



INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE

Quiz 2, 2025 January Semester

Course Name Systems & Impl. of Algorithms	Course Code DS3254
Date of Exam 21 st Mar 2025	Duration 02 hours (08:00–10:00)
Instructor	Total Score 56 (Questions: 4, Pages: 3)

Instructions:

- (I) The input and output file names will be provided as a command-line arguments to your program.
- (II) Apart from your own previously written code, you are not allowed to use any other external resources.

1. A scheduler manages a job queue. Each job possesses a unique identifier (a string) and a time requirement (an integer), representing the units of time needed for its completion. Jobs can arrive at any time. When a **process** instruction is received, the scheduler selects the job with the shortest remaining time requirement from the queue. This job is executed for one time unit, its time requirement is reduced by one, and it is returned to the queue. Implement the functionality of this scheduler using a priority queue.

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The input consists of a sequence of commands, one per line. Each command is either:

add job_id time_required – Adds a job with the given **job_id** and **time_required**.

process Executes the job with the shortest remaining time for one time unit.

For each **process** command, output the **job_id** of the job that was executed on a separate line. If there is no job in the queue, output **none**.

Input	Output
add job1 5	job1
process	job2
add job2 2	job2
process	job1
process	job3
process	job1
add job3 1	job1
process	
process	
process	

2. Given two integer arrays, **preorder** and **inorder**, representing the preorder and inorder traversals of a binary tree, respectively. Write a program that generates the postorder traversal.

If the given preorder and inorder arrays do not represent a valid binary tree (i.e., they are inconsistent), output **None**. The input consists of two lines:

- The first line contains a space-separated list of integers representing the preorder sequence.
- The second line contains a space-separated list of integers representing the inorder sequence.

Input

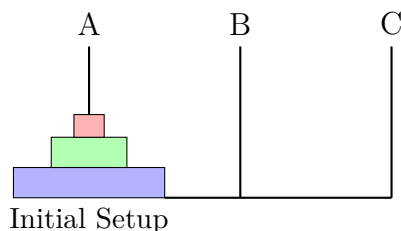
```
1 2 4 5 3 6 7
4 2 5 1 6 3 7
```

Output

```
4 5 2 6 7 3 1
```

3. The Tower of Hanoi is a puzzle involving three rods (say, A, B, and C) and n disks of different sizes, which can slide onto any rod. The puzzle starts with the disks stacked in decreasing size (with smallest at the top) on rod A, thus making a conical shape. The objective of the puzzle is to move the entire stack to rod C, obeying the following rules:

- Only one disk can be moved at a time.
- A larger disk cannot be placed on top of a smaller disk.
- A move consists of taking the upper disk from one rod and placing it on another rod.



```
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A C
A B
C B
A C
B A
B C
A C
```

Write a C++ program that reads a sequence of moves for a Tower of Hanoi puzzle from an input file and verifies if these moves are valid and if they correctly solve the puzzle for a given number of disks.

The first line of the input file will contain a single integer representing the number of disks. Subsequent lines will each describe a move in the format **source_rod destination_rod**, where **source_rod** and **destination_rod** are single uppercase characters (A, B, or C) representing the rods involved in the move. For example,

The output file will have for each move in the input file, whether the move is **valid** or **invalid**. After processing all the moves, a final line indicating whether the puzzle was **solved** or **unsolved**.

4. For a relation R defined on the set $A = \{1, 2, \dots, n\}$, we are interested in determining if it is reflexive, symmetric and transitive.

Reflexive For every $a \in A$, $(a, a) \in R$.

Symmetric If $(a, b) \in R$ then $(b, a) \in R$.

Transitive If $(a, b) \in R$ and $(b, c) \in R$ then $(a, c) \in R$.

Write a C++ program that reads a binary relation R on the set $\{1, 2, \dots, n\}$ from an input file and determines if the relation is reflexive, symmetric, and transitive. The input file begins with a positive integer n on the first line. Subsequent lines each contain two space-separated integers, n_i and n_j , representing an ordered pair (n_i, n_j) belonging to R . The output file will contain **Yes** or **No** for each property (reflexive, symmetric, transitive), each on a new line in that order. Examples of input and output files are shown below.

3	Reflexive Yes
1 1	Symmetric No
1 2	Transitive Yes
2 1	
2 2	
3 3	
1 3	
3 1	
3 2	