University of Nevada, Las Vegas Computer Science 477/677 Fall 2026

Answers to Assignment 6: Due Saturday November 14 2026

Follow our TA, Shareem Arjyal's (`arjyal@unlv.nevada.edu`) instructions on how to turn in the assignment.

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet.

However, note that these friends and books, and the internet, will not be able to help you on the tests. I have no way of checking whether someone else did your homework, but if they did, you will not be able to pass the exams.

1. What is the meaning of *topological order* of a directed graph?

   A topological order on a directed graph $G = (V, E)$ is an order "$<$" on V such that $u < v$ implies there is no directed path from v to u. If G has a topological order, G must be acyclic.

2. Let $G = (V, E)$ be an acyclic directed graph of n vertices and m arcs. Describe, in words or pseudocode, an algorithm which finds the maximum number of vertices of any directed path in G.

   We define $u \in V$ to be an *immediate predecessor* of $v \in V$ if $(u, v) \in E$.

   if (n = 0) return 0
   else
   $Max = 1$ let $v_1, v_2, \ldots v_n$ be a list of V in topological order.
   for i from 1 to n
   $M(v_i) = 1$
   for each immediate predecessor u of v_i
   $M(v_i) = max(M(v_i, M(u) + 1)$
   $Max = max(Max, M(v_i))$
   return Max

3. Your company sells boating accessories. You need to choose a hash function for your set of customer files. Which of the following would be a better hash function?

   (a) The last four digits of the customer's social security number.

   (b) the last four digits of the customer's zip code.

   Last four digits of the social security number.

   Why did you make that choice?
   Because customers would be concentrated in zip codes near water.

4. If separate chaining is used to resolve collisions in a hash table of size m which stores n items, Assume that the hash values of the items are chosen inpendently at random. The probability that a given place

has exactly k items is given by the Poisson distibution. If $m = 100$ and $n = 200$, the average number of items in a place is 2. Approximately how many places are expected to have exactly 2 items? Choose from the following list.

100

55

45

27

21

13

The expected number is irrational, but is close to 27.

5. You are trying to construct a cuckoo hash table of size 10, where each of the 9 names listed below has two possible hash values, as indicated in the array. Can you construct that table such that no two names are assigned the same hash value? Construct the table, or show that it can't be done by using Hall's marriage theorem.

	h1	h2
Ann	0	3
Bob	1	3
Ted	6	8
Sue	3	6
Gus	2	7
Cal	4	7
Dan	1	9
Sal	6	9
Eve	5	8

0	Ann
1	~~Bob~~ ~~Dan~~ Bob
2	Gus
3	~~Sue~~ ~~Bob~~ Sue
4	Cal
5	Eve
6	~~Ted~~ ~~Sue~~ Sal
7	
8	Ted
9	Dan

It is possible for each name to be assigned a unique place. Executing the algorithm is shown in the table on the right.

6. A 3-dimensional $9 \times 7 \times 10$ rectangular array A is stored in main memory in row major order, and its base address is 8192. Each item of A takes one word of main memory, that is, one addressed location. Find the address of A[4][5][2].

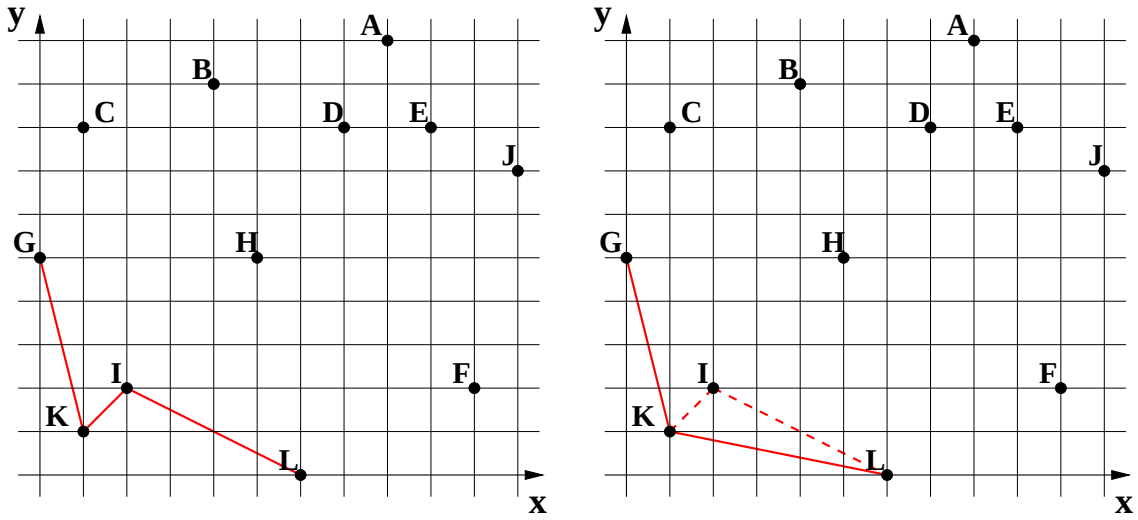
   We assume that the intial value of each index is 0. When A is written in row-major order, the number of predecessors of A[i][j][k] is $i * 7 * 10 + j * 10 + k$, hence A[4][j][k] has $280 + 50 + 2 = 332$ predecessors. Each predecessor takes 1 position in that memory, hence it is located at position $8192 + 332 * 1 = 8424$ in main memory.

7. Write, in correct C++ code, a dynamic programming algorithm for another version of the coin-row problem. Assume that a sequence of positive numbers $X[N]$ is given, where $X[i]$ is the value of the i^{th} coin in the row. Find the maximum total value of any subset of the coins subject to the restriction that no two coins which are either adjacent or have just one coin between them can be in the subset. For example, if the subset contains the first coin, it cannot contain the second or the third coin.

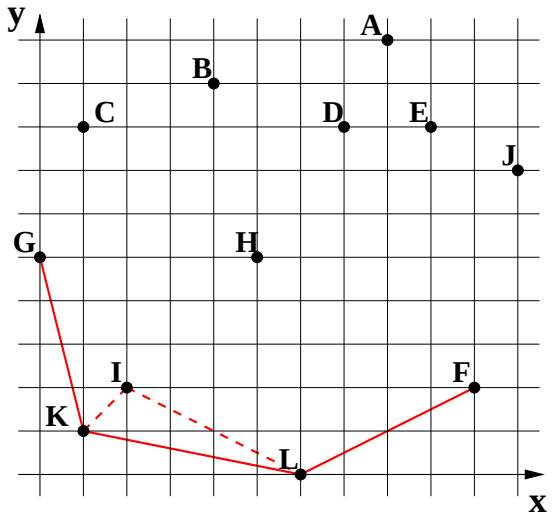
Let $A[i]$ be the maximum value of any legal subset of the first i coins. It appears that the number of coins is N-1, but perhaps it is N. In the code below, I will assume that there are N coins.

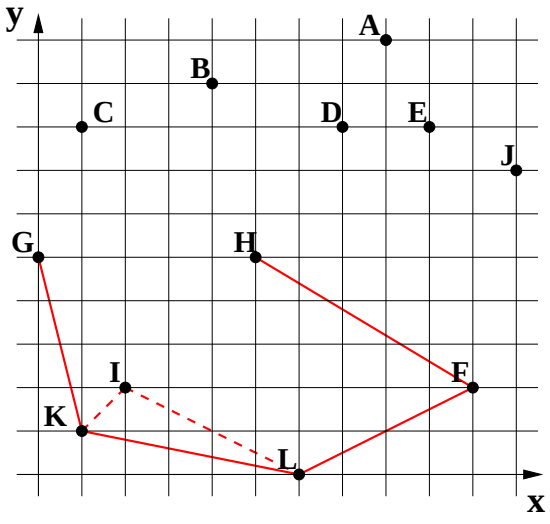
```
int A[N+1];
A[0] = 0; // default
A[1] = X[1];
A[2] = max(A[1],X[2]);
A[3] = max(A[2],X[3]);
for(int i = 4; i <= N; i++)
 A[i] = max(max(A[i-1],A[i-2]),A[i-3]+X[i]);
return A[N];
```

8. Use Graham Scan to find the convex hull of the set of points illustrated in the figure below. To make things easier for the grader, let G be the pivot, and sort the other points by the slope of the line segment from G to the point. Do not erase deleted lines.



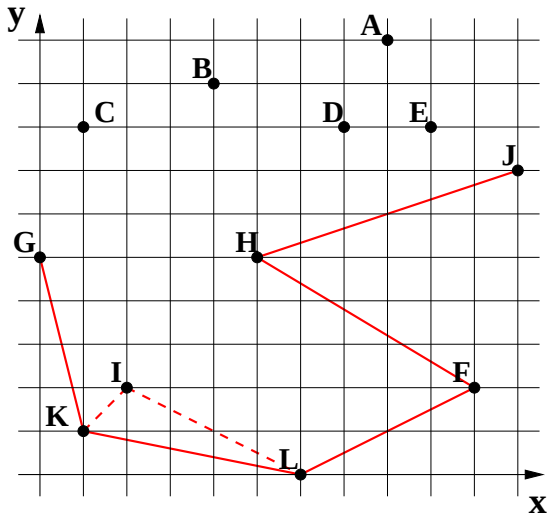
From pivot G, We visit the vertices in order: K,I,L,F,H,J,E,D,A,B,C, then back to G.

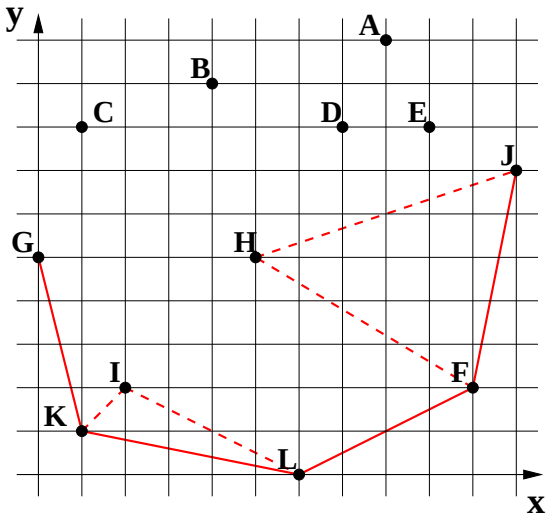




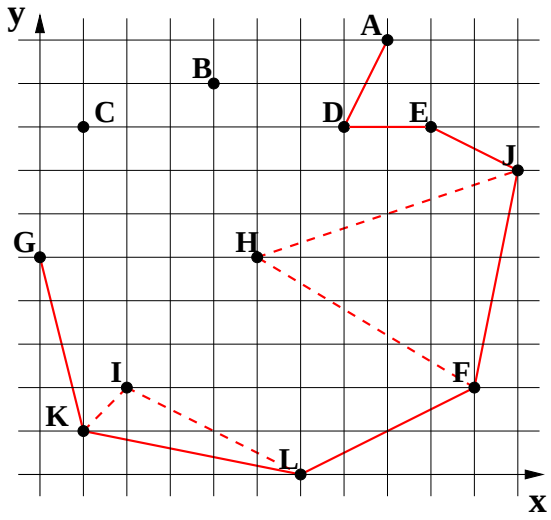
G,K,I,

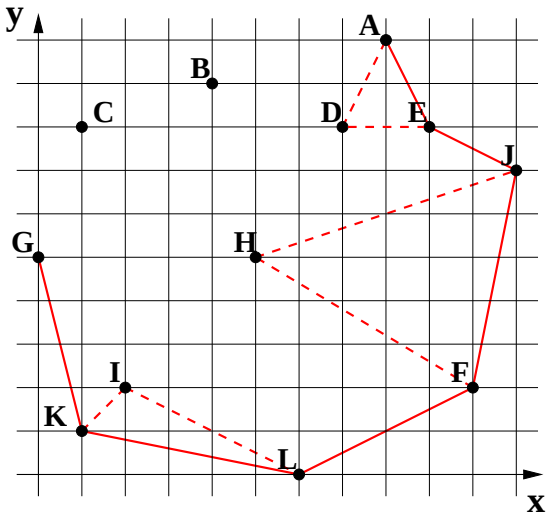
but IL is a right turn. Delete KI and IL, replace with KL.



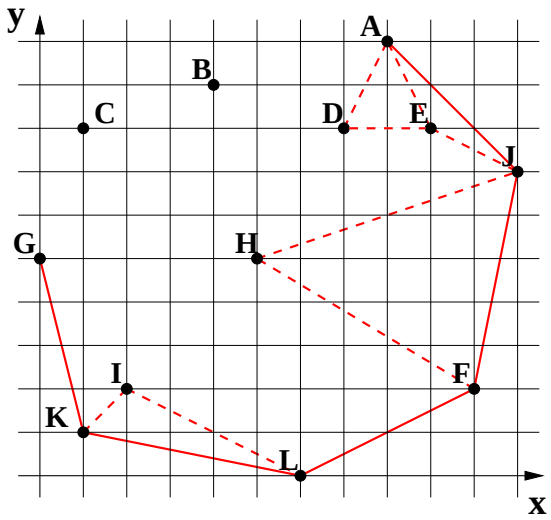


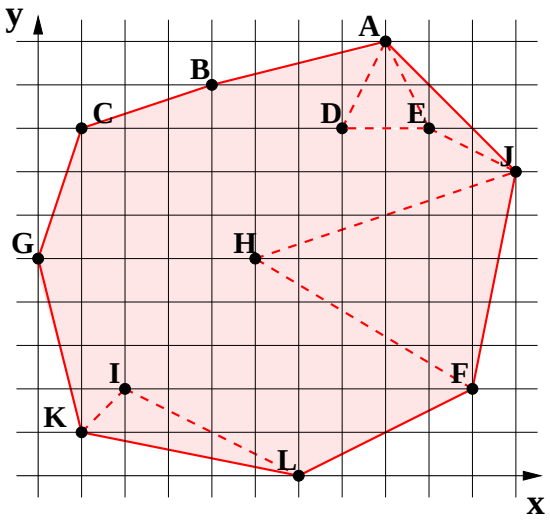
GH, HJ is a right turn. Replace GH and HJ with GJ.





ED, DA is a right turn. Replace ED and DA with EA.





JE, EA is a right turn. Replace JE and KA with JA

All remaining steps are left turns, and we return to G. The outer polygon is GKLFJABCG. The convex hull consists of the polygon and its interior.