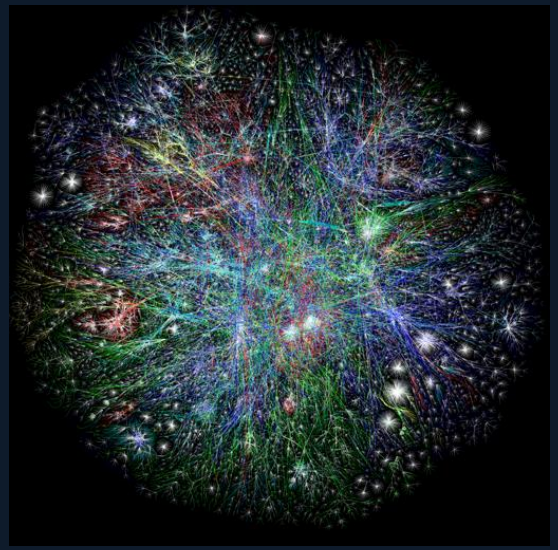
Graphs Traversal



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Lecture Contents

- Traversing a Graph
- Depth First Search
- Breadth First Search
- Minimum Spanning Trees

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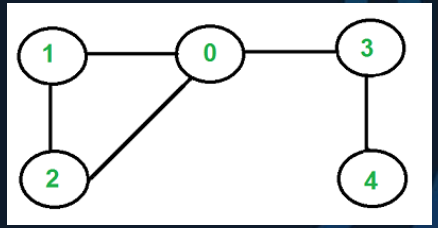
Traversing a graph

- There's no point in storing information in a graph unless you want to explore the relationships between nodes.
- We calculate this information by traversing the graph.
- We can find out all sorts of things by traversing a graph:
  - How to get from one node to another, when they aren't directly connected
  - How far away one node is from another
  - How many once removed connections (friends of friends), thrice removed connections, etc, two nodes share.
  - Check if a graph is connected or unconnected.

Traversing a graph



- Traversing a graph is just, when starting at a given node, jumping along edge to edge touching every connected node in the graph, performing some processing at each node.
- Because a node in a graph can have more than one incoming edge, traversing a graph has some problems not found in traversing lists or trees.
- We can come to a node from multiple directions as we traverse the graph. In cyclic or non-directed graphs, this could lead to an infinite loop.
- Specifically we want to make sure we only touch each node once.

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Traversing a graph

- The typical solution to this is quite simple.
- Just use a bool as a visited flag inside each node.
- Before traversing the graph, loop through every node, setting their visited flags to false.
- Then, when traversing, as we reach each node, set its visited flag to true.

Traversing a graph

- There are two common algorithms for traversing a graph:
  - Depth First Search (DFS)
  - Breadth First Search (BFS)

Depth First Search

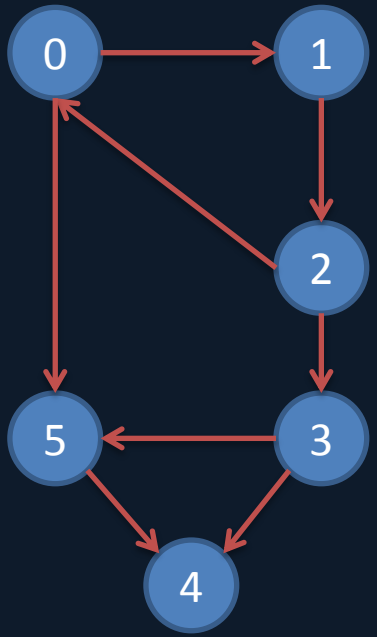
- Depth first search involves searching as far down a path as possible before backtracking.

- Can be done recursively, or by using a stack.

Depth First Search

- The algorithm is:
  - Push first node on stack
  - While stack not empty
    - Get the top off the stack and remove it
    - Process it.
    - Mark it as traversed
    - Loop through its edges
      - If end node of edge not traversed or on the stack
        - » Push end node onto the stack

Depth First Search



= untraversed

= traversed

Stack:

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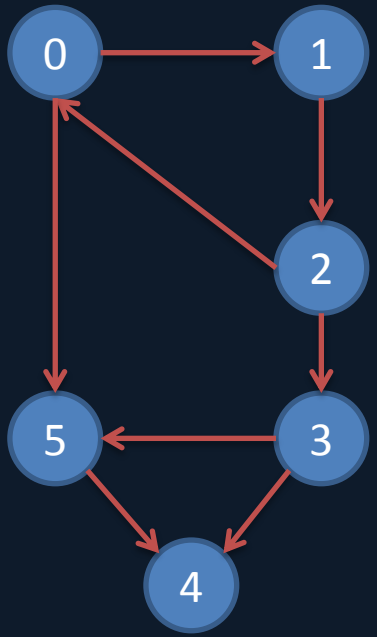
Depth First Search



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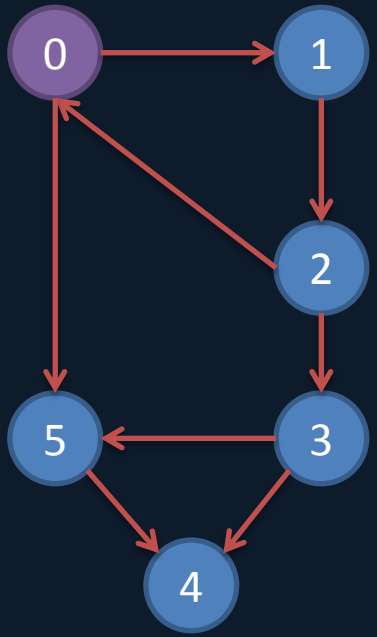
= traversed

Stack: 0

Depth First Search



= untraversed

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Stack:

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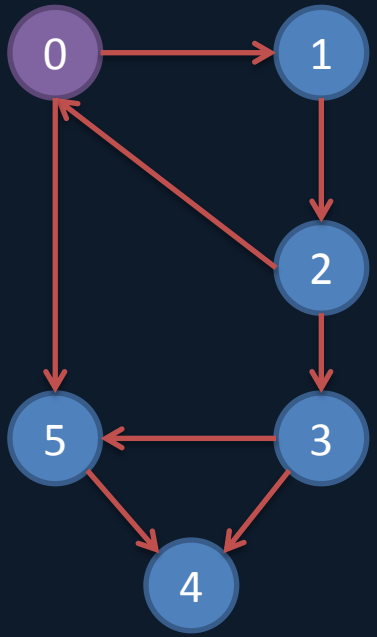
Depth First Search



= untraversed

= traversed

Stack: 1

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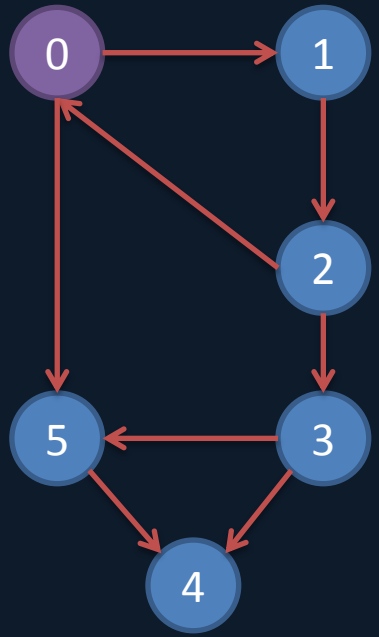
Depth First Search



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Stack:

5
1

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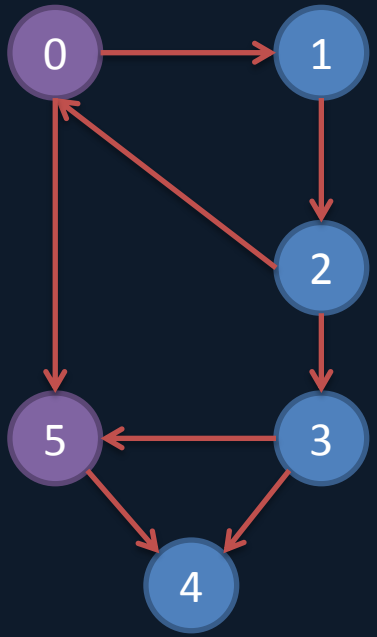
Depth First Search



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= traversed

Stack: 1

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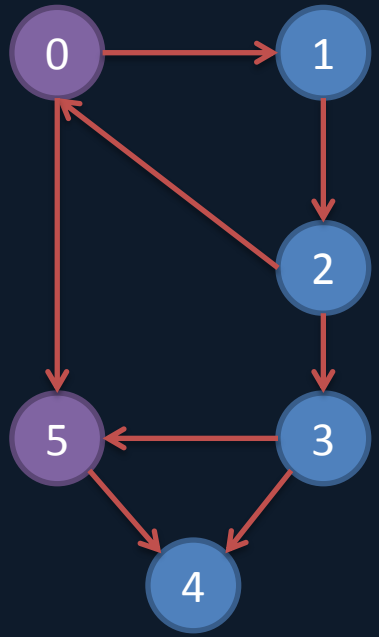
Depth First Search



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Stack:

4
1

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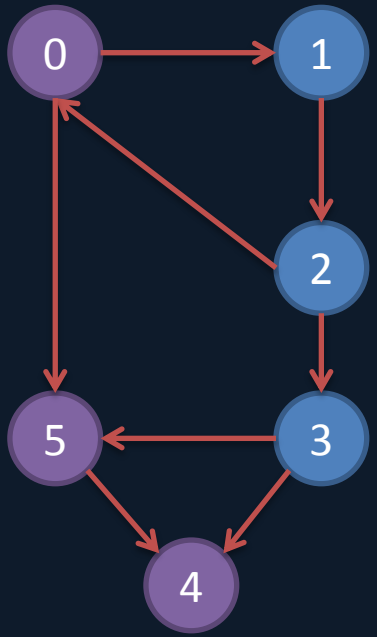
Depth First Search



= untraversed

= traversed

Stack: 1

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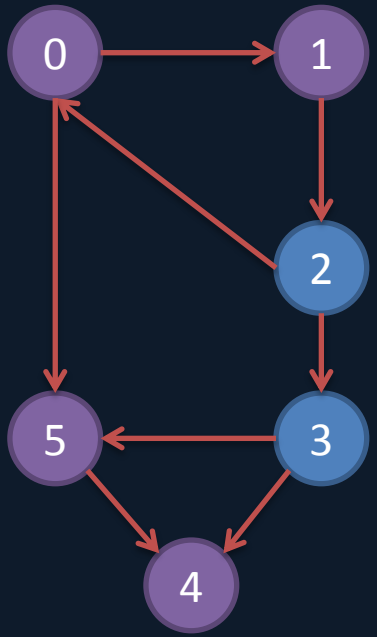
Depth First Search



= untraversed

= traversed

Stack:

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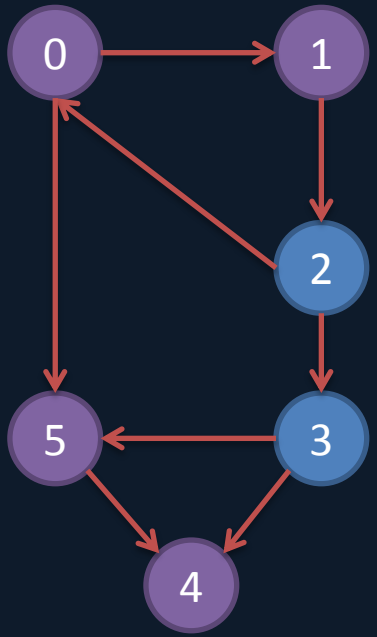
Depth First Search



= untraversed

= traversed

Stack: 2

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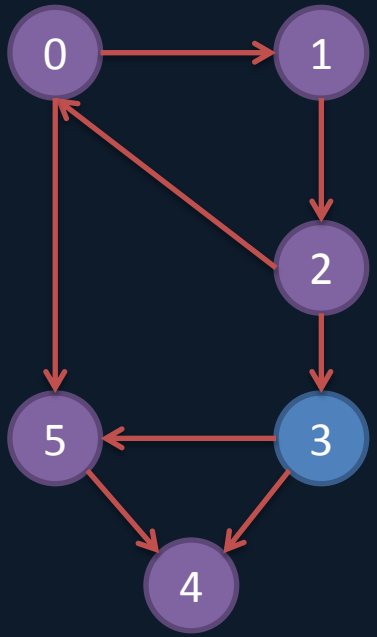
Depth First Search



= untraversed

= traversed

Stack:

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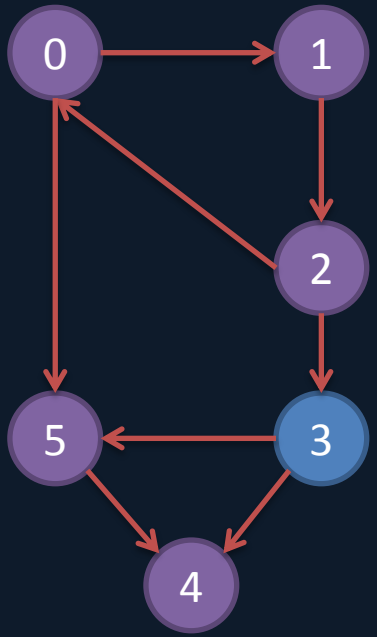
Depth First Search



= untraversed

= traversed

Stack: 3

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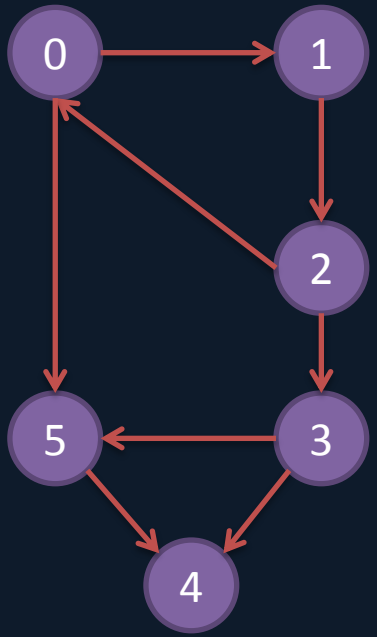
Depth First Search



= untraversed

= traversed

Stack:

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Breadth First Search

- Breadth-First Search involves processing all of the neighbours of each node before processing their neighbours and so on.
- You can think of it as fanning out from the starting node, evenly in all directions.
- It is typically implemented with a queue

Breadth First Search

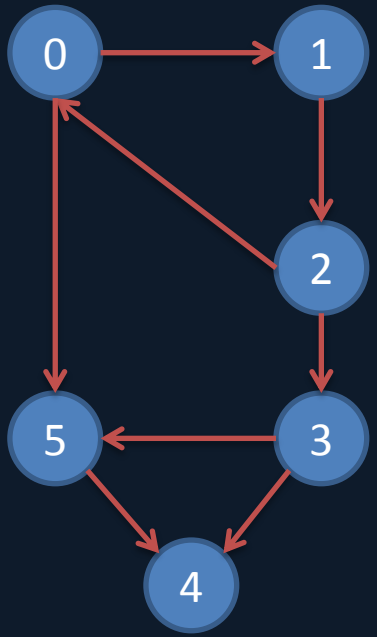
- The algorithm is:
  - Push first node onto queue
  - While queue not empty
    - Get the end off the queue and remove it
    - Process it.
    - Mark it as traversed
    - Loop through its edges
      - If end node of edge not traversed or in the queue
        - » Push end node onto the queue

Breadth First Search

- You'll notice this algorithm is *very* similar to the DFS search.

- The only difference is we are using a queue instead of a stack to pick the next node to traverse.

Breadth First Search



Queue:

= untraversed

= traversed

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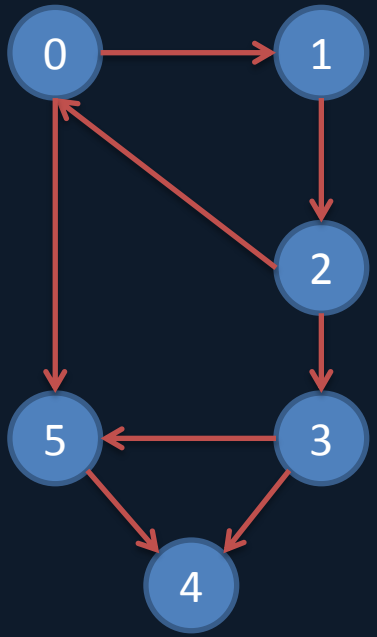
Breadth First Search



Queue: **0**

= untraversed

= traversed

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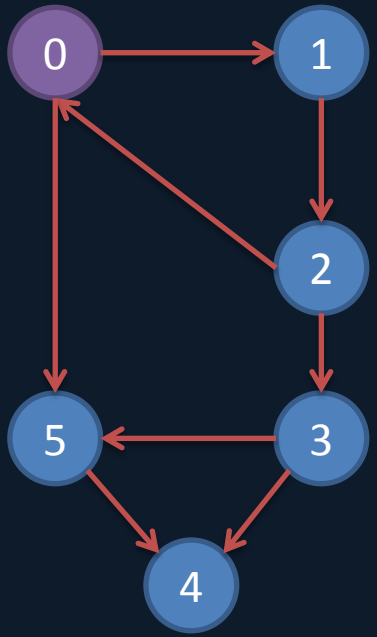
Breadth First Search



Queue:

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= traversed

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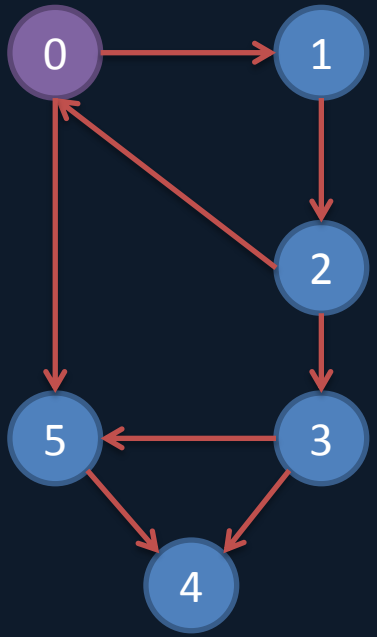
Breadth First Search



Queue: 1

= untraversed

= traversed

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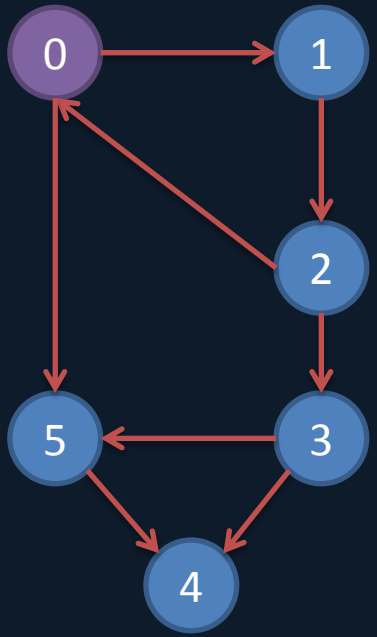
Breadth First Search



Queue:

1
5

= untraversed

= traversed

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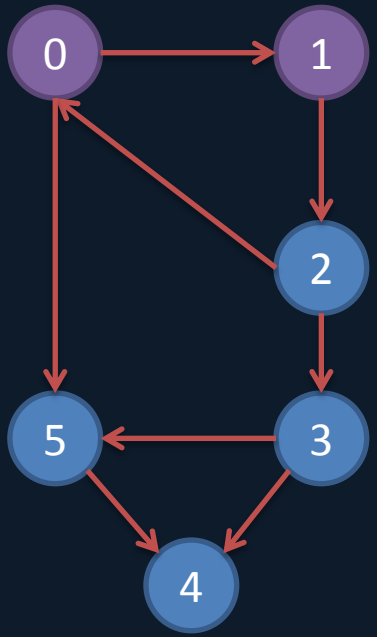
Breadth First Search



Queue: 5

= untraversed

= traversed

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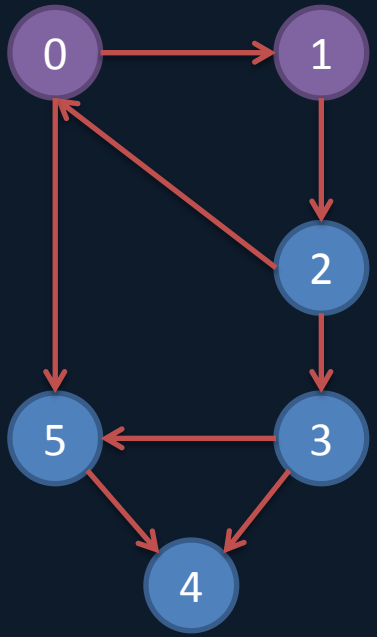
Breadth First Search



Queue:

5
2

= untraversed

= traversed

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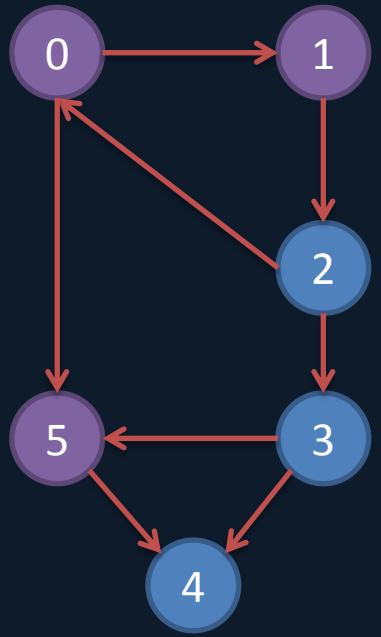
Breadth First Search



Queue: **2**

= untraversed

= traversed

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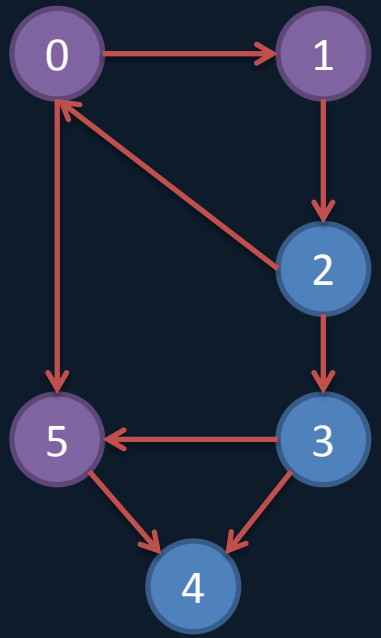
Breadth First Search



Queue:

2
4

= untraversed

= traversed

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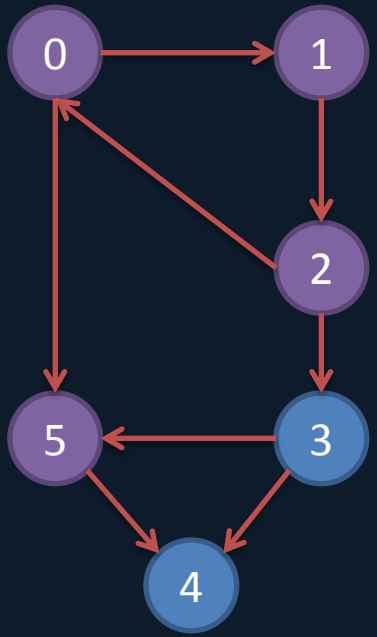
Breadth First Search



Queue: 4

= untraversed

= traversed

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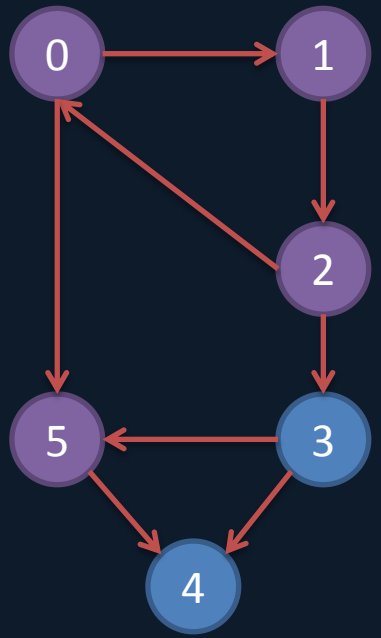
Breadth First Search



Queue:

4
3

= untraversed

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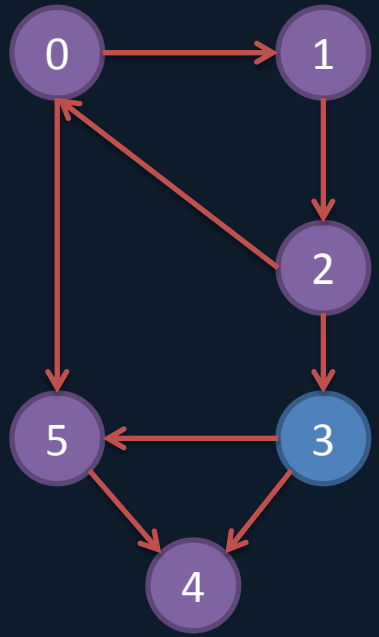
Breadth First Search



Queue: 3

= untraversed

= traversed

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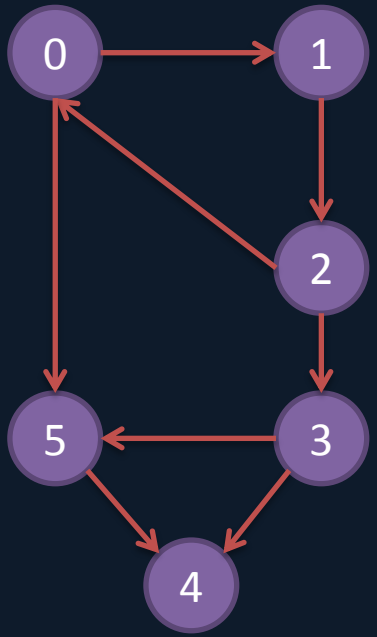
Breadth First Search



Queue:

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Questions?


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