VG101 — Intoduction to Computers & Programming

Lab 5

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Goals of the lab

- Random Function
- Arrays and Pointers
- Recursion and Bisection Method

1 Introduction

Krystor and Frank are staying up late every night despite they still have many dues and exams this week.

Because it's the FIFA World Cup time!

They are very curious about the final result of the World Cup, so they want to simulate the matches between different countries according to their FIFA world rankings (though the rankings actually means nothing).

2 Working Flow

2.1 Estimation of Win Rate

In order to get the same answer for the same input, a random seed must be set to a fixed value. Frank chooses a number as the seed, and clarifies the match result estimate method:

He figured out a simple function about the opportunity whether Team A will beat Team B based on their rankings r_A, r_B, and $k \geqslant 0$ is an integer coefficient.

$$win\ rate = \frac{r_B + k}{r_A + r_B + 2k}$$

First generate a number with `rand`, transform it to the range [0,1), and then compare the value with the win rate. If the random value is no more than the win rate, then Team A wins, otherwise, Team B wins. There are no draws in the finals of FIFA World Cup.

Note that once a seed is set, the order of random numbers are fixed, so you must carefully follow the random number generation order to be accepted on JOJ.

2.2 Tree structure

The match map of the FIFA World Cup is usually in a tree view, such as one of an estimation shown in Figure 1.

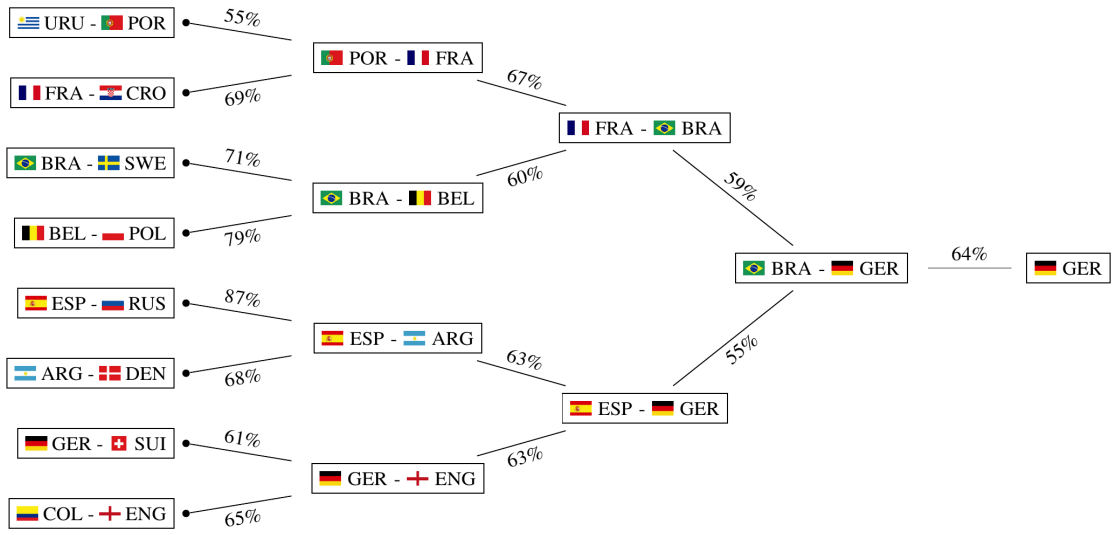

Figure 1: A simulation of the FIFA World Cup 2018.

You should use these structures defined by Krystor to implement the simulation.

```
typedef struct country {
    int rank;
    char name[4];
} country_t;

typedef struct node {
    struct country *country;
    struct node *left, *right;
} node_t;
```

Then you should transverse the tree in post order (left->right->root) to simulate the result. Only call the random function when needed.

Take Figure 1 as an example, the transverse order should be URU-POR, FRA-CRO, POR-FRA, BRA-SWE, BEL-POL, BRA-BEL, FRA-BRA, ...

2.3 Input and Output Format

The first line of the input only contains two integers $seed$ and k, each of the next 16 lines contains a country name of length 3 and its FIFA ranking. The order of the countries is same as their order on the match map.

Take Figure 1 as an example, the sample input is (note that the win rate shown in the figure is not calculated by our method, so your result may be different):

```
0 0
URU 14
POR 4
FRA 7
CRO 20
BRA 2
SWE 24
BEL 3
POL 8
ESP 10
RUS 70
ARG 5
DEN 12
GER 1
SUI 6
COL 16
ENG 12
```

The output should be the result of the 15 matches between the 16 countries, ordered by the postorder transverse.

The sample output is (slightly different from Figure 1, but exactly the same on JOJ):

```
URU LOSE POR
FRA WIN CRO
POR LOSE FRA
BRA WIN SWE
BEL LOSE POL
BRA WIN POL
FRA LOSE BRA
ESP WIN RUS
ARG WIN DEN
ESP LOSE ARG
GER WIN SUI
COL LOSE ENG
GER WIN ENG
ARG LOSE GER
BRA LOSE GER
```