NSUPS Bootcamp Week 2

Getting more serious

Different I/O Specifications

where beginners struggle

I/O Specifications

1. When test case number is given.
2. When no test case number is given and you have to take input till EOF.
3. When different test cases are separated by a blank line.

Some I/O Pitfalls

1. Using gets() right after scanf()
2. Trying to take non-blank character input using scanf()

Getting Started with STL

String & Map & Sort

But, you cannot use STL in C

How to convert a C code into C++ code

```
#include <stdio.h>
#include <math.h>
int main(){
    int x = sqrt(9);
    printf("%d\n", x);
    return 0;
}
```

```
#include <bits/stdc++.h>
using namespace std;
int main(){
    int x = sqrt(9);
    printf("%d\n", x);
    return 0;
}
```

You can now use STL that's available in C++ by simply adding two lines your code.

How to use STL

- Watch me do stuff on board

Problems that were very easy using STL

1. UVa 12592 - Slogan Learning of Princess
2. UVa 10226 - Hardwood Species
3. UVA 10815 Andy's First Dictionary

Resources on STL
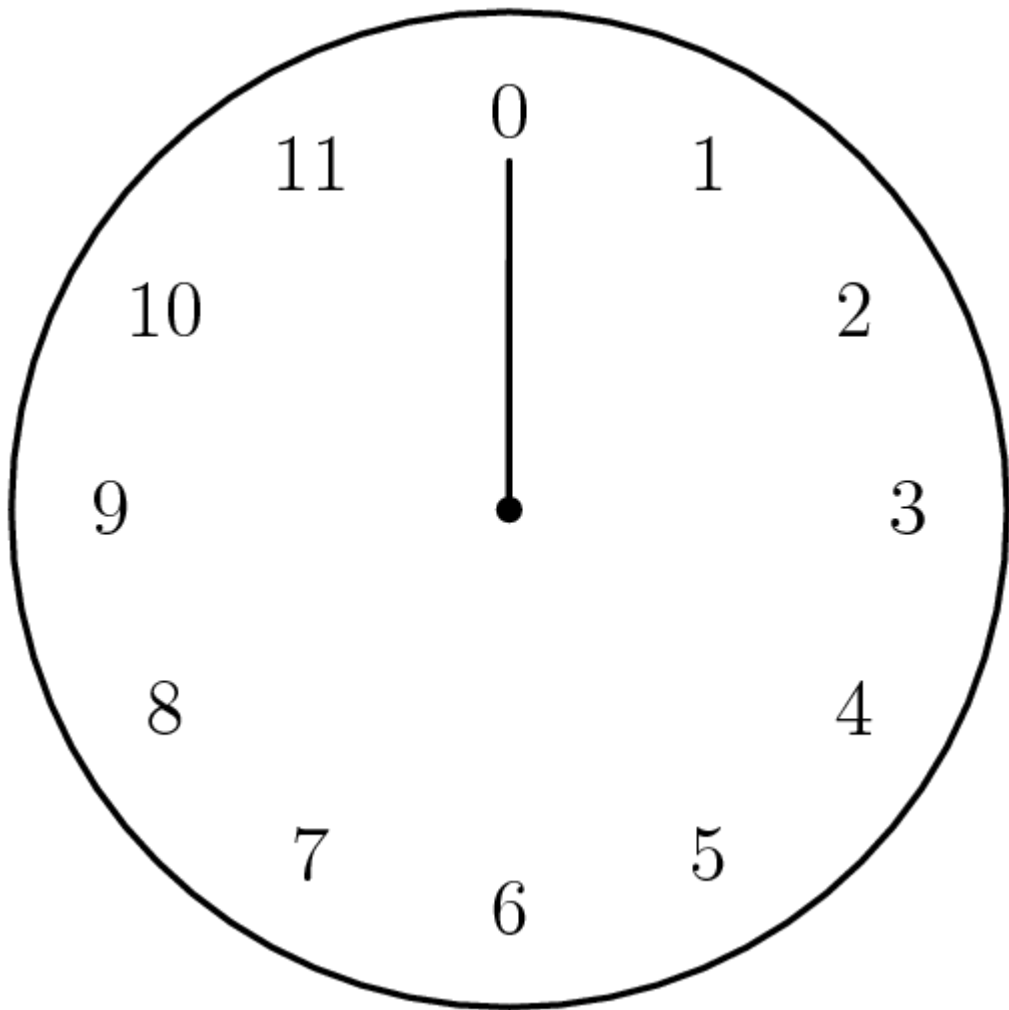
1. https://www.hackerearth.com/practice/notes/standard-template-library/
2. STL Resource in Bangla: https://sites.google.com/site/smilitude/stl

Modular Arithmetic

Motivation

- A clock counts in module 12.
- What does that mean?
- It counts from 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and then again 0, 1, 2 … and so on
- Can it count negative? -3?
- Can anyone give example of another real life modulo system?

Finding Residue of a Number

- How do we find residue of a number A, if we divide it by M?
- In programming, we can use the remainder operator: A % M
- Did you notice that we call it "Remainder Operator" instead of "Modulo Operator". Why?
- Modulo operator will always give non-negative output.
- How do we convert "remainder output" to "modulo output"?
  - If the remainder output is non-negative, then the modulo output is the same.
  - If the remainder output R is negative, then modulo output will be R + M.

Mathematical Notation

$$a \equiv b \ (\bmod\ m)$$

Solving Problems with Modulo Operator

- If today is Friday, what day will it be after 100 days?
- Convert a 24 hour clock to 12 hour clock
- Is a number X divisible by Y?
- If you hit a billiard ball sitting on center of billiard table with dimension X*Y, with a speed of S and direction vector of Ui + Vj, where will the ball be after T seconds?

Identities for Modular Arithmetic

- $(a + b) \% m = ((a \% m) + (b \% m)) \% m$
- $(a * b) \% m = ((a \% m) * (b \% m)) \% m$

Horner's Rule: Divisibility of large number X with Y

1. Suppose we are given a large number: X = 1381739128301983911384 and you need to find X % Y, where Y is small: Y = 1234.
2. Since the number is too big, it won't fit in integer or long long variable. How to solve it?
3. We use Horner's Rule + Modular Arithmetic.
4. Horner's Rule: 12345 is same as (((1*10+2)*10+3)*10+4)*10+5. Using this concept, we just need to inject modular arithmetic within to find the result of X%Y.

Resources on Modular Arithmetic

1. Khan Academy: https://www.khanacademy.org/computing/computer-science/cryptography/modarithmetic/a/what-is-modular-arithmetic
2. Art of Problem Solving: https://artofproblemsolving.com/wiki/index.php/Modular_arithmetic/Introduction