

### THE COMPUTER AT CHAPEL HILL

An account of the installation of the Remington Rand Univac 1105 at the University of North Carolina in 1959, and the resulting development of The Computation Center in its local, national, and world perspective.

Chapel Hill, North Carolina

1960

# Facts About the Univac 1105

## **Its correct name:**

Automatic electronic digital computing system.

## **Its "age":**

It was installed here in August 1959.

## **Its "size":**

As large as any University computer installation in the world, so far as we know.

## **Its cost:**

The list price of this installation was \$2,450,000.

## **Its speed:**

30,000 to 40,000 additions and subtractions per second; approximately 4,000 multiplications per second; and approximately 2,000 divisions per second.

## **Its volume of storage ("memory"):**

8,192 words of magnetic core storage with an access time of 8 microseconds (millionths of a second); over 32,000 words of directly operable magnetic drum storage, to which the access time is 17 milliseconds (thousandths of a second).

## **Its uses:**

Data processing and record keeping; research in fields as varied as chemistry, city planning, forestry, mathematics, biostatistics, and business administration; eventually linguistics (concordances, translations, etc.).

## **Its future:**

Experts are already speaking of "the computer revolution" and foretelling the introduction of "computer-oriented mathematics" as early as the 9th grade.

# The Computer at Chapel Hill

In August, 1959 the Consolidated University of North Carolina installed a new Univac Scientific 1105 Digital Computer in Phillips Hall, the newly remodeled physics and mathematics building at Chapel Hill. This is as large as any university computer installation in the world, so far as we know, and is almost identical to the computer in use by the Armour Research Foundation at the Illinois Institute of Technology, Chicago, and similar to those at M.I.T., Berkeley, Michigan, U. C. L. A., and Ohio State University. Two other identical installations are operated by the Bureau of the Census at Suitland, Maryland, and others are in use by the various Air Materiel Commands.

## **Financing the Computer**

The development here was made possible by the generosity and cooperation of state and Federal governments, the company who made the machine, and the National Science Foundation. The list price of this installation was \$2,450,000. Sources of funds were: a Remington-Rand Univac donation of fifty per cent of the list price; Bureau of the Census, \$700,000; National Science Foundation, \$500,000; and the State of North Carolina, which contributed \$225,000 to activating and initial operating expenses in addition to providing the building.

In return for its contribution the Bureau of the Census is using the computer to process statistics involved in the 1960 census of population and housing, and is currently sharing proportionately in the operating cost. After this initial operation, the Bureau of the Census has an option on a portion of time daily until 1968. The North Carolina population census for 1960 will be processed right here in Chapel Hill (as will that for many other states as well.)

## **Speed and Volume of the Computer**

The Univac-1105, as it is most commonly called, has tremendous operating capacity, "memory", and speed: it can perform approximately 30,000 additions and subtractions per second; approximately 4,000 multiplications per second; and approximately 2,000 divisions per second. It has 8,192 words of magnetic core storage with an access time of 8 microseconds (millionths of a second), and over 32,000 words of directly operable magnetic drum storage, to which the access time is 17 milliseconds (thousandths of a second).

In addition the computer has seventeen Uniservo magnetic tape units, punched card and paper tape input-output, and an off-line high-speed printer with a maximum speed of 600 lines per minute. Complete buffering allows independent operation of the main computer unit and magnetic tapes, making possible efficiency when many different research and data processing activities are going on at the Computation Center simultaneously.

$$(A \cap B) \cap C = A \cap (B \cap C)$$

### Automatic Programming Aids

The Computation Center, since its inception, has stressed the use and development of automatic programming facilities and the development of new languages for users of the machine. At present there are various versions of the IT (Internal Translator) Compiler, with complete simplified input-output and symbol manipulation facilities; a GAT (Generalized Algebraic Translator) system: compatible with IBM 650 systems; and the standard USE compiler-assembly systems. Work is proceeding on an ALGOL translator, a COBOL compiler, and an IPL-VI information processing system. Further work is planned on systems identical or similar to COMIT and LISP, as well as an overall monitoring system.

All these esoteric titles are names of programming systems and languages, in the areas of the natural and social sciences, business data processing, linguistics—including language translations, and the other humanities. These systems and languages will enable students and professors and other residents of North Carolina to use these machines more easily and more fully.

$$2^4 < 20 < 2^5$$

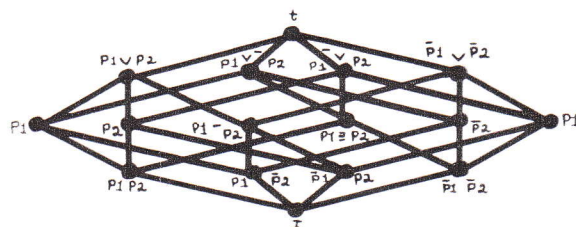
### Research Uses

In addition to serving as a teaching tool in University classes, the computer is being used as a research tool in such areas as automatic programming, automatic numerical analysis, solution of partial differential equations, and linear equations. The computer here is being used for research also in fields as diverse as chemistry, city planning, biostatistics, business administration studies, and forestry. The gray ranks of the computer's units have joined the microscope and the test tube as a symbol of research, going far beyond the more prosaic functions of bookkeeping and data processing.

## Computers Beyond the Seas and the Sky

Use of computers as tools for research, engineering, and data processing is increasingly widespread throughout the world. Contact with European and Latin American computer scientists and research people is maintained and encouraged here at the Computation Center in Chapel Hill. Under the support of the National Science Foundation, the Center has continued its study of digital computer mathematics and techniques in the Soviet Union, and graduate assistantships are available for students with ability in reading Russian.

Journals describing computer research and activity in the People's Republic of China are beginning to come in, chiefly by means of Soviet translations available in England. Particular emphasis appears to be given currently in the U. S. S. R. and in China to language translations, which is a promising field for a research computer in a university center, and is expected to be developed here. Analytical studies in numerical analysis are being carried out in parallel with computer runs on our Univac 1105. In addition to these uses, this computer is capable of involved data-processing, and can be a valuable tool in University administration as the size of the institution increases. It goes without saying that the computer is a basic and indispensable factor in the exploration of outer space.



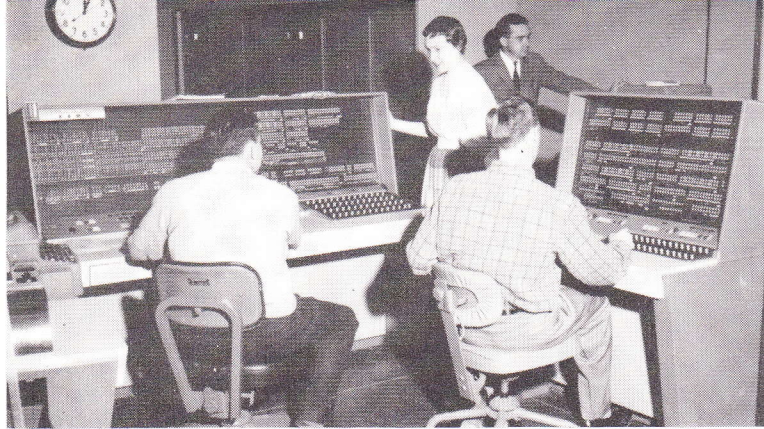
Lattice Design—Boolean Algebra

### Courses and Seminars

Among the courses and seminars in computer-oriented mathematics given or planned to be given in the current two-year period are:

- Theory of Computer Programming
- Theory of Computability and Decidability
- Numerical Solution of Partial Differential Equations
- Calculations of Orbital Trajectories
- Error Analysis in Numerical Computations
- Theory and Practice in Linear Systems

The University has been awarded six National Defense Graduate Fellowships in "The Theory and Practice of Digital Computers". (Continued on page 6)



## The Computer in Operation

Upper left: Supervisory Control Panel of the Univac Scientific Electronic Digital Computer. About half of the panel consists of indicator lights. Most of the switches and buttons are seldom used.

Lower Left: The Univac High-Speed-Printer has a capacity of up to 600 lines per minute. It can even make five carbon copies.

Upper right: The gray ranks of the Computer, looking toward the supervisory control panel, reach far back into the building with the Maintenance Area beyond.

Lower right: An engineer checks a spare chassis. Interchangeable parts contribute dependability to the Computer's near-continuous functioning.



### Administrative Organization of the Computation Center

The Computation Center is a Consolidated University of North Carolina function, administered by a director who reports to the Vice-President of the Consolidated University, and who is also an associate professor of mathematics. The Center has an associate director, responsible for financial affairs and general operation of the computer.

There is one secretary to the director with two assistants, who share in the duties of punching cards and operating the Flexowriters which punch the paper tape. In addition there is one full-time administrative assistant with a number of responsibilities, including work on publications, the summer conferences, and various editorial and liaison activities. There is also a part-time editorial assistant who works exclusively with the new journal, *Computing Reviews*.

The **Programming Staff** is responsible for designing ways and means of putting various research and data problems into the computer. There are three full-time programmers and a varying number of graduate assistants.

The **Operations Staff** has seven full-time people, and three part-time assistants. The Center maintains an active training program in this and other fields, recruiting personnel for courses at the Remington-Rand Washington and Chicago establishments.

The **Maintenance Staff** is an important cog in the wheel, and claims its own "holiday" weekly for the busy machine to do "preventive" maintenance. A marked characteristic of the Center staff is its relative youth; this is quite plainly a field of the future. However, it is far from a juvenile operation. On each of the three campuses there is a faculty advisory committee for coordinating relationships with the Computation Center. Beyond this there is a joint faculty advisory committee which maintains a degree of perspective on the program of the Computation Center and warm interest in its development.

## Courses and Seminars

(Continued from page 3)

This group of young men and young women, who are supported by the Department of Health, Education and Welfare under the National Defense Education Act, including students who graduated from Universities in almost every area of the country, constitute the beginnings of a pool of scientists who will be able to teach other interested oncoming students here or elsewhere.

The Chair of Computing Mathematics at Moscow State University, headed by Academician Sobolev, graduates "over 50" students each year in the area of computer oriented mathematics—probably as many as all U. S. universities combined at the present time. The presence among us of these National Defense fellows who are potential future teachers may help to even the scales.

**Dr. Cornelius Lanczos of the Institute of Advanced Study, Dublin**, has occupied the post of Visiting Mathematician in the Center for Spring of 1960, and similar guests will be invited for later periods. Dr. John W. Carr, III, formerly of Michigan and Past-President of the Association for Computing Machinery, assumed the post of Director of the Computation Center and Associate Professor of Mathematics in February, 1959.

The first of a series of Conferences on Frontier Research in Digital Computers was held in August 1959 with distinguished American and foreign lecturers participating. Similar Conferences, with lectures from the United States and overseas, are projected for the coming summer. Graduate students accepted for enrollment in the departments of the University are allowed to attend this conference without tuition charges.

0111-(0110 → 0100·0000)-1000

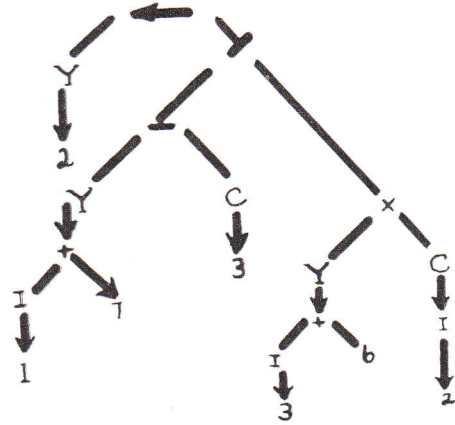
## A New Journal

Editorial offices of the new journal, *Computing Reviews*, to be published by the Association for Computing Machinery, are now located at the Computation Center in Chapel Hill. This new and needed venture has been well received here and abroad.

## University Use of the Computer

Use of the computer by the various disciplines and departments of the University is increasing, as the incredible potential of this fabulous machine becomes less unfamiliar. Pure research in the physical sciences is a very important use for the computer, but the computer's competence is by no means limited to this broad field of knowledge.

In addition to record-keeping and other aspects of office management and data processing, complicated financial and other transactions, computers are becoming more and more significant in legal, medical, and literary areas. Current research on computers in "game playing", musical composition, literary concordances, and complex language response is directed toward the development of programs and processes which will enable the computer to operate in a closer approximation to human behavior. Neurological research is in process to aid in simulating the human nervous system.



Decomposition of an IT (Internal Translation) Algebraic Language

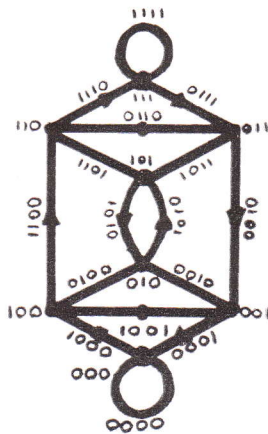
The computer is becoming increasingly popular not only with the faculty as a research tool, but as an eighth wonder of the world to the public at large. Thousands of people have visited the Computation Center and hundreds of high school students, some of them beset with mathematical problems, have yearned over the performance of the marvelous monster. Even the Cub Scouts have begun to make the trek. Out of all this interest the Center staff hopes to raise up some good computer-oriented mathematicians.

## Impact on the Future

Philosophers in the field have long been trying to evaluate the social, educational, industrial, intellectual, even spiritual, implications of the "computer revolution." Many developments have come about since Charles Babbage, a Cambridge professor, designed in England (but did not complete) the first computer back in the 1840's. Soviet scientists report that a computer was built in Russia in 1911 to solve differential equations. The pace of these changes has accelerated greatly in the last decade, since the first truly electronic machine was built in the United States in 1945.

Use of the computer is increasingly widespread, and it is estimated that over 3000 automatic digital computers are now installed in the United States, with many more on the way. About 400 of the so-called "giant computers" have been built in this country since 1951, and it is estimated that the next *two* years will see 500 added to this number.

The resulting requirement for personnel to man these machines is enormous, estimated at 30,000 mathematicians. This situation has great significance for the undergraduate program in our colleges and universities, and is expected to augment sharply the study of computer oriented mathematics, a term which belies the "pure" and theoretical knowledge fundamental to the management of the computer's processes. The computer's challenge to men of many academic disciplines and a wide range of vocations becomes more evident as time goes by.



*Abstraction of  
a Ring Counter*

**Auxiliary Equipment**—Various types of machines, either connected or not connected to the computer, that are used to prepare and insert information, record the results of computations, translate information from one form of code representation to another, and transfer information from one type of external storage form to another.

Familiar terminology around the computer are these words: **Flex**—an automatic typewriter and paper tape punching machine, called a Flexowriter; **Punch**—an IBM machine which punches cards which carry programs into the computer; **Bull**—a French manufactured machine which receives the cards; and the **High Speed Printer**—an automatic press which prints as many as 600 lines a minute.

**Binary**—A number system which uses two numbers, zero and one, in arithmetic processes instead of the numbers zero through nine as in the decimal system.

**Binary Code**—A fixed pattern of ones and zeroes which, according to their position in a series of these numbers, equal a corresponding amount in the decimal or any other number system. For instance, 101 in binary is equal to 5 in decimal.

**Buffer Storage**—Equipment located between two other parts of a computer or auxiliary or between a section of the computer and an auxiliary outside the computer, which temporarily holds information after it is received from one location and before it is sent on to another.

**Data**—Usually numbers, letters, and/or symbols which are acted upon in one way or another, in contrast to information, which usually is considered to include both data and the commands given to the computer to perform various operations upon the data.

**Digit**—A number, but as used in computing terminology, also any information in numerical form including numbers, letters, and/or symbols.

**Memory**—The sections or units within the computer or auxiliary unit or the materials such as tape or cards where the information is stored pending future use. A memory unit within the computer is frequently also called a storage unit, but tapes and cards, which are used for storing information away from the computer, are commonly referred to as storage media.

**Program**—The precise sequence of coded commands given the computer to carry out the operations desired on the data and usually also containing the data itself. At times the procedures directing the operations of an auxiliary are also referred to as a program. The terms program and routine are often used synonymously.

