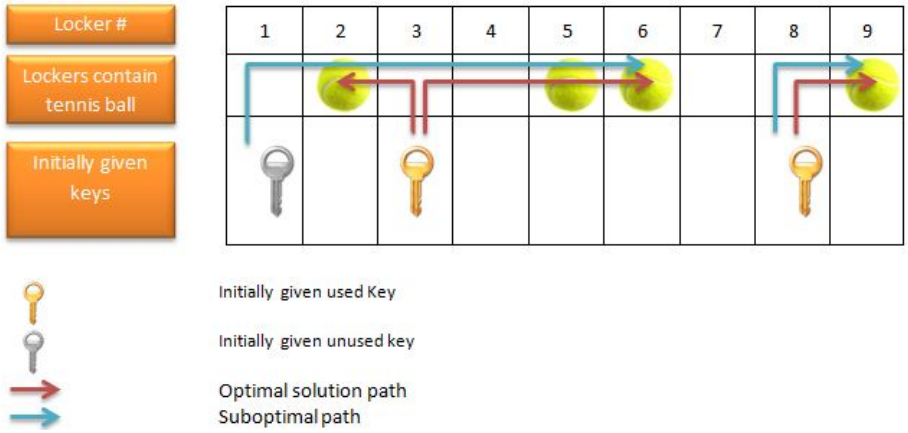
Dynamic Programming- Programming Assignment 4

Due: Friday, November 13th

Directions: This assignment will be due on Friday, November 13th, 1 hour before lab. You will demo this assignment in lab.

Credit: This assignment is an adaptation of Glencora Borradaile's assignment.

The locker room of the Rec has N lockers that are labeled $1, 2, \ldots, N$. Each locker is locked, but can be opened using its unique key. Copies of the key to each locker are in its adjacent lockers; i.e. a copy of the key to locker i is placed in locker $i+1$ and $i-1$ (the key to locker 1 is only in locker 2 and the key to locker N is only in locker $N-1$). T tennis balls are inside T distinct lockers (and you know which of the lockers they are in). You are given keys to M of the lockers and your goal is to collect all of the tennis balls by opening the least number of lockers. And example input and solution is given below.



In one solution (blue), only the first and last key are used and to collect all of the tennis balls, lockers 1,2,3,4,5,6 and 8,9 are opened. This solution is not optimal. In an optimal solution (red), only the second and third key are used: the second key is used to open locker 3 which gives us access to the keys to locker 2 and 4. In this way, the optimal solution only opens lockers 2,3,4,5,6 and 8,9.

You will design, analyze and implement a dynamic programming algorithm to solve instances of this problem correctly. Be sure that your algorithm correctly finds the minimum number of lockers that can be opened to collect all of the tennis balls.

Format:

You will be given a file containing 3 lines:

- The first line will contain 3 integers, N, M, T where $N(1 \leq N \leq 600)$ is the number of lockers, $M(1 \leq M \leq N)$ is the number of initially given keys, and $T(1 \leq T \leq N)$ is the number of tennis balls.
- The second line contains M numbers which represents the labels of the lockers whose keys you are given.
- The third line contains T numbers that are the labels of lockers that contain tennis balls.

For the example given above, the input file would have the following form:

9 3 4

1 3 8

2 5 6 9

Your algorithm should output 7 for this case.

You will find three sample input files on PolyLearn.

What to turn in:

- Turn in the following on PolyLearn as a PDF:
  - All four components of your dynamic program.
    - Pay specific attention to the definition (in words).

What to demo:

- Your algorithm executed against three test cases supplied during lab.