

ตัวอย่างที่ 3 Symetric Matrix หมายถึงแมตริกซ์ที่ element
ตำแหน่งที่ i, j มีค่าเท่ากับ element ที่ตำแหน่ง j, i ดังตัวอย่างต่อไปนี้

$$C_{5 \times 5} = \begin{vmatrix} 1 & 4 & 5 & 8 & 2 \\ 4 & 3 & 1 & 9 & 7 \\ 5 & 1 & 5 & 0 & 2 \\ 8 & 9 & 0 & 7 & 5 \\ 2 & 7 & 2 & 5 & 14 \end{vmatrix}$$

สามารถจะจัดโครงสร้างในการจัดเก็บให้มีประสิทธิภาพได้ดังนี้คือ

$$C_{15 \times 1} = \begin{vmatrix} 1 \\ 4 \\ 5 \\ 8 \\ 2 \\ 3 \\ 1 \\ 9 \\ 7 \\ 5 \\ 0 \\ 2 \\ 7 \\ 5 \\ 14 \end{vmatrix}$$

2.2 Record เป็นโครงสร้างของตัวแปรกลุ่มอีกประเภท หนึ่งที่นิยมใช้กัน ในลักษณะของการเก็บข้อมูลในแนวคิดเดียวกับ Array แต่มีข้อแม้ว่าโปรแกรมบางภาษาจะไม่มีให้ใช้ ในขณะที่ Array นั้นเป็นรูปแบบที่ใช้ได้กับทุกภาษาโปรแกรม โครงสร้างของข้อมูลชนิดนี้จะปรากฏดังนี้

สมมติว่าเรามีข้อมูลของคณงานจำนวน 20 คน โดยที่แต่ละคนมีข้อมูลปรากฏดังนี้คือ

- name A 20 element array of character
- year in school : An integer between 1 and 4
- Grade point average : real
- Fees Paid : boolean

จากลักษณะข้อมูลดังกล่าว เรานำมาเขียนคำสั่งเพื่อสร้างที่เก็บข้อมูลได้ดังนี้คือ

```

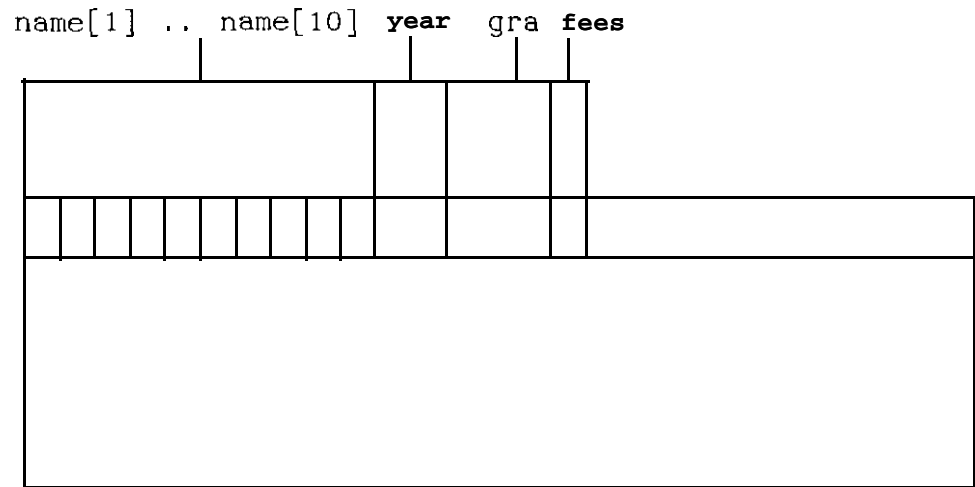
type studentrec = record
    name : array [1..10] of char;
    year : 1..4;
    gra : real;
    fees : boolean
end.{student}

var
    student : array[1..20] of studentrec ;

```

ตัวอย่างของการประกาศจองพื้นที่ดังกล่าวจะปรากฏในคอมพิวเตอร์ตามโครงสร้างรูปนี้คือ

student[1]



ผลที่เกิดจากโครงสร้างแบบ Record เมื่อเทียบกับ Array ก็คือ การดำเนินงานกับ Record กว่า อาทิ เช่น การข้อมูลจาก external file เช่น disk ทำได้เพียงแต่สั่งว่า `read(fp,student[i])` เท่านั้นก็สามารถจะอ่านข้อมูลของนักเรียนคนที่ `i` ตามโครงสร้างข้อมูลทั้งหมดของนักเรียน 1 คนที่มีข้อมูล 4 รายการคือ ชื่อยาว 10 character ,year,gra,fees (ในที่นี้ fp คือ file pointer) นอกจากนี้ในกรณีที่มีการ ย้ายข้อมูลจาก record `j` ไปที่ record `i` ก็กระทำได้ง่ายเพียงกำหนดว่า

`student[i] := student [j]`

ผลที่เกิดขึ้นก็คือจะได้ว่าข้อมูลจาก record ของ student ที่ `j` จะไปปรากฏอยู่ที่ record ของ student ที่ `i` (ทุกสมาชิกใน record) ซึ่งถ้าเปรียบเทียบกับการใช้ Array แล้ว จะเห็นว่าเราจะต้องดำเนินการ assign ทีละรายการซึ่งเสียเวลาในการเขียนคำสั่งยาวมาก

การอ้างอิงถึงชื่อของตัวแปรใน Record ในภาษาปาสคาลจะคล้ายกับการอ้างอิงถึงตัวแปร Structure ในภาษา C คือ อ้างอิงถึงตัวแปรหลักก่อนแล้วจึงตามด้วยแปรกลุ่ม อาทิเช่น การอ้างถึงรายการข้อมูลต่างๆของ student ที่ 1 เราจะอ้างดังนี้

```
student[1].name[1], ..., student[1].name[19]
student[1].year
student[1].gra
student[1].fees
```

ตัวอย่างคำสั่งในการใช้งานที่เกี่ยวข้องกับการใช้งานที่เกี่ยวข้องกับ Record

a.

```
with student[1] do
begin
    for i:=1 to 20 do
        read(name[i]);
    year := 1;
    gra  := 4.0;
    fees := true;
```

b.

```

type status      = (married,divorced,widowed);
  maritalrec     = record
    name : array[1..20] of char;
    age  : integer;
    sex  : (male,female);
    case maritalstatus :status of
      married : (length :integer;
                 children:integer;
                 spouse:array[1..20] of char)
      divorced : (divorcedate :record
                  month:integer;
                  year :integer
                  end);
      widowed  : (yearofdeath:integer;
                 insurance:boolean)
    end;
end;

```

แบบฝึกหัด

1. Show the Pascal representation of the following constants.

- *(a) π
- (b) e (the base of the natural logarithms)
- *(c) the fractional value 1/2
- *(d) 6.02×10^{23}
- (e) the number 7
- *(f) the character 7
- (g) the color red
- *(h) 18 billion
- (i) truth
- (j) the blank character

2. Which of the following are valid Pascal const declarations? Identify the error(s) in each of the invalid declarations.

- (a) const
 highvalue = 200;
- (b) const
 lowvalue = 0 or 1 or 2;
- (c) const
 firstchar : 'a';
- (d) const
 greatest = 200.0;
 least = -100.0;
- (e) const
 range = 200..800;

3. Write a single **type** declaration to create the following three new data types.

- (a) the integer subrange (-100, +100)
- (b) the six New England states
- (c) the lowercase letters of the alphabet

4. Which of the following **type** declarations are illegal?

If a **type** declaration is illegal correct it, if possible.

- *(a) **type** integer = - maxint.. +maxint;
- *(b) **type** correlation = 0.0..+1.0;
- *(c) **type** yearinschool = (1,2,3,4);
- (d) **type** colors: (red,blue,green,yellow,pink,che violet,brown);
- (e) **type** hyphenatedwords = (pre-set,lower-limit, upper-limit);

5. Which of the following are valid Pascal **var** declarations?

Identify the error(s) in each of the invalid declarations and correct them.

(a) **var**

1a,2a,3a :char;

(b) **var**

a1,a2,a3 :char;

b1 :real;

a3 :integer;

(c) var

```

a      : integer;
b      : integer;
c      : integer;
abc    : real;

```

(d) var

```

resulta, resultb:real;
count          : integer;
c1             :char;
x,y           :real;

```

6. Choose reasonable names and write a single var declaration for the following values.

- (a) the three real coefficients of a quadratic equation
- (b) the two real roots of that equation.
- (c) a boolean value indicating whether or not there was a solution
- (d) an integer value that indicates the data set number
- (e) the primary colors red, yellow, and blue

7. Choose reasonable names and write a single var declaration for the following values.

- (a) a six-digit student identification number
- (b) year in school (freshman, sophomore,...)
- (c) year of graduation
- (d) grade point average (A = 4.0)

(e) a variable indicating whether or not all current fees have been paid

8. Rewrite these declarations so that they accomplish the same operations but using only var declarations.

type

list = (alpha,beta,gamma);

range = 'a'..'z';

var

a,b :char;

greek :list;

num :integer;

letters :range;

9. Classify each of the following character strings as a reserved word standard identifier, user identifier, constant, or invalid.

*(a) begin	(h) 1e1
(b) real	*(i) 1e
*(c) start	(j) 234
(d) sqr	*(k) truncate
*(e) maxint	(l) character
(f) xyz	*(m) .7
*(g) e1	(n) 3

10. Look up the character code used on your computer and state what the result of each of the following expressions would be on your computer.

- (a) `ord('q')` (b) `chr(3)`
 (c) `succ('z')` (d) `pred(ord('#'))`
 (e) `chr(trunc(sqrt(517)))`

11. Using the relational operators and the knowledge that true > false implement the following logical operators as defined by the given truth tables.

- (a) `p=q`(equivalence)

P	Q	P=Q
F	F	T
F	T	F
T	F	F
T	T	T

(b) $p \oplus q$ (exclusive -or)

P	Q	$P \oplus Q$
F	F	F
F	T	T
T	F	T
T	T	F

(c) $p \alpha q$ (NEGATIVE IMPLICATION)

P	Q	$P \alpha Q$
F	F	F
F	T	F
T	F	T
T	T	F

12. Assign the following given value of three variables

```

a := 4;
b := -15;
c := 7;
d := red;

```

What is the value of each of the following Pascal expressions?

- (a) $(\text{abs}(b-10) + a \bmod (c-1))$
- (b) $a + 103 \text{ div } \text{sqr}(a-c)$
- (c) $\text{pred}(a * 6 + b \text{ div } 5)$
- (d) $\text{succ}(d)$
- (e) $(2 + a * b \bmod c + 1) \wedge 2$

13. Using the declarations from Exercise 12 as well as the following new variables:

```

var
    x,y,z : real;

    x: = 1.52E1;
    Y: = 0.3;
    Z: = -5.1E3;

```

What is the value of each of the following Pascal expressions?

- (a) `trunc(x *y + 1.0) a`
- (b) `x/y *3.4 + z`
- (c) `abs(sqr(sin(y) + cos(y)) - 0.5)`
- (d) `round(x) div round(y + 1.6) + b`
- (e) `exp(c - 4)`

14. Using the declarations from Exercises 12 and 13 and the following additional declarations:

```

var
    m,n : boolean;
    p    : char;

    m    := true;
    n    :=false;
    p    := 'a'

```

What are the values of the following expressions?

- (a) `m and not n`
- (b) `(a>b) and (b>c) or not(c = 7)`
- (c) `not odd(c)and m`
- (d) `(x>0.0) or (y>0.0) and(z>0.0)`
- (e) `chr(succ(ord(p)))`

15. Determine whether the following Pascal expressions are a correct translation of the corresponding mathematical notation. If not, add the necessary parentheses to correct it.

$$(a) \quad \frac{\sin \theta - 1}{\cos \theta + 1}$$

$$k := \text{sqrt}(\sin(\text{theta}) - 1.0 / \cos(\text{thata}) + 1.0)$$

$$(b) \quad ax^2 + bx + c, \quad k := a * \text{sqr}(x) + b * x + c$$

$$(c) \quad \frac{a}{b} + \frac{c}{d} - \frac{e}{f}, \quad \text{sqrt}(a / b + c/d - e/f)$$

16. Translate each of the following English or mathematical specifications into a correct Pascal assignment statement. Show the `var` declaration for all variables used in the expressions.

(a) Taxable pay is gross pay less a fixed deduction of \$14 and less \$11 for each dependent.

(b) The interest charge is 5% on the part of the balance that exceeds \$100 (you may assume that balance \geq \$100).

(c) The average is sum of all scores
number of scores less illegal ones

18. Write the declarations and the input commands needed to read in data prepared for the following format.

- (a) A master payroll card containing a social security number(integer) and a department number(integer), followed by a separate timecard containing hours worked this week (real).
- (b) A single student grade card containing a 6 digit student identifier (integer) followed by three letter grades (a,b, c, d, e) all separated by exactly one blank character.

19. Show how the data cards should be prepared if the input commands in OUR program are written like this.

var

- (a) `read(x,ch1);`
`read(y,ch2)`
- (b) `readln(x,y);`
`readln(ch1,ch2)`
- (c) `readln(x,y,ch1,ch2)`
- (d) `readln(x);`
`readln(y);`
`readln(ch1);`
`readln(ch2)`

20. Assume that the variables w , x , y , z have been declared to be of type integer and that the symbol ' ' represents the end-of-file condition. If our input data is as follows:

```
input pointer
      |
      13  80
      21   0
```

for each of the following input sequences, give the value assigned to each variable and the value of the boolean function `eof` on completion of the entire sequence. Also state whether or not the sequence would lead to an error condition caused by attempting to perform a read (or `readln`) while `eof` is true.

```
*(a) read(w);      (b) readln(x,y,z)
    read(x);
    read(y);      (c) read(w,x)
    read(r)       read(y,z)

(d) readln(x);
    readln(y);
    readln(z)
```

21. Assume our input was currently:

```

input pointer
  |
  |
line 1 eoln next line eoln times up ....

```

pointer on completion of the input sequence. (Assume ch1 and ch2 have been declared to be of type char.)

- (a) read(ch1);readln
- (b) readln;read(ch1)
- (c) read(ch1,ch2)
- (d) readln(ch1,ch2)
- (e) readln(ch1);readln(ch2)

22. Show the exact output produced by each of the following output sequences. Assume that we are presently at the beginning of a new line and that the referenced variables have the following values.

```
x := 1.23456
```

```
y := 567.89
```

```
z := 10
```

```
c := '$'
```

- (a) writeln(x,y,z);writeln(c)
- (b) writeln(x:15:1,y:8:3,z)
- (c) write(x:15); write(y:15); write(c:3)
- (d) writeln(x:16:4);writeln(y);writeln(z:1)

23. Show the output commands needed to produced the following output formats Assume the necessary values have already been computeed and stored in the indicated variables.

(a) Produce the more legible tax report.

The variables are called:

ssnumber, dependent, gross,
fedtax, statetax,net

(b) Variables: month, year, amount, tax, total.

Date: mm/yy

Gross Amount \$xxx.xx

Tax \$xxx.xx

Grand Total \$xxx.xx

(c) Variables: count, average, high, low.

<u>total number</u>	<u>average</u>	<u>range</u>
xxxx	xx.x	xx.x-xx.x

(d) No variables are needed, but assume your character

includes the

acters '-' , '|' , and '>' (ASCII 95,124,62).

```

          [ - - - - ]
          :           :
-----> :           : ----->
          :           :
          [ - - - - ]
    
```

{
}
}

2-

24. Write a complete Pascal program to input a data card containing three values

- (a) A real value corresponding to the amount of a loan m dollars and principal).
- (b) A real value corresponding to the interest rate of the loan.
- (c) An integer quantity, N , giving the number of payment periods per year. The program should complete the loan payment required for each pay period repay the outstanding principal in one year at the indicated interest rate in N payments. The formula for doing this is:

$$\text{Payment} = \frac{p(1+i)^N + 25}{N}$$

where p = principal
 i = interest rate
 N = number of pay periods per year
 $\$25$ = annual service charge

The program should print out the input data and the answer in some nice, format. NOW attempt to run this program on the computer facilities available at your installation. If appropriate, run the program in both a batch access and sharing mode. Familiarize yourself with all aspects of the operations policy your computer center. This would include:

Location of keypunches and computer terminals.
 Operating procedure for keypunches and terminals.
 Location of program submission stations.
 Commands required for program preparation, execution, and stage.
 Availability of consulting help and documentation.

25. Write the complete Pascal for solving this solutions to the equation

$$3x + 2y + 7z = 5$$

for values of x, y, and z in the range 01 to 100.

26. Let v1 and v2 represent boolean variables and let s1, s2, and s3 represent Pascal statements. Suppose that one of the statements is to be executed based on the values of the boolean variables. as follows.

		v2	
		t	f
v1	t	s1	s2
	f	s3	s4

Set up a conditional statement to achieve this effect.

27. Write a complete Pascal program to computer the average of all legal examination scores. A legal score is one in the range 0 to 150. Your program should read scores until an end-of-file condition occurs and then produce as output:

- (a) The average of all legal scores.
 - (b) The number of legal scores.
 - (c) The number of legal scores.
- (Be sure your program works properly even when there are no legal scores.)

28. The Fibonacci series is defined as

$$n_0 = 1, \quad n_1 = 1$$

$$n_{i+2} = n_{i+1} + n_i \quad i = 0, 1, 2, \dots$$

Thus, the first few Fibonacci numbers are

$$1, 1, 2, 3, 5, 8, 13, \dots$$

Write a complete Pascal program to compute and print the first k Fibonacci numbers, where k is input to the program. (Your program should work properly even if $k \leq 0$.)

29. Temperatures on the Celsius (or centigrade) scale are related on the Fahrenheit scale by the formula

$$C = \frac{5}{9}(F - 32)$$

Write a complete program that prints the Celsius equivalent of Fahrenheit temperatures in the range low to high where low and high are input to the program. The increment size of the table should also be input to the program.

30. Write a program that reads text and produces encoded text by replacing each character with the character that occurs five positions "later" in the character set. (Thus, considering the typical ordering for alphabetic character, 'a' would be replaced by 'f,' 'b' by 'g,' etc.) This replacement should "wrap around" the end of the character set so that there is a well-defined replacement for each character. (That is, the character that occurs at the end of the character set should be replaced by the character in the fifth position. You will have to know how large the character set is on your computer.) Read text and print the encoded form until an end-of-file condition occurs.

31. Write a complete program that compute the minimum number of coins and bills needed to make change for a particular purchase. The cost of the item and the amount tendered should be read as data values. Your program should indicate how many coins and bills of each denomination are needed for change. Make use of these denominations.

Coins: \$0.01,\$0.05,\$0.10,\$0.25 , Bills: \$1,\$5,\$10

32. Write a program to determine the frequency of each vowel in some English language text. The input will consist of sentences running over a number of lines. The end of the text is indicated by the special symbol '*' that will not appear anywhere else in the text. The output of the program should be the input text and the percentage of characters that were equal to 'a,' 'e,' 'i,' 'o' 'u,' Blanks and punctuation marks should not be treated as characters and should not be included in the total.

33. Write a program to count the total number of words in some English language text. The input will consist of text running over a number of cards or lines. The end of the text will be indicated by the end-of-file condition becoming true. Your program should count the number of words in the entire input, where a word is defined as any sequence of nonblank characters bounded on either side by one or more blank characters. (Therefore things like + 1.2, real-life, don't, and 1,000,000 are all counted as one word.) The output from your program should simply be the number of words in the text.

34. The area of a circle with a radius of 1 is π , and the area of a square that just contains the circle is 4. Therefore, if a large number of points is chosen randomly in the square, the fraction of those points that fall within the circle

will be approximately $\pi/4$. Assuming the existence of a standard real-valued function called `random` that returns a `random` number, `r`, between 0 and 1, write a program to compute an approximation to π .

35. Assuming `randomnumber` is a standard real-valued function that return a `random` number, `r`, between 0 and 1, write a program that approximates the probabilities for rolling the values 2 to 12 with two dice. Use a `CASE` statement in the program.

36. Write a Pascal program to process the weekly payroll of the Brooks Leather Company (BLC). For each employee of BLC your program will compute the gross pay, deductions, and net pay. This information is to be clearly printed in the output along with certain summary information for the entire payroll. Each week BLC punches a data card for each employee that includes the following information. Social security number (9 digets)

Hourly pay rate	(xx.xx)
Number of exemptions	(0 to 19)
Health insurance code	(1,2,3,or 4)
Hours worked	(xx.x)

Using this information, your program should carry out the following computations.

- (a) Gross Pay. Regular pay for the first 40 hours and time-and-a-half beyond that up to a limit of 54 hours in any given week.
- (b) Deductions. Let g represent gross pay and t taxable pay. Let e represent number of exemptions.

- (i) Federal income tax withholding is defined as

$$\text{Let } t = g - \$14.00 * e - \$11.00$$

$$\text{Withholding} = t * (0.14 + 2.3 * 10^{-4} * t)$$

- (ii) State income tax withholding State withholding is defined as 31% of the amount withholding for federal income tax.
- (iii) Health insurance

1-No coverage

2-Employee coverage (\$2 per week)

3-Family coverage (\$7.50 per week)

4-Major medical coverage (\$13 per week)

- (c) Net Pay. Gross pay less all deductions.

For each employee, your program should produce an output report in a legible format with each item clearly labeled. After the last employee has been processed, your program should print a summary report that includes the number

employee processes, total gross pay total deductions of each type, and total net pay. Your program must be capable of processing an arbitrary number of data cards and should perform reasonable operation for all data sets regardless of how meaningless they are (For example, what if deductions exceed net pay? What if taxable pay is negative? Be careful to check those and similar situations and decide the appropriate action.)

37. Assume that another program has already computed the mean, m , and standard deviation, on a homework assignment for our class. We now wish to write a program that assigns letter grades to the individual homework scores. The input to this program will be m and followed by student grade cards containing an identification number (integer) and a score, s . The rules for assigning letter grades are follows.

If S is greater than	But No More Than	Letter Grade
M + 2 s.d.	100	A
M + 1 s.d.	M + 2 s.d.	B
M - 1 s.d.	M + 1 s.d.	C
M - 2 s.d.	M - 1 s.d.	D
0	M - 2 s.d.	

38. Write a Pascal program that first reads, row by row, and $n \times n$ two-dimensional array, where n is an input parameter. The program should then determine whether the array just read falls into any of the following special classes.

(a) Symmetric

$$a_{ij} = a_{ji} \text{ for all } i, j$$

(b) Upper triangular.

$$a_{ij} = 0 \text{ whenever } i < j$$

(c) Diagonal.

$$a_{ij} = 0 \text{ whenever } i \neq j$$

Print out the array and state whether or not it belongs to any of the classes just listed.

39. Write a Pascal program that reads a sequence of characters into an array and counts the number of *words* in that text. A word is any sequence of non-blank characters bounded on either side by at least one blank character. For example, given the following text:

Jefferson Scholl is on Hennepin Avenue.

the output should be:

The above sentence contains 6 words.

(You may wish to go back and reread Section 2.2.4, which describes the development of an algorithm for just this problem.)

40. Write a Pascal program that read an element of matrix A and B and then calculate the following operation

Addition: If A is $m \times n$ and B is $m \times n$

then $C = A + B$ means

$$c_{ij} = a_{ij} + b_{ij} \quad \begin{array}{l} i = 1 \dots m \\ j = 1 \dots n \end{array}$$

Multiplication: If A is $m \times p$ and B is $p \times n$

then $C = A \times B$ means

$$c_{ij} = \sum_k (a_{ik} * b_{kj}) ; k = 1 \dots p$$

41. Write a complete Pascal program to read input data containing names in the following format.

cccc... cccc... cccc... c = any alphabetic character

first	middle	last
name	name	name

All three names may be of arbitrary length and there will always be one or more blanks between each name. The first and last name will always be present, but the middle name may be omitted, in which case there will only be two names on the card. All three names fit on a single line of 80 characters.

After reading in a name, print it out in the more standard "report-oriented" format.

```

CCCCC , CCCC C.
first   last   middle
name    name   initial

```

where 'last name' and 'first-name' include only the first

42. characters of each. Additional characters beyond 15 are not printed. The middle initial is the first letter of the middle name followed by a '.'. If the middle name is not present, this field is omitted.

Continue printing names until you come to the end of file. As an example, the following input card:

```

Rebecca Al i son Schne i der (. Means blank)

```

will result in the following output line:

```

Schneider, Rebecca A

```

43. **Palendromes.** A palendrome is something that reads the same way backward andforwaed. The unit in a palindrome can vary Sometimes it is a letter (WOW or MOM) or a number (4884 or 121) or words: STRAP ON NO PARTS.

(a) Find some integers N which when squared are palindromes.

$$26 = 676$$

(b) FIND some palindrome integers N which when squared are palindromes.

$$22 = 484$$

(c) Generalize the above for powers larger then 2

(d) Write a program that is also a palidrome.

here is the example of a parlindrome

$$\begin{array}{r}
 78 \\
 + 87 \\
 \hline
 165 \\
 + 561 \\
 \hline
 726 \\
 + 627 \\
 \hline
 1353 \\
 + 3531 \\
 \hline
 4884
 \end{array}$$

Check this conjecture out for the first 100 integers. Side note: 196 is the first number where it isn't known if it works. For reference, see Howard W. Bergerson, Palindromes and Anagrams, New York, Dover Publications, 1973 and Martin Gardner, "Mathematical Games," Scientific American, August 1970.

44. Write a program that will do one of the following conversions.

(a) FORTRAN to BASIC

(b) BASIC to FORTRAN

You may wisely decide to implement only part of the conversion.