South China University of Technology

《Course》Experiment Report

Experiment Title：Experiment 5 A Shortest-Path problem solved

by Dynamic Programming Algorithm

Name： Yeo King Student ID： 201969990051

Class： CST 2019 International Group： -

Collaborator： -

Teacher： Mr Yan Xiaoyang

|  |
| --- |
| **Description** |
| 【Objective and Requirement】  Objective：  （1）Know the shortest-path problem for multistage undirected graph can be solved by the dynamic programming algorithm.  （2）Learn what is the dynamic programming strategy and the method of this algorithm.  （3）Learn how to find out the recurrence relations.  （4）Learn how to represent the problem by a multistage graph.    Requirement：   1. The template should be used for all kinds of data type, such as: integer, real, double, etc., in the program; 2. Programs should be made by Object-Oriented Programming (OOP) method; 3. Use the backward and forward approaches to perform this algorithm. 4. And compare the efficiency between the backward and forward approaches. 5. Write down the report in which there should be the execution results of the program.   【Environment】  Operating System：Windows |
| **Content** |
| A multistage graph G = (V, E) is a directed graph where vertices are partitioned into k (where k > 1) number of disjoint subsets S = {s1,s2,…,sk} such that edge (u, v) is in E, then u Є si and v Є s1 + 1 for some subsets in the partition and |s1| = |sk| = 1.  The vertex s Є s1 is called the source and the vertex t Є sk is called sink. G is usually assumed to be a weighted graph. In this graph, cost of an edge (i, j) is represented by c(i, j). Hence, the cost of path from source s to sink t is the sum of costs of each edges in this path.  T he multistage graph problem is finding the path with minimum cost from source *s* to sink *t*. In multistage graph problem we have to find the shortest path from source to sink.  The cost of a path from source (denoted by S) to sink (denoted by T) is the sum of the costs of edges on the path. In multistage graph problem we have to find the path from S to T. there is set of vertices in each stage. The multistage graph can be solved using forward and backward approach.  Example of random multistage graph solve using backward and forward approach :    **Solve using backward approach**  d(S, T)=min {1+d(A, T),2+d(B,T),7+d(C,T)} …(1)  We will compute d(A,T), d(B,T) and d(C,T).  d(A,T)=min{3+d(D,T),6+d(E,T)} …(2)  d(B,T)=min{4+d(D,T),10+d(E,T)} …(3)  d(C,T)=min{3+d(E,T),d(C,T)} …(4)  Now let us compute d(D,T) and d(E,T).  d(D,T)=8  d(E,T)=2 backward vertex=E  Let us put these values in equations (2), (3) and (4)  d(A,T)=min{3+8, 6+2}  d(A,T)=8 A-E-T  d(B,T)=min{4+8,10+2}  d{B,T}=12 A-D-T  d(C,T)=min(3+2,10)  d(C,T)=5 C-E-T  d(S,T)=min{1+d(A,T), 2+d(B,T), 7+d(C,T)}  =min{1+8, 2+12,7+5}  =min{9,14,12}  d(S,T)=9 S-A-E-T  The path with minimum cost is S-A-E-T with the cost 9.  **Solved using Forward Approach**  d(S,A)=1  d(S,B)=2  d(S,C)=7  d(S,D)=min{1+d(A,D),2+d(B,D)}  =min{1+3,2+4}  d(S,D)=4  d(S,E)=min{1+d(A,E), 2+d(B,E),7+d(C,E)}  =min {1+6,2+10,7+3}  =min {7,12,10}  d(S,E)=7 i.e. Path S-A-E is chosen.  d(S,T)=min{d(S,D)+d(D,T),d(S,E),d(E,T),d(S,C)+d(C,T)}  =min {4+8,7+2,7+10}  d(S,T)=9 i.e. Path S-E, E-T is chosen.  The minimum cost=9 with the path S-A-E-T  Graph that will be solved in the program    From vertices 1 to 9 with 4 stages , the execution result of the program is below |
| **Conclusion** |
| I have learnt to understand how to solve multistage graph using dynamic program algorithm using the forward approach and backward approach. |
| **Teacher’s Comments and Score** |
| Comment：  Score：           Signature：                                                 Date： |