John C. Keegel English For Careers

The Language of Computer Programming in English

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FOREWORD

This book is one of a series of texts called *English for Careers*, intended to introduce students of English as a foreign language to a number of different professional and vocational fields. The career areas that are covered are those in which English is widely used throughout the world; these include air travel, computer programming, international commerce, or in the case of this book, engineering and specifically mechanical engineering.

Each book in the series serves a dual purpose: to give the student an English introduction to a particular vocational area in which he or she is involved and to improve the student's use of English as a foreign language. This book is not a detailed training manual. It is a broad introduction to the language and terminology of mechanical engineering.

From the point of view of learning English as a foreign language, *English for Careers* books are intended for a student at the high intermediate or advanced level—one who is acquainted with most of the structural patterns of English. The principal goals of the learner should be mastering vocabulary, using language patterns, and improving his or her ability to communicate naturally in English.

These books are helpful with all of these needs. Each lesson begins with a glossary of special terms in which words and expressions used in the specific vocation are discussed and defined. The special terms are followed by a vocabulary practice section in which questions and answers help the reader use these terms. Then these terms are used again within a contextual frame of reference. Each section is followed by questions for discussion which give the opportunity to use both special terms and structural patterns.

Each lesson ends with a review section in which some of the exercises pose problems which occur when actually working in the field.

In this book, the student is asked to identify different types of machine components and explain their characteristics or to describe key features of the engines that have acted as power sources since the Industrial Revolution. Doing such exercises is excellent practice in the specialized vocabulary, general vocabulary, and structural patterns of the English language.

Much successful language learning is not conscious. In offering these books, it is hoped that the student's interest in the career will enhance his or her ability to communicate fluently in English.

EUGENE J. HALL
Washington, D.C.

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UNIT ONE
ELECTRONIC DATA PROCESSING

Special Terms

Data: Properly prepared items or pieces of information. *Properly* is the key word in this definition, since a computer cannot act on data that are incorrectly prepared. *Data* is the plural form of *datum,* a word which is seldom used.

Processing: Handling or manipulating data for some purpose. The verb form, *to process* the data, is also commonly used.

Computer: An electronic machine or device for processing data. It can solve problems by accepting data, performing certain operations on the data, and giving the results of these operations.

Input: Data that are put in the computer so that they can be operated upon.

Output: What is put out by the computer; that is, the results from processing the data when they are made available by the computer.

Program: A step-by-step plan consisting of a sequence of instructions to the computer that is used to solve a specific problem. The person who prepares the step-by-step plan is a *programmer.* The verb form, *to program* data, also occurs frequently, and so do the noun *programming* and the adjective *programmed* that are derived from the verb.

Code: A system of communication that consists of symbols or signals. An alphabet is a written code in which the letters are symbols for the sounds of a language. The verb is *to code.*

Analog Computer: A computer that can simulate, or imitate, measurements by electronic means, such as varying voltages.

Digit: A single-character number; in other words, the numbers from 0 through 9.
Digital Computer: A computer that receives data in a code composed of digits.
Core: A tiny circle of metal with a hole in the middle; it is made of material that can be magnetized.
Debug: To remove a defect or an error from a program.
GIGO: "Garbage in, garbage out." If a computer does not receive correctly programmed or coded data, the output will not make sense; in other words, it will be "garbage."

Vocabulary Practice

1. What are *data*? Why is *properly* a key word in the definition? Of what word is *data* the plural form?

2. What is *processing*?

3. What is a *computer* and what can it do?

4. What is the difference between *input* and *output*?

5. What is a *program*? Who prepares a program? What other derivations of the word are frequently used?

6. What is a *code*? Give an example. Can you think of another example besides the one given?

7. What can an *analog computer* do?

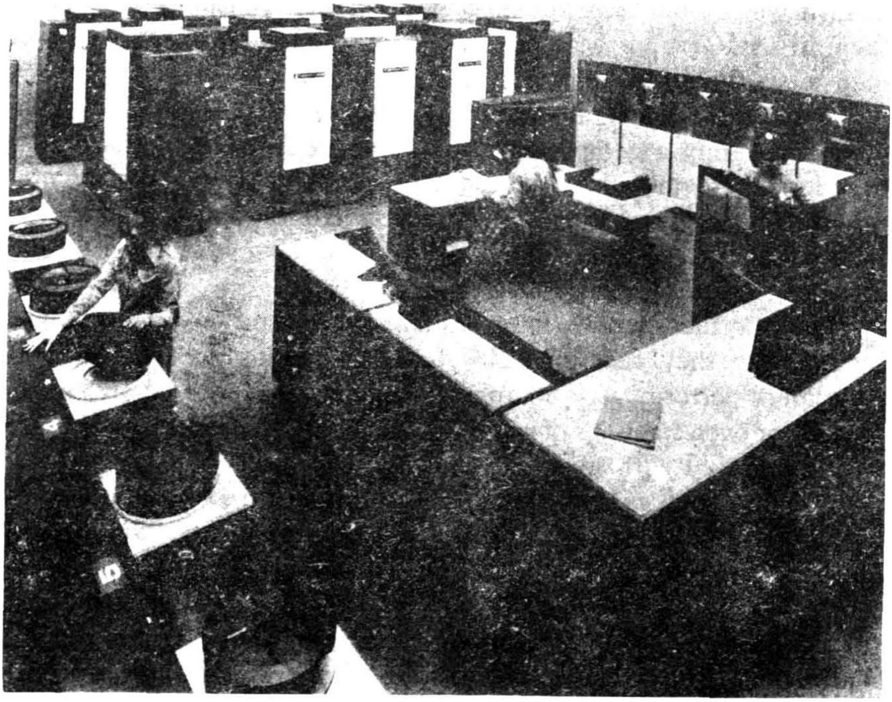
8. What is a *digit*?

9. What is a *digital computer*?

10. What is a *core*? What special kind of material is it made of?

11. What does *debug* mean?

12. What does *GIGO* stand for? What is the significance of the expression?



A bank of computers and other components in a modern computer installation. (Courtesy Honeywell, Inc.)

Electronic Data Processing

Computers are electronic machines for processing *data*. Data are pieces or items of information that have been properly prepared so that the machine can work with them. *Processing* means handling or manipulating the material that has been presented to the machine in such ways as performing calculations, classifying information, or making comparisons. A computer is made of millions of electronic devices that can store the data or switch them through complex circuits with different functions at incredible speeds.

In only a short time, computers have profoundly changed the way in which many kinds of work are done. Indeed, they have created whole new areas of work that did not exist prior to their development. We have all heard of computers plotting the course of rockets, preparing bank statements, predicting elections, forecasting weather, and so forth. Computers do many tasks for us that would be extremely difficult if we did not have them. Computers take routine tasks and do them in a fraction of the time it would take a man or even a team of men to do them.

Many people imagine that a computer is a very large adding machine. Certainly a computer can function in that way, but this is a very restricted view of the nature of a computer. The message of a familiar advertisement is that machines should work, but men should think. This is the basic philosophy of computer science, even in the advanced states of computer technology.

Despite the scientific basis of computers, many people are awed by the way they function. This is probably due to the fact that computers perform very complex operations in a very short time—seconds or even fractions of a second. In the modern world, people are often impressed with speed.

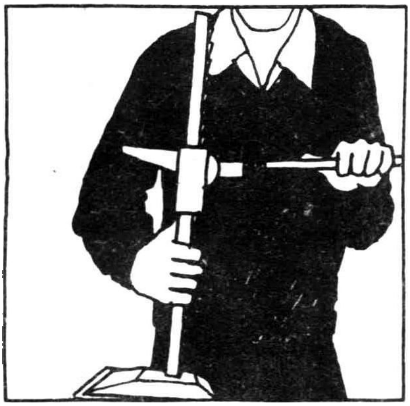
Devices such as traffic lights and telephones are a part of modern life. In a sense they are computers too. All computers have several features in common, regardless of make or design. Information is presented to the machine, the machine acts on it, and a result is then returned. The pieces of information, or data, that are presented to the machine are called the *input*. The internal operations of the machine are called *processing*. The result that is returned is called the *output*.

The telephone works in just that way. The input is dialing a number; the processing is the switching system that locates the number that has been dialed; and the output is completing the call. A traffic light works in the same way. A predetermined electrical timing impulse is given to the light (the input); the switch inside the mechanism selects a color (the processing); and the light changes color (the output).

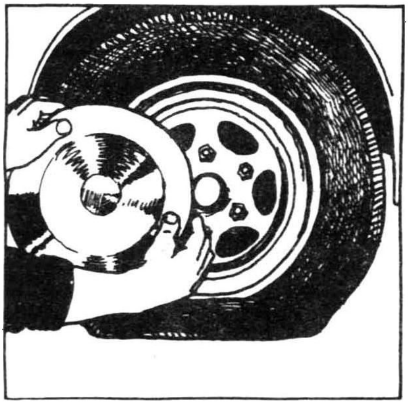
These three basic concepts of input, processing, and output appear in almost every phase of human life. In school the input is the subject matter, the processing is studying, and the output is knowledge. When someone cooks a meal, the input is the uncooked food, the processing is the cooking itself, and the output is the completed meal.

The input, the processing, and the output are determined by a human agent. This person is called the *programmer*. His job is to determine what information is needed and what operations the computer must perform in order to solve a problem. He determines how the information is to be processed in order to obtain the desired result.

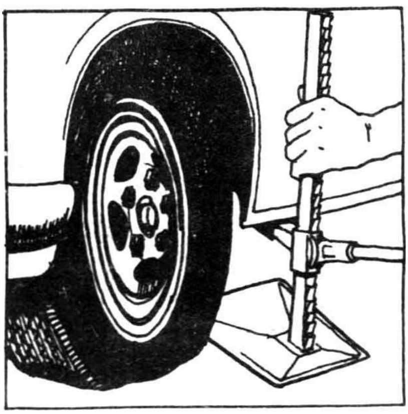
Many everyday tasks can be viewed as *programs;* that is, they can be worked out in a step-by-step plan. For example, if you want to write a program for changing a flat tire, you might list the following steps:



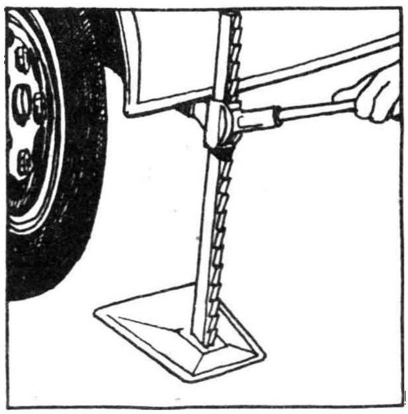
1. Assemble the jack.



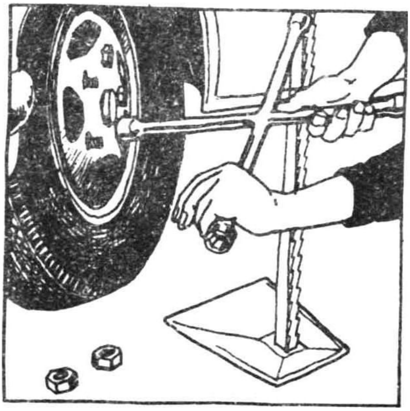
2. Remove the hub-cap from the wheel that has the flat tire.



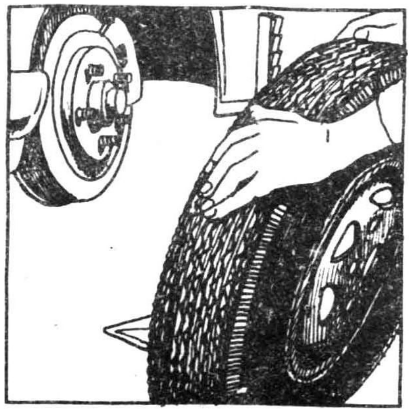
3. Place the jack in the correct position to lift the car.



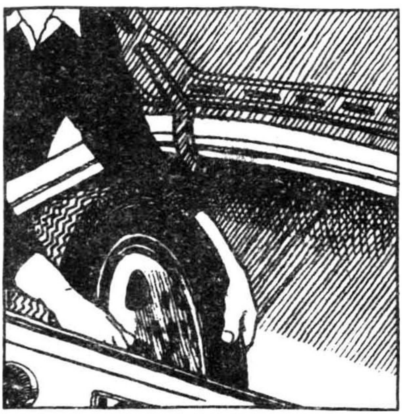
4. Jack up the car enough to clear the ground.



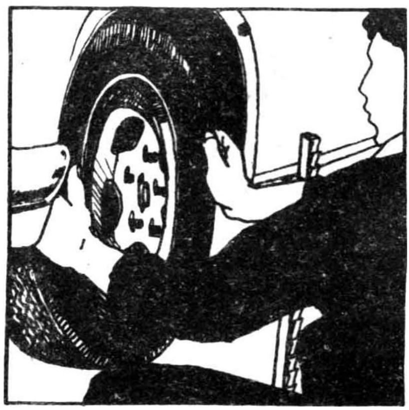
5. Loosen and remove the nuts that hold the tire and rim in place.



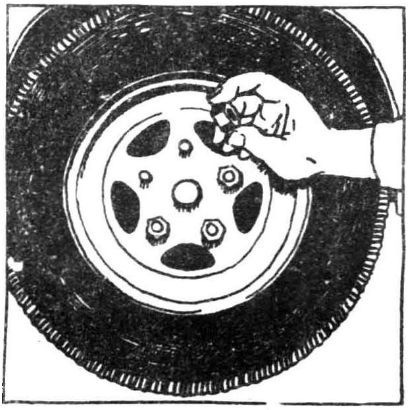
6. Remove the tire.



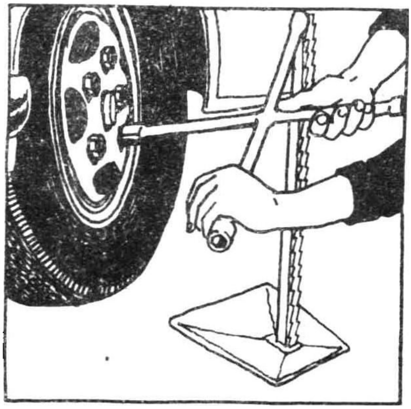
7. Get the spare tire from the trunk of the car.



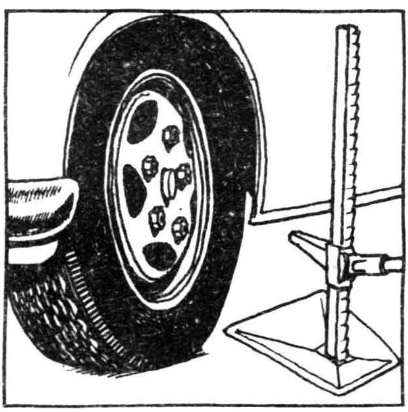
8. Put the spare tire in place.



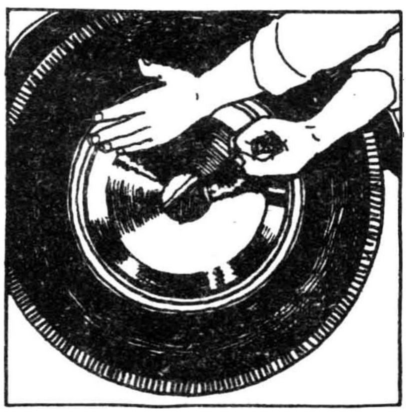
9. Replace the nuts on the wheel.



10. Tighten the nuts.

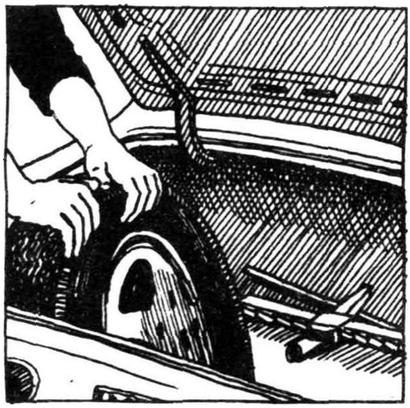


11. Lower the car.



12. Replace the hub-cap.

13. Put the jack and flat tire in the trunk of the car.



As you can see, the concept of programming is very simple. It calls for breaking down an action into a succession or sequence of separate steps. For another example, let's suppose we wished to program the addition of three numbers. We would proceed as follows:

1. Add the first number to the second number. 202 + 312 = 514

2. Add the result of the previous step to the third number. 514 + 198 = 712

This is very easy. If you were confronted with the task of adding 5 million numbers, it would not be much more complicated from a programming standpoint than adding three numbers. Nevertheless, there is a big problem in adding 5 million numbers—the time involved. With a pencil and paper you could probably add 10 numbers in a matter of seconds; but to add 5 million numbers would take a very long time indeed. A high-speed computer, however, can do it in only seconds, and with perfect accuracy. This is amazing, but not because the task is complicated. It is amazing because such a large task can be done so rapidly. It is the speed and accuracy that make us look with astonishment at the work of computers. Even in our astonishment, however, we would not say that the machine is more intelligent than a man, anymore than we would say that an automobile is more intelligent than a man because it can travel at seventy-five miles an hour.

While we may be amazed at the speed and accuracy of a computer, we would soon be very bored with it if all it did was to add numbers. We should realize that a computer is not a single-purpose machine. A computer can respond only to a certain number of instructions, but these instructions can be combined in an infinite number of sequences. Thus a computer does not have a known limit on the kinds of things it can do. The versatility of the machine is limited only by the imagination of the people who use it.

There are in fact two different kinds of computers. One of them, the *analog computer,* is used essentially for problems involving measurements. It can simulate, or imitate, different measurements by electronic means, such as varying the voltage in the same proportions as the measurements vary in a problem. A common device that acts on the analog principle is the speedometer of a car which is connected to a generator on the drive shaft. As the drive shaft turns faster, it generates a higher voltage which is translated into readings of corresponding rates of speed on the dial.

About 90 percent of the computers now in use are *digital computers.* They get their name because the data that are presented to them are made up of a *code* consisting of *digits*—single-character numbers. This book will be concerned with digital computer programming, since this is by far the most common. It is used in electronic data processing for business or statistical purposes, for example.

A computer is an intricate network of electronic circuits that operate switches or magnetize tiny metal *cores.* The switches are capable of being in one of two possible states—that is, they can either be on or they can be off. Similarly, the cores can either be magnetized or unmagnetized. The machine is capable of storing and manipulating numbers, letters, and special characters in terms of these on or off switches or magnetized or unmagnetized cores. While more of the technical details will be discussed later, the basic idea of a computer is simply that we can make the machine do what we want by sending signals that turn certain switches on and others off, or that magnetize or do not magnetize the cores.

A computer can remove many of the routine and dull tasks from our lives, thereby leaving the individual more time for creative work in which he is interested. This seems to contradict the common belief that computers dehumanize the individual. When used properly, computers can make life more human.

Another remark that is heard frequently is that the computer has made a mistake. As a matter of fact, computers rarely make mistakes, since they are mechanical devices, not human beings. Mechanical or electronic failures don't occur very often. Mistakes usually occur because the computer is doing exactly what it was told to do—and not what the programmer intended it to do. In other words, it was the programmer who made the mistake. It was a human and not a mechanical error.

This is the great frustration in dealing with machines. They cannot read our minds and they have no intuition or imagination of their own. In other words, they are not human and they cannot think. The mistakes that they make are usually caused by our incomplete or incorrect instructions. Thus, when one of these mistakes occurs, the programmer must *debug* his program. That is, he must remove the error or correct the omission in his instructions to the machine.

Computers cannot give meaningful results when they have been programmed with data and instructions that are not meaningful themselves. If a computer is given unintelligible data, it returns unintelligible results. This has a name—*GIGO*, which means "garbage in, garbage out." In order to get reliable output, the input must also be reliable.

Computers do what they are told—nothing more, nothing less. It is the work of the programmer to make sure that the data that are presented to the machine will give accurate results.

Discussion

1. What are computers made of? What can they do?

2. How have computers changed the way in which many things are done? What effect have they had on your life?

3. Why is it not right to think of a computer only as a very large adding machine?

4. Why do many people regard the way computers function as a kind of witchcraft or magic?

5. What features do all computers have in common?

6. How does a telephone work? How is this like a computer?

7. How does a traffic light work? How is this like a computer?