Programming Assignment #4

CMPE 250, Data Structures and Algorithms, Fall 2015
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Due: January 11, 2016, 23:59 Sharp

Introduction:

This project is about Byteotia; a country consisting of ***N*** cities connected via ***M*** bidirectional roads. Everything was going great in Byteotia until one day, this beautiful land was struck with a terrible and incurable disease. The disease appeared out of nowhere, and infected ***K*** different cities within one night. As if this was not enough, this disease kept spreading. At each day, cities that are directly connected to one of the already infected cities gets infected. This infection spread for a total of ***T*** days until the king of Byteotia decided to take action; and ordered a country-wide quarantine, which stopped the infection from furthermore spreading. However it was too late for the cities that were already infected; they had to be removed completely from Byteotia. Doing so, however, made it so that the remaining cities in Byteotia were no longer connected, thus Byteotia had to be separated into individual connected states.

Your task in this project is to, given the initial layout of Byteotia, the ***K*** cities that were infected at the first day, and the amount of days ***T*** in which the disease spread, calculate into how many different states Byteotia needs to be divided after the quarantine occurred and the infected cities were removed.

Input Format:

- In the first line, four space separated integers; the number of cities **N** (2<=**N**<=100 000), the number of bidirectional roads **M** (2<=**M**<=1 000 000), the number of cities infested in the first night **K** (1<=**K**<=**N**), and the amount of days passed **T** (1<=**T**<=**N**) in which the disease spread.
- In each of the following **M** lines, two integers $\mathbf{a_i}$ and $\mathbf{b_i}$ (1<= $\mathbf{a_i}$, $\mathbf{b_i}$ <= **N**) describing a single bidirectional road.
- In the following **K** lines, one integer $\mathbf{c_i}$ per line; the indexes of the **K** cities initially infected with the disease.
- See the last page of the document.

Output Format:

- In a single line; the number of connected states Byteotia needs to be separated into.

Remarks:

- On 40% of the inputs, the number of cities **N** will be less than 1000. So, first try to find an efficient algorithm and implement it afterwards.
- If you have a question related to the assignment, send it to bk.bariskaya@gmail.com.

Implementation Details:

- As always, your program will be compiled with make command. Therefore, if you add new files, you have to update Makefile accordingly so that your code can be auto-compiled. Note that it is fine to code in a single file in this project
- I will execute your program with `./project4 inputFile outputFile` command. So, implement your main function accordingly.
- Warning: All source codes are checked automatically for similarity with other submissions and also the submissions from previous years. Make sure you write and submit your own code.
- Your program will be graded based the correctness of your output and the clarity of the source code. Correctness of your output will be tested automatically so make sure you stick with the format described above.
- There are several issues that makes a code piece 'quality'. In our case, you are expected to use C++ as powerful, steady and flexible as possible. Use mechanisms that affects these issues positively.
- Make sure you document your code with necessary inline comments, and use meaningful variable names. Do not over-comment, or make your variable names unnecessarily long.
- Try to write as efficient (both in terms of space and time) as possible. Informally speaking, try to make sure that your program completes in meaningful amount of time.

Example Input/Output:

Input	**Output**
9 8 1 2 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 5	2
In this input, Byteotia is in a single line, and after the first day, cities 4 and 6 gets infected, after the second day, cities 3 and 7 gets infected. After the second day, the unaffected cities are therefore; 1, 2, 8 and 9. 1 & 2 make a single connected state, and 8 & 9 make a single connected state, so the answer is 2.	
12 14 2 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 1 3 9 9 10 10 3 7 11 11 12 12 7 1 5	2
This time there are two cities that are infected on the first day; 1 and 5, but the infection spreads for only one day. After the first day, the infection spreads into cities 2, 4, 6 and 8. Then the unaffected cities are; 3, 7, 9, 10, 11, 12. 3, 9 and 10 form a single connected state, and 7, 11 and 12 form a single connected state, thus the answer is 2.	