ENGR151 — Accelerated Introduction to Computer and Programming

Lab 6

Manuel — UM-JI (Fall 2021)

Goals of the lab

- Loops and conditional statements
- Structures
- Arrays

1 Background

This is Friday night and the three sisters are preparing to go back home for the weekend. When Haruka closes her drawer after taking her notebook, she can feel that something is blocking. She first pushes stronger but quickly realises she should re-open it and see what the issue is. After dismantling the drawer with her screwdriver she finds an old magazine probably left by some previous students. Intrigued by her discovery she recalls her sisters who are already downstairs.

This old damaged magazine is all about the 2018 football World Cup held in Russia. The three sisters think it would be rather interesting to look at it knowing the outcome. Indeed the excitement comes from the "unpredictability" of each game. So the predictions of this old magazine published before the World Cup starts are probably very different from what really happened. Quickly they find a page featuring a diagram representing a sort of tree (Fig. 1).

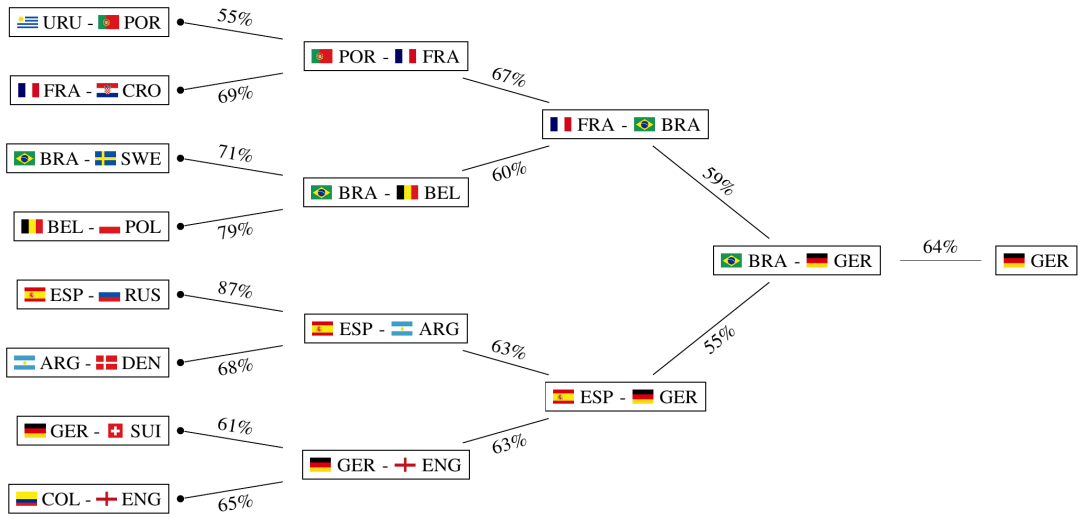

Figure 1: Predictions for the 2018 World Cup found in the old magazine

In fact the actual result of the FIFA 2018 World Cup is far different from the one predicted in the magazine. The three sisters loving programming, they decide to write their own simulation program to "predict" the World Cup results.

2 Tasks

Kana would like to implement a simulation process for the games, however none of the sister has any idea where to start. They remember than Jane has taken a very interesting course related to data modeling

(VE406) and even a more advanced one on Big Data (VE472), so she must know what to do. They immediately contact her on Wechat. Jane thinks that they need a simple model since their goal is only to learn programming, a more complicated one would not bring much for them as VG101 students.

Mandatory part

2.1 Simulating a single game

After a short discussion Jane suggests the following approach. If two teams A and B have ranks r_A and r_B, respectively, then define the winning rate of the match as

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

where k is an arbitrary coefficient specified on the input. Unfortunately it seems that Jane, who is in a train, lost the signal. The three sisters are left alone and have to figure out the rest of the process by themselves.

Help the three sisters to

- Find a way to determine the winner of a game when knowing both ranks, and an integer k; (2 min – 2-3 students)
- Define a structure to represent the countries: (3 min – 1 student)
  - What fields are necessary when defining a country?
  - Knowing a country is represented using three letters, how large should be the array containing the country's name?
- Figure out how to generate a random number and how to adjust its range; (2 min – 2-3 students)
- Write a function `get_winner()` to determine the winner between two teams knowing their FIFA rank and an integer k; Decide on the input data type, in particular should the keyword `const` be used in this context? (3 min – 1 student)

Present and demonstrate to the three sisters the result of your work. (4 groups – 4 min each)

2.2 Simulating the whole competition

The three sisters are pretty happy however a new difficulty awaits them: how to play all the games in the correct order? As they have just studied arrays their first idea consists in storing all teams in a array. While Chiaki wants to start from the left Kana suggests to start on the right. Initially Chiaki is pretty upset and complains that Kana always want to do things differently, but she soon understands why Kana wants to do it this way: figure 1 looks like a (fallen) tree with it root on the right (`GER`) and its leaves as all the games on the left of the picture.

Help the three sisters to

- Place all the countries from the final to the quarter of final in a array on a piece of paper; (2 min – 1 student)
- Figure out the relationship between the index i of a country and the one of (i) its parent (toward

the root) and (ii) its children (toward the leaves)[1]; (2 min – 2-3 students)

- Write the pseudocode of a clear iterative algorithm which given a list of teams and an integer k[2] fills in an array "from right to left" and returns the World Cup winner; (5 min – 1 student)

Present and demonstrate to the three sisters the result of your work. (2 groups – 3 min each)

Optional part

The three sisters having finished their algorithm they follow Jane's advice to run it on an simple example to quickly test its correctness before starting to implement it in C. As everything looks fine they are about to start writing the C code when they realise they have not yet defined their input and output formats. A few minutes later this done: the input is a file where the first line contains the arbitrary integer k, and the subsequent ones a three letter code representing a country, a space, its FIFA rank. The output is written in a file where each line is composed of two countries separated by "LOSE" or "WIN" depending whether the first country lost of won the game. As Haruka is very fast at typing she has already prepared the input file during the discussion.

Help the three sisters to

- Implement their algorithm in C;
- Write a function to read the input file;
- Write a function to dump the results of the games in file;

Sample input

```
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
```

Sample output

```
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
```

[1] Warning: what is the first index of an array in C?

[2] The arbitrary coefficient used to determine the winning rate.