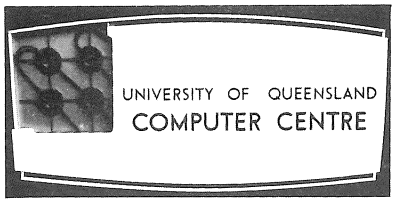

COMPUTER CENTRE BULLETIN

Volume 3, Number 2.
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Editor:
H. L. Smythe.

THIS EDITION

This month's Bulletin contains some general Computer Centre service information which should be noted by clients. Recent Computer Science library accessions are also listed and a series of seminars is announced. A discussion of the simulation of mineral treatment processes should be of particular interest to mining and metallurgical engineers.

SEMINARS IN COMPUTER SCIENCE

This year, the Department of Computer Science is sponsoring a series of seminars in computer science. The aim of these seminars is to present some of the newer techniques that are emerging in the computer field. The seminars will be held at regular intervals throughout the year, and, while a tentative schedule has been already planned, the Department would be very happy to sponsor additional seminars if there is sufficient interest. Any enquiries or suggestions should be directed to the Seminar Convener, Mr. John Williams, extension 8288.

Although the seminars are open to the public, each speaker, however, will assume the audience has some general knowledge of computing, although no knowledge of the specific subject area would be necessary. At this early stage, arrangements are not yet finalised, the actual day and time of each seminar being subject to the availability of rooms at the University. Any enquiries about the final arrangements should be directed to the Secretary of the Department of Computer Science, extension 688.

The first seminar will be held during the week beginning the 15th March, the day, time and room to be decided. The speaker, Mr. Ian Oliver, a former Departmental Lecturer and now a Consultant, will discuss *Problem Solving by Simulation*. The following abstract outlines the theme of his seminar:

Simulation is the most powerful of all techniques for the solution of certain types of problems. A great deal of knowledge about nuclear processes, aircraft design, planning in organisations, telephone traffic, chemical plants, and so on has been obtained through simulation on digital computers.

In this talk, Mr. Oliver will outline the concepts fundamental to simulation including model construction, verification, experimentation on the model, and evolutionary techniques for the optimization of some measures of effectiveness.

The second seminar of the series will be presented by Mr. Michael McLean, a Senior Demonstrator within the Department, who will discuss some aspects of *Paging in the Management of Core Storage*. This seminar is to be held in the week beginning 12th April. Further details will be published in the March issue of the Bulletin.

CONSULTATION WITH PROGRAMMERS

Because of recent organisational changes within the Computer Centre, consultation with clients will exist by appointment only, from 2.00 p.m. to 3.00 p.m. every afternoon. Clients seeking advice should first contact the Administrative Officer (Mr. John Jauncey, extension 8471).

REVISED CHARGES FOR COMPUTER SERVICES

Clients should also take note of the revised schedule of charges which will be operating for the PDP 10 computer system from the 1st February, 1970. Circulars describing the new arrangements have been sent to departmental and external users. Revision of charges was caused by increased operating costs, particularly in salary commitments necessary to hasten systems development, and the limitations imposed by non-delivery of equipment for the PDP 10 and inadequate systems software.

STAFF NEWS

INTRODUCING A DEMONSTRATOR .....

The Department of Computer Science welcomes with pleasure *Mrs. Robyn Thomas* who was recently appointed to the position of Demonstrator.

In 1964, Robyn graduated with a Bachelor of Science degree from the University of Queensland. She was employed by the Main Roads Department of Queensland as a technical programmer for two years, and worked at International Computers Limited for one year, when she was stationed at the Southern Electric Authority as a programmer and adviser in the Engineering section. Robyn then taught mathematics and science at Somerville House, a Brisbane girls' secondary college, for two years.

Robyn's duties in the Department include conducting courses, assisting in the supervision of the practical work of the two post-graduate Diplomas, and general research activities.

LIBRARY ACCESSIONS

This section lists the books on computer science that were acquired by the Libraries of the University of Queensland in October 1969.

Kotz, Samuel. *Russian-English Dictionary and Reader in the Cybernetical Sciences.* 1966. (001.5303 KOT, Engin.Lib.)

IBM Scientific Computer Symposium on Statistics, Yorktown Heights, N.Y., 1963. *Proceedings.* 1965. (519 IBM, Engin.Lib.)

Robinson, Enders A. *Multichannel Time Series Analysis with Digital Computer Programs.* 1967. (519 ROB, Maths.Lib.)

Rosenthal, Myron R. *Numerical Methods in Computer Programming.* 1966. (517.6 ROS, Accountancy Seminar Room)

Rummer, Dale I. *Introduction to Analogue Computer Programming.* 1969. (519.92 RUM, Engin.Lib.)

Calahan, Donald A. *Computer-Aided Network Design.* 1968. (621.3851 CAL, Elect.Engin.Lib.)

Anton, Hector R. *FORTRAN and Business Data Processing.* 1968. (Q651.8 ANT, Main Lib.)

Barnett, Cecil C. *The Future of the Computer Utility.* 1967. (651.8 BAR, Main Lib.)

Phillips, Arthur H. *Computer Peripherals and Typesetting.* 1968. (655.28 PHI, Main Lib.)

Luzadder, Warren J. *Basic Graphics for Design, Analysis, Communications and the Computer.* 1968. (744.422 LUZ, Architecture Lib.)

THE SIMULATION OF MINERAL TREATMENT PROCESSES

W. J. Whiten

The author of this article, Mr. Bill Whiten, holds a Bachelor of Science degree with Honours from the University of Canterbury, New Zealand. Mr. Whiten was employed as a Demonstrator in computing at the University of Queensland Computer Centre for fifteen months, and has spent the last four years as a Research Officer in the Department of Mining and Metallurgical Engineering where he is working under Dr. A.J. Lynch on the simulation, control and optimization of mineral processing plants. Mr. Whiten delivered a paper on this topic at the Australian Computer Conference which was held in Adelaide in August last year.

Abstract

The use of computers by a University of Queensland research project for the simulation of mineral treatment processes, is described. Several systems of FORTRAN simulation programs have been written for this work. The design, advantages and disadvantages of these programs are discussed.

Introduction

A research group at the University of Queensland supported by the Australian Mineral Industries Research Association and Mount Isa Mines Ltd., has been working for several years on the simulation and control of mineral treatment processes. The objective of the research work is to develop techniques for the optimization and automatic control of these processes. Up to the end of 1967, the work was mainly on grinding (the breaking of ore to a fine powder) and classification (the separation of ore into fine and coarse size fractions). This work has been extended to include froth flotation (the concentration of valuable mineral grains using surface interaction with bubbles). Post-graduate students associated with the project are working on the crushing of ore, flow through storage bins, and wet concentration of beach sands. To the present time, the University of Queensland's GE 225 computer has been used.

The Development of Models

The simulation models are derived and verified from tests performed on full scale industrial equipment wherever possible. Multiple linear regression analysis has been used to aid the analysis of data, but it is not a substitute for insight into the physical processes operating within the equipment.

The Models Used

To indicate the type of simulation model used, the two most used models are described:

1. The *Ball Mill* (this machine breaks the ore particles).

The size distribution of ore particles in the feed and product is described by a vector. The product is calculated by multiplying the feed vector by a power of a lower triangular matrix. This power is calculated from the feed rate and is not usually an integer.

2. The *Hydrocyclone* (a separation of coarse and fine sizes of ore particles).

The behaviour of the hydrocyclone is described by an efficiency curve of almost constant shape but variable position. The position of the curve is found from empirical relations. The behaviour of the feed water and feed pressure is also calculated.

The models allow the calculation of the products given the feed. Usually several machines are used in closed circuit and the flow around the closed circuit is calculated iteratively. Optimization and design of control systems have been done, up to now, by working from the printed results of simulation.

The Simulation Programs

Firstly, we look at some of the factors affecting the design of the simulation programs. These may be summarised as follows:

1. The data describing one machine or one stream may not have a uniform structure.

2. Usually only a few values in the data are changed during a series of simulations.

3. Three or four runs per day are required during manual examination.

4. Modification of programs is often required.

5. The programs should be simple enough for use and modification by industry and students.

The following design criteria have been used:

1 Detail should be required only where it is used.

2. A change to one part of the system should not affect unrelated parts.

3. Programs should be of a general purpose design.

4. The data should be simple to prepare and check.

No one system of programs satisfies all of the above criteria. The compromises that have been developed are:

A. Initially, a series of subroutines simulating the various machines was written in FORTRAN II. Input, output, convergence tests, and circuit description were written in the main program. The chief deficiencies were the length of the data decks, the time required to produce and test main programs, and the number of programs required to cover trivially-different cases.

B. The efficiency of the simulation system was greatly improved by a program that reads the circuit description and can read changes to the circuit description and to other data. The input and output which are completely automatic, are identified by the alphabetic names used in the circuit description. The extra flexibility and ease of use provided by this program rapidly paid for the extra development costs. The main deficiencies are in the alteration and expansion of the system.

C. An experimental simulation system using list data structures has been written to handle more complicated data and unsteady state simulation. The data structure consists of dynamically allocated vectors containing one of REAL values, INTEGER values, or pointers to vectors. FORTRAN IV supplemented by a few assembly language subroutines was used. The data structures are created

by calling FORTRAN subroutines, and contain an alphabetic name, input and output directions and all relevant numeric data. Debugging facilities are included in the system. The programs that describe the circuit by calling subroutines are very straightforward, but unfortunately, the amount of store (5K for program) available means that most runs must be segmented. Further development requires a larger computer.

D. To provide programs for student use, use outside the University, and rapid utilization of the new PDP 10 computer, a system of FORTRAN IV subroutines has recently been written. These have incorporated new algorithms which are designed to allow automatic optimization. Subroutines for simulation of each process and also input and output of each data type, are included in the system. The problems of input data and complicated data are not neatly solved by this system.

Conclusion

Simulation programs have been developed and proved of practical use for the optimization and control of mineral processing machinery. The simulation of a grinding circuit at Mount Isa Mines led to the re-arrangement of the circuit which increased the throughput from 115 tph to 125 tph. An automatic control system designed by simulation, further increased the throughput to 130 tph. These techniques are now being applied to several other plants.

Acknowledgements

Are due to the Australian Mineral Industries Research Association, Mount Isa Mines, the Staff of the University of Queensland Computer Centre, and in particular, Dr. A.J. Lynch.

References

A.J. Lynch, W.J. Whiten & N. Draper. *Developing the Optimum Performance of a Multi-Stage Grinding Circuit.* Transactions of the Institution of Mining and Metallurgy, C169, Vol. 76, 1967.

A.J. Lynch, T.C. Rao, W.J. Whiten and J.R. Kelly. *An Analysis of the Performance of a Ball Mill-Rake Classifier Comminution Circuit.* Aust.I.M.M. Proceedings, No. 224, December 1967.

A.J. Lynch, T.C. Rao and W.J. Whiten. *Technical Note on On-Stream Sizing Analysis in Closed Grinding Circuits.* Aus.I.M.M. Proceedings, No. 223, September 1967.

A.J. Lynch and K. Dredge. *Course Notes - Second Residential School on Mineral Processing.* May 1968.

A.J. Lynch and W.J. Whiten. *Time Dependent Equations of Comminution.* Presented at the 34th Chem. Eng. Symposium, American Chemical Society, December 1967.

A.J. Lynch, T.C. Rao and W.J. Whiten. *The Behaviour of Galena and Marmatite in the Grinding Circuit at New Broken Hill Consolidated Limited.* Presented at the Annual Conference of the Aus.I.M.M., August 1968.