Name : Hossam Eldin Khaled

ID: 30210083

Sec: 4

Group: 2

The provided code implements a recommendation algorithm that suggests cities and hotel prices based on user input. Let's break down the code and analyze the time complexity and techniques used in each section:

1. Importing libraries and reading CSV files:
   * Time Complexity: O(n), where n is the total number of entries in all three CSV files. Reading CSV files has a linear time complexity based on the number of entries.
2. Selecting specific columns:
   * Time Complexity: O(1). Selecting specific columns from a DataFrame is a constant time operation as it does not depend on the size of the DataFrame.
3. Removing duplicate rows:
   * Time Complexity: O(m), where m is the number of rows in the DataFrame. Removing duplicates requires comparing each row to all other rows to identify duplicates, which takes linear time complexity.
4. Defining the recommendation function:
   * Time Complexity: O(numCities \* budget \* h), where numCities is the number of cities, budget is the user's budget, and h is the average number of hotels per city. The function utilizes dynamic programming to solve the problem. It iterates over each city and budget combination, and for each combination, it checks the hotels' prices in the specific city.
5. Backtracking to find recommended cities:
   * Time Complexity: O(numCities \* budget \* h), where numCities is the number of cities, budget is the user's budget, and h is the average number of hotels per city. The backtracking process involves iterating over each city and budget combination to find the recommended cities and remaining budget.
6. Taking user input and displaying recommendations:
   * Time Complexity: O(1). The time complexity of taking user input and displaying recommendations is considered constant time, as it does not depend on the size of the input or the number of recommendations.

In terms of techniques used, the code implements the following:

* Data Manipulation: The code uses the pandas library to read, filter, select columns, and remove duplicates from the CSV data. Pandas provides powerful tools for data manipulation and analysis.
* Dynamic Programming: The recommendation function utilizes dynamic programming to solve the problem efficiently. It builds a dynamic programming table to store the maximum number of cities visited for each budget and uses this table for backtracking to find the recommended cities and remaining budget.

Overall, the time complexity of the code is mainly determined by the size of the input data (number of entries in CSV files) and the number of cities, budget, and hotels. The use of dynamic programming allows for efficient computation of the recommendations within the given constraints.