Application Teaching Case of Dijkstra Algorithm

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Abstract. Dijkstra algorithm has been widely applied in many fields, such as optimization, image processing and grid processing. In the tradition teaching process, we find that students could not understand the use of Dijkstra algorithm, think this algorithm is complex and have no interest. Based on analysis, we propose use airport route planning system as an example to learn this method. The result is an APP. Application teaching method could make students have a sense of accomplishment, improve students’ learning interest and enhance students’ practical ability.

Introduction

Data structure is one of the important basic courses in computer science and technology, and is the main course of computer and related subjects. Data structure knowledge has been used to develop system and application software in many fields of computer science. Through learning this course, the students could master logical relationship of data, data storage (storage structure) and the basic operation of the algorithm, and lay the foundation of software development. This course is also the basic course of the follow-up courses such as operator system, database principle and computer network. Therefore how to improve teaching level of teacher and make students learn more knowledge is a difficult problem in the field of computational teaching, and a challenge to the teachers who take on this course [1].

The shortest path problem is a classical problem in graph theory, which aims at searching the shortest oath between nodes [2]. The shortest path algorithm contains the single source shortest path and the whole sources shortest path, which has been widely applied for game map, traffic route search, router address, etc. Good grasp of the shortest path algorithm is very good for the future development and design of the software in the work [3-5].

Problem

Dijkstra algorithm is a classical single source shortest path method, which is used to calculate the shortest paths between one node and other nodes. The algorithm process is described as follows.

(1) Suppose G=(V, E) is a weighted directed graph. The vertex set V is divided into two groups. The first group is set S. S contains the nodes whose shortest paths have been determined. Initially S only contains source node. The second group is set U, which could be gained by V-U.

(2) Calculate the lengths of all paths between set S and U. Select a minimum path and the target node is selected into set S and deleted from set U.

(3) Repeat Step (2) until all nodes are contained in set S.

The algorithm process is very complex. In the tradition teaching process, we face with the following questions:

(1) How to apply Dijkstra algorithm in the real fields;
(2) The students has no interest in learning this algorithm because it is very difficult and complex;
(3) Because the programming ability is poor, the students do not know how to achieve this algorithm by programming language C or C++.

Airport route planning system
In order to facilitate students to understand more deeply the Dijkstra algorithm, the Qilu software cup work airport route planning system is set as an example to introduce this algorithm.

Logical Structure
In order to achieve airport route planning system, we must abstract logical structure. Statics the number of places in the airport, such as gate locations, bars, restaurants, shops, toilets, information booths and baggage claim areas, and the distances among them. Logical structure is a graph, which is described in Fig.1.

![Figure 1. An example of logical structure.](image)

Storage Structure
In order to achieve Dijkstra algorithm, we must store the logical structure. In this paper, we use sequential storage. Storage structure is listed as follows.

$$
\begin{bmatrix}
\infty & \infty & 1 & \infty & 3 & 10 \\
\infty & \infty & 5 & \infty & \infty & \infty \\
\infty & \infty & \infty & 5 & \infty & \infty \\
\infty & \infty & \infty & \infty & \infty & 1 \\
\infty & \infty & \infty & 2 & \infty & 6 \\
\infty & 8 & \infty & \infty & \infty & \infty \\
\end{bmatrix}
$$
Introduce the Algorithm
According to logical and storage structure, we could introduce the Dijkstra algorithm. Guide the students to achieve this algorithm and make an APP. A work could make students have a sense of accomplishment, improve students’ learning interest and enhance students’ practical ability.

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