Algorithms

Online Judge

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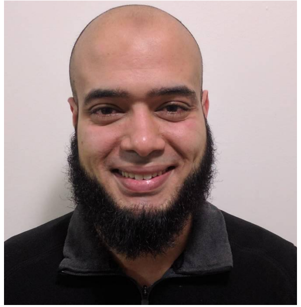


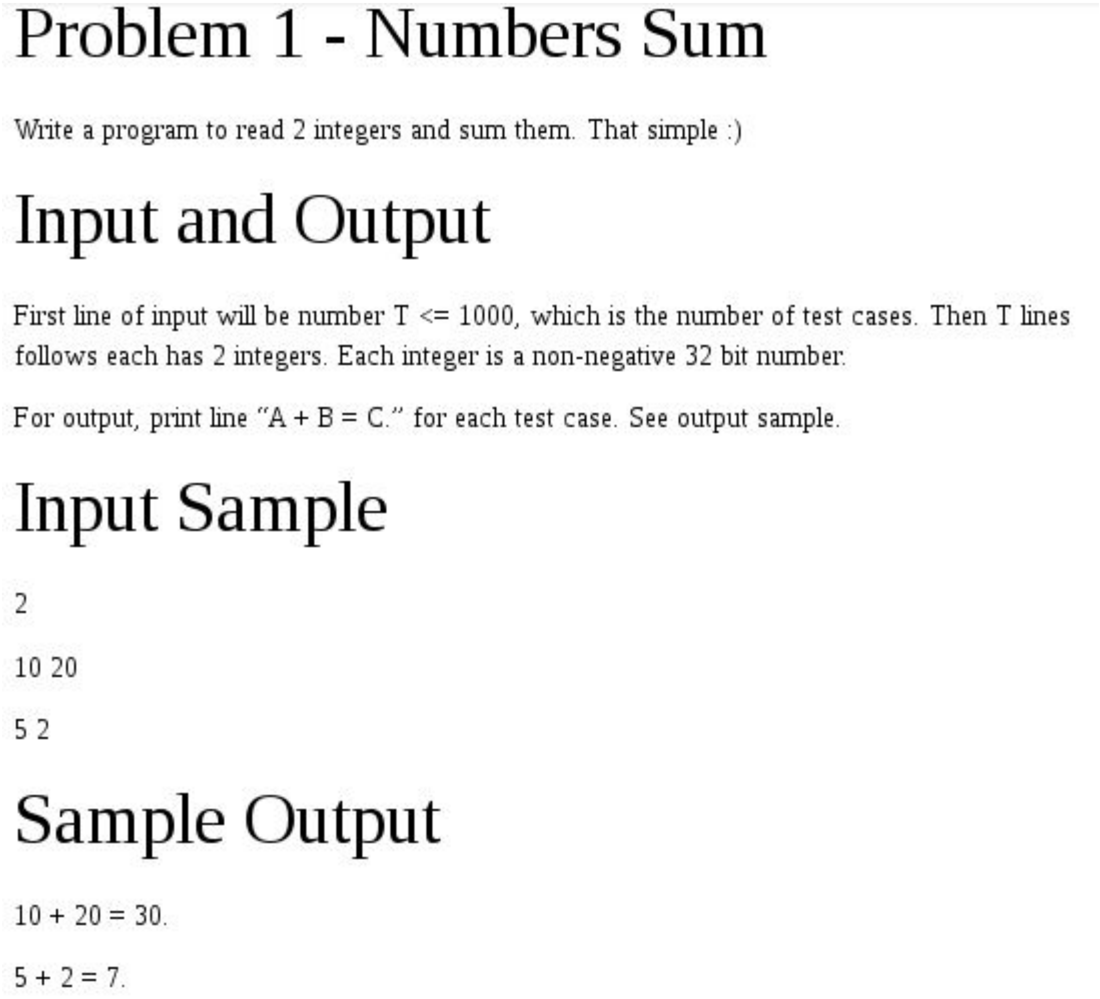
Online Judge (OJ)

- A site/app that is used to evaluate a programming solution
    - Task: read 2 numbers and print their sum
    - Behind the scenes: some files with test cases
        - Input file: 10 17   Output file: 27
    - Write your code in your chosen language
        - Upload and submit
    - Behind the scenes: **automatic** compilation, and running your code with the input files
        - Comparing the output file for each test case
        - Checking if the solution takes a lot of time or memory
        - Verifying correctness, by checking your outputs against the expected outputs

Online Judges

- Online judges became more popular with competitive programming
- There are many judges out there with thousands of problems
  - **Uva, SOJ, Timus, Codeforces**, topcoder, hackerank, Euler Project
  - Typically you **read from a file or a console** and print to the console
  - We may use the first 4 OJs here.
- LeetCode **OJ**
  - An online judge with focus on algorithmic **interview** problems
  - Problem description is usually simple and direct. It's doesn't attempt to trick you in the text, and avoids very special cases, e.g. to force a RTE or overflow from your codeNo main/reading/writing. Only implement a **class's method**
  - **During the course, many problems are from this LeetCode**
  - *It also has other types of questions, such as Database, Shell, and Concurrency*

Problem Statement



Problem 1 - Numbers Sum

Write a program to read 2 integers and sum them. That simple :)

Input and Output

First line of input will be number T <= 1000, which is the number of test cases. Then T lines follows each has 2 integers. Each integer is a non-negative 32 bit number.

For output, print line “A + B = C.” for each test case. See output sample.

Input Sample

2

10 20

5 2

Sample Output

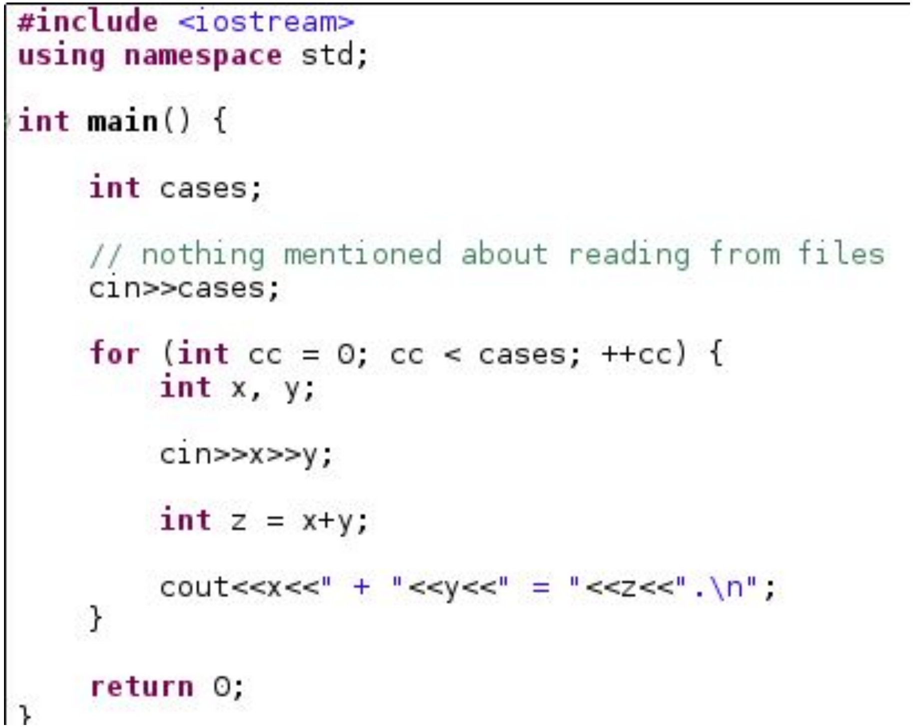
10 + 20 = 30.

5 + 2 = 7.

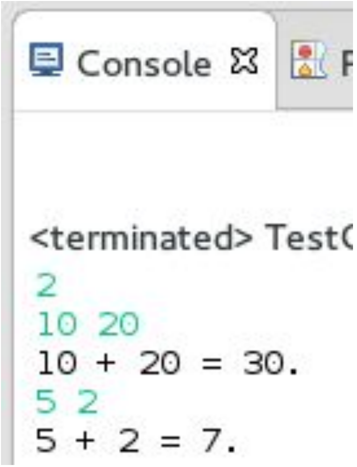
Following the statement

- It is very important to realize these 2 points
  - Judge is **automatic.** It **compares** your result with **predefined** results
- In most online judges, we read and write to the **console**
  - A few specify input and output files
- When the statement says print **A + B = C.**
  - Assume judge output is: “10 + 20 = 30.”
  - If your output includes anything extra, even something seemingly as trivial as an extra space; or is missing anything, such as an additional dot, the comparison will fail. For example:
    - “10+20=30.”
    - “10 + 20=30.”
    - “10 + 20= 30”
    - “10 + 20= 30. ”
    - Dear user, 10 + 20= 30.”
  - FOLLOW **strictly** what it asks you to doIn UVA, be careful about extra blank lines or spaces

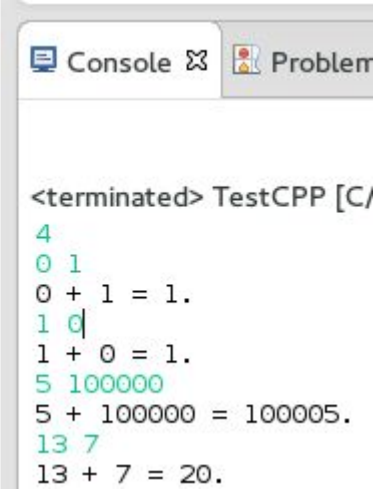
Let’s code it



```
#include <iostream>
using namespace std;

int main() {

    int cases;

    // nothing mentioned about reading from files
    cin>>cases;

    for (int cc = 0; cc < cases; ++cc) {
        int x, y;

        cin>>x>>y;

        int z = x+y;

        cout<<x<<" + "<<y<<" = "<<z<<".\n";
    }

    return 0;
}
```



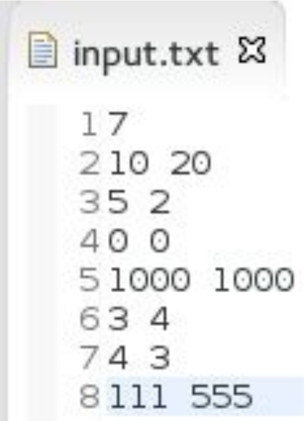
```
<terminated> Test(
2
10 20
10 + 20 = 30.
5 2
5 + 2 = 7.
```



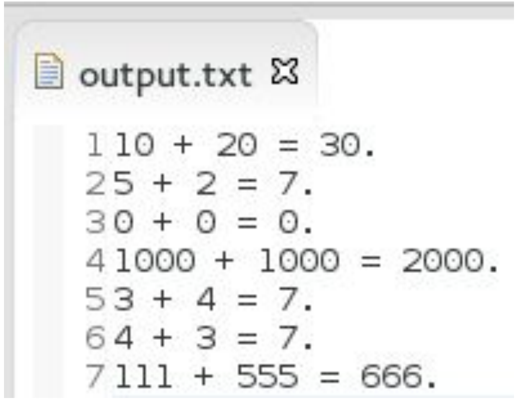
```
<terminated> TestCPP [C/
4
0 1
0 + 1 = 1.
1 0
1 + 0 = 1.
5 100000
5 + 100000 = 100005.
13 7
13 + 7 = 20.
```

Problem setter test cases

- Sample input is usually 2-3 cases
- However, the real success is to do well on the **hidden test cases** of the problem setter
- The cases ensure your code is really correct and consider time/memory/all scenarios
- Most of the online judges never tell you the test cases (e.g. UVA/UVA), while others give some examples (e.g. **LeetCode**, Topcoder and Codeforces)
- Tip: Getting accepted is NOT a proof of correctness
    - The cases might be weak



```
7
10 20
5 2
0 0
1000 1000
3 4
4 3
111 555
```



```
10 + 20 = 30.
5 + 2 = 7.
0 + 0 = 0.
1000 + 1000 = 2000.
3 + 4 = 7.
4 + 3 = 7.
111 + 555 = 666.
```

Judge responses

- Judge actually sends different types of responses, based on code status
- Accepted (AC), Wrong Answer (WA)
- Compile Error (CE)
    - Your code doesn’t compile. You probably used the wrong language (e.g. Python instead of C++), or selected incorrect version of the compiler.
- Presentation Error (PE)
    - If your program has the correct calculation, but is displaying the output incorrectly (e.g. missing a dot, or including an extra line or space)
    - However, judge may also send WA (wrong answer)

Judge responses

- Time Limit Exceeded (TLE)
  - You need time more than allowed by judge
- Memory Limit Exceeded (MLE)
  - Reserved too much memory (e.g. 1e9) or has a memory leak
- Run Time Error (RTE)
  - Code crashes...E.g. Index out of the boundary
- The above lists the most common responses, but some OJs may define their own ones

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."