# HKUST Programming Contest 2006 Fall

## Sponsored by Radica Systems

Date: October 1ˢᵗ, 2006
Time: 13:00 – 17:00
Venue: CS Lab 3

**Rules:**
1. Teams are ranked according to the most problems solved. Teams who solve the same number of problems are ranked by least total time. The total time is the sum of the time consumed for each problem solved. The time consumed for a solved problem is the time elapsed from the beginning of the contest to the submission of the accepted run plus 20 penalty minutes for every rejected run for that problem regardless of submission time. There is no time consumed for a problem that is not solved.
2. The correctness of each submission is judged by inputting test cases into the submitted program. The submission is regarded as correct if its output matches completely with the judge's output. The submission is judged as correct or wrong. No partial credit is given.
3. The contestants can re-submit another source code after previous wrong submissions.
4. The contestants should read the input from standard input and Print the output to standard output for all the problems.
5. The time limits for all the problems are 5 seconds.
6. The programming language to be used in this contest is C/C++. The contestants use $PC^2$ to submit their source codes to the judge and the source codes are compiled by Visual Studio 6.0.
7. The contestants are allowed to bring any hard copies of books, notes, references, dictionaries and sketch papers to the contest site. Electronic devices are forbidden.

# Problem A – Infinite Path
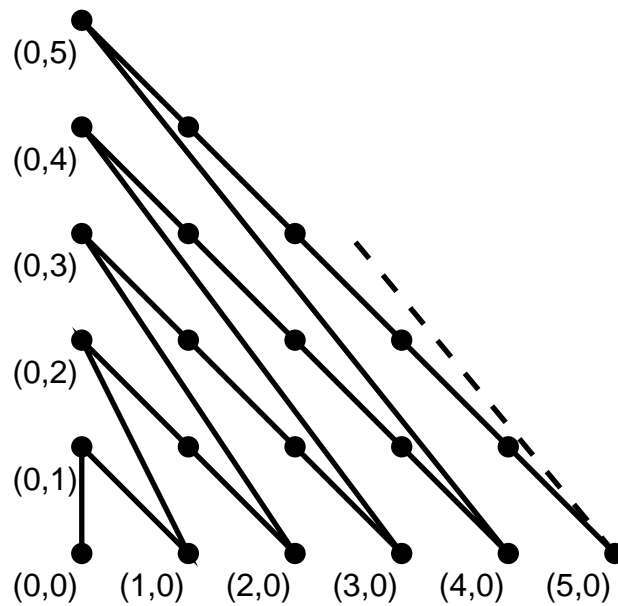


The above figure shows an infinite path starting at the origin. Given two points with non-negative integer coordinates, what is the path length between the two points on the above path?

**Input**

The input begins with an integer $N$ ($\leq 100$) which indicates the number of test cases followed. Each of the following test cases consists of four non-negative integers $x_1$, $y_1$, $x_2$, $y_2$. None of the input value is greater than 100.

**Output**

For each test case, print out the length of the subpath between $(x_1, y_1)$ and $(x_2, y_2)$ on the infinite path. Print out the answer with 3 digits after the decimal point in a single line.

**Sample Input**
```
5
0 0 0 1
0 0 1 0
2 3 3 1
99 99 9 9
5 5 5 5
```

**Sample Output**
```
1.000
2.414
10.646
54985.047
0.000
```

# Problem B – Combination and Modulo

What is the value of $\binom{n}{r}$ modulo 2?

Note 1: $\binom{n}{r}$ = nCr = the number of ways to select *r* objects from *n* distinct objects

Note 2: *x* modulo 2 is the remainder when *x* is divided by 2.

**Input**
Each test case consists of two integers *n* and *r* in a single line where $2 \leq n \leq 10^9$ and $0 \leq r \leq n$. The input is terminated by a pair of -1. There are almost 1000 test cases.

**Output**
Print out the answer in a single line for each test case.

**Sample Input**
```
6 2
10 1
1000000000 1000000
-1 -1
```

**Sample Output**
```
1
0
0
```

# Problem C – Marble Arrangement

Given the number of marbles of three different colors (red, blue, green), how many ways are there to arrange them into a line so that no two consecutive marbles share the same color?

**Input**
Each test case consists of three integers $r$, $g$ and $b$ in a single line where $0 \le r$, $g$, $b \le 7$ and $r + g + b > 0$. $r$, $g$, $b$ represent the number of red, blue, green marbles respectively. The input is terminated by a line contain three -1's. There are almost 600 test cases.

**Output**
For each test case, output the number of ways to arrange the marbles into a line so that no two consecutive marbles share the same color.

**Sample Input**
```
2 0 0
7 0 7
1 1 1
4 5 6
-1 -1 -1
```

**Sample Output**
```
0
2
6
4315
```

# Problem D – Balance Parentheses

A string of parentheses is said to be balanced if the number of '(' is equal to the number of ')' and no prefix of the string contains more ')' than '('. Given a partially filled string of parentheses, how many different strings of parentheses can be constructed by filling the remained positions?

**Input**
The input begins with an integer $N$ ($\leq 100$) which indicates the number of test cases followed. Each of the following test cases consists of string of parentheses and asterisk with length at most 30.

**Output**
For each test case, print out the number of ways to replace all the asterisks by parentheses so that the resultant string is a balanced parentheses

**Sample Input**
```
4
((
(*****)
********
(****)****
```

**Sample Output**
```
0
0
14
23
```

# Problem E – Meeting Place

Anna, Boris, Christian are three good friends and would like to gather every Sundays. Given the locations of their living places $(x_1, y_1)$, $(x_2, y_2)$, $(x_3, y_3)$, help them to find out the best place to meet such that the total traveling distance of them is minimized.

**Input**

The input begins with an integer $N$ ($\leq 100$) which indicates the number of test cases followed. Each of the following test cases consists of six integers $x_1, y_1, x_2, y_2, x_3, y_3$. None of the input value has absolute value greater than 1000.

**Output**

For each test case, print out the best meeting place with format: `(x,y)` (without quote) where `x` and `y` are two numbers with 3 digits after the decimal point.

**Sample Input**
```
4
1 1 1 1 1 2
-2 -2 3 3 1000 1000
0 0 10 0 0 10
-1 1 2 -5 8 3
```

**Sample Output**
```
(1.000,1.000)
(3.000,3.000)
(2.113,2.113)
(1.931,-0.632)
```

# Problem F – Forbidden Palindrome

A palindrome is a sequence of one or more characters that reads the same from the left as it does from the right. For example, *a*, *aba*, *bb* and *abbba* are palindromes, but *abab* is not.

In this problem, you will be given a forbidden string *s* and an integer *n*. You need to compute the number of different palindromes which satisfy the following properties:
1. Consisting of *n* characters.
2. Consisting of character *a* and *b* only.
3. Not containing the forbidden string *s* as a substring
You just need to return the answer modulo 10000.

For example, with *n* being 10, there are 32 possible palindromes. But with *s* being *abab*, the following 6 palindromes become forbidden:
***abab****aabab**a*
***abab***bbbaba*
*a****abab***babaa*
*b****abab***babab*
***abab***bbbaba*
*a****abab***babaa*
So there are only 26 valid palindromes.

**Input**
The input begins with an integer *N* (≤ 100) which indicates the number of test cases followed. Each of the following test cases consists of a string *s* and an integer *n*. *s* will be a string with length between 1 and 10 and consists of characters *a* and *b* only. *n* will be between 1 and 100.

**Output**
For each test case, print out the answer in a single line.

**Sample Input**
```
3
abab 10
abaabbbaab 9
a 100
```

**Sample Output**
```
26
32
1
```