

## PROJECTS

### KEYBOARD PRACTICE, COMPUTER ARITHMETIC, DISPLAY DESIGN

1 Type the following program exactly as shown. At the end of each line, press the RETURN KEY. If you make a mistake while typing a line use the DELETE key to rub it out and retype the correct characters. Note that this program has several deliberate spelling errors. Do not attempt to correct them as you will be required to make the necessary corrections using the edit facility after the whole program has been typed:

```
90 CLS
100 PRINY "MULTIPLICATION TABLE"      <- Should be PRINT
110 PRINT
120 LET C = 0
130 INPUT "YOOR NUMBER PLEASE ";N      <- Should be YOUR
140 LET C = C + 1
150 PRINT C;"MULTIPLIED BY ";N;" = ";C + N  <- Should be C * N
160 IG C = 12 THEN 190                  <- IG should be IF AND 190
0
                                should be 180
170 GOTO 130                            <- Should be GOTO 140
180 END
```

The program could be edited by simply typing complete replacement lines but most computers have an edit facility and following are the actions to be taken on an Acorn microcomputer:

- Line 100 - use the 'arrow' edit keys to position the cursor under the 1 of the 100.
- Press COPY a number of times until 100 PRINY is displayed at the bottom of the screen.
- Press DELETE once to produce 100 PRIN and then type T.
- Press COPY until the remainder of line 100 appears. Now press RETURN.

This line has now been corrected and is the new line 100. Although the old line 100 is still displayed on the screen, it no longer exists! The last version of a line edited or retyped is the version that the computer uses. To check this, type LIST and you will see the new version of the program. Continue the editing procedure to correct the remaining mistakes. When you are sure that no further mistakes exist, type RUN [RETURN] to execute or 'run' the program. After you have finished with the program type NEW [RETURN] to clear the program from memory.

2. If  $A = 3$ ,  $B = 2$  and  $C = -2$ , what are the values of the following expressions:

- |                    |               |                    |              |
|--------------------|---------------|--------------------|--------------|
| a) $A + B/2$       | b) $15/A + B$ | c) $A/(B * 2) - C$ | d) $B^2 - A$ |
| e) $(A + 1)/B * C$ | f) $A^B * C$  | g) $(A + B)/2$     | h) $16/B$    |

3 Rewrite the following 'algebraic' expressions in BASIC.

- |                  |                       |             |          |
|------------------|-----------------------|-------------|----------|
| a) $X + Y^2$     | b) $X + Y - 4$        | c) $XY + 6$ | d) $X^2$ |
| e) $(D - B) - A$ | f) $(A - B)(C - D)^2$ |             |          |

4 Convert the following exponential numbers to decimal numbers:

- |                 |                  |             |                 |
|-----------------|------------------|-------------|-----------------|
| a) $23.9415E+8$ | b) $975.6134E-6$ | c) $1.1E+6$ | d) $0.99179E-2$ |
|-----------------|------------------|-------------|-----------------|

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5 What are the errors in the following BASIC expressions:

a) AB

b) X \* - Y

c) ((A + B)/(C + D)^4

6 Design a tabular display with a title and headers which will show the results of 4 tests taken and the average mark obtained, by each of 3 students.

7 Design a display to present all of the relevant information about your last (imaginary) electricity bill.

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- 8 Type in and execute the Temperature Conversion program on page III-3 of 'BCP'.
- 9 Using the computer in Direct Mode, type in the statements on page IV-1 of 'BCP' and check the result obtained.
- 10 Type in and execute the program at the top of page IV-2 of 'BCP'. Modify line 50 to include your name.

### NUMERIC VARIABLES, LET, PRINT

11 Type in and execute Lists 1 to 7 in 'BCP' as required. Do not include List 3a on page VI-8.

12 Trace (desk-check) the following program. Determine how the variables change and what would be printed by the program:

```
90 CLS
100 LET T = 5
110 LET X = T + 6      After you have 'desk-checked' this program,
120 LET Z = (X + 1)/2  type it in, execute it and check your
130 LET Z = Z + 1     answers against those supplied by the
140 PRINT T,X,Z       computer.
150 END
```

13 The following 3 lines are the beginning of a program to determine the squares and cubes of 3 numbers stored in variables A, B and C. Complete the program, desk-check it and then implement it on a computer. The display produced should be as shown and the values displayed for SQUARE and CUBE should be derived by the program:

The Display:

```
10 CLS
20 LET A = 5
30 LET B = 7
40 LET C = 9
50 .....
```

	NUMBER	SQUARE	CUBE
	5	?	?
	7	?	?
	9	?	?

14 Write and execute a program to produce the following display. All values should be stored as variables, say L1, W1, L2, W2, and the AREA results, A1 and A2 should be derived by the program. Use comma zoning or the TAB function where applicable.

### RECTANGULAR AREAS

LENGTH	WIDTH	AREA
20	8	?
17	9	?

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15 Write and execute a program which will convert 3 Fahrenheit temperatures, 60, 70 and 80, stored in variables F1, F2 and F3 into their corresponding Centigrade equivalents, C1, C2 and C3. The general conversion expression required is  $C = 5/9 * (F - 32)$ . Screen output should be based on that shown on page III-1 of 'BCP'.

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16 Using the TAB function, write and execute the program lines which will produce a screen output similar to the following:

CAR MAKE OR MODEL -----	TIME OWNED -----	TOTAL COST OF REPAIRS -----	COST PER YEAR -----
-------------------------------	------------------------	-----------------------------------	---------------------------

17 Using your design from project 6, write the program lines to produce that display.

18 Write and execute a program which will display the radius and area for each of 3 circles having radii, R1, R2 and R3, of 2, 4 and 6 cms. The display should include a title and headers. The area of a circle is given by the general expression,  $A = \_ * R^2$ , where A is the area,  $\_ = 3.14159$  and R the radius.

19 Write and execute a program which will determine the number of tins of paint required to paint a factory chimney, 20 meters high and 2 meters in diameter. Assume that each tin of paint will cover 9 square meters. The surface area of a cylinder (chimney) is given by the expression,  $A = 3.14159 * D * H$  where A is the surface area, D the diameter and H the height.

When you have the program running correctly, add the necessary lines to find the cost of the job if the price of each tin of paint is £5.50!

### STRING VARIABLES, INPUT, GOTO

20 Type in and execute Lists 8 to 23 in 'BCP' as required.

21 Consider and desk-check this program:

```
10 LET S = 85           This program is an infinite loop
20 LET C = 45           a) When the program is first
30 PRINT "THERE ARE ";S;" SEATS AVAILABLE" run, if 4 is INPUT at line
40
40 INPUT "HOW MANY SEATS REQUIRED ";R      what will be the value of S
50 LET T = R * C        after line 60 has been
60 LET S = S - R        executed and what value will
70 PRINT "COST OF TICKETS = ";T          be printed for T at line
70?
80 PRINT                b) After line 90 has been
90 GOTO 30              executed, what will be
                        printed by line 30 on the
                        second pass?
```

c) The second time through, if 6 is INPUT at line 40, what will be printed by line 70 and what value will S have after the two passes?

To check your results, execute the program and enter the values suggested in a) and c). There is a basic error in this program:  
it

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will allow a situation to arise which should not be allowed to arise! What is this situation?

22 Consider the program segment you have written for project 17. Add further lines (positioned before this segment) to allow a student's name and four test marks to be INPUT, the average mark to be determined, and these details to be correctly printed under the relevant headers. When this part of the program is running correctly, add the necessary lines to allow a further 3 students' names and marks to be INPUT and re-execute the program. Note that the INPUT lines should be at the front of the program and the output (PRINT) lines should form the last part of the program.

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23 Write and execute a program to produce and output an address 'label' on the screen. The information to be INPUT comprises 7 items; first name, last name, house number, road or street, town, county and postcode. The address 'label' should take the following form, for example:

```
KENNETH BROWN,           Note the punctuation that has to be
27, LATHAM ROAD         provided by the program when the
BEXLEYHEATH, KENT. DA16 5FG 'label' is output!
```

24 Write and execute a program that will ask for the date, an employees name, hourly rate of pay and the number of hours worked and which will the output to the screen a suitable wages slip. Use your imagination to create the wages slip and incorporate any other details on it that you think fitting. Note that dates may be INPUT as strings in the form DD/MM/YY, that is 25/12/91.

25 The following is an 'invoice' from a freight company for the transport and delivery of a crate:

```
-----
SUPERFAST FREIGHT      01-303-8765   The capacity charges is £3 per
                        cubic meter and the weight
CRATE CAPACITY: 8 CU.MTRS  £24.00   surcharge, £1.50 per kilogram.
WEIGHT SURCHARGE: 3 KG    4.50    Write and execute a program that
                        will allow the length, width and
TOTAL TRANSPORT COSTS    £28.50   height of the crate and its
                        weight to be INPUT and which will
YOUR EARLY REMITTANCE APPRECIATED   then display such an invoice on
-----_   the screen.
```

26 Write and execute a program to determine the cost per mile travelled from INPUT's of the number of miles travelled, the number of gallons of petrol used and the price per gallon of petrol. Include in the output a title and headers showing clearly what the program is doing.

27 Write a program which will display a table of conversion between 3 temperature scales, Fahrenheit, Centigrade and Reamur. The table should include a title and headers for each temperature scale. The temperature INPUT from the keyboard will be in degrees Fahrenheit and this must be converted using the following expressions to provide the Centigrade and Reamur equivalents:

```
CENTIGRADE = (FAHRENHEIT - 32) * (5/9)      REAMUR = CENTIGRADE *
(4/5)
```

28 Modify the program produced for project 19 so that the data required by the program is INPUT from the keyboard. The following are the items concerned: the chimney height, the chimney diameter, the area covered per tin of paint and the cost per tin of paint. Note that this program will invariably produce a result like, for example, 15.78765 for the number of tins of paint required to do the job. If this was real life, you would actually buy 16 tins of paint. In this version of the program you may use the following statement to obtain the correct value for the number of tins

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of paint, assuming that the number derived by the program is stored in numeric variable TP:- LET TP = INT(TP) + 1. This statement will 'integer' the value and add 1. For example, if the result were 15.78765 this would be integered to give 15 and then 1 would be added!

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29 Write and execute a program to output a simple telephone bill. Your program should INPUT, the name of the customer, the customers address, the telephone number, the previous and the present meter readings. Assume a cost of 5 pence per unit used and a quarterly rental charge of £12.00. VAT must be added to the sub-total to give the total amount due. The 'bill' output should look something like the following example:

```
----- <- 'Line' across screen.
          BRITISH TELEPHONES PLC      <- Name of telephone company.
CUSTOMER:  F BLOGGS          0224-61613  <- Customer name and tel. no.
ADDRESS:   32 THE BROADWAY,      <- Customer address.
           OXFORD
PREVIOUS METER READING: 21794      <- Old meter reading.
CURRENT METER READING:  21936      <- New meter reading.
CALLS: 142 UNITS AT 5P PER UNIT   £ 7.10 <- Derived from meter
readings.
QUARTERLEY RENTAL CHARGE          £12.00 <- Standard charge.
SUB-TOTAL                          £19.10 <- Cost + Standard charge.
VAT AT 17.5%                       £ 2.86 <- VAT = (Sub-total * 17.5).
TOTAL NOW DUE                      £21.96 <- Total = Sub-total + VAT.
-----
```

### DATA, READ, IF-THEN

30 Type in and execute Lists 24 to 30 in 'BCP' as required.

31 Trace the following program segment. What will the values of A, B, C, D and E be after execution?

```
200 READ A,B,C Now substitute the lines below. What will
210 READ D,E,A   happen when the program is executed?
220 READ E
800 DATA 4,7,32,16 800 DATA 15,32,45
810 DATA 21,8,9    810 DATA -88,17.9,99
```

32 Write and execute a program having DATA statements containing a batsmans name, number of innings, runs scored. For example DATA BOTHAM, 21,467. The program should have 5 such DATA statements and should display this information in a tabular form with a title and headers and should include the batsmans average score.

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33 Write and execute a program with a title and headers having 5 DATA statements containing the following type of information:

DATA MILK,17,19        These items represent a product name, its old  
DATA EGGS,54,43 etc.... price and its new price.

Your program should output a four column table showing the product, old price, new price, price change. The price change should be derived by the program and should show a change as, for example, 'UP 2', 'DOWN 11'. Page XVIII-1 of 'BCP' shows the ABS statement which may be used to ensure that negative values (DOWN in price) are printed without the minus sign!

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34 Write and execute a program that will display the amounts of Building Society interest earned on sums from £100 to £1000 in steps of £100. The output should have a title and headers and should show the total investment after one year assuming no withdrawals have taken place. Initially, the program should request an INPUT from the keyboard of the current interest rate (I) and should then go on to display the table. Note that interest should be entered as say, 11 for 11% and when using this figure within the program to calculate interest earned, it should be represented as I/100! Following is the style of output required, this example assumes an input of 10% was made for the current interest rate:

```
-----  
BUILDING SOCIETY DEPOSIT ACCOUNT      <- Title.  
CURRENT INTEREST RATE = 10%          <- Indicate current rate.  
  
AMOUNT      INTEREST      TOTAL AFTER      <- Headers underlined.  
DEPOSITED   EARNED         ONE YEAR  
-----  
100         10             110             <- The values 100, 200, 300  
etc  
200         20             220             <- up to 1000 are contained in  
a  
.....  
1000        100            1100            <- DATA statement. Interest  
                                     earned and total after 1 year  
                                     <- is derived by the program.  
-----
```

35 The following is a list of employees and their hourly rates of pay:

SMITH,2.89,READ,1.56,WILLIAMS,2.05,DREW,1,15,BROWN,3.84

Write this list in a DATA statement and complete the remainder of the program that will allow you, the employer, to search the list for a name which you have INPUT, read the associated hourly rate of pay and from the number of hours worked (INPUT), find the employees gross wage for the week. The output from the program should be in the form of a simple wage slip (display). Note that for a name to be 'found', the INPUT must be an exact match with the name in the DATA list. In your program, allow for the fact that a name may be entered wrongly or indeed, for the fact that the name requested does not exist in the DATA list. Do this by arranging for the program to display 'NAME NOT FOUND' if either of these situations arise!

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36 Following is a list of marks scored by ten students in a computing exam:

JOHN JONES	56	PAT WOODS	86	JILL FISH	50
KEN WILLIAMS	79	PETER DREW	27	FRED BLOGGS	67
LEN SMITH	38	PAUL BROWN	40	BILL HAYLES	21
ANN SMITH	62				

Grades for this exam are awarded as follows:

0 - 39	FAIL	60 - 79	CREDIT
40 - 59	PASS	80+	DISTINCTION

Write and execute a program which will provide an output similar to the following, the decisions as to what grade is to be awarded being made within your program (IF-THEN statements):

```

-----
COMPUTING EXAMINATION                1991

NAME            MARK            GRADE
-----            -----            -----

JOHN JONES            56            PASS
KEN WILLIAMS            79            CREDIT   etc ..... for all 10
students!
-----

```

37 Using DATA statements to contain the name of ten countries and their capital cities, write a quiz program which will ask, 'WHAT IS THE CAPITAL OF XXXXXX?', and which will then check the answer against the correct answer. Incorporate in your program a means of counting the number of incorrect answers given and allow the correct answer to be displayed when this occurs. The number of incorrect answers should be displayed at the end of the quiz!

38 A small engineering company makes bolts and the length of each bolt has to be carefully checked before dispatch. Any bolts which fall outside the length limits of 10.90 mm to 11.15 mm must be returned to the process line for melting and remaking. Following is a list of ten bolts selected at random for checking purposes:

10.91, 10.98, 10.83, 11.16, 11.15, 10.90, 11.00, 10.91, 10.92, 11.15

Write and execute a program having these lengths stored in a DATA statement. The program must check each length, determine if it is within the limits permitted, and provide the following style of output:

```

-----
RANDOM CHECK - BOLT LENGTH

LIMITS 10.90 - 11.15 MMS           The program should finally print

```

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and SAMPLE 1      10.91      (not shown) a message indicating  
OK      the number of bolts rejected

SAMPLE 2      10.98      OK      the percentage which passed the

SAMPLE 3      11.16      REJECT      check.

etc .....

-----

**RESTORE, MULTISTATEMENT LINES**

39    Enter and execute List 32 on page XI-1 of 'BCP'. Then apply the modifications suggested on page XI-2 and re-execute.

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40 Trace (desk-check) the following program and determine what should be printed by lines 140, 170 and 190. Then type the program, execute it and check your answers!

```
100 DATA 4,5,7,3,2,1,3,8,4,6,7,9          160 READ H,K
110 READ A,B,C,D                            170 PRINT;H,K
120 READ A,B,C,D                            180 READ L,M,N,O,P
130 READ E,F,G                              190 PRINT;L,M,N,O,P
140 PRINT;E,F,G
150 RESTORE
```

41 Find the errors, if any, in the following associated pairs of DATA and READ statements:

```
100 DATA 4,9,6;34.8                        300 DATA 45.98,56.12,A+4,54
110 READ A,B,C,D                            310 READ M,N,O,P,Q

200 DATA WILLIAMS,SMITH,BROWN,READ 400 DATA BRADMAN,45,EDRICH,78

210 READ A,B,C,D                            410 READ S1,B1$,S2,B2$
```

42 Modify project 35 to permit repetitive operation (infinite loop) and to take into account the requirement that if an employee works for more than 35 hours then the hours in excess of 35 are paid at time and one half the normal hourly rate. The output for the wages slip should be modified to show the number of hours worked (normal time) and the amount earned, the number of hours worked (overtime) and the amount earned, and the total gross wage for the week.

43 Write and execute a program that will provide a currency conversion facility. The program should request the customers name, account number, country to be visited, the amount (sterling) to exchange and the date. Details of countries, their currencies and the exchange rates should be contained in DATA statements.

The output style should be something like the following and the program should be repetitive in operation.

```
----- Here are some DATA items:
BANK OF WELLING PLC. NORWAY,KRONER,10.82
FOREIGN EXCHANGE DEPT 23/06/91 SWITZERLAND,FRANCS,3.80
CUSTOMER: MR J READ SWEDEN,KRONE,10.46
ACCT NO: 1234536 SPAIN,PESETAS,185.50
ITALLY,LIRE,2330
COUNTRY TO BE VISITED: YUGOSLAVIA YUGOSLAVIA,DINARS,85
AMOUNT IN STERLING: £100 PORTUGAL,ESCUDOS,141
AMOUNT IN DINARS: 8500 HOLLAND,GUILDERS,4.66
```

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RECEIVED WITH THANKS ..... DENMARK, KRONE, 14.62  
----- GERMANY, MARKS, 4.22

44 Write and execute a program having 5 or more DATA entries similar to that which follows:

DATA SMITH,JOHN,145,BELMONT ROAD,ERITH,KENT,DA17 5FJ

The 7 items in each DATA statement must fall into the following categories, Last Name, First Name, House Number, Road or Street, Town, County, Postcode. The program should allow for each item in each DATA statement to be searched for the occurrence of a 'target string' which has been INPUT from the keyboard. If that target string is found (EXACT MATCH), the program should output the whole DATA entry concerned in the format suggested for project 23. Note that any of the following target strings would result in such an output for the above example DATA statement; SMITH, ERITH, KENT, BELMONT ROAD etc.

## COUNTERS

45 Enter and execute Lists 33 to 38 in 'BCP' as required. (See also project 46.)

46 Add the necessary program lines to List 37 so that the number of drinkers is also displayed.

47 Trace the following program. For what purpose are the variables S and N being used? What does the program do?

```
200 LET S = 0           340 PRINT X
210 LET N = 0           350 GOTO 300
300 READ X              400 LET A = S/N
310 IF X = -99 THEN 400 410 PRINT; A
320 LET S = S + X      420 GOTO 999
330 LET N = N + 1      800 DATA 4,9,7,5.4,2.9,1.98,45,23,-99
```

48 A traffic survey is being carried out in your locality. Write a program which will allow the person responsible for the counting of the vehicles to signify the passing of each of the various vehicles concerned. The program should be arranged so that when for example a car passes, the letter 'C' will be typed (followed by RETURN) to record the passing of this vehicle. 'L' will represent a lorry, 'M' a motor cycle, 'P' a pushbike and 'B' a bus. The INPUT statement will be used to obtain this information.

The program should count the number of entries for each type of vehicle and when terminated, should present the following information:

Date, Start Time and Finish Time

The number of each type of vehicle and its percentage

The total number of vehicles passing during the survey period.

Note that the program must allow for a date, start time and finish time to be 'INPUT', and you should arrange for the survey to terminate when an X is input instead of either a C, L, M, P or B. You should guard against invalid inputs, that is the entry of any letters other than C, L, M, P, B or X. If you feel able, try some of the suggested expansions of this project in the answers section.

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49 The following is a list of the mid-day temperatures recorded on the roof of the London Weather Centre during June 1991. The figures are the temperatures measured in degrees Fahrenheit:

58,62,62,65,61,55,51,50,58,66,72,72,76,75,69,71,70,75,77,79,83,85,72,65,59,57,60,64,65

Write and execute a program which will present a report something like the following noting that the temperatures must be printed in degrees Centigrade.

=====

LONDON WEATHER CENTRE  
MID-DAY CENTRIGRADE TEMPERATURES

MONTH: JUNE 1991

The day number should be derived by the program

DAY 1 14.4  
DAY 2 16.6  
DAY 3 16.6

.  
. etc ... to DAY 30

It will not be possible to display the whole of the report on the screen at once. Arrange

===== and then the final part following key depression. Also,

AVERAGE DAILY TEMPERATURE: ? consider the modifications  
HIGHEST DAILY TEMPERATURE: ? required to output the report  
LOWEST DAILY TEMPERATURE: ? to a printer.

50 Write and execute a program which will simulate a shop till or cash register. The program should present a display/receipt (on the screen) similar to that below. Note that the receipt has a title (shop name), a date and that a customer number is included. Also, each item on a particular receipt is numbered. The receipt should provide a total cost for the customer, the cash tendered and the change to be given.

At the end of the day, the program should produce an 'End Of Trading' report.

A suggested display/receipt for a customer's purchases is shown below:

~~~~~

JOE'S SUPERSTORE LTD  
15TH JUNE 1991

The date must be INPUT at the beginning of the day and is used on each receipt thereafter.

CUSTOMER NUMBER: 1

Customer numbers and Item numbers are derived by the program.

ITEM 1: 2.34  
ITEM 2: 1.80  
ITEM 3: 0.50

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TOTAL: 4.64

TENDERED: 5.00

CHANGE: 0.36 Change is derived by the program.

THANK YOU FOR YOUR CUSTOM!

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Having dealt with the first customer, the program should ask if there are any further customers (ANY MORE CUSTOMERS Y/N?). If so, the display/receipt for the next customer should be presented as follows:

```
-----  
JOE'S SUPERSTORE LTD  
15TH JUNE 1991  
  
CUSTOMER NUMBER: 2  
  ITEM 1:  
-----
```

If however, the days trading is finished, an end of trading report similar to that below should be presented:

```
-----  
  
                JOE'S SUPERSTORE LTD  
  
                END OF TRADING REPORT  
                15TH JUNE 1991  
  
NUMBER OF CUSTOMERS:  ?      Total number of customers served  
TOTAL SALES           :  ?      should be counted by the  
program.  
VAT PAYABLE          :  ?      VAT is the amount to be repaid  
by  
                                the shopkeeper.  
BALANCE              :  ?      BALANCE is the remainder after  
-----                    repayment of VAT.
```

When the program is executing correctly, consider what modifications you would make to provide a hard copy of the customer receipt and the end of trading report.

### LOOPS, THE FOR-NEXT STATEMENT

- 51 Enter and execute Lists 39 to 50 in 'BCP' as required.
- 52 Modify List 36 (page XIII-2 in 'BCP') to operate with a For-Next loop.
- 53 Write and execute a program having a For-Next loop to:
  - a) Print a row of 30 asterisks across the screen.
  - b) Print a column of 10 asterisks down the screen.
- 54 Comment on the errors in the following segments of code:

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a) 10 FOR I = 10 TO 1

b) 10 FOR I = 1,3

20 FOR J = 1,4

c) FOR I = 1 TO 25

LET I = 3 \* I + 4

d) 100 FOR T = 2 TO 26 STEP

-2

NEXT I

55 Write and execute a program having a For-Next loop to sum the numbers from 1 to 100. (See also Project 56.)

56 Write and execute a program having a For-Next loop to sum the numbers in a range supplied by the computer operator.

57 Write and execute a program having a For-Next loop to sum the squares of the even numbers from 0 to 50.

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58 The table below shows the seasonal trends in the sales of one product taken over six years. Write and execute a program having a For-Next loop to present this table on the screen, and to calculate and display the average sales for each quarter.

YEAR	QUARTERS			
	1	2	3	4
-----				
1976	46	57	60	55
1977	45	56	62	54
1978	51	58	65	54
1979	49	59	61	53
1980	52	60	59	53
1981	53	59	64	54
-----				

59 Computers can supply random numbers. The following two statements will generally provide a random number between 1 and 6, depending upon the computer you are using. Try both of these statements on your computer to find which one works correctly:

```

100 T = RND(6)
110 PRINT T
100 T = INT(RND(1)*6)+1
110 PRINT T
    
```

When executed, a random number between 1 and 6 (inclusive) will be stored in variable T. If the statement is then re-executed, a different number might be produced. This ability to provide a random result may be used for simulations and games of chance such as dice throwing or the selection of a particular numbered question from amongst a series of numbered questions.

Write and execute a program which will supply two random numbers (R1 and R2) and which will then ask for the sum of these numbers to be input from the keyboard. If the answer input is wrong then a message to that effect should be displayed together with the correct answer. A correct answer merits a 'WELL DONE' message!

When this part of the program is working correctly, convert it to ask ten questions. Use random numbers between 1 and 100. This final version of the program should also indicate at the end of the test how many incorrect answers were given to the ten questions asked.

60 The following table represents the number of cars sold at a garage over a period of six months.

MONTH	CARS SOLD
1	5

Write and execute a program to display this

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	2	4	table and provide a bar chart something
	3	7	like the following to illustrate sales in
a	4	9	graphic form. Car sales figures should be
	5	8	stored in an array.
	6	6	

The bar chart:

```
          0....5....10      SALES
1  !*****
2  !****
3  !*****
4  !*****
5  !*****
6  !*****
   MONTH
```

Graphic symbols may be used instead of asterisks if you feel able.

## PROJECTS

---

61 Write and execute a program to use the computer as a teaching machine for computer aided learning (CAL). The subject is the dates of historical events and ten questions are to be asked relating to these events. The student is invited to type in the date associated with an event, if the date is wrong the question is to be repeated to give the student a second chance to give the correct answer. If the date is still wrong after the second attempt, the correct answer should be displayed and the next question asked. For every correct answer the student should be awarded one point and at the end of the test the points score should be displayed. The following is a list of events which may be used:

Battle of Hastings	1066	
Magna Carta signed	1215	After successful implementation
Start of Black Death	1348	of the program, consider what
Defeat of Spanish Armada	1588	modifications must be made so
Civil War in Britain	1642	that more help can be given to
Great Fire of London	1666	the student if the first

answer

Start of French Revolution	1789	is wrong. For example, a
----------------------------	------	--------------------------

message

Start of Boer War	1899	such as 'THE CORRECT DATE IS
Accession of Elizabeth II	1952	EARLIER (or LATER) THAN YOUR
First Man in Space	1961	ANSWER' might be used.

62 Consider a set of childrens wooden building bricks, each brick being a different colour. If two bricks are placed side by side they will form a pattern. Change the position of one brick and a second pattern will be formed.

i.e. RED YELLOW                      YELLOW RED

Thus, the number of patterns that can be formed using two bricks is two,  $(1 * 2)$ . If three bricks are used, the possible patterns are:

RED YELLOW GREEN	RED GREEN YELLOW
YELLOW RED GREEN	YELLOW GREEN RED
GREEN RED YELLOW	GREEN YELLOW RED

Therefore, the number of patterns that can be formed with three bricks is 6,  $(1*2*3)$ . With four bricks the number of patterns is 24,  $(1*2*3*4)$ , and so on.

From these results you can deduce that the number of patterns is always the product of the numbers (integers) from 1 to the number of bricks concerned.

Write and execute a program that will display a table of the number of patterns that can be formed as the number of coloured bricks increases from 3 to 9.

## PROJECTS

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### ARRAYS

63 Enter and execute Lists 51 to 55 in 'BCP' as required.

64 Comment on the possible errors in the following program segments:

```
10 DIM A(12)           10 DIM X(I)           10 DIM V(10)
20 FOR I = 1 to 50     20 LET X1 = 3.4         20 FOR I = 1 TO N
30 INPUT A(I)         30 LET X2 = 14           30 READ V(I)
40 NEXT I             40 LET X3 = -73        40 NEXT J
                    50 DATA RED, GREEN, BLUE
```

65 Write and execute a program to read the following numbers into an array named A. The program should then copy the numbers in array A into array B so that B contains the numbers in reverse order. The numbers are:

2,4,6,8,10,12,14,16,18,20. The program should output the contents of both arrays to the screen.

## PROJECTS

---

66 Devise a program to input (singly) each of the letters forming a word and store each letter in a cell (compartment) of a string array named V. The program should then count the number of vowels in the word and output the value of the count.

67 The prices of five different articles are stored in an array as shown:

PRICE	20	15	16	18	14	(Price for one of each product)
PRODUCT CODE		1	2	3	4	5 (This is the array compartment)

Articles are referenced or priced by means of their product code. If for example, the array used is named A, then the price for product code 1 would be found in A(1). In other words, the product code is the subscript value.

Write and execute a program which will request from the keyboard operator the product code and the numbers of that article sold. The program should then calculate and output the cost of the sale. The program should be repetitive in operation and should only terminate when an invalid product code is entered.

68 Write and execute a program which will allow 15 numbers to be input from the keyboard and stored in an array named A. The program should then:

- Copy all even numbers into array B and odd numbers into array C.
- Sum the even number array and find the average.
- Sum the odd number array and find the average.

Arrange for the program to output full details of the array contents together with the sums and average of arrays B and C.

69 The following list represents a product and the number of units in stock. Write and execute a program which will read this information into two arrays, P\$ and S. Devise a procedure such that when the name of an item is input from the keyboard, the product array will be searched and when a match is found, the number of units in stock will be displayed:

Fish Fingers	32	Haddock Slices	86
Beefburgers	94	Hamburgers	128
Sausage Rolls	67	Peas	142
Beans	27	Carrots	17
Sprouts	56	Chips	46

## PROJECTS

---

The program should be repetitive in operation and should terminate when XXX is input for the product name. You must guard against invalid inputs! When the program is operating satisfactorily, consider what modifications must be made so that the number in stock can be adjusted by the computer operator.

70 Write a program which will simulate the throw of a single die 100 times. The program should provide output (screen) of the following nature together with a bar chart illustrating the result of the throws in a simple graphic form, possibly similar to that below, or better!

```
NUMBER 1 WAS THROWN 18 TIMES          0    5    10    15    20    25    30
NUMBER 2 WAS THROWN 15 TIMES          !    !    !    !    !    !    !
NUMBER 3 WAS THROWN 21 TIMES          !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
NUMBER 4 WAS THROWN 12 TIMES          1    !*****
NUMBER 5 WAS THROWN 17 TIMES          2    !*****
NUMBER 6 WAS THROWN 17 TIMES          3    !*****
                                         4    !*****
                                         5    !*****
                                         6    !*****
```

## ARRAYS &amp; SORTING

71 Write and execute a program which will permit the entry of ten names from the keyboard and will then:

- a) Print the original list.
- b) Print the list sorted into alphabetical order.
- c) Print the list in reverse alphabetical order.

72 Project 44 involved a search routine which allowed names, addresses etc. to be searched for and displayed by means of a simple global search (all data items searched). In actual practice, this sort of search would prove to be inefficient and slow. If an address is required, the program should simply search the list for say the name entry only and provide all necessary details from this single-category search. Consider the menu below:

## ADDRESS FILE

```

1   LAST NAME SEARCH           <- Find entry by last name
2   TOWN SEARCH                <- Find entry by town
3   SORT & DISPLAY ADDRESS LIST <- Display sorted file
4   TERMINATE PROGRAM         <- End program execution

OPTION (1-4)?                 <- Ask for menu option required
                               (by means of an INPUT statement)

```

Write and execute a program to provide the facilities mentioned above using a menu as shown. For the purpose of this project, the names and addresses will be held in DATA statements such as that which follows and these must first be READ into the required number of single-dimension arrays (5) before the menu is displayed:

```
DATA "SMITH,""JOHN","34, AVONDALE ROAD,""WELLING","KENT"
```

Note that the DATA items are enclosed in quote marks to allow the use of embedded commas (commas which form part of the DATA item as in the house number and street name component). Use 5 DATA statements in your program.

In the computing profession, this type of program would fall into the category known as 'Database'. Database programs invariably read in data from a 'Data File' and do not use DATA statements for storage as such. On initiation, the data would be read, typically from a disc file, directly into arrays. Another method known as random or relative access never reads the whole of the data into memory but accesses the disc directly when the

## PROJECTS

---

data is required. Whichever method is used, the ability to modify file entries is always built in.

Consider what changes would be required to your program to allow record modification (for example a change of address). This would normally be done having searched for and found the entry in question. If you have time, introduce these changes but bear in mind that each time you run the program the DATA list will be read in 'as was', since any modification to records will only affect the array entries concerned during that particular 'run' of the program and not the DATA statements which form part of your program. (The DATA statements themselves could be modified but this must be done in the direct program editing mode.)

Disc files are not covered at this stage due to the fact that different makes of computer handle these files in different ways. If you are interested in such files they are covered in the companion second-year course.

If you can master this project then you have done well!

# PROJECTS

## LOGICAL OPERATORS

73 Enter and execute List 56 in 'BCP' as required.

74 Convert the following statements into a sequence of BASIC statements:

a) If income (I) is less than £10,000 and there are more than three dependants (D), then the tax (T) is zero, otherwise the tax (T) is six percent of income.

d) If the person at the bar is under 18 than indicate that he/she may not buy drinks, otherwise indicate that you are willing to take the order!

75 Write and execute a program using a random number generator which will produce 100 random numbers between 1 and 300. The results of the operation should output to the screen a display similar to the following which can be improved on!

### RANDOM NUMBER DISTRIBUTION

### 100 NUMBERS

NUMBERS CHOSEN FROM 1 TO 100 = ?      GROUP A  
NUMBERS CHOSEN FROM 101 TO 200 = ?      GROUP B  
NUMBERS CHOSEN FROM 201 TO 300 = ?      GROUP C

GROUP A PERCENTAGE = ? %

GROUP B PERCENTAGE = ? %

GROUP C PERCENTAGE = ? %

(Include a bar chart in the screen output)

76 Consider project 36. Modify this project using IF/THEN/AND statements to determine the grade and provide the required output.

77 The following is a list of clients on a file at a dating agency:

JIM,M,33,READING	JILL,F,67,MOTORING	DAN,M,25,FISHING
JANE,F,31,COOKING	HENRY,M,101,SLEEPING	ANN,F,27,SWIMMING
JOHN,M,50,COMPUTING	KAREN,F,18,WRITING	STEVIE,F,16, ASTRONOMY
MAGGIE,F,46,CYCLING	PETER,M,30,MOTORING	PETER,M,30,MOTORING
PAUL,M,22,SWIMMING		

The agency wishes to modify its operations and to become a Computer Dating Agency. The general requirements are as follows:

The ability to:

- Find a suitable partner from information supplied.
- Print an ordered list of all female clients.

## PROJECTS

---

- c) Print an ordered list of all male clients.
- d) Print an ordered list of all clients.

Write and execute a menu program which will provide these options together with one further option to terminate the program execution. Your program should first READ the clients details (DATA list) into the required number of arrays, sort the list into alphabetical order and then present the menu.

OPTION A. To find a suitable partner. The following questions will need to be asked by the program in order to find a suitable partner (or partners) from the list of clients:

- 1 Male or female
- 2 Lowest acceptable age
- 3 Highest acceptable age
- 4 Main interest.

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The program should then search the client list for a complete match with the stated requirements and if found, the listed name(s) should be displayed. If no suitable clients are listed, a message to this effect should be displayed.

OPTION B. This option should simply output a complete list (full details) of all male clients.

OPTION C. Same as B but all female clients.

OPTION D. Same as B but all listed clients.

### MENUS, ON-GOTO & GOSUB

78 Enter and execute Lists 60 and 61 in 'BCP' as required. Rewrite the pseudo-program in List 61b in good BASIC.

79 Consider Lists 57 and 59 in 'BCP'. Combine these and add the necessary routines at lines 1000, 2000 and 3000 to complete the program.

80 Write and execute a program having a menu something like the following:

```
MATHS TEST                                RANGE OF NUMBERS: 1 TO ?

1  ADDITION
2  SUBTRACTION
3  MULTIPLICATION
4  DIVISION

OPTION REQUIRED (1-4)?
```

The student should be able to select the operation required by inputting 1,2,3 or 4 in answer to the OPTION REQUIRED (1-4) question. (Invalid inputs must be dealt with!)

A complete test should comprise ten questions and each correct answer given a score of one point. The percentage scored should be displayed at the end of the test together with an option to either take another test or to terminate program execution.

**DEGREE OF DIFFICULTY.** The student must be able to set the degree of difficulty for the test before the main menu is displayed. (The program should ask the question 'RANGE OF NUMBERS: 1 TO ?'.) If numbers between 1 and 50 were required for the test, then '50' would be input in answer to this question. This value should be stored in variable N.

You should use a random generator to produce two random numbers (R1 and R2) between 1 and N (within the range selected by the student). The following is an example of the type of screen output to be provided by the program, in this case an addition test:

```
QUESTION 1      WHAT IS 23 + 31? 54          (Division tests should be
```



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---

If another test is opted for, execution should return to the point where the range of numbers is requested.

```
81  Consider the following subroutine:
    1000 FOR T = 1 TO 2000
    1010 NEXT T
    1020 RETURN
```

Whenever this subroutine is 'called', program execution will be delayed for a while, whilst the computer processes lines 1000 - 1010. The delay will depend upon the upper limit (in this case 2000) of the FOR-NEXT loop. The higher the limit, the longer the delay. Many programs utilise a time delay (pause in program execution) to allow an operator, for example, to read a message on the screen before execution resumes.

a) Determine the time delay on your computer for FOR-NEXT loops having differing limits and derive the necessary limits required to provide delays of 1, 2, 3, 4 and 5 seconds. Make a careful note of these limits.

b) Write and execute a program which will allow a student to improve his/her speed of reading by having a number of phrases displayed on the screen, one at a time, for a specified time. This time should be selected by the student. After each phrase has been displayed, the screen should clear and the student be invited to type in what he/she saw. This must be checked against what was actually displayed. When the test has been completed, the number of points scored for correct answers must be presented.

The time of exposure must be selectable by the student before the test commences and you should therefore offer a number of options (seconds) from a brief 'flash' to a lengthy exposure.

The phrases to be used may be stored in DATA statements and you should provide ten phrases (questions). Guard against invalid inputs and use subroutines where possible. When the program is operating correctly, consider what modifications need to be made so that the phrases are displayed in a random fashion from a selection of say, 30 phrases. This would avoid repetition of the same phrases to some extent.

82 The following list of DATA statements each contain a German verb and its English translation:

DATA SPIELEN,TO PLAY	DATA GEHEN,TO GO	DATA SEHEN,TO SEE
DATA SITZEN,TO SIT	DATA TRINKEN,TO DRINK	DATA RAUCHEN,TO SMOKE
DATA HABEN,TO HAVE	DATA LEBEN,TO LIVE	DATA ESSEN,TO EAT
DATA SPECHEN,TO SPEAK	DATA SCHLAFEN,TO SLEEP	DATA FAHREN,TO DRIVE

Write a program having a menu something like the following:

```
VERB DICTIONARY          GERMAN-ENGLISH
                          ENGLISH-GERMAN
```

```
1  TRANSLATE GERMAN TO ENGLISH
2  TRANSLATE ENGLISH TO GERMAN
```

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---

3 TERMINATE PROGRAM

OPTION (1-3)?

## PROJECTS

---

The program should allow either of the options to be selected and should then request the translation required. Note that translations from English to German require an answer like 'TO SPEAK', whereas from German to English the answer is simply the German verb, for example, 'ESSEN'. Having displayed the translation, the request for translation should be repeated thus allowing further words to be entered. You should arrange for program execution to return to the menu whenever an 'XXX' is entered in answer to the translation request. You must guard against invalid inputs, for example, the word requested is not in the Dictionary or has been mis-spelt (an exact match is required). If an invalid input occurs, an appropriate message should be displayed and the request repeated.

The following is an example of the screen display having opted for English to German translations:

```
ENGLISH VERB? TO HAVE
GERMAN TRANSLATION - HABEN           Having provided the answer,
the
                                     next translation should be
ENGLISH VERB? TO SLEEP               requested.
GERMAN TRANSLATION - SCHLAFEN

ENGLISH VERB? TO PAINT
SORRY! NOT IN DICTIONARY

ENGLISH VERB? TO DRINK
GERMAN TRANSLATION - TRINKEN

ENGLISH VERB? XXX .....           This answer would return control to the
menu.
```

83 Consider the addition of a further option to the menu of project 82 which will provide a ten translation test using a random number generator to select pairs of DATA entries from the Dictionary!

### LIBRARY FUNCTIONS

84 Enter and execute Lists 62 to 67 in 'BCP' as required.

85 Comment on the errors in the following BASIC statements:

- |                          |                           |
|--------------------------|---------------------------|
| a) LET K\$ = LEFT\$(J,3) | b) PRINT RIGHT\$(G\$,4,6) |
| c) LET Y\$ = VAL(X)      | d) LET K = STR\$(N)       |
| e) LET Y\$ = Y\$ - Z\$   | f) PRINT MID("X\$",3,4)   |

86 Write and execute a program that will read from a DATA statement the entire alphabet. Your program should then print:

- The entire alphabet
- The first six letters of the alphabet

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---

- c) The last ten letters of the alphabet
- d) The tenth, eleventh and twelfth letters in the alphabet.

87 Write and execute a program to create a string from every other letter of the alphabet beginning with letter A (i.e. ACEG ...etc), and the print:

- a) The length of the string
- b) The position of the letter 'Q', as the number of character positions from the beginning of the string.

88 Write and execute a program to input a short sentence from the keyboard. The program should then analyse the sentence and output a table showing the frequency of use of each letter of the alphabet.

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---

89 Write and execute a program which will allow a sentence to be input from the keyboard and which will then display:

- a) The number of words in the sentence
- b) The number of vowels in the sentence

c) The number of characters in the sentence (spaces count as characters)

90 Write and execute a program which will read the following DATA strings into a numeric array, sum them, and find the average value:

```
DATA "127.88", "99.34", "0.345", "459.342", "89.3".
```

91 Consider the 'INSTRING' search discussed during the tutorial sessions.

Write and execute a program having a series of DATA statements containing say, names and addresses, this DATA to be READ into the required number of arrays. Duplicate several of both the name entries and the town entries and devise the rest of the program to allow an instring search of each of these entries for a 'target string' entered from the keyboard. The complete DATA entry should be displayed if the target string is found.