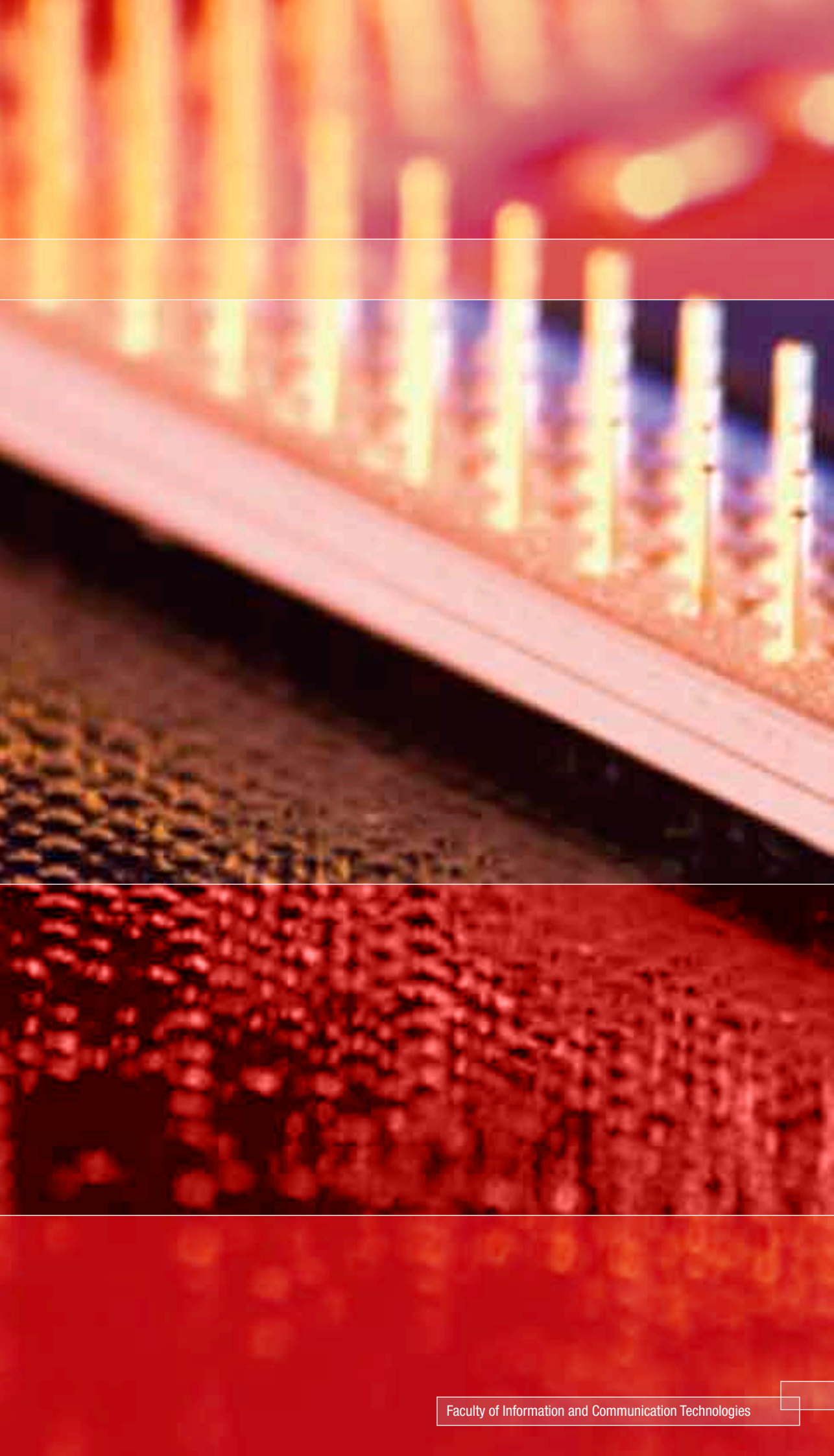


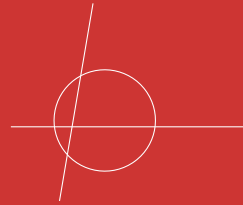
## Centre for Information Technology Research

The Centre for Information Technology Research (CITR) at Swinburne University of Technology is one of the largest IT research centres in Australia, having some 80 staff researchers and research students. It commands an international reputation in its areas of research expertise with internationally leading researchers, and has close involvement with industry and the international research community. It enjoys strong support from national and international competitive research grants and generous industry sponsorships.

### Aims

CITR aims to significantly advance Information Technology theory and practice, embracing Intelligent Systems and Software Engineering, and delivering high quality results, leading-edge technologies and novel business solutions of national and international benefit.





# Centre for Information Technology Research

## Research themes

The Centre's research is organised into three major research themes, supported by six research programs. The three research themes are Intelligent Computing, Reliable Software Systems, and Service Oriented Computing.

**Intelligent Computing:** Research in Intelligent Computing (IC) aims at developing computational, social and interactive systems that exhibit aspects of intelligent behaviour. Such intelligent systems are built using methods and techniques derived from classical artificial intelligence, evolutionary and adaptive computing, bio-inspired computing, computational intelligence, multi-agent systems and advanced human computer interaction. Sample application areas of IC include optimisation, planning, scheduling, resource allocation, pattern recognition, data mining, networked and distributed system management, virtual environments and computer supported co-operative work in business, enterprise and engineering domains.

**Reliable Software Systems:** Research in Reliable Software Systems (RSS) aims at a great challenge of how to deliver complex and large-scale software systems that are reliable. Software has become a necessity in almost every aspect of the daily lives of individuals and organisations, from self-contained applications to those embedded in various devices (mobile phones, cars, aeroplanes, heart pacemakers, etc). A large proportion of these systems are mission/life-critical. This research theme tackles this challenge by adopting an engineering approach and investigating methods, techniques and tools for the development of reliable software systems. Some key issues include precise requirements elicitation, dependable system architecture and design, systematic validation, verification and testing, and robust infrastructure and deployment environments.

**Service Oriented Computing:** Research in Service Oriented Computing (SOC) focuses on a new emerging paradigm for distributed computing and e-business processing, which is poised to dramatically reshape the future landscape of the ICT industry and beyond. It treats individual ICT systems and software components as independent services geared for integration, and uses them as fundamental elements to build agile networks of collaborating service applications distributed within and across organisational boundaries. As such, it enables seamless communications and interactions among businesses and individuals, promises quick adaptation to changing business environments, and offers new business opportunities. Key research issues include business workflow modelling and management, services engineering and validation, services interoperability and composition, and services management.

## Research programs

Supporting the research themes, the Centre has six research programs:

- ▶ Complex Intelligent Systems
- ▶ Component Software and Enterprise Systems
- ▶ Intelligent Agent and Multi-Agent Systems
- ▶ Software Testing
- ▶ Web and Data Engineering
- ▶ Workflow Technology

These programs closely collaborate with each other to deliver outcomes of significance in the three research theme areas.

# Centre for Information Technology Research

## Funding, collaboration and external links

With a strong national and international reputation, CITR researchers have been very successful in attracting national and international competitive research grants and securing industry funding for collaborative research. For example, funding for research projects and research scholarships current at 1 June 2007 amounts to over \$7 million. About 70% of the external funding relates to industrial collaboration funded by industry supported grants and research projects directly contracted with industry partners. Such support further cements CITR's international leading position and generates greater benefits for its industry collaborators.

CITR conducts research in close collaboration with industry and research partners nationally and internationally, delivering scientifically advanced and industrially relevant outcomes. CITR is a key partner in three national flagship Cooperative Research Centres (CRCs): Advanced Automotive Technology CRC, Smart Internet Technology CRC and Smart Services CRC.

Some of our past and present collaborators include:

- ▶ Australian Government Departments
- ▶ CA (Computer Associates)
- ▶ Defence Science and Technology Organisation (DSTO)
- ▶ Everyday Interactive Networks
- ▶ General Motors Holden

- ▶ GKN Aerospace Engineering Services
- ▶ Microsoft
- ▶ Powercor Australia/Citipower
- ▶ SAP
- ▶ Telstra Corporation
- ▶ Visy
- ▶ EU FP6 Adaptive Services Grid Consortium
- ▶ Chinese Academy of Sciences

The Centre has close links with leading international universities and research organisations, and continuously hosts a number of visiting scholars and researchers from all over the world, to collaborate on research of common interests.

## Research training

The Centre provides a supportive and vibrant research environment for students. The Centre has over 40 PhD and Masters students, pursuing research across a diverse range of areas within the Centre. A large majority of these students are supported by scholarships from Governments, University, project grants and industry organisations.

Over the past 2 years alone, some 20 candidates have completed their research higher degrees (mostly PhD).

With a strong research record, the Centre's research graduates have been very competitive in securing academic and research positions in leading institutions.

The Centre also offers opportunities for undergraduate and coursework postgraduate students to undertake research projects, through honours programs, units of research studies and vacation scholarships.

Funded by research grants, the Centre has a large number of research-only staff, mostly postdoctoral research fellows. The Centre offers a stimulating, multidisciplinary environment for them to grow their research careers and go on to be future research leaders.



# Centre for Information Technology Research

## Highlights

**Adaptive Service Grids:** CITR has led one of the most significant international collaborations between Australian and EU researchers in the area of Service Oriented Computing. As the only Australian organisation endorsed by EU, CITR has participated in an international project on Adaptive Services Grid that is one of the largest IT projects funded by the Sixth EU Framework Programme for Research and Technological Development (EU FP6), and the first and largest Australia-EU FP6 collaboration in Service Oriented Computing.

**Services Management:** CITR has led collaborative research on Adaptive Service Agreement and Process Management and developed new solutions for agent-based service composition, SLA/QoS negotiation, execution and adaptation in services grids. The project has been funded by the Australian Department of Education, Science and Training (DEST) in collaboration with Australian industry partners (EIN, Telstra and DSTO). It is the largest grant for an ICT R&D project awarded by DEST IST-ISL in 9 rounds, the largest R&D project in intelligent services computing in Australia, and one of the largest single university based projects in that area internationally.

**Failure-Based Testing – An In-Depth Theoretical and Experimental Study:** Funded by the ARC: Since the testing of all possible inputs to a program is prohibitively expensive or even impossible in many situations, test case selection is regarded as the most important activity in software testing. Failure-causing inputs are usually amalgamated into failure patterns that exhibit various features. Our previous investigations, making use

of the shapes of failure patterns to design test cases, delivered very successful results. In this project, we propose an in-depth study of failure-based testing by investigating the impact of every feature of failure patterns. The project will contribute to the theory of software testing and deliver new effective testing methods.

**System Performance and Scalability:** A CITR research team has successfully completed a study for Citipower and Powercor Australia. The study involved the performance and scalability assessment of the data processing systems for “smart” electricity meters across the state of Victoria, soon to be rolled out. The project has provided the necessary quantitative information and recommendations for a multi-million dollar IT investment decision by the company.

**Rationalised Software Architecture Design:** A CITR research team has developed the methodology and related tool support for capturing and reasoning about the decision-making process of software architecture design, ARM. The methodology has been incorporated into the UML design tool, Enterprise Architect. The project has enjoyed close collaboration from Sparx Systems (the developer of Enterprise Architect), National ICT Australia and Monash University. The research has received best paper awards and high acclaim.

**Evolution of Instant Messaging:** In collaboration with the Smart Internet Technology CRC, the centre undertakes research into a better Instant Messaging (IM) tool for use by individuals and organisations. With the aim to effectively

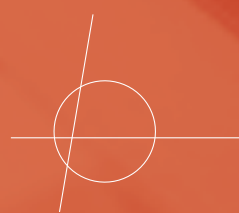
handle multiple IM sessions, the project represents a promising approach to the next generation of IM.

**Service Workflow for eScience and eBusiness:** Funded by the ARC and other sources, the centre is building workflow systems that will better support process management, with a current focus on grid and peer-to-peer based systems. The systems are designed to not only support eScience and eBusiness processes within organisations but also across organisations.

**Testing the Non-testable Software:** The Centre has made some fundamental advances in software testing strategies applicable to software programs whose outputs are not known or difficult to verify. Such strategies have applications in a wide range of contexts.

**Agent-Enabled Social Networks:** Funded by ARC and in collaboration with Everyday Interactive Networks, a CITR team has developed novel technology solutions for agent-based discovery, trustful interconnection and policy-based management of peer-to-peer social networks and 3D virtual environments.

**Reconfigurable Vehicle Software Systems:** A research team from the Centre undertakes a large scale research project in reconfigurable embedded vehicle systems, funded by the AutoCRC and in collaboration with General Motors Holden. The project investigates advanced software techniques for vehicle data monitoring and processing capabilities, to improve the vehicle design and maintenance practice and deliver significant economic benefits.



### **Web Service Enabled**

#### **Business Collaboration and**

#### **Inter-Organisational Transactions:**

Funded by the ARC and supported by SAP, a CTR research team is investigating an advanced inter-organisational workflow system that supports collaborative business processes in the Web service environment. It addresses the cooperation, autonomy, and openness issues in supporting business collaborations, and the consistency and reliability issues of collaborative business transactions.

#### **XML Data Integration and Flexible**

#### **Query Processing:**

Funded by the ARC, a research team from the Centre is engaged in research into the issues of integrating XML schema and data and providing flexible querying support on large collections of heterogeneous XML data sources on the Web.

#### **XML Views of Relational Databases –**

#### **Semantics and Update Problems:**

XML is the standard for representing, publishing and exchanging data over the Internet and relational database is the dominant technology for data management. Updating XML views over relational data is fundamental to bring these two technologies together to serve Internet-based applications. This project aims to develop a theory on the semantics of XML views and a set of techniques for checking XML view updatability, detecting and handling data redundancy and unintended updates, translating view updates to relational updates, and processing recursive view updates.

**Utility Grid Project:** A CTR team has developed new mechanisms for distributed market-based resource allocation based on multi-agent learning

techniques for the Utility Grid Project funded by DEST-IAP in collaboration with University of Melbourne and other Australian partners, and EU FP6 Projects on CoreGrid and CatNets.

**Anomaly Detection:** Many anomalous billing practices go undetected as they occur within a flood of other transactions. A CTR research team has investigated Artificial Intelligence techniques in constructing and delivering tools to perform continuous on-line anomaly detection enabling unintentional transaction errors to be corrected while deliberate errors are identified for further action. This work has been carried out in collaboration with the Australian Government.

#### **Service Oriented Architecture for IT Infrastructure Management:**

Funded by the ARC with support and collaboration from CA, a research team from the Centre is engaged in research into the next generation Service Registries, which will be the centre piece of any future enterprise information systems deploying the service-oriented architecture. These registries support capability (business and application)-based service modelling, publication, discovery and composition, and facilitate adaptive lifecycle management of the services and applications and their auditing and legal compliance from an enterprise perspective.

#### **Large-Scale Enterprise Systems**

**Emulation:** With support and collaboration from CA, researchers from the Centre are investigating advanced techniques to emulate simultaneously a large number of large-scale enterprise information systems with various and varied behaviours in diverse real-world deployment environments. One particular application of this emulation platform

will be the provision of a testing environment for large-scale integration of enterprise systems.

#### **Testing the “Virtual Earth”:**

Funded by Microsoft, CTR researchers are investigating new methods and techniques for automatically testing the Virtual Earth system. “Virtual Earth” is an international research initiative, aimed at allowing people to “browse” the Earth or the World on the Web, visualising in real-time the Earth’s spatial, geographic and environmental data such as locations, neighbourhoods, weather, and traffic. The new testing methods and techniques being developed will help to ensure the delivery of high-quality Virtual Earth services.

#### **SwinGrid – Swinburne Grid**

**Infrastructure at CTR:** With support from the University, the Centre has established a service grid infrastructure named SwinGrid. It is capable of supporting effective resource sharing for diverse scientific and business grid applications and simulations. It hosts the Centre’s decentralised peer-to-peer grid workflow system (SwinDeW-G) and grid service management platform (ASAPM).

**e-Security:** Swinburne, through CTR, is a cornerstone foundation member of SECIA, a Victorian e-Security Cluster, supported by the Victorian Government through Multimedia Victoria. The Cluster involves a large number of industry, government and research organisations. In collaboration with other partners of the Cluster, CTR is involved in delivering significant benefits for the State and beyond in the e-Security domain. In particular, CTR has internationally leading expertise in the engineering of software and service-based systems with predictable security outcomes.

## Further information

Whether you are interested in exploring collaborative research opportunities or undertaking research studies, the Centre is always happy to hear from you.

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