Contest: OCT09 **GOLD** Division

# ANALYSIS MODE
## Submit solutions for your own enjoyment.

```
*************************************************************************
                              GOLD PROBLEMS
*************************************************************************
                   Nine problems numbered 1 through 9
*************************************************************************
```

Problem 1: Even? Odd?   [25 points] [Rob Kolstad, 2009]

Bessie's cruel second grade teacher has assigned a list of N (1 <= N <= 100) positive integers I (1 <= I <= 10^60) for which Bessie must determine their parity (explained in second grade as "Even... or odd?"). Bessie is overwhelmed by the size of the list and by the size of the numbers. After all, she only learned to count recently.

Write a program to read in the N integers and print 'even' on a single line for even numbers and likewise 'odd' for odd numbers.

POINTS: 25

PROBLEM NAME: evenodd

INPUT FORMAT:

* Line 1: A single integer: N

* Lines 2..N+1: Line j+1 contains I_j, the j-th integer to determine
        even/odd

SAMPLE INPUT (file evenodd.in):

```
2
1024
5931
```

INPUT DETAILS:

Two integers: 1024 and 5931

OUTPUT FORMAT:

* Lines 1..N: Line j contains the word 'even' or 'odd', depending on
        the parity of I_j

SAMPLE OUTPUT (file evenodd.out):

```
even
odd
```

OUTPUT DETAILS:

1024 is eminently divisible by 2; 5931 is not

```
*************************************************************************

Problem 2: The Robot Plow [25 points] [Rob Kolstad (traditional), 2009]

Farmer John has purchased a new robotic plow in order to relieve
him from the drudgery of plowing field after field after field. It
achieves this goal but at a slight disadvantage: the robotic plow
can only plow in a perfect rectangle with sides of integer length.

Because FJ's field has trees and other obstacles, FJ sets up the
plow to plow many different rectangles, which might end up overlapping.
He's curious as to just how many squares in his field are actually
plowed after he programs the plow with various plow instructions,
each of which describes a rectangle by giving its lower left and
upper right x,y coordinates.

As usual, the field is partitioned into squares whose sides are
parallel to the x and y axes. The field is X squares wide and Y
squares high (1 <= X <= 240; 1 <= Y <= 240). Each of the I (1 <= I
<= 200) plow instructions comprises four integers: Xll, Yll, Xur,
and Yur (1 <= Xll <= Xur; Xll <= Xur <= X; 1 <= Yll <= Yur; Yll <=
Yur <= Y) which are the lower left and upper right coordinates of
the rectangle to be plowed. The plow will plow all the field's
squares in the range (Xll..Xur, Yll..Yur) which might be one more
row and column than would initially be assumed (depending on how
you go about your assumptions, of course).

Consider a field that is 6 squares wide and 4 squares high. As FJ
issues a pair of plowing instructions (shown), the field gets plowed
as shown by '*' and '#' (normally plowed field all looks the same,
but '#' shows which were most recently plowed):

    ......           **....           #####.
    ......  (1,1)(2,4) **....  (1,3)(5,4) #####.
    ......           **....           **....
    ......           **....           **....

A total of 14 squares are plowed.

POINTS: 25

PROBLEM NAME: rplow

INPUT FORMAT:

* Line 1: Three space-separated integers: X, Y, and I

* Lines 2..I+1: Line i+1 contains plowing instruction i which is
        described by four integers: Xll, Yll, Xur, and Yur

SAMPLE INPUT (file rplow.in):

6 4 2
1 1 2 4
1 3 5 4

INPUT DETAILS:

As in the task's example.

OUTPUT FORMAT:

* Line 1: A single integer that is the total number of squares plowed

SAMPLE OUTPUT (file rplow.out):
```

```
14

*************************************************************************

Problem 3: Barn Echoes [50 points] [Traditional, 2009]

The cows enjoy mooing at the barn because their moos echo back,
although sometimes not completely. Bessie, ever the excellent
secretary, has been recording the exact wording of the moo as it
goes out and returns. She is curious as to just how much overlap
there is.

Given two lines of input (letters from the set a..z, total length
in the range 1..80), each of which has the wording of a moo on it,
determine the greatest number of characters of overlap between one
string and the other. A string is an overlap between two other
strings if it is a prefix of one string and a suffix of the other
string.

By way of example, consider two moos:

    moyooyoxyzooo
    yzoooqyasdfljkamo

The last part of the first string overlaps 'yzooo' with the first
part of the second string. The last part of the second string
overlaps 'mo' with the first part of the first string. The largest
overlap is 'yzooo' whose length is 5.

POINTS: 50

PROBLEM NAME: echo

INPUT FORMAT:

* Lines 1..2: Each line has the text of a moo or its echo

SAMPLE INPUT (file echo.in):

abcxxxxabcxabcd
abcdxabcxxxxabcx

OUTPUT FORMAT:

* Line 1: A single line with a single integer that is the length of
        the longest overlap between the front of one string and end of
        the other.

SAMPLE OUTPUT (file echo.out):

11

OUTPUT DETAILS:

'abcxxxxabcx' is a prefix of the first string and a suffix of the second
string.

*************************************************************************

Problem 4: Papaya Jungle [80 points] [Rob Kolstad, 2009]

Bessie has wandered off the farm into the adjoining farmer's land.
He raises delicious papaya fruit, which is a delicacy for cows. The
papaya jungle is partitioned into a grid of squares with R rows and
```

C columns (1 <= R <= 40, 1 <= C <= 40), as is popular in Wisconsin.
Bessie can travel from a given square to any existing adjacent
square whose route is parallel to the X or Y axis.  So in the
following diagram, if Bessie is at the square labeled "B", she can
travel to any of the squares labeled "T":

```
      .T.
      TBT
      .T.
```

Bessie always starts out by munching the papayas in square
(row=1,col=1).  After she's done with one square, Bessie always
uses her trusty binoculars to count the low-hanging fruit in each
of the adjacent squares. She then always moves to the square with
the most visible uneaten fruit (a square that happily is always
unique).

Sooner or later, following this rule, Bessie always ends up in
square (R,C) and eats the fruit there.

Given the dimensions of the papaya jungle and the amount of fruit
$F_{ij}$ in each square (1 <= $F_{ij}$ <= 100), determine the total number
of fruit Bessie consumes for a given papaya jungle.

POINTS: 80

PROBLEM NAME: papaya

INPUT FORMAT:

* Line 1: Two space-separated integers: R and C

* Lines 2..R+1: Line i+1 describes row i of the jungle with C
        space-separated integers that tell how many fruit are in each
        square: $F_{i1}$, $F_{i2}$, ..., $F_{iC}$

SAMPLE INPUT (file papaya.in):

```
3 4
3 3 4 5
4 5 3 2
1 7 4 2
```

INPUT DETAILS:

Three rows; four columns. Bessie starts in upper left corner at the '3'.

OUTPUT FORMAT:

* Line 1: A single integer that is the total number of papayas that
        Bessie eats by the time she finishes off the papayas at the
        barn in the lower right corner at coordinate (R,C).

SAMPLE OUTPUT (file papaya.out):

```
39
```

OUTPUT DETAILS:

Bessie eats the papayas in the order given by the letters next to the
numbers below:

```
      (1,1) ---> (1,C)
(1,1) 3a   3   4g  5h  (1,C)
  |   4b   5c  3f  2i    |
```

```
(R,1) 1   7d  4e  2j  (R,C)
      (R,1) ---> (R,C)
```

She declines to eat 4 of the papayas but consumes 39 (visiting all
but two squares of the grid).

```
************************************************************************
```
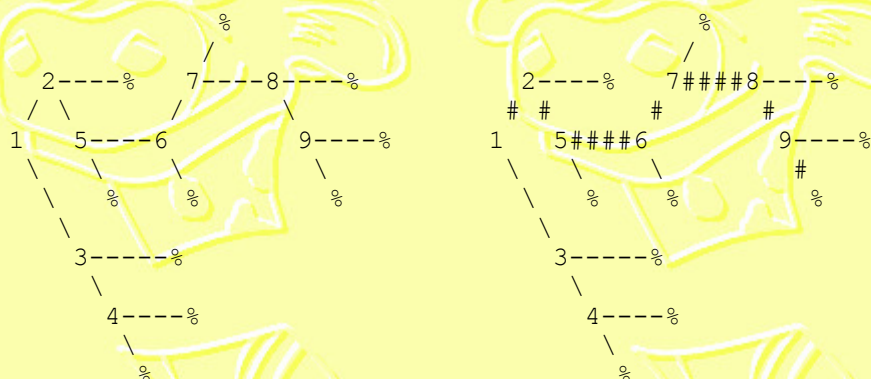
Problem 5: The Leisurely Stroll [100 points] [Rob Kolstad (traditional), 2009]

Bessie looks out the barn door at the beautiful spring day and
thinks to herself, "I'd really like to enjoy my walk out to the
pastures for the tender spring grass." She knows that once she
leaves the barn, she will traverse a path for a while, take one of
two choices that lead to other paths, follow one of them, take one
of two other choices, and continue on until the path leads to a
verdant pasture.

She decides to make the set of path choices that enables her to
walk over the greatest number of cow paths on her way to breakfast.
Given the description of these paths, determine how many cow paths
she traverses, presuming that she commences choosing various paths
as soon as she leaves the barn.

The farm has P (1 <= P <= 1,000) pastures that are lead to by P-1
choice-nodes (range 1..P-1) connected by paths. From the barn (which
is node 1), only one set of path traversals exists to reach any
choice-node or pasture.

Consider this set of paths (lines), pastures ('%'), and the highlighted
('#') route to a pasture on the right:

```
            %                            %
           /                            /
     2----%   7----8----%         2----%   7####8----%
    / \      /         \          # #      #         #
   1   5----6         9----%     1   5####6         9----%
    \   \    \         \          \   \    \         #
     \   %    %         %          \   %    %         %
      \                             \
       3-----%                       3-----%
        \                             \
         4----%                        4----%
          \                             \
           %                             %
```

The pasture reached from choice-node 9 is one of two that enable
Bessie to traverse seven different cowpaths on the way to breakfast.
These are the 'furthest' pastures from node 1, the barn.

Three integers describe each node: Cn, D1, and D2. Cn is the
nodenumber (1 <= Cn <= P-1); D1 and D2 are the destinations from
that node (0 <= D1 <= P-1; 0 <= D2 <= P-1). If D1 is 0, the node
leads to a pasture in that direction; D2 has the same property.

POINTS: 100

PROBLEM NAME: stroll

INPUT FORMAT:

* Line 1: A single integer: P

* Lines 2..P: Line i+1 contains three space-separated integeres that

```
        describe a choice-node: Cn, D1, and D2

SAMPLE INPUT (file stroll.in):

10
7 8 0
5 0 6
9 0 0
6 0 7
3 4 0
2 5 0
8 0 9
4 0 0
1 2 3
```

INPUT DETAILS:

This input describes the example farm layout in the task description.

OUTPUT FORMAT:

* Line 1: A single integer that is the largest number of paths Bessie
       can traverse on the way to the furthest pasture.

SAMPLE OUTPUT (file stroll.out):

7

OUTPUT DETAILS:

1-2-5-6-7-8-9-P is one of the longest routes.

************************************************************************

Problem 6: Invasion of the Milkweed [125 points] [Rob Kolstad, 2009]

Farmer John has always done his best to keep the pastures full of
luscious, delicious healthy grass for the cows. He has lost the
battle, though, as the evil milkweed has attained a foothold in the
northwest part of his farm.

The pasture, as usual, is partitioned into a rectilinear grid of
height Y (1 <= Y <= 100) and width X (1 <= X <= 100) with (1,1)
being in the lower left corner (i.e., arranged as a normal X,Y
coordinate grid). The milkweed has initially begun growing at square
(Mx,My). Each week the milkweed propagates to all non-rocky squares
that surround any square it already occupies, as many as eight more
squares (both the rectilinear squares and the diagonals). After
only one week in those squares, it is ready to move on to more
squares.

Bessie wants to enjoy all the grass she can before the pastures are
taken over by milkweed. She wonders how long it can last. If the
milkweed is in square (Mx,My) at time zero, at what time does it
complete its invasion of the pasture (which, for the given input
data, will always happen)?

The pasture is described by a picture with '.'s for grass and '*'s
for boulders, like this example with X=4 and Y=3:

     ....
     ..*.
     .**.

If the milkweed started in the lower left corner (row=1, column=1),

then the map would progress like this:

```
    ....   ....   MMM.   MMMM   MMMM
    ..*.   MM*.   MM*.   MM*M   MM*M
    M**.   M**.   M**.   M**.   M**M
week  0      1      2      3      4
```

The milkweed has taken over the entire field after 4 weeks.

POINTS: 125

PROBLEM NAME: milkweed

INPUT FORMAT:

* Line 1: Four space-separated integers: X, Y, Mx, and My

* Lines 2..Y+1: Line y+1 describes row (Y+2-y) of the field with X
        characters ('.' for grass and '*' for a boulder)

SAMPLE INPUT (file milkweed.in):

```
4 3 1 1
....
..*.
.**.
```

OUTPUT FORMAT:

* Line 1: A single integer that is the week number when the milkweed
        takes over the last remaining non-boulder square of the
        pasture.

SAMPLE OUTPUT (file milkweed.out):

```
4
```

```
**********************************************************************
```

Problem 7: Allowance [250 points] [Brian Dean, 2004]

As a reward for record milk production, Farmer John has decided to
start paying Bessie a small weekly allowance.

FJ has a set of coins in N (1 <= N <= 20) different denominations,
where each denomination of coin evenly divides the next-larger
denomination.

Using the given set of coins, he would like to pay Bessie at least
some given amount of money C (1 <= C <= 100,000,000) every week.
Please help him compute the maximum number of weeks he can pay
Bessie.

POINTS: 250

PROBLEM NAME: allow

INPUT FORMAT:

* Line 1: Two space-separated integers: N and C

* Lines 2..N+1: Each line corresponds to a denomination of coin and
        contains two integers: the value V (1 <= V <= 100,000,000) of
        the denomination, and the number of coins B (1 <= B <=
        1,000,000) of this denomation in Farmer John's possession.

```
SAMPLE INPUT (file allow.in):

3 6
10 1
1 100
5 120

INPUT DETAILS:

FJ would like to pay Bessie 6 cents per week.  He has 100 1-cent coins,
120 5-cent coins, and 1 10-cent coin.

OUTPUT FORMAT:

* Line 1: A single integer that is the number of weeks Farmer John can
        pay Bessie at least C allowance

SAMPLE OUTPUT (file allow.out):

111

OUTPUT DETAILS:

FJ can overpay Bessie with the one 10-cent coin for 1 week, then pay Bessie
two 5-cent coins for 10 weeks and then pay Bessie one 1-cent coin and one
5-cent coin for 100 weeks.

*************************************************************************

Problem 8: Bessie's Weight Problem [250 points] [Rob Kolstad (traditional), 2009]

Bessie, like so many of her sisters, has put on a few too many
pounds enjoying the delectable grass from Farmer John's pastures.
FJ has put her on a strict diet of no more than H (5 <= H <= 45,000)
kilograms of hay per day.

Bessie can eat only complete bales of hay; once she starts she can't
stop. She has a complete list of the N (1 <= N <= 500) haybales
available to her for this evening's dinner and, of course, wants
to maximize the total hay she consumes. She can eat each supplied
bale only once, naturally (though duplicate weight valuess might
appear in the input list; each of them can be eaten one time).

Given the list of haybale weights W_i (1 <= W_i <= H), determine the
maximum amount of hay Bessie can consume without exceeding her limit
of H kilograms (remember: once she starts on a haybale, she eats
it all).

POINTS: 250

PROBLEM NAME: diet

INPUT FORMAT:

* Line 1: Two space-separated integers: H and N

* Lines 2..N+1: Line i+1 describes the weight of haybale i with a
        single integer: W_i

SAMPLE INPUT (file diet.in):

56 4
15
19
```

```
20
21
```

INPUT DETAILS:

Four haybales of weight 15, 19, 20, and 21. Bessie can eat as many as she
wishes without exceeding the limit of 56 altogether.

OUTPUT FORMAT:

* Line 1: A single integer that is the number of kilograms of hay that
        Bessie can consume without going over her limit.
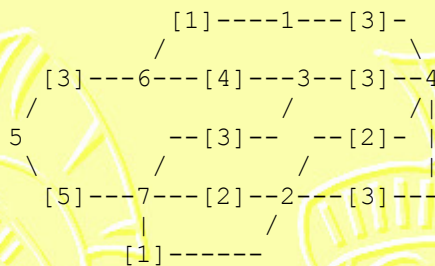
SAMPLE OUTPUT (file diet.out):

```
56
```

OUTPUT DETAILS:

Bessie can eat three bales (15, 20, and 21) and run right up to the limit
of 56 kg.

************************************************************************

Problem 9: Heat Wave [300 points] [Rob Kolstad (traditional), 2009]

The good folks in Texas are having a heatwave this summer. Their
Texas Longhorn cows make for good eating but are not so adept at
creating creamy delicious dairy products. Farmer John is leading
the charge to deliver plenty of ice cold nutritious milk to Texas
so the Texans will not suffer the heat too much.

FJ has studied the routes that can be used to move milk from Wisconsin
to Texas. These routes have a total of T (1 <= T <= 2,500) towns
conveniently numbered 1..T along the way (including the starting
and ending towns). Each town (except the source and destination
towns) is connected to at least two other towns by bidirectional
roads that have some cost of traversal (owing to gasoline consumption,
tolls, etc.). Consider this map of seven towns; town 5 is the
source of the milk and town 4 is its destination (bracketed integers
represent costs to traverse the route):

```
                    [1]----1---[3]-
                   /                \
              [3]---6---[4]---3--[3]--4
             /             /      /|
            5          --[3]--  --[2]- |
             \        /        /       |
             [5]---7---[2]--2---[3]---
              |           /
             [1]------
```

Traversing 5-6-3-4 requires spending 3 (5->6) + 4 (6->3) + 3 (3->4)
= 10 total expenses.

Given a map of all the C (1 <= C <= 6,200) connections (described
as two endpoints R1i and R2i (1 <= R1i <= T; 1 <= R2i <= T) and
costs (1 <= Ci <= 1,000), find the smallest total expense to traverse
from the starting town Ts (1 <= Ts <= T) to the destination town
Te (1 <= Te <= T).

POINTS: 300

PROBLEM NAME: heatwv

```
INPUT FORMAT:

* Line 1: Four space-separated integers: T, C, Ts, and Te

* Lines 2..C+1: Line i+1 describes road i with three space-separated
        integers: R1i, R2i, and Ci

SAMPLE INPUT (file heatwv.in):

7 11 5 4
2 4 2
1 4 3
7 2 2
3 4 3
5 7 5
7 3 3
6 1 1
6 3 4
2 4 3
5 6 3
7 2 1

INPUT DETAILS:

As in the sample map.

OUTPUT FORMAT:

* Line 1: A single integer that is the length of the shortest route
        from Ts to Te. It is guaranteed that at least one route
        exists.

SAMPLE OUTPUT (file heatwv.out):

7

OUTPUT DETAILS:

5->6->1->4 (3 + 1 + 3)

******************************************************************
```

**Submit a program for grading:** [ ]  Browse…  Submit

**To run your program with your own test data, enter the program file name and input file name then click 'Test':**

**Program File:** [ ]  Browse…

**Input File:** [ ]  Browse…   Test

**Backup a file:** [ ]  Browse…  Backup   See Backups

The following solution files are saved for grading:

| Name | Size | When | Age | Name | Size | When | Age |
|------|------|------|-----|------|------|------|-----|
| echo.c | 625 | 9h17:00 | 41h06:49 | papaya.c | 904 | 9h36:09 | 40h47:40 |
| evenodd.c | 395 | 8h48:49 | 41h35:00 | rplow.c | 613 | 9h01:55 | 41h21:54 |
| milkweed.c | 1248 | 10h16:37 | 40h07:12 | stroll.c | 778 | 9h52:11 | 40h31:38 |

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