UNIVERSITY OF QUEENSLAND
COMPUTER CENTRE

COMPUTER

CENTRE

BULLETIN

THIS EDITION

With Volume 2 of the Bulletin close to completion, we ask that individual readers who wish to continue receiving the Bulletin next year, fill in the application form on the last page of this issue. As a large proportion of individual clients are closely associated with the Computer Centre for only a year, this *individual* mailing list is maintained on an annual basis, hence the need to re-apply for Volume 3.

It is emphasized, however, that *organizations* and *departments* will receive Volume 3 of the Bulletin, unchanged, throughout 1970 as their mailing list is permanent.

Prompt notification of any change of address to the Editor, would be greatly appreciated.

In this issue is a somewhat timely article on the PDP 10 Accounting System, describing the differences in operation between the PDP 10 and the GE 225, and hence differences in accounting procedures. Another article introduces readers to the techniques of direct access.

STAFF OF THE COMPUTER CENTRE

A very warm welcome is extended to two new members of staff, *Julie Hislop* and *Barbara Farnsworth*. Julie has been appointed a Computer Operator, and Barbara, whose duties include typing and general clerical work, is a Female Assistant.

PDP 10 OPERATING SYSTEM

BUGS ATTACKED

During the last month, Digital Equipment Australia released new versions
of the FORTRAN IV compiler and loader which, after testing, were placed in the
System Library. These new versions are intended to correct most of the error
conditions that have been previously reported.

It is always possible, however, that a particular combination of errors
may escape the checking capability of the programs. Users are therefore asked
to report any errors, particularly those which seem to duplicate the problem
areas described in previous issues of the tne Bulletin.

LIBRARY ACCESSIONS

This month's list outlines the books, theses, and periodicals that the
Libraries of the University of Queensland acquired in May 1969.

Arbib, Michael A.ed.   *Algebraic Theory of Machines, Languages, and Semi-groups.*
1968. (621.8 ARB, Maths Lib.)

Nuffield Mathematics Project.   *Computation and Structure.* 1967. (510 NUF,
Education Methods Lib.)

Encyclopaedia of Cybernetics. 1968. (001.5303 ENC, Main Reference)

Orchard-Hays, William. *Advanced Linear Programming Computer Techniques.* 1968.
(519.92 ORC, Engin. Lib.)

Queensland University, Computer Centre. *Technical Manual No. 1.* 1968 and onwards.
(510.7834 QUE, Engin. Lib.)

Prausnitz, J.M.   *Computer Calculations for High Pressure Vapor-Liquid
Equilibria.* 1968. (541.363 PRA, Engin. Lib.)

Brown, John A.   *Computers and Automation.* 1968. (651.8 BRO, Main Lib.)

DIRECT ACCESS

J. S. Williams

Modern methods of storage of information on the computer make considerable use of magnetic disks. For this reason, the techniques of direct access of information on the disk are introduced to readers, and more detailed articles will be included in future Bulletins.

A *file* is a highly structured collection of information. It can contain a program for processing by a compiler or assembler, or data to be processed by a program. Conceptually, files are associated with all input and output devices, (e.g. a card deck is a file). However, files are usually regarded as existing on magnetic tape and magnetic disk.

A file is divided into sections, called *records*. For example, consider a card deck containing a program or data. The physical shape and size of each card are fixed, and therefore, the number of character positions on each card is also fixed. A card can thus be called a *physical record*. Each logical unit of information (instruction or data) to be punched on the cards, can fill a part of a card or more than a card. As a result, the logical unit of information is called a *logical record*.

In general, a file contains logical records but, due to the physical limitations of the device, files are written as a series of physical records. A physical record can contain one logical record or part thereof, or more than one logical record. To access a given logical record, the appropriate physical record(s) must be obtained and the logical record extracted.

There are two methods of accessing the appropriate physical record(s) to extract the desired logical record, viz.:

    (i) *Sequential Access*
    (ii) *Direct Access*

Sequential access of a record is gained by reading sequentially through the file from the present record. As files on *magnetic tape* are processed in this way,

it is an advantage to have the records in the order of processing, or to have records that can be processed in any order. When updating a file on magnetic tape, the file to be modified must be transferred to another magnetic tape, and the changes made during this process. Magnetic tape is, therefore, best suited to files where the records are to be processed sequentially.

The physical characteristics of the *magnetic disk* enable *direct access* of records without reading intervening records. For some files, this is of no advantage, i.e. for files where the next record required is always the next sequential record. There are, however, many types of files that benefit greatly from direct access techniques - particularly in the age of the teletype where conversational programs are possible. These files have the common characteristic that the nth record contains information about the nth product, client, experiment, or whatever it may be. Using direct access, this nth record can be written onto the disk or read back from the disk, directly. A file on disk can be updated by changing the appropriate records in the existing file, provided no additional records are to be inserted or deleted.

The two disks attached to the PDP 10 are each capable of recording approximately half a million words. These disks are mounted on a vertical plane and are continually rotating. A band, placed towards the edge of each side of the disk, is used to record information, and is made up of a series of concentric tracks. As the disk is divided into sectors (like a piece of cake), each track is divided into sections, each of which is a *physical record*. There is a read and write head for every track and the disk "knows" which sector of the disk is passing under the head at any time. When a request to read or write a particular record is received, the device selects the appropriate head and the sector. Since the disk knows which sector is passing under the head, it can calculate when to begin reading or writing. Thus, the maximum delay before commencing to read or write is the time taken for one revolution of the disk.

Fortunately, most programmers do not have direct contact with physical records. In the high-level languages, e.g. FORTRAN IV, special forms of the input and output instructions are provided to read or write logical records. The packing or splitting into physical records is shielded from the programmer by the operating system. Even low-level assembly languages have input and output

routines that enable the programmer, in effect, to input and output logical records.

To summarize:

(a) Disk direct access allows random access of the records in a file without significantly increasing the time compared with sequential processing of the file.

Figure 1. Diagrammatic Representation of a Disk

(b) Updating a file on the disk can be done in situ, providing no records are to be deleted or inserted (records *can* be added to the end of the file).
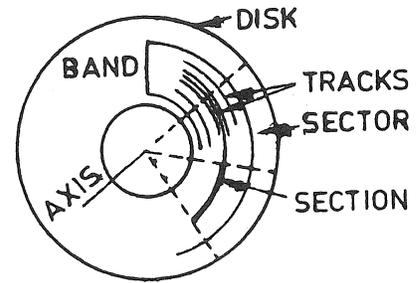
THE PDP 10 ACCOUNTING SYSTEM

J. D. Noad

Now that the PDP 10 Computer System has been operational for some months, most users have probably realized that the accounting systems for the GE 225 and PDP 10 differ in major respects. The main reason for these differences is the particular philosophy underlying each computer system.

The GE 225 is strictly a *batch* system, performing one job at a time. Thus, although the job may not use magnetic tapes, for example, this facility will remain completely idle as that job effectively ties up the system. This means that users pay a flat rate for time spent on the system. The PDP 10, on the other hand, is a *time-sharing* system which can handle many jobs simultaneously so that users can share all system facilities. As two different users, each unbeknown to the other, may have programs in memory at the same time, it would obviously be unfair to charge both for using full-memory space. Charges are made only for the actual facilities used – card reading, memory space, central processing unit time, and printing. As further facilities become available on the PDP 10, each will be charged for on an individual usage basis. These charges will be levied for file reading

and writing, file opening, and teletype input and output. Because charges
are made for the use of system facilities, teletype charges are based, not on
the length of time for which the user's teletype is connected to the computer,
but on the amount of data transmitted to and from the teletype.

It is to be expected that the accounting procedures of the GE 225 and
PDP 10 would vary considerably because of the differences in philosophy
between the two systems. With the GE 225, the operator determines the time
taken for each physical job as only one job at a time is loaded and executed.
With the PDP 10, however, several jobs are run simultaneously, each executed
in turn for a short period of time, e.g. 20 milliseconds, so that it is
impossible for the operator to determine the system usage of an individual job.
The PDP 10, itself, must therefore calculate the charges for the job as it
runs. It is possible, then, to produce a detailed statement of charges for a
job at the end of each run.

Because of the time-sharing nature of the PDP 10, the operator cannot know
if a job runs into an infinite loop. All users must specify an upper cost limit
for each run as the PDP 10 will not perform any processing in excess of this
limit. It therefore serves as a safety check against a runaway job.

As well as these technical considerations, the PDP 10 accounting system
must satisfy other requirements. All charges made against University Departments
are handled by the University Administration. The accounts produced by the
computer must interface with the University's internal accounting system, and,
ideally, invoices sent from the Computer Centre to Departments should be
summarized on the basis of the internal accounting structure of the University.
At the same time, of course, it is necessary for the Computer Centre to produce
invoices in sufficient detail to satisfy the requirements of non-university clients.

It is clear that the production and implementation of an accounting system of
this complexity is a major task. In order that clients could begin using the
PDP 10 as early as possible, the accounting system was designed to be implemented
in a number of phases.

The first phase established all necessary accounting files, enabled data entry to these files, and permitted charging for all facilities used. This phase, which was operational in May, involved the writing of a suite of thirty-five large and complex programs. The second phase of the implementation of the accounting system involved the production of programs to process charge information and produce detailed summaries of charges for the University Administration and University Departments, and invoices for non-university clients. This phase is now very close to completion. A number of other phases are yet to come, but, as they are concerned mainly with internal procedures, clients will be unaware of their implementation.

It is hoped that clients will find that this new system of accounting meets all their requirements. Any queries on particular accounts or on the accounting system in general, should be directed to the Administrative Officer (Mr. John Jauncey, extension 8471).

BULLETIN MAILING LIST

       The Bulletin is distributed according to two mailing lists, one for organizations and departments which is permanent, and the other, for individuals, maintained on an annual basis.

       To receive Volume 3 of the Bulletin, please complete the appropriate section of the following form, and return it to:-

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