2023_DS_Fall_Homework 1

Notice

The deadline is 2023/10/26 23:59. Homework should be submitted as a c source file, not an executable file. In your homework assignment, read the input from stdin and write your output to stdout. The file's name should be hw1_p1.c.

Execution environment and Constraint.

- CPU core: 1
- Memory: 2 GB
- Execution time limit: 1 second
- C Compiler: GCC
  - compiled with -O3 -std=c11 -Wall
- C Standard: C11
- Use header file only from C Standard Library
- OS: Linux 22.04.1 LTS

Problem 1 : Prefix, Infix and Postfix (2%)

Write two C functions. The first one transforms an infix expression into a postfix one, and the second one transforms a postfix expression into a prefix one.

The function should be stored in a different file, such as hw1_p1-1.c and hw1_p1-2.c.

Problem 2 : Disjoint Sets (2%)

Write a C function heightUnion that uses the height rule for union operations instead of the weight rule. The following is the definition of this rule.

> **Definition [Height Rule]**:
>
> If the height of tree i is less than that of tree j, then make j the parent of i.
>
> Your function must run in O(1) time and should maintain the height of each tree as a negative number in the parent field of the root.

Input Format

The first line is the number of test cases.

In each test case, a line with 2 integers n and *ops* is given.
n is the number of elements in the full set. Elements are labeled from 0 to (n−1).
ops is the number of operations that you need to do.
There are 3 operations as follows.

1. **union** a1 b1
2. **find** a2
3. **same** a3 b3

(Note: If two sets with same height perform union, the first set a1 be the parent)

Output Format

- Each time you get the operation find, output the root of the set.
- Each time you get the operation same, output true if they are in the same set. Output false if they are not in the same set.

Constraints

- $1 \le n \le 10^4$
- $1 \le ops \le 10^4$

Problem 3 : Graphs (3%)

Write a C function that finds a minimum cost spanning tree using Kruskal's algorithm.

Input Format

The first line shows V and E. V represents the vertex number while E is the edge number. The rest shows the edge detail. Each line contains s, t and c, which means there is an edge between s and v with cost c.

Output Format

The output consists of one number, C. It represents the sum of all edge cost in the minimum spanning tree in terms of the given graph.

Constraints

- $1 < V \le 10^6$
- $V - 1 \le E \le min(\frac{V(V-1)}{2}, 2 \times 10^6)$
- $1 < c, s, t < 10^6$