

Exercise 1: Sample Count

[50 marks]

Problem Statement

A sample count is performed at the start of the counting process for each electoral division to get an early indication of the possible electoral outcome. This will be released once for each electoral division. Releasing the sample count helps to prevent speculation and misinformation from unofficial sources while the counting is underway, and before the formal election results are announced.

In this exercise, assume two teams A and B are competing in an electoral division with N polling stations, $1 \leq N \leq 5$. After the end of the polling hours, the election officer will select **100** tickets from **each station**.

Write a program to compute the sample counts for teams A and B. Your program should read in the following inputs (all of type **int**) from the user:

- **numStation**: The total number of polling stations in the electoral division.
- **numVoterDivision**: The total number of voters in the electoral division.

For each polling station, you will read in the following data:

- **numVoteA**: The number of votes for team A.
- **numVoteB**: The number of votes for team B.
- **numVoterStation**: The total number of voters in the polling station.

Your program should compute the **sample count** (of type **float**) for each team weighted by the number of voters in each polling station. To compute the sample count of team A, we have:

$$sampleCountA = \sum_{polling\ station=1}^{numStation} \left(\frac{numVoteA}{100 - numInvalidVote} \times \frac{numVoterStation}{numVoterDivision} \right),$$

where **numInvalidVote** = 100 – numVoteA – numVoteB.

For example, in the first sample run, the numbers of invalid votes in the two stations are $100 - 80 - 15 = 5$ and $100 - 65 - 25 = 10$, respectively.

Therefore, the sample count for team A is $\left(\frac{80}{100-5} \times \frac{600}{1000} \right) + \left(\frac{65}{100-10} \times \frac{400}{1000} \right) = 79.42\%$

The sample count for team B can be similarly computed by replacing numVoteA with numVoteB in the equation.

Your program should output the **computed sample counts**. In addition, it should also print a **summary message** based on which team wins and how big is the win margin.

- If there is no difference between the sample counts, output "There is no winner in this election."
- If the difference is less than 5%, say 52% for team A and 48% for team B, output "Team A narrowly wins this election."
- If the difference is between 5% and 30% (both inclusive), say 42.50% for team A and 57.50% for team B, output "Team B wins by a significant margin."

- If the difference is more than 30%, say 79.42% for team A and 20.58% for team B, output “Team A wins by a landslide.”

You may assume that the input is valid (*i.e.*, all integers are positive, the total number of voters in the stations is equal to the total number of voters in the division, and the total number of votes for the two teams in each station does not exceed 100).

Write on the skeleton file **election.c** given to you. You need to include one function:

- **printSummary()**

This function prints the summary message based on the sample counts for the two teams. You are to decide the appropriate parameters and return type for this function.

You may define additional functions as needed. However, you are advised to implement the computation of sample counts in the main function instead of in a separate function. Check sample runs for input and output format and read the comments in the skeleton code for additional instructions.

In addition, due to the relatively large number of inputs for this exercise, you are advised to make use of input redirection to test your program with the given input files.

For example, to run your executable code (e.g., a.out) with an input file (e.g., election1.in), in your UNIX command prompt, enter the following command:

```
a.out < election1.in
```

Sample Runs

Four sample runs are shown below with user input highlighted in **bold**.

```
Enter number of voters in the division: 1000
Enter number of stations: 2
Enter number of voters in station 1: 600
Enter number of votes for Team A: 80
Enter number of votes for Team B: 15
Enter number of voters in station 2: 400
Enter number of votes for Team A: 65
Enter number of votes for Team B: 25
Sample count for Team A = 79.42%
Sample count for Team B = 20.58%
Team A wins by a landslide.
```

```
Enter number of voters in the division: 1000
Enter number of stations: 1
Enter number of voters in station 1: 1000
Enter number of votes for Team A: 50
Enter number of votes for Team B: 50
Sample count for Team A = 50.00%
Sample count for Team B = 50.00%
There is no winner in this election.
```

```
Enter number of voters in the division: 5000
Enter number of stations: 3
Enter number of voters in station 1: 1000
Enter number of votes for Team A: 60
Enter number of votes for Team B: 40
Enter number of voters in station 2: 2000
Enter number of votes for Team A: 40
Enter number of votes for Team B: 60
Enter number of voters in station 3: 2000
Enter number of votes for Team A: 60
Enter number of votes for Team B: 40
Sample count for Team A = 52.00%
Sample count for Team B = 48.00%
Team A narrowly wins this election.
```

```
Enter number of voters in the division: 2000
Enter number of stations: 2
Enter number of voters in station 1: 500
Enter number of votes for Team A: 20
Enter number of votes for Team B: 80
Enter number of voters in station 2: 1500
Enter number of votes for Team A: 50
Enter number of votes for Team B: 50
Sample count for Team A = 42.50%
Sample count for Team B = 57.50%
Team B wins by a significant margin.
```