



The SOL-20 in a New England parlor context, obviously enjoying life. The entire system fits on one table with a video monitor on top of the computer and an audio tape recorder for mass storage to the right.

User's Report: The SOL-20

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John Kemmeny in his book, *Man and the Computer*, reveals his thoughts concerning the future of computers. Kemmeny believes that people will have access to large regional computers in the future. This will allow people to do many jobs in the home and provide entertainment and knowledge. A computer terminal in the home will be tied to a large regional supercomputer giving people the ability to do many things at home not now possible, such as reading the latest news stories, studying subjects for degree credit, storing recipes to allow the input of a week's menu and production of a grocery list of needed items, and the recording and computation of family financial matters. The possible uses of this type of computer are unlimited.

Processor Technology has taken this concept of the home computer terminal attached to a supercomputer one step toward reality by providing the home user with a terminal and microprocessor combination, the SOL, capable of functioning

with, or independent from, another computer. The operating systems provided by Processor Technology allow the SOL system to operate as a microprocessor independent of any outside processor with its own peripherals until the terminal command is issued, which causes SOL to operate as a computer terminal. This combination will allow the greater use of your home microcomputer today and in the future. What follows is a brief description of a SOL system based on my personal experiences.

Hardware

My microprocessor, a SOL-20, uses an 8080 processor chip. (The 8080A and the 9080A are also available.) This system has both parallel and serial communication interfaces, a keyboard interface, audio cassette interface, a video display generator, 1024 8 bit words of volatile system memory, and 1024 8 bit words of volatile display refresh memory. My system also has 8 K

bytes of volatile main user memory for programming and an operating system in a "personality module" with preprogrammed read only memories.

A feature of the hardware is a parallel interface consisting of eight bits for each input and output plus control handshaking signals. The output bus uses three state TTL levels for bidirectional interfaces. The serial interface circuit includes both asynchronous RS-232 and 20 mA current loop provisions and operates at from 75 to 9600 bits per second, switch selectable. (When I say that something is switch selectable, I mean that there is a series of small switches on the printed circuit board and an explanation in the hardware manual of what the switch does and what your options are.) The keyboard interface handles a 7 level ASCII encoded TTL keyboard which requires a strobe pulse after the data is stable.

The audio cassette interface is program controllable and self-clocking with a phase lock loop. It operates at the dual rate of 300 or 1200 bits per second. Included is an automatic level control in both the record and playback modes. Recording is the CUTS/BYTE standard compatible, an asynchronous Manchester code at 1200/2400 Hz or 600/1200 Hz.

The video display circuitry generates 16 lines from data stored in its 1 K refresh memory. Alphanumeric and control characters (the character set includes all upper and lower ASCII plus control characters) are displayed in either black on white or white on black (this feature is switch selectable). The solid video cursor with a switch selectable blink is programmable. This circuitry can drive any video monitor or monochrome television converted to handle video input.

The assembly of the SOL appears to be relatively easy. I bought my SOL fully assembled, but I read the assembly instructions, looked at the diagrams, and thoroughly examined the hardware. I believe that I could quite easily put a SOL together. The instructions are simple and straightforward. The assembly notes include parts lists, assembly tips and precautions, pictures and drawings, and step-by-step instructions on assembly and testing. Also included are instructions on handling integrated circuits, soldering techniques, and a list of the tools that will be needed. Processor Technology provides schematic and detailed assembly drawings in a separate section of their manual.

Another important feature of the SOL is the system's completeness and modularity. All of the hardware is in one package and looks like a large electric typewriter. The

DUMP	ADDR, ADDR	Dump memory locations to screen
ENTER	ADDR	Enter data to memory
TLOAD		Load to memory
EXECUTE	ADDR	Execute a program at a given address
BASIC		Execute a program located at address zero
TERMINAL		Return to terminal mode

Table 1: CONSOL operating system command summary.

DUMP	ADDR, ADDR	Dump memory locations to screen
ENTER	ADDR	Enter data to memory
TLOAD		Load data from tape to memory
EXECUTE	ADDR	Execute a program at a given address
BASIC		Execute a program located at address zero
TERMINAL		Return to terminal mode
TSAVE (NAME)	ADDR, ADDR	Save certain memory locations on tape
TXEQ (NAME)	ADDR	Load a certain program from tape and execute it
TCAT		List tape header information
SET		Allows the setting of the following things
SET DI		Set display speed
SET IN		Set input driver
SET OUT		Set output driver
SET TAPE		Set tape speed
SET CI		Set custom input driver address
SET CO		Set custom output driver address
SET TY		Set types into tape save header
SET XE		Set execute address into tape save header

Table 2: SOLOS operating system command summary.

video monitor and cassette recorders are attached at the back panel with cables. The system does not have exposed boards or parts to collect dust or be damaged. The system can be easily transported.

Operating Systems

SOL, at present, has three operating systems. They are CONSOL, SOLED and SOLOS. CONSOL allows simple terminal operations and computer functions. SOLED allows more advanced terminal operations than CONSOL with additional screen, file and cassette tape operations. SOLOS allows use of the full range of the microprocessor plus the full functions of an intelligent terminal. I cannot describe SOLED any further, not having the information available to me. However, CONSOL and SOLOS will be described in detail.

CONSOL, the simplest of these operating systems, allows the SOL to function both as a standard CRT terminal and as a microcomputer. This software system is not as sophisticated as SOLOS which has many more commands and greater abilities.

All the operating systems work in the following fashion. The same switch to power up the hardware serves to initialize the operating system. The operating system initializes system memory, clears the screen and enters the terminal mode. Depressing the mode key causes SOL to operate as a microcomputer. The operating system issues a prompt character and awaits further commands.

```

10 REM THIS PROGRAM IS FOR TEACHING YOUNGSTERS MULTIPLICATION.
20 PRINT "DO YOU WANT TO TRY THE MULTIPLICATION PROGRAM?"
30 PRINT "ANSWER 1 FOR YES, AND 2 FOR NO."
40 INPUT X
50 IF X=2 THEN 340
60 PRINT
70 PRINT "INPUT THE FIRST NUMBER."
80 INPUT A
90 PRINT A;" TIMES"
100 PRINT
110 PRINT "INPUT THE SECOND NUMBER."
120 INPUT B
130 PRINT A;" TIMES";B;" EQUALS"
140 PRINT
150 PRINT "INPUT WHAT YOU THINK THE ANSWER SHOULD BE."
160 J=A*B
170 INPUT C
180 PRINT A;" TIMES";B;" EQUALS";C
190 IF C=J THEN 260
200 PRINT
210 PRINT "YOUR ANSWER WAS INCORRECT."
220 PRINT
230 PRINT A;" TIMES";B;" EQUALS";J
240 PRINT
250 GOTO 290
260 PRINT
270 PRINT "CONGRATULATIONS, YOUR ANSWER WAS CORRECT."
280 PRINT
290 PRINT "DO YOU WANT TO CONTINUE?"
300 PRINT "ANSWER 1 FOR YES, AND 2 FOR NO."
310 INPUT X
320 IF X=2 THEN 340
330 GOTO 60
340 PRINT
350 PRINT "HAVE A NICE DAY!"
360 END

```

*RUN

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DO YOU WANT TO TRY THE MULTIPLICATION PROGRAM?
ANSWER 1 FOR YES, AND 2 FOR NO.
?1

INPUT THE FIRST NUMBER.
?2
  2 TIMES

INPUT THE SECOND NUMBER.
?2
  2 TIMES    2 EQUALS

INPUT WHAT YOU THINK THE ANSWER SHOULD BE.
?2
  2 TIMES    2 EQUALS    2

YOUR ANSWER WAS INCORRECT.
  2 TIMES    2 EQUALS    4

DO YOU WANT TO CONTINUE?
ANSWER 1 FOR YES, AND 2 FOR NO.
?1

INPUT THE FIRST NUMBER.
?2
  2 TIMES

INPUT THE SECOND NUMBER.
?2
  2 TIMES    2 EQUALS

INPUT WHAT YOU THINK THE ANSWER SHOULD BE.
?4
  2 TIMES    2 EQUALS    4

CONGRATULATIONS, YOUR ANSWER WAS CORRECT.

DO YOU WANT TO CONTINUE?
ANSWER 1 FOR YES, AND 2 FOR NO.
?2

HAVE A NICE DAY!

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Listing 1: A tutorial BASIC program of the simplest variety, created one evening to instruct a 6 year old in some of the complexities of arithmetic.

There are five commands for operating SOL as a microcomputer under CONSOL, two for entering data, two for executing programs, and one for displaying the contents of memory on the monitor. (See table 1 for the complete list of CONSOL commands.) A person can enter data either through the keyboard by means of the ENTER command or through a cassette tape recorder by means of the TLOAD command. The ENTER command permits the altering of any byte or series of bytes of storage with either data or a machine language program. Program execution begins with the issuance of either of two commands. EXECUTE allows the execution of a program beginning at any point that you name in memory, whereas the issuance of the BASIC command starts program execution from memory location zero. The fifth command, DUMP, allows the displaying of any byte or series of bytes on the video monitor.

The SOLOS operating system allows for more advanced operation of the SOL. (See table 2 for a complete list of SOLOS commands.) Besides the six basic commands allowed under CONSOL, there are four additional commands, with one of these additional commands, SET, having eight different options. To begin with, the TLOAD command is different under SOLOS than under CONSOL. Under SOLOS, the TLOAD command allows the searching of a tape with multiple files for a certain named file, skipping over all files before it. Under CONSOL, you have to manually move the tape to the beginning of the tape file.

TSAVE allows the saving on tape of the contents of the memory locations indicated. TXEC allows the loading of a named program from tape to memory and the immediate execution of that program. TCAT allows the listing of the tape file header information on the monitor. This information includes the file name, execution address, and the beginning and ending addresses of the program when loaded to memory.

The SET command has eight different options. One can set the display speed, allowing the speeding up and slowing down of characters on the monitor to suit your programming. Using this option of the BASIC language interpreter, I was able to generate a very impressive lightning bolt image for my young son and his friends. The input and output driver speeds can be controlled through the use of the SET command along with the tape speed, and

the input and output driver addresses. The tape save headers can also be altered using SET. The more useful of the two operating systems is obviously SOLOS since it allows greater flexibility.

Software

My system has a BASIC interpreter, the BASIC-5 package. This interpreter has many of the usual BASIC commands and statements. It also allows use of system commands within programs. BASIC-5 allows the usage of single dimension arrays, many BASIC functions, and the ability to read and write tapes. It also has 8 digit precision and the ability to link to machine language subprograms.

I would advise the purchase of the 8 K BASIC for one important reason: the ability to have several commands and features not available in the BASIC-5 interpreter. These would be the RNUM command which allows the renumbering of statements, and also the ability to utilize alphanumeric and matrices (instead of only single dimension arrays) which would be particularly useful.

Uses

I have utilized my SOL for several things. First and foremost, I have introduced my 6 year old son to computers through games and learning programs, such as the multiplication program reproduced and described in listing 1. I have also used it for entertainment especially through the use of the target game provided by Processor Technology, and a few games I have written. Lastly, I have used it to fool around with my first love, history. I have written several statistical analysis programs for the SOL using the BASIC-5 software to continue with my research on colonial New England. Also reproduced here, as listing 2, is a sample of a simple program to do elementary fertility figures.

I have reproduced and wholly written a few programs to assist in the mathematical education of my son. MULT and two other programs have been written as interactive quizzing programs to test and teach mathematics through praise when he is correct and by showing him the correct way when he is wrong. Thus the computer acts as a teacher and could be utilized in this fashion in every home and classroom for elementary school aged children. More sophisticated programs could be implemented on the SOL for older children. These programs, in the form of games, could serve two purposes, entertainment and education.

Listing 2: A sample of a statistical BASIC application typical of programs used by the author in his avocation of historical studies.

```

10 PRINT"THIS PROGRAM WILL PRODUCE FERTILITY FIGURES"
11 PRINT"FOR THE DATA INPUT. THE OUTPUT CONSISTS OF"
12 PRINT"THE PROPORTION OF BIRTHS TO MARRIAGES OVER"
13 PRINT"A DECADE WITH FIVE YEAR INCREMENTS BETWEEN DATA."
14 PRINT"THESE FERTILITY FIGURES (THE BIRTH RATE) CONSIST OF"
15 PRINT"THE NUMBER OF BIRTHS FOR A DECADE DIVIDED BY THE"
16 PRINT"NUMBER OF MARRIAGES FOR A DECADE WHICH BEGAN FIVE"
17 PRINT"YEARS EARLIER."
65 D1=0
66 I=0
100 PRINT"INPUT THE STARTING YEAR (BETWEEN 1650/1795) DESIRED"
105 INPUT Y
106 PRINT"INPUT THE NUMBER OF SETS OF YEARS OF DATA"
107 INPUT D
110 PRINT"INPUT THE NUMBER OF FIVE YEAR INCREMENTS DESIRED"
120 INPUT N
128 DIM Y1(40),M1(40),B1(40),F1(40),Y2(40)
129 DIM F2(40),Y3(40)
130 FOR J=1 TO D
140 READ Y1(J),M1(J),B1(J)
160 NEXT J
195 PRINT"                MARRIAGE YEARS                FERTILITY"
200 FOR J=1 TO D
205 IF I=N THEN 340
210 IF Y1(J)<Y THEN 290
220 Y2(J)=Y1(J+2)-1
230 F1(J)=(B1(J+1)+B1(J+2))/(M1(J)+M1(J+1))
250 PRINT Y1(J),Y2(J),F1(J)
260 S=S+F1(J)
270 D1=D1+1
280 I=I+1
285 F2(I)=F1(J)
286 Y3(I)=Y1(J)
290 NEXT J
340 M=S/D1
350 PRINT"MEAN OF FERTILITY FIGURES"
395 PRINT
396 PRINT
398 PRINT " YEAR                FERTILITY"
399 PRINT"++++"
400 FOR K=1 TO I
420 L=INT((F2(K)*10)/2)
430 PRINT Y3(K);"+";TAB(L);"*"
490 NEXT K
500 PRINT"++++"
900 DATA 1650,5,28,1655,8,32,1660,14,43,1665,9,44
910 DATA 1670,20,78,1675,18,90,1680,26,125,1685,29,168
920 DATA 1690,24,163,1695,20,156,1700,24,179,1705,34,196
930 DATA 1710,54,239,1715,40,247,1720,64,287,1725,66,289
940 DATA 1730,84,333,1735,88,328,1740,88,371,1745,92,354
950 DATA 1750,87,372,1755,105,365,1760,88,388,1765,80,377
960 DATA 1770,65,342,1775,80,311,1780,108,298,1785,105,344
970 DATA 1790,118,228,1795,99,350
999 END

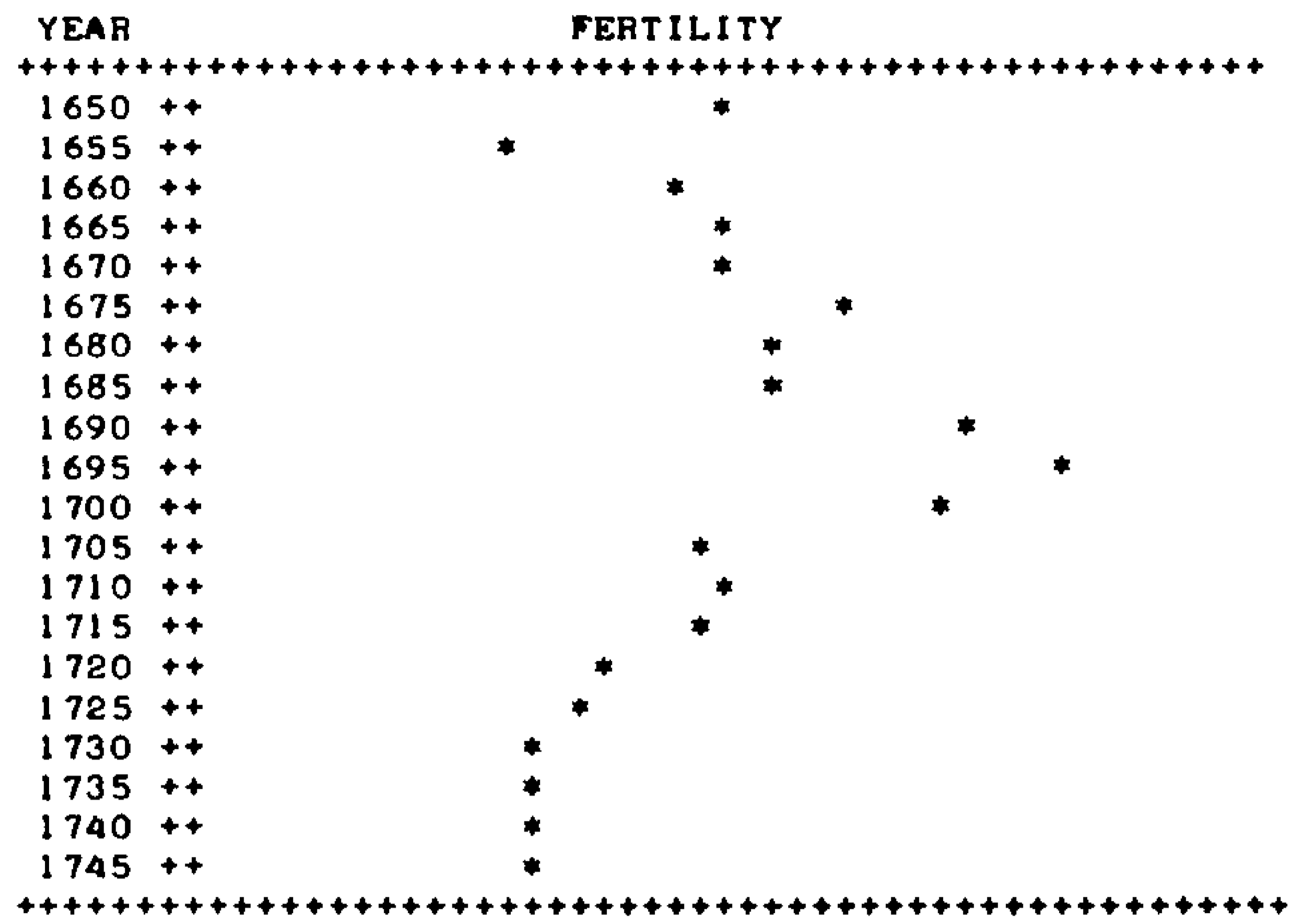
```

THIS PROGRAM WILL PRODUCE FERTILITY FIGURES
FOR THE DATA INPUT. THE OUTPUT CONSISTS OF
THE PROPORTION OF BIRTHS TO MARRIAGES OVER
A DECADE WITH FIVE YEAR INCREMENTS BETWEEN DATA.
THESE FERTILITY FIGURES (THE BIRTH RATE) CONSIST OF
THE NUMBER OF BIRTHS FOR A DECADE DIVIDED BY THE
NUMBER OF MARRIAGES FOR A DECADE WHICH BEGAN FIVE
YEARS EARLIER.

INPUT THE STARTING YEAR (BETWEEN 1650/1795) DESIRED:
?1650
INPUT THE NUMBER OF SETS OF YEARS OF DATA:
?30
INPUT THE NUMBER OF FIVE YEAR INCREMENTS DESIRED:
?20

MARRIAGE YEARS	FERTILITY
1650	5.769231
1655	3.954545
1660	5.304348
1665	5.793100
1670	5.657895
1675	6.659091
1680	6.018182
1685	6.018868
1690	7.613636
1695	8.522727
1700	7.5
1705	5.522727
1710	5.680851
1715	5.538462
1720	4.784615
1725	4.406667
1730	4.063953
1735	4.119318
1740	4.033333
1745	4.117318
MEAN OF FERTILITY FIGURES:	5.553943

Listing 2, continued:



In closing, I find the SOL system easy to use, fun to program, and important in our home. It provides my family with entertainment in the form of games both from Processor Technology and written by us. It also provides a mathematics tutor at home for my son. It has also given my son an interest in and understanding of computers far beyond his years and education. I definitely recommend the SOL, based on my experiences with it. ■