BACK TRACKING METHOD

CSA0695

DESIGN ANALYSIS AND ALGORITHMS FOR AMORTIZED ANALYSIS

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PROBLEM STATEMENT:

There are n tasks assigned to you. The task times are represented as an integer array tasks of length n, where the ith task takes tasks[i] hours to finish. A work session is when you work for at most session Time consecutive hours and thentake a break. You should finish the given tasks in a way that satisfies the following conditions: If you start a task in a work session, you must complete it in the same work session. You can start a new task immediately after finishing the previous one. You may complete the tasks in any order. Given tasks and sessionTime,return the minimum number of work sessions needed to finish all the tasks following the conditions above.

The tests are generated such that sessionTime is greater than or equal to the maximum element in tasks[i].

Example 1:

Input: tasks = [1,2,3], sessionTime = 3

Output: 2

Explanation: You can finish the tasks in two work sessions.

- First work session: finish the first and the second tasks in 1 + 2 = 3 hours.

- Second work session: finish the third task in 3 hours.

ABSTRACT:

The problem is about scheduling tasks into work sessions such that the total time spent in each session does not exceed a given limit (sessionTime). The solution involves partitioning the tasks into the minimum number of groups where the total duration of each group does not exceed sessionTime. This problem can be solved using a combination of greedy algorithms and backtracking.

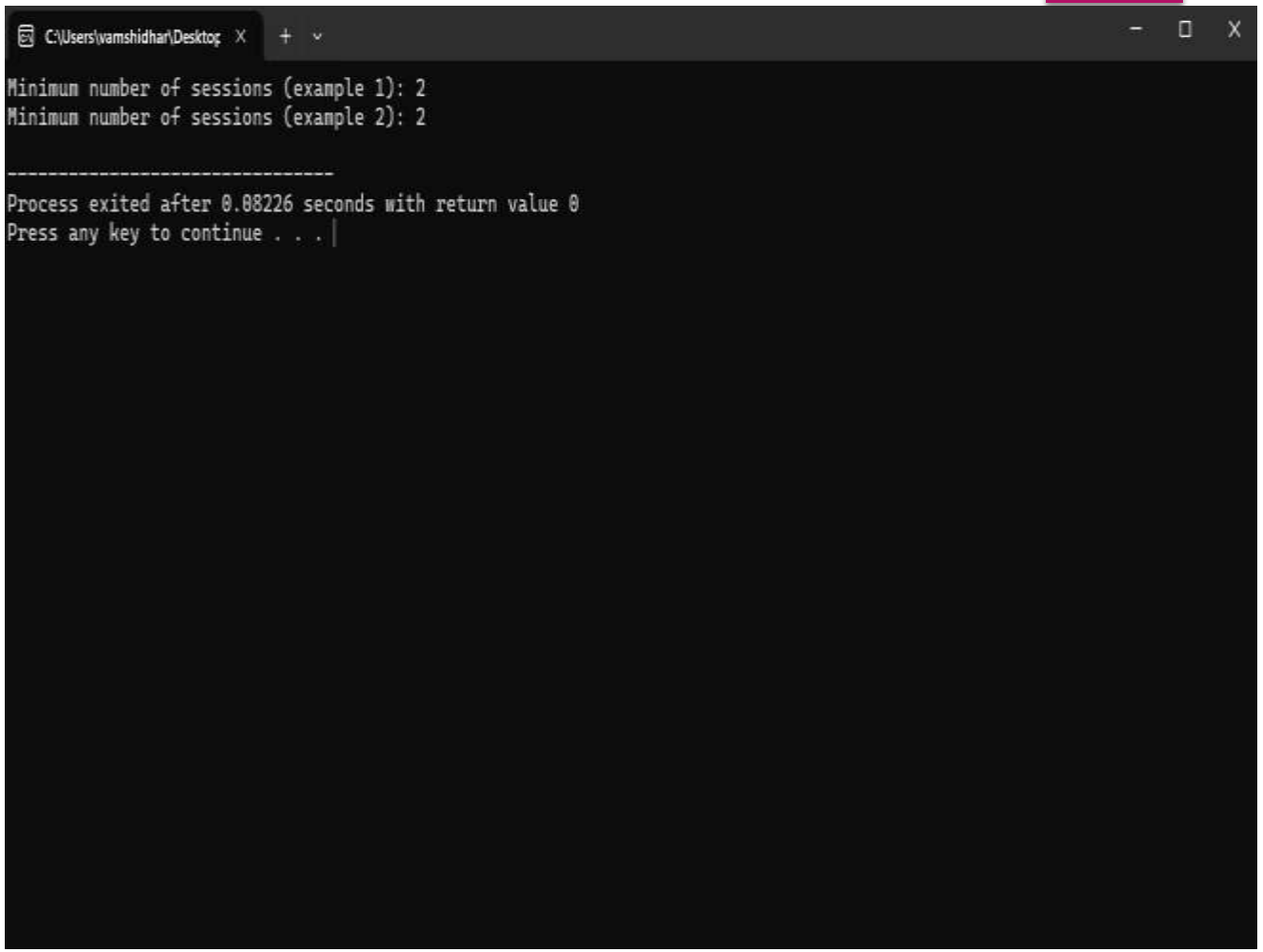
INTRODUCTION

This problem involves scheduling tasks such that the total number of work sessions is minimized. Each session allows for continuous work of up to sessionTime hours, and tasks must be completed without interruptions. The goal is to determine the fewest work sessions required to complete all tasks, where tasks can be rearranged but each must be fully finished within a single session.

KEY FEATURES:

- Key features of this problem include the constraints that tasks must fit within the sessionTime limit, tasks can be reordered, and each task must be completed within one session. The solution explores how to efficiently schedule tasks into these sessions, optimizing for the fewest number of sessions while ensuring no session exceeds the time limit. The input guarantees that no task is larger than the sessionTime.

OUTPUT


C:\Users\vamshidhar\Desktop
Minimum number of sessions (example 1): 2
Minimum number of sessions (example 2): 2

Process exited after 0.08226 seconds with return value 0
Press any key to continue . . .

COMPLEXITY ANALYSIS

- **Time Complexity**: The time complexity of the provided code is influenced by both the binary search and the recursive backtracking approach. The binary search operation iterates over the possible number of sessions, which takes O(log n) time, where n is the number of tasks. For each binary search iteration, the canFitTasks function is invoked to determine if the tasks can fit into the current number of sessions. O(n·2n). Here, 2n represents the exponential growth in the number of possible task allocations. Therefore, the combined time complexity is O(n·2n).

- **Space Complexity**:The space complexity of the code is determined by the memory used for dynamic arrays and the recursive call stack. Specifically, the sessionLoad array, allocated dynamically in the minSessions function, requires O(n) space where n is the number of tasks. Additionally, the recursion depth in the canFitTasks function, which can go up to n levels deep, adds to the space complexity. Therefore, the total space complexity is O(n), accounting for both the array used to track session loads and the recursive call stack depth.

CASES

BEST CASE

The best case occurs when all tasks can fit into a single session. In this case, the algorithm will quickly determine the minimum number of sessions needed.

WORST CASE

In the worst case, the complexity involves checking all possible combinations of task distributions across sessions. The complexity can be exponential in terms of the number of tasks due to the recursive nature of the backtracking approach

AVERAGE CASE

The average case complexity depends on the specific distribution of task times and session time. The binary search combined with the backtracking approach generally provides a good balance between complexity and performance.

FUTURE SCOPE

The future scope of this problem extends to applications in optimizing resource allocation and task scheduling in various real-world scenarios, such as project management, manufacturing, and computational processes. Enhancements can involve adding complexities like variable session times, task dependencies, or breaks between tasks. It can also be expanded to include more dynamic systems, where task durations or session limits may change over time, making the scheduling algorithm adaptive. Additionally, the problem could be extended to multi-processor systems where tasks need to be distributed among different workers or machines, optimizing overall efficiency.

CONCLUSION:

This C program uses a backtracking approach combined with binary search to efficiently solve the task scheduling problem by minimizing the number of work sessions required. By using this method, you can handle a variety of task scheduling scenarios while ensuring that each work session does not exceed the given sessionTime.