Quiz 6: ECS 342/442/642 Competitive Programming

2 pm to 2:55 pm on 4^{th} April, 2025

Instructions

- Please show your code to the invigilator and make sure he makes a note of it.
- Suppose your enrollment number is `20001`.
  - Open Linux and create folder `quiz-06-20001`.
  - The folder should contain files `quiz-61-20001.cpp`, `quiz-62-20001.cpp`, and `quiz-63-20001.cpp` corresponding to the following three questions.
  - Zip the folder and upload it at http://172.28.153.65:5000
- Your output should use the following line of code.

```
int main()
{
   int final_output; // or other relevant declaration
   cout << ``20001\t'' << ``Donald Knuth\t'' << final_output << endl;
   //Replace `20001' by your roll number and `Donald Knuth' by your name.
 }
```

Questions

1. (10 pts) **Double Exponential**

   Your task is to efficiently calculate values a^{b^c} modulo $10^9 + 7$. Note that in this task we assume that $0^0 = 1$.

   Input: The first input line has an integer n: the number of calculations. After this, there are n lines, each containing three integers a, b and c.

   Output: Print sum of each value a^{b^c} modulo $10^9 + 7$.

   Constraints: The problem has a time limit of 1 second.

2. (10 pts) **Extending Bracket Sequences**

   Your task is to calculate the number of valid bracket sequences of length n when a prefix of the sequence is given.

   Input: The first input line has an integer n. The second line has a string of k characters: the prefix of the sequence.

   Output: Print the number of sequences modulo $10^9 + 7$.

   Constraints: The problem has a time limit of 1 second and $1 \leq k \leq n \leq 10^6$.

3. (10 pts) **Skewed Dice**

You throw a skewed dice that has n faces with outcome between 1 and n. Assume that n is even. Every even number between 1 and n can turn up with probability $0.8/n$ whereas every odd number can turn up with probability $1.2/n$. What is the expected sum of three such roles?

Input: An integer n.

Output: Print the expected sume rounding decimal places to the next integer (i.e. 4.34 goes to 5).

Constraints: The problem has a time limit of 1 second.