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Week 7 Quiz

The due date for submitting this assignment has passed.

Due on 2021-10-13, 23:59 IST.

Score: 10/10=100%

Assignment submitted on 2021-10-12, 15:07 IST

All questions carry equal weightage. You may submit as many times as you like within the deadline. Your final submission will be graded.

You are playing an old-style video game in which you have to shoot down alien spaceships as they fly across the screen from left to right. Each spaceship flies across the screen at a specified height. You have an antiaircraft gun set to shoot down all spaceships at a certain height. Spaceships fly one at a time, so if your gun is set to fire at the correct height, it will shoot down the spaceship currently flying across the screen.

You can set the initial height at which the gun fires. As the game progresses, you can reset the height, but only to a lower value. You are given in advance the height at which each spaceship flies. There are n spaceships numbered 1, 2, … , n in the order in which they fly across the screen. For 1 ≤ i ≤ n, h[i] denotes the height at which spaceship i flies.

1) Let V[i] denote the maximum number of spaceships from i, i+1, … , n that you can shoot down with a single gun, assuming you start by shooting V[i]. Which of the following is a valid recursive formulation of V[i]? (Note that the maximum of an empty set is defined to be 0.) ***2 points***

- V[1] = 1
  For 1 ≤ i ≤ n, V[i] = 1 + max{V[j] | j < i and h[j] ≤ h[i]}

- V[1] = 1
  For $1 \le i \le n$, $V[i] = 1 + \max\{V[j] \mid j < i \text{ and } h[i] \le h[j]\}$
- V[n] = 1
  For $1 \le i \le n$, $V[i] = 1 + \max\{V[j] \mid j > i \text{ and } h[i] \ge h[j]\}$
- V[n] = 1
  For $1 \le i \le n$, $V[i] = 1 + \max\{V[j] \mid j > i \text{ and } h[j] \ge h[i]\}$

Yes, the answer is correct.
Score: 2

Feedback:
The problem is the same as finding the longest descending subsequence.

Accepted Answers:
V[n] = 1
For $1 \le i \le n$, $V[i] = 1 + \max\{V[j] \mid j > i \text{ and } h[i] \ge h[j]\}$

2) What is the size of the memo table for this problem? ***2 points***

- n-1
- n
- n+1
- n^2

Yes, the answer is correct.
Score: 2

Feedback:
One entry per spaceship, n spaceships

Accepted Answers:
n

3) What is a good order to compute the values of V[i] using dynamic programming? ***2 points***

- From V[n] to V[1]
- From V[1] to V[n]
- Either from V[n] to V[1] or from V[1] to V[n]
- None of these

Yes, the answer is correct.
Score: 2

Feedback:
V[i] depends on V[j], $i < j \le n$

Accepted Answers:
From V[n] to V[1]

4) How much time will it take to compute V[1] using standard dynamic programming? ***2 points***

- O(n)
- O(n log n)
- $O(n^2)$
- $O(n^2 \log n)$

Yes, the answer is correct.
Score: 2

Feedback:

Computing V[i] requires scanning V[i+1] to V[n] so it takes time O(n-i). Hence, the overall time is 1+2+...+n-1 or $O(n^2)$

Accepted Answers:
$O(n^2)$

5) Suppose we have 30 spaceships whose heights are as follows.

[71, 68, 98, 46, 33, 48, 51, 5, 54, 28, 28, 92, 65, 15, 41, 63, 21, 34, 84, 98, 70, 44, 58, 91, 12, 67, 61, 27, 91, 6]

What is the maximum number of spaceships we can shoot down starting from the first one?

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Yes, the answer is correct.
Score: 2

Accepted Answers:
(Type: Numeric) 9

2 points