問題 9 – 凌亂不堪的玩具 (Messy Toys)

(25 分)

問題敍述

天才兒童 Zisk 非常熱愛資訊科學，也因此他要求自己的家必須形如一棵資訊科學中 N個節點的樹，也就是說，恰有 $N-1$ 條通路連接著他家中的 N 個房間，每條通路雙向地連接著兩個房間，且滿足任意兩個房間都能夠經過唯一的一連串通路以互相來往。

不過，天才兒童也是需要放鬆玩耍的，這天 Zisk 玩遊戲玩到一半時突然發現他的玩具們散落一地，原本這些玩具每個都恰好有一個自己歸屬的獨特房間，而每個房間裡也恰好只擺放著一個玩具。

Zisk 想一一將他們放回原位，**放完之後再回來原地繼續玩還沒玩完的遊戲**，但他又很懶得移動，因此在那之前，熱愛資訊科學的他想到了一個問題，如果他只會進行以下四種操作的話，他能**移動**的最少步數是多少呢？

而這四種操作分別是：
1. 在手上沒有任何玩具的情況下，撿起所在房間的玩具
2. 在手上有玩具、所在房間沒有玩具的情況下，將其放置在所在房間。
3. 在手上有玩具、所在房間也有玩具的情況下，將手上的玩具與所在房間的玩具交換。
4. 透過一條連接著所在房間的通路走到另一個房間。

也就是說，Zisk 希望最小化使用操作 4 的次數，來將所有玩具歸回原位，並回到原地繼續玩還沒玩完的遊戲。

Zisk 知道你也很熱愛資訊科學，因此他決定邀請你決鬥，來較量看看誰可以比較早解出這道題目。

輸入格式

首行輸入兩個正整數 N, X，代表 Zisk 家中的地形圖是一棵 N 個點的樹，且 Zisk 與他的遊戲機在房間 X。
接下來一行以空格隔開的 N 個數字 $p_1, \ldots\ldots, p_N$，代表房間 i 上擺放著必須歸位到房間 p_i 的玩具。
接下來 $N-1$ 行，第 i 行兩個以空格隔開的正整數u_i, v_i，代表房間 u_i 和房間 v_i 之間有一條通路。

輸出格式

輸出一個整數，代表 Zisk 將所有玩具歸回原位，並回到原地繼續玩還沒玩完的遊戲所需要移動的最少步數。

資料範圍

- $1 \leq N \leq 600$
- $1 \leq X, u_i, v_i \leq N$
- $p_1 \sim p_N$ 是一個 $1 \sim N$ 的排列
- 保證 Zisk 家中的地形圖是一棵合法 N 個點的樹

輸入範例 1

```
5 1
4 1 3 2 5
1 2
1 3
3 4
3 5
```

輸出範例 1

```
6
```

輸入範例 2

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

輸出範例 2

```
12
```

輸入範例 3

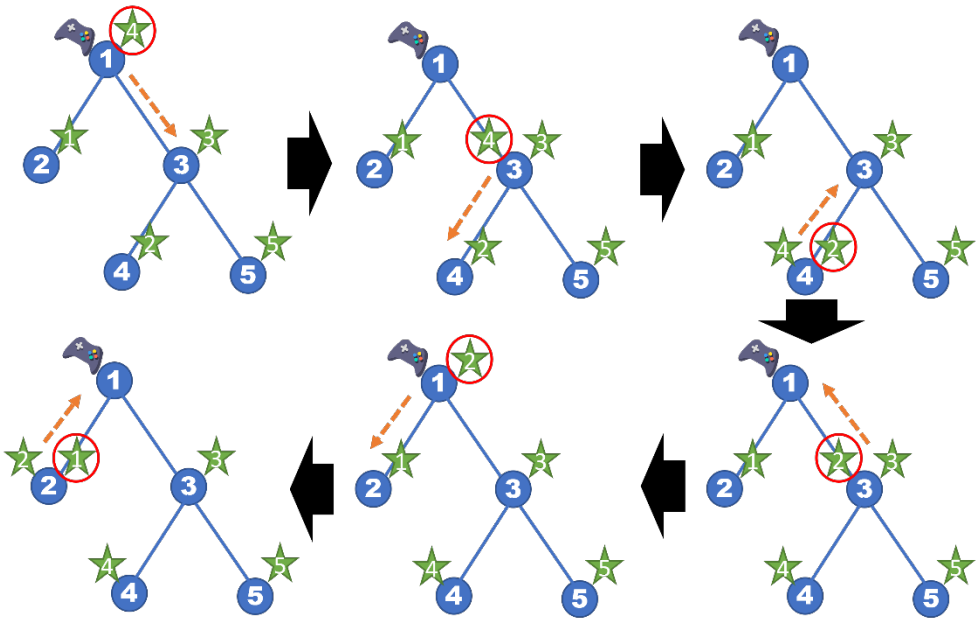
```
8 6
1 2 3 4 5 6 7 8
1 2
1 3
2 4
2 8
3 5
3 7
5 6
```

輸出範例 3

```
0
```

範例說明

在輸入範例 1，Zisk 可以：
先拿起房間 1 的玩具 → 走兩步到房間 4 → 交換房間 4 的玩具 → 走三步到房間 2 → 交換房間 2 的玩具 → 走一步到房間 1 → 放下手上的玩具
便可以花六步完成任務。



在輸入範例 2，Zisk 可以：
先走一步到房間 3 → 拿起房間 3 的玩具 → 走一步到房間 5 → 交換房間 5 的玩具 → 走一步到房間 3 → 放下手上的玩具 → 走兩步到房間 2 → 拿起房間 2 的玩具 → 走一步到房間 4 → 交換房間 4 的玩具 → 走一步到房間 7 → 交換房間 7 的玩具 → 走一步到房間 4 → 交換房間 4 的玩具 → 走一步到房間 6 → 交換房間 6 的玩具 → 走兩步到房間 2 → 放下手上的玩具 → 走一步到房間 1
便可以花十二步完成任務，注意到即使玩具已經整理完畢 Zisk 還是得走回原地（房間 1）繼續玩遊戲。

在輸入範例 3，因為 Zisk 的玩具們都已經歸位了，所以他不需要任何移動，開心待在原地繼續玩遊戲就好。

Q9: Messy Toys

(25 points)

Description

Zisk, a child prodigy, who is very passionate about Computer Science. Therefore, he requested to build his home in the shape of a tree of Computer Science with N nodes. Generally speaking, there are exactly $N-1$ corridors connect the N rooms of his home. Each of the corridors bidirectionally connects two rooms, which satisfies that each pair of the two rooms can pass through a unique series of corridors to go back and forth.

However, the child prodigy also needs to relax and play games. Today, Zisk found his toys messed up when he was playing a game. Originally, each of these toys has its own unique room it belongs to. Also, each of the rooms has exactly a toy in there.

Zisk wants to put these toys back in place one by one. **And then return to the room where he is in at the beginning to continue playing his game**. Merely, he is too lazy to make moves. Hence, he thought of a question before tidying up these toys, as a fanatic of Computer Science. What is the minimum number of **moves** he can make if he only does the following four operations?

The four operations are:

1. Pick up the toy in the room he is in when he has no toy in his hand.
2. Put the toy in the room he is in when he has a toy in his hand and the room he is in has no toy in it.
3. Swap the toy in the room he is in with the toy in his hand when he has a toy in his hand and the room he is in has a toy in it.
4. Move to another room by passing through a corridor directly connect to the room he is in.

In other words, Zisk wants to minimize the number of the 4th operations to put all the toys back in place. And then return to the room where he is in at the beginning to continue playing his game.

Zisk knows that you love Computer Science, too. So, he decides to duel with you, for seeing who can solve this problem earlier.

Input Format

The first line of the input contains two integers N, X, indicating that Zisk's home is a shape of a tree with N nodes, and Zisk and his gaming console are at room X.

The next line contains N integers $p_1, \ldots\ldots, p_N$ separated by spaces, indicating that the toy in room i should be put back into room p_i.

Next, followed by $N-1$ lines, each line contains two integers u_i, v_i, indicating that there is a corridor connects room u_i and room v_i.

Output Format

Output an integer, indicating the minimum number of moves can Zisk make to put all the toys back in place. And then return to the room where he is in at the beginning to continue playing his game.

Data Range

- $1 \leq N \leq 600$
- $1 \leq X, u_i, v_i \leq N$
- $p_1 \sim p_N$ is a permutation of $1 \sim N$
- It is guaranteed that the shape of Zisk's home is a valid tree with N nodes

Input Example 1

```
5 1
4 1 3 2 5
1 2
1 3
3 4
3 5
```

Output Example 1

```
6
```

Input Example 2

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

Output Example 2

```
12
```

Input Example 3

```
8 6
1 2 3 4 5 6 7 8
1 2
1 3
2 4
2 8
```

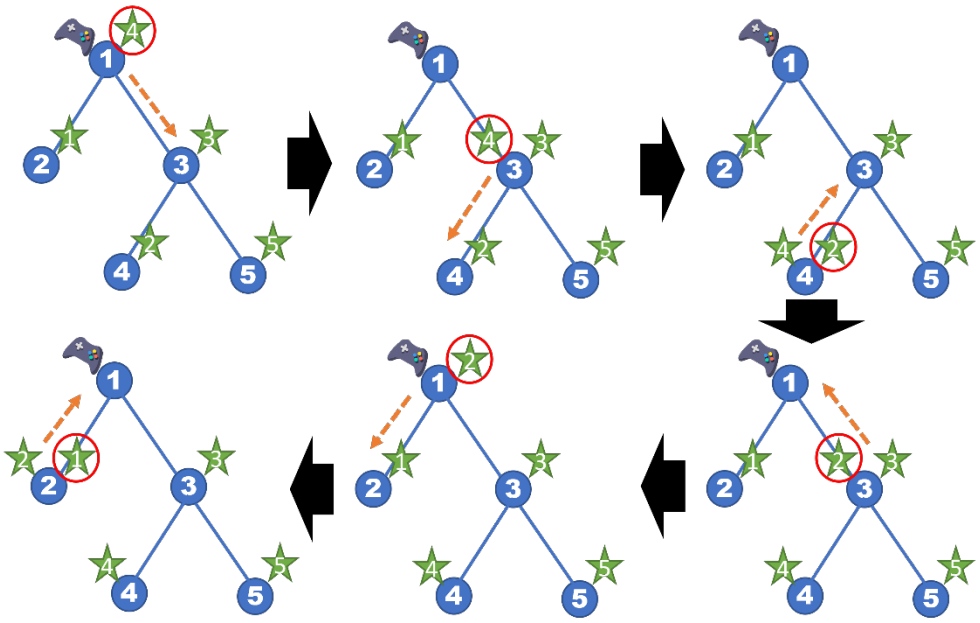
```
3 5
3 7
5 6
```

Output Example 3

```
0
```

Example Explanation:

In Input Example 1, Zisk can:
Pick up the toy in room 1 → Make two moves to room 4 → Swap the toy in room 4 → Make three moves to room 2 → Swap the toy in room 2 → Make one move to room 1 → Put down the toy in his hand
Then he can finish the task in six moves.



In Input Example 2, Zisk can:
Make one move to room 3 → Pick up the toy in room 3 → Make one move to room 5 → Swap the toy in room 5 → Make one move to room 3 → Put down the toy in his hand → Make two moves to room 2 → Pick up the toy in room 2 → Make one move to room 4 → Swap the toy in room 4 → Make one move to room 7 → Swap the toy in room 7 → Make one move to room 4 → Swap the toy in room 4 → Make one move to room 6 → Swap the toy in room 6 → Make two moves to room 2 → Put down the toy in his hand → Make one move to room 1
Then he can finish the task in six moves. Notice that even though the toys have been tidied up, Zisk still needs to go back to the original room (room 1) to keep playing his game.

In Input Example 3, since Zisk's toys have already been tidied up, he doesn't need any move. He can just stay in place and play his game happily.