50 1D Dynamic Programming Practice Questions

Basic Level (Questions 1-15)

1. Fibonacci Sequence

Calculate the 15th Fibonacci number using dynamic programming with tabular method. F(0) = 0, F(1) = 1, F(n) = F(n-1) + F(n-2).

2. Climbing Stairs - Variant 1

You are climbing a staircase with 8 steps. Each time you can climb 1 or 2 steps. In how many distinct ways can you reach the top?

3. Climbing Stairs - Variant 2

You are climbing a staircase with 12 steps. Each time you can climb 1, 2, 3, or 4 steps. In how many distinct ways can you reach the top?

4. Minimum Cost Climbing Stairs

Given cost array: [10, 15, 20, 5, 10, 5, 15]. You can start from index 0 or 1 and can climb 1 or 2 steps. Find the minimum cost to reach the top (beyond last index).

5. House Robber - Simple

Houses: [2, 7, 9, 3, 1]. You cannot rob two adjacent houses. What is the maximum amount you can rob?

6. Maximum Sum - Non-Adjacent Elements

Array: [5, 1, 3, 8, 2, 9]. Find the maximum sum of non-adjacent elements.

7. Coin Change - Minimum Coins

Coins: [1, 5, 10, 25]. Amount: 47. Find the minimum number of coins needed to make the amount.

8. Coin Change - Number of Ways

Coins: [1, 2, 5]. Amount: 11. In how many ways can you make the amount?

9. Jump Game - Can Reach End

Array: [2, 3, 1, 1, 4]. Each element represents max jump length from that position. Can you reach the last index? (Return 1 for yes, 0 for no)

10. Decode Ways

A message containing letters A-Z is encoded as '1'-'26'. Given string "226", how many ways can it be decoded? (e.g., "226" = "BZ", "VF", "BBF")

11. Maximum Product Subarray - Positive Only

Array: [2, 3, 4, 5]. Find the maximum product of a contiguous subarray.

12. Best Time to Buy and Sell Stock

Prices: [7, 1, 5, 3, 6, 4]. Find maximum profit from one buy and one sell transaction.

13. Count Binary Strings Without Consecutive 1s

Find the number of binary strings of length 6 that don't have consecutive 1s.

14. Tiling Problem

You have a 2×8 board and tiles of size 2×1. In how many ways can you tile the board?

15. Paint House - Two Colors

Houses: 5. Cost to paint each house Red or Blue: [[17,2], [16,16], [14,3], [19,5], [3,18]]. No two adjacent houses same color. Find minimum cost.

Intermediate Level (Questions 16-35)

16. House Robber II - Circular

Houses arranged in circle: [2, 3, 2, 7, 1]. Cannot rob adjacent houses. First and last are adjacent. Maximum amount?

17. Longest Increasing Subsequence Length

Array: [10, 9, 2, 5, 3, 7, 101, 18]. Find length of longest strictly increasing subsequence.

18. Maximum Sum Increasing Subsequence

Array: [1, 101, 2, 3, 100, 4, 5]. Find maximum sum of an increasing subsequence.

19. Minimum Jumps to Reach End

Array: [2, 3, 1, 1, 2, 4, 2, 0, 1, 1]. Find minimum number of jumps to reach the last index.

20. Delete and Earn

Array: [3, 4, 2, 3, 4]. If you pick a number x, you earn x points but delete all x-1 and x+1. Maximum points?

21. Ugly Numbers

Find the 15th ugly number. Ugly numbers have only prime factors 2, 3, or 5. (1, 2, 3, 4, 5, 6, 8...)

22. Perfect Squares

Given n = 43, find the least number of perfect square numbers that sum to n.

23. Integer Break

Given n = 10, break it into at least 2 positive integers and maximize their product. What is the maximum product?

24. Wiggle Subsequence

Array: [1,7,4,9,2,5]. A wiggle sequence alternates between increasing and decreasing. Find longest wiggle subsequence length.

25. Arithmetic Slices

Array: [1, 2, 3, 4, 7, 10, 13]. Find number of arithmetic subarrays (at least 3 elements with same difference).

26. Paint Fence

You have 7 fence posts and 3 colors. No more than 2 adjacent posts can have the same color. How many ways to paint?

27. Domino and Tromino Tiling

You have a 2×5 board. You can use 2×1 dominos and L-shaped trominos. How many ways to tile it?

28. Knight Dialer

On a phone keypad, a knight can move in chess L-shape. Starting from digit 4, how many distinct 10-digit numbers can be dialed?

29. Partition Equal Subset Sum - Possible?

Array: [1, 5, 11, 5]. Can you partition into two subsets with equal sum? (Return 1 for yes, 0 for no)

30. Last Stone Weight II

Stones: [2, 7, 4, 1, 8, 1]. Smash stones together to minimize the final stone weight. What is minimum possible weight?

31. Counting Bits

For all numbers from 0 to 8, count the number of 1s in their binary representation. Sum all counts.

32. Russian Doll Envelopes - 1D Version

Widths: [5, 4, 6, 7, 3, 2, 8]. Heights: [4, 5, 6, 2, 3, 1, 9]. You can fit envelope (w1,h1) into (w2,h2) if w1<w2 and h1<h2. Maximum nesting?

33. Best Time to Buy and Sell Stock with Cooldown

Prices: [1, 2, 3, 0, 2]. After selling, must cooldown 1 day before buying again. Maximum profit?

34. Word Break - Possible?

String: "leetcode", Dictionary: ["leet", "code"]. Can the string be segmented into dictionary words? (Return 1 for yes, 0 for no)

35. Palindrome Partitioning II

String: "aabbc". Find minimum cuts needed so each substring is a palindrome.

Advanced Level (Questions 36-50)

36. Maximum Length of Repeated Subarray - Same Array

Array: [1,2,3,2,1,3,2,1]. Find length of longest repeated contiguous subarray (appears twice).

37. Length of Longest Fibonacci Subsequence

Array: [1, 2, 3, 4, 5, 6, 7, 8]. Find length of longest Fibonacci-like subsequence (at least 3 elements).

38. Longest Arithmetic Subsequence

Array: [3, 6, 9, 12, 15, 18, 21]. Find length of longest arithmetic subsequence.

39. Count Different Palindromic Subsequences

String: "abba". Count distinct palindromic subsequences. (Result modulo 10^9+7)

40. Minimum ASCII Delete Sum

String1: "sea", String2: "eat". Find minimum ASCII sum of deleted characters to make strings equal.

41. Coin Change 2 with Limits

Coins: [2, 3, 5], each coin can be used at most twice. Amount: 9. How many ways to make the amount?

42. Shopping Offers - Simplified 1D

Item costs: [2, 3, 4]. Special offer: pay 7 get 2 of each. You need: [2, 2, 2] items. Minimum cost?

43. Best Time to Buy and Sell Stock III - Two Transactions

Prices: [3, 3, 5, 0, 0, 3, 1, 4]. Complete at most 2 transactions. Maximum profit?

44. Best Time to Buy and Sell Stock IV - K Transactions

Prices: [2, 4, 1, 5, 2, 6, 3]. Complete at most K=2 transactions. Maximum profit?

45. Minimum Swaps To Make Sequences Increasing

Array A: [1, 3, 5, 4], Array B: [1, 2, 3, 7]. Swap same indices to make both strictly increasing. Minimum swaps?

46. Profitable Schemes

You have 5 workers. Schemes require workers: [2, 2, 3] and generate profit: [2, 3, 4]. Need minimum profit of 5. Count valid combinations.

47. Knight Probability in Chessboard

8×8 board. Knight starts at (0,0). After 3 moves, what's probability knight stays on board? (Give as fraction in simplest form)

48. Freedom Trail - Character Distances

Ring: "godding", Key: "gd". At each step, rotate ring and press button. Minimum total rotations needed? (Ring length 7, can rotate clockwise or counter-clockwise)

49. Number of Ways to Stay in Same Place

Array length: 5. You start at index 0. You have 6 moves. Each move: stay, go left, or go right. Count ways to end at index 0.

50. Stone Game - Optimal Play

Piles: [5, 3, 4, 5, 8, 2, 7, 3]. Two players alternate taking from ends. Both play optimally. What's the maximum difference (winner score - loser score)?

Instructions for Students:

1. Write the recursive formula/recurrence relation for each problem
2. Identify base cases
3. Solve using tabular method (bottom-up approach)
4. Build the DP table step by step
5. State the final answer clearly
6. Analyze time and space complexity

Note: All problems should be solved iteratively using dynamic programming. Recursive solutions without memoization or tabulation will receive partial credit only.