ECOO 2004
Programming Contest

Board wide
Contest

**to be written
after March 1rd**

Problem 1 - Integer Triangles

An integer triangle has sides that are whole numbers, and an area that is a whole number also.

DATA11 (**DATA12** for the second try) contains 5 positive numbers representing the perimeters of 5 integer triangles. Write a program that will read these 5 numbers and print, for each, the integer triangle with the largest possible area. State the 3 sides in descending order and the area for each. If no integer area can be found, say that there are no solutions.
Perimeters in the sample input are between 12 and 300

You might find it useful to know that the area of a triangle, where the sides are a,b,c and one half of the perimeter is s, is given by Heron's formula:

$$Area = \sqrt{s(s-a)(s-b)(s-c)}$$

SAMPLE INPUT:

```
161
12
84
90
100
```

SAMPLE OUTPUT:

```
There are no integer triangles with a perimeter of 161

sides     5     4     3   yield the largest area:        6

sides    30    28    26   yield the largest area:      336

sides    36    29    25   yield the largest area:      360

sides    34    34    32   yield the largest area:      480
```

Problem 2 - Ceasar Cipher

Ceasar ciphers are the easiest codes to create and crack. The code consist of shifting the letters of a message over a constant number of characters. A Ceasar cipher of 5 for example would shift over the letters five characters: the letter "**A**" becomes an "**F**" , the letter "**B**" a "**G**" and so on. The letter "**Z**" would wrap around and become an "**E**"
the letters of the top row in this chart would be translated to the letters of the bottom row:

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
FGHIJKLMNOPQRSTUVWXYZABCDE
```

Since the most common letter in the English language is the letter E, most ceasar codes can be broken simply by checking which letter in the message is the most common.
in the message:

```
CH UHINBYL GIGYHN XIQH QYHN UFCWY UZNYL CN
HYPYL IHWY WIHMCXYLCHA BIQ CH NBY QILFX MBY QUM NI AYN ION UAUCH
```

the letter "Y" is the most common letter (frequency=12), and very likely, the letters in the message have been shifted by 20, since the letter "E" is the 5th letter, and "Y" is the 25th letter.
Shifting all the letters over by 20 gives us the decoded message:

```
IN ANOTHER MOMENT DOWN WENT ALICE AFTER IT
NEVER ONCE CONSIDERING HOW IN THE WORLD SHE WAS TO GET OUT AGAIN
```

DATA21 and **DATA22** each contain 5 messages of 10 lines or less; each line containing no more than 80 characters. All characters are either capital letters or the space character, as shown in the example below. Messages are terminated by a line containing three stars (***).

Write a program that will read from DATA21 (DATA22 for the second try) the messages in ceasar code, and DECODE them by matching the most frequently occuring letter to the letter "E".

SAMPLE INPUT (three of 5 messages)

```
LZWJW OSK FGLZAFY KG NWJQ JWESJCSTDW AF LZSL
FGJ VAV SDAUW LZAFC AL KG NWJQ EMUZ GML GX LZW OSQ
LG ZWSJ LZW JSTTAL KSQ LG ALKWDX
GZ VWSJ GZ VWSJ A KZSDD TW DSLW
***
NRCQNA CQN FNUU FJB ENAH MNNY XA BQN ONUU ENAH BUXFUH
OXA BQN QJM YUNWCH XO CRVN JB BQN FNWC MXFW CX UXXT JKXDC QNA
JWM CX FXWMNA FQJC FJB PXRWP CX QJYYNW WNGC
ORABC BQN CARNM CX UXXT MXFW JWM VJTN XDC
FQJC BQN FJB LXVRWP CX KDC RC FJB CXX MJAT CX BNN JWHCQRWP
***
OCZI NCZ GJJFZY VO OCZ NDYZN JA OCZ RZGG
VIY IJODXZY OCVO OCZT RZMZ ADGGZY RDOC XPKWJVMYN VIY WJJFNCZGQZN
CZMZ VIY OCZMZ NCZ NVR HVKN VIY KDXOPMZN CPIB PKJI KZBN
NCZ OJJF YJRI V EVM AMJH JIZ JA OCZ NCZGQZN VN NCZ KVNNZY
DO RVN GVWZGGZY JMVIBZ HVMHVGVYZ
WPO OJ CZM BMZVO YDNVKKJDIOHZIO DO RVN ZHKOT
NCZ YDY IJO GDFZ OJ YMJK OCZ EVM AJM AZVM JA FDGGDIB NJHZWJYT
NJ HVIVBZY OJ KPO DO DIOJ JIZ JA OCZ XPKWJVMYN VN NCZ AZGG KVNO DO
***
```

SAMPLE OUTPUT (three of 5 messages)

```
THERE WAS NOTHING SO VERY REMARKABLE IN THAT
NOR DID ALICE THINK IT SO VERY MUCH OUT OF THE WAY
TO HEAR THE RABBIT SAY TO ITSELF
OH DEAR OH DEAR I SHALL BE LATE

press any key to continue..

EITHER THE WELL WAS VERY DEEP OR SHE FELL VERY SLOWLY
FOR SHE HAD PLENTY OF TIME AS SHE WENT DOWN TO LOOK ABOUT HER
AND TO WONDER WHAT WAS GOING TO HAPPEN NEXT
FIRST SHE TRIED TO LOOK DOWN AND MAKE OUT
WHAT SHE WAS COMING TO BUT IT WAS TOO DARK TO SEE ANYTHING

press any key to continue..

THEN SHE LOOKED AT THE SIDES OF THE WELL
AND NOTICED THAT THEY WERE FILLED WITH CUPBOARDS AND BOOKSHELVES
HERE AND THERE SHE SAW MAPS AND PICTURES HUNG UPON PEGS
SHE TOOK DOWN A JAR FROM ONE OF THE SHELVES AS SHE PASSED
IT WAS LABELLED ORANGE MARMALADE
BUT TO HER GREAT DISAPPOINTMENT IT WAS EMPTY
SHE DID NOT LIKE TO DROP THE JAR FOR FEAR OF KILLING SOMEBODY
SO MANAGED TO PUT IT INTO ONE OF THE CUPBOARDS AS SHE FELL PAST IT

press any key to continue..
```

Problem 3 - Magic Squares

A magic square is an arrangement of numbers in a square, such that all rows, all columns and both diagonals add to the same magic sum. The 3x3 magic square is the most popular. One interesting property of a 3x3 magic square is that the center number always corresponds to 1/3 the magic sum. Some examples:

8	1	6
3	5	7
4	9	2

5	6	-5
-8	2	12
9	-2	-1

8	19	15
21	14	7
13	9	20

Consider (1,1) the x and y values of the upper left corner, (1,3) the upper right corner and (3,3) the bottom right corner.

DATA31 (DATA32 for the second try) contains five sets of data, the contents of three squares in each set: Then the first line of each set will contain the contents of the center square. The second and third line the x and y values respectively of the second square, followed on the fourth line by the contents of the second square. The next three lines similarily will specify the third known square.

The data of these files will always yield a unique solution.
Write a program that will print the five completed squares as in the sample below:

SAMPLE INPUT | **SAMPLE OUTPUT**

```
SAMPLE INPUT     SAMPLE OUTPUT
 5      1           7      6      2
 1      0           0      5     10
 1      3           8      4      3
 7      3                          the magic sum is 15
 1      1          10      7     10
 2      1           9      9      9
 6      3           8     11      8
 9      4                          the magic sum is 27
 1      4           1     33      5
 2      3          17     13      9
 7      2          21     -7     25
 3      1                          the magic sum is 39
 3      3          -1     -3      4
 8      3           5      0     -5
13      5          -4      3      1
 2                                 the magic sum is 0
 3                  3      7      2
 9                  3      4      5
 1                  6      1      5
 1                                 the magic sum is 12
```

Problem 4 - the World of Wobits

Wobits are a cedentary race of beings that live on a 10x10 grid. Each square on the grid can potentially house a Wobit, but never more than one at a time. A wobit invariably lives there for 8 years

If a square is empty, and there is at least one male between the ages of 2 and 6 inclusive, and at least one female between the ages of 2 and 4 inclusive in any of the 8 adjacent squares, then a new wobit will be born there. The new wobit will be a male, if the adult female population is larger than the adult male population. The new wobit will be a female otherwise. Note that when the numbers balance, the newborn will be female.

In any given year, births will take place at the start of the year, and deaths of all 8-year olds will take place at the end of the year.

Note that (1,1) corresponds to the upper left square. (1,10) the upper right square, and (10,10) the lower right square)

Let's examine in detail the first set of the sample data (next page):

> We must find the situation at the end of the 7th year.
> At the start there is a 2-year old female in location (1,3) and a 2-year old male in location (2,2). The two will produce offspring at the start of year 1 in (1,2) and (2,3), at age 3. Note that both original parents die in year 6, leaving three generations of wobits: the two females born in year 1; the four males born in year 3 and the two females born in year 5. Note that in year 7 the spot vacated by the first male (2,2) cannot be filled, since the two neighbouring females there are both 6 years old.

at the start   end of year 1   end of year 2   end of year 3

end of year 4   end of year 5   end of year 6   end of year 7
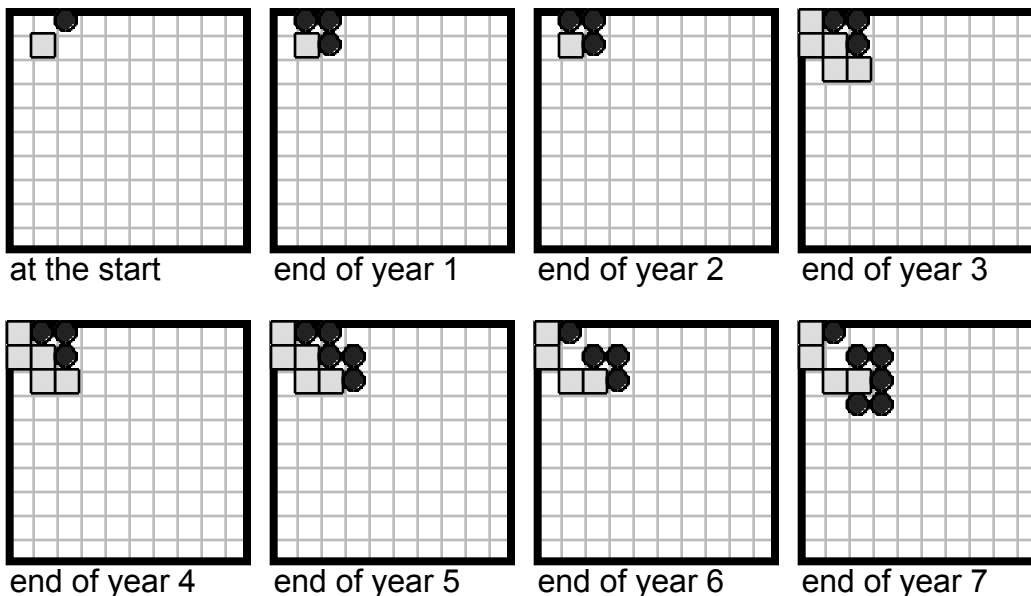
DATA41 (DATA42 for the second try) will contain five sets of 7 lines, the first line contains n, the number of years that will pass before taking a look (a positive number). The next three lines contain the x and y values respectively of the female and her age. The final three lines contain the x and y values of the male and his age.

Write a program that will simulate the world of Wobits, and that prints out for each of the five cases, the world as it exists at the end of year n.

Let the female wobits be represented by dark circles, and the male wobits by light squares, or, in text mode, represent the 10x10 space by dots , the females by O's and the males by X's. Both options are illustrated below: Choose one or the other: not both.

SAMPLE INPUT   **SAMPLE OUTPUT** (choose text mode or graphics, not both)
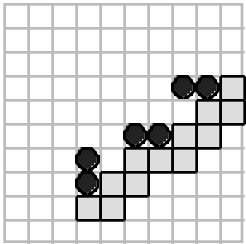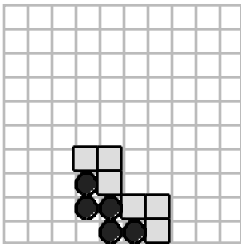
SAMPLE INPUT:
```
7
1
3
2
2
2
2
8
3
3
2
3
4
1
12
5
6
2
5
7
2
7
10
4
2
8
6
2
7
5
10
3
6
8
2
```

(1)
```
X O . . . . . . . .
X . O O . . . . . .
. X X O . . . . . .
. . O O . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
```
press any key to continue

(2)
```
. . . X X . . . . .
. . O O X . . . . .
. . . . X . . . . .
. . O O X . . . . .
. . . X X . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
. . . . . . . . . .
```
press any key to continue

(3)

press any key to continue

(4)

press any key to continue

(5)

press any key to continue

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Computer Science Department
University of Westen Ontario

April 3rd 2004

Problem 1- For the Birds

In the land of Diophantasia money has not been invented yet, and people buy and sell using lifestock. A hog costs 5 birds, a donkey costs 7 birds but a ox 19 birds and a camel 79 birds. Recently birds have been banned from the kingdom, and so it is no longer easy to trade in Diopantasia. A merchant wants to buy goods worth 2000 birds. Furthermore he wants to find the least number of animals to pay for the merchandize.

According to the sample solution, below, he must pay for his goods with 30 animals: 5 hogs and 25 camels.

DATA11 (DATA12 for the second try) contains data on 25 lines: 5 sets of 5 positive integers. They represent the value in birds of a hog, donkey, ox and camel respectively and the value of the goods the merchant wishes to buy.

Write a program that will find the least number of animals that will be equal to the value of the goods the merchant wants to trade.

SAMPLE INPUT: (25 integers, one on each of 25 lines)

5	43	2500	29
7	53	7	83
19	3000	13	89
79	7	23	5000
2000	29	41	
11	11	4500	
13	71	3	

SAMPLE OUTPUT:

```
hog = 5, donkey = 7, ox = 19, camel = 79, goods = 2000
the cost is 30 animals: 5 hogs, 0 donkeys, 0 oxen, 25 camels


hog = 11, donkey = 13, ox = 43, camel = 53, goods = 3000
the cost is 60 animals: 0 hogs, 0 donkeys, 18 oxen, 42 camels


hog = 7, donkey = 29, ox = 11, camel = 71, goods = 2500
the cost is 40 animals: 4 hogs, 2 donkeys, 0 oxen, 34 camels


hog = 7, donkey = 13, ox = 23, camel = 41, goods = 4500
the cost is 112 animals: 0 hogs, 2 donkeys, 2 oxen, 108 camels


hog = 3, donkey = 29, ox = 83, camel = 89, goods = 5000
the cost is 58 animals: 0 hogs, 0 donkeys, 27 oxen, 31 camels
```

Problem 2 - T-cells

Consider a rectangular array of characters. The array consists of periods (.) and upper case X's. The X's form clusters, and represents various shapes or cells found in a blood sample on a technician's slide. One of these shapes are arrangements of 5 X's that form the letter "T", the T-cell. These cells have 4 different orientations:

```
XXX      X      X            X
 X       X      XXX      XXX
 X      XXX      X            X
```

Any X is considered part of a shape, when it touches that shape with one of its four sides. Any X, that touches the shape with one corner only, is not part of the shape.

DATA21 (DATA22 for the second try) contains 5 sets of data. Each set is composed of two numbers representing the length, x and width, y of an array of characters, which follows in the form of x lines of length y. Note that x and y are each 80 or less.

Write a program that counts and prints the number of T-cells that are to be found in the array.

SAMPLE INPUT (only 3 of 5 sets of data shown):

```
25                              5
20                              10
X..XX......XXXXX.XXX             XXX..X.XXX
XXX....XXX....XXX.X.             .XXX.X..X.
X....XXX....X...X.X.             X...XXX.X.
......X.X.XXX....X..             XX.....X..
......X.X...X.......             XXX...XXX.
......XXX.X.........             12
.XXXX......XXX......             30
..X........X.......             ..............................
..X...........XXXX..             ...X.X........................
...................             XXXX.XXX......................
.................X             ...X.X........................
..XXXX.....XXXX..XXX             ......XXXXXXXXXXXXXXXXXXXX....
..XXXX.....XXX....X             ...XXXXXXXXXXXXXXXXX........
...XX...X.X.........             ............XXX..............
.....XXX.X.XXX.....             ...............X.............X.
.......X.X..X..X...             ...............X.............X.
..XXXX......X..X...             ......X..................XXX
........XXXX..XXX..             ......X......................X.
...................             .....XXXX...................X.
.XXX...............
..X................
..X................
X................X.
XXX...XXX........X.
X......X........XXX
```

SAMPLE OUTPUT (only 3 of 5 sets of data:)
```
There are 12 T-cells on slide #1
There are  2 T-cells on slide #2
There are  1 T-cells on slide #3
```

Problem 3 - Rotating Cipher

The rotating cipher is a secret code that goes as follows:

(A)

1   the message is written using capital letters only, and spaces, all other characters are removed.

2   replace all spaces by the period (.)

3   replace all double letters with the single letter and the @ character. For example, HELLO would become: HEL@O

(B)

1   perform the three instructions from (A) with the keyword or keyphrase also

2   fill the 4x7 chart (see example) with the characters, in order, of the keyword, taking care to ignore all duplicate occurences of the characters

3   fill the rest of the chart with the remaining characters, in order of occurence in the string: "@ABCDEFGHIJKLMNOPQRSTUVWXYZ."

(C)

1   substitute the first letter with the letter you find above the one in the chart. If the letter is in the top row, use the letter in the same column from the bottom row.

2   substitute the second letter with the letter you find to the left of the one in the chart. If the letter is in the leftmost column, use the letter in the right most column that is in the same row instead

3   substitute the third letter with the letter you find below the one in the chart. If the letter is in the bottom row, use the letter in the same column from the top row.

4   substitute the fourth letter with the letter you find to the right of the one in the chart. If the letter is in the rightmost column, use the letter in the leftmost column that is in the same row instead

5   repeat instructions 1,2,3,4 for each of the next sets of four characters.

Example:

The chart below is constructed using the key phrase: MARY HAD A LITTLE LAMB. Notice that the key phrase used up the first 13 letters of the chart; note the double T of LITTLE; and note that repeating letters are dropped, as the letters are entered in the chart:

Let's encode the short message: "Hello John"

Instructions A will prepare the message to say: "HEL@O.JOHN"

the H is replaced by the X "above" the H in the chart
the E is replaced by the @ "left"
the L is replaced by the F "below"
the @ is replaced by the E "right"
the O is replaced by the B "above"
the . is replaced by the Y "left"
the J is replaced by the U "below"
the O is replaced by the P "right"
the H is replaced by the X "above"
the N is replaced by the K "left"

M	A	R	Y	.	H	D
L	I	T	@	E	B	C
F	G	J	K	N	O	P
Q	S	U	V	W	X	Z

"Hello John" will therefore be in code: "X@FEBYUPXK"

Note: If one line does not contain a multiple-of-4 letters, the rotation carries through to the next
            line, as in the 3rd sample's output

The above instructions tell you how to **ENCODE** a message.
It is your job to **DECODE** a message, given the encoded message and the keyword or
keyphrase. Note that the keyword or keyphrase may be in lower case, and may contain
spaces and double letters. Print each decoded message separately on a cleared screen
or window, and let the user press any key to see the next result.

DATA31 (DATA32 for the second try) contains 5 sets of data. The first line of each set
contains the key phrase or word, possibly in lower case letters. The last line contains three
stars (***). The lines in between contain the encoded message using the 28 characters of
the chart. There are never more than 10 lines in the message, and each line contains 100
characters or less.

SAMPLE INPUT (3 of 5 sets of data only):

```
Canada
GZFNWCIN
G.YUNMUCTCH@TAGMDULUECH@
***
thy sons
QQYFVMIHIGEHVKEWOYRTV@WAVNA.V.ETWYKNEFITS
***
true north
KGH@XPXTKGDIXFBBSORNKUCVWHCRTUINSGR.X
OG.XO@EWEDTSOGNIO@TYPCBYCCHSUIN
OTFPXDJUX@DFXVSFWE
FN.@DBN@CXWERRU.MNZ.CIV@@FXDFUXOG.RE
***
```

SAMPLE OUTPUT:

```
O CANADA
OUR HOME AND NATIVE LAND

press any key to continue..

TRUE PATRIOT LOVE IN ALL THY SONS COMMAND

press any key to continue..

WITH GLOWING HEARTS WE SEE THEE RISE
THE TRUE NORTH STRONG AND FREE
FROM FAR AND WIDE
O CANADA WE STAND ON GUARD FOR THEE

press any key to continue..
```

Problem 4 - Crown Swap

Kings of the neigbouring countries of Arbos, Botor, Carpol, Dovis, Etham, Fastock and Gorbor swap crowns during the spring festival. The magicians of the seven countries in a complex game draw a set of cards each containing one pair of kingdoms. Each card represents a crown swap that must take place between the two kingdoms.
There are 21 cards: (AB), (AC), (AD),...,(BC), (BD), ..., (CD), (CE),..., (FG)

The magicians select a subset of the 21 cards, anywhere from 1 to 21
These swaps can almost always be simplified.

For example (AB)(BC)(CD)(AC) means effectively that
A's crown goes to D (via B and C)
B's crown goes to C (via A)
C's crown goes to B
D's crown goes to A (via C)
The whole thing could therefore be simplyfied to: (AD)(BC)

Sometimes one king might get his own crown back, such as the king of Arbos here:
(AB)(BC)(AC) simplifies to: (BC)

Sometimes, the swap becomes a three-way swap, or more:
(AB)(BC) becomes (ACB) ,
that is: A's crown goes to C, C's crown goes to B, and B's crown goes to A

Note, that (AB) could equally have been written as (BA), and (ACB) could be written as (CBA) or (BAC), however, by convention, the magicians always start the sequence with the lowest letter of the alphabet.

DATA41 (DATA42 for the second try) contains 5 lines of data containing up to 21 swaps each. Write a program that will simplify the swaps as described above

SAMPLE INPUT:
```
(AB)(DE)(EF)(AD)(AF)(CE)
(AB)(EF)(BE)(AC)(AD)(DE)(AG)(DF)
(AC)(DF)(AE)(AD)(AF)(CE)(AB)(DE)(BD)(AG)(CE)(DG)(BF)
(CD)(AD)(AF)
(CE)
```

SAMPLE OUTPUT:
```
(ABD)(CEF)
(AFBCEDG)
(AFBDG)(CE)
(ADCF)
(CE)
```

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May 1, 2004

Problem 1 - Symmetry

Consider a rectangular array of characters containing various shapes formed by a given letter (See for example the back of this page).

The center of gravity of a two dimensional shape may be found, by first finding the horizontal line that divides the area in two equal parts, and next the vertical line which does the same. The center of gravity is then the point of intersection of the two lines.

DATA11 and DATA12 are two data files, each with a rectangular array of characters. The array containing 5 shapes formed from the first 5 letters of the alphabet. Line 1 contains the height (h, a number between 1 and 50) and line 2 contains the width (w, a number between 1 and 100) of the array of characters. After line 2 there follow h lines containing w characters each. The period (.) fills in the empty spaces around each shape. Let's name the top left character (1,1), the top right character (w,1) and the bottom left character (1,h).

Since the shapes are formed of letters, the center of gravity will naturally fall somewhere on a line of characters, or exactly between two of the lines. If it falls somewhere **on** a line, the x or y value for the center will be considered whole numbers. If x or y falls **between** two lines, then their values will be the average of the two lines. If the horizontal line dividing the area in two falls between lines 6 and 7 for example, then the y-value will be taken as 6.5

Consider shape A (below). It contains 120 letters. there are 60 letters to the left of vertical line 23 and including line 23, There are 60 letters to the right of vertical line 24 including line 24. We then say that the x-value of the center of gravity is 23.5.

On the other hand, there are 58 letters of shape A above line 11 and 58 letters of shape A below line 11. Since both sums are less than half of 120, the center lies somewhere on line 11 and we say that the y-value of the center is 11.

Similarily, shape D contains 9 character, and 2 of these characters lie to the left of vertical line 23 and 4 lie to the right of line 23. Since both 2 and 4 are less than half of 9, the center lies somewhere on line 23, and we say that the x-value of the center of gravity is 23.

Write a program that will examine each shape and find the center of gravity of each. State furthermore, if the shape is symmetric about a horizontal line and if it is symmetric about a vertical line.

Make your output similar to the sample output on the next page.

Sample Input:

```
18
50
......................AA...........................
....EEEE...........AAAAAA................BB.....
....EEEEEEEEE........AA.................BB.....
.......EEEEE........AA.................BB.....
........E...........AA.................BB.....
....................AAAA................BB.....
..................AAAA..AAAA............BBBB....
................AAA.......AAA...........BBBB....
..............AAA..CCCCCCCC..AAA...........BB.....
.......AAAAAAAAAA..C.DDD..C..AAAAAAAAAA....BB.....
.......AA..........C..DDD.C..........AA....BB.....
.......AAAA........C.DDD..C........AAAA....BB.....
.........AAA......CCCCCCCC.......AAA......BB.....
.........AAAAAAAAAAAAAAAAAAAAAAAAA.............
....................AAAA........................
....................AA..........................
...................AAAAAA.......................
..................AAA....AAA....................
```

Sample Output:

```
The centre of gravity of shape A is: (23.5,11)
   It is symmetric about the vertical line
   It is not symmetric horizontally

The centre of gravity of shape B is: (44.5,7.5)
   It is symmetric about the vertical line
   It is symmetric about the horizontal line

The centre of gravity of shape C is: (23.5,11)
   It is symmetric about the vertical line
   It is symmetric about the horizontal line

The centre of gravity of shape D is: (23,11)
   It is not symmetric vertically
   It is symmetric about the horizontal line

The centre of gravity of shape E is: (9,3)
   It is not symmetric vertically
   It is not symmetric horizontally
```
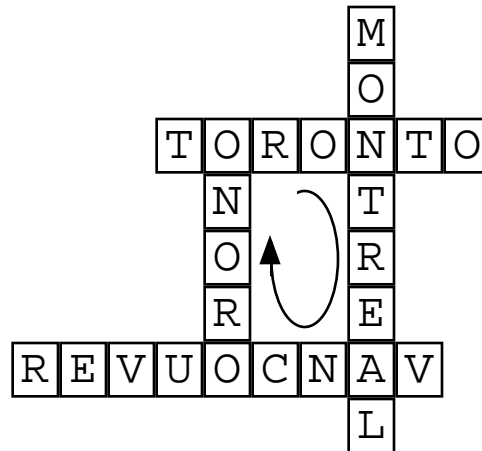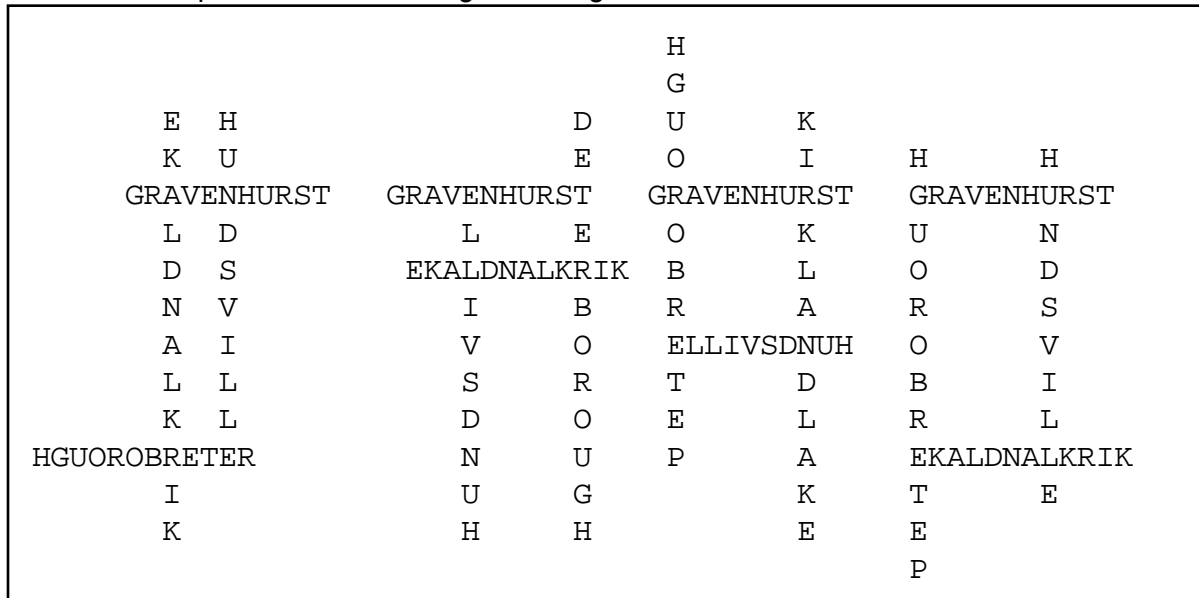
Problem 2 - Crossword

You will be given four words, which can form a rectangle, where word #1 crosses word #2, word #2 crosses word #3, word #3 crosses word #4 and finally word #4 crosses word #1.
The words MONTREAL, ORONO, TORONTO and VANCOUVER can form such an arrangement:

Note as well, that the top word is spelled from left to right; the right word from top to bottom; the bottom word from right to left; and the left word from bottom to top.
Often the solution is not unique, and so the third set of four words in the sample on the next page could for example form the following 4 rectangles. ANY one of these solutions would be valid.

```
                                        H
                                        G
          E   H               D    U         K
          K   U               E    O         I      H         H
       GRAVENHURST         GRAVENHURST     GRAVENHURST     GRAVENHURST
          L   D               L    E         O    K        U         N
          D   S            EKALDNALKRIK      B    L        O         D
          N   V               I    B         R    A        R         S
          A   I               V    O      ELLIVSDNUH       O         V
          L   L               S    R         T    D        B         I
          K   L               D    O         E    L        R         L
     HGUOROBRETER              N    U         P    A     EKALDNALKRIK
          I                    U    G              K        T         E
          K                    H    H              E        E
                                                            P
```

DATA21 (DATA22 for the second try) contains 20 words representing 5 sets of 4 words. Write a program that finds one of the rectangular arrangements for each set and print them on the screen, one set at a time on a cleared window. Present each new solution after pressing a key.

Note that efficiency may be a factor: All five solutions together should take no longer than 30 seconds to complete.

Sample Input data

```
NORFORK
SCARBOROUGH
SUDBURY
THUNDERBAY
ELLIOTLAKE
HAMILTON
KINGSTON
LENNOX
GRAVENHURST
HUNDSVILLE
KIRKLANDLAKE
PETERBOROUGH
HEARST
NORTHBAY
SARNIA
WATERLOO
GUELPH
HAMILTON
KITCHENER
LEAMINGTON
```

Sample Output

```
        S
        C
        A
        R
     Y  B
   NORFORK
     U  R
     B  O
 YABREDNUHT
     U  G
     S  H


press any key to continue..
```

```
      N
      O H
 ELLIOTLAKE
      S M
      G I
   XONNEL
      I T
      K O
        N


press any key to continue..
```

```
 H         H
 GRAVENHURST
 U         N
 O         D
 R         S
 O         V
 B         I
 R         L
 EKALDNALKRIK
 T         E
 E
 P


press any key to continue..
```
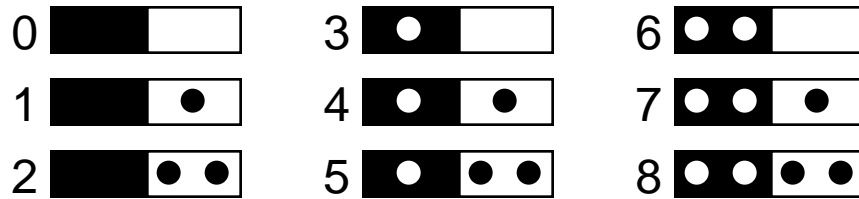
```
        N
        O
        R
    HEARST
     I  H
     N  B
 OOLRETAW
     A  Y
     S


press any key to continue..
```

```
 N
 O
 T
 GUELPH
 N       A
 I       M
 M       I
 A       L
 RENEHCTIK
 L       O
         N


press any key to continue..
```

Problem 3 - Tetrominoes

```
0 ██ ▢     3 █● ▢     6 ●● ▢
1 ██ ▢●    4 ●█ ▢●    7 ●●▢●
2 ██ ▢●●   5 ●█ ▢●●   8 ●●▢●●
```

Tetrominoes are dominoes with only a 0, 1 or 2 on the side. One side is black, and one side white. In a game each person is given an equal amount of tetromino stones and is challenged to make the largest chain possible. However, each stone in a chain is connected to another stone so that their values match. As well, only a black side may touch a white side. Finally, one must start with the first stone received.

Tetrominoes may be thought of as representing two-digit numbers in base 3, where the white side represents the units (right) digit and the black side the triples (left) digit .
The tetrominoes 00, 01, 02, 10, 11, 12, 20, 21, 22 are represented by the decimal digits 0, 1, 2, 3, 4, 5, 6, 7, 8 respectively.

DATA31 (DATA32 for the second try) contains 5 strings of numbers from 0 to 8 representing tetrominoes. No string contains more than 20 tetrominoes.

Write a program that constructs the largest possible chain of tetrominoes. There may be several different chains that contain the greatest number of tetrominoes, and so any one of these is a valid solution.

Note that efficiency may be a factor: All five solutions together should take no longer than 30 seconds to complete.

One possible solution to the first sample question is given as:
```
●● ▢   █ ▢   █ ▢   █ ▢●●  ●●▢   █ ▢●●  ●●▢●●
```
represented by: `-20-00-00-02-20-02-22-`

Your output should list the chain of tetrominoes in base 3, separated by the minus sign, -, as in the sample below, and the length of the chain.

Sample Input:

```
6600224258
25682688277044118162
217771260432074842
15668422
1170250003341331
```

Sample Output:

```
-20-00-00-02-20-02-22- has length 7
-02-20-00-02-20-02-20-02-21-11-11-12-22-22-22-22-21- has length 17
-02-20-00-00-02-21-10-02-22-21-11-11-11- -- has length 13
-01-11-12-20-02-20-02-22- has length 8
-01-10-00-00-00-00-01-10-01-10-01-10-02-21-11-12- has length 16
```

Problem 4 - Magic Triangles

A magic triangle is a triangle made up of 9 numbers arranged 4 numbers to each side, so that the 4 numbers along each side add to the same magic number.
Here for example is a triangle with the magic sum of 196.
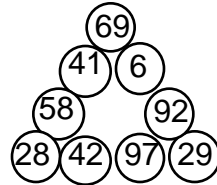
DATA41 (DATA42 for the second try) contains 45 positive integers< 1000, representing 5 sets of 9 numbers. Write a program that will print each set in a magic triangle as illustrated in the sample below. There is at least one solution for each set of numbers in the file. Find the solution that has the largest possible magic sum.

Note that any solution may have many variations: The triangle may be rotated, flipped and the numbers on the same side that are not in a vertex may be switched.
To eliminate some variations, orient the triangle in such a way, that the largest vertex is on top and the smallest vertex is bottom left.

Sample Input   **Sample Output**


```
97    66                         69                                    78

92    60

69    57              41          6                      60          86

58    52

42    73         58                 92                83                52

41    72

29    62     28        42        97        29        66        57        93        71

28    57

6     50     the magic total = 196          the magic total = 287

93    28     press any key to continue..    press any key to continue..

77    26

64    18                 77                                    57

53    7

46                  5         53                      18          7

44

14              64                 14                73                62

7

5            44        7        93        46        28        26        72        50

90

80           the magic total = 190          the magic total = 176

72           press any key to continue..

53                       90                      press any key to continue..

42

40                  40        8

39

37              42                 72

8

93           37        53        80        39

86

83           the magic total = 209

78           press any key to continue..

71
```