Chess Class

Time Limit: 4000/2000 MS (Java/Others) Memory Limit: 262144/262144 K (Java/Others)
Total Submission(s): 0 Accepted Submission(s): 0

Problem Description

This class is on chess. Baby Volcano is playing a special chess game with his friend, Baby Evil.

In this chess game, there is a directed graph $G = (V, E)$. Vertices are indexed from 1 to n. It is guaranteed that every vertex has at least one out-going edge, i.e. $\forall v \in V, \exists w \in V, (v, w) \in E$, Baby Volcano takes control of a subset of vertices $X \subseteq V$, Baby Evil takes control of $V \setminus X$. Every vertex v is assigned a weight $W(v)$.

There is a chess, positioning at $s \in V$ initially. The game consists of three phases.

1. For every $p \in X$, Baby Volcano chooses an out-going edge $(p, q) \in E$ and delete other out-going edges of vertex p.

2. After Volcano's operation, Baby Evil would similarly choose an out-going edge $(p', q') \in E$ and delete other out-going edges of p' for every $p' \notin X$. Both two babies make decisions based on chess's initial position s.

3. After two processes above, every vertex would remain only one out-going edge. The chess starts moving along the unique path in the processed graph, resulting in an infinite path $L = v_0 v_1 v_2 \cdots$, where $v_0 = s$. Baby Volcano gains score CV at last, which is computed below:

$$CV := \max \{W(v_i) \mid v_i \text{ appears in } L\}$$

Baby Volcano wants to maximize CV, while Baby Evil wants to minimize it.

Your task is to determine, for every $s, 1 \leq s \leq n$, compute CV under the circumstance that the chess is put at s initially.

Input

In the first line there is a number T, denotes the number of test cases.

Then there are T parts of input, each part describes a test case. Each parts begins with n, m, R, B, denotes the number of vertices, edges, the range of $W(v)$, and the size of X, the set which baby volcano takes control.

Then there is a line consists of B numbers, denotes elements in X.

Then there is a line with n numbers, the i-th number, denotes $W(i), 1 \leq W(i) \leq R$.

Then there are m lines, each line consists of 2 numbers, u, v, showing that there is an edge from u to v in G.

$1 \leq T \leq 100$

$1 \leq m, R \leq 5 \times 10^5$

$1 \leq B \leq n \leq 5 \times 10^5$

$1 \leq \sum n, \sum m, \sum R \leq 10^6$

Output

For each test case, you should first output "Case #t:"(without quotes), denotes the test number.

Then you need to output n numbers in the next line, the i-th number is CV under the circumstance that the chess is put at i initially.

Sample Input

```
2
3 3 2 1
3
1 1 2
1 2
2 3
3 3
4 6 10 1
4
8 7 3 2
1 3
2 4
3 2
```

```
4 2
2 1
2 2
```

Sample Output

```
Case #1:
2 2 2
Case #2:
8 7 7 7
```

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