



Computer Science Olympiad

Pennsylvania State University

Deadline: April 15, 2011

Hazleton Campus
Second Round, Spring 2011

Problem 1 [*Binary numbers*] Given a string s , containing only three different characters $\{0, 1, 2\}$. Find the beginning (the index) of all *substrings* that could be converted into *binary numbers* which value is the *maximum* in that string.

Example:

$s = "12011020011220201101202212020110121011"$

The index of the first substring: 15

The index of the second substring: 28

Input:

s // s – string consisting of only three different characters

Output:

index // The index of first substring which value is the maximum possible

index // The index of second substring which value is the maximum possible

...

Problem 2 [*Chess knight path*] Given a table of positive integers with m rows and n columns, m and n are integers, where $0 < m < 10$ and $0 < n < 10$ (Fig.1).

	0	1	2	3	4	5	6
0	S	1	20	4	3	5	19
1	2	4	5	1	12	2	11
2	25	10	3	5	11	7	5
3	6	15	2	2	4	6	29
4	22	5	15	21	8	4	26
5	23	6	16	5	25	2	13
6	14	7	10	26	12	23	E

Fig. 1. Two possible paths are:

- Red color: $5 + 3 + 7 + 2 + 4 = 21$
- Green color: $10 + 15 + 25 = 50$

	$j-2$	$j-1$	j	$j+1$	$j+2$
$i-2$				6	
$i-1$					5
i			*		
$i+1$	1				4
$i+2$		2		3	

Fig.2. The chess knight is located at (i, j) .

There are maximum six possible next moves: $(i+1, j-2)$, $(i+2, j-1)$, $(i+2, j+1)$, $(i+1, j+2)$, $(i-1, j+2)$, and $(i-2, j+1)$

The aim is to move from the upper left corner to the bottom right and to get the highest total score. The score starts at zero (*position S*), then you add all the other numbers you pass through on your way to the bottom right corner (*position E*). You are moving using a “chess knight”

(Fig.2) with the restriction that if the chess knight is located in the cell with coordinates (i, j) than the coordinates of the next position (p, q) must satisfy the condition $(p > i \parallel q > j)$.

Write a program that will calculate and output the maximum total score that is attainable on a given table. The numbers in the table are in the range $[a..b]$ and should be randomly generated, a and b - integers, $0 < a < 100$, $0 < b < 100$. In the example on Fig. 1, $m = 7$, $n = 7$, $a = 1$ and $b = 30$.

Input data:

m n a b // four integers as they are described above

Output:

The maximum total score