CMPSC 250

Analysis of algorithms

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A breadth-first search (BFS) explores nodes nearest the entry node before exploring nodes further away.

- Implemented using a queue.
- At any point of time, BFS keep track of all the visited nodes, final result, and the elements in the queue.

An example will help understand:
DFS Graph Traversals - Example
DFS

Start with vertex 1, apply BFS technique
DFS Graph Traversals - Example

-Queue = [1]; Adjancency List [2, 5, 9]; Visited = [1]
-Queue = [2,5,9]; Adjancency List [1,4,8]; Visited = [1,2]
-Queue = [5,9,4,8]; Adjancency List [2,9]; Visited = [1,2,5]
-Queue = [9,4,8]; Adjancency List [1,4]; Visited = [1,2,5,9]
-Queue = [4,8]; Adjancency List [2,9]; Visited = [1,2,5,9,4]
DFS Graph Traversals - Example

- Queue = [8]; Adjancency List [2,3,5]; Visited = [1,2,5,9,4,8]
- Queue = [3]; Adjancency List [8,10]; Visited = [1,2,5,9,4,8,3]
- Queue = [10]; Adjancency List [3]; Visited = [1,2,5,9,4,8,3,10]
- Queue = []; Adjancency List []; Visited = [1,2,5,9,4,8,3,10]

Done, queue empty
**BFS Graph Traversals - Algorithm**

**BFS PSEUDOCODE**

```plaintext
Procedure BFS(input: graph G)
    Queue Q; Integer s, x
    while (G has an unvisited node) do
        s := an unvisited node
        visit(s)
        Enqueue(s,Q)
        While (Q is not empty) do
            x := Dequeue(Q)
            For (unvisited neighbor y of x) do
                visit(y)
                Enqueue(y,Q)
```

Algorithms

Graph Traversal Techniques, Branch & Bound
DFS and BFS Complexity

- Space complexity of DFS is lower than that of BFS.
- Time complexity of both is same - $O(|V| + |E|)$. 
Applications of DFS

- Finding connected components in a given graph
- Topological Sorting
- Cycle detection in a given graph
Applications of BFS

- Testing a graph for bipartiteness
- Topological Sorting
- Find a shortest path from vertex s to vertex v in a unweighted graph
- Cycle detection in a given graph
Bipartite Graph
Thinking Exercise

- How to implement BFS to test a graph for bipartiteness
- How to implement BFS to detect cycles in a graph
- How to implement DFS to detect cycles in a graph
Questions
Class activity: Post your solution in slack to get attendance points

1. Solve the exercise provided in the handout given in class.