

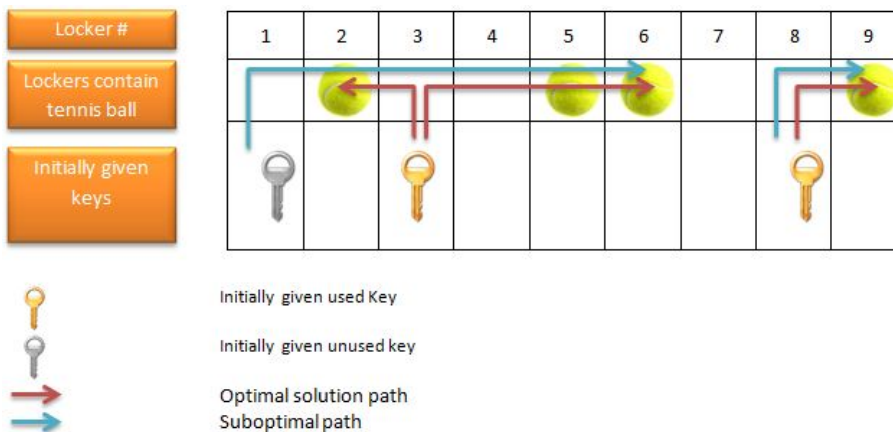
## Dynamic Programming- Programming Assignment 4

### Due: Thursday, November 2nd and Friday, November 3rd

**Directions:** Your code will be due by 8pm, Friday, November 3rd on PolyLearn. You may use either Python 3.4.3 or Java 8.

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

The locker room of the Rec has  $N$  lockers that are labeled  $1, 2, \dots, N$ . 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. An 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 bring with you to lab:**

- Your pseudocode.

**What to turn in on PolyLearn:**

- Your algorithm should take an input file as described above and return the smallest number of lockers that are necessary to open.
- Submit all of your source code along with a shell script driver named “asgn4.sh”. I should be able to run your program by typing, “./asgn4.sh <input file name>”. Your program must read input from a file and write output to stdout. Your output will be tested using diff, so it must match exactly. Please don't zip your files.

You will be provided with a working example with sample input and output.