CS 325 - Activity 3
You may work in groups with up to 3 students. When submitting solutions in Gradescope select a page for each problem and the students in your group.

Written: (5 pts)
Canoe Rental Problem: There are n trading posts numbered 1 to n as you travel downstream. At any trading post i you can rent a canoe to be returned at any of the downstream trading posts j, where $j \geq i$. You are given an array R[i, j] defining the costs of a canoe which is picked up at post i and dropped off at post j, for $1 \leq i, j \leq n$. Assume that R[i,i] = 0 and and R[i,j] = -1 if i > j. Your task is to determine a sequence of rentals which start at post 1 and end at post n, and that has the minimum total cost.

a) Give a written description and pseudocode for a DP algorithm to compute the cost of the cheapest sequence of canoe rentals from trading post 1 to n. Give the recursive formula you used to fill in the table or array.

- CanoeCost(R)
- Take in n as a user input.
- Generate the [n*n] table of the costs of the canoe.
- n<-#rows[R]
- C[1]<-0
- for i<- 2 to n
- min <- R[1,i]
- for k <- 2 to i -1
- if C[k] + R[k,i] < min
- min <- C[k] + R[k,i]
- C[i]<-min
- return C[n]

b) Give a written description and pseudocode for code to print the sequence of trading posts visited.

- CanoeSequnce(R)
- n<-#rows[R]
- C[1]<-0, P[1]
- for i <- 2 to n
- min <- R[1,i]
- P[i] <- 1
- for k <- 2 to i -1
- if C[k] + R[k,i] < min
- min <- C[k] + R[k,i]
- P[i]<-k
- C[i]<-min
- return P
- —----------
- PrintSequence(P, i)
- if i > 1
- PrintSequence(P, P[i])
- print “rented at P[i] and dropped off at i”

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- For each of the downstream posts, subtract the highest travel cost possible from the total cost.
    - Store the index of the values in an integer array.
    - Go through the array of indexes and remove any repeats.
    - Print array.

c) What is the running time of your algorithms to find the minimum cost and to find the sequence of trading posts?

DP Problem:

O(n*j) (N in the number of total trading posts, j is the number of downstream trading posts)

Print:

- O(n*j)?

Code: (10 pts)
Implement your algorithms for the Canoe Rental Problem in C++. The test cases have the following structure

Input:
```
4
0 10 15 40
-1 0 5 15
-1 -1 0 8
-1 -1 -1 0
```

Output:
```
23 1 3 4
```

where
Input is the number of trading posts, n, followed by an nxn table of rental costs R. R[i][j] is the cost to rent a canoe at trading post i and return it to trading post j. R[i][i] = 0 R[i][j] = -1 if i > j.

Output the minimum cost and a list of trading posts that were stopped at.

You can use the code template 3 provided. The name of the file you submit to Gradescope must be **act3.cpp**. You may submit multiple times. Select all group members each time you submit and include the names of the group members in your comments.