Collecting computers —and computer users

Richard Gillespie

A door seems an odd object to include in a computing collection. Yet the wooden-framed glass door now proudly displayed in the School of Computing and Information Systems (pictured below) represents the beginning of more than six decades of computing at the University of Melbourne.

On 14 June 1956, a group of dignitaries and nervous staff passed through the door of the Computation Laboratory, located in what is now called the Old Physics Building on the Parkville campus. Sir Ian Clunies-Ross, chairman of CSIRO, formally transferred the CSIR Mark 1 computer to the university; vice-chancellor George Paton then named the re-assembled computer 'CSIRAC' and pressed a button on the control panel. After a tantalising pause, the computer began printing a programmed message:

> Mr Vice Chancellor.
> Thank you for declaring me open.
> I can add, subtract and multiply;
> solve linear and differential
> equations; play a mediocre game
> of chess and also some music.[1]

Because CSIRAC printed at the rate of only four or five characters per second, the assembled guests had to wait about a minute for the message to be completed. But they had no doubt that the event marked a significant moment in the university's history. The newspapers reported enthusiastically about the university's 'electronic brain'.[2]

Among the world's first computers

The door that is now preserved in the collection thus symbolises the university's entry into computing, both for research and teaching. Earlier that year, physics researchers had been observed emerging from the lab after seeing the computer being put through its first trials in Melbourne, excited by the prospect of using CSIRAC to speed up their calculations. The first course in programming CSIRAC had been run in February 1956, attracting some 30 participants from university departments, research organisations, government and business. Determining the foundation date of a computer science department is a contentious and competitive endeavour, but when the Computation Laboratory at the University of Melbourne was formally established as a separate department in October 1955, it was one of only a handful in the world.

CSIRAC was by then a computer with an impressive history. It had been designed and built in Sydney by British physicist Trevor Pearcey and electrical engineer Maston Beard, as a research project of the Division of Radiophysics of the Council of Scientific and Industrial Research. The CSIR Mark 1, as the computer was called in Sydney, ran its first test

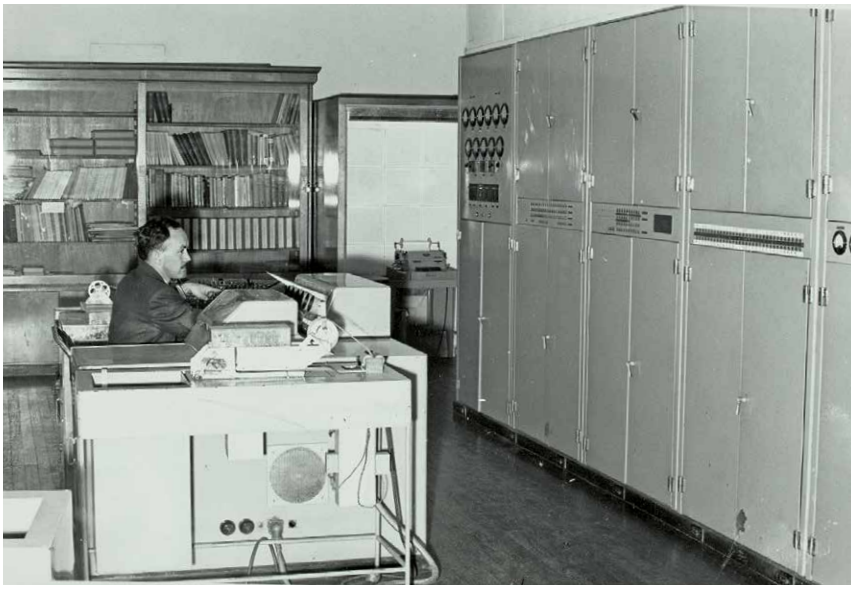
Opposite: Door of the University of Melbourne Computation Laboratory, 1955. CSIRAC054, School of Computing and Information Systems Collection, University of Melbourne.

Below: Jurij Semkiw at the control console of CSIRAC at the University of Melbourne, late 1950s. 2017.0071.00157, University of Melbourne Photograph Collection 1857–1990, University of Melbourne Archives.

program around November 1949, making it the fourth electronic digital computer in the world. The Mark 1 was used extensively for computations in radio-astronomy and cloud physics, the two main research areas of the Division of Radiophysics, as well as by other researchers and organisations, such as the Snowy Mountains Authority. In 1951 it was even used to play some simple tunes—now recognised as being the world's first computer music.[3]

By 1954, however, CSIR radiophysics chief Edward Bowen had decided to terminate the computer project, in part to focus his division's limited funds on radio-astronomy and cloud physics, but also to pressure the government and universities into picking up responsibility for electronic computing. By then Harry Messel, newly appointed physics professor at the University of Sydney, was raising funds for a more powerful computer, to undertake research in nuclear physics. CSIR offered the Mark 1 to interested parties.

Thomas Cherry, the University of Melbourne's professor of mathematics, jumped at the opportunity. Up to now, complex mathematical and statistical calculations in the university required mechanical calculators or logarithm



tables. Betty Laby in the Statistics Department managed a team of women 'computers', who undertook this work for the (overwhelmingly male) researchers. Cherry had been sending computations to Sydney to be run on the Mark 1 and recognised the benefits of building a computational capacity in Melbourne, but he also foresaw that digital computing was about to transform many fields of research. Cherry forged an alliance with his Melbourne colleague Leslie Martin, professor of physics, who also saw the benefits of a machine that could perform calculations 1,000 times faster than a human computer. Extolling the powers of the machine, Martin stressed to the University of Melbourne Council that the hydrogen bomb could not have been developed without computers, for it would have been impossible for humans to undertake the complex calculations: 'It is simply a device which is absolutely essential today in mathematics, theoretical physics and statistics'.[4]

It was never going to be straightforward to gain approval for such a project in a university that was operating a deficit budget and struggling to invest in research equipment. Cherry and Martin

An early printed circuit board, made by Jurij Semkiw to extend CSIRAC's disk store, 1961. CSIRAC036, School of Computing and Information Systems Collection, University of Melbourne.

argued that the Mark 1 was worth £50,000 to £100,000 and available on permanent loan at no cost. Additional staff and operational expenses would cost £6,500 a year, but CSIRO had promised half that amount for three years, provided it could continue to use the machine for its own projects. Martin anticipated, rather optimistically, that the computer could earn £2,000 from external users, so that the real charge to university funds would only be £1,000 a year. (University researchers and administrators will appreciate this financial sleight-of-hand.) Council approved the funding and the Mark 1 was carefully dismantled, loaded onto a truck, covered with a tarpaulin, and transported down the Hume Highway in June 1955.

Physics lecturer Dr Frank Hirst had been put in charge of the new Computation Department, which was overseen by Thomas Cherry and Leslie Martin. Hirst later recalled: 'We had only one committee meeting of five minutes duration when, by chance, the two Professors were visiting the Computation Department at the same time'.[5] Hirst had to oversee the re-assembly of the large cabinets (containing more than 2,000 vacuum tubes), redesign the mercury delay lines for the operating memory, and construct a new magnetic-disk store. After 12 months of testing and technical upgrades, the renamed CSIRAC (Commonwealth Scientific and Industrial Research Organisation Automatic Computer) was ready to meet the needs of university researchers and external users.

Over the next eight years, from June 1956 to November 1964, CSIRAC operated for some 30,000 hours, with maintenance accounting for only 10 per cent of that time. This was an extraordinary performance for a first-generation computer, and testimony to the skills and dedication of the operating team, which over that period included Frank Hirst, maintenance engineer Ron Bowles, Jurij Semkiw, Peter Thorne and Kay Thorne. CSIRAC was available for use by university staff and students, CSIRO researchers, and government departments; in addition, income was generated from business users, although rather more modestly than Martin had promised! Some 700 projects were undertaken, including physics computations, processing of survey data, solar radiation tables, loan repayment tables, life insurance tables, structural engineering for buildings (including ICI House), forestry research, electricity supply and climate research.

Preserving CSIRAC

Fortunately, the operating team understood CSIRAC's historical significance. Whereas the other first-generation computers in Britain and the United States were scrapped, or only parts retained, in 1964 the complete units of CSIRAC were donated to the Institute of Applied Science (now part of Museums Victoria). As a result, CSIRAC is the only intact first-generation computer surviving anywhere in the world.[6] The computer remained in storage until CSIRAC's original designer, Trevor Pearcey, became dean of the School of Computing and Information Systems at Caulfield Institute of Technology; in 1980 he arranged for the display of CSIRAC at Caulfield, where it remained until 1992, when it returned to storage. Once again, a former CSIRAC operator came to the rescue. Peter Thorne, by then head of the Department of Computer Science at the University of Melbourne, arranged in 1996 for CSIRAC to be displayed in the School of Computer Science in Bouverie Street, to mark the 40th anniversary of CSIRAC's operation in Melbourne.

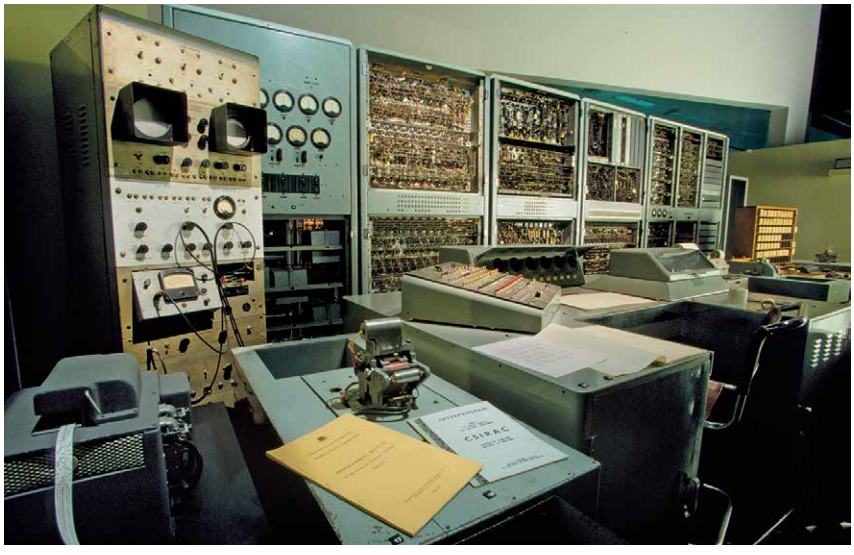
This event triggered a more systematic documentation of CSIRAC's history, and of computer science at the university. A CSIRAC History Team documented CSIRAC,

Right: Country school students visiting CSIRAC on Open Day, 1963 (Victorian Pressphoto). 2017.0071.00480, University of Melbourne Photograph Collection 1857–1990, University of Melbourne Archives.

Below: CSIRAC on display in Melbourne Museum, 2001. The panels have been removed to show the valves and circuitry. Photograph courtesy Museums Victoria.

assisted with the display of CSIRAC at the new Melbourne Museum (where it remained on view from 2000 to 2017), re-assembled archives from departmental records and personal papers, recorded oral histories and video interviews, and published a book to celebrate CSIRAC's achievements.[7] John Spencer wrote an emulator program so that CSIRAC's programs could be run on a modern computer, and the team helped composer Paul Doornbusch recreate CSIRAC's original music. Through close collaboration with Museums Victoria, the History Team has ensured that the rich history of CSIRAC is preserved and accessible. CSIRAC is currently in storage, with options for its return to public display being considered.

As the Computation Laboratory door and the rich history of CSIRAC suggest, computer collections, when appropriately documented, can encompass far more than a technical history represented by motherboards and technical specifications. Sometimes the most peripheral and incidental items can capture the flavour of working with a computer at a particular moment. The CSIRAC collection includes a puzzling wooden stick with a rubber stopper attached: this was the CSIRAC 'donger', used by the engineers to tap suspect vacuum tubes when CSIRAC was showing an intermittent fault. Tapping a faulty tube could make the fault permanent, thereby identifying the tube responsible. Sadly, not in the collection is the electric jug used for morning tea, which could cause a power spike that erased CSIRAC's memory during a computational run.



Computing after CSIRAC

The collection now maintained by the School of Computing and Information Systems documents significant aspects of the history of computing at the university. In addition to teaching and research, the department provided central computing services for the entire university; a Computer Centre was eventually split off from the teaching department in 1969. As CSIRAC was reaching the end of its life, in 1964 the university invested in an IBM 7044, a second-generation computer with transistors, ferrite-core memory and ten large magnetic-tape drives (those spinning tape drives that have become the iconic representation of 1960s computers, beloved of film directors).

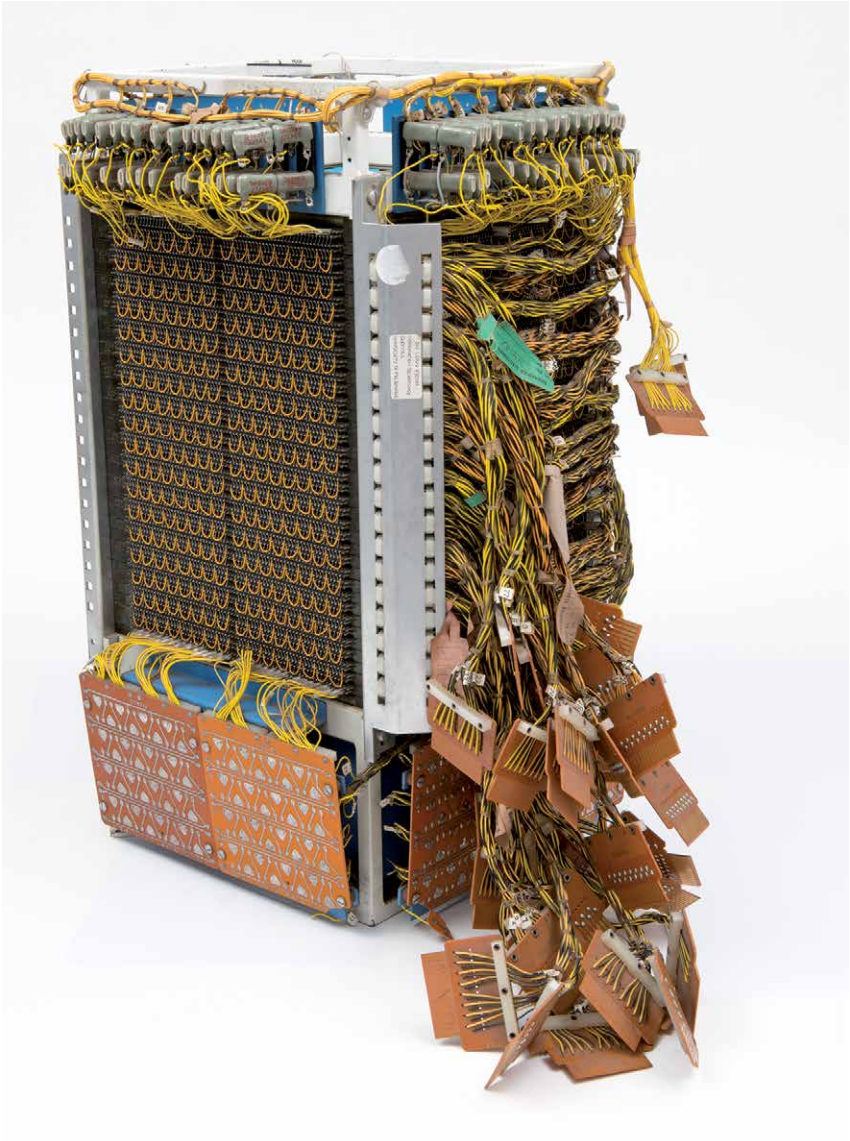
This was a very different machine from CSIRAC. The IBM 7044 was a plug-in machine, costing at the time a staggering $1 million, and

IBM (International Business Machines Corporation, USA, est. 1911), IBM 7044 operating console, 1964. The colourful 'COMPUTER' lettering was added by a university staff member, above the formal asset number. Hrd0028, School of Computing and Information Systems Collection, University of Melbourne.

with a service contract that precluded tinkering. Whereas computer users had driven CSIRAC from the control console, the IBM was a batch-processing mainframe; users brought their punch cards for offline spooling, then returned hours later to collect the results of their job. At first the computer was housed at IBM's offices in St Kilda; it then moved to the ground floor of the Architecture Building. Engineering student Peter Weymouth recalls 'steaming up the window of the Architecture building, peering in to see if my job had been run … Nine times out of ten the printout would say "Error nnn—Job Cancelled" and it would be back to the drawing board'.[8] Postgraduate students using the IBM would gather at the key-punch room to enter and collect data, and the room became a forum for the exchange of ideas and approaches to computing problems. The computing collection includes the operating console of the IBM 7044 (possibly the only one surviving internationally), the memory core and the programming and operating manuals.

While the mainframe computers in the Computer Centre continued to be funded and managed centrally, researchers were discovering the benefits of purchasing a minicomputer for their own department or research team. In 1968 the Computation Department purchased a Digital Equipment Corporation PDP-8, the first successful minicomputer (more than 50,000 were sold worldwide). This was a scalable, benchtop computer that could fit in the lab and be adapted to specific teaching or research requirements. Jurij Semkiw gradually expanded the computer and added peripherals as funds became available; these included a state-of-the-art controller to connect the computer to a disk drive, and a high-speed data channel to connect to the IBM 7044. The PDP-8 is a highly significant computer in the department's history, used by staff and graduate students for many of their research projects.

Revealingly, the Computation Department's PDP-8 was not the first of its type to arrive at the university. Dr David Dewhurst, a reader in biophysics in the Physiology Department, had purchased the first PDP-8 in Australia in 1966. Dewhurst was a pioneer in the field of biomedical engineering, and the PDP-8 allowed him to undertake real-time acquisition and processing of physiological data from his experiments on motor activity. Dewhurst became an expert programmer, opening up new research fields for fellow researchers and graduate students. Dewhurst's lab moved to Electrical Engineering in 1975, where he and his graduate students undertook the electronic engineering for the development of the bionic ear, as part of Graeme Clark's team in the Otolaryngology



IBM (International Business Machines Corporation, USA, est. 1911), IBM 7044 magnetic-core memory, 1964. This memory-storage technology would be supplanted by semiconductor memory chips in the mid-1970s. Hrd0015, School of Computing and Information Systems Collection, University of Melbourne.

Department. Ian Forster and Jim Patrick designed the electronic circuits for the implantable chip, while Peter Seligman and Jim Patrick worked with Dewhurst on the development of speech-processing software. The PDP-8 is now a particularly significant item in the Electrical and Electronic Engineering Department's Collection.[9]

Other minicomputers began to appear around the university: the electron microscopy group in Physics purchased a PDP-8, as did Dr Alan Head at the CSIRO Tribophysics Division at the university. Professor David Caro in Physics purchased a PDP-9 to control the cyclotron; he reputedly thought he had discovered a new element until it became apparent that the orange paint on the computer was slightly radioactive.[10] Thus by the end of the 1960s computing was no longer the province of a single department and the university's central Computer Centre. Decentralisation was not necessarily approved; when an edict was issued that all computers were to be centralised in the Computer Centre, research teams took to describing their new minicomputers as 'data acquisition systems'.

The student demand for access to computers exploded in the 1970s,

Right: Digital Equipment Corporation (USA, 1950s–90s), PDP-8 minicomputer, 1968. Hrd0025, School of Computing and Information Systems Collection, University of Melbourne.

Below: Digital Equipment Corporation (USA, 1950s–90s), Programs for the PDP-8 minicomputer, 1965–68. CScM0018, School of Computing and Information Systems Collection, University of Melbourne.

Punched tape had been used since the 19th century to program weaving looms and send telegraph messages; it was adopted as the standard means to store programs and data for early generations of computers.

ranging from postgraduate research to undergraduates taking introductory courses in programming. Graham Menhennitt recalls 'standing in line for access to the Interdata 7/16 computers'.[11] In 1974 the department adopted MONECS, a low-cost system for teaching programming that had been developed by Monash University, in which students prepared programs on mark-sense cards (marked with pencils), or cards with push-out chads (using a paperclip). The cards could then be read by an optical card-reader and processed by a locally manufactured minicomputer. Peter Thorne was able to use such a system to teach a course in computing at Pentridge Prison; he would enjoy telling his students back on campus that he had just been released from prison.

Innovation and commercialisation

In 1975, Peter Poole commenced as foundation professor of the renamed Department of Computer Science, and it grew rapidly in terms of staff, students, courses, research and equipment. With Poole's encouragement, the department also undertook significant commercial ventures. Poole was a strong advocate

Apple Inc. (USA, est. 1976), Apple Macintosh personal computer, 1984. Hrd0048, School of Computing and Information Systems Collection, University of Melbourne.

for using open-source operating systems, such as Unix, rather than the proprietary systems of computer manufacturers. Technical staff designed a computer that would take advantage of Unix software and be sufficiently robust and cheap for educational and commercial applications. The Unison computer was developed as a commercial venture between the university and a local manufacturer, and although the project was short lived, the computers were used in the department and other universities for teaching and research.

The technical and commercial lessons learnt from this project were important in shaping subsequent commercial ventures. In the early 1980s the department used Apple Macintosh computers in its teaching labs, but these came with very little capacity to be networked to a central computer. Technical staff, including Jurij Semkiw, Robert Elz and David Hornsby, developed a communications bridge based on Unison technology that could link the Macs to Unix servers. A local manufacturer, Webster

Webster Computer Corporation (Australia, 1970–2016, previously Webster Electronics Pty Ltd), Multigate network terminal, 1988. Hrd0026, School of Computing and Information Systems Collection, University of Melbourne.

Computer Corporation, was licensed to manufacture and distribute the Multigate network equipment, which was sold widely in Australia and the United States, including to the head office of Apple. The university and department received substantial royalties from the licence agreement.

Other commercial ventures emerged from software development. Poole had established a Development Group in the department, which worked with the National Museum of Victoria (now Museums Victoria) to develop a database management system for museum collections, built around innovative search algorithms. The Titan database was released in 1984, and Knowledge Engineering Pty Ltd was spun off as an independent company. The database, now called EMu (Electronic Museum) and owned by the Swedish Axiell Group, is used widely by major museums and archives around the world, including the Smithsonian Institution in Washington DC and the Natural History Museum in London. Appropriately, it is used at the university to manage collections at the Ian Potter Museum of Art, University of Melbourne Archives, Baillieu Library Print Collection and Grainger Museum.

The most successful commercial venture was the least expected, yet it confirms the department's international perspectives and leadership. Robert Elz had been appointed in the late 1970s to facilitate the implementation of Unix on the department's new VAX 11/780 computer, working closely with the Unix group at University of California Berkeley. Elz established electronic mail links with Berkeley and the rest of the world during the 1980s, managing a computer called 'munnari' to provide access for computer science staff and other researchers in Australian universities; this would evolve into the hub for the Australian Academic and Research Network in 1990.[12]

One of Elz's administrative tasks was managing internet domain name registrations in Australia, and he developed 'reasonableness' criteria for registration that prevented the kind of domain name sitting and speculation that occurred overseas. As the internet expanded, the carefully managed Australian domain system was publicly floated as Melbourne IT in 1999, raising almost $80 million for the university. It is perhaps ironic that this hugely successful commercialisation is not represented in the collection; all that has survived is a photograph of a modem to the munnari server from the early 1980s.

The collection today

At the time of writing, the School of Computing and Information Systems Collection comprises some 100 objects, including entire computers, control panels, processors, peripherals such as disk drives and printers, program tapes and media. There is also an extensive archive, comprising some 900 documents and archival files, including computer operating and software manuals, department reports, student research reports and photographs. Selected items are displayed on Levels 7 and 8 of the Doug McDonnell Building on the Parkville campus, along with graphic panels celebrating the school's history and achievements. The collection is catalogued on Microsoft Access software and stored in the Doug McDonnell Building. The CSIRAC collection at Museums Victoria comprises some 300 objects, 300 images and more than 1,000 documents; the collection can be explored online at collections.museumvictoria.com.au/articles/3145.

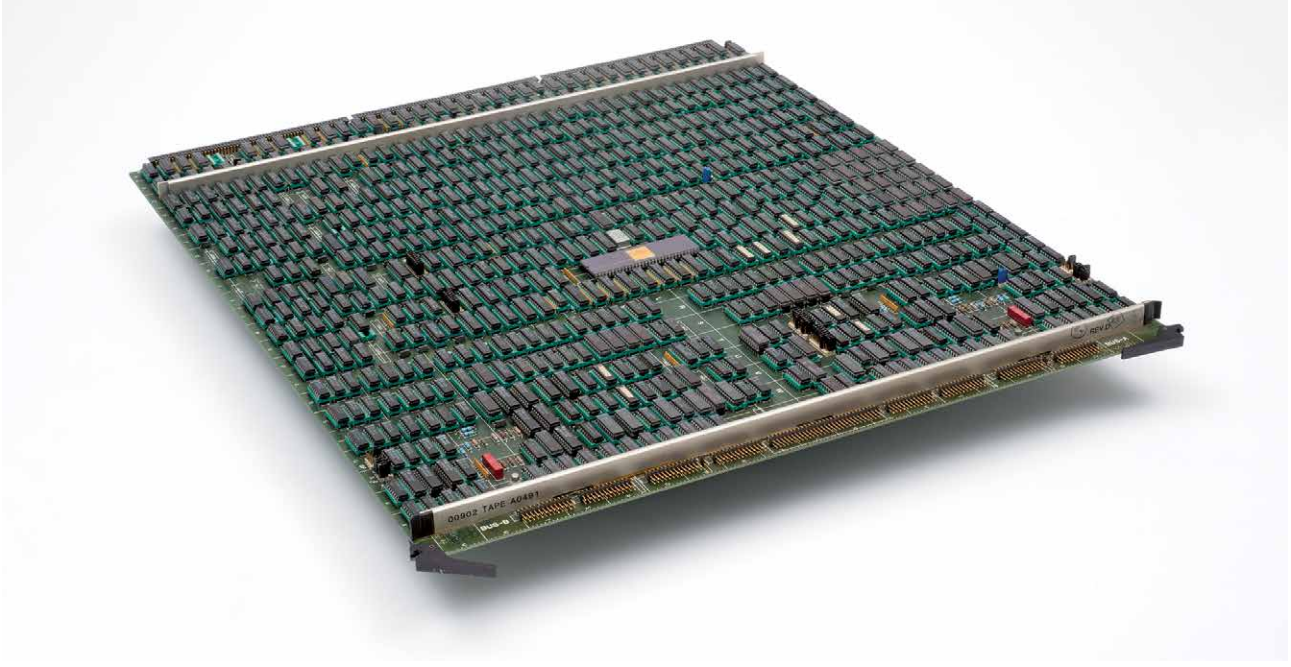
The School of Computing and Information Systems has made a conscious effort to develop a collection that documents its history. The rapid technological change that has occurred in computing over the past 60 years has prompted academic and technical staff to hold on to

Elxsi (USA, est. 1979, now Tata Elxsi), Elxsi 6400 mini-supercomputer's large printed circuit board, densely populated with chips, mid-1980s. Hrd0030, School of Computing and Information Systems Collection, University of Melbourne.

significant items. Most critically, a core of staff recognised the national and international significance of CSIRAC, and worked tirelessly to preserve and document the computer and its history. The CSIRAC History Team, led by Professor Peter Thorne, has collaborated with university colleagues, Museums Victoria, the Australian Computer Society and the Pearcey Foundation. The CSIRAC project naturally flowed into documentation of the wider history of computing at the university.[13]

Yet inevitably there are weaknesses and notable gaps in the collection of artefacts, documents, archives and photos. The last three decades are not as well documented as the earlier years. The work of the Information Systems Department, a separate department from its inception in 1995 until the creation of the integrated Department of Computing and Information Systems in 2012, is notably absent. Missing too are collections documenting the university's centralised computer infrastructure and the staff who maintain and support research platforms.

There is a larger challenge. The history of computing at the university has spread out from the Computation Laboratory and Computer Centre to virtually every department and centre, and through cross-institutional and government collaborations such as the Victorian Life Sciences Computation Initiative (now Melbourne Bioinformatics). Indeed, just as CSIRAC and its



associated archives are now part of Museums Victoria's collection, the university's computing 'collection' is more accurately characterised as a distributed collection, spread across the university and encompassing CSIRAC.

Recording and preserving the significant aspects of computing at the university now require a more strategic approach, one that would identify objects, images and stories across all research fields and research platforms. We now need to think of the collection as a distributed collection that encompasses the perspectives and endeavours of many different parts of the university. Computing can be a case study for analysing the transformation of teaching and research at the university, encompassing discovery and innovation by individuals and teams, but also the resources required, the technical support, the institutional climate and strategic commitment. This is a story of computer users rather than computers.

For further information and access to the **School of Computing and Information Systems Collection**, please contact Dr Richard Gillespie on gillespie.r@unimelb.edu.au.

Dr Richard Gillespie is an honorary principal fellow in the School of Historical and Philosophical Studies at the University of Melbourne, and formerly head of the Humanities Department at Museums Victoria. He has written widely on the history of science and technology, including *The Great Melbourne Telescope* (Melbourne, 2013).

Acknowledgements: The author acknowledges the advice and support of Robin Evans, Tony Klein, Bernard Meade, Alistair Moffat, Michael Poloni, Jurij Semkiw, Graeme Shanks, Liz Sonenberg, Peter Thorne and Justin Zobel.

1 Doug McCann and Peter Thorne, *The last of the first: CSIRAC: Australia's first computer*, Department of Computer Science and Software Engineering, University of Melbourne, 2000, p. 46.
2 'He's a real Mr. Felix!', *Argus*, 4 May 1956, p. 3.
3 Paul Doornbusch, *The music of CSIRAC: Australia's first computer music*, Melbourne: Common Ground Publishing, 2005, pp. 23–7.
4 'Giant "brain" sets 'varsity a problem', *Age*, 7 December 1954, p. 3.
5 Quoted in McCann and Thorne, *The last of the first*, p. 39.
6 See Heritage Council Victoria, 'CSIRAC (Commonwealth Scientific and Industrial Research Organisation Automatic Computer): Statement of significance', vhd.heritagecouncil.vic.gov.au/places/114928, viewed 16 April 2018.
7 McCann and Thorne, *The last of the first*. See also Maston Beard and Trevor Pearcey, 'The genesis of an early stored-program computer: CSIRAC', *Annals of the History of Computing*, vol. 6, no. 2, 1984, pp. 106–15.
8 Peter Weymouth, 'After CSIRAC: A non-user's view, 1970–2000', Museums Victoria, 2007, collections.museumvictoria.com.au/articles/1349, viewed 28 February 2018.
9 Veronica Bondarew and Peter Seligman, *The Cochlear story*, Melbourne: CSIRO Publishing, 2012, pp. 32–4; Graeme M. Clark, *Sounds from silence: Graeme Clark and the bionic ear story*, Sydney: Allen & Unwin, 2000, pp. 76–88; Richard L.G. Kirsner and John S. McKenzie, 'David Dewhurst: Biomedical engineer and IFMBE pioneer', in Laura M. Roa (ed.), *XIII Mediterranean Conference on Medical and Biological Engineering and Computing 2013, IFMBE Proceedings*, vol. 41, 2014, pp. 9–12.
10 Max Burnet, 'CSIRAC, Melbourne University and Digital: A long relationship', in McCann and Thorne, *The last of the first*, p. 98.
11 Graham Menhennitt, quoted in 'History of computing in the department', www.cis.unimelb.edu.au/about/history/computing/, viewed 28 February 2018.
12 Glenda Korporaal, *AARNET: 20 years of the internet in Australia, 1989–2009*, Sydney: AARNET, 2009.
13 Suelette Dreyfus, 'The first years 1996–2004' [History of the Department of Information Systems], School of Computing and Information Systems, Melbourne School of Engineering, University of Melbourne, 2004, www.cis.unimelb.edu.au/about/history/pdf/department-history.pdf, viewed 28 February 2018; Alistair Moffat, 'Fifty years of computing at the University of Melbourne', Melbourne School of Engineering, University of Melbourne, 2006, people.eng.unimelb.edu.au/ammoffat/fifty-years/mof06history.pdf, viewed 28 February 2018; 'Computing at the University of Melbourne, 1956–2015', School of Computing and Information Systems, Melbourne School of Engineering, University of Melbourne, www.cis.unimelb.edu.au/about/history/, viewed 28 February 2018. University of Melbourne Archives also holds records and artefacts relating to the early history of computing; see Mary Hurley McGillivray, 'Early computing', University of Melbourne Archives, archives.unimelb.edu.au/resources/subject_guides/early-computing.