Evolutionary Algorithms

Problem

Ada is working on a science project for school. She is studying evolution and she would like to compare how different species of organisms would perform when trying to solve a coding competition problem.

The $\mathbf{N}$ species are numbered with integers between 1 and $\mathbf{N}$, inclusive. Species 1 has no direct ancestor, and all other species have exactly one direct ancestor each, from which they directly evolved. A (not necessarily direct) ancestor of species x is any other species y such that y can be reached from x by moving one or more times to a species direct ancestor starting from x. In this way, species 1 is a (direct or indirect) ancestor of every other species.

Through complex genetic simulations, she calculated the average score each of the $\mathbf{N}$ species would get in a particular coding competition. $\mathbf{S_i}$ is that average score for species i.

Ada is looking for *interesting triplets* to showcase in her presentation. An interesting triplet is defined as an ordered triplet of distinct species (a, b, c) such that:

1. Species b is a (direct or indirect) ancestor of species a.
2. Species b is not a (direct or indirect) ancestor of species c.
3. Species b has an average score strictly more than $\mathbf{K}$ times higher than both of those of a and c. That is, $\mathbf{S_b} \geq \mathbf{K} \times \max(\mathbf{S_a}, \mathbf{S_c}) + 1$.

Given the species scores and ancestry relationships, help Ada by writing a program to count the total number of interesting triplets.

Input

The first line of the input gives the number of test cases, $\mathbf{T}$. $\mathbf{T}$ test cases follow.
The first line of each test case contains two integers $\mathbf{N}$ and $\mathbf{K}$, denoting the number of species and the factor which determines interesting triplets, respectively.
The second line of each test case contains $\mathbf{N}$ integers $\mathbf{S_1}, \mathbf{S_2}, \dots, \mathbf{S_N}$, where $\mathbf{S_i}$ denotes the average score of species i.
The third line of each test case contains $\mathbf{N} - 1$ integers $\mathbf{P_2}, \mathbf{P_3}, \dots, \mathbf{P_N}$, meaning species $\mathbf{P_i}$ is the direct ancestor of species i.

Output

For each test case, output one line containing `Case #`x`:` y, where x is the test case number (starting from 1) and y is the total number of interesting triplets according to Ada's definition.

Limits

Time limit: 40 seconds.
Memory limit: 2 GB.
$1 \leq \mathbf{T} \leq 100$.
$1 \leq \mathbf{K} \leq 10^9$.
$1 \leq \mathbf{S_i} \leq 10^9$, for all i.

$1 \leq \mathbf{P_i} \leq \mathbf{N}$, for all i.
Species 1 is a (direct or indirect) ancestor of all other species.

Test Set 1 (Visible Verdict)

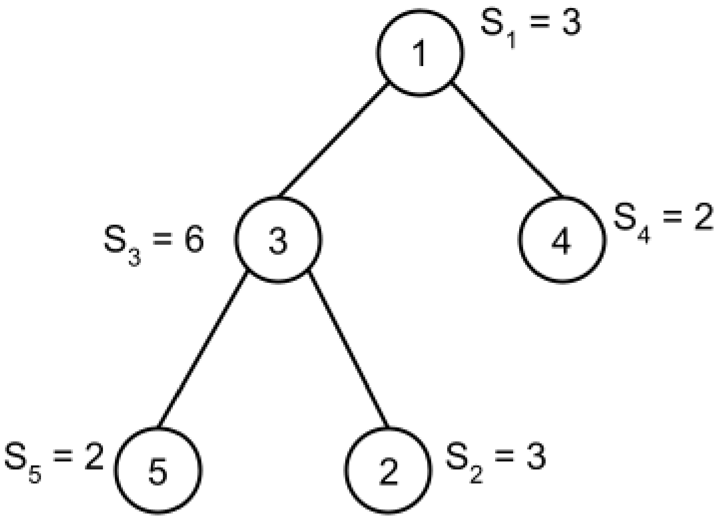
$3 \leq \mathbf{N} \leq 1000$.

Test Set 2 (Hidden Verdict)

For at most 30 cases:
$3 \leq \mathbf{N} \leq 2 \times 10^5$.
For the remaining cases:
$3 \leq \mathbf{N} \leq 1000$.

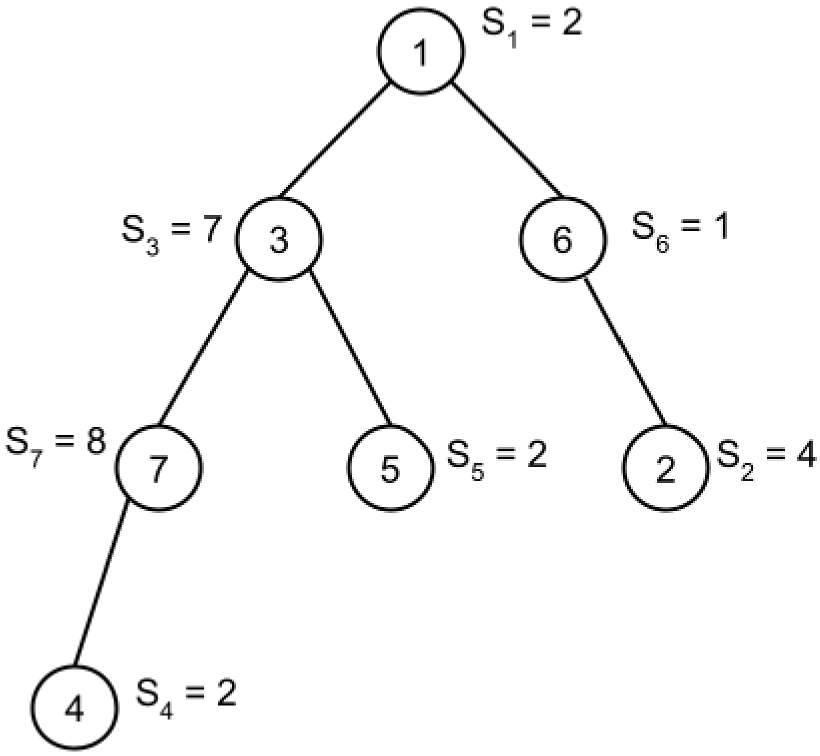
Sample

Sample Input	Sample Output
2 5 2 3 3 6 2 2 3 1 1 3 7 3 2 4 7 2 2 1 8 6 1 7 3 1 3	Case #1: 1 Case #2: 7



In Sample Case #1, there is only one possible interesting triplet: $(5, 3, 4)$. Indeed, we can verify that:

1. Species $b = 3$ is an ancestor of species $a = 5$.
2. Species $b = 3$ is not an ancestor of species $c = 4$.
3. The score of species $b = 3$ is more than $\mathbf{K}$ times higher than the scores of both $a = 5$ and $c = 4$: $6 = \mathbf{S_3} \geq \mathbf{K} \times \max(\mathbf{S_4}, \mathbf{S_5}) + 1 = 2 \times \max(2, 2) + 1 = 5$.



In Sample Case #2, there are seven interesting triplets:

- $(4, 3, 1)$
- $(4, 3, 6)$
- $(4, 7, 1)$
- $(4, 7, 5)$
- $(4, 7, 6)$
- $(5, 3, 1)$
- $(5, 3, 6)$