homomorphic encryption) to improve data security for cloud computing. This project aims to place Australia at the forefront of efficient cloud adaption for secure collaboration with industry.

UOW WELCOMES THE OPPORTUNITY TO WORK WITH GOVERNMENT AND INDUSTRY PARTNERS TO DELIVER EXCEPTIONAL OUTCOMES

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