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[NPTEL \(https://swayam.gov.in/explorer?ncCode=NPTEL\)](https://swayam.gov.in/explorer?ncCode=NPTEL) » [Design and analysis of algorithms \(course\)](#)
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Course outline

How does an NPTEL online course work?

Week 1 :
Introduction

Week 1 :
Analysis of algorithms

Week 1 Quiz

Week 2 :
Searching and sorting

Week 2 Quiz

Week 2
Programming Assignment

Week 3 : Graphs

Week 3 Quiz

Week 7 Programming Assignment: Here there be Dragons

Due on 2020-03-24, 23:59 IST

- Select your language (C/C++/Java/Python2/Python3)
- Paste your code into the submission window.
- There are some public test cases and some (hidden) private test cases.
- "Compile and run" will evaluate your submission against the public test cases.
- "Submit" will evaluate your submission against the hidden private test cases. There are 10 private testcases in all, each with equal weightage. You will get feedback about which private test cases pass or fail, though you cannot see the actual test cases.
- For each private testcase, you will get a status 'Evaluated', 'Not Evaluated' or 'Time Limit Exceeded'.
 - 'Evaluated' does not mean your answer is correct, just that the entire testcase completed and reported some answer.
 - 'Time Limit Exceeded' means your code took too long.
 - 'Not Evaluated' means this testcase was not run. This typically happens to all testcases after the first one that times out.
- Ignore warnings about "Presentation errors".

Here there be Dragons

(IOI Training Camp, 2012)

The kingdom is falling into ruin. People live in fear. Dragons pillage, kill, and just generally cause as much havoc as they possibly can. The king has just sent out a royal decree:

To any man out there who is able to bring me the heads of K dragons, I

Week 3 Programming Assignment

Week 4 : Weighted graphs

Week 4 Quiz

Week 4 Programming Assignment

Week 5: Data Structures: Union-Find and Heaps

Week 5 : Divide and Conquer

Week 5 Quiz

Week 6: Data Structures: Search Trees

Week 6: Greedy Algorithms

Week 6 Quiz

Week 6 Programming Assignment

Week 7: Dynamic Programming

Week 7 Quiz

Week 7 Programming Assignment

- Week 7
Programming
Assignment:
Here there be
Dragons
(/noc20_cs27/progassignment?
name=128)

shall bequeath a lordship—to him, his sons and his grandsons, till the end of time.

Having seen this royal decree, and knowing that you are capable of killing dragons thanks to your extensive medieval combat training, you set out on a quest to hunt down the evil creatures. Being a busy kind of guy, you would like to complete your quest quickly and kill K dragons through the shortest route.

The kingdom is arranged in a grid with R rows, numbered 0 to $R-1$, and C columns, numbered 0 to $C-1$. You start your quest at the top left corner of the grid, $(0,0)$.

The total number of dragons in the kingdom is D , of which you have to kill K . Dragons are very territorial in nature, so each row of the grid contains at most one dragon. Also, since the kingdom is situated on a hill, you travel only downwards on the grid, though you may move left or right as you please.

You are told that no two dragons are on the same row of the grid. Also, no dragon is at position $(0,0)$.

For example, suppose the grid has 5 rows and 5 columns with 3 dragons, of which you have to kill any 2. The three dragons are located at $(1,4)$, $(2,3)$ and $(4,4)$, as shown below. In this case, your shortest route is to take 7 steps and kill the dragons in row 1 and row 2. Killing any other combination of 2 dragons takes 8 steps, so this is the minimum possible. Note that once you've killed K dragons, you don't incur any cost to return home. You just want to find how long

it takes to do all the killing.

	0	1	2	3	4
0					
1					D
2				D	
3					
4					D

Solution hint

Number the dragons $1, 2, \dots, D$ in ascending order of rows. Let $\text{mindist}(i, j)$ denote the minimum distance travelled when the j^{th} dragon killed is dragon i . Recall the constraint that there is no dragon at $(0,0)$. Use dynamic programming to compute $\text{mindist}(i, j)$ for all values of i and j , then find the minimum among $\text{mindist}(i, K)$ for all $i \geq K$.

Input format

- Line 1 : Four space-separated integers, R , C , K and D .
- Lines 2 to $D+1$: Each line has two-space separated integers r and c , the row and column of the corresponding dragon.

Output format

A single integer, the minimum total distance travelled to kill K dragons.

Week 8: Linear Programming and Network Flows

Week 8: Intractability

Week 8 Quiz

Text Transcripts

Books

Download Videos

Test Data:

- In all testcases, $K \leq D \leq R$, and, for each dragon position (r,c) , $0 \leq r < R$, and $0 \leq c < C$.
- In all testcases, $1 \leq K, D \leq 300$.
- In 60% of the testcases, $1 \leq R, C \leq 300$. In the remaining testcases, $1 \leq R, C \leq 100000$.
- No two dragons will be on the same row.
- No dragon will be at position $(0,0)$.

Sample Input:

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

Sample Output:

```
7
```

Sample Test Cases

	Input	Output
Test Case 1	<pre>300 300 300 300 178 32 19 273 27 74 173 58 202 167 265 108 112 121 140 202 195 172 143 24 126 5 283 200 264 179 289 33 65 13 114 198 130 283 73 77 20 153 8 166 5 34 136 170 39 131</pre>	<pre>30342</pre>

74 57
269 6
146 4
28 10
106 221
207 133
232 148
30 173
142 72
86 103
21 141
41 110
72 234
294 272
3 128
290 24
91 248
78 53
14 125
240 167
134 75
297 197
110 164
109 202
263 15
59 291
55 138
33 87
272 238
10 105
248 259
17 111
273 191
216 222
60 108
139 174
79 108
101 269
127 80
298 11
84 13
285 189
212 5
245 277
262 280
103 81
155 220
242 265
132 278
222 275
241 117
174 259
291 110

45 138
261 13
276 100
188 212
210 199
231 118
214 294
282 41
131 216
120 87
200 225
83 203
197 293
150 243
6 13
170 208
268 207
125 168
22 41
88 186
254 276
234 243
36 116
205 187
104 79
145 148
75 262
179 63
243 207
147 232
171 287
228 46
281 66
76 162
141 299
0 28
223 263
201 25
257 232
85 169
35 194
258 141
7 164
253 138
26 214
295 236
255 148
259 261
97 21
163 197
196 14
138 178
42 69

119 176
252 291
193 65
206 173
251 155
107 13
23 200
13 178
154 166
280 126
160 278
37 84
116 270
63 291
186 89
98 250
52 280
148 175
271 90
292 217
51 253
278 15
153 259
44 289
215 2
49 154
208 129
192 21
191 186
80 262
204 127
181 197
11 141
32 113
82 216
165 224
213 57
94 140
152 187
53 201
161 245
158 49
211 176
89 39
177 269
239 216
4 17
2 275
1 99
128 156
144 94
270 46
137 41

260 4
100 18
299 145
293 60
156 266
77 293
190 211
62 282
67 124
9 38
247 28
102 87
218 268
61 285
129 243
18 182
287 39
189 126
95 56
47 4
183 23
135 246
68 110
50 30
96 262
267 110
217 266
48 241
56 109
57 132
64 185
162 100
220 245
12 230
123 26
40 196
99 245
133 61
238 159
46 182
167 80
184 82
70 120
209 284
151 55
108 210
233 177
187 264
31 84
24 49
81 10
249 289
229 218

244 246
169 112
118 68
115 274
93 133
92 34
111 224
87 166
180 65
198 106
199 18
224 93
105 46
286 42
230 298
168 198
185 121
121 10
58 70
29 105
219 288
122 44
266 167
182 79
225 97
71 102
166 261
279 145
69 212
157 189
237 190
34 196
38 86
256 109
15 183
149 46
117 120
25 217
226 70
194 101
203 5
246 294
275 254
284 129
236 80
90 281
175 109
54 47
16 209
172 182
164 289
288 277
277 199


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235 194
250 66
176 269
43 147
113 95
221 139
296 238
159 232
124 42
66 31
227 109
274 283
```

Test Case 2

```
300 300 102 189
33 279
181 149
242 137
62 291
244 248
47 118
154 228
16 286
279 209
196 51
18 124
235 13
122 239
126 123
89 232
116 265
78 154
123 68
51 106
230 220
289 129
267 177
23 261
39 174
45 156
172 117
292 161
132 31
133 149
260 86
70 122
64 51
275 45
103 268
202 234
254 188
245 251
53 209
137 285
```

3510

92 297
249 143
284 97
206 38
197 145
107 36
166 6
148 66
83 267
155 212
94 121
136 85
198 95
269 23
49 71
184 298
135 23
90 260
227 114
190 235
129 75
117 233
14 211
22 140
125 249
247 159
170 19
20 212
112 288
3 70
212 44
219 236
127 63
252 195
238 83
266 4
250 13
263 199
239 30
100 206
27 266
84 60
151 145
54 215
255 77
264 133
272 276
216 273
233 131
164 39
44 165
152 125
271 214

201 44
110 31
1 162
207 133
73 150
58 240
12 185
278 161
183 63
0 161
273 251
118 96
209 272
293 12
59 55
160 26
32 263
37 148
186 289
236 291
256 150
200 22
104 141
35 24
43 11
102 184
295 228
120 298
138 224
21 281
86 14
71 155
222 80
253 204
281 84
2 123
26 220
81 44
274 59
224 192
268 77
80 136
114 27
131 204
187 36
105 37
294 108
215 198
162 216
299 176
57 134
163 185
178 31

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177 182
96 160
193 85
55 55
101 179
9 128
88 241
106 288
194 30
13 194
228 106
108 237
99 66
270 76
290 71
143 259
91 280
41 210
169 280
85 215
261 35
203 163
248 295
124 220
231 223
173 15
225 202
262 27
210 253
15 79
142 199
63 284
192 273
285 174
204 24
297 13
188 91
72 121
115 97
218 119
174 2
11 143
40 114
179 197
```

Test Case 3

```
300 300 1 180
58 38
203 44
187 139
208 108
6 50
32 22
221 276
```

16

125 46
110 172
138 43
177 147
232 75
288 277
180 98
269 204
127 104
86 29
99 168
49 28
2 286
228 163
229 293
242 150
268 52
184 194
238 267
192 96
215 273
124 249
206 94
73 99
64 194
14 169
233 70
142 12
40 67
109 203
51 224
264 218
201 97
220 229
164 75
161 97
111 283
254 275
225 48
170 262
290 19
134 92
176 274
121 124
108 89
133 99
231 113
247 62
115 88
236 297
19 185
186 275
42 130

299 262
17 180
23 190
160 213
143 110
272 30
50 133
129 147
198 108
248 55
171 188
155 120
25 157
43 240
281 65
260 236
141 15
219 274
53 83
66 168
67 32
130 156
100 137
126 218
292 37
175 215
41 292
82 144
85 35
174 23
54 105
296 244
140 129
122 47
214 229
16 211
234 105
295 250
256 196
291 90
105 183
72 32
123 283
84 31
202 63
243 179
178 268
15 1
166 79
263 120
78 280
271 216
244 52

217 211
189 84
224 267
277 73
240 126
52 100
74 255
81 248
60 170
265 180
136 95
274 42
191 210
83 222
35 184
199 203
167 155
209 126
79 74
44 173
68 52
196 69
257 76
149 230
37 175
96 220
287 192
252 67
245 182
284 50
204 134
139 10
0 228
266 288
55 288
36 296
101 103
118 215
205 197
137 120
65 105
213 138
104 276
270 168
80 81
135 193
179 90
157 23
282 225
285 78
4 127
13 71
169 209

```
103 298
147 77
210 108
163 25
93 259
172 177
98 223
246 151
223 63
275 167
165 53
297 8
293 48
255 233
```

Test Case 4

```
300 300 106 133
151 14
165 119
97 190
268 120
172 10
126 113
31 225
193 209
175 258
155 215
225 187
237 249
188 147
218 130
263 134
51 257
171 58
28 216
58 118
211 23
64 257
269 233
219 229
158 138
20 263
247 260
69 68
179 231
133 229
123 102
191 176
180 21
61 186
258 80
24 112
273 27
2 49
```

6741


```
40 163
157 194
73 112
167 15
19 81
0 190
121 286
91 109
108 177
202 291
236 105
289 51
87 33
86 72
142 38
245 213
38 298
16 195
294 62
239 43
296 181
206 289
234 110
9 293
272 249
177 49
244 232
284 99
166 254
184 238
190 3
8 178
221 256
201 183
104 138
63 277
160 221
192 1
279 247
136 233
52 150
39 238
143 186
22 110
259 116
217 58
209 292
132 264
265 182
134 3
253 90
59 82
262 150
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115 40
15 59
42 45
102 55
18 16
162 208
120 263
280 236
37 196
228 163
57 56
140 104
277 249
43 5
254 47
270 173
90 182
79 170
264 33
285 261
275 150
12 113
178 178
124 112
30 154
238 52
208 65
99 27
278 55
235 25
117 287
128 251
291 222
68 264
21 82
66 284
75 282
138 22
290 100
286 123
164 135
103 10
111 86
```

Test Case 5

```
300 300 109 132
42 297
227 2
169 3
217 298
186 3
22 297
7 3
273 2
```

8068

39 297
129 3
284 0
287 4
130 3
111 295
260 2
74 295
194 297
94 2
165 0
116 1
62 299
48 295
237 295
245 296
16 298
68 298
293 2
139 298
291 299
218 299
96 2
193 296
12 4
56 4
181 0
95 4
79 298
281 3
55 1
21 297
156 296
86 0
159 297
141 2
136 299
238 1
35 2
121 299
170 295
183 296
157 3
120 298
78 3
195 0
235 298
246 4
228 295
90 0
198 2
75 296
197 296

44 2
155 3
131 296
164 299
263 296
72 1
192 297
27 1
20 1
269 2
289 0
296 299
93 1
70 4
166 299
140 0
65 297
288 2
196 2
103 0
162 0
299 297
118 4
114 3
200 295
142 297
160 297
267 4
298 2
275 298
176 0
215 299
10 299
220 3
216 4
25 297
51 3
98 4
167 0
209 4
213 4
179 3
43 4
1 295
47 295
208 299
259 299
99 297
45 297
14 296
272 4
28 1
85 299

```
199 4
13 295
280 298
38 2
214 3
249 0
257 3
191 297
248 2
212 296
264 295
69 4
244 299
239 296
63 299
113 2
206 295
110 296
```

Test Case 6

```
300 300 200 250
220 296
46 296
176 295
256 299
102 4
232 4
79 3
150 1
83 296
143 2
222 3
121 299
38 297
164 0
206 299
202 299
237 299
13 298
157 4
69 299
295 296
178 297
3 1
141 2
26 3
20 1
271 297
86 4
147 1
39 299
287 2
216 296
133 0
```

10268

```
163 1
97 3
41 3
261 295
258 2
135 2
31 299
189 2
291 297
215 3
136 1
208 0
260 296
58 1
253 1
103 3
140 4
231 3
99 299
114 1
100 298
50 298
36 299
284 299
144 4
128 1
73 295
49 298
12 0
263 295
294 0
19 297
42 4
120 3
211 296
64 296
285 2
10 295
126 297
109 0
254 295
212 0
149 3
196 0
293 295
115 3
8 296
47 3
145 296
268 1
7 0
156 298
57 2
```

251 0
165 299
267 298
217 2
117 2
23 2
9 295
160 1
213 298
108 299
204 4
85 295
218 295
283 1
241 2
188 296
45 295
63 0
87 2
187 298
190 296
203 3
195 3
227 296
44 2
250 295
298 3
207 299
77 3
234 299
171 296
264 298
131 1
134 1
53 295
243 4
105 296
5 4
221 299
6 2
101 295
223 1
127 2
248 295
40 297
18 0
17 298
112 3
30 295
81 296
175 4
225 4
224 2

252 298
130 1
246 3
139 298
107 4
153 3
270 0
193 4
111 4
33 1
2 297
11 296
281 0
197 297
168 297
262 298
296 297
159 295
230 4
25 296
113 298
65 296
55 295
137 2
191 1
48 295
174 1
233 297
249 299
56 2
14 296
177 4
289 2
74 296
54 0
0 299
21 299
110 296
181 1
35 297
192 4
142 1
276 296
214 297
34 4
209 1
70 296
186 2
104 4
226 4
123 0
238 298
84 1

60 4
22 297
169 296
173 297
154 299
172 2
32 3
292 297
29 3
166 2
116 299
155 0
129 2
279 1
194 1
93 299
88 296
98 3
95 1
91 299
94 295
15 299
201 2
146 0
219 297
182 0
229 298
184 2
76 296
278 298
273 0
179 2
61 299
228 298
272 295
286 297
4 298
80 3
299 299
265 3
16 3
148 0
297 296
290 297
244 295
274 295
199 3
161 297
152 297
240 296
75 0
62 1
27 4

	277 297 66 3 275 299 96 297 151 299	
Test Case 7	1 300 1 1 0 3	3
Test Case 8	82096 91868 300 300 61666 82875 34462 10021 20423 11810 66534 23770 40487 59087 69932 46137 45822 27389 75635 23167 37155 18404 11233 53592 26436 7236 33375 48453 23271 63092 79857 68899 79133 71217 11662 52799 5732 86961 13656 64674 66174 44517 40303 87095 77829 5723 23694 11577 37513 39088 70198 20869 35088 20011 31992 78161 5030 72638 404 61183 69047 89171 13479 82072 52870 70457 73619 21370 78396 36784 50306 25545 60283 29526 63930 45813 44952 48691 56774 63113 66516 67990 58639 83263 77918 45644 37652 46370 59850 20780	8833658

45782 45916
70927 43360
59392 41086
32406 13561
81963 28953
74942 18223
18362 1297
72653 60808
21748 62646
49273 81924
24067 16054
25522 51207
78501 23372
40535 79317
35232 39981
7969 65925
46851 89868
18863 78501
50544 6484
41682 82595
81530 76437
36834 26107
68646 84854
35072 81544
52063 57163
28389 14897
79573 76877
3309 35903
5953 82135
61331 82190
3802 66652
62712 63613
39103 41316
29797 90412
23813 75699
26957 1297
21976 79055
42101 86399
53005 34518
30264 23602
38927 63804
22126 23535
32080 32421
22888 54345
62686 72102
19967 66228
63033 49375
6413 31154
30364 61863
31939 72348
6473 79472
30694 48555
46517 59908

33442 37236
77497 70746
17342 65441
28040 1869
14748 85576
75137 46143
41986 17919
71756 10692
6441 19863
42334 32091
14057 90628
50059 15320
77436 69480
64761 18652
27322 5077
52382 9721
47091 56982
21603 48122
79966 38347
39402 75698
25595 84355
48343 39099
40354 74395
34181 44694
26815 87236
59723 29376
59571 24106
17705 2230
30508 32578
27938 77866
52851 51725
1199 14303
50421 73871
78741 69513
50978 61620
52397 38064
40522 26742
42727 57138
27530 25852
46585 60381
29631 59582
26913 7130
35057 84914
65159 42065
20681 2340
77990 2990
28450 72539
71374 17002
27207 56084
9367 19925
43546 36854
29413 88759
13540 48032

70750 43838
17458 22535
73267 85222
55959 62761
35201 36627
49845 20228
23159 73636
2590 91625
18853 55381
68871 60600
76877 29714
49116 77976
3550 39965
42328 15832
16470 54510
57767 61744
61017 83378
59499 30576
65673 84773
12179 9073
58649 33994
31434 1380
32973 82402
10727 31446
40965 89454
14545 62978
76054 68936
38245 73891
69844 56249
3790 70832
52297 75422
32108 59430
69625 7661
20996 11746
31080 23376
19109 87762
80854 21119
9978 12234
57898 44059
54173 69512
19281 80739
1081 88389
63371 86648
64485 72940
53626 15885
57941 79169
10102 83927
60494 18991
42025 31349
37099 32851
17952 20873
81627 76367
24345 15479

52644 56734
57141 17427
24109 34043
17763 91512
48454 90200
44380 88721
28611 87055
79129 66912
37894 65167
28342 84735
53814 3287
77220 56980
71424 28438
7602 19504
45686 32325
7399 7734
75910 31133
65099 18070
71422 48874
73488 91628
36941 17867
50672 55904
952 52721
66782 74156
48012 13674
8527 72607
49434 63350
52946 65950
51269 85820
20124 42206
34318 39369
40851 81855
43287 19051
18824 4310
63196 49784
42775 62114
16962 11544
53928 54490
29124 90945
78331 90270
78249 27620
7390 28337
78386 11046
52681 38793
5247 88359
12755 84086
46603 31280
5831 61470
14984 26294
29793 85712
40558 66004
32343 3213
34150 51382

```
40719 71808
14303 9898
23927 50731
48078 65173
14899 91007
22831 6409
34084 6632
26673 5277
60256 58526
42223 28468
779 41416
44813 78099
20396 39803
37421 47940
7149 62309
65673 87973
57502 54615
35252 77750
26695 16868
7377 12667
6609 32900
59901 52815
18052 89949
71283 41267
25042 29555
50174 53242
60730 89612
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Test Case 9

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Test Case 10

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28228 88266
83771 68398
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46395 6659
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73750 28447
24034 73534
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61235 13466
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71743 23681
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9146 25573
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46432 28487
60423 87848
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4620 6822
20546 20270
34432 39699
83707 31053
29702 84803
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8961 94130
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26998 35107
47244 18351
49941 61335
66709 64783
70563 97666

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Test Case 12	<pre>5 5 3 4 1 1 3 2 2 4 0 4</pre>	<input type="text" value="9"/>
Test Case 13	<pre>10 10 5 7 1 7 3 6 5 1 6 5 7 4 4 3 2 2</pre>	<input type="text" value="17"/>

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

