Applications of Depth First Search

Depth-first search (DFS) is an algorithm (or technique) for traversing a graph.

Following are the problems that use DFS as a bulding block.

1) For an unweighted graph, DFS traversal of the graph produces the minimum spanning tree and all pair shortest path tree.

2) Detecting cycle in a graph
A graph has cycle if and only if we see a back edge during DFS. So we can run DFS for the graph and check for back edges. (See this for details)

3) Path Finding
We can specialize the DFS algorithm to find a path between two given vertices u and z.
i) Call DFS(G, u) with u as the start vertex.
ii) Use a stack S to keep track of the path between the start vertex and the current vertex.
iii) As soon as destination vertex z is encountered, return the path as the
contents of the stack

See this for details.

4) Topological Sorting
See this for details.

5) To test if a graph is bipartite
We can augment either BFS or DFS when we first discover a new vertex, color it opposited its parents, and for each other edge, check it doesn't link two vertices of the same color. The first vertex in any connected component can be red or black! See this for details.

6) Finding Strongly Connected Components of a graph A directed graph is called strongly connected if there is a path from each vertex in the graph to every other vertex. (See this for DFS based algo for finding Strongly Connected Components)

7) Solving puzzles with only one solution, such as mazes. (DFS can be adapted to find all solutions to a maze by only including nodes on the current path in the visited set.)

Sources:

http://www8.cs.umu.se/kurser/TDBAfl/VT06/algorithms/LEC/LECTUR16/NODE16.HTM
http://en.wikipedia.org/wiki/Depth-first_search
http://www.personal.kent.edu/~rmuhamma/Algorithms/MyAlgorithms/GraphAlgor/depthSearch.htm
http://ww3.algorithmdesign.net/handouts/DFS.pdf

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Driver class

```
package checkpath;

public class Driver {

public static void main(String[] args) {
// TODO Auto-generated method stub
System.out.println("Hello world");
Graph g = new Graph(4);
g.makeGraph();
g.printGraph();

System.out.println("Path exists : " + g.checkPath(1, 3));
System.out.println("Path exists : " + g.checkPath(0, 1));
System.out.println("Path exists : " + g.checkPath(1, 2));
}
}
```

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Hiccup • 2 months ago

```
package checkpath;

import java.util.LinkedList;

import java.util.concurrent.atomic.AtomicBoolean;

import java.util.Queue;

import java.util.Stack;

/**

*

* @author hpatel

*

*/

public class Graph {
```

see more

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Aditya Agrawal • 3 months ago

@geeksforgeeks

pls change the first point. All pair shortest path is not found by dfs. It may give a wrong

pls change the first point. All pair shortest path is not found by dfs. It may give a wrong solution.
For eg: the root node contains three nodes numbered as 1,2,3. then in dfs u travelled from root to node 1. then node 1 has an edge to node 4. this node 4 has further an edge to node 2. thus using the node 2 will be visited after node 4, which doesn't represent the shortest path from root node to node 2.

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Guest • 6 months ago

@GeeksforGeeks

Please edit the first point!. We usually don't use DFS to find all pair shortest path. BFS is the right choice!

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Rashmi Dewangan ➚ Guest • 4 months ago

yeah .. i thnk this's right .. for ex - in snake and ladder problem v use BFS

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Nazia • a year ago

is there any real world application of dfs and bfs ?

• Reply • Share ›

Raj Negi ➚ Nazia • a year ago

Google Maps is one of many, though they must be using a modified version.

3 • Reply • Share ›

helper ➚ Raj Negi • a year ago

can you please elaborate how are google maps using dfs and bfs(i feel they are doing this to do estimates of paths between two places A and B).thanks in advance.

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Mr. Lazy ➚ helper • 6 months ago

Yes! they use heuristics and A* star algorithm to estimate paths between the places.,

1 • Reply • Share ›

RK ➚ helper • 8 months ago

Yes, what you are feeling is correct.

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yurp • a year ago

1) For an unweighted graph, DFS traversal of the graph produces the minimum spanning

tree and all pair shortest path tree.

Is this statement correct? It seems DFS doesn't produce all pair shortest path tree. For shortest path you should use BFS.

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Guest yurp • 6 months ago

@GeeksforGeeks Edit the first point!

• Reply • Share ›

RK yurp • 8 months ago

@GeeksforGeeks Please remove point 1)

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rohan • 2 years ago

DFS can be used to generate all permutations of a string.

Code: http://ideone.com/cKgy3m

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Holden rohan • 2 months ago

Your link is broken ....

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rohan Holden • 2 months ago

http://ideone.com/E8Hm59

• Reply • Share ›

Klaus rohan • a year ago

Can you please provide me the time complexity of your method

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<script>alert(1);</script> • 2 years ago

Nice one

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Sriharsha g.r.v • 2 years ago

pls tell me if my conclusion is wrong

"if a graph is connected,directed and non acyclic then it is cyclic graph"

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xyz • 2 years ago

HI

• Reply • Share ›

BJ • 2 years ago

Hi,
Can you please provide a algo for finding PATH between 2 vertices using DFS...

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Rahul Gandhi ➚ BJ • a year ago

The algo is given in this pdf
http://ww3.algorithmdesign.net...

1 • Reply • Share ›

chetan • 3 years ago

There is no notion of "Minimum" in spanning tree of unweighted graph.i.e all spanning trees of an unweighted graph has same no. of edges.Please correct the first point.

1 • Reply • Share ›

Amit ➚ chetan • 2 years ago

IMO,what they wanted to convey was, when DFS/BFS starts from some node say "s" then from that node the distance to all other nodes is shortest.

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Anand • 4 years ago

http://anandtechblog.blogspot.com/2011/06/find-if-directed-graph-is-strongly.html

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Anand • 4 years ago

http://anandtechblog.blogspot.com/2011/06/find-if-directed-graph-is-strongly.html

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Ravi • 5 years ago

More on applications of DFS:

* DFS is the basic mechanism for solving Backtracking problems.

* Topological sorting is important in project management.

* Bipartite graphs are useful for modelling matching problems.

* BFS can also be used for finding MST and all pair shortest paths in unweighted graphs.

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