Computer Science II: Data Structures: Programming Assignment 4

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Problem Description

The problem we are solving for this assignment is the implementation of graphs and the topological sorting of those graphs.

To represent the graph, I used an array of `graphNode`s, each of which contains: the node identifier/name; two boolean values, one indicating whether the node has been assigned and another indicating whether the node has been visited; and a linked list of the indices within the array of its successor nodes.

The assignment sheet asked us to find the topological ordering for an AOV network. A possible ordering for the given network is: S G D A H E B I F C T

Source Code and Test Results

Please see `main.cpp` for the source code of my solution.
The following are examples of input and output of the program. The first example is of the AOV network detailed on the homework assignment sheet.

```
Enter ordered pairs of nodes: (A,B),(A,E),(B,C),(C,T),(D,A),(D,E),(E,C),(E,F),(E,I),
(F,C),(F,T),(G,D),(G,E),(G,H),(H,I),(H,E),(I,F),(I,T),(S,A),(S,D),(S,G)
Enter the number of nodes: 11

Your graph is represented as follows:
0    | A --> [1, 2]
1    | B --> [3]
2    | E --> [3, 6, 7]
3    | C --> [4]
4    | T --> []
5    | D --> [0, 2]
6    | F --> [3, 4]
7    | I --> [6, 4]
8    | G --> [5, 2, 9]
9    | H --> [7, 2]
10   | S --> [0, 5, 8]

The topological sorting of your graph is:
S G H D A E I F B C T



Enter ordered pairs of nodes: (A, B), (B, C), (B, D), (C, D), (C, E), (D, E)
Enter the number of nodes: 5

Your graph is represented as follows:
0    | A --> [1]
1    | B --> [2, 3]
2    | C --> [3, 4]
3    | D --> [4]
4    | E --> []

The topological sorting of your graph is:
A B C D E



Enter ordered pairs of nodes: (Bravo, Alpha), (Charlie, Delta), (Alpha, Foxtrot),
(Alpha, Echo), (Delta, Foxtrot)
Enter the number of nodes: 6

Your graph is represented as follows:
0    | Bravo --> [1]
1    | Alpha --> [4, 5]
2    | Charlie --> [3]
```

Source Code and Test Results continued on next page. . .

```
3    | Delta --> [4]
4    | Foxtrot --> []
5    | Echo --> []

The topological sorting of your graph is:
Charlie Delta Bravo Alpha Echo Foxtrot
```

Comments

The output includes both the graph representation and the topological sorting. In the graph representation, the left-most column is the index of that node in the array. Just to the right of the vertical bar is the node identifier. The right arrow points to a list which contains the indices of the nodes which are successors to the node in that row.

The program can handle any strings (even numbers) as the node identifiers, but it is fragile in that each instance of a node name must always be exactly the same. Node names also cannot contain spaces, parentheses, or commas. These are delimiting characters and the program will interpret them as such. Note that whitespace is ignored, as long as the parentheses and commas are properly placed.

The program can theoretically hold any data type in the `graphNode.nodeID` field. With minimal modification, this code could utilize any class (including methods) to actually perform actions at each vertex.

Topological sorting was implemented using the depth-first search (DFS) algorithm.