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ATTX Coding Challenge

Coin Flip Simulation for Optimizing Maximum Heads

This report aims to provide a comprehensive overview of the code functionality and offers insights into potential improvements and areas of focus. The code aims to simulate flipping of five unfair coins each with the unique probability of landing heads with a goal to maximize the number of heads observed in a set of 20 flips (one run). The code design includes the following functionality:

- Simulating coin flips based on given probabilities.
- Gathering data through an initial exploration phase.
- Using the gathered data to make informed decisions on subsequent flips.
- Performing 100 runs to compute and analyze the statistics of the algorithm.

Components:

Constants and Helper Functions:

- **PROBABILITIES**: A 2D array defining the probability of each coin landing either heads or tails.
- **flipCoin(double probHead)**: Simulates a coin flip of a biased coin where the probability of landing heads is given by probHead.
- **chooseCoin(const vector<int>& headsCount, const vector<int>& totalFlips)**: Chooses the coin to flip based on the estimated probability of heads from past flips.

Simulation Function:

performRun(): Executes a single run of 20 flips. The run is split into two phases –

- Phase 1: Initial exploration where each coin is flipped a fixed number of times to estimate its heads generating probability.
- Phase 2: Using the estimated probability from phase 1 to maximize the number of heads by flipping the coins with highest estimated probability.

Main Function:

main(): Executes 100 runs of the simulation function. It also collects and computes statistics including mean number of heads, max and min number of heads.

Results:

Executed 100 runs of 20-coin flips. Statistics for the runs were as follows:

Mean Heads Results/Run	12.12
Maximum Heads in a Run	18
Minimum Heads in a Run	5
Number of Runs with More than 10 Heads	79
Number of Runs with Less than 10 Heads	15

Conclusions:

- Coin Flipping Simulation: The code simulates flipping each of the five different coins based on their given probabilities.
- Data Gathering and Decision Making: It collects data on heads counts and total flips, then uses this data to choose which coin to flip to maximize the number of heads.
- Statistical Analysis: The program performs multiple runs, calculates the mean, maximum, minimum number of heads, and counts runs with more or fewer than 10 heads.

Recommendations:

- **Adjust `initialFlips`**: Experiment with different values between tests to find an optimal balance between exploration and exploitation.
- **Testing and Validation**: Ensure thorough testing to validate that the results exist within expected probabilities and no logical errors exist.