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AUSTRALIAN NATIONAL UNIVERSITY

Box 4, G.P.O.,

Canberra.

COMPUTER CENTRE
ANNUAL REPORT - 1970

prepared by
Drs. M.R. Osborne and R.S. Anderssen

COMPUTER CENTRE STAFF

Head: M.R. Osborne, B.A., Ph.D.
(on study leave for 12 months
from December 5, 1970)

Fellows: R.S. Anderssen, M.Sc., Ph.D.
(Acting Head from December 5, 1970)
D.E. Lawrence, M.A., D.Phil.
B.W. Smith, B.A., B.Ec.
(resigned March, 1970)

Research Fellows: K.E. Atkinson, M.Sc., Ph.D.
(arrived June, 1970)
P.M. Fenwick, M.Sc., Ph.D.
(arriving February, 1971)

Students: P.N. Creasy, B.Sc.
(Staff Candidate)
L.S. Jennings, B.Sc.
(arrived January, 1970)
D.P. McKee, M.Sc.
(resigned June, 1970)
D.M. Ryan, B.Sc., M.Sc.
R. Weiss, Dpl. Ing. (Vienna)
(arrived October, 1970)

Senior Programmer: B.F. Butterfield, B.Sc.

Programmers: P.N. Creasy, B.Sc.
(resigned July, 1970)
H. McKinley (Miss)
(appointed July, 1970)
J.M. Rohl (Miss), B.Sc.
I.R. Simpson, B.Sc.
P. Tindale

Computer Supervisor: A.J. Harris

Operators: M.M. Brinkley (Mrs)
K.E. France
(arrived October, 1970)
P.N. Fry
(deceased April, 1970)
C. Lek (Miss)
(arrived June, 1970)
M. McKinley (Miss)
(transferred July, 1970)
E. Rumpf

Secretary: S. Larkham (Mrs)

Typist: P. Hauke (Mrs)

STAFF MOVEMENT AND VISITORS

Mr. B.W. Smith resigned in March to take up a position with Compunet as Manager of their Government Systems Division. Dr. K.E. Atkinson, Indiana University, Bloomington, took up his appointment as a Research Fellow in June. Mr. L.S. Jennings, Adelaide, and Mr. R. Weiss, Vienna, arrived to commence work on Ph.D. degrees within the Centre. Mr. P.N. Creasy resigned as a programmer to take up a lectureship in the newly formed Computer Science Department, School of General Studies, ANU. One of our operators, Miss H. McKinley, was appointed on probation to the resulting vacant programmer's position.

Dr. R.S. Anderssen was absent for four months on an Australian National University - Moscow University Exchange Scholarship. During his stay in Russia, he visited Professor V.B. Glasko, Mathematical Physics, Moscow State University, Acad. A.A. Dorodnitsyn, Head of the USSR Academy of Sciences Computer Centre in Moscow, Acad. V.M. Glushkov, Vice-President of the Ukrainian Academy of Sciences and Head of its Institute of Cybernetics, Kiev, Professor S.G. Mikhlin, Mathematics and Mechanics, Leningrad State University, and Professor E.A. Lubimova, Institute of the Physics of the Earth, Moscow.

In early December, Dr. M.R. Osborne left on a year's study leave. Most of his time will be spent at the "Year of Numerical Analysis" at the University of Dundee. While away he will give a number of invited addresses at International Conferences on Optimization. Dr. R.S. Anderssen will be Acting Head during his absence.

The sudden death of Mr. Bob Fry, one of the Centre's operators, was a deep shock to all and a loss that will be hard to replace.

COMPUTER USE, FACILITIES AND EQUIPMENT

This year has been one of frustration and disappointment for not only has the load on the machine continued to grow (so that slow job turnaround is a cause of major concern), but also the anticipated Joint Centre with CSIRO has still failed to win official approval. This situation is a cause of considerable concern as no provision was made for the expansion of the present campus computing facilities in this triennium because it was expected that the Joint Centre would be in full operation in 1971.

The overloading of the present facilities is best illustrated by length of job turnaround times and the following is the result of a survey to investigate this carried out in July:

- (i) Turnaround time for the simplest jobs (excluding express batch jobs) is one day.
- (ii) For jobs, which are simple to schedule (requiring at most one tape and/or access to a disc which is usually mounted) and which require 5-15 minutes execution time, a delay of from one to three days is normal.
- (iii) Jobs, which require full core (>150K) or two special disc drives, can expect an average delay of three days.
- (iv) Jobs which require special discs and which direct output to the line printer (jobs with a high volume of printed output) can expect an average delay of five days.
- (v) Bookings for out-of-hours operation (the only feasible way of running jobs with more than 30 minutes execution time) have also had to be restricted, and users are requesting two hours time for every one that is available.

These figures illustrate the severe delays facing users, and, in particular, the way in which the processing of jobs requiring disc backing store is affected. A consequence of this is that research projects involving extensive data processing are worst affected by the current lack of resources. However, the delays fall on all users and have particular significance for research scholars and research workers on short term appointments. A supplementary submission has been made to the AUC for interim relief pending the establishment of the regional centre, but, as yet, no reply has been received. The most urgently required component of the supplementary submission was two additional disc drives, and alternative methods for funding these were investigated. Approval to buy two Calcomp CD1 disc drives was obtained in mid-December. This addition represents the cheapest, quickest and most efficient way to yield a limited improvement in turnaround time. The drives should be operational early in the new year.

Further evidence of the high level of activity on the computer during the year is shown in the attached figure of principal computing statistics.

RESEARCH AND SERVICE ACTIVITIES(1) Operating Systems and Programming Support

Further general purpose programs and subroutines have been made available to users during the year. However, activity in this area is decreasing as, after almost five years of operation with the present computer, the Centre has quite a comprehensive set of basic computational routines and utility packages.

The Release 17 version of the IBM Operating System has been maintained throughout 1970 and preparations are now under way for the implementation of the Release 19 version early in 1971.

Recent work in the area of operating systems and programming support has been mainly directed towards improving the turnaround for short development jobs and a continuation of efforts to increase system utilization in general.

Short development job turnaround has been provided in the case of FORTRAN work, which covers 90% of projects initiated, by the introduction at the commencement of 1970 of an Express Batch jobstream. This allows up to eight runs per job per day for jobs requiring no more than thirty seconds run time and five hundred lines of printout. The Express Batch system is based on a compiler obtained from the University of Mississippi and known as the FORTLAGO compiler. It is compatible with the IBM Operating System FORTRAN compilers and has the advantages of running in about half the amount of storage and compiling faster. The compiled code is less efficient and execution is consequently slower. However, for short jobs there is an appreciable net gain in throughput and the ability to multiprogram several partitions, including the proposed typewriter console partition, is enhanced.

Avenues for significant improvement in system utilization have been explored, and short of the acquisition of new equipment, none remain open. The Centre has, in order to increase throughput, resolved to eliminate some of the existing functions performed, and the only area in which this appears possible is in job accounting. The ANU Monitor, a supervisory sub-system to enable faster processing of part of our workload by eliminating job scheduling overheads of the IBM Operating System, at present provides comprehensive accounting statistics for each job it handles. Partly to realize a small gain in system throughput and partly to take advantage of the benefits inherent in the FORTLAGO compiler described above, it is proposed that the ANU Monitor facility be replaced by a similar facility which will employ the FORTLAGO compiler operating in batch mode, and which will provide a very basic accounting record, logging jobs on a departmental basis only.

Work is currently in progress towards this end, and this includes rewriting some FORTRAN library routines, resident at execution time. The rewriting is being done in order to compress the routines, so that storage may be saved to offset additional code that will be inserted to provide the basic accounting and job submission, both from the central jobstream and from remote entry points, such as the console typewriters.

(2) Courses and Colloquia

FORTRAN and JOB CONTROL LANGUAGE (JCL) courses are given to small groups (usually 10-20) whenever there is sufficient demand, and intending students register by obtaining a form from the Secretary. Three FORTRAN and two JCL courses were held during the year. In addition a course on more advanced topics and good programming practices was again held at the beginning of the last academic year.

Courses were held to introduce users both to available facilities and to the relevant theoretical background in the fields of scientific computation, information processing, digital circuit design, and real time computer use. These courses occupy several lectures a week throughout the year.

Once again colloquia have been organised jointly with the CSIRO Division of Computing Research and have been held fortnightly. Topics have covered a wide range of fields of interest to both organisations.

A one-day seminar on "Data Acquisition and Real Time Systems" was held in the Coombs Theatre on December 9. This was attended by over 250 participants from all parts of Australia. The aim of the seminar was to show how problems have been solved using readily available hardware. The papers fell into three sections - special purpose hardware for Data Acquisition, real-time programming techniques, and examples of Real Time Systems.

(3) Console System

A flexible data input/output (I/O) bus for the 360/50 has been constructed, based on the Direct Control and External Interrupt Feature of System/360. This I/O bus provides a straightforward way of interfacing any one-byte peripheral device to the 360/50.

A limited number of typewriters (IBM Selectric Input/Output Writers Model 735) will be attached to the I/O bus. These will be used to develop an experimental console system. The first local typewriter will be operational in early '71. Installation of the first remote typewriter is dependent upon obtaining lines around the University campus.

Most of the software to be used in the initial version of the console system has been written and tested. The control program which rolls user programs in and out of core and controls their execution has been tested, using a console simulator which can simulate any number of consoles operating at any desired rate. As the simulator also uses the direct control feature, the console I/O supervisor has been tested using the simulator.

The programs which will be available to the user include a desk calculator, BASIC interpreter (which can also run in a desk calculator mode and permits editing) and job submission to the FORTRAN monitor. These programs were written in the Computer Centre. A modified in-core editor is also available. In addition it is hoped to provide FORTRAN and PL/1 syntax checkers and certain "special" packages.

The console system, both hardware and software, was described in two papers presented at the One-day Seminar in December.

(4) Numerical Analysis

Major progress was made during the year in the area of improperly posed problems, and methods have been developed, in particular, for Fredholm and Volterra equations of the first kind, for the solution of elliptic boundary value problems by an imbedding technique, and for estimating coefficients in a differential equation given information about its spectrum. In addition, an important concept related to improperly posed problems is the generalized inverse of an operator. Methods for estimating this in the matrix case have been studied, and it has also been used to develop a unified treatment of 'Newton-like' methods for minimising a sum of squares.

Work on the design of automatic packages for a general class of Fredholm second kind equation and the study of product integration methods for first kind Volterra equations has been commenced.

The development of penalty function methods for nonlinear programming problems has now reached a considerable level of sophistication. Particular attention has been paid to the development of hybrid methods which combine the attractive features of several algorithms, and very efficient procedures have been produced in this way.

An examination of formalisms for the use of Monte Carlo Inversion for the inversion of data has commenced in association with the Statistics Department, School of General Studies. The progress to date with this important problem has been very encouraging. As a consequence of this progress it has been possible to throw further light on the density modelling controversy and develop a new method for random search in optimization.

OTHER ACTIVITIES

The University of Queensland Press undertook the publication of the proceedings of the very successful one-day seminar organised by the Centre in late 1969 on DATA REPRESENTATION. The success of this seminar as well as the previous one on LEAST SQUARES METHODS IN DATA ANALYSIS acted as a stimulus to all involved in preparing our third one-day seminar on December 9 on DATA ACQUISITION AND REAL TIME SYSTEMS. The response of 250 to our first circular and an estimated attendance of 300 at some of the sessions was extremely encouraging and indicative of the need for such intensive seminars of the form of our one-day seminars.

Throughout the year, a number of members of staff were invited to give seminars. Dr. K.E. Atkinson spoke at the Universities of Melbourne and Tasmania about his recent work on second kind integral equations. Dr. Osborne gave seminars at the Universities of Melbourne, Sydney and La Trobe on his and his students' recent work. Except for Dr. R.W. Hamming, Bell Telephone Laboratories, Mr. B.W. Smith was the only overseas guest speaker at the Second National Computer Conference of the New Zealand Computer Society in August. In addition, Mr. Smith spoke about computing to a number of Branches of the Australian Computer Society and the ANU-CSIRO Joint Computing Seminar. Other members of the Centre gave seminars at the ANU-CSIRO Joint Computing Seminar; these were Dr. K.E. Atkinson, Dr. D.E. Lawrence, Mr. L.S. Jennings and Mr. D.M. Ryan.

Dr. M.R. Osborne, Mr. D.M. Ryan and Mr. L.S. Jennings read papers to the Numerical Analysis Section of the Australian Mathematics Society meeting in Melbourne in May.

Dr. Lawrence represented the Centre at conferences on "An Overview of Computer Control", "Computer Communications and Display" and "CSIRO Workshop on Applications of Small Computers". He and Mr. P.N. Creasy read papers at our recent one-day seminar on Data Acquisition and Real Time Systems.

Mr. B. Butterfield represented the Centre at the recently formed IBM OS User's Group.

During his visit to Russia, Dr. R.S. Anderssen gave seminars at the Mathematics Institute, Leningrad, Mathematical Physics Department, Moscow University, and the Institute of Cybernetics, Kiev. On the return journey he visited the Central Computing Laboratory, Darmstadt, Germany, and gave seminars at the Mathematics Department, University of Dundee, and the Computer Science Department, Stanford University.

Dr. M.R. Osborne has been invited to speak at two International Conferences on Optimization during the coming year. He is a member of the IFIP Technical Area 1 subcommittee.

Mr. B.W. Smith is a Vice-President of the Australian Computer Society, Chairman of the Canberra Branch of the Society and with Dr. M.R. Osborne a member of the Course Advisory Committee in Computing Studies at the Canberra College of Advanced Education.

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* Not a member of this University.

** Not a member of the Computer Centre.

PRINCIPAL COMPUTING STATISTICS
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