**《数据结构与算法\*课程设计》实验指导书与任务书**

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**Project 1: Travel information advisor**

Nowadays, we can select different types of transport to travel to various places. However, different people may have different preferences. For example, a business man will travel by plane since most of plane-based journeys take less time (but this may not always true because situations are different from different sources and destinations). Whereas, a poor people will choose to travel by slow train, because most of train tickets are quite cheap (also, this may not always be true).

It should be noted that the design of the “best” travel suggestion for a user should considers both the traffic information between source and destination, and the preference of the user.

Please design and implement a program to provide travel information for users with different preferences, including

(1) shortest travel time;

(2) lowest travel cost;

(3) minimum number of transition.

The program allows the user to specify their travel requirement. **Please provide user-friendly interfaces for the user to interact with your program.**

You need to design travel information, design algorithms, select or design data structures, and prepare initial data to support the execution of your program.

In the report, please clarify your solution by answering the following questions:

(1) How do you design data structures to represent the information required by your program?

(2) Please clarify and describe your algorithm.

(3) Please clarify the correctness and effectiveness of your program.

(4) Please demonstrate the functionality of your program by designing different input information and showing the relevant output results (showing results for **at least 3 different inputs**).

(5) Please discuss the advantages and limitations of your algorithm.

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**Project 2: Exploring a Maze**

Given a maze and a staring location, please write a program that attempts to find a way out of the maze. If a path is found, please print out the path; otherwise, please tell the user that from the starting location, no path can reach the exit of the maze.

You have to design algorithms, select or design data structures, and prepare initial data to support the execution of your program.

**Please visually show the maze and the path information.**

You need to design maze information, design algorithms, select or design data structures, and prepare initial data to support the execution of your program.

In the report, please clarify your solution by answering the following questions:

(1) How do you design data structures to represent the information required by your program?

(2) Please clarify and describe your algorithm.

(3) Please clarify the correctness and effectiveness of your program.

(4) Please demonstrate the functionality of your program by designing different input information and showing the relevant output results (showing results for **at least 3 different inputs**).

(5) Please discuss the advantages and limitations of your algorithm.

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**Project 3: How to fill oils**

With highways available, driving a car from Hangzhou to any other city is easy. But since the tank capacity of a car is limited, we have to find oil stations on the way from time to time. Different oil station may give different price. You are asked to carefully design the cheapest way for filling oils.

It is assumed that the tank is empty at the beginning. If it is impossible to reach the destination, print the maximum travel distance = X where X is the maximum possible distance the car can run.

The input to your program include:

The capacity of the tank, the distance from Hangzhou to the destination, the average distance per unit oil that the car can run;

and a list of oil stations information, each of which includes a serial number identifying the station, price per unit of oil, the distance from the station to Hangzhou.

The outputs of your program are the stations for filling oils, and the total cost spent on filling oils.

Your program has to consider:

(1) Different situations of the car and oil stations;

(2) Deliver a good solution for the user;

**(3) Please provide user-friendly interfaces for the user to interact with your program.**

You need to design station information and rote information, design algorithms, select or design data structures, and prepare initial data to support the execution of your program.

In the report, please clarify your solution by answering the following questions:

(1) How do you design data structures to represent the information required by your program?

(2) Please clarify and describe your algorithm.

(3) Please clarify the correctness and effectiveness of your program.

(4) Please demonstrate the functionality of your program by designing different input information and showing the relevant output results (showing results for **at least 3 different inputs**).

(5) Please discuss the advantages and limitations of your algorithm.

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**Project 4: string compression and decompression**

Write a program to implement a Huffman codes based compression and decompression system.

The program allows:

1. enter a string (or the path to a file)

2. show the representation for each character

3. show the compressed information

4. do decompression

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Your program has to implement the following functionalities:

(1) Given a string as input, the program output is a sequence of bits (compression);

(2) Given a sequence of bits as input, the program output is a string (decompression).

You have to design algorithms, select or design data structures, and prepare initial data to support the execution of your program.

**Please provide user-friendly interfaces for the user to interact with your program.**

In the report, please clarify your solution by answering the following questions:

(1) How do you design data structures to represent the information required by your program?

(2) Please clarify and describe your algorithm.

(3) Please clarify the correctness and effectiveness of your program.

(4) Please demonstrate the functionality of your program by designing different input information and showing the relevant output results (showing results for **at least 4 different inputs**).

(5) Please discuss the advantages and limitations of your algorithm.

**Project 5: Graph Coloring**

Graph coloring (also called vertex coloring) is a way of coloring a graph’s vertices such that no two adjacent vertices share the same color.

Given a graph, coloring it and minimizing the total number of colors used.

Please design graph and candidate colors to support the above task, demonstrating the effectiveness of your algorithm and also the scalability of the algorithm.

**Please visually display the colored graph, interact with users and show the solution.**

In the report, please clarify your solution by answering the following questions:

(1) How do you design data structures to represent the information required by your program?

(2) Please clarify and describe your algorithm.

(3) Please clarify the correctness and effectiveness of your program.

(4) Please demonstrate the functionality of your program by designing different input information and showing the relevant output results (showing results for **at least 4 different inputs**).

(5) Please discuss the advantages and limitations of your algorithm.