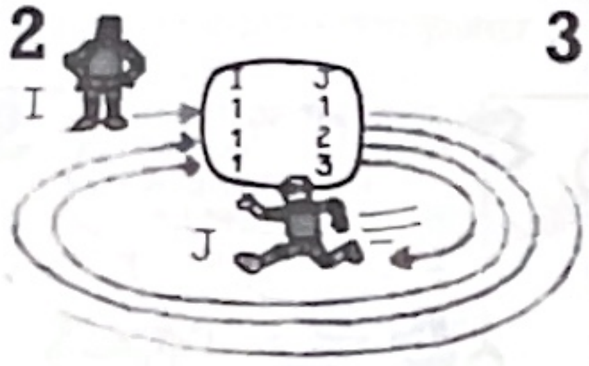
Tricks with loops

Here are some more programs using loops. Below you can find out how you can use loops within loops to repeat several things at the same time. These are called nested loops.

1 Nested loops

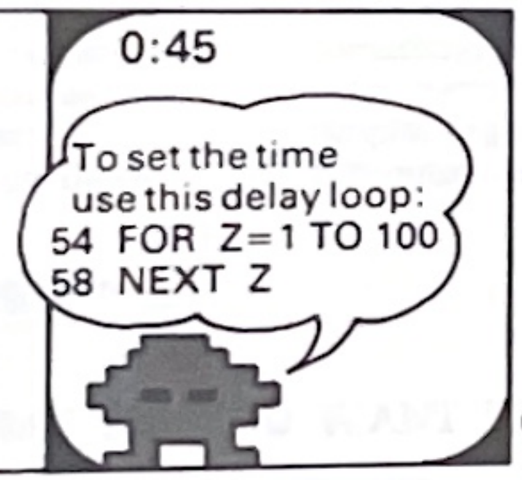
```
5 PRINT "I", "J"
10 FOR I=1 TO 3
20 FOR J=1 TO 3
30 PRINT I, J    J loop
40 NEXT J
50 NEXT I        I loop
60 END
```



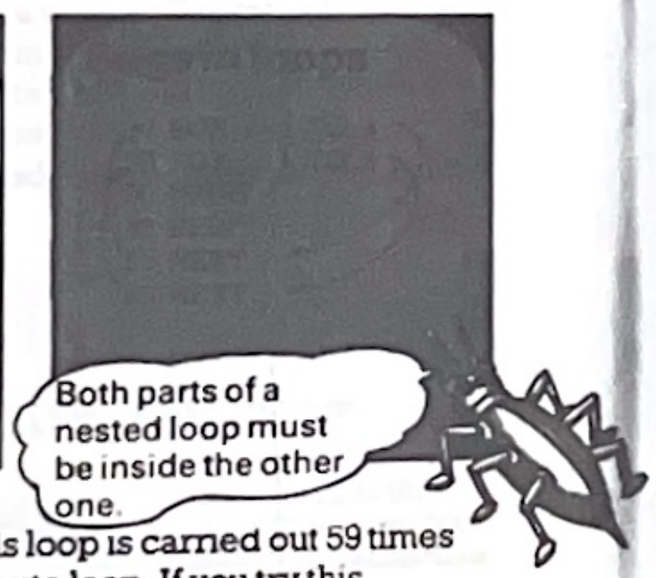
This program has an I loop and a J loop. The J loop is nested inside the I loop and for each time that the I loop is carried out, the J loop is repeated three times, printing out the value for J each time. The picture above shows the result of this program. The commas spaced the figures out like this.

Computer clock

```
5 CLS
10 LET M=0
20 LET S=0
30 FOR M=0 TO 59
40 FOR S=0 TO 59
50 PRINT M;":";S
60 CLS          Seconds loop
70 NEXT S
80 NEXT M       Minutes loop
90 END
```



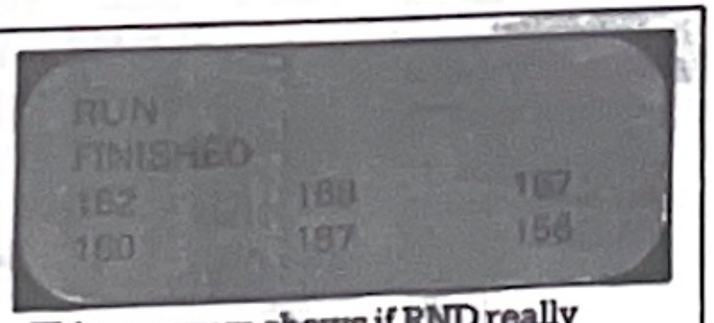
Inside a computer there is an electronic "clock" which sets the rhythm for all the computer's work. The clock pulses at between one and four million pulses a second. This program makes the computer behave like a digital clock. It has nested loops, one to count the seconds and one to count the minutes.



The seconds loop is carried out 59 times for each minute loop. If you try this program on a computer it might run very fast at first. You need to put in an extra "delay loop", then set it by changing the figure in the loop so your computer clock "ticks" at the same rate as a real one.

Random number tester

```
10 FOR I=1 TO 1000
20 LET R=INT(RND(1)*6+1)
30 IF R=1 THEN LET A=A+1
40 IF R=2 THEN LET B=B+1
50 IF R=3 THEN LET C=C+1
60 IF R=4 THEN LET D=D+1
70 IF R=5 THEN LET E=E+1
80 IF R=6 THEN LET F=F+1
90 NEXT I
100 PRINT "FINISHED"
110 PRINT A, B, C
120 PRINT D, E, F
130 END
```



This program takes a long, long time. You can make it shorter by changing the number in line 10 to 500 or even 250.

This program shows if RND really works. The loop from lines 10 to 90 makes the computer pick a random number between 1 and 6 a thousand times. It keeps count of how often each number is picked in the variables A to F, then prints out the results.*

*On some computers, e.g. ZX81 and BBC micro, you need some extra lines at the beginning of the

Pattern repeat program

This program uses nested loops to repeat a small pattern all over the screen. The program looks quite complicated but if you read it through carefully and work out what each line does, you will soon see how it works. The shape of the pattern is decided by random numbers and will be different each time you run the program.

For computers which have high resolution graphics use larger random numbers, e.g. on BBC micro change figure in lines 10 to 40, to 60.

```
5 CLS
10 LET A=INT(RND(1)*6+1)
20 LET B=INT(RND(1)*7+1)
30 LET C=INT(RND(1)*6+1)
40 LET D=INT(RND(1)*4+1)
50 INPUT "HOW MANY POINTS
   ACROSS THE SCREEN";W
60 INPUT "HOW MANY UP";V
65 CLS
70 FOR I=0 TO V STEP V/6
80 FOR J=0 TO W STEP W/6
90 PLOT (J+A,I+B)
100 PLOT (J+A,I+C)
110 PLOT (J+C,I+D)
120 PLOT (J+B,I+D)
130 NEXT J
140 NEXT I
150 END
```

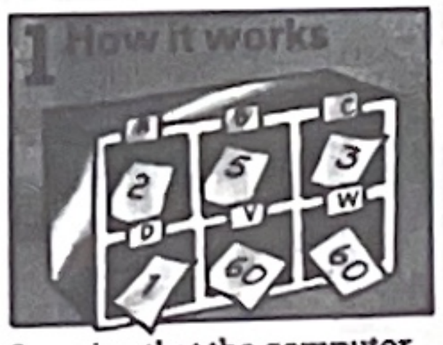
These lines choose the random numbers for the pattern and store them in A, B, C and D.

Lines 50 and 60 ask for the width (W) and height (V) of your screen.

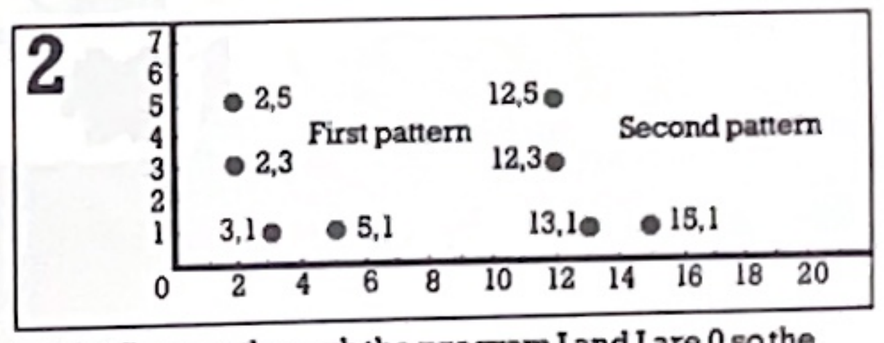
The I loop counts the number of times the pattern is repeated up the screen. Each time, I is increased by the height of the screen (V) divided by 6, so the pattern is repeated six times up the screen.

Each time the loops are repeated, lines 90 to 120 tell the computer to plot four pixels using the current values for I and J plus the random numbers.

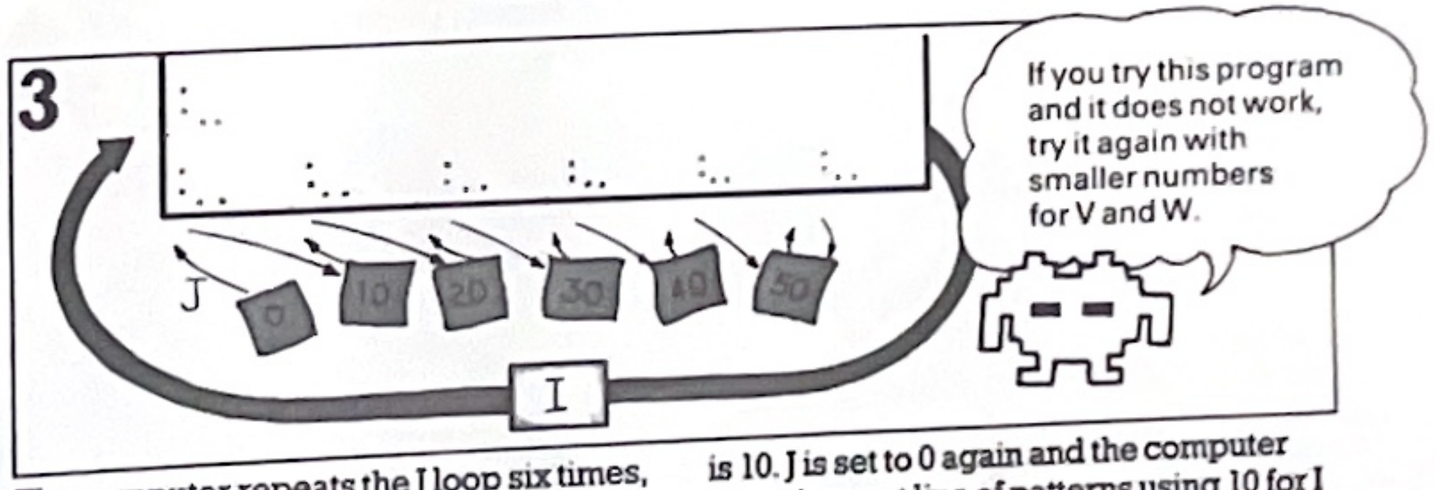
The J loop counts the number of times the pattern is repeated across the screen. It works in the same way as the I loop.



Imagine that the computer has chosen the random numbers 2, 5, 3 and 1 and that the width and height of the screen are both 60.



On the first run through the program I and J are 0 so the computer plots the first pattern of dots using only the random numbers. Line 130 sends it back to find the next value for J which is J+60/6, i.e. 10. Then it plots the second pattern using the random numbers plus 10 for J. This repeats the pattern along the screen.



The computer repeats the J loop six times, each time adding 10 to J and so plotting the pattern further along the screen. It then goes back to find the next value for I which is 10. J is set to 0 again and the computer plots the next line of patterns using 10 for I and increasing J by 10 each time as before.

Program puzzle – Can you write a pattern repeat program which repeats a space invader shape over the screen? There are some hints to help you on page 45.