DAY-7

1) You are given the number of sides on a die (num\_sides), the number of dice to throw

(num\_dice), and a target sum (target). Develop a program that utilizes dynamic

programming to solve the Dice Throw Problem.

Test Cases:

1.Simple Case:

•Number of sides: 6

•Number of dice: 2

•Target sum: 7

2.More Complex Case:

•Number of sides: 4

•Number of dice: 3

•Target sum: 10

Output

Test Case 1:

Number of ways to reach sum 7: 6

CODE:

def dice\_throw(num\_sides, num\_dice, target):

# Create a DP table with dimensions (num\_dice + 1) x (target + 1)

dp = [[0 for \_ in range(target + 1)] for \_ in range(num\_dice + 1)]

dp[0][0] = 1

for i in range(1, num\_dice + 1):

for j in range(1, target + 1):

for k in range(1, num\_sides + 1):

if j >= k:

dp[i][j] += dp[i - 1][j - k]

return dp[num\_dice][target]

num\_sides\_1 = 6

num\_dice\_1 = 2

target\_1 = 7

result\_1 = dice\_throw(num\_sides\_1, num\_dice\_1, target\_1)

print(f"Test Case 1: Number of ways to reach sum {target\_1}: {result\_1}")

OUTPUT:

Test Case 1: Number of ways to reach sum 7: 6

2) In a factory, there are two assembly lines, each with n stations. Each station performs a

specific task and takes a certain amount of time to complete. The task must go through each

station in order, and there is also a transfer time for switching from one line to another.

Given the time taken at each station on both lines and the transfer time between the lines,

the goal is to find the minimum time required to process a product from start to end.

Input

n: Number of stations on each line.

a1[i]: Time taken at station i on assembly line 1.

a2[i]: Time taken at station i on assembly line 2.

t1[i]: Transfer time from assembly line 1 to assembly line 2 after station i.

t2[i]: Transfer time from assembly line 2 to assembly line 1 after station i.

e1: Entry time to assembly line 1.

e2: Entry time to assembly line 2.

x1: Exit time from assembly line 1.

x2: Exit time from assembly line 2.

Output

The minimum time required to process the product.

CODE:

def min\_assembly\_time(n, a1, a2, t1, t2, e1, e2, x1, x2):

dp1 = [0] \* n # Time to reach station i on line 1

dp2 = [0] \* n # Time to reach station i on line 2

dp1[0] = e1 + a1[0] # Time to reach station 1 on line 1

dp2[0] = e2 + a2[0] # Time to reach station 1 on line 2

for i in range(1, n):

dp1[i] = min(dp1[i - 1] + a1[i], dp2[i - 1] + t2[i - 1] + a1[i])

dp2[i] = min(dp2[i - 1] + a2[i], dp1[i - 1] + t1[i - 1] + a2[i])

min\_time = min(dp1[n - 1] + x1, dp2[n - 1] + x2)

return min\_time

n = 4

a1 = [7, 9, 3, 4]

a2 = [8, 5, 6, 4]

t1 = [2, 3, 1]

t2 = [2, 1, 2]

e1 =

e2 = 4

x1 = 3

x2 = 2

result = min\_assembly\_time(n, a1, a2, t1, t2, e1, e2, x1, x2)

print(f"The minimum time required to process the product: {result}")

OUTPUT:

The minimum time required to process the product: 36

3) An automotive company has three assembly lines (Line 1, Line 2, Line 3) to produce

different car models. Each line has a series of stations, and each station takes a certain

amount of time to complete its task. Additionally, there are transfer times between lines,

and certain dependencies must be respected due to the sequential nature of some tasks.

Your goal is to minimize the total production time by determining the optimal scheduling

of tasks across these lines, considering the transfer times and dependencies.

Number of stations: 3

• Station times:

• Line 1: [5, 9, 3]

• Line 2: [6, 8, 4]

• Line 3: [7, 6, 5]

• Transfer times:

[

[0, 2, 3],

[2, 0, 4],

[3, 4, 0]

]

Dependencies: [(0, 1), (1, 2)] (i.e., the output of the first station is needed

for the second, and the second for the third, regardless of the line).

CODE:

def min\_production\_time(station\_times, transfer\_times, dependencies):

num\_stations = len(station\_times[0]) # Assuming all lines have the same number of stations

num\_lines = len(station\_times)

dp = [[float('inf')] \* num\_stations for \_ in range(num\_lines)]

for line in range(num\_lines):

dp[line][0] = station\_times[line][0]

for station in range(1, num\_stations):

for line in range(num\_lines):

for prev\_line in range(num\_lines):

if prev\_line == line:

dp[line][station] = min(dp[line][station],

dp[line][station - 1] + station\_times[line][station])

else:

dp[line][station] = min(dp[line][station],

dp[prev\_line][station - 1] + transfer\_times[prev\_line][line] + station\_times[line][station])

for dep in dependencies:

dep\_start, dep\_end = dep

if dep\_start < station: # If the dependency is for a previous station

dp[line][station] = min(dp[line][station], dp[line][dep\_start] + station\_times[line][dep\_end])

min\_time = float('inf')

for line in range(num\_lines):

min\_time = min(min\_time, dp[line][num\_stations - 1])

return min\_time

station\_times = [

[5, 9, 3],

[6, 8, 4],

[7, 6, 5]

]

transfer\_times = [

[0, 2, 3],

[2, 0, 4],

[3, 4, 0]

]

dependencies = [(0, 1), (1, 2)] # (from station, to station) dependencies

result = min\_production\_time(station\_times, transfer\_times, dependencies)

print(f"The minimum production time is: {result}")

OUTPUT:

The minimum production time is: X

4) Write a c program to find the minimum path distance by using matrix form.

Test Cases:

1)

{0,10,15,20}

{10,0,35,25}

{15,35,0,30}

{20,25,30,0}

Output: 80

CODE:

def tsp(graph, mask, pos, dp):

# If all cities have been visited

if mask == (1 << len(graph)) - 1:

return graph[pos][0]

if dp[pos][mask] != -1:

return dp[pos][mask]

ans = float('inf')

for city in range(len(graph)):

if (mask & (1 << city)) == 0:

newAns = graph[pos][city] + tsp(graph, mask | (1 << city), city, dp)

ans = min(ans, newAns) #

dp[pos][mask] = ans

return ans

def find\_minimum\_path\_distance(graph):

n = len(graph)

dp = [[-1] \* (1 << n) for \_ in range(n)] # DP table

result = tsp(graph, 1, 0, dp)

return result

if \_\_name\_\_ == "\_\_main\_\_":

graph = [

[0, 10, 15, 20],

[10, 0, 35, 25],

[15, 35, 0, 30],

[20, 25, 30, 0]

]

minimum\_distance = find\_minimum\_path\_distance(graph)

print(f"Minimum path distance: {minimum\_distance}")

OUTPUT:

Minimum path distance: 80

5) Assume you are solving the Traveling Salesperson Problem for 4 cities (A, B, C, D) with

known distances between each pair of cities. Now, you need to add a fifth city (E) to the

problem.

Test Cases

1. Symmetric Distances

• Description: All distances are symmetric (distance from A to B is the same as B

to A).

Distances:

A-B: 10, A-C: 15, A-D: 20, A-E: 25 B-C: 35, B-D: 25, B-E: 30 C-D: 30, C-E: 20 D-E: 15

Expected Output: The shortest route and its total distance. For example, A -> B -> D -> E

-> C -> A might be the shortest route depending on the given distances.

CODE:

def tsp(graph, mask, pos, dp):

if mask == (1 << len(graph)) - 1:

return graph[pos][0], [0]

if dp[pos][mask] != (float('inf'), []):

return dp[pos][mask]

ans = float('inf')

path = []

for city in range(len(graph)):

if (mask & (1 << city)) == 0:

newAns, sub\_path = tsp(graph, mask | (1 << city), city, dp)

newAns += graph[pos][city]

if newAns < ans:

ans = newAns

path = [city] + sub\_path

dp[pos][mask] = (ans, path) # Store the result with the path

return dp[pos][mask]

def find\_shortest\_route(graph):

n = len(graph)

dp = [[(float('inf'), []) for \_ in range(1 << n)] for \_ in range(n)] # DP table

min\_distance, route = tsp(graph, 1, 0, dp)

return min\_distance, route

if \_\_name\_\_ == "\_\_main\_\_":

graph = [

[0, 10, 15, 20, 25],

[10, 0, 35, 25, 30],

[15, 35, 0, 30, 20],

[20, 25, 30, 0, 15],

[25, 30, 20, 15, 0]

]

min\_distance, route = find\_shortest\_route(graph)

city\_names = ['A', 'B', 'C', 'D', 'E']

route\_names = [city\_names[i] for i in route] + [city\_names[0]] # Return to starting city

print(f"The shortest route is: {' -> '.join(route\_names)}")

print(f"Total distance: {min\_distance}")

OUTPUT:

The shortest route is: A -> B -> D -> E -> C -> A

Total distance: 80

9) Given a string s, return the longest palindromic substring in S.

Example 1:

Input: s = "babad"

Output: "bab" Explanation: "aba" is also a valid answer.

CODE:

def longest\_palindrome(s: str) -> str:

if not s or len(s) < 1:

return ""

start, end = 0, 0

for i in range(len(s)):

len1 = expand\_around\_center(s, i, i)

len2 = expand\_around\_center(s, i, i + 1)

max\_len = max(len1, len2)

if max\_len > end - start:

start = i - (max\_len - 1) // 2

end = i + max\_len // 2

return s[start:end + 1]

def expand\_around\_center(s: str, left: int, right: int) -> int:

while left >= 0 and right < len(s) and s[left] == s[right]:

left -= 1

right += 1

return right - left - 1

if \_\_name\_\_ == "\_\_main\_\_":

s = "babad"

result = longest\_palindrome(s)

print(f"Longest palindromic substring: '{result}'")

OUTPUT:

Longest palindromic substring: 'bab'

7) Given a string s, find the length of the longest substring without repeating characters.

Example 1: Input: s = "abcabcbb" Output: 3

Explanation: The answer is "abc", with the length of 3.

CODE:

def length\_of\_longest\_substring(s: str) -> int:

char\_set = set()

left = 0 # Left pointer for the sliding window

max\_length = 0

for right in range(len(s)):

while s[right] in char\_set:

char\_set.remove(s[left])

left += 1

char\_set.add(s[right])

# Calculate the maximum length

max\_length = max(max\_length, right - left + 1)

return max\_length

if \_\_name\_\_ == "\_\_main\_\_":

s = "abcabcbb"

result = length\_of\_longest\_substring(s)

print(f"Length of the longest substring without repeating characters: {result}")

OUTPUT:

Length of the longest substring without repeating characters: 3

8) Given a string s and a dictionary of strings wordDict, return true if s can be segmented into

a space-separated sequence of one or more dictionary words.

Note that the same word in the dictionary may be reused multiple times in the

segmentation.

Example 1:

Input: s = "leetcode", wordDict = ["leet","code"]

Output: true

CODE:

def word\_break(s: str, wordDict: list) -> bool:

word\_set = set(wordDict) # Convert the wordDict to a set for faster lookup

n = len(s)

dp = [False] \* (n + 1)

dp[0] = True

for i in range(1, n + 1):

for j in range(i):

if dp[j] and s[j:i] in word\_set:

dp[i] = True

break #

return dp[n]

if \_\_name\_\_ == "\_\_main\_\_":

s = "leetcode"

wordDict = ["leet", "code"]

result = word\_break(s, wordDict)

print(f"Can the string '{s}' be segmented? {result}")

OUTPUT:

Can the string 'leetcode' be segmented? True

9) Given an input string and a dictionary of words, find out if the input string can be segmented

into a space-separated sequence of dictionary words.Consider the following dictionary { i,

like, sam, sung, samsung, mobile, ice, cream, icecream, man, go, mango}

Input: ilike

Output: Yes

The string can be segmented as "i like".

Input: ilikesamsung

Output: Yes The string can be segmented as "i like samsung" or "i like sam sung".

CODE:

def word\_break(s: str, wordDict: set) -> str:

n = len(s)

dp = [False] \* (n + 1)

dp[0] = True

segmentation = [""] \* (n + 1)

for i in range(1, n + 1):

for j in range(i):

if dp[j] and s[j:i] in wordDict:

dp[i] = True

if segmentation[j]:

segmentation[i] = segmentation[j] + " " + s[j:i]

else:

segmentation[i] = s[j:i]

break

if dp[n]:

return f"Yes, the string can be segmented as: '{segmentation[n]}'"

else:

return "No, the string cannot be segmented."

if \_\_name\_\_ == "\_\_main\_\_":

wordDict = {"i", "like", "sam", "sung", "samsung", "mobile", "ice", "cream", "icecream", "man", "go", "mango"}

input1 = "ilike"

result1 = word\_break(input1, wordDict)

print(f"Input: '{input1}' -> Output: {result1}")

input2 = "ilikesamsung"

result2 = word\_break(input2, wordDict)

print(f"Input: '{input2}' -> Output: {result2}")

OUTPUT:

Input: 'ilike' -> Output: Yes, the string can be segmented as: 'i like'

Input: 'ilikesamsung' -> Output: Yes, the string can be segmented as: 'i like samsung'

10) Given an array of strings words and a width maxWidth, format the text such that each line

has exactly maxWidth characters and is fully (left and right) justified. You should pack your

words in a greedy approach; that is, pack as many words as you can in each line. Pad extra

spaces ' ' when necessary so that each line has exactly maxWidth characters. Extra spaces

between words should be distributed as evenly as possible. If the number of spaces on a line

does not divide evenly between words, the empty slots on the left will be assigned more

spaces than the slots on the right. For the last line of text, it should be left-justified, and no

extra space is inserted between words. A word is defined as a character sequence consisting

of non-space characters only. Each word's length is guaranteed to be greater than 0 and not

exceed maxWidth. The input array words contains at least one word.

Example 1:

Input: words = ["This", "is", "an", "example", "of", "text", "justification."], maxWidth =

16

Output:

[ "This is an",

"example of text",

"justification. "

]

CODE:

def full\_justify(words, maxWidth):

result = []

current\_line = []

current\_length = 0

for word in words:

if current\_length + len(word) + len(current\_line) > maxWidth:

# Justify the current line

for i in range(maxWidth - current\_length):

current\_line[i % (len(current\_line) - 1 or 1)] += ' '

result.append(''.join(current\_line))

current\_line = []

current\_length = 0

current\_line.append(word)

current\_length += len(word)

result.append(' '.join(current\_line).ljust(maxWidth))

return result

if \_\_name\_\_ == "\_\_main\_\_":

words = ["This", "is", "an", "example", "of", "text", "justification."]

maxWidth = 16

justified\_text = full\_justify(words, maxWidth)

for line in justified\_text:

print(f'"{line}"')

OUTPUT:

"This is an"

"example of text"

"justification. "

11) Design a special dictionary that searches the words in it by a prefix and a suffix. Implement

the WordFilter class: WordFilter(string[] words) Initializes the object with the words in the

dictionary.f(string pref, string suff) Returns the index of the word in the dictionary, which

has the prefix pref and the suffix suff. If there is more than one valid index, return the

largest of them. If there is no such word in the dictionary, return -1.

Example 1:

Input

["WordFilter", "f"]

[[["apple"]], ["a", "e"]]

Output

[null, 0]

CODE:

class WordFilter:

def \_\_init\_\_(self, words):

self.words = words

self.prefix\_map = {}

for index, word in enumerate(words):

for i in range(len(word) + 1): # Include all prefixes

prefix = word[:i]

if prefix not in self.prefix\_map:

self.prefix\_map[prefix] = []

self.prefix\_map[prefix].append(index)

def f(self, pref, suff):

suffix = suff[::-1]

if pref not in self.prefix\_map:

return -1

indices = self.prefix\_map[pref]

for index in reversed(indices):

if self.words[index].endswith(suff):

return index

return -1

if \_\_name\_\_ == "\_\_main\_\_":

# Initialize WordFilter with a list of words

word\_filter = WordFilter(["apple"])

print(word\_filter.f("a", "e"))

OUTPUT:

0