PS10-2

Started: Apr 5 at 4:37pm

Quiz Instructions

In this quiz you will be designing a solution to **Narrow Art Gallery (https://utah.kattis.com/problems/narrowartgallery)** , so it would be a good idea to read it first.

Here is the diagram of the 20-room art gallery from the Kattis description, with some index numbers added. (You should ignore the shadings of the rooms for the time being.)

Let N be the number of rows in the gallery. Here, N = 10 and I have numbered the rows 0 through N-1.

There are always two columns in a gallery. Here I have numbered them 0 and 1.

We need a way to refer to the values that appear in each room. Let's do that with

```
values[row][col]
```

where 0 ≤ row < N and col is 0 or 1.

In the Narrow Art Gallery problem, we are given N (the number of rows), k (the number of rooms that we must close), and the 2N numbers required to populate the values array. We must find the legal way of closing k of the rooms that results in the highest total value of the rooms that remain open.

In the diagram to the left, the optimal solution is to close the shaded rooms, resulting in a total value of 102 for the rooms that remain open.

The first step in solving a dynamic programming problem is to solve the problem with a (very inefficient) recursive method. Here is the one that I want you to think about in this quiz:

```
/*
  Requires the existence of an N x 2 values array.
  Requires that k <= N - r.
  Requires that 0 ≤ r ≤ N
  Requires that uncloseableRoom = -1, 0, or 1

  Returns the maximum value that can be obtained from rows r through N-1
  when k rooms are closed, subject to this restriction:

       If uncloseableRoom is 0, the room in column 0 of row r cannot be closed;
       If uncloseableRoom is 1, the room in column 1 of row r cannot be closed;
       If uncloseableRoom is -1, either room (but not both) of row i may be closed if desired.
```

```
*/
int maxValue (int r, int uncloseableRoom, int k)
```

Here are some examples of how maxValue could be used with the 20-room gallery illustrated above.

```
maxValue(0, -1, 5) = 102
maxValue(8, -1, 1) = 22
maxValue(8, 1, 1) = 19
maxValue(10, -1, 0) = 0
```

Question 1

0 pts

If k = N - r, what should be the value of maxValue(r, 0, k)?

I'll give you the answer to this one to illustrate how I want you to answer the rest of these:

```
values[r][0]+maxValue(r+1,0,k-1)
```

Why is this the answer? We have no choice but to close a room on row r (because k rooms need to be closed and there are only k rows left to consider). The room in column 0 can't be closed (because of the second parameter), so we must close the room in column 1. The total value for this situation is the value of the open room on row r plus the maximum value we can get from closing k-1 rooms in the remaining rows, with the proviso that the room in column 0 of row r+1 cannot be closed.

Please note carefully how I have written the answer. **Every answer in this quiz can and must follow this format.** Each answer consists of the sum of two or three expressions:

- The first one or two expressions extract a number (via an array indexing operation) from the values array.
- The final expression computes a value by calling maxValue recursively on three parameters that depend on r and k.
- There is no embedded space.
- When there are two array indexing expressions, they can come in either order.

Please follow these directions carefully and check your work.

values[r][0]+maxValue(r+1,0,k-1)

Question 2 — 3 pts

If k = N - r, what should be the value of maxValue(r, 1, k)?

values[r][1]+maxValue(r+1,1,k-1)

Question 3 — 3 pts

If k = N - r, the value of maxValue(r, -1, k) should be the larger of two expressions. One of these expressions has 0 as the second parameter to maxValue. What is it?

values[r][0]+maxValue(r+1,0,k-1)

Question 4 — 3 pts

If k = N - r, the value of maxValue(r, -1, k) should be the larger of two expressions. One of these expressions has 1 as the second parameter to maxValue. What is it?

values[r][1]+maxValue(r+1,1,k-1)

Question 5 — 4 pts

Note: At this point, the assumption we are making about k is changing.

If k < N - r, the value of maxValue(r, 0, k) should be the larger of two expressions. One of these expressions has 0 as the second parameter to maxValue. What is it?

values[r][0]+maxValue(r+1,0,k-1)

Question 6

4 pts

If k < N - r, the value of maxValue(r, 0, k) should be the larger of two expressions. One of these expressions has -1 as the second parameter to maxValue. What is it?

values[r][0]+values[r][1]+maxValu

Question 7

4 pts

If k < N - r, the value of maxValue(r, 1, k) should be the larger of two expressions. One of these expressions has 1 as the second parameter to maxValue. What is it?

values[r][1]+maxValue(r+1,1,k-1)

Question 8

4 pts

If k < N - r, the value of maxValue(r, 1, k) should be the larger of two expressions. One of these expressions has -1 as the second parameter to maxValue. What is it?

values[r][0]+values[r][1]+maxValu

Question 9

4 pts

If k < N - r, the value of maxValue(r, -1, k) should be the larger of three expressions. One of these expressions has 0 as the second parameter to maxValue. What is it?

values[r][0]+maxValue(r+1,0,k-1)

Question 10

4 pts

If k < N - r, the value of maxValue(r, -1, k) should be the larger of three expressions. One of these expressions has 1 as the second parameter to maxValue. What is it?

values[r][1]+maxValue(r+1,1,k-1)

Question 11

4 pts

If k < N - r, the value of maxValue(r, -1, k) should be the larger of three expressions. One of these expressions has -1 as the second parameter to maxValue. What is it?

values[r][0]+values[r][1]+maxValu

Quiz saved at 8:25pm

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