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A Primer in Computer Literacy For Students of English in a Second Language

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A PRIMER IN COMPUTER LITERACY

for Students of

English as a Second Language

by

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FILE ABSTRACT FORM

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Abstract:

This series of seven readings for ESL students covers various topics in computer literacy. Their main aims are cognitive formation of basic concepts in computer literacy and acquisition of vocabulary pertaining to those concept areas. The intended readers are sixth grade students with an intermediate ESL ability. Grammatical structures are limited to those covered in an intensive beginners' course. Non-technical vocabulary is limited to a 1000-word frequency list. The readings are written at a fourth grade reading level according to Fry's Readability Scale.

Eric Descriptors: ESP, ESL, BME

TABLE OF CONTENTS

Teacher's Introduction

This primer in computer literacy is written for students of English as a Second Language with the intention that it will open up the subject with a manageable amount of vocabulary and English usage. Hopefully it will prove to be a stepping-stone from the study of English language to the study of motivating content areas in English.

The readings are geared towards sixth grade students, especially those whose performance is good to excellent in math and science in their native languages.

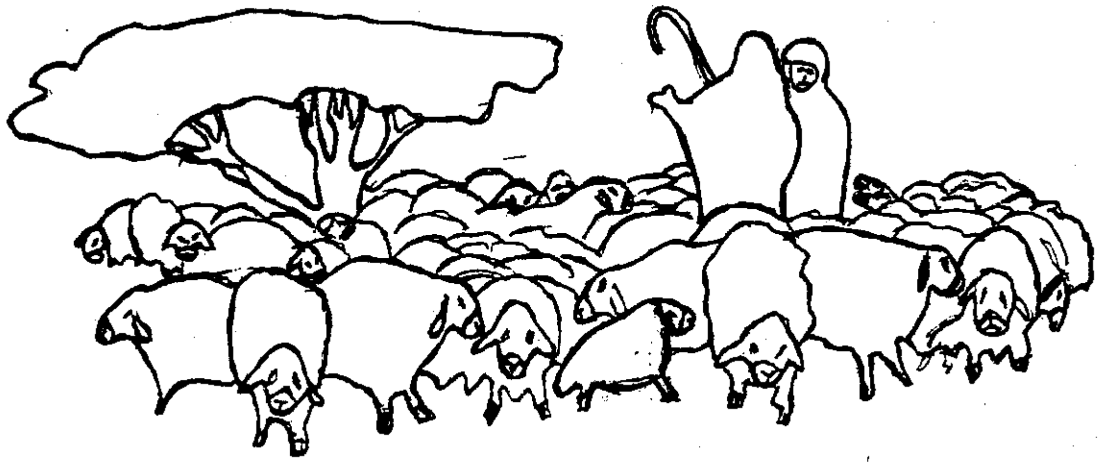
The grammatical structures are generally limited to those given in an intensive beginners' course.[1] The vocabulary is limited to a 1000-word frequency list.[2] The other limit set upon the readings is that of readability. According to the scale used[3], the readings maintain a fourth grade reading level.

The use of these readings presupposes a qualified teacher. Such a teacher should be proficient in the use of English and familiar with the conceptual area. It would be the teacher's responsibility to consistently monitor the students' grasp of the material as regards both the content area and the language used. The teacher is also the key to pronunciation, since pronunciation is not treated in this work.

In Appendix III a suggested format for accompanying English Language exercises is laid out for passive voice, comparatives and expressions. A very thorough course would continue such exercises beyond the first chapter.

After a course using this material, students should feel at home with the basic concepts of computers. Thus they should be able to knowledgeably participate in a course of math or computer science in the English medium.

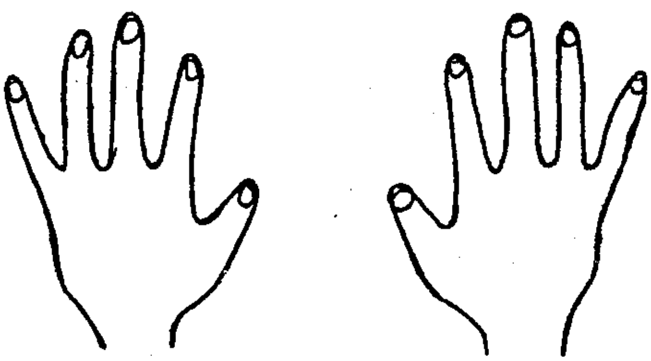
NUMBERS AND COUNTING



Large Numbers

Once, long ago, a man had a lot of sheep. He wanted to sell them, but he didn't know how many he had. He only knew that he had very many sheep. How could he count the sheep and remember how many?

Finger Counting



He looked at his hands, then he looked at his sheep. He had many more sheep than fingers. Usually, counting with fingers was helpful. But with all those sheep it was hard to remember. It was hard to remember big numbers with only his fingers to help him.

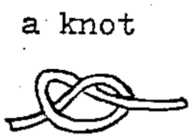
Recording Large Numbers

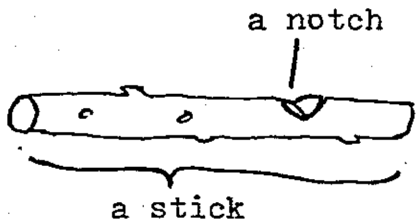
He had another problem. After he found the number of sheep, how could he remember that number for a long time? What a problem! He had so many sheep that he didn't know what to do. Can you think of a way for him to remember how many sheep he had?

It's easy, right? To solve (Solve = to find the answer) this problem he got a lot of small stones and a big bag. He put one stone in the bag for each sheep. Then he sold his sheep because he knew how many he had. Sadly for him, it was a very heavy bag!

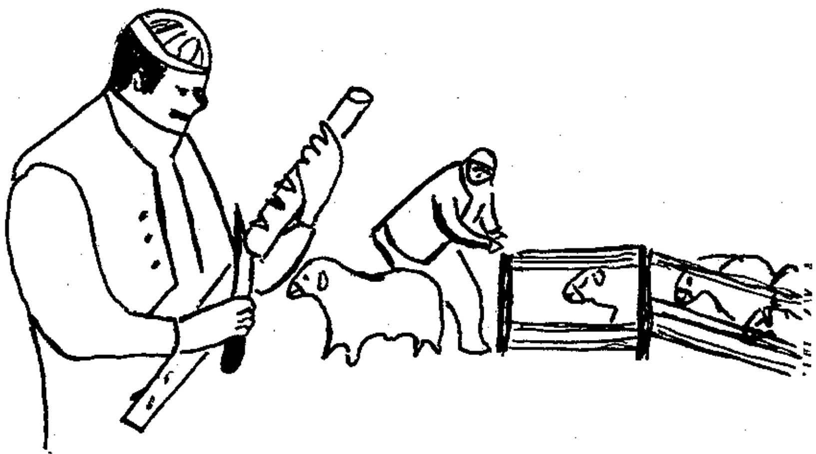
Other Ways of Recording Numbers

Some people cut notches in sticks to remember how many. Others tied knots in string to keep count.[1]





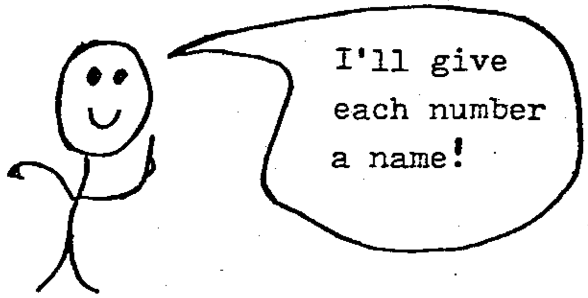
A man tying knots.



A man cutting notches.

Counting: Naming the Numbers

All these were good ways to remember numbers. But counting with them was difficult. Then somebody had a very good idea.



So each number was given a name: one, two, three,... up to ten. We don't stop there. We also name groups of ten: two tens is twenty, ten tens is a hundred, and ten hundreds is a thousand. The numbers come from ten. That's because people first used their fingers to count things. We call it a <u>base ten</u> system.

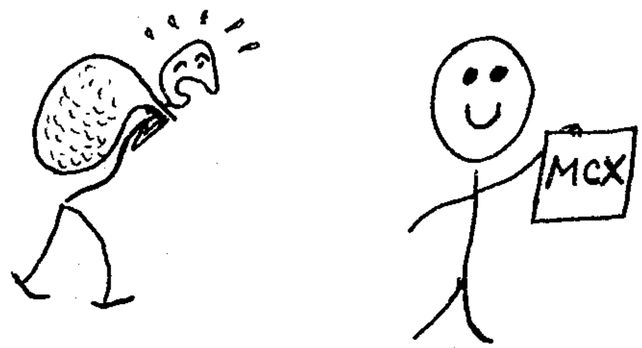
Questions to Think About

1. What did people first use to count things with?
2. What number does our number system come from?
3. What are three ways people remembered numbers? Write them in a list.
4. What if people had eight fingers instead of ten. Would that change the way we count?

Roman Numerals

The Romans were busy people. They used much of their time conquering the world. (Conquer = to take something by force.) They didn't have time to carry stones or cut notches in sticks. They had to find an easier way to remember numbers. What did they do?

The Romans used letters as symbols for numbers. (Symbol = something that means something else.  is a symbol for restaurant, a place to eat.) Their symbols for numbers are called Roman numerals. These numerals are easier to write than cutting notches in a stick. If you write them on paper, they are much lighter than a bag of stones!



Here are some of the symbols for Roman numerals:

I = one	VI = six	L = fifty
II = two	VII = seven	C = a hundred
III = three	VIII = eight	D = five hundred
IV = four	IX = nine	M = a thousand
V = five	X = ten	

The Romans conquered the world, but they couldn't do simple arithmetic. You can do arithmetic better than a Roman general.

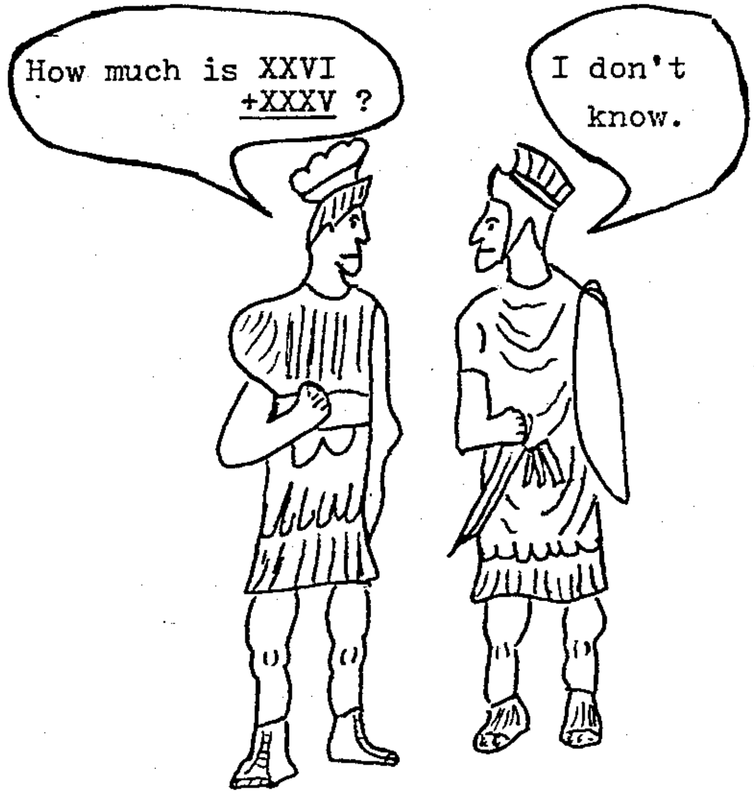
Arithmetic

$\begin{array}{r} 2 \\ +2 \\ \hline 4 \end{array}$ Addition

$\begin{array}{r} 6 \\ -2 \\ \hline 4 \end{array}$ Subtraction

$\begin{array}{r} 3 \\ \times 3 \\ \hline 9 \end{array}$ Multiplication

$4\overline{)8}$ with quotient 2 — Division



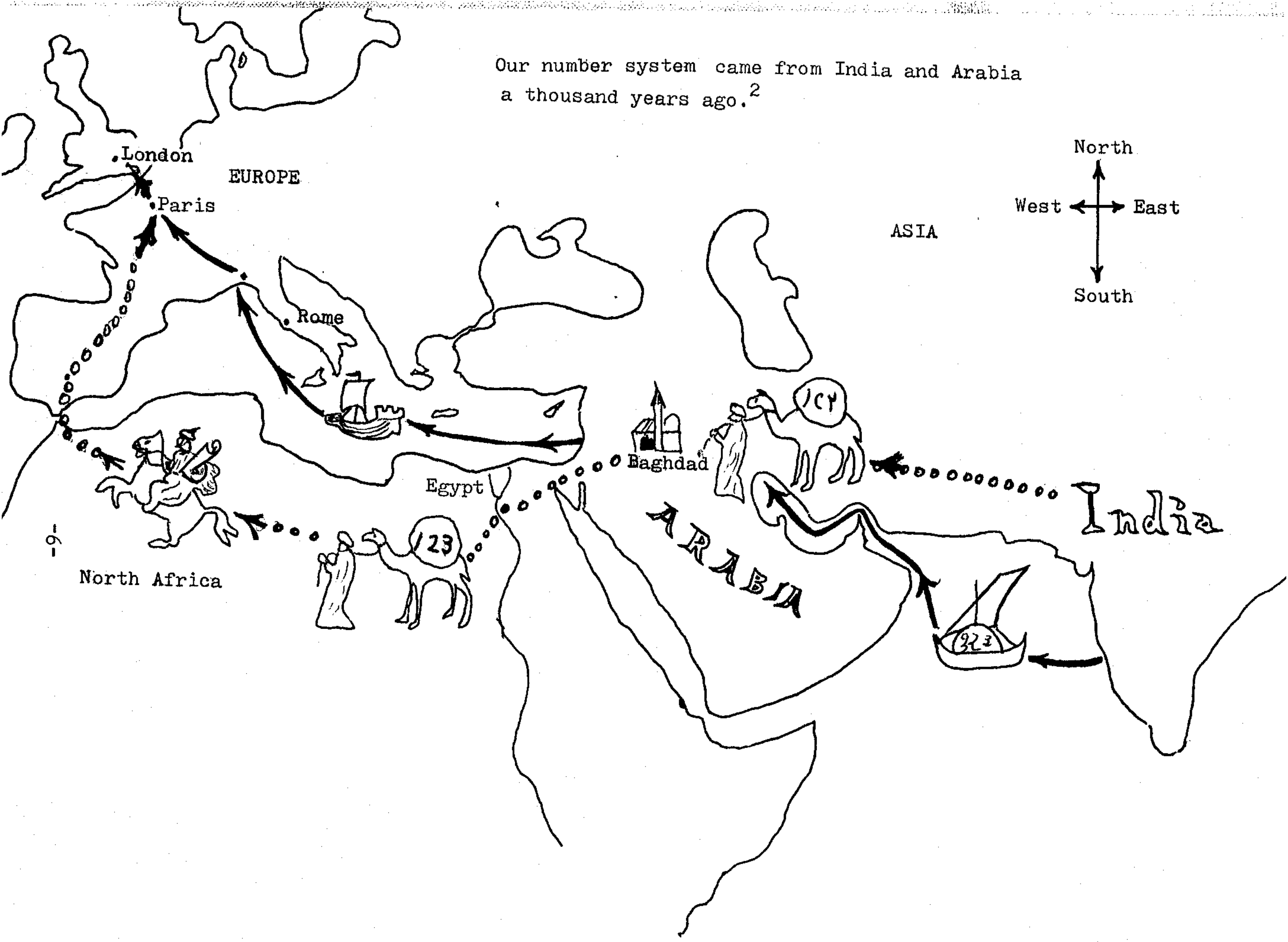
That's because the number of places in the number doesn't help you. Roman numerals don't have place value.

For example: L X V (sixty-five) has three places.

X X I I I (twenty-three) has five places.

A smaller number can have more places. So Roman numerals did not help us do arithmetic.

Our number system came from India and Arabia a thousand years ago.[2]



Questions to Think About

1. What did the Romans do to remember big numbers?
2. Why were Roman numerals better than other ways of remembering numbers?
3. What couldn't the Romans do?
4. Why is it hard to do arithmetic with Roman numerals? (What don't Roman numerals have?)

Arabic Numerals

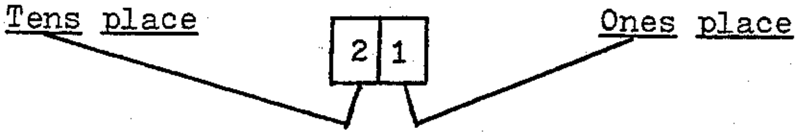
Even after the time of the Romans people still used Roman numerals. Then the Arabs brought a new way of writing numbers to the West. (The Arabs are the people from Arabia.) This new way wasn't invented by the Arabs. (Invent = to make something that hasn't been made before.) They learned these new numbers in India.

This new system helped people do arithmetic. Now it's easy using Arabic numerals (0,1,2,3,4,5,6,7,8,9). Arabic numerals are the symbols that we use for writing numbers. Now we can add (+), subtract (-), multiply (x), and divide (÷) easily with pen and paper.

Place Value

Arabic numerals work so well because of place value. The number of places in a number tells you something about the value or size of a number.

For example, the number twenty-one has two places.



The place on the left is called the tens place. There is a two in the tens place. That means two tens (2 x 10). There is a one in the ones place (1 x 1). That makes the number twenty-one.

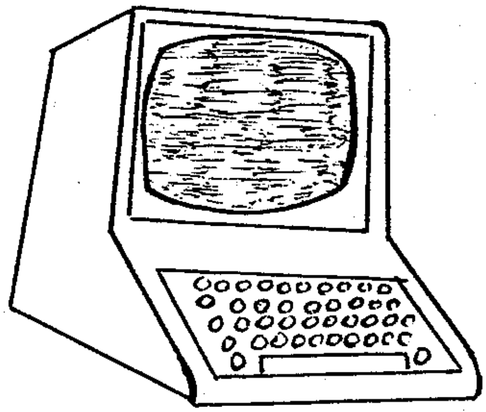
By having place value, this system makes arithmetic easy. It is a <u>base ten</u> system. Every number has ten times the value of the same number to the right of it. For example,[3] look at the number four thousand four hundred and forty-four.

Thousands	Hundreds	Tens	Ones	
			4	Four
		4	0	Forty
	4	0	0	Four Hundred
4	0	0	0	Four Thousand
4	4	4	4	

The four in the tens place has a value of forty. It has ten times the value of the four in the ones place.

Different Number Systems

Ten is not the only base number. Other base numbers can be used. Computers use a different number system - base two.



In the next chapter we will see how base two works.

Questions to Think About

1. Who did we get our number system from?
2. Did the Arabs invent it? Where did they get it?
3. What are Arabic numerals?
4. What can we do easily with pencil and paper using Arabic numerals? Four things. Write the symbol, then spell the words.

   a. __ ____________________

   b. __ ____________________

   c. __ ____________________

   d. __ ____________________

5. Why do Arabic numerals work so well? (What do they have that Roman numerals don't have?

6. In base ten every number has ______ times the value of the number to the right of it.

7. Our system is base ten. What system do computers use?

Crossword Exercise for Numbers and Counting

Across

1. The people who brought our number system from India.
2. To make something that has not been made before.
3. A picture or letter that stands for (means) something else.
4. To use your memory. The opposite of forget.
5. Our number system is based on this number.
6. A machine that remembers and does arithmetic.
7. To take one number away from another number. This is its symbol: (-).
8. To find one number times another number. This is its symbol: (x).
9. A simple adding machine used by the Romans.
10. To separate something into equal pieces. This is its symbol: (÷).
11. To say one number after another in order.

Down

1. People who lived in Rome.
2. A way of putting something in order.
3. How much something is. Roman numerals don't have place _____. Arabic numerals have place _____.
4. We have a ____ ten number system.
5. Symbol for a number.
6. The answer for a problem.
7. To put two numbers together. This is its symbol: (+).
8. A short but important verb.

List of Words used in Crossword Exercise

abacus

add

Arabs

base

be

computer

count

divide

invent

multiply

numeral

remember

Romans

solution

subtract

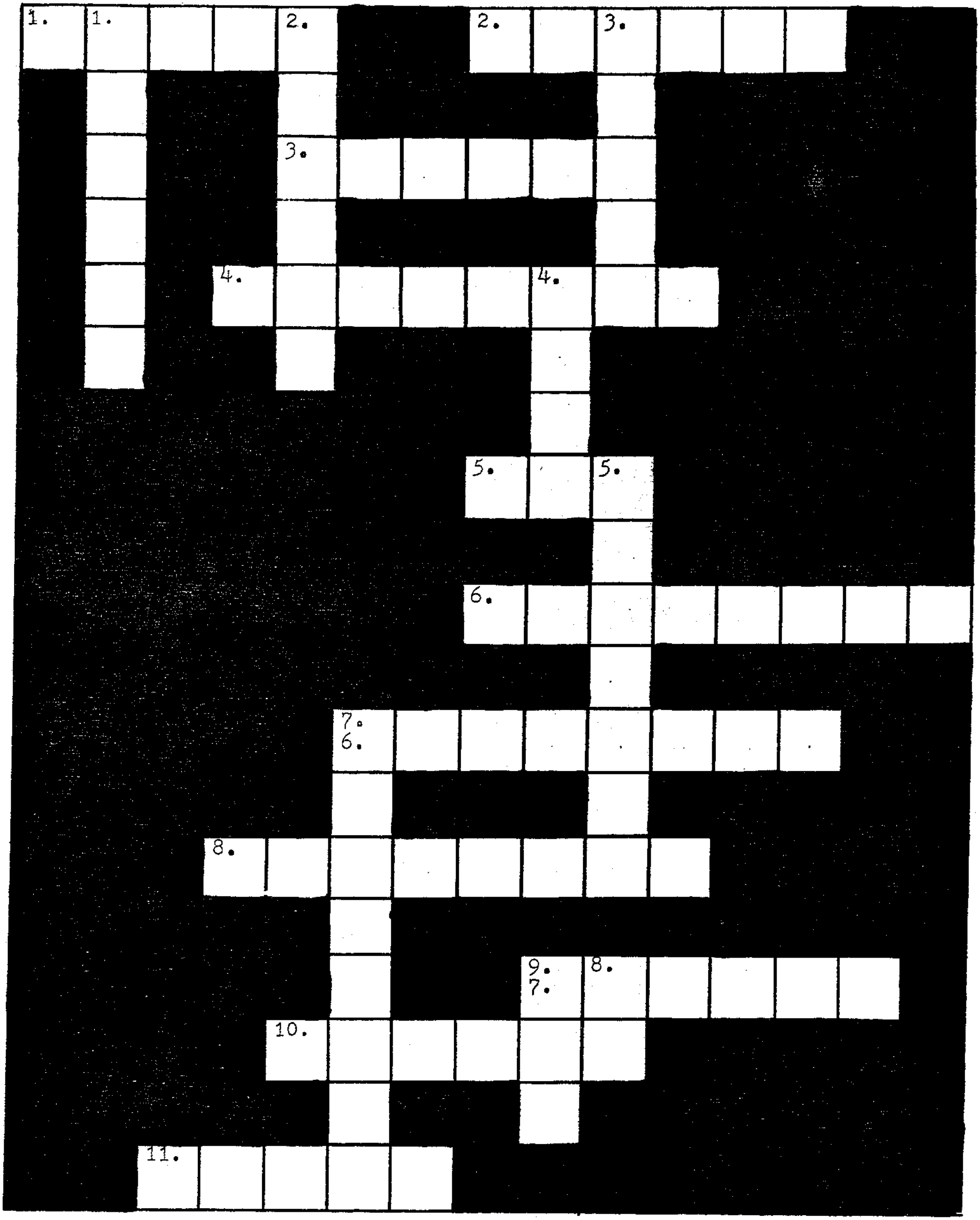
symbol

system

ten

value

Crossword Exercise: Numbers and Counting



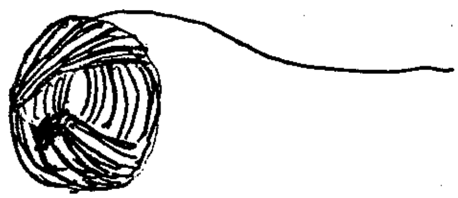
CHAPTER TWO: Base Two Numbers

Doubling Experiment[1]

Do you have a ruler?

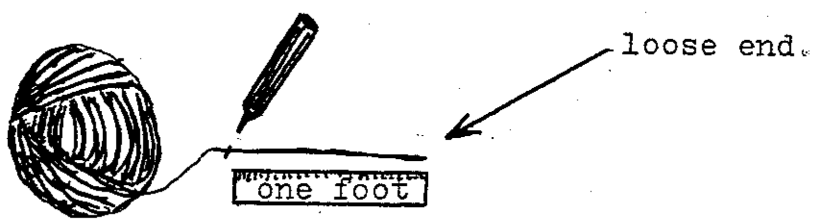
one foot (30 eentimeters)

How about a ball of string?



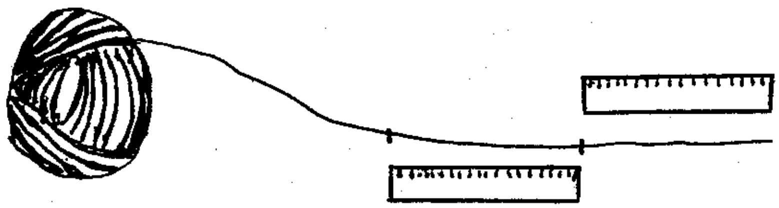
You'll need both for this experiment. (Experiment = doing something to learn new facts.)

Take the ball of string and pull off a foot. Measure it with your ruler. Then mark it with a pen.



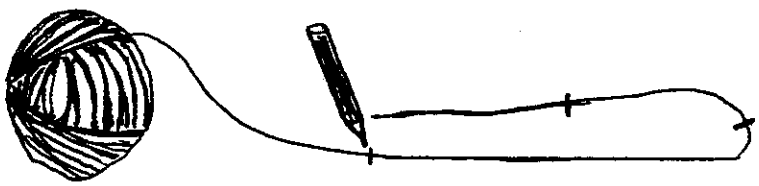
Pull off more string. Double the string. To double it, fold it at the one foot mark. Take the pen and mark the string again, even with the loose end.

Measure the new length with the ruler.



How long is it?

Now double the length again. Mark it even with the loose end as before. Guess how long it is before you measure it.



Did you guess right?

Double it one more time. Guess how long it is, then measure it. Were you right?

You began with one foot. You doubled that then you had two feet, then four feet, then eight feet.

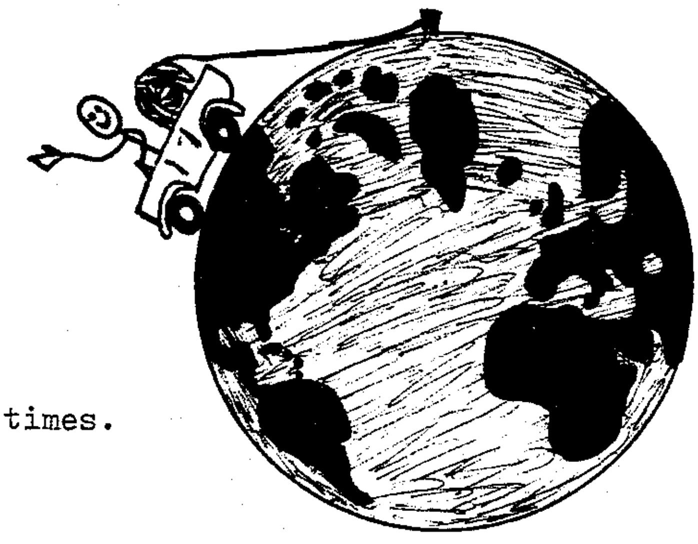
1, 2, 4, 8, ? What comes next? Guess the answer, then double the string. Measure the new length.

Every doubling makes the string twice as long. (Twice = two times) You doubled the eight foot string. The new length was sixteen feet.

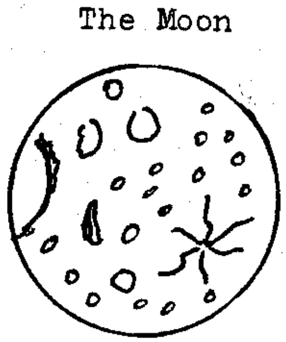
Go back and count how many times we doubled the string to get sixteen. If we double it one more time, how many feet is it?

Soon we will use all the string on the ball. How many times can we double it before we run out of string? (Run out of = to use all of something.)

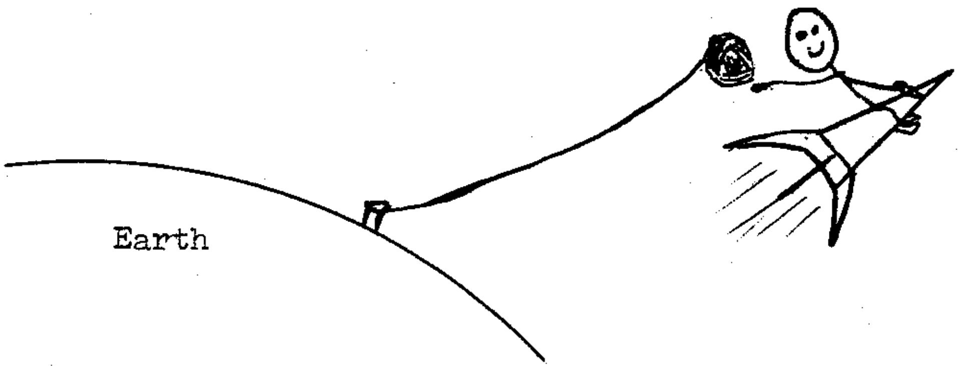
Do you want to go all the way around the world? You need a very big ball of string!



But you only need to double it 27 times.



Do you want to go to the moon?



31 doublings is more than enough to get to the moon!

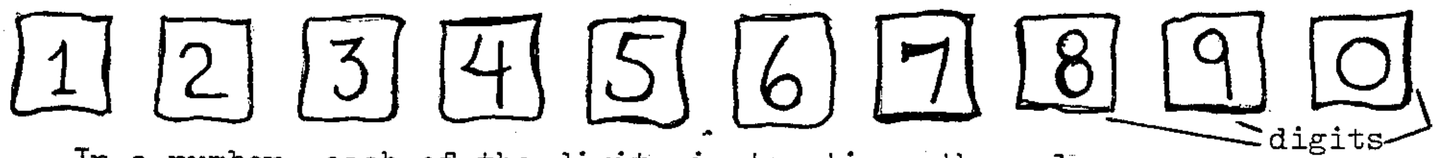
Get a pen and piece of paper. Do the experiment again. Write down how many feet you get with each doubling. You have one foot before doubling so you can write:

Number of Doublings	Number of Feet
0	1
1	2
2	4
3	?
4	?
5	?
6	?

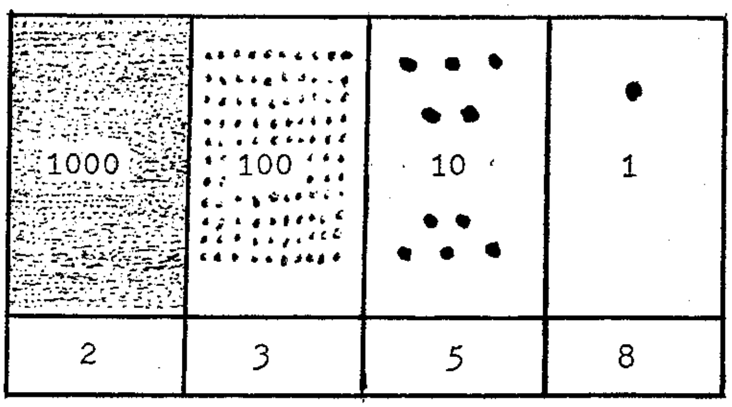
This set of numbers, 1, 2, 4, 8, 16, 32, 64,... is called the binary number sequence. Each number is two times the one before it. We can use this to count in a different way. The binary (base two) number system comes from these numbers.

Base Ten and Base Two[2]

In the last chapter we said that our numbers are base ten. The system is based on tens. In it there are ten digits.



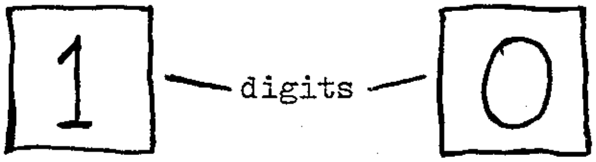
In a number, each of the digits is ten times the value of the digit on its right. For example, the number 2358 means, reading from the right:



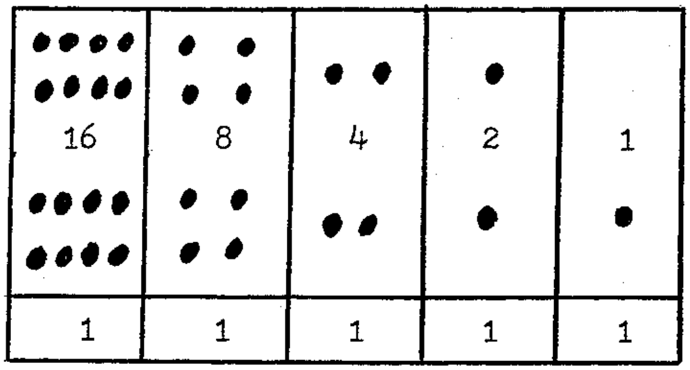
8 groups of	1	=	8
5 groups of	10	=	50
3 groups of	100	=	300
2 groups of	1000	=	2000
All added together			2358 or

two thousand, three hundred and fifty-eight.

We can write numbers in base two instead of base ten. The system is based on twos. There are only two digits.



Each of the digits is twice the value of the digit on its right. For example, the binary number 11111 means, reading from the right:

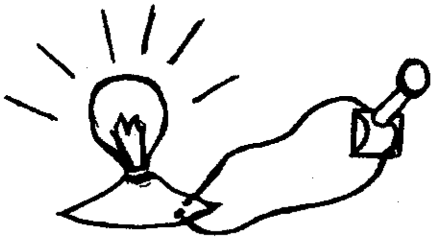


1 group of	1	=	1
1 group of	2	=	2
1 group of	4	=	4
1 group of	8	=	8
1 group of	16	=	16
All added together			31

So 11111 in base two is thirty-one in our number system.

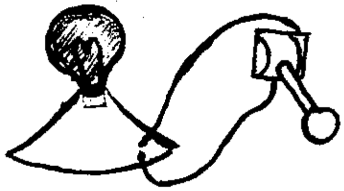
Computers and Base Two

Base two is often used in computers. Why? Because they only know the difference between "on" and "off."



ON

OFF



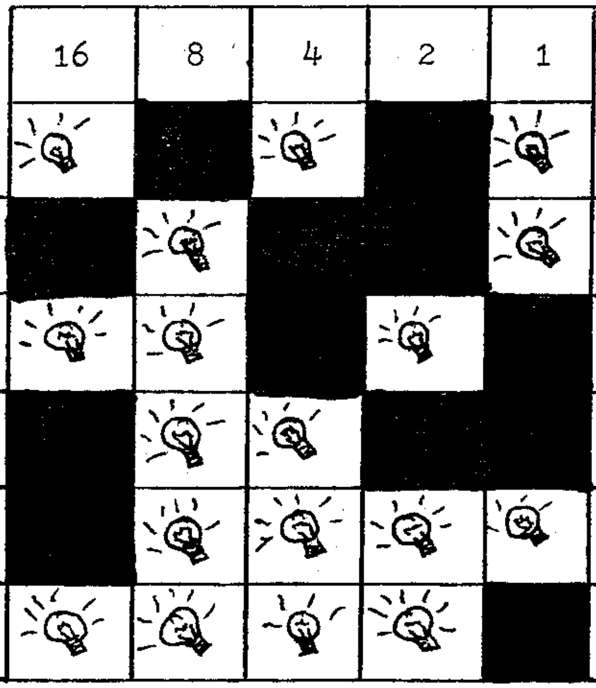
ON

OFF

Let's say	ON	=		=	1
	OFF	=		=	0

Now we can make numbers like a computer does.[3]

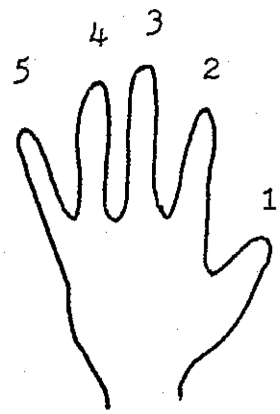
Binary Numbers	Decimal Numbers
10101	16 + 4 + 1 = 21



Can you fill in the rest of this?

Finger Computer[4]

Sometimes people use their fingers to count with. You can count to five with one hand, right?

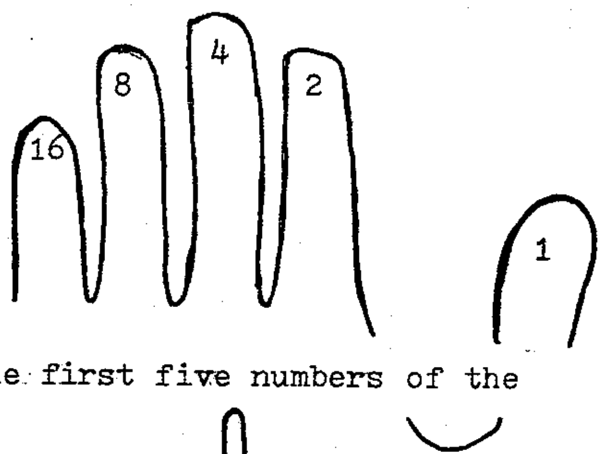


That's not much!

Did you know you can count to 31(thirty-one)? You need a finger computer to do it.

Here's how to make a finger computer. It's easy.

Write numbers on the fingers of your right hand as below.

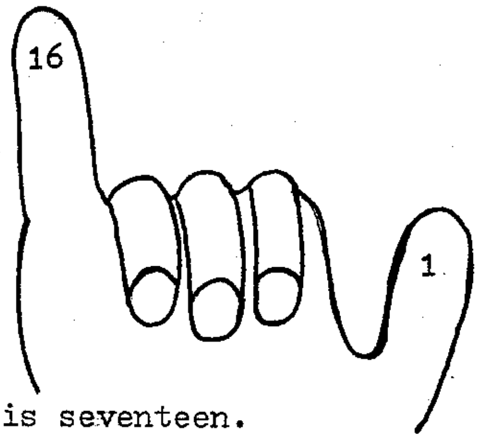


(Notice that these are the first five numbers of the binary sequence.

Hold up a finger to stand for "1". 

Put down a finger to stand for "0". 

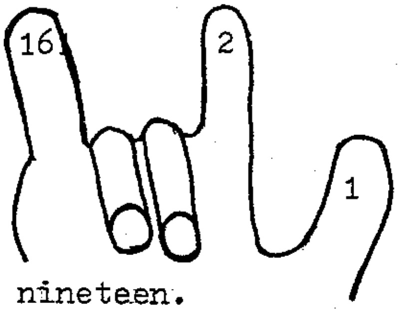
Now try it!



16 + 1 = __?

The answer is seventeen.

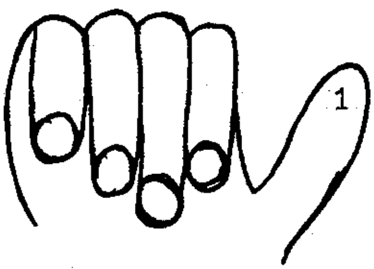
Try it again.



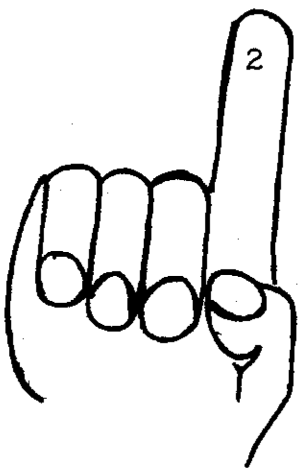
16 + 2 + 1 = __?

The answer is nineteen.

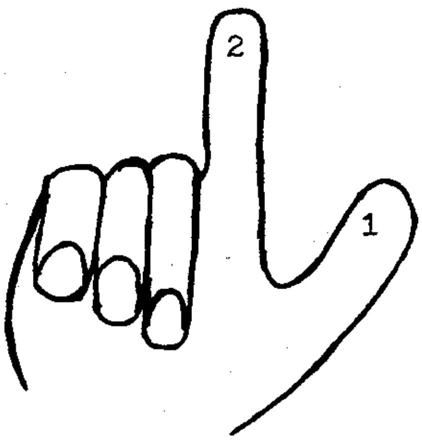
Maybe you don't believe we can count to thirty-one this way. Start from the beginning. Go through all the numbers. See if you miss any.



one



two



three

A. Can you change these base two numbers to base ten? Use your finger computer.

1. 1011	6. 10000
2. 11	7. 10001
3. 111	8. 11111
4. 1101	9. 11011
5. 1111	10. 11001

Check your answers on page 109.

B. Now change these numbers to base two.

1. 1	6. 6
2. 2	7. 3
3. 11	8. 9
4. 15	9. 20
5. 16	10. 30

Check your answers on page 109.

Writing Messages Using Binary Code[5]

Do you know this code? (Code = a special way of writing.)

A = 1	G = 7	M = 13	S = 19
B = 2	H = 8	N = 14	T = 20
C = 3	I = 9	O = 15	U = 21
D = 4	J = 10	P = 16	V = 22
E = 5	K = 11	Q = 17	W = 23
F = 6	L = 12	R = 18	X = 24

Y = 25

Z = 26

Put the code into binary numerals. Use your finger computer to help you.

A = 1	G = 111	M = 1101	S = 10011
B = 10	H = ?	N = ?	T = ?
C = 11	I = ?	O = ?	U = ?
D = ?	J = ?	P = ?	V = ?
E = ?	K = ?	Q = ?	W = ?
F = ?	L = ?	R = ?	X = ?

Y = ?

Z = ?

Now you can send <u>messages</u>. (<u>Message</u> = something you want to tell some one.)

What does this say?

(1000-101-1100-1100-1111)

How about this?

(10111-1000-1-10100) (1001-10011) (11001-1111-10101-10010) (1110-1-1101-101) ?

Can you complete this?

(1101-11001) (1110-1-1101-101) (1001-10011) (_______________) .

Computers use a code like this one. Remember, they only know the difference between on and off. They use a binary code to remember numbers, letters, words, and almost anything.

Would you like to see how computers do this? We will see how they work soon. First we will look at machines people have used to help them with numbers.

To Think About

1. Suppose you have 100 feet of string. Start with one foot. How many times can you double it?

2. Why is base two often used in computers?

3. Think of a short sentence. Write it in binary code.

4. The first people to work with computers used binary code to talk to the computers. Was that easy or hard?

5. Many people think binary code is hard to work with. So they invented <u>computer language</u>. Computer language is certain words people use with computers. They use computer language instead of binary code. Inside computers only binary code is used.

Crossword for Base Two Numbers

Across

1. Any one of the ten Arabic numeral symbols, 0 to 9.
2. A special way of writing something. You wrote with binary ____.
3. Another word for base two.
4. Something you want to tell someone.
5. Something flat and straight for taking measurements.

Down

1. If two things are not the same, there is a __________ between them.
2. Two times.
3. To make two of something.
4. Something we do to learn new facts.
   We did an __________ to learn how base two works.
5. To see how big or how long something is.

Base Two Numbers

Vocabulary List for Crossword Exercise

binary

code

difference

digit

double

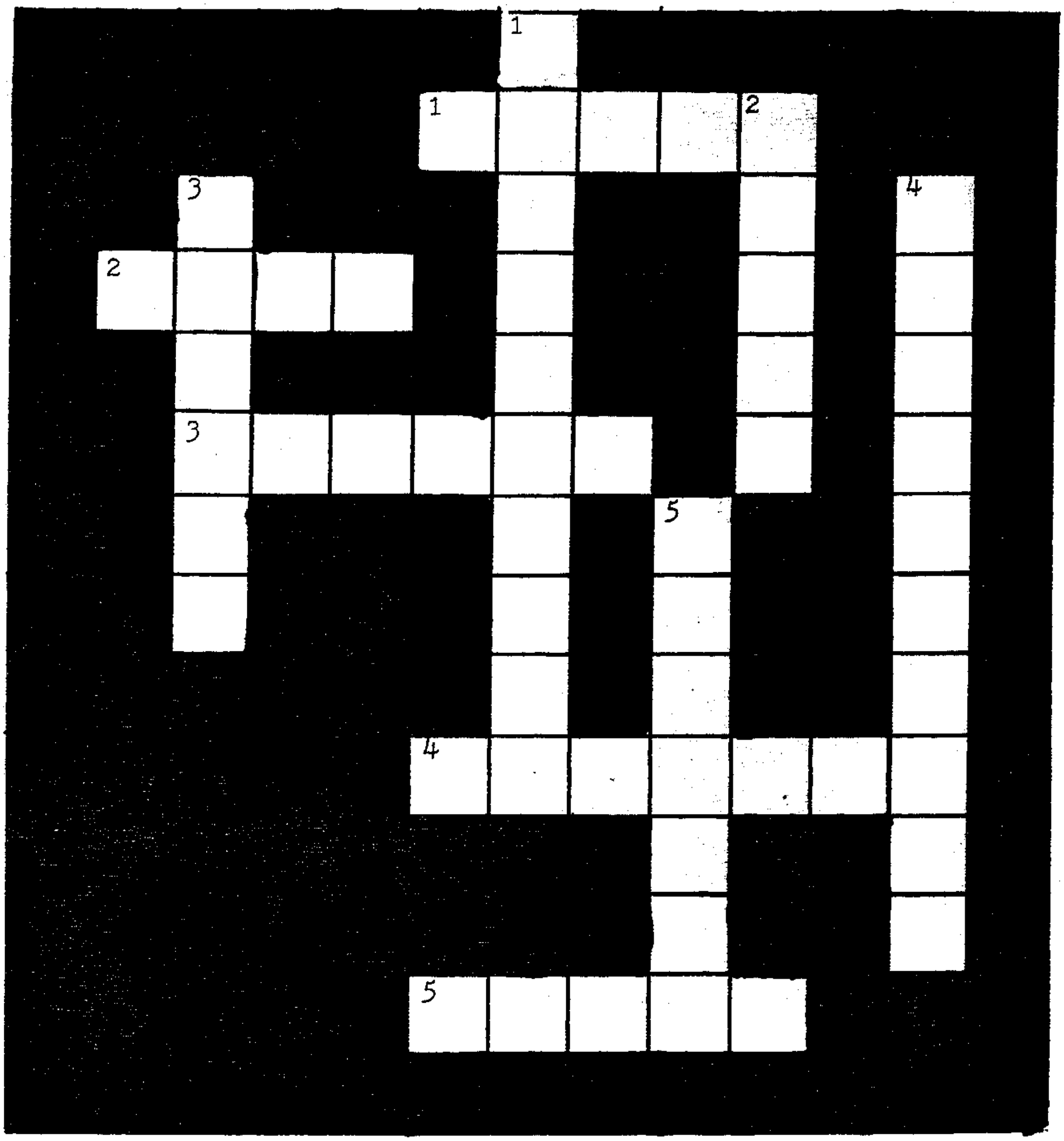
experiment

measure

message

ruler

twice



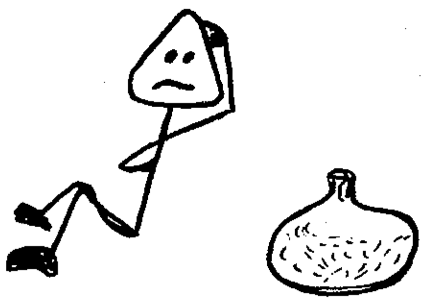
Crossword Exercise for Base Two Numbers

CHAPTER THREE:

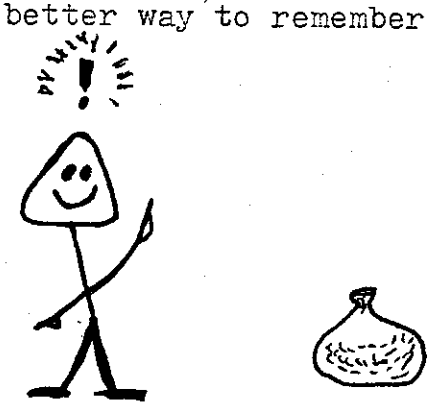
The First Computing Devices

We saw how important place value is in the first chapter. People couldn't use Roman numerals to do arithmetic. How did they work with numbers? They used a simple device (Device = machine.) called an abacus. Here is a story about how people started using the abacus.

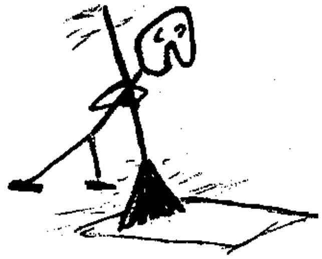
Do you remember the man with all the sheep? He got tired of carrying all those stones around just to remember how many sheep he had.



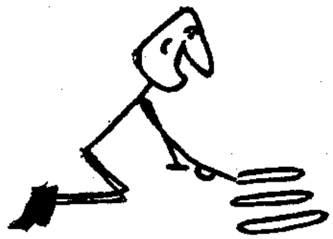
So he thought of a better way to remember how many.



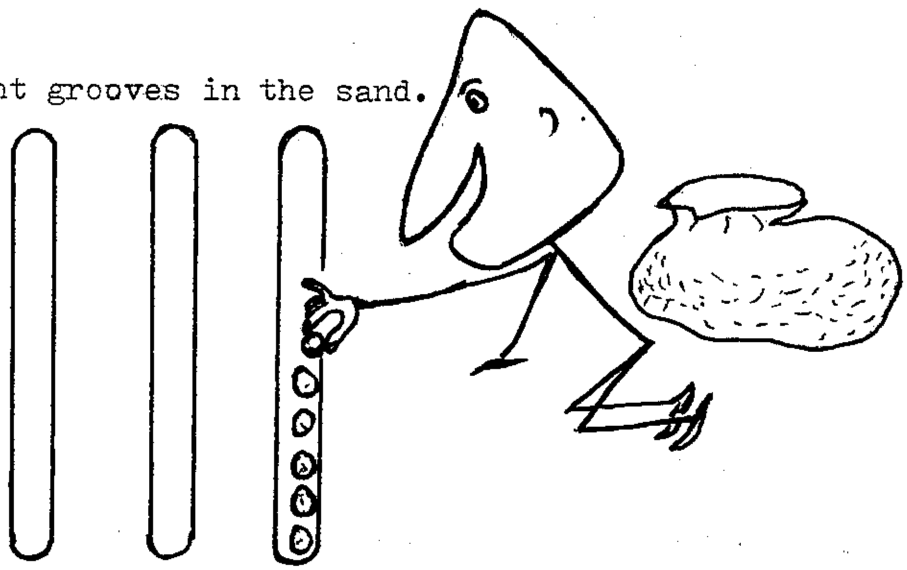
Counting with the Sand Abacus



First he found a flat place. Then he swept it off.

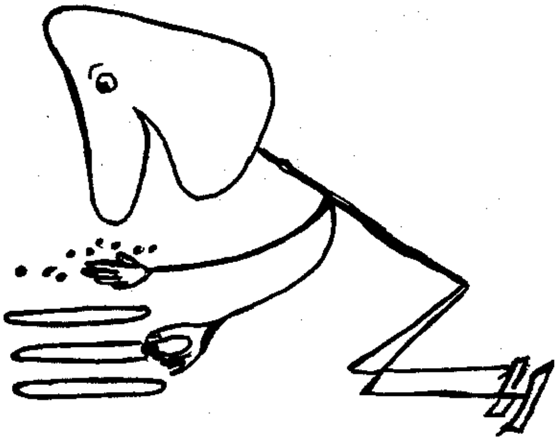


Next he drew straight grooves in the sand.

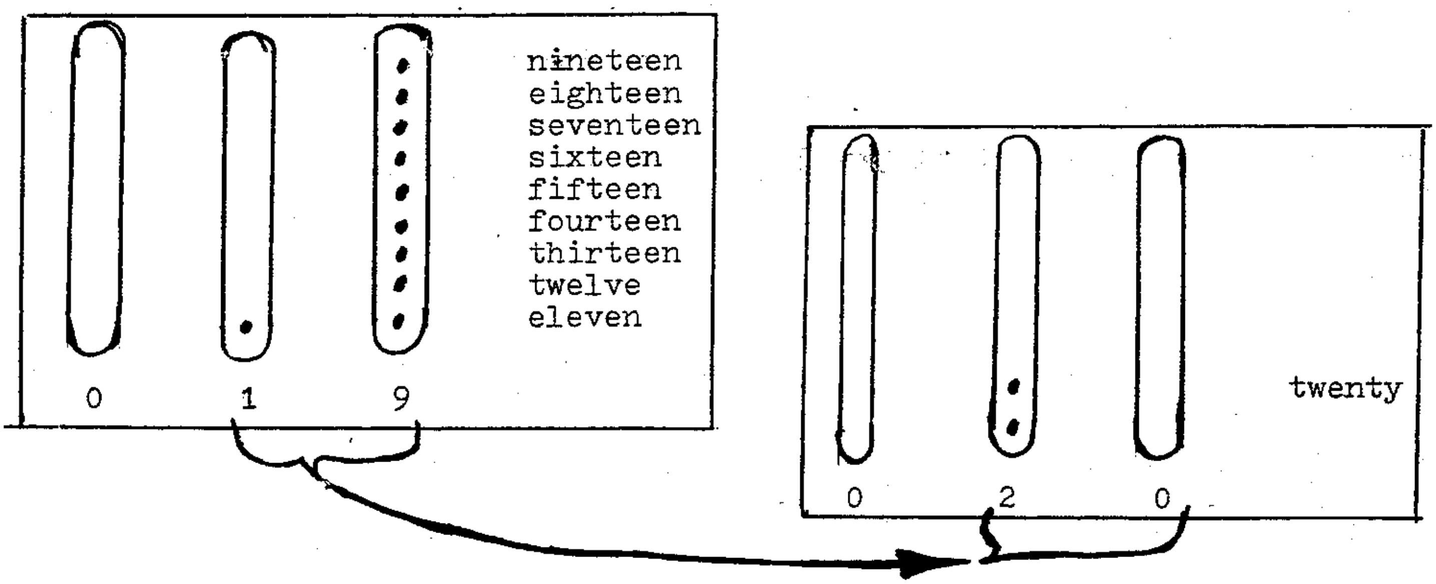


Then he began counting out stones into the right hand groove. One, two, three, ... up to nine. He decided not to have more than nine stones in any groove.

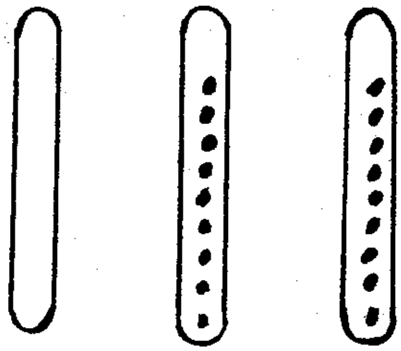
So what did he do when he got to the tenth stone?



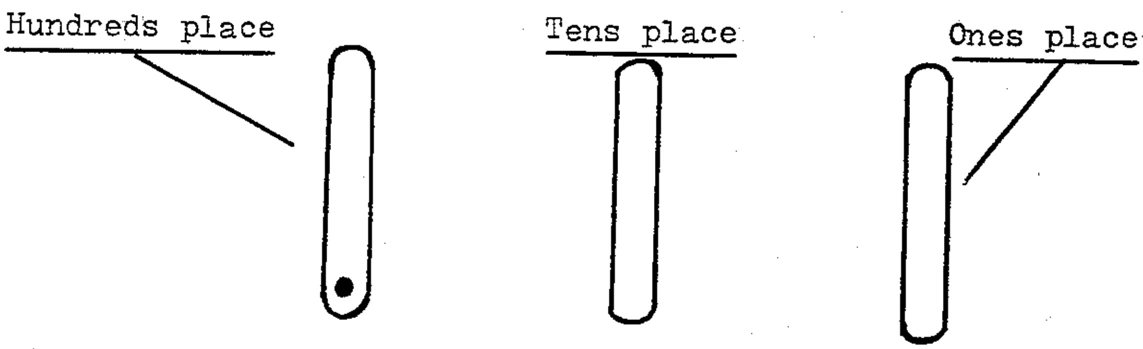
Right! He put it in the middle groove. The one stone in the middle groove meant he had ten. So he took all nine stones out of the right hand groove. Then he started all over again. He continued counting stones into the right hand groove. Eleven, twelve, thirteen,...., up to nineteen.



When he got to twenty, he did the same as with ten. He put another stone into the middle groove and started again in the right hand groove. He kept counting like this.

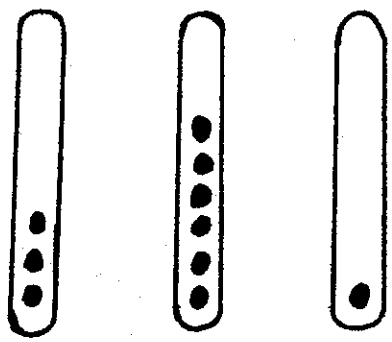


Finally he had nine stones in both the middle and right hand grooves. Nine times ten(9 x 10) and nine times one(9 x 1) are ninety-nine. To count one more, he took out all the stones. One stone in the left hand groove meant one hundred.



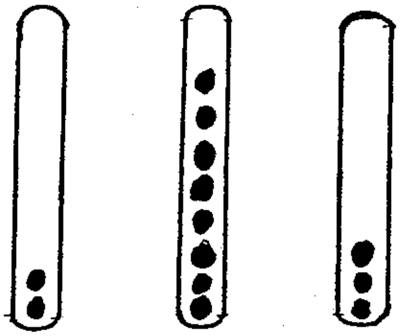
Do you see how it works? The right hand groove is the ones place. The middle groove is the tens place. The left hand groove is the hundreds place. This way of counting stones keeps place value. It also makes adding and subtracting easy.

He finished counting out his stones. He had three hundred and sixty-one.



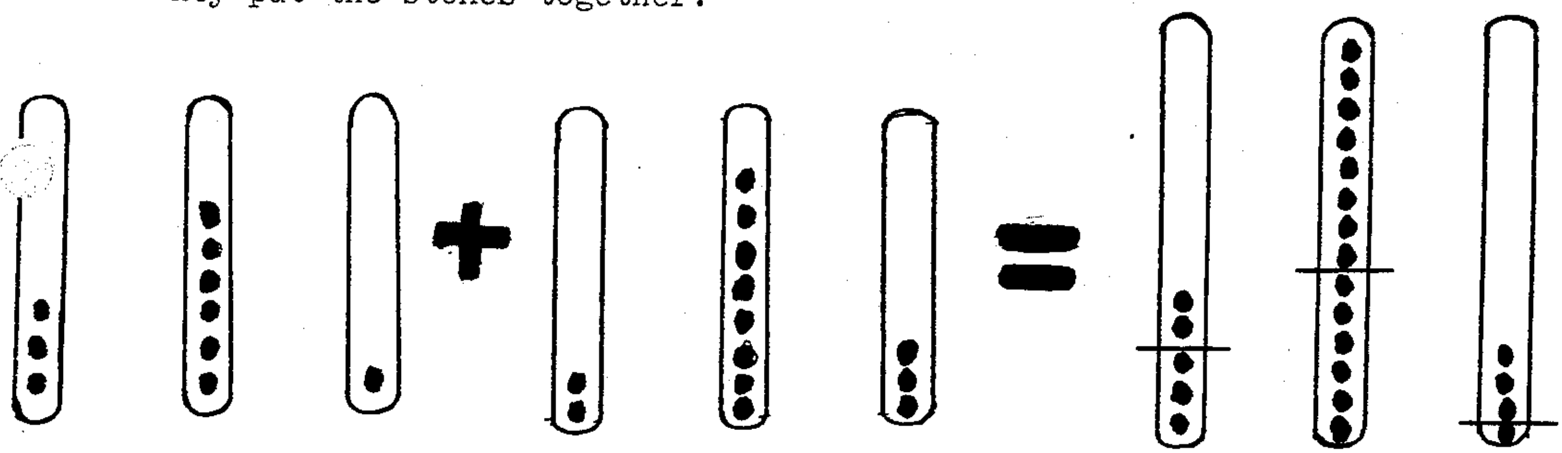
Adding with the Sand Abacus

His friend sold some sheep, too. They wanted to figure out (Figure out = find out) how many they sold in all. This is how many his friend had:



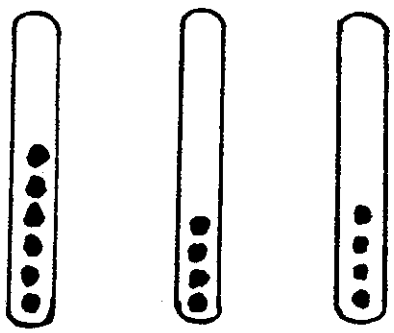
two hundred and eighty-three.

They put the stones together.



They had a problem in the tens place. There are more than ten stones. Can you make it right?

Sure you can! Take ten out of the tens place and put one more in the hundreds place. How many did they have when added together?



six hundred and forty-four

Questions to Think About

1. How many stones did the first man have in all?

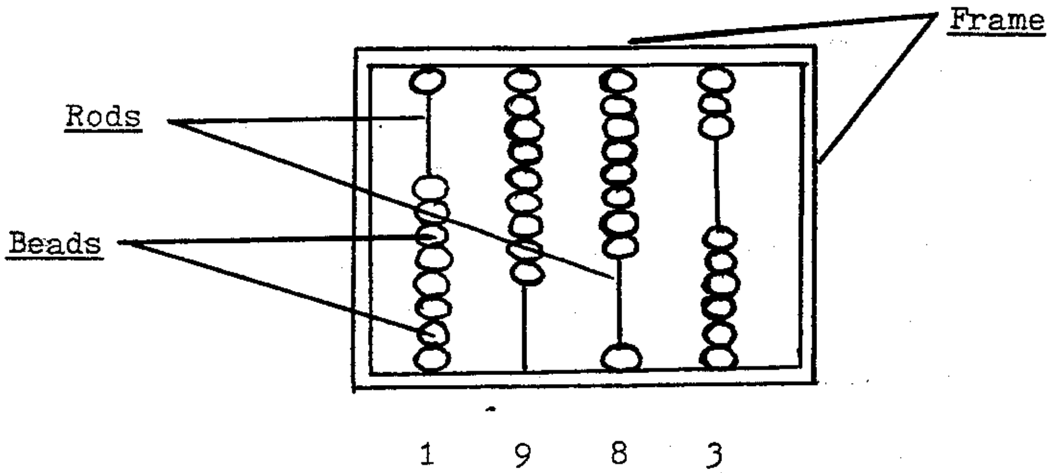
2. The man thought of a new way to count using grooves in the sand. How many stones did he need to show that he had three hundred and sixty-one stones?

3. Why was the new way of counting better?

4. When the men added their stones together, there were more than ten stones in the tens place. How did they solve that problem?

<u>The Mechanical Abacus</u>

So our friend invented the sand abacus. That is what this way of counting is called. Later on, <u>beads</u> were put on <u>rods</u>. The rods were put into <u>frames</u>. Each rod has nine beads.



This device is called an abacus. The abacus was the first mechanical counting device. It has been used as a machine to count with for thousands of years. Many people in Japan, China, and Russia still use an abacus to do arithmetic.

<u>The Abacus and Arabic Numerals</u>

Adding on the abacus is like doing arithmetic with Arabic numerals. Did you notice that when adding the stones? There were more than ten stones in the tens place. So he took ten out of the tens place and put one more stone in the hundred's place. This is what we call "carrying" in arithmetic.

In fact, the Arabic system comes from the abacus. Arabic symbols are the same no matter what place they are in. The place value tells you if it is ones, tens, hundreds, or thousands. Knowing Arabic numerals is like having an abacus in your head. Only it's better because you can multiply and divide too.

Questions to Think About

1. What do we call a counting device with beads and rods?

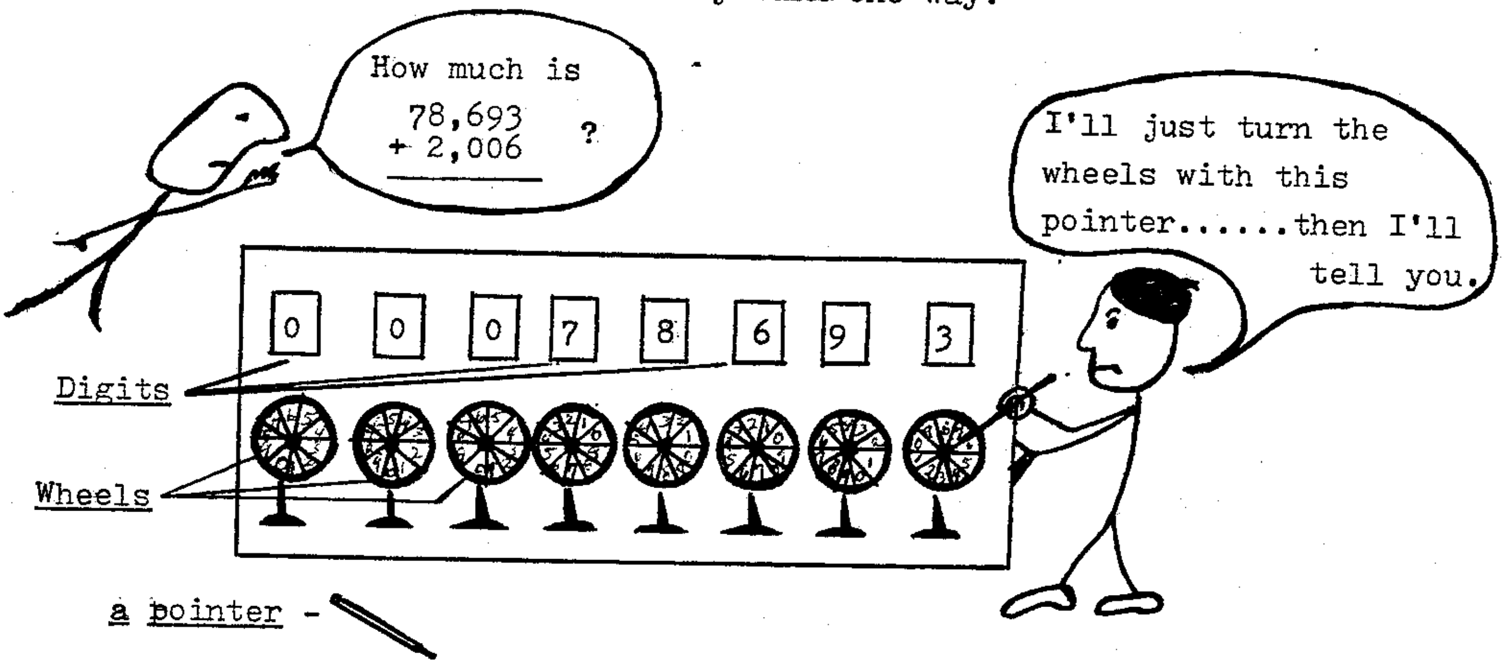
2. In what countries is that device used now?

3. In adding we took ten stones out of the tens place and put one stone into the hundreds place. What is that called when we do that?

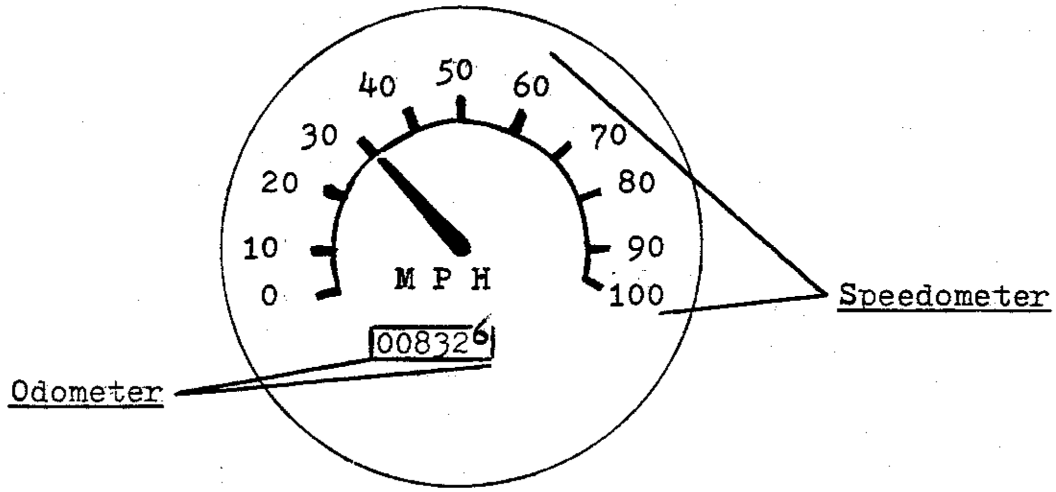
4. Why is knowing the Arabic numeral system better than carrying around an abacus?

Pascal's Digital Calculator [1]

The first machine showing digits was invented in 1647. Remember the abacus didn't show the digits. You count the beads on each rod to find out what digit is in each place. This digital machine was built by Blaise Pascal, a French mathematician. (Mathematician = a person who works with numbers or mathematics.) His calculator could add or subtract, but not both. The wheels could only turn one way.

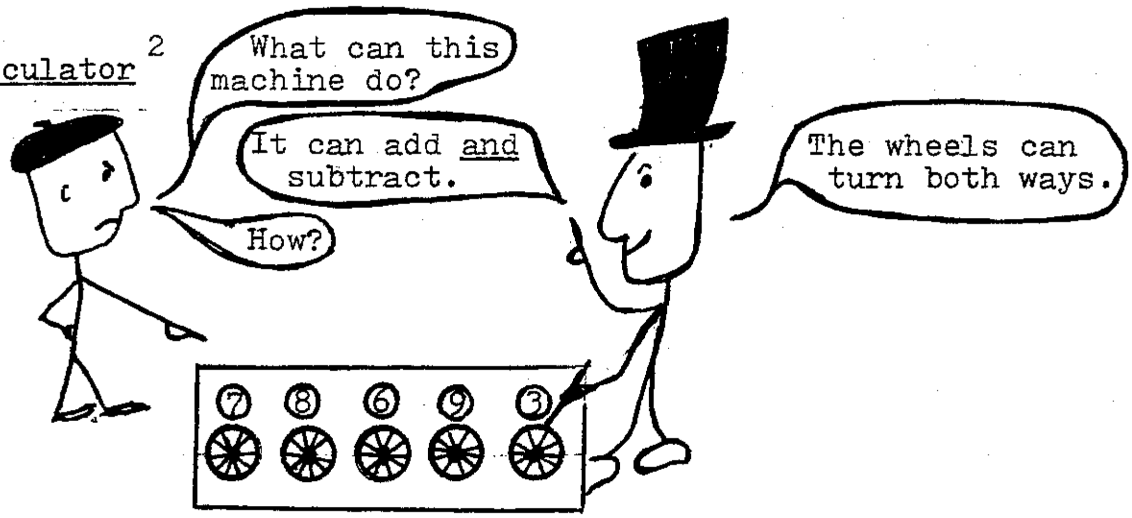


Pascal's calculator was the size of a large shoe box. It had eight wheels, all in a row. Each wheel was numbered from 0 to 9. The wheels were turned with a pointer to add. Above the wheels were windows in which a number appeared.



The odometer in a car is like Pascal's machine. The odometer shows the number of miles a car has travelled.

Morland's Calculator [2]



In 1662 another mechanical calculator was built in England. It was used to <u>compute</u> <u>taxes</u>.(<u>Compute</u> = to add up.)(<u>Taxes</u> =money paid to the government.) This second digital calculator could add <u>and</u> subtract. For addition, the wheels were turned <u>clockwise</u>. (<u>Clockwise</u> = the direction in whicha clock moves.) For subtraction, the wheels were turned <u>counter-clockwise</u>. (<u>Counter-clockwise</u> = opposite to the direction a clock moves.)

Questions to Think About

Pascal's Digital Calculator

1. How is Pascal's calculator different from an abacus?

2. Pascal's calculator is the first ________ calculator.

3. An abacus uses beads to count with. What does Pascal's machine use?

4. Where do you see the numbers that you are working with?

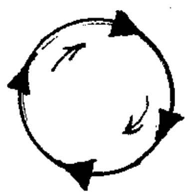
5. Where can you find an odometer? What does it count?

Morland's Calculator

1. How was Morland's calculator like Pascal's?

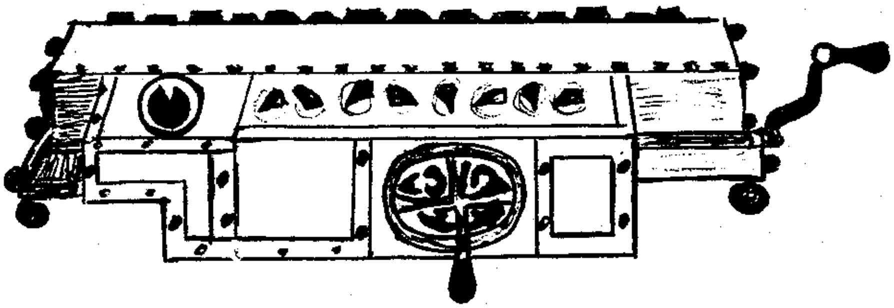
2. How was it different?

3. Write the names of the two directions of motion.

______________________ 

____________ ______________________

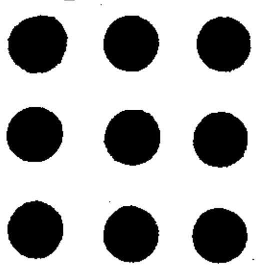
Leibniz's Calculator [3]



In 1694 a more advanced calculator was built by Leibniz, a German mathematician. It could multiply and divide as well as add and subtract. Leibniz's calculator could even find square roots. (Square root = a number which multiplied by itself gives another number. For example, 4 x 4 = 16. So 4 is the square root of 16.) This was done by repeated additions. Solving problems in this way is the same process used by computers today. (Process = way of doing something.)

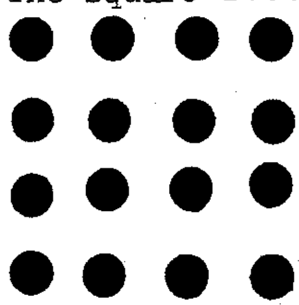
3 x 3 = 9

The square root of 9 is 3.



4 x 4 = 16

The square root of 16 is 4.



Questions to Think About

1. Leibniz built the third calculator. How was it more advanced than the other two?

2. What is the square root of twenty-five?

3. What other device solves problems by repeated additions?

The First Computing Devices

Crossword Exercise

Across

1. Leibniz's calculator was more ________ than the two before it. It could do more than the other two calculators.
2. The place in the sand where the stones were put in the first abacus.
3. In the mechanical abacus, the long, thin piece along which the beads move.
4. Like a machine or using machines. The abacus was the first ___________ calculator.
5. Four is the square _____ of sixteen.
6. The round thing which turns in Pascal's calculator.
7. A way of doing something. Leibniz's calculator used the same _______ to solve problems as computers today.
8. Five is the ______ root of twenty-five.

Down

1. A person who works with numbers.
2. To count with an abacus, a ______ is moved along a rod.
3. Another word for machine.
4. The same direction as the hands of a clock move.
5. A machine which does arithmetic.
6. In addition, when you take ten out of the tens place(or out of any other place) and put one in the hundreds place.
7. In an abacus, the part around the rods and beads.

The First Computing Devices

Vocabulary List for Crossword Exercise.

advanced

bead

calculator

carrying

clockwise

device

frame

groove

mathematician

mechanical

process

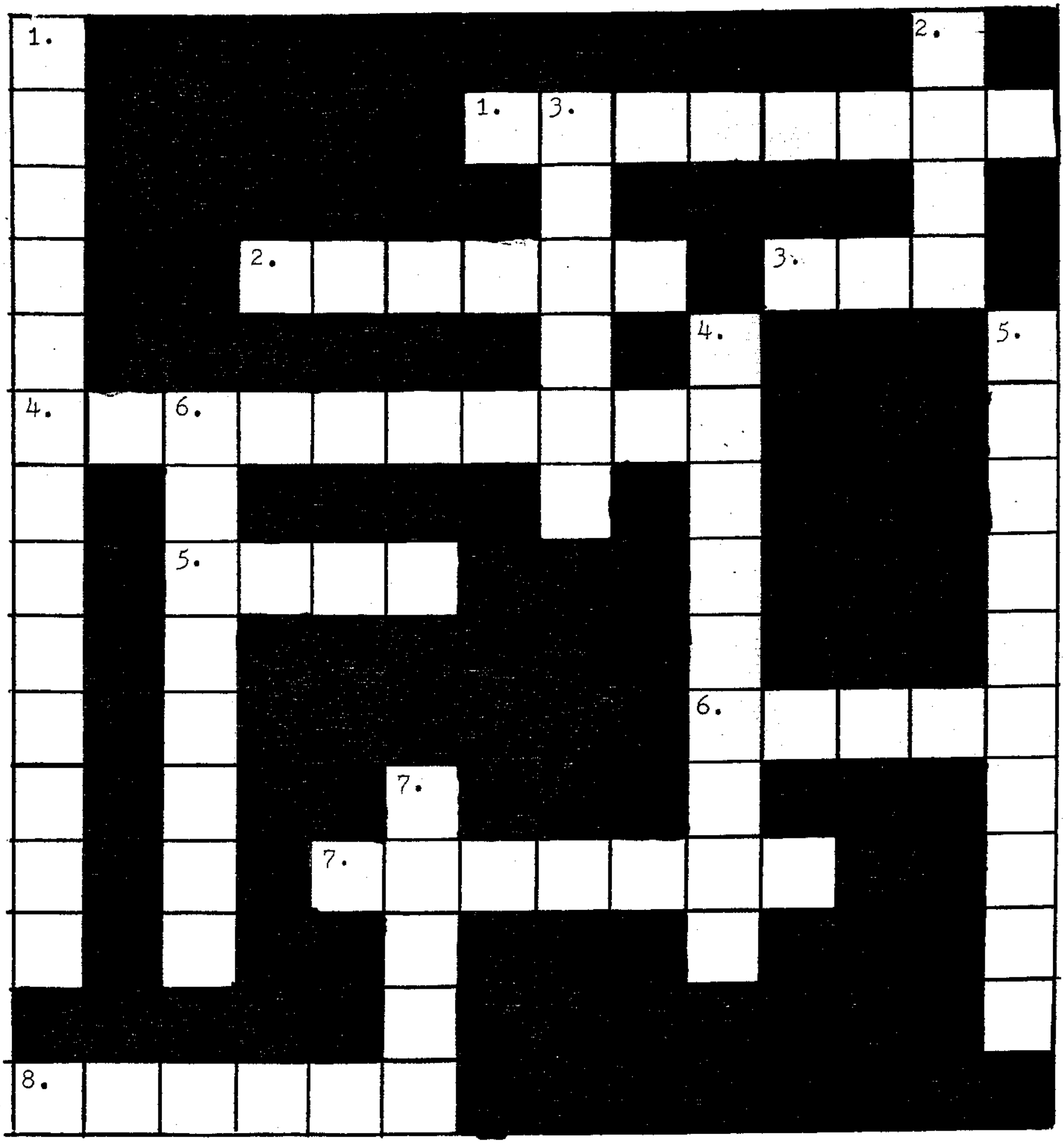
rod

root

square

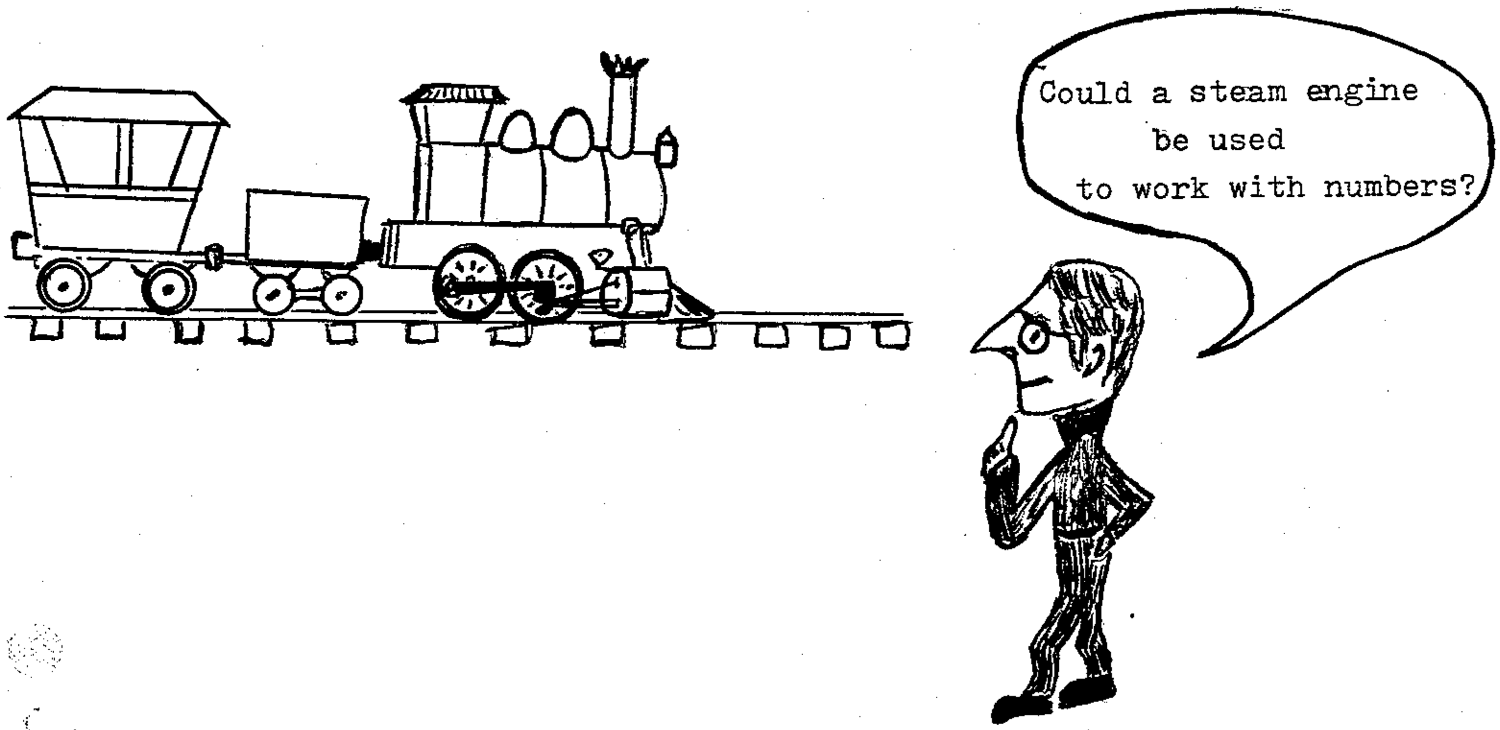
wheel

The First Computing Devices
Crossword Exercise



CHAPTER FOUR: From the Analytical Engine to the Mark I

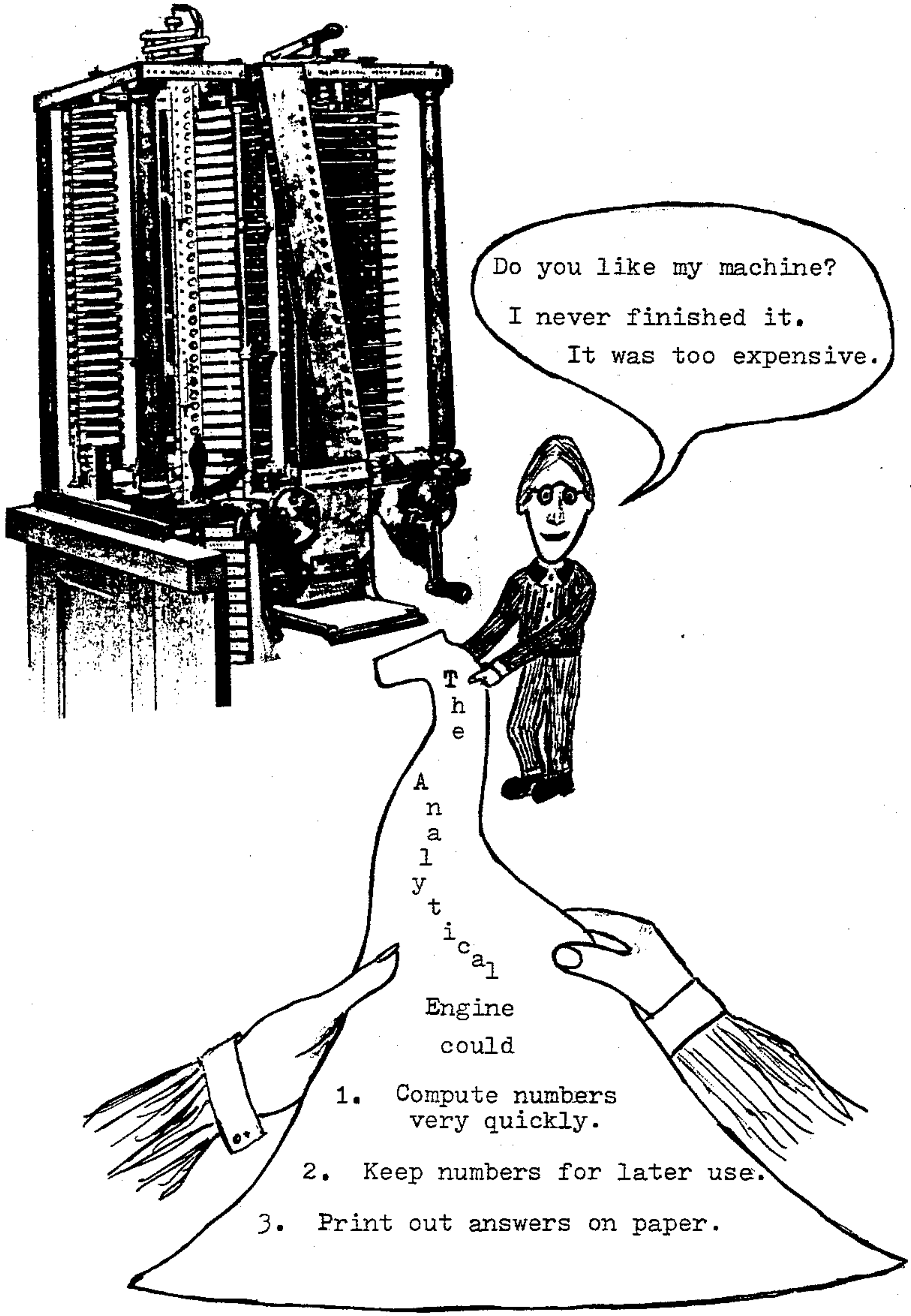
Babbage's Analytical Engine



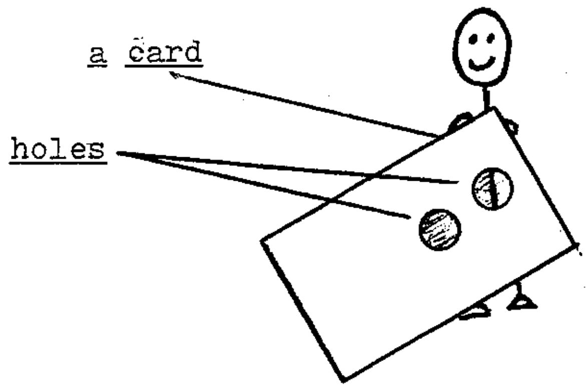
In the 1830s the steam engine was changing the lives of many people. Charles Babbage, an Englishman, thought that another kind of engine could be built - an engine to compute numbers quickly and easily. So he designed plans for an "analytical engine." (Design = to write plans and drawings in order to build something.)

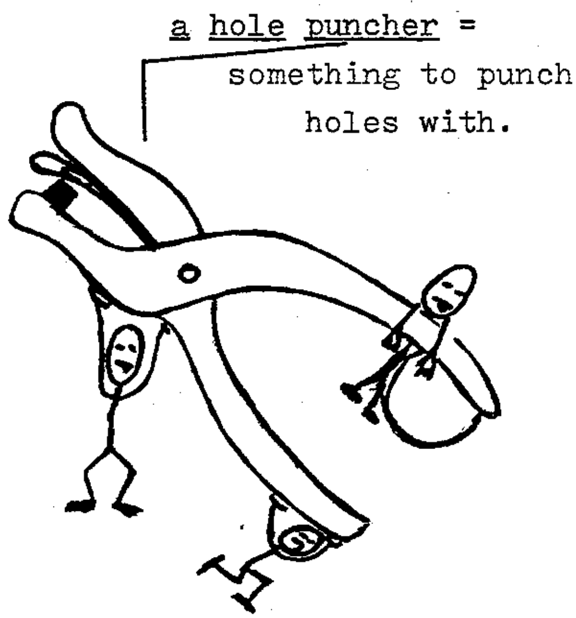
Babbage's machine was designed to compute formulas quickly. (Formula = an exact order for doing mathematics. For example, A + B = C is a formula. If A = 3 and B = 2, then C = 5 because 3 + 2 = 5.) (Compute = to find out a number by doing arithmetic.) So the analytical engine could add and subtract quickly.

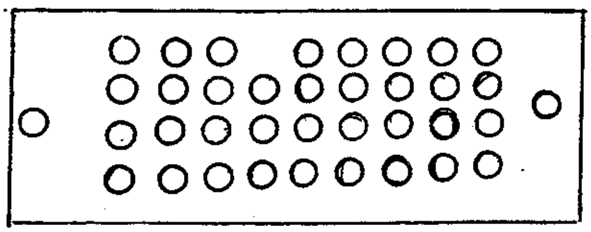
The Analytical Engine [1]



The analytical engine could also keep numbers to be used later. The numbers were kept on cards for the machine to read. It read by feeling, not by seeing. So holes were punched into the cards. Then the machine could read the numbers.







A card like those used by Babbage's machine to keep or store numbers.

Finally, Babbage's machine printed the answers on paper. (Print = to write with a machine.)

The engine that Babbage designed was never completely built. The cost was too high. Several machines like this were built but they were simpler. These have proved Babbage's ideas to be correct. Babbage discovered most of the basic ideas used in today's digital computers. (Basic = the simplest and most important.)

Questions to Think About

1. What kind of engine did Babbage want to build? What did he want it to do?

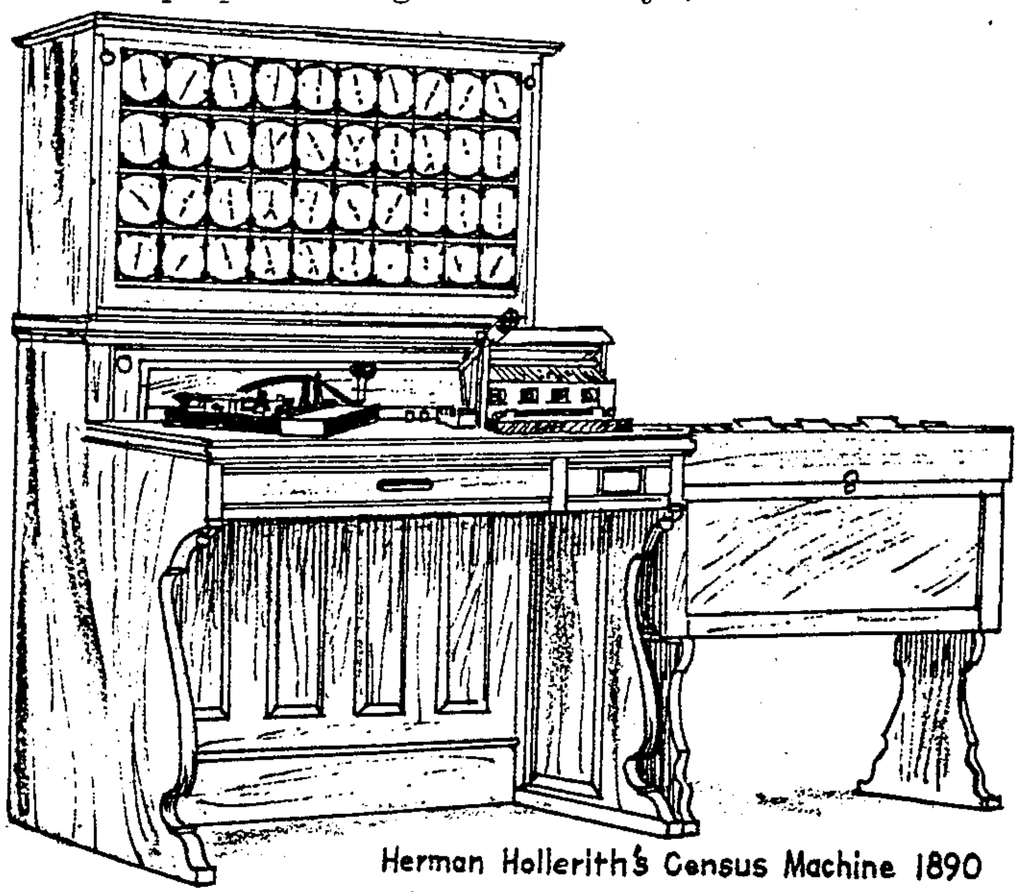
2. Babbage's machine could keep or store numbers. What did it use to store them on?

3. The analytical engine could read by "feeling." What did it feel in order to read the cards?

Hollerith's Census Machine [2]

Herman Hollerith, an American, had a big job to do. He had to count all the people living in the United States. In 1887 he made a machine to help him. His machine was different from Babbage's. Babbage kept numbers in his machine with cards punched in certain places. Hollerith used punched cards to give instructions to his machine. (To give instructions = to tell it what to do, step by step.)

Hollerith's cards were used to process the United States' census in 1890. (To process = to prepare.) (Census = Counting all the people living in a country.)



Herman Hollerith's Census Machine 1890

Questions to Think About

1. What was Hollerith's big job?

2. How was his machine different from Babbage's?

3. What was Hollerith's machine used for?

The Mark I

Babbage's writings were used to build a computer a hundred years after his lifetime. In 1937 Howard Aiken of Harvard University made plans for a digital computer. He needed the computer to solve problems in his research.(Research = studying something to find out about it.) The IBM company (International Business Machines) built the computer Aiken designed in 1944. They called it the Mark I.(The Mark One)

The Mark I was a very large computer. It filled a large room. It had 700,000 moving parts and over 500 miles of wire. Addition and subtraction was done by electro-mechanical switches. That means switches controlled by electricity. The Mark I could add three eight-digit numbers per second.

```
  99,999,999
  88,888,888
+ 77,777,777
```

Does that seem fast? It was only the beginning. The Mark I was one of the last computers to use moving parts. Computers since the Mark I have been completely electronic. They have no moving parts. Everything inside computers is now done with electricity. Computers are now much faster than the Mark I. But the Mark started the Age of Computers.

Questions to Think About

1. Why did Aiken design plans for a digital computer?

2. What controls electro-mechanical switches?

3. Computers since the Mark I have no ___________ ___________.

Below are listed the nine devices we talked about in this chapter. They are not in order. Put a number beside the description of each device. Write "1" beside the first, "2" beside the second and so on.

___ A calculator that could add, subtract, multiply, divide and find square roots.

___ A counting machine that uses beads on rods.

___ One of the last computers to use electro-mechanical switches.

___ A way of counting by putting stones into grooves.

___ A machine that computed quickly, stored numbers for later use and printed answers. It was never completely finished.

___ A digital calculator that could only add or subtract, but not both.

___ A machine that used cards to give it instructions.

___ A digital calculator that could add and subtract.

___ A system of numerals that came from a simple machine.

From the Analytical Engine to the Mark I

Crossword Exercise

Across

1. To prepare information.
2. To give ______________ means to tell some one what to do.
3. A + B = C is a _________.
4. To make holes.
5. This thing is long and thin like string. Electricity passes through it.
6. This word means the simplest and most important.
7. A hard, strong piece of paper.
8. To make plans and draw pictures in order to make something.

Down

1. To write with a machine.
2. Studying something to find out more about it.
3. To find out a number by doing arithmetic.
4. A puncher is used to punch _____ in cards.
5. ________________ are used to turn lights on and off.
6. To count all the people living in a country.

From the Analytical Engine to the Mark I

Vocabulary List for Crossword Exercise

basic

card

census

compute

design

formula

holes

instructions

print

process

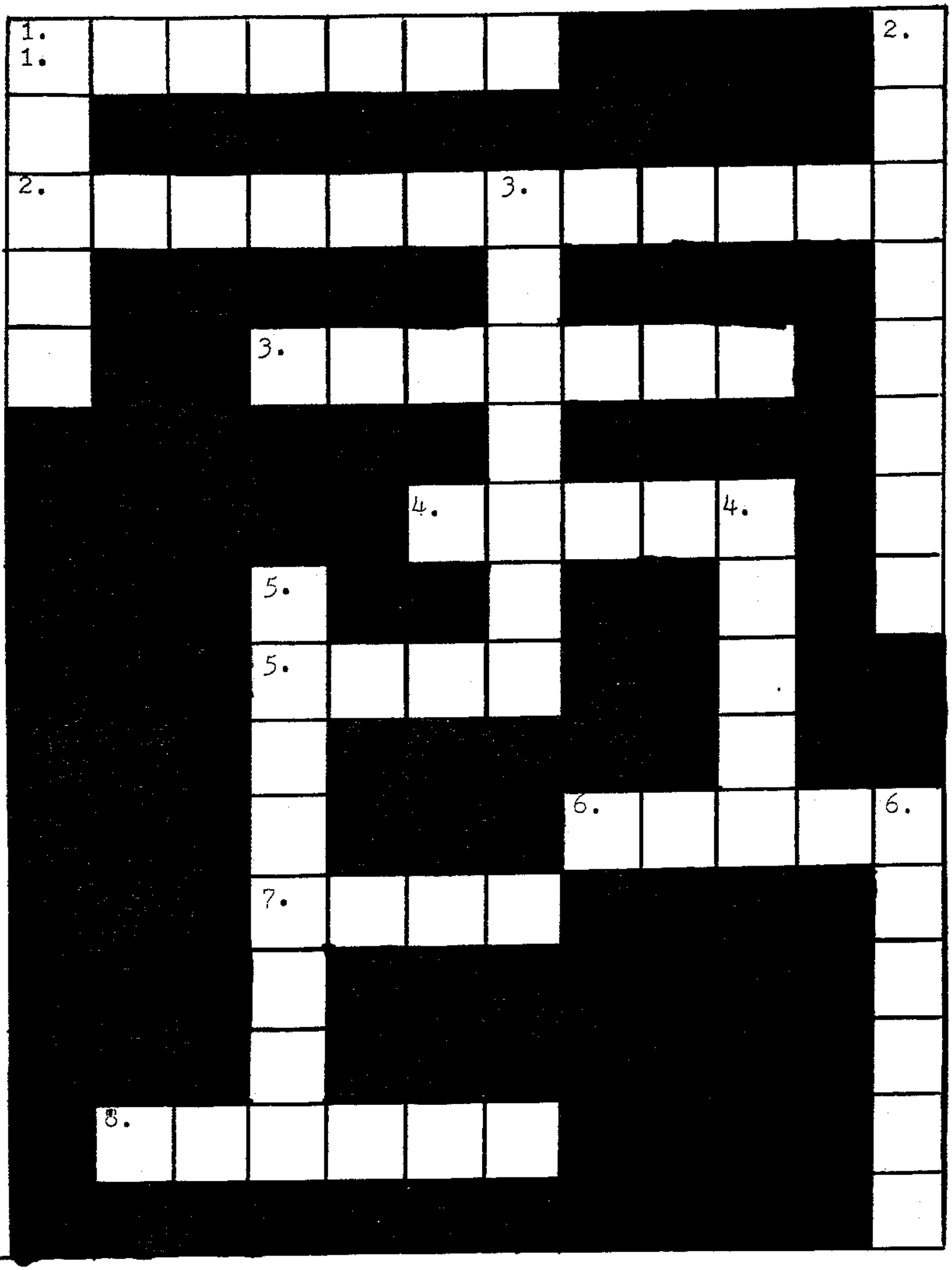
punch

research

switches

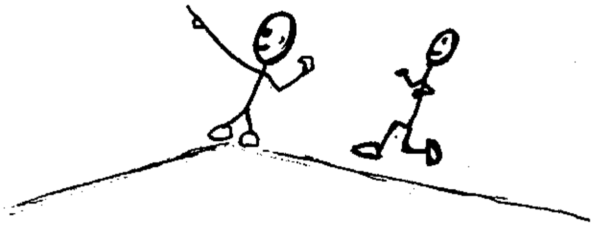
wire

From the Analytical Engine to the Mark I
Crossword Exercise



CHAPTER FIVE:

Electronic Computers since 1946



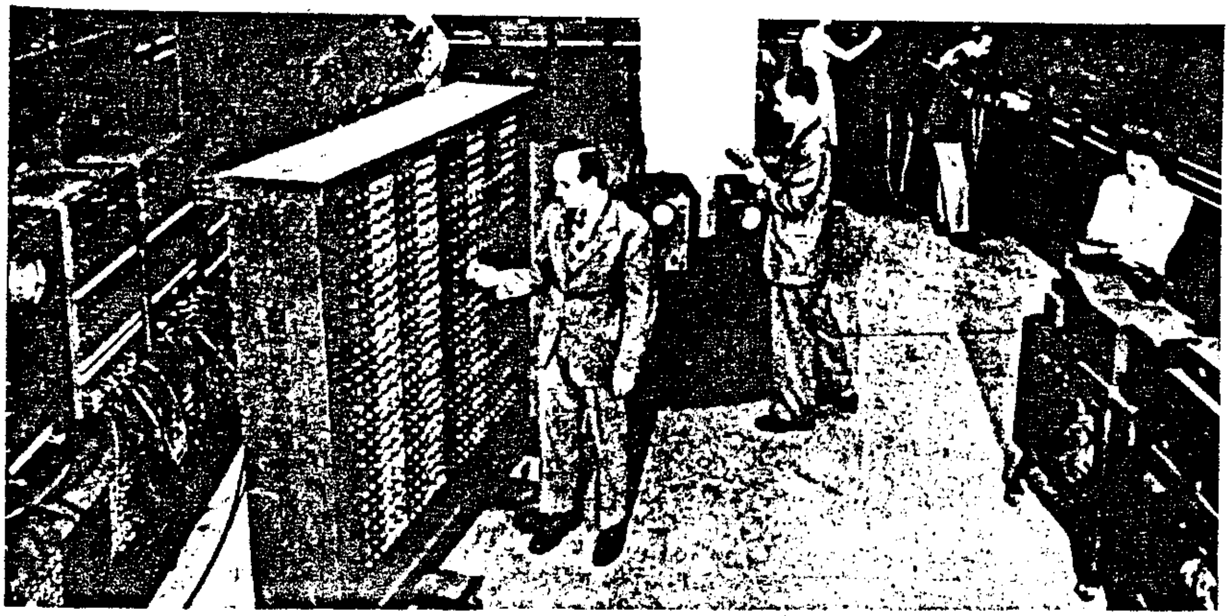
Do you like things that go fast? The story of electronic computers is a story of speed, speed, and more speed. How would you like a machine that could do your homework in the wink of an eye?

a wink

Modern day computers can do many things like that very quickly. Would you like to see how they got to be so fast? Here's how the story goes.

Do you remember the Mark I computer? It used electro-mechanical switches. That is moving switches turned on and off by electricity. The Mark I could do three additions per second. That seems fast if you try to add three big numbers in your head. Wait till you see what the first all-electronic computer could do!

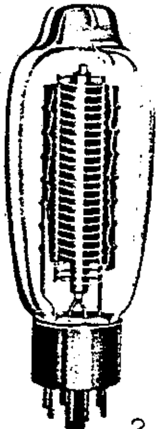
The ENIAC of Penn State University [1]



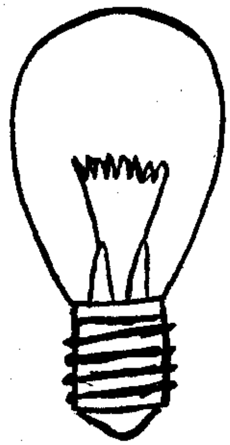
ENIAC at Penn State University, 1946.

The first completely electronic computer was called ENIAC. The ENIAC could add, subtract, and do other calculations. Guess how many additions it could do per second. "Ten? Fifty? Surely, not more than one hundred?" you say. The ENIAC could do five thousand (5000) additions per second! That's amazing isn't it?

How could it work so fast? All the work was done by electricity. There were no moving parts.



VACUUM TUBE [2]



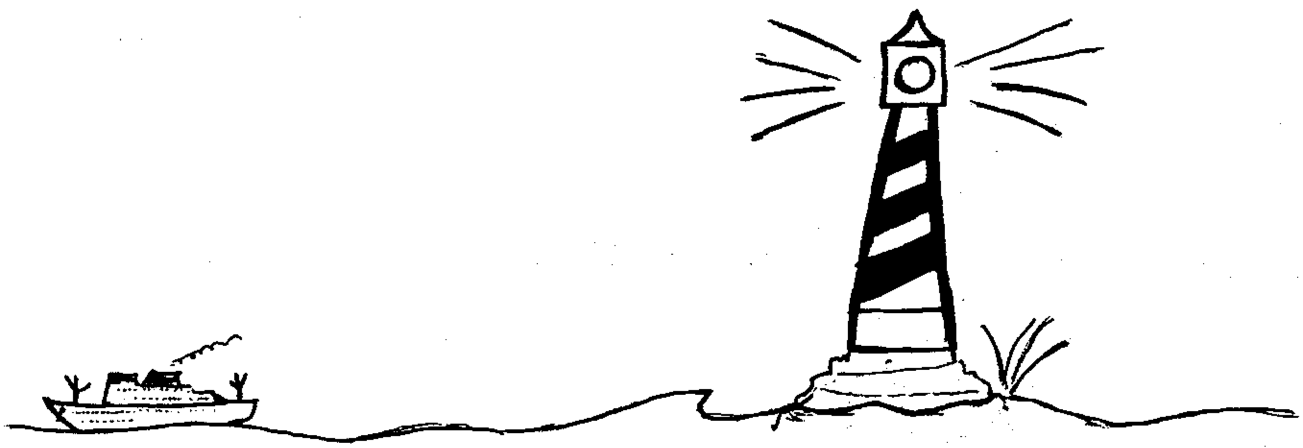
Ordinary light bulb

Rather than electro-mechanical switches, ENIAC used vacuum tubes. A vacuum tube is a glass tube, filled with gas. It looks a little like a a light bulb.

The ENIAC once did a problem in two hours. The same problem would have taken 100 engineers a year to solve. (Engineer = some one who designs and builds machines and buildings)

In spite of all the work it could do, ENIAC wasn't perfect. It was very big and heavy. It weighed 30 tons. ENIAC filled a large room.

Another thing was that the ENIAC used too much electricity. It used the electrical power needed to run 100 light houses.



Finally, ENIAC had thousands of vacuum tubes. Vacuum tubes burned out very often. So, ENIAC often broke down, sometimes after only a few minutes. (Break down = to stop working.)

Questions to Think About

1. The Mark I could do three additions per second. The ENIAC could do 5,000 per second. Why was the ENIAC able to work so much faster?

2. The ENIAC wasn't perfect. What did the engineers want to change?

3. What usually caused the ENIAC to break down (stop working)?

Von Neumann and Binary Arithmetic

At about the time of ENIAC (1946), John Von Neumann first used binary arithmetic in building high-speed computers.

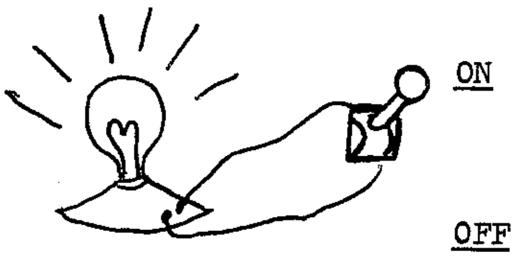
For us:

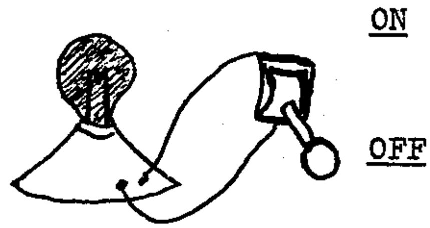
	999
+	888
	1887

For computers:

		1	1	1	1	1	0	0	1	1	1
+		1	1	0	1	1	1	1	0	0	0
	1	1	1	0	1	0	1	1	1	1	1

You remember from chapter two that the digits 1 and 0 can be used to stand for all numbers. (page 22) For computers, then, a light switching on stands for the digit 1. Switching off or no light stands for the digit 0.





ON = 1

OFF = 0

Therefore, any work with numbers, no matter how large, can be made very very simple. Calculation becomes as simple as on and off. Binary arithmetic helped computers to become even faster.

Questions to Think About

1. Why do computers like binary numbers?

2. What did binary numbers do for computers?

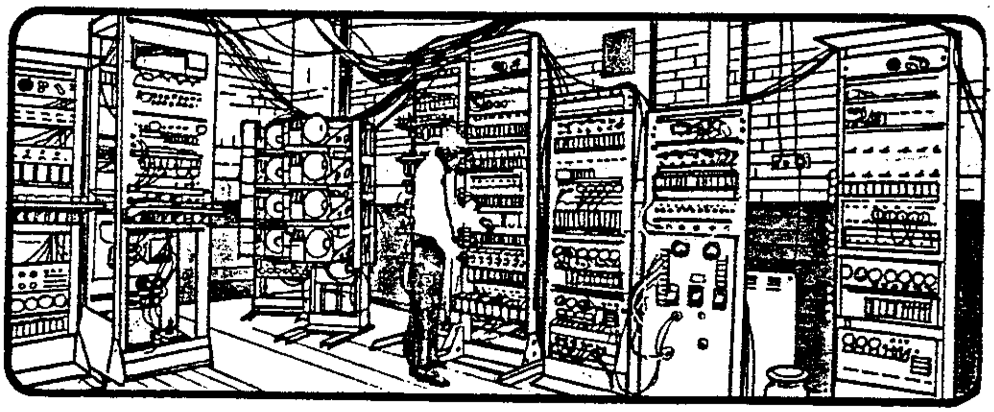
Von Neumann and Computer Programming

John Von Neumann helped the people who make computers another way, too. ENIAC (the first computer) needed someone to tell it what to do at all times. Suppose you wanted to do the same calculation more than one time. You had to adjust the machine at every step the second time too.(Adjust = change) It was just as if you had never done those calculations before.

Von Neumann changed all that. He made a computer in 1947 (EDVAC) that could remember instructions.(Instructions = what you tell it to do.) The instructions it stored or remembered were called a program. So after once programming the computer, it stored the program. The same program could be run many times.

First Generation Computers

Computers used vacuum tubes until 1958. Those computers are called first generation computers. First generation computers could do up to 40,000 additions per second.



Early British Computer like the EDVAC.[3]

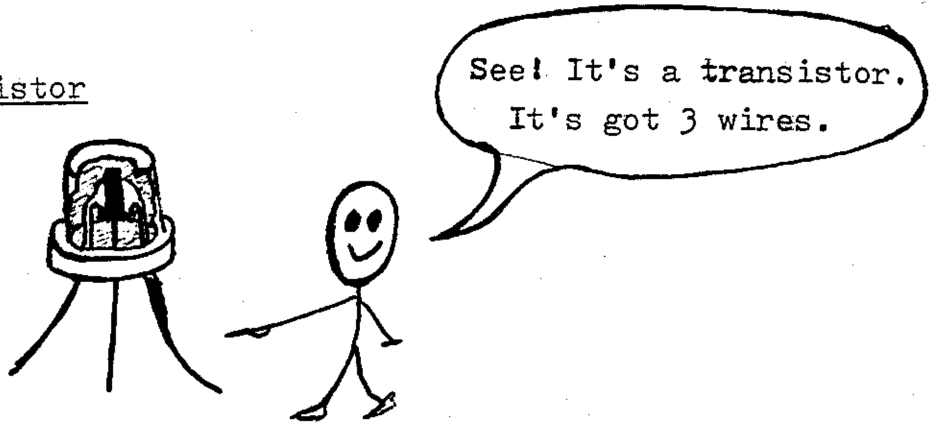
Questions to Think About

1. What could the computer EDVAC do that ENIAC couldn't do?

2. If you want a computer to do something, you give it instructions. What do we call these instructions that a computer remembers?

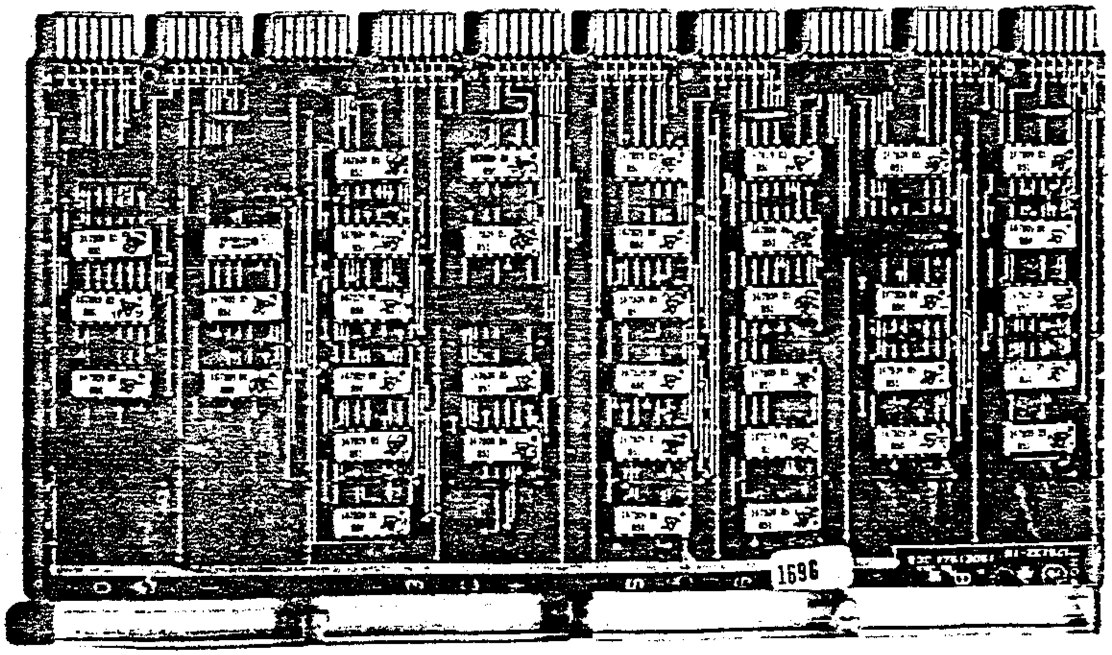
3. Computers used vacuum tubes till 1958. What are those first computers called?

The Coming of the Transistor



In 1958 transistors took the place of vacuum tubes in computers. This is called the second generation. Computers became smaller, less expensive, and faster. Transistorized computers could do about 200,000 additions per second. (Transistorized = made with transistors.) Transistors used less electricity than vacuum tubes. They also gave off less heat.

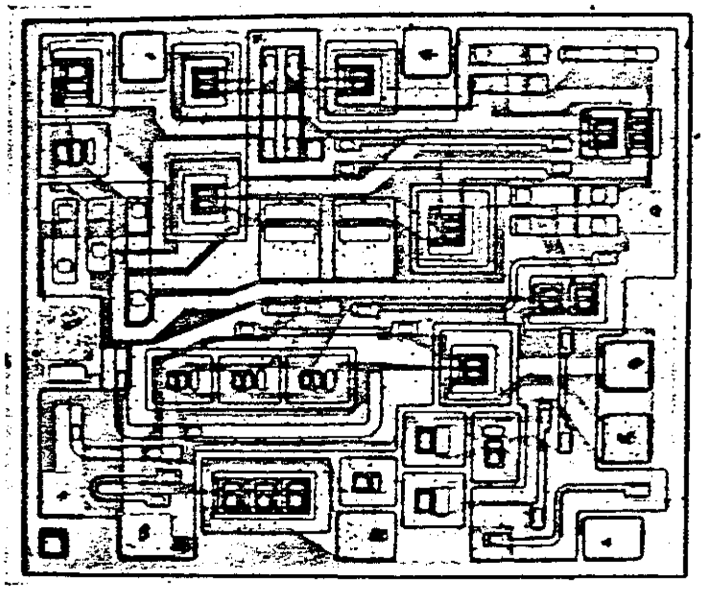
In spite of all this, transistors had a short-coming. (Short-coming = something wrong.) The wires often broke off. That also caused computers to stop working.



Transistor [4] circuit used in computers.

Integrated Circuits

Transistors were used in computers until 1964. In that year IBM started using integrated circuits. The electronic parts of a computer could all be put into one unit. The unit with all the parts made into it is called an integrated circuit. The parts of a computer became very small in size. And there were no more broken transistor wires. We call these third generation computers. They could do 1,250,000 additions per second.



An integrated circuit 5
1974.

Questions to Think About

1. How were transistors better than vacuum tubes?

2. How did transistors help computers? (What happened to second generation computers?)

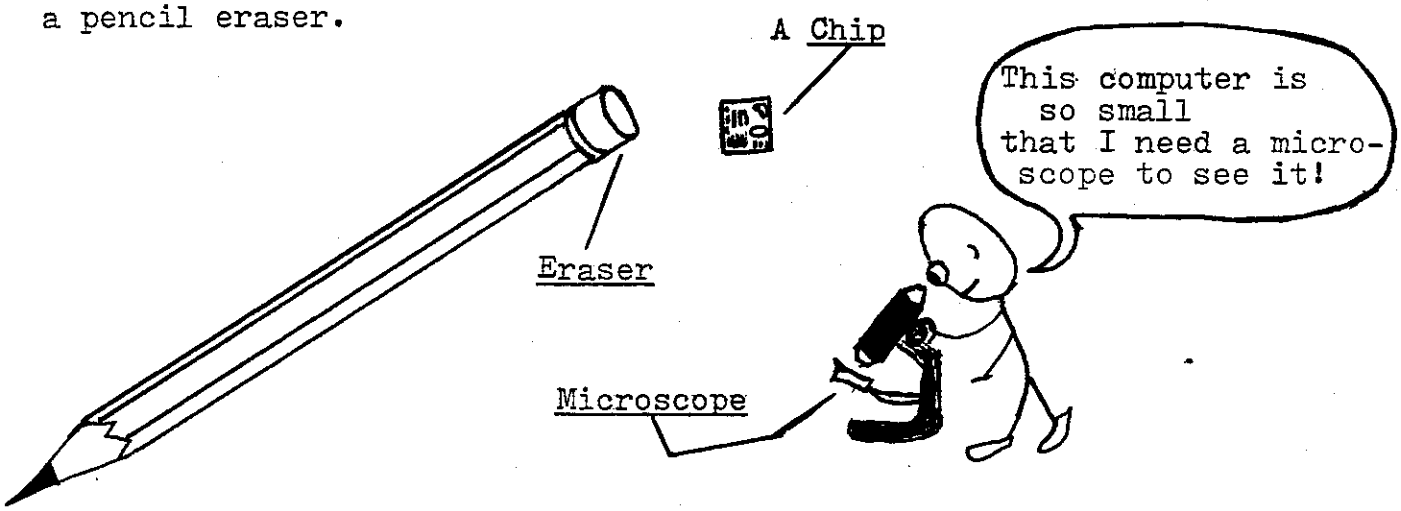
3. What was the short-coming that transistors had? (What was wrong with transistors?)

4. In 1964, IBM started using ____________ ____________.

5. The parts of the computer could be put into _____ unit called integrated circuits.

The Chip - 1978 to Present

Now several hundred thousand circuits can be put into one unit. This unit is called a chip. A chip is about the size of a pencil eraser.



The parts of a computer have become microscopic in size. You can't see them without a microscope because they are so small. These computers are the fourth generation. They can do about 10,000,000 (ten million!) additions per second.

Chips are becoming smaller and smaller. At the same time, more and more electronic parts are put on them. The workings of ENIAC or EDVAC could all be put into a chip the size of a penny!

What do you think the fifth generation of computers will be able to do?

Questions to Think About

1. How big is a chip?

2. The parts of the computer have become microscopic.
   That means those parts are __________. (Mark one)

   (a.) very large

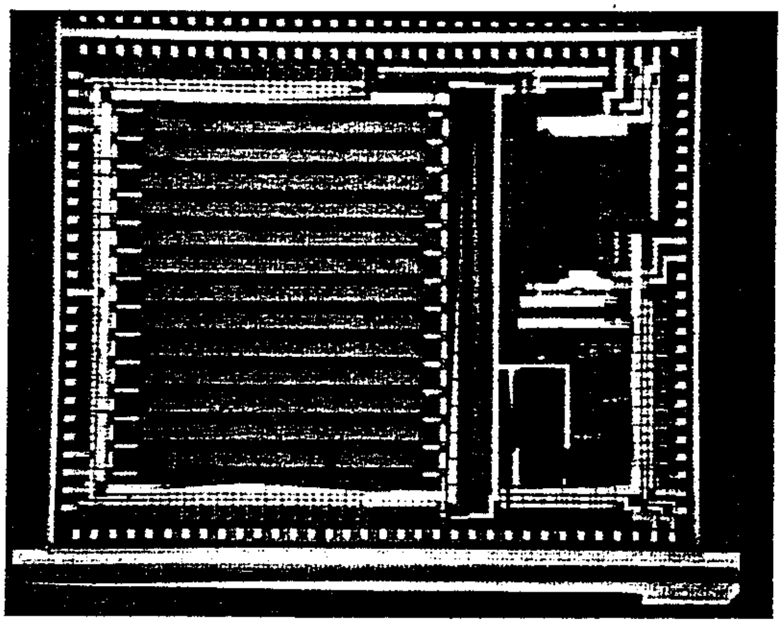
   (b.) middle-sized

   (c.) small

   (d.) very small

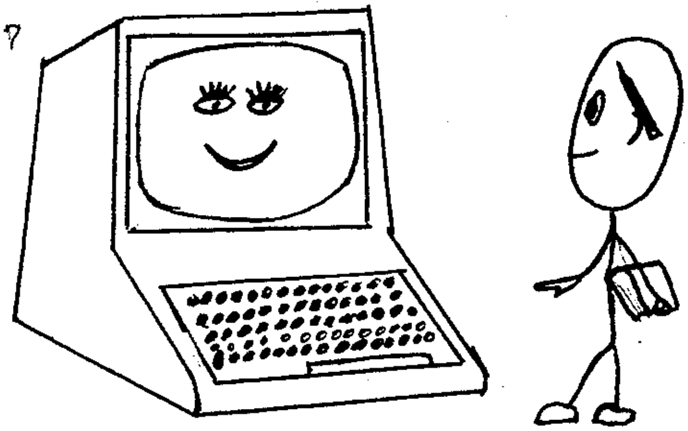
3. How big was the ENIAC?

4. What size would a computer be to do the same work as ENIAC or EDVAC?



This is a microchip. It is as small as, or smaller, than your fingernail. 6

Computers of the Future [7]



Not only will computers become smaller, they will also become easier to use. Computers will understand spoken and written language. They they will translate it to computer language. After that, they will print answers on paper automatically. (Automatically = without help or instructions.) All you will have to do is speak a command. If the machine doesn't understand, it will ask questions. It will learn from its mistakes, too. (Mistakes = wrong answers.) Does all this seem impossible? Scientists are working hard to make computers do all these things.

Questions to Think About

1. Fill in the blanks.

   Computers will understand _______ and __________ language.

   They will __________ it to computer language.

   After that, they will ________ answers on paper automatically.

2. If a computer of the future doesn't understand what will it do?

3. What will computers of the future learn from?

4. Draw lines from the words on the left to the matching words on the right.

First Generation	The parts of the computer were put on very small chips.
Second Generation	You will speak to a computer to program it. If it doesn't understand, it will ask you a question.
Third Generation	The first all electronic computers using vacuum tubes.
Fourth Generation	Transistors and other parts were all put into one unit. this unit was called an integrated circuit.
Fifth Generation	Transistors were used instead of vacuum tubes.

Electronic Computers since 1946

Crossword Exercise

Across

1. Wrong answers
2. This is the fourth __________ of electronic computers. First _____________ computers used the vacuum tube.
3. Strength or energy as it is used. ENIAC used the electrical ______ needed to run 100 light houses.
4. The connection of electronic parts so that electricity can pass through. Many electronic parts made into one unit is called an integrated ________.
5. The part that took the place of vacuum tubes. It has three wires.
6. A long, round, empty piece of glass or other material.
7. Sets of instructions given to computers.

Down

1. The _______ number system is based on the digits 0 and 1.
2. The person who makes plans to build machines or buildings.
3. To close and open one eye quickly. As quick as a _____.
4. To be put together into one unit.
5. To tell some one what to do is to give ____________.
6. The very small integrated circuit.
7. This kind of tube was used in the first electronic computers.

Electronic Computers since 1946

Vocabulary List for Crossword Exercise

binary

chip

circuit

engineer

generation

instructions

integrated

mistakes

power

programs

transistor

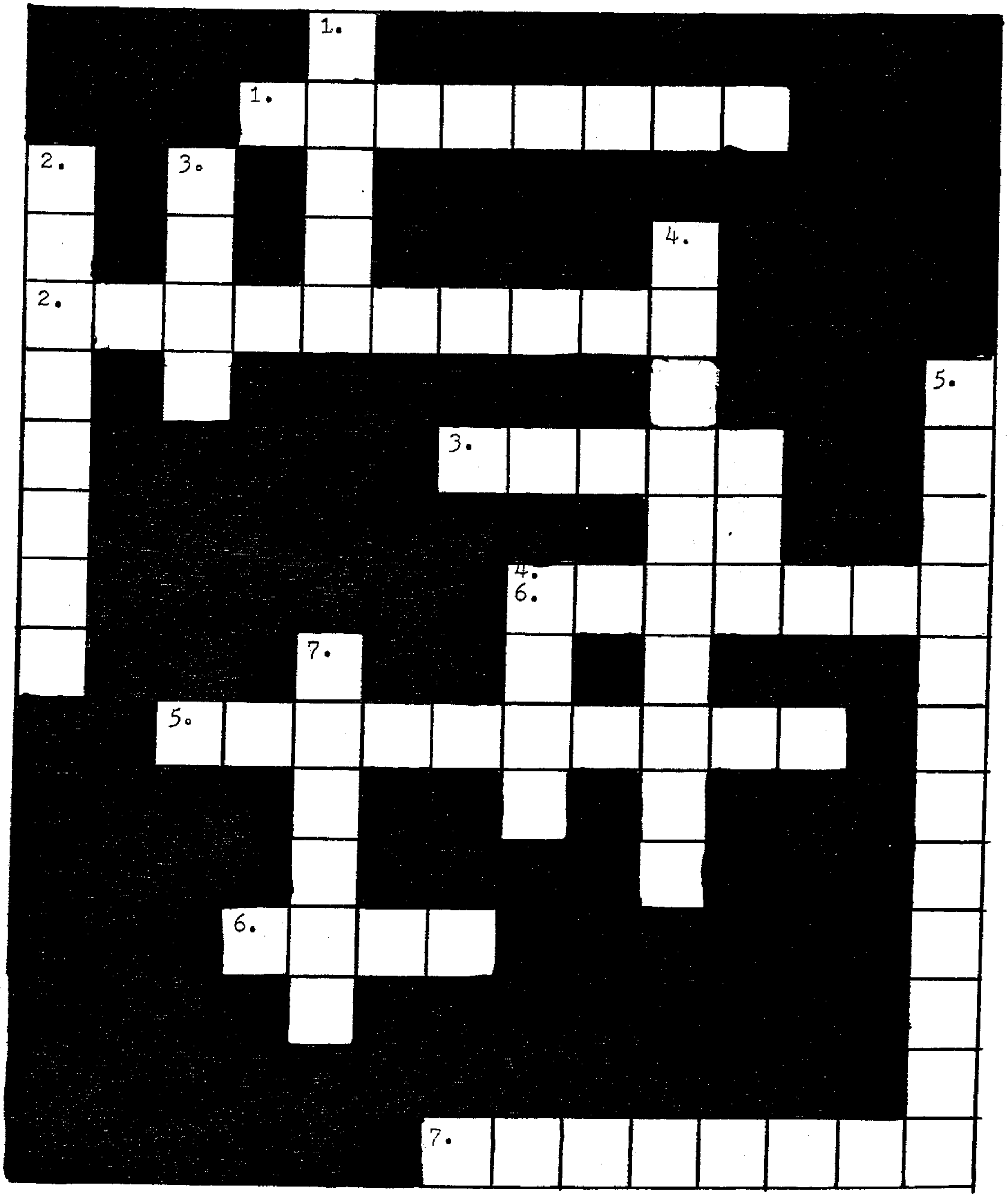
tube

vacuum

wink

Electronic Computers since 1946

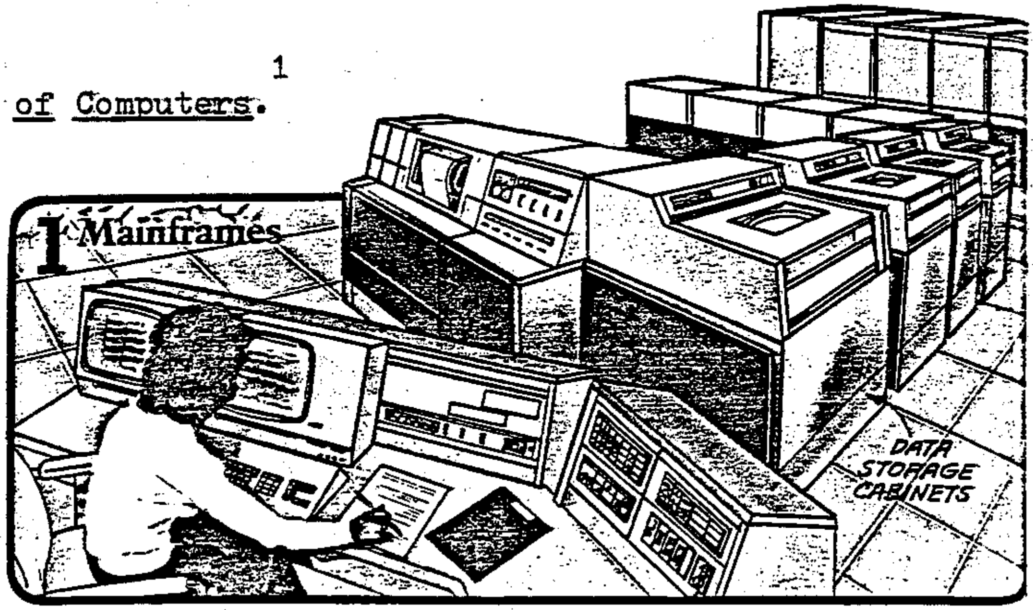
Crossword Exercise



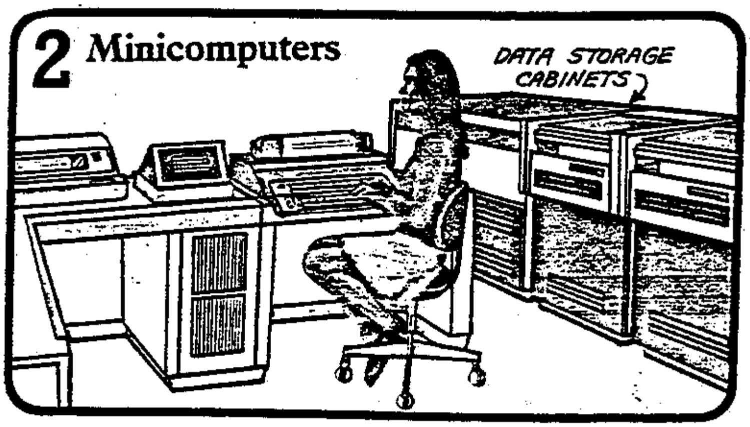
CHAPTER SIX:

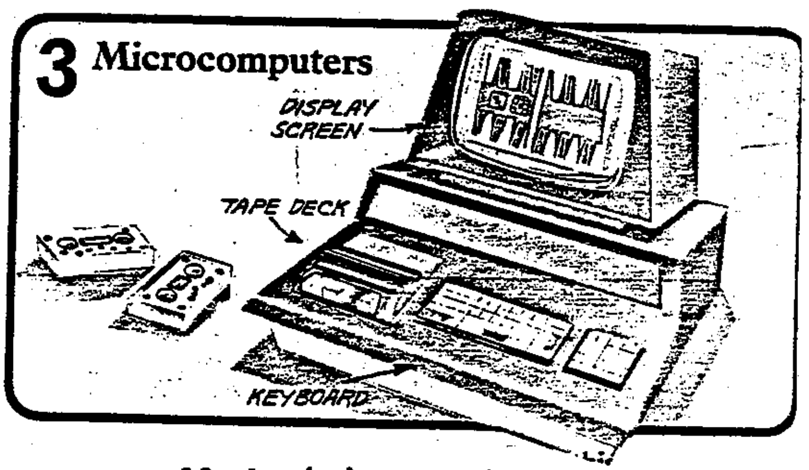
How a Computer Works

Types of Computers.[1]



Computers come in many sizes. Some are so large that only the government and largest businesses use them. (Government = the leaders of a country and the people who work for them.) These are called main-frame computers.





Other computers, not so big, are called mini-computers. They are used by many schools and businesses.

The smallest computers are called micro-computers. They are used by small businesses and even children in school.

All Computers, large or small, have the same basic parst. These parts are called: input, central processing unit, arithmetic unit, memory and output.

How It All Works Together [2]

Suppose you want to multiply the numbers 4 and 5.

You need:

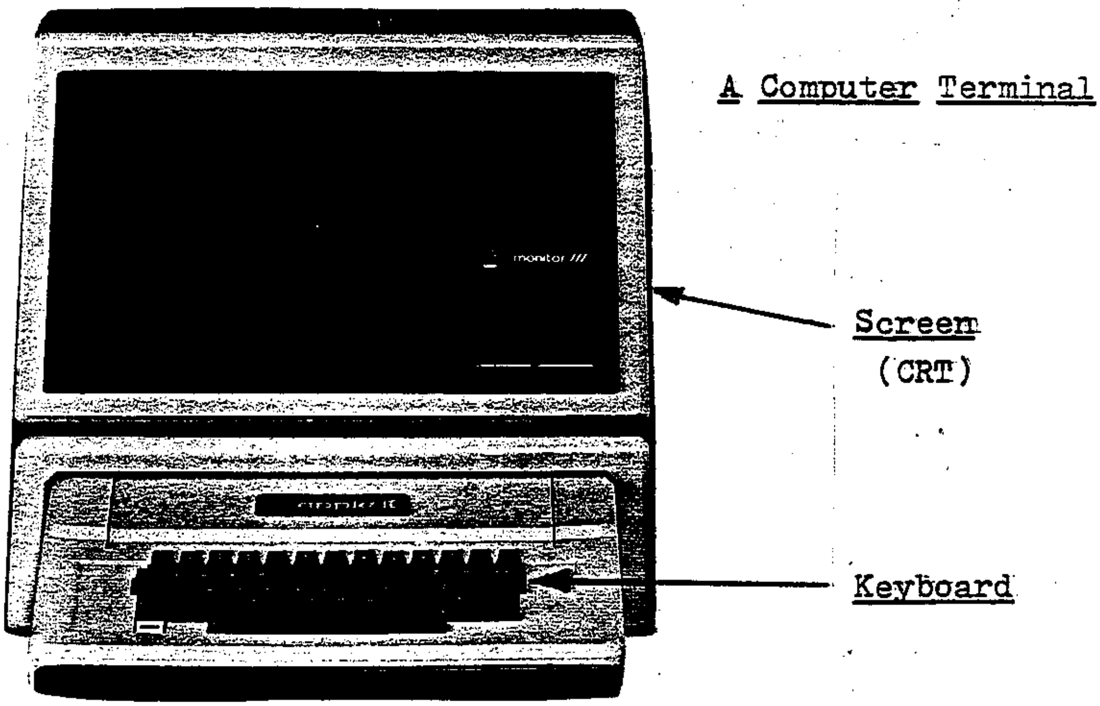
- your eyes to see the problem,
- your hand to write the answer,
- one part of your brain to remember the numbers.
- another part of your brain to multiply the numbers
- another part of your brain to control these activities.

A computer works the same way.

YOU	PROBLEM	COMPUTER
See	the numbers 4 & 5	Input - CRT screen
Your brain	Control the activity	CPU
Memory in your brain	Remember 4 & 5	Memory
Compute in your brain	multiply	Arithmetic unit
your hand	give answer 20	Output - CRT screen

Questions to Think About

1. What are the three types of computers?
2. Who uses main-frame computers?
3. What are the five basic parts found in all computers?
4. In what ways does the computer work like you do to multiply two numbers?



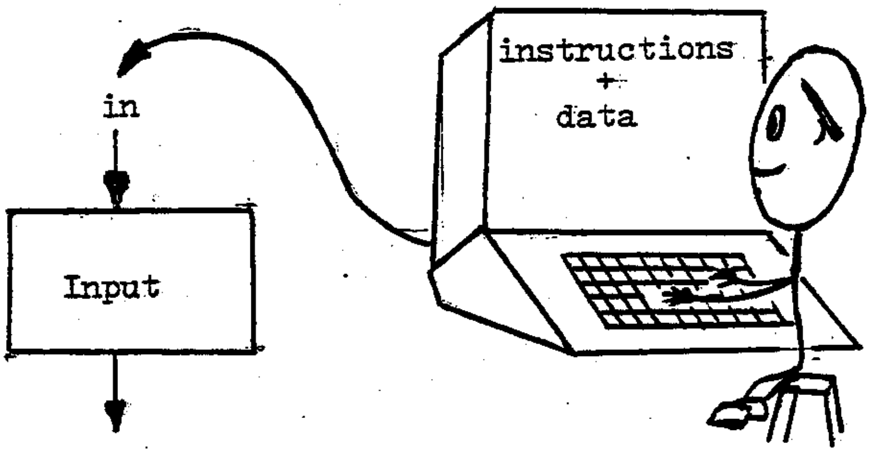
Input

To solve a problem, we give the computer instructions and data. (Data = information.) All the instructions plus all the data is called input.

Instructions + Data = Input

Data goes into a computer at the computer terminal. The terminal has a keyboard that looks like a typewriter.

It has a screen that looks like a television. We use the keyboard to give the machine the input. As we type this information into the computer, it appears on the screen. (Type = write using the keyboard.) The screen is called the cathode ray tube or CRT.



Input

1. Where does information go into the computer?

2. What part of a computer looks like a typewriter?

3. What does the screen look like?

4. What is another word for information?

5. What two things go together to make input?

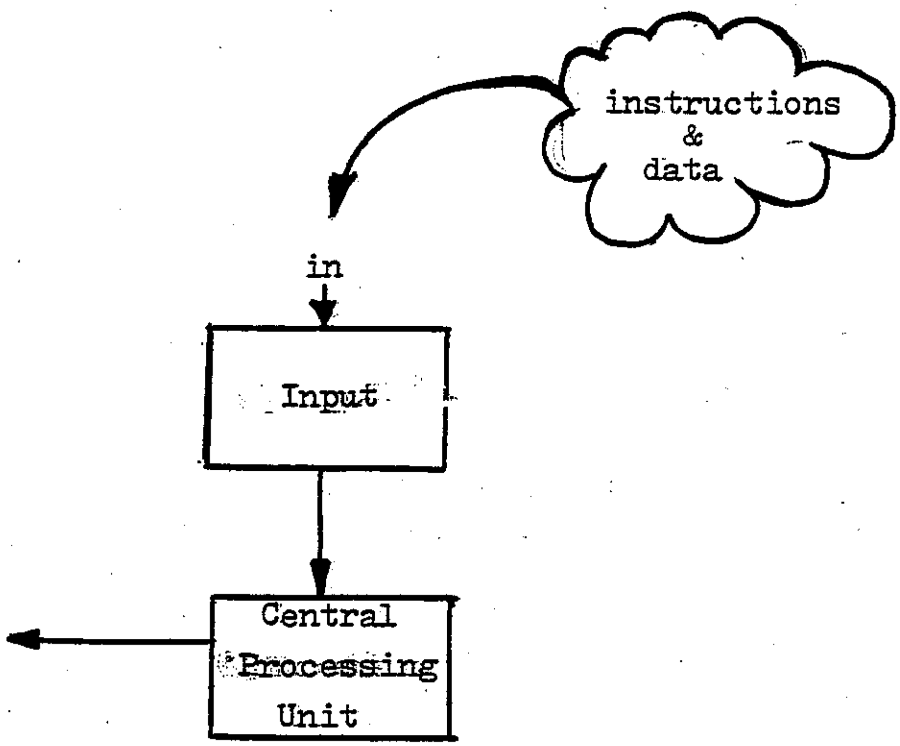
6. How do we put information into the computer?

Central Processing Unit

The central processing unit (CPU), like your brain, controls everything that happens inside the computer. Sometimes it is called the control unit. The CPU controls input, output, memory, and the arithmetic unit.

All instructions and data (input) go first to the CPU. The CPU changes the input into a code that the computer understands. Do you remember the messages in binary code? (p.28) The computer uses a code like that.

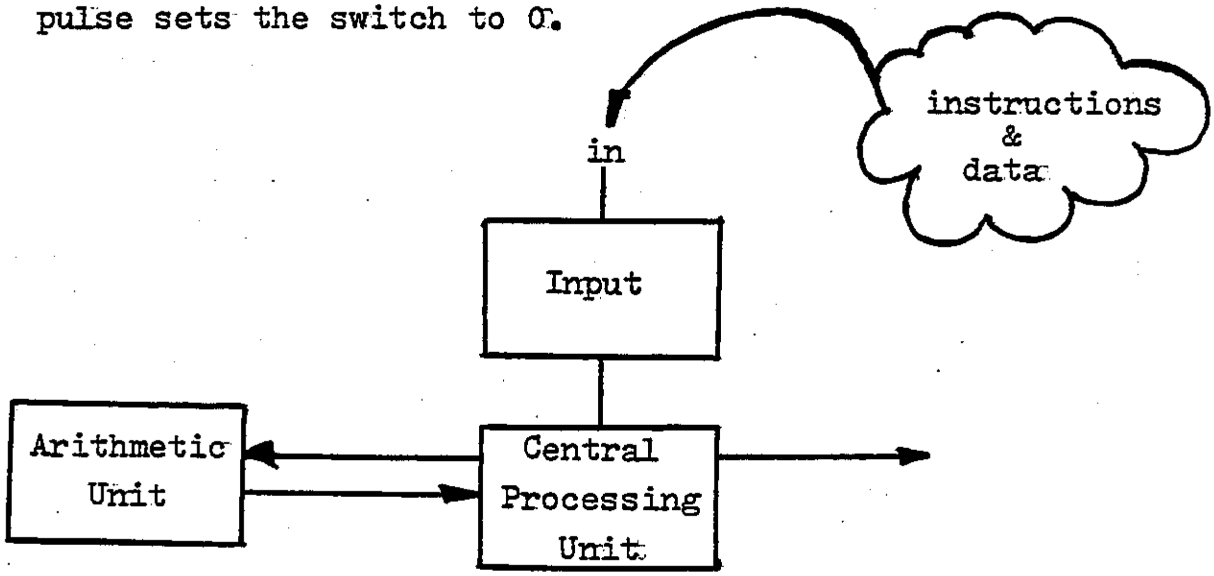
Then the input is sent to the correct part of the computer to be processed. When the work is finished, the CPU collects the results. (Results = what you get when you do a calculation. For example, the result of adding 2 + 2 is 4.) The CPU changes the results into a form you can read. Then it sends them to output.



Arithmetic Unit

The computer has another part where it does all its calculations. This part is called the arithmetic unit. The arithmetic unit is controlled by the CPU.

The counters of the arithmetic unit are its electric switches. When the switch is on, it <u>represents</u> the digit 1. (<u>Represents</u> = stands for, or means.) When the switch is off it represents 0. One <u>pulse</u> of electricity sets the switch to 1. (<u>Pulse</u> = very small push or movement of electricity.) Another pulse sets the switch to 0.



Questions to Think About

Central Processing Unit

1. What is another name for the CPU?

2. What does the CPU do with input that comes in?

3. What three things does the CPU do with the results of the computer' work?

Arithmetic Unit

1. What does the arithmetic unit do?

2. What are the counters in the arithmetic unit?

3. When the switch is ___ it represents the digit 1.
   When the switch is ___ it represents the digit 0.

4. What sets the switch to 1 and 0?

Memory

The CPU stores instructions, data, and results in the memory. (Stores = keeps) The are two kinds of memory in a computer, ROM and RAM.

Read Only Memory (ROM)

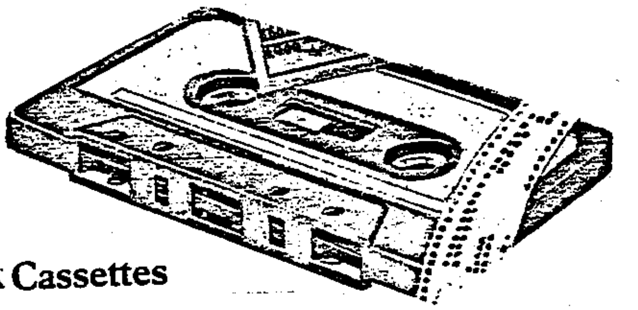
There is a permanent memory in a computer. (Permanent = It does not go away or disappear.) This memory is put into the computer when it is built. The permanent memory keeps instructions that tell the computer how to work. This memory is called Read Only Memory. (ROM) The computer cannot change or erase information in ROM. (Erase = make something disappear by rubbing. He is erasing something on his paper.)

Random Access Memory (RAM)

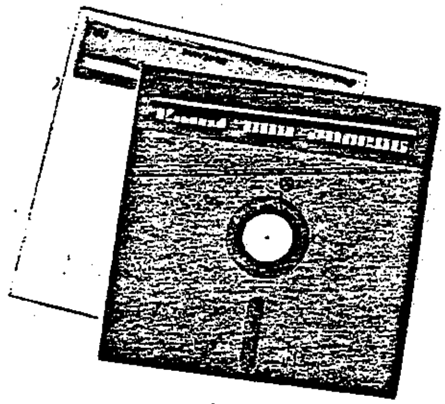
RAM is where all data and instructions from input are stored. Results from calculations are also stored in RAM. When the computer is turned off, RAM is lost.

Kinds of Memory Storage

Maybe you want to keep what is in the RAM. Then there are several ways to keep it. Just which way you use depends on the kind of computer you have.

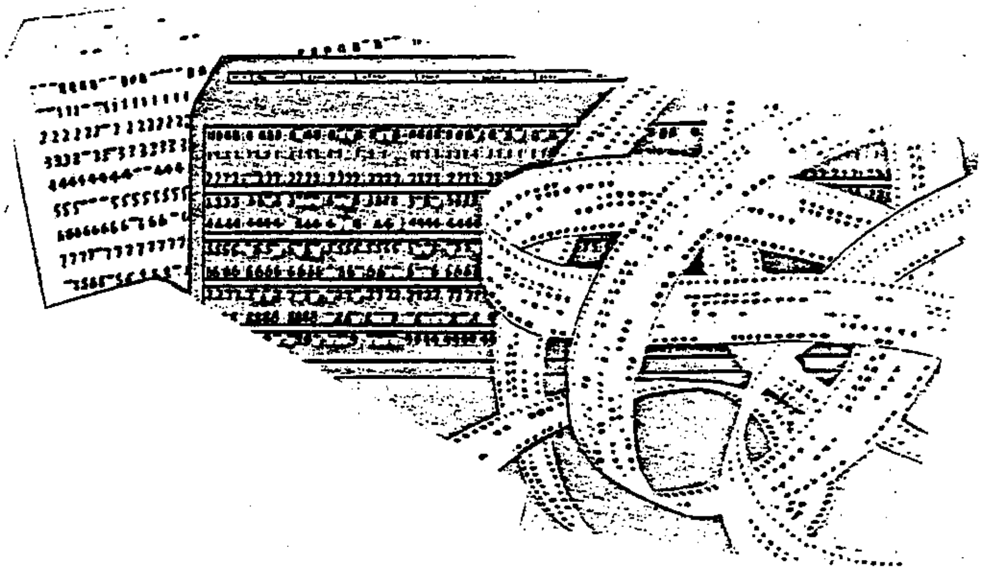


▲ Cassettes

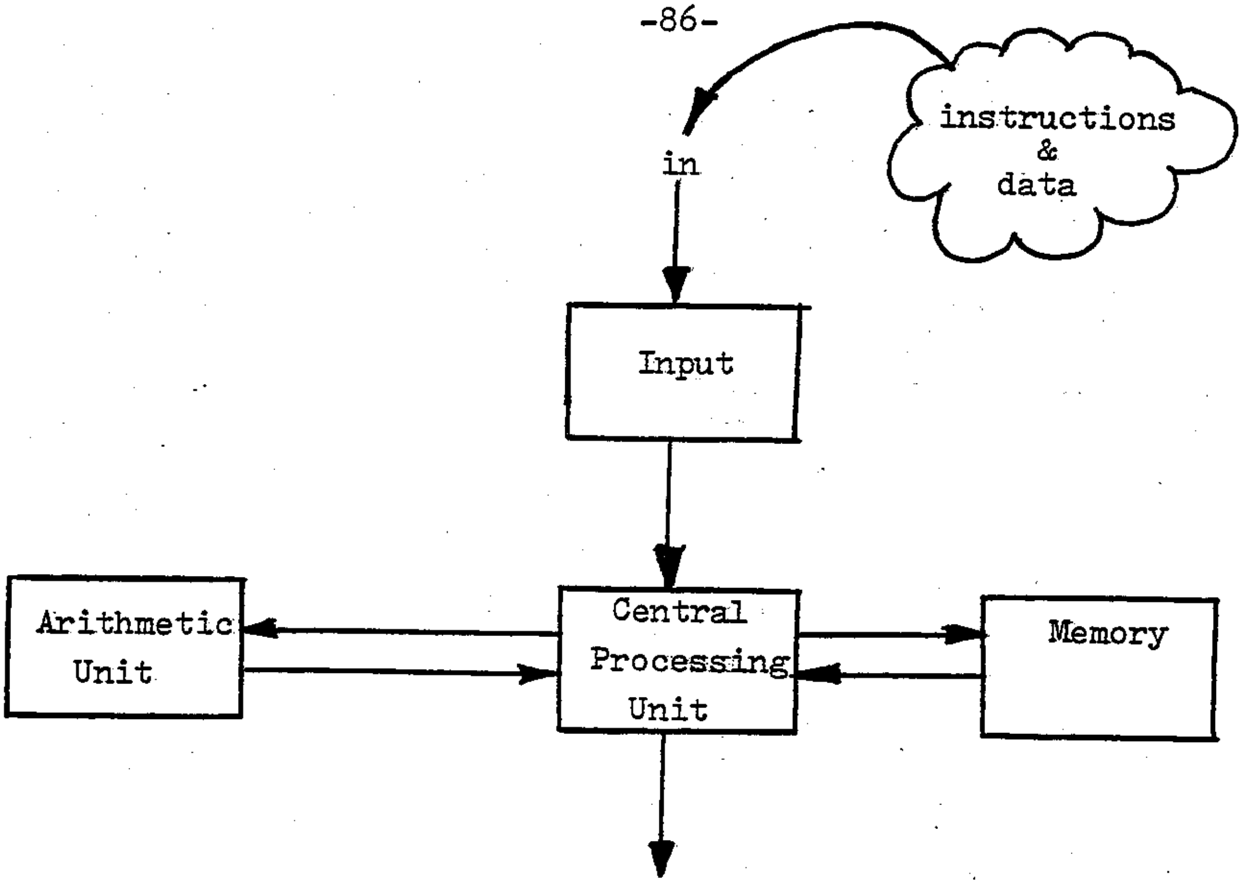


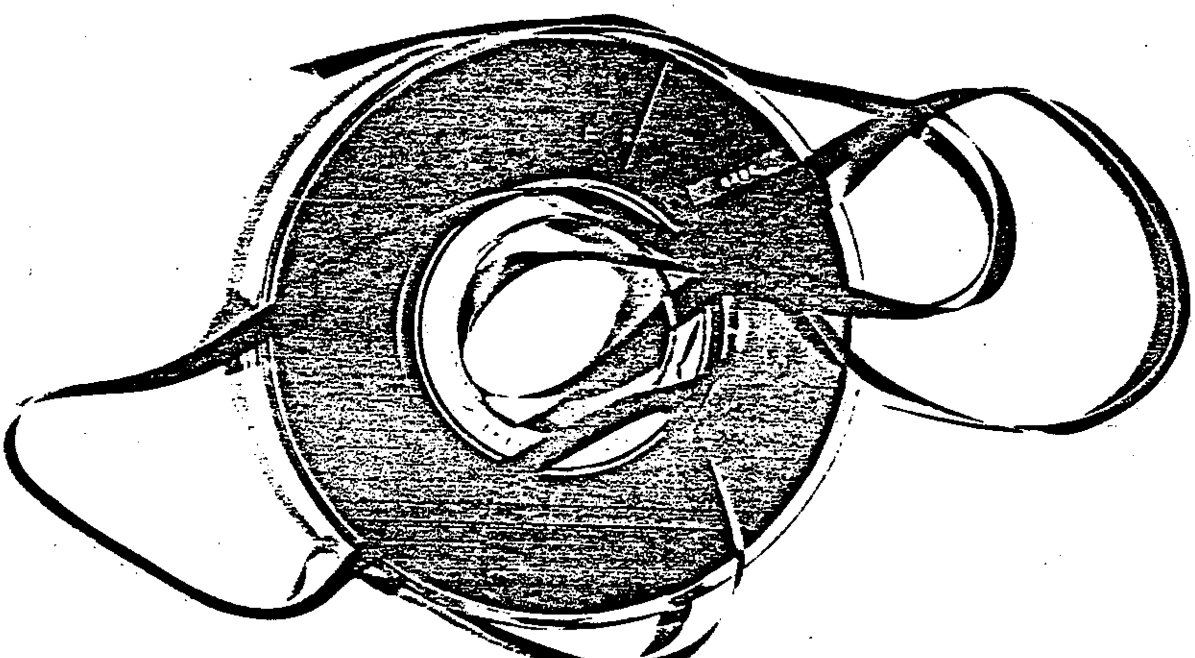
▲ Floppy discs

Most micro-computers can store information on cassette tapes or on floppy disks.[3]



Larger computers use magnetic tapes, paper tapes, or punch cards.





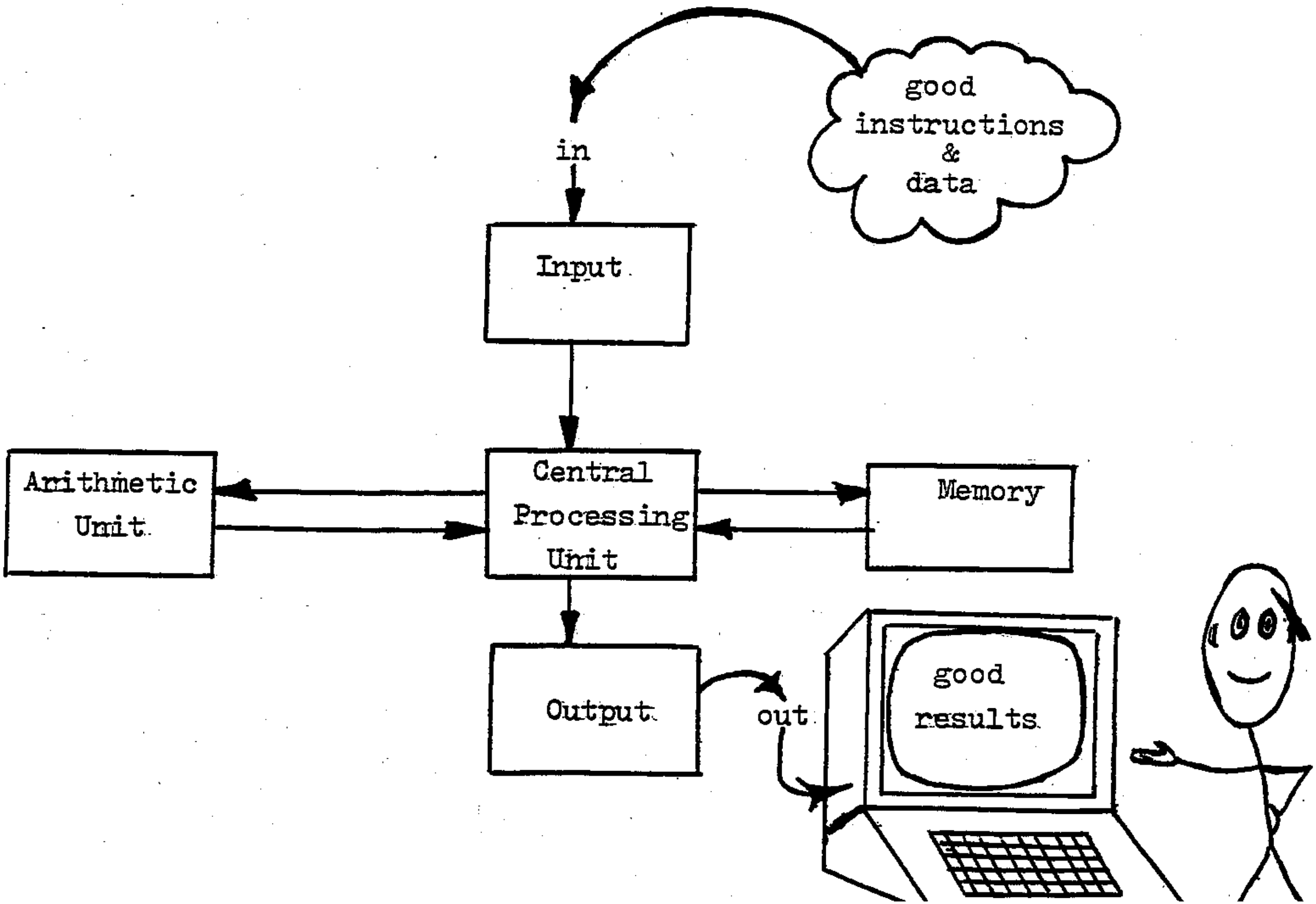
Magnetic tape for storing computer information.

4

Output

When a computer finishes its work, it shows the answers. These answers are shown on the output unit. The output uses some of the same devices as the input. Usually, the answer is shown on the CRT. Sometimes, computers print answers on paper.

In output the computer only does what it was told to do. If you put in good information, it will give good answers. If you put in bad information, it will give bad answers. The computer works only as well as the input lets it.



Questions to Think About

Memory

1. What does the computer store in its memory?

2. What kind of instructions are stored in the computer's permanent memory?

3. ROM memory is ___________ memory.
   RAM memory isn't ___________.
   RAM memory is _____ when the computer is turned off.

4. What things do micro-computers use to store information?

Output

1. Where are answers shown?

2. The output uses some of the __________ devices as the input.

   Mark the correct answer.
   a. same ___
   b. different ___

3. What does the CRT screen look like?

4. If you put in good information, the computer will give good ________.

To Think About

Fill in the parts of the computer that do the things in the list below.

YOU	PROBLEM	COMPUTER
See	The numbers 4 & 5	________
Your brain	Control the activity	________
Memory in your brain	Remember 4 & 5	________
Compute in your brain	Multiply	________
Your hand	Give answer 20	________

How a Computer Works

Crossword Exercise

Across

1. The part that controls everything that happens inside a computer.
2. To make something disappear by rubbing. The computer cannot ______ Read Only Memory.
3. The part of you that thinks, computes numbers, and controls what you do.
4. To mean or to stand for something.
5. Information goes into a computer at the computer ________.
6. To write using a keyboard.
7. To keep
8. The largest computers are called ____ - frame.
9. The part of the computer that does the calculations is the ____________ unit.

Down

1. The part of the computer that looks like a television.
2. The part of the computer that stores information.
3. The instructions and data that we give to a computer.
4. What we get when we do a calculation.
5. Something that does not go away, grow old, or wear out is ________.
6. A part of the computer terminal. On it are letters and numbers that we press to make the machine write.
7. Part of a machine. The Central Processing ________.
8. The computers that are neither the largest nor the smallest.
9. Another word for information.
10. The smallest computers.

How a Computer Works

Vocabulary List for Crossword Exercise

arithmetic

brain

CPU

data

erase

input

keyboard

main

memory

micro

mini

permanent

represent

result

screen

store

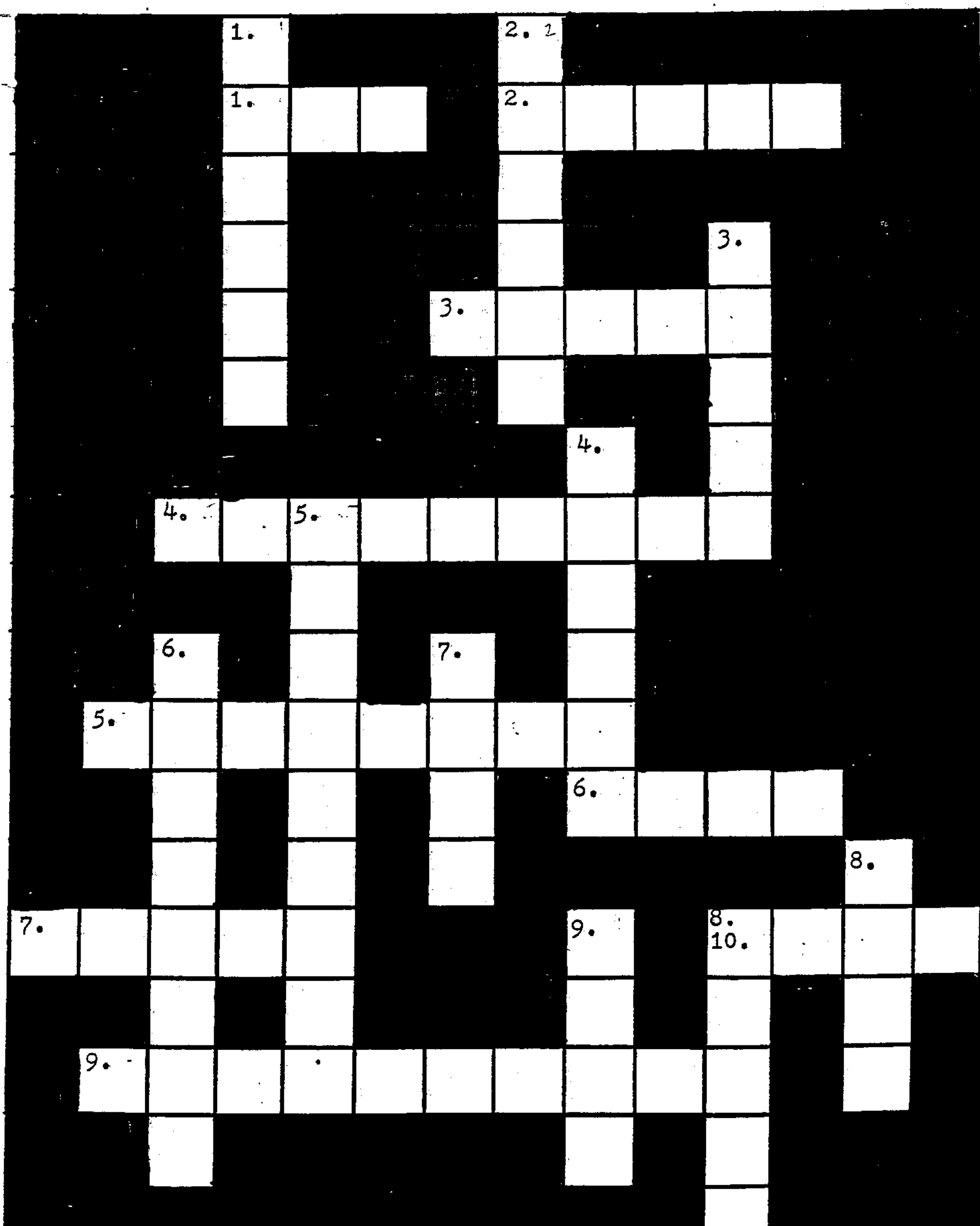
terminal

type

unit

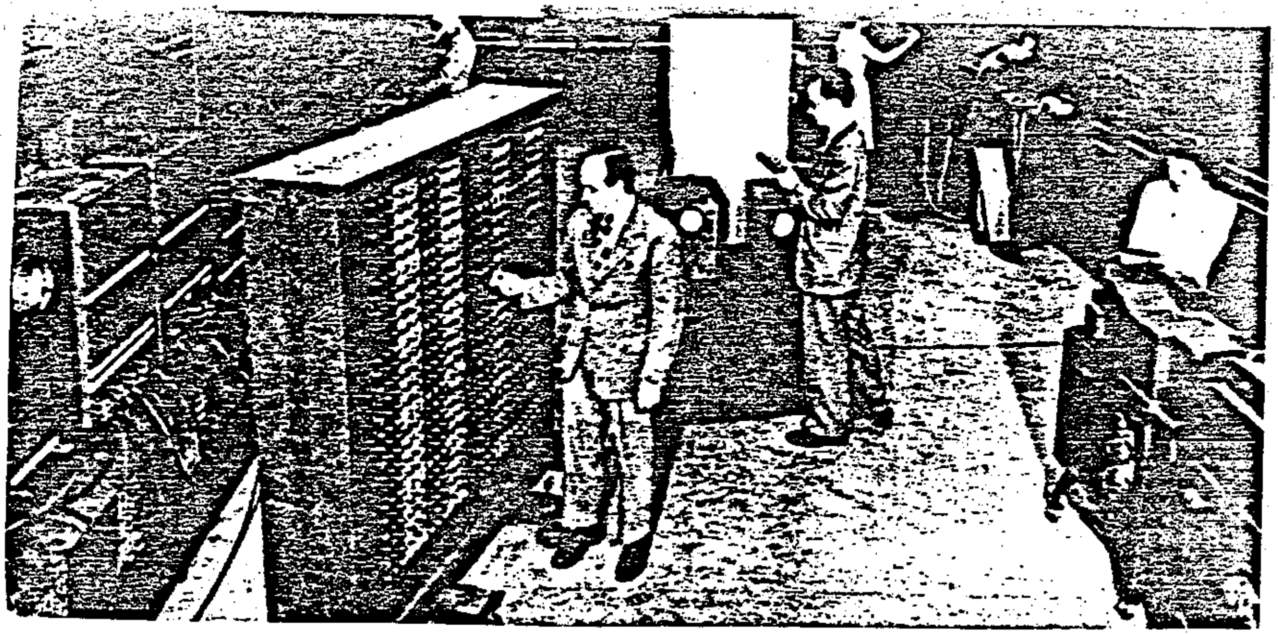
How a Computer Works

Crossword Exercise



PROGRAMMING: Telling the Computer What to Do.

What is a Program?



Do you remember the first computer, ENIAC?[1] It had to be told what to do at all times. That is because it could not store instructions. Then Von Neumann made the EDVAC computer. The EDVAC could remember instructions. Those instructions were called a program. Now all computers use programs. In fact, to make a computer work, it must be programmed.

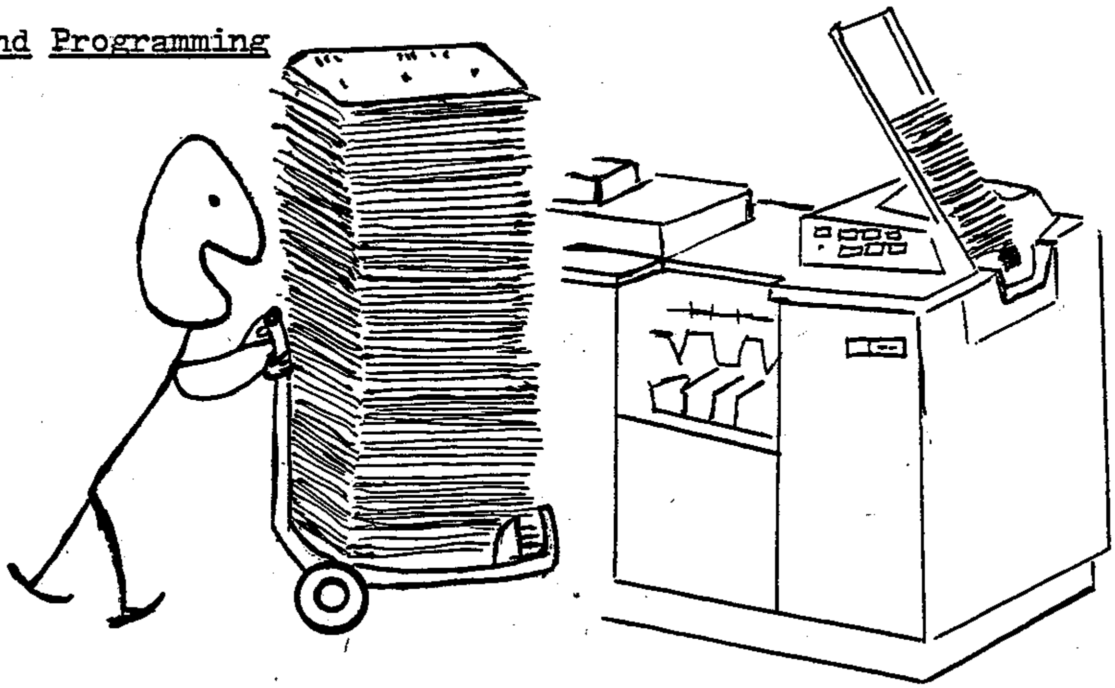
A program is a list of instructions telling the computer what to do. To program a computer means to give it a list of instructions. For example, a program may tell the computer, "Find all the people born on June 1, 1972." Or "Add these two numbers and remember the answer (15,6)."[2]

Two Kinds of Programs

Remember there are two kinds of programs. Some programs control the way a computer works. These programs are stored permanently in the Read Only Memory. An example of this kind of program is the language that the computer uses.

Other programs tell the computer what to do for a certain job. (Job = something you want it to do. A certain job = something special you want it to do.) For example, "Find all the families with more than three children." These programs have to be written specially by the person using the computer. When the computer is turned off, these programs disappear.

Programmers and Programming



A person who gives a computer instructions is called a programmer. Suppose a programmer wants to give a computer a job to do. He gives it lots of data and many instructions.

Instructions are simple but they must be exact. They must be in correct order, step by step. Using simple instructions, a computer can do complicated things. (Complicated = difficult to understand.) But the computer can only do what the program tells it to do. And it can only use data that has been given to it.

Questions to Think About

1. What is a program?

2. How many kinds of programs are there?

3. Some programs are stored permanently in the Read Only Memory. Can these programs be erased? Why or Why not?

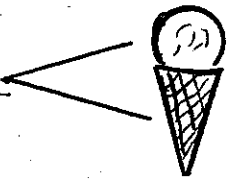
4. What do we call a person who programs a computer?

5. If a programmer gives a computer a job, he gives it lots of _______ and many _____________.

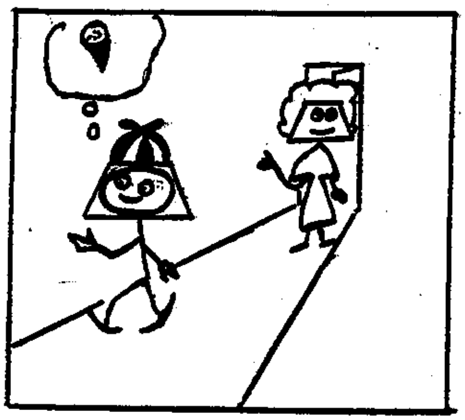
Silly Ice Cream Program[3]

Here is a list of instructions for buying an ice cream cone.

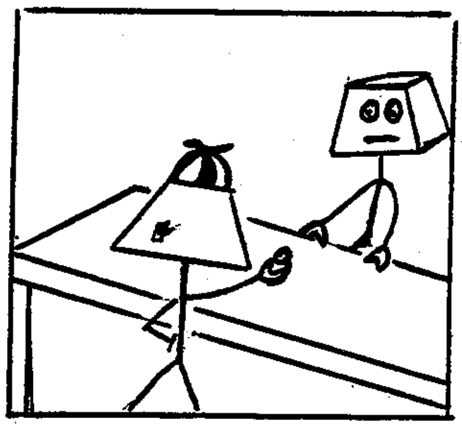
An Ice Cream Cone



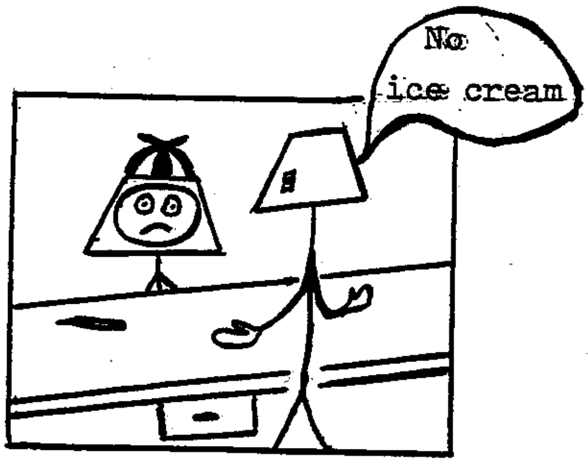
The instructions are written as a computer program would be written. There are some <u>bugs</u> in this program. (<u>Bugs</u> = mistakes.) Can you find them?



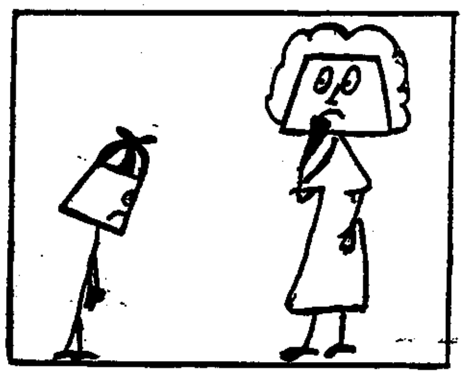
1. Leave home.



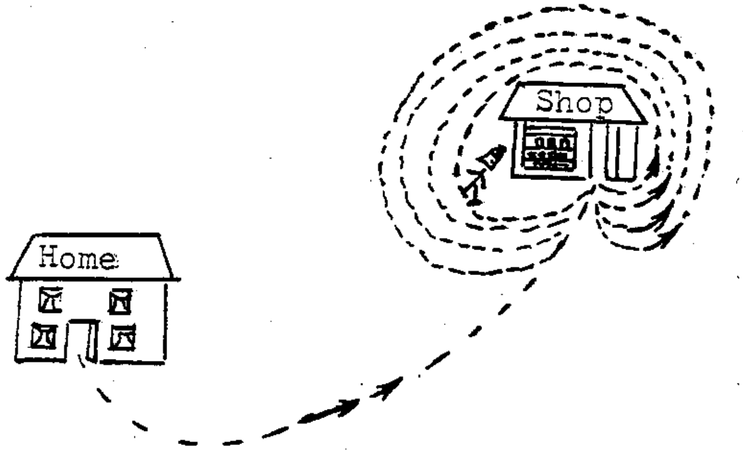
2. Go to shop.
3. Ask for ice cream cone.



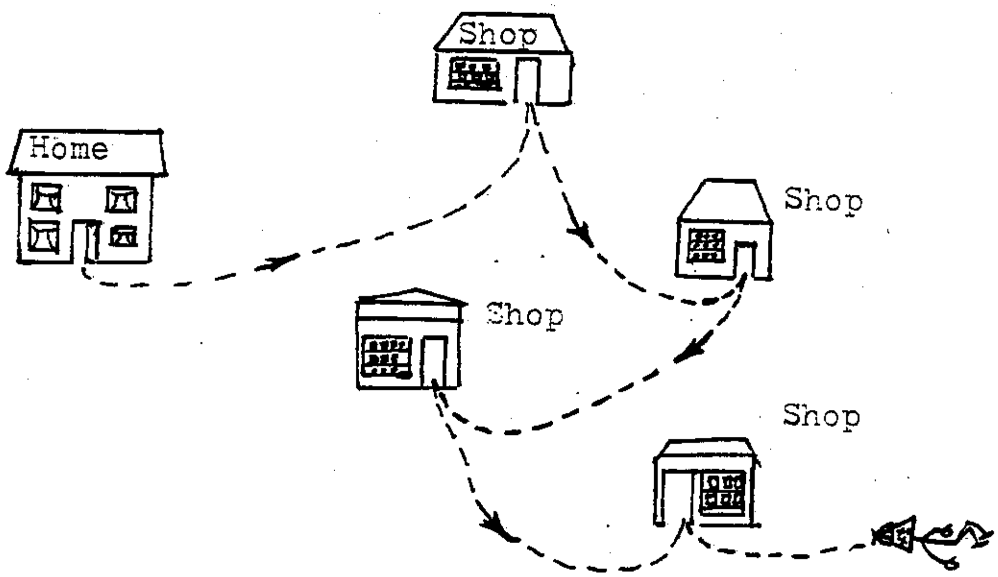
4. If shop has none, go back to line 2.



5. Go home.

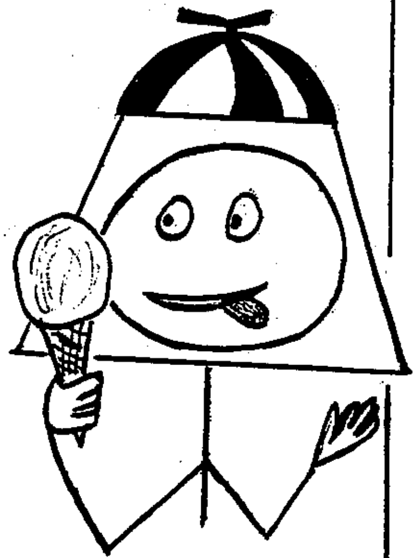


The first bug is in line two. Line two doesn't tell the computer to try a different shop. So it would keep on going to the same shop to ask for ice cream.



The other bug is in line 4. It doesn't tell the computer when to stop. If there were no ice cream cones anywhere, the computer would keep trying.

1. Leave home.
2. Go to nearest shop you haven't visited.
3. Ask for ice cream cone.
4. If shop doesn't have any, are you tired? If not tired, go to line 2.
5. Go home.



Above is a better way to write the program. At line 4 the program asks if the computer is tired. If it is tired, it goes home.

Questions to Think About

1. What is another word meaning mistake?

2. What is the second bug in the program?

Programming Languages

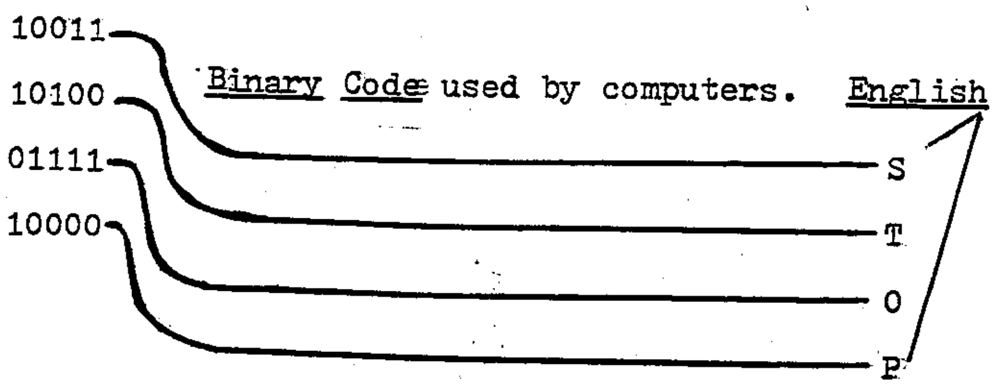
Every time some one writes a program, he uses a computer language. Computer languages are also used when a computer writes an answer. These languages are like English but easier for the computer to use.

Here are some instructions in FORTRAN, a computer language. For example, in English, "Add 6 to 15 and then stop."[4]

```
                "A = 15
FORTRAN          B = 6
                 C = A + B
                 STOP"
```

Inside computers, another language is used. In fact, it is a code using binary numbers. The computer changes the data and program to this binary code. Then it stores the binary code with electric pulses.

Here is an example:



You could program a computer in binary code. But that would be very difficult. So computers keep a language program in their ROM memory. That program changes the programming language to binary code.

Three Computer Languages

There are different languages to work with different kinds of problems. Three of these languages are FORTRAN, COBOL, and BASIC.

FORTRAN is used for problems in science and mathematics.
COBOL is used for problems in business.
BASIC is a language for beginners and can be used for many kinds of problems.

Software and Hardware

Programs and programming languages are called <u>software</u>. The parts of the computer such as the keyboard, screen, and CPU are called <u>hardware</u>.

Questions to Think About

1. Computer languages are like English, but they are ____ for computers.

2. What code is used inside computers?

3. How is this code stored?

4. Match the language to itš use.

Problems in science.	COBOL
Problems in business,	BASIC
A language for beginners,	FORTRAN

PROGRAMMING: Telling the Computer What to Do

Crossword Exercise

Across

1. Something difficult to understand with many parts. The opposite of simple.
2. We call programs and programming languages ________________.
3. A list of instructions for the computer.
4. Mistakes in a computer program.
5. All the electronic parts of a computer such as the screen, CPU, etc.
6. A number system with only two digits.
7. A special way of writing something.

Down

1. A computer language for business.
2. A push or movement of electricity.
3. A person who gives instructions to a computer.
4. A computer language for science and math.
5. A computer language for beginners.
6. Something to do.

PROGRAMMING: Telling the Computer What to Do

Vocabulary List for Crossword Exercise

BASIC

binary

bugs

COBOL

code

complicated

FORTRAN

hardware

job

program

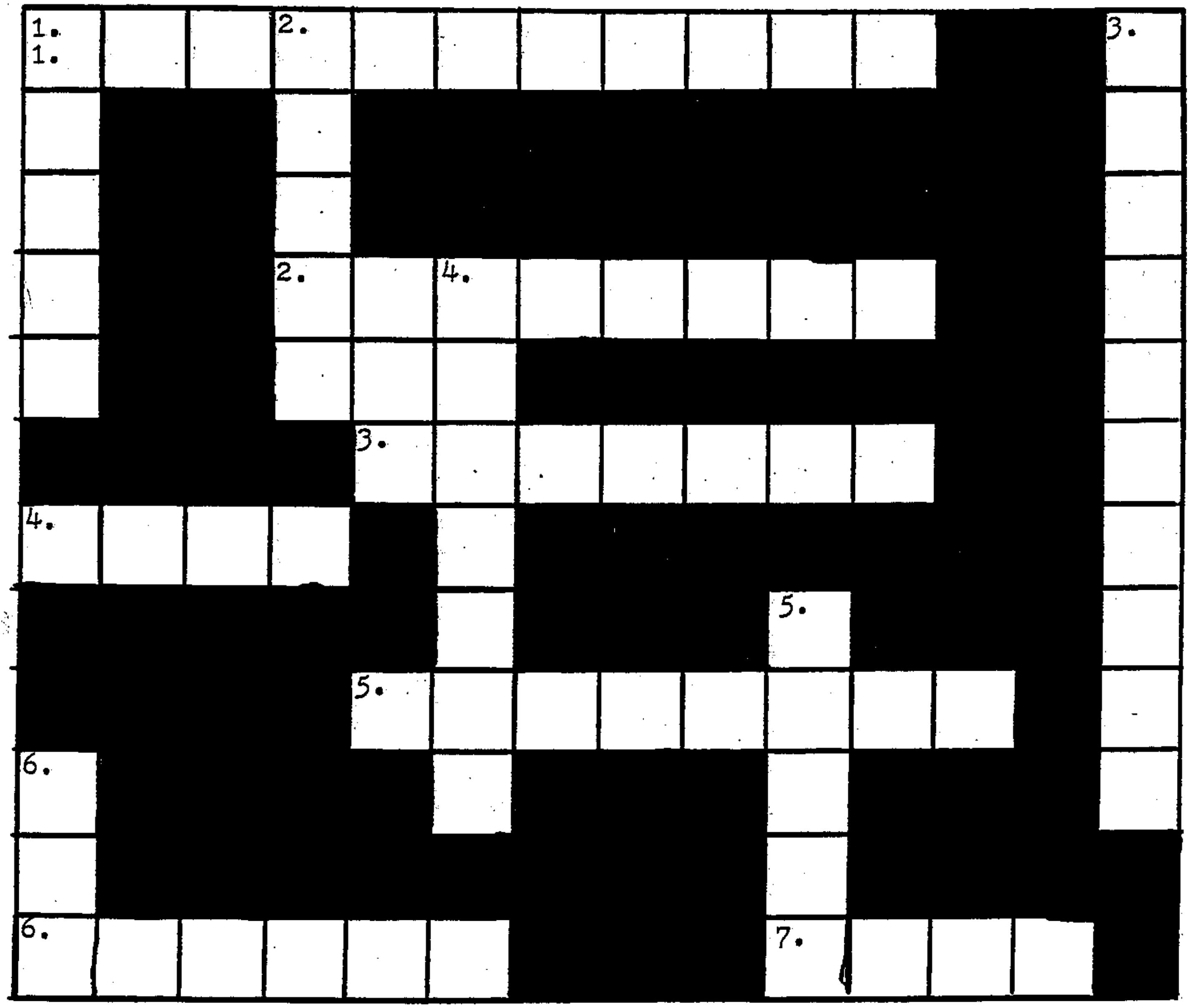
programmer

pulse

software

PROGRAMMING: Telling the Computer What to Do

Crossword Exercise



FOOTNOTES

TEACHER'S INTRODUCTION

[1]Judith A. Zoebelein, High Interest Readings for the Adult Beginning ESL Student (unpublished master's thesis, School for International Training, 1976)

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CHAPTER ONE: Numbers and Counting

[1]Illustrations adapted from Lancelot Hogben, The Wonderful World of Mathematics(Garden City Books, 1955) pp. 8,9.

[2]Ibid., pp. 48, 49. Adapted.

[3]Philip Carona, Numbers(Children's Press, 1982) p. 43.

CHAPTER TWO: Base Two Numbers

[1]Clyde Watson and Wendy Watson, Binary Numbers(Thomas Y. Crowell, 1977) pp. 1-9.

[2]Brian Reffin Smith, Computers(Usborne Publishing, Ltd; 1981) p. 8.

[3]Gary B. Bitter, Exploring with Computers(Julian Messner, 1981) p. 60.

[4]Smith, Op. Cit., p. 8.

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CHAPTER THREE: The First Computing Devices

[1]Bitter, Op. Cit., p. 13.

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FOOTNOTES

CHAPTER FOUR: From the Analytical Engine to the Mark I

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[2] D. S. Halacy, What Makes a Computer Work? (Little, Brown, and Company, 1973) p. 13.

[3] Bitter, Op. Cit., p. 16.

CHAPTER FIVE: Electronic Computers since 1946

[1] Illustration from Bitter, p. 17.

[2] Illustration from Dale Gustafson, "The Chip: Electronic Mini-marvel," The National Geographic Magazine, 162, No. 4 (October, 1982) p. 443.

[3] Illustration from Smith, p. 4.

[4] Illustration from Bitter, p. 19.

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[6] Illustration from Karen Jacobsen, Computers (Childrens Press, 1982) p. 43.

[7] Allen A. Boraiko and Charles O'Rear, "The Chip: Electronic Mini-marvel," The National Geographic Magazine, 162, No. 4 (October, 1982) p. 445.

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[2] Bitter, Op. Cit., p. 23.

[3] Smith, Op. Cit., p. 11.

[4] Bitter, Op. Cit., p. 28.

CHAPTER SEVEN: PROGRAMMING: Telling the Computer What to Do

[1] Bitter, Op. Cit., p. 17.

[2] Jane Jonas Srivastava, Computers (Thomas Y. Crowell, 1972) p. 15.

[3] Smith, Op. Cit., p. 12.

[4] Srivastava, Op. Cit., p. 17.

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APPENDIX I: Answer Key

CHAPTER ONE

Page 6

1. fingers
2. ten
3. a. notches in sticks
   b. knots in strings
   c. stones
4. We would probably have a base eight number system.

Page 10

1. They used letters as symbols for numbers.
2. They were easy to work with.
3. The Romans couldn't do arithmetic.
4. Roman numerals dont have <u>place</u> <u>value</u>.

Page 12

1. The Arabs
2. No. They got it from India.
3. Arabic numerals are the symbols we use for writing.
4. + Add, - Subtract, x multiply, ÷ divide.
5. They have place value.
6. ten
7. base two.

CHAPTER TWO

Page 26

A.
1. eleven
2. three
3. seven
4. thirteen
5. fifteen
6. sixteen
7. seventeen
8. thirty-one
9. twenty-seven
10. twenty-five

B.
1. 1
2. 10
3. 1011
4. 1111
5. 10000
6. 110
7. 11
8. 1001
9. 10100
10. 11110

Page 27

D = 100	H = 1000	N = 1110	T = 10100
E = 101	I = 1001	O = 1111	U = 10101
F = 110	J = 1010	P = 10000	V = 10110
Y = 11001	K = 1011	Q = 10001	W = 10111
Z = 11010	L = 1100	R = 10010	X = 11000

Page 28

The messages say,
"HELLO"
"WHAT IS YOUR NAME?"
"MY NAME IS ______"

Page 29

1. six
2. Computers only know the difference between on and off.
3. Any reasonable sentence.
4. Hard!

CHAPTER THREE

Page38

1. 361
2. ten
3. There were much fewer stones to carry around.
4. They "carried" ten stones from the tens place to the hundreds place.

Page 40

1. an abacus
2. China, Japan, and Russia
3. Carrying
4. You can do arithmetic any time any where without carrying an abacus around.

Page 43 Pascal's Calculator

1. It shows the digits.
2. digital
3. wheels
4. in windows above the wheels.
5. in a car. It counts miles.

Morland's Calculator

1. It was a digital calculator with wheels.
2. It could add and subtract.
3. clockwise
counter-clockwise

Page 45

1. It could add, subtract, multiply, divide, and find square roots.
2. five
3. modern digital computers

CHAPTER FOUR

Page 52

1. He wanted an engine that could compute numbers quickly and easily.
2. cards with holes punched in them.
3. holes in the cards.

Page 54

1. to count all the people living in the United States.
2. Hollerith used punched cards to give his machine instructions.
3. to process the United States census in 1890.

Page 56

1. to help him solve problems in his research.
2. electricity
3. moving parts
4. 6
   2
   9
   1
   7
   4
   8
   5
   3

CHAPTER FIVE

Page 63

1. All the work was done by electricity. There were no moving parts.
2. ENIAC was big, and heavy. It used too much electricity.
3. Its vacuum tubes burned out often.
3.

Page 64

1. Binary numbers work well with on and off.
2. to become faster.

Page 66

1. The EDVAC could remember instructions.
2. a program
3. first generation computers

Page 69

1. They used less electricity and gave off less heat.
2. Computers became smaller, less expensive, and faster.
3. Sometimes the wires broke off.
4. integrated circuits
5. one

Page 71

1. About the size of a pencil eraser.
2. very small
3. It filled a large room and weighed 30 tons.
4. a penny

Page 73

1. spoken and written
   translate
   print
2. It will ask questions.
3. Their mistakes.

CHAPTER SIX

Page 79 Types of Computers

1. main-frame, mini, micro
2. the government and the largest businesses.
3. input, CPU, arithmetic unit, memory, output
4.

Page 80 Input

1. at the computer terminal
2. the keyboard
3. a television
4. data
5. data + instructions
6. We type in information on the keyboard.

Page 83 Central Processing Unit

1. control unit
2. The CPU changes input into a form that the computer understands.
3. a. collects the results
   b. changes the results into a form you can understand.
   c. sends the results to the output.

Page 83 Arithmetic Unit

1. The arithmetic unit does all the computer's calculations.
2. electric switches
3. on
   off
4. pulses of electricity

Page 88 Memory

1. instructions, data, and results
2. instructions that tell the computer how to work.
3. permanent
   permanent
   erased
4. cassetes and floppy disks

Page 88 Output

1. on the output unit. on the CRT screen.
2. same
3. a television
4. answers or results

Page 90

input
CPU
memory
Arithmetic unit
output

CHAPTER SEVEN

Page 96

1. a list of instructions for the computer.
2. two
3. No, because they are stored permanently.
4. a programmer
5. data, instructions

Page 99

1. bug 2. The program doesn't tell the computer when to stop.

Page 102

1. easier 2. binary 3. with electric pulses.

APPENDIX II: Key to Crossword Exercises

CHAPTER ONE

Across
1. Arabs
2. invent
3. symbol
4. remember
5. ten
6. computer
7. subtract
8. multiply
9. abacus
10. divide
11. count

Down
1. Romans
2. system
3. value
4. base
5. numeral
6. solution
7. add
8. be

CHAPTER TWO

Across
1. digit
2. code
3. binary
4. message
5. ruler

Down
1. difference
2. twice
3. double
4. experiment
5. measure

CHAPTER THREE

Across
1. advanced
2. groove
3. rod
4. mechanical
5. root
6. wheel
7. process
8. square

Down
1. mathematician
2. bead
3. device
4. clockwise
5. calculator
6. carrying
7. frame

CHAPTER FOUR

Across
1. process
2. instructions
3. formula
4. punch
5. wire
6. basic
7. card
8. design

Down
1. print
2. research
3. compute
4. holes
5. switches
6. census

CHAPTER FIVE

Across
1. mistakes
2. generation
3. power
4. circuit
5. transistor
6. tube
7. programs

Down
1. binary
2. engineer
3. wink
4. integrated
5. instructions
6. chip
7. vacuum

CHAPTER SIX

Across
1. CPU
2. erase
3. brain
4. represent
5. terminal
6. type
7. store
8. main
9. arithmetic

Down
1. screen
2. memory
3. input
4. result
5. permanent
6. keyboard
7. unit
8. mini
9. data
10. micro

CHAPTER SEVEN

Across: 1. complicated 2. software 3. program 4. bugs 5. hardware 6. binary 7. code

Down: 1. COBOL 2. pulse 3. programmer 4. FORTRAN 5. BASIC 6. job

APPENDIX III: Suggested English Language Exercises

Passive Voice

In most sentences, the <u>subject</u> of the sentence does something to the <u>object</u>.

SUBJECT — [VERB] → OBJECT

<u>Example</u>: Many people use the computer.

Sentences like the example are in the <u>active voice</u>. The subject does the action.

In the example, the word "computer" comes last. Suppose we want to put the words, "the computer" at the front of the sentence. How can we do it?

1. First write the words, "The computer."

The computer...

2. Put in the verb "to be." It must be the correct form.

The computer is ....

3. Take the past participle of the verb "to use."

   present = use   past = used   past participle = <u>used</u> *

The computer is used ....

4. Put in the preposition "by."

The computer is used by ....

5. What comes next?

The computer is used by many people.

What if we said "computers" instead of "the computer."

1. Put "computers" at the front of the sentence.

Computers...

2. Put in the verb "to be." Be careful!

Computers are...

The rest is the same as before. Can you write the whole sentence?

Computers ___ ____ __ ____ ______.

Sometimes we only want to know what and when. We don't care about who.

Example: Some one wrote this book in 1981.

What do you do if you want to put "this book" at the front?

1. Put "this book" at the front.

This book...

2. Put in verb "to be." Which form do you use? Past, present, or future?

This book was...

3. Take the past participle of the verb "to write."

   present = write past = wrote past participle = written*

This book was written...

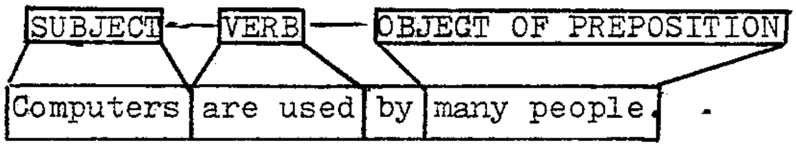
4. We don't care who wrote the book. So we don't put in "by some one."

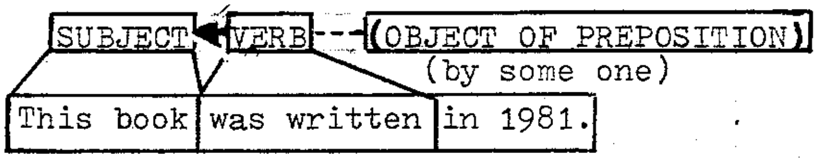
   This book was written. (by some one)

5. Complete the sentence.

   This book was written in 1981.

Look at these sentences again.





The subject doesn't do the action. Something else does the action. Sentences like these are in the passive voice.

See if you can find the correct sentence in each group. Put a mark beside the correct one.

Example: (a) Stones was used to count with.

X (b) Stones were used to count with.

(c) Stones were use to count with.

EXERCISE ONE

Put a mark beside the correct sentence in each group.

1. (a) The abacus is used by the Romans.

   (b) The abacus were used by the Romans.

   (c) The abacus was used by the Romans.

2. (a) These symbols is call Roman numerals.

   (b) These symbols was called Roman numerals.

   (c) These symbols are called Roman numerals.

3. (a) Our number system were invented a thousand years ago.

   (b) Our number system was invented a thousand years ago.

   (c) Our number system is invented a thousand years ago.

4. (a) Arabic numerals are used in many lands.

   (b) Arabic numerals was used in many lands.

   (c) Arabic numerals is used in many lands.

5. (a) They is based on the number ten.

   (b) They were based on the number ten.

   (c) They are based on the number ten.

EXERCISE TWO

Now see if you can write sentences. Use the words that are written for you.

Example: (stones)(use)(to count with)

Stones were used to count with.

1. (Our number system)(invent)(people in India)
2. (It)(not)(invent)(the Arabs)
3. (Arabic numerals)(use)(many people)
4. (It)(call)(a base ten system)
5. (Base two)(use)(computers)

EXERCISE THREE

Write three sentences about yourself using passive voice.

1.

2.

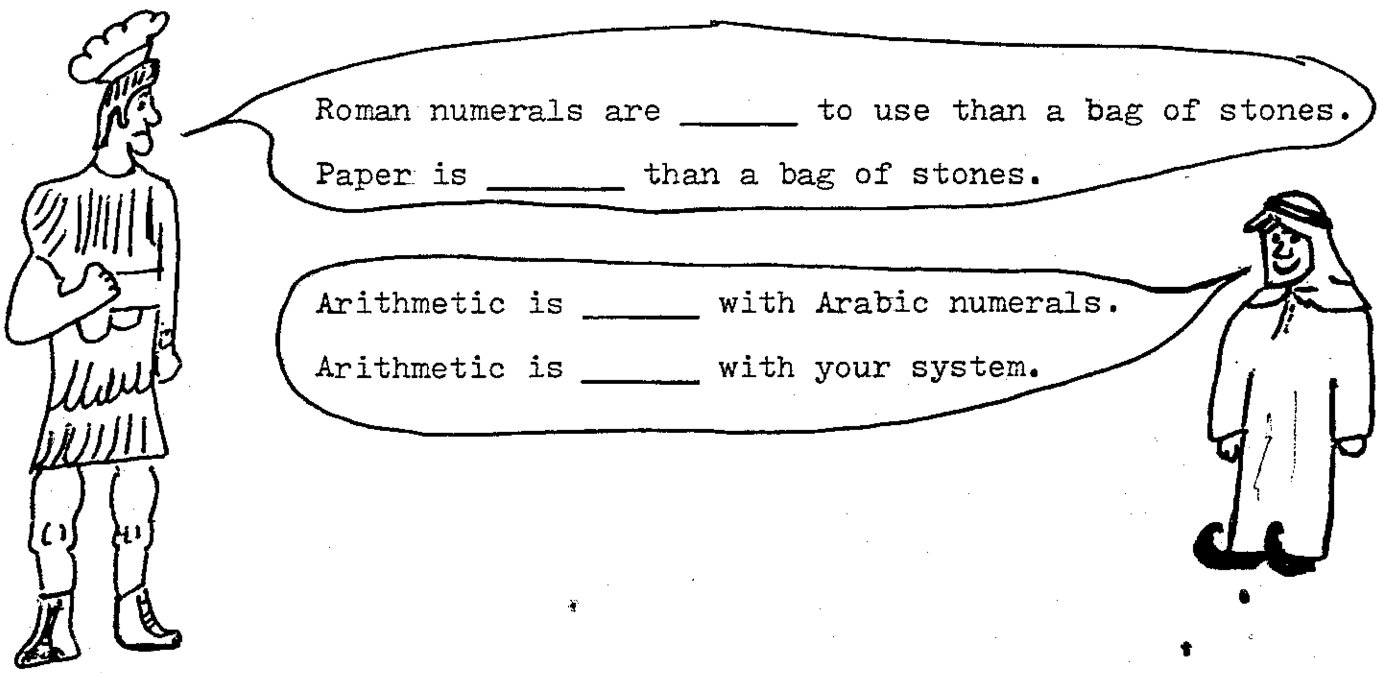
3.

Comparatives

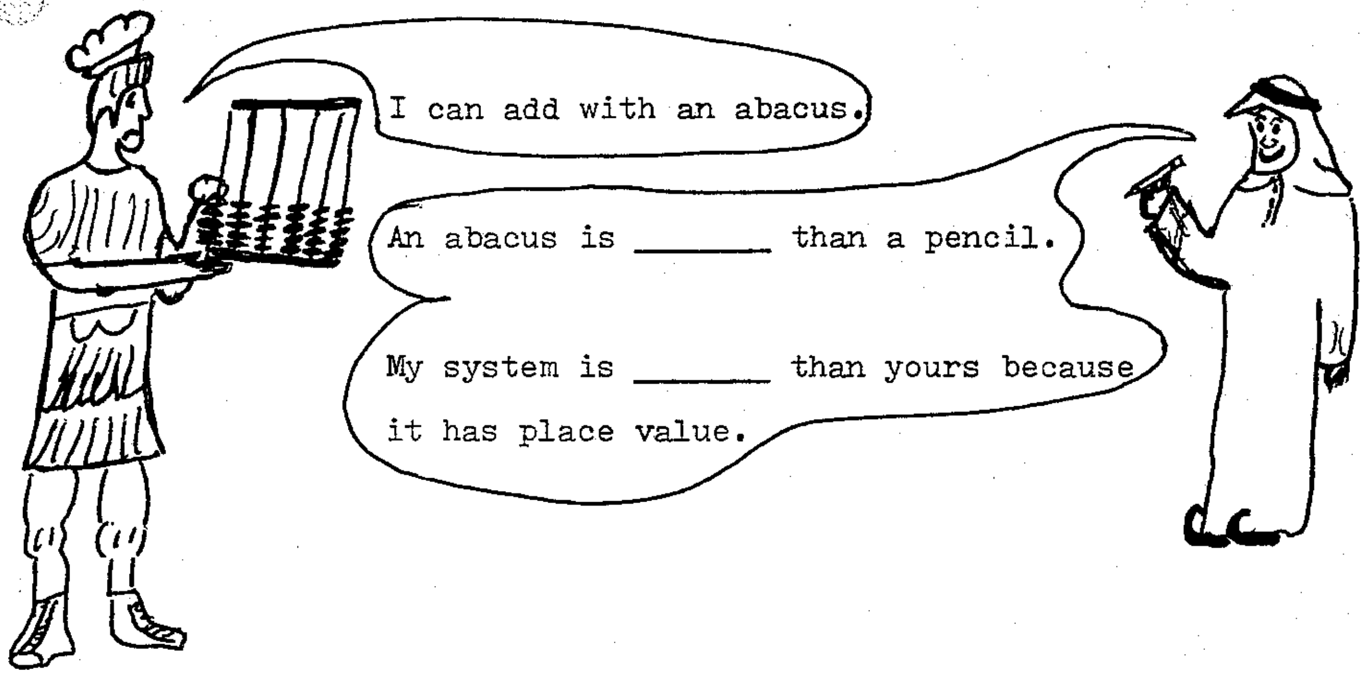
This is a long pen. — This pen is longer.

Adjective	Comparative
long	longer
good	better
bad	worse
many	more
much	more
some	more
few	less
little	less
easy	easier
hard	harder
difficult	more difficult
light	lighter
heavy	heavier

A Roman and an Arab are talking about their number systems. Fill in the blanks. Use comparatives from the list.



Comparatives



Verbal Expressions

Expression	Definition (Meaning)	Example from text	Page
Put in order	to organize	System = putting something in order.	1
Come from	is a result of	Our number system comes from having ten fingers.	1
Stand for	to mean	Symbol = something that stands for something else.	4
Keep count	to remember how many	People tied knots to keep count.	3
Get from	take from	They got it from India.	7
Take away	to remove, to subtract	To take one number away from another number.	11

Fill in the blanks. Use the above expressions.

1. The symbol "4" _____ ___ the number four.
2. Six ___ ____ two equals four. (6 - 2 = 4)
3. Some people kept stones in bags to ____ _____.
4. Our number system _____ _____ having ten fingers.
5. She ___ her ideas ____ a book.
6. The teacher ___ the chairs __ _____ before class.