

Queues

William Fiset

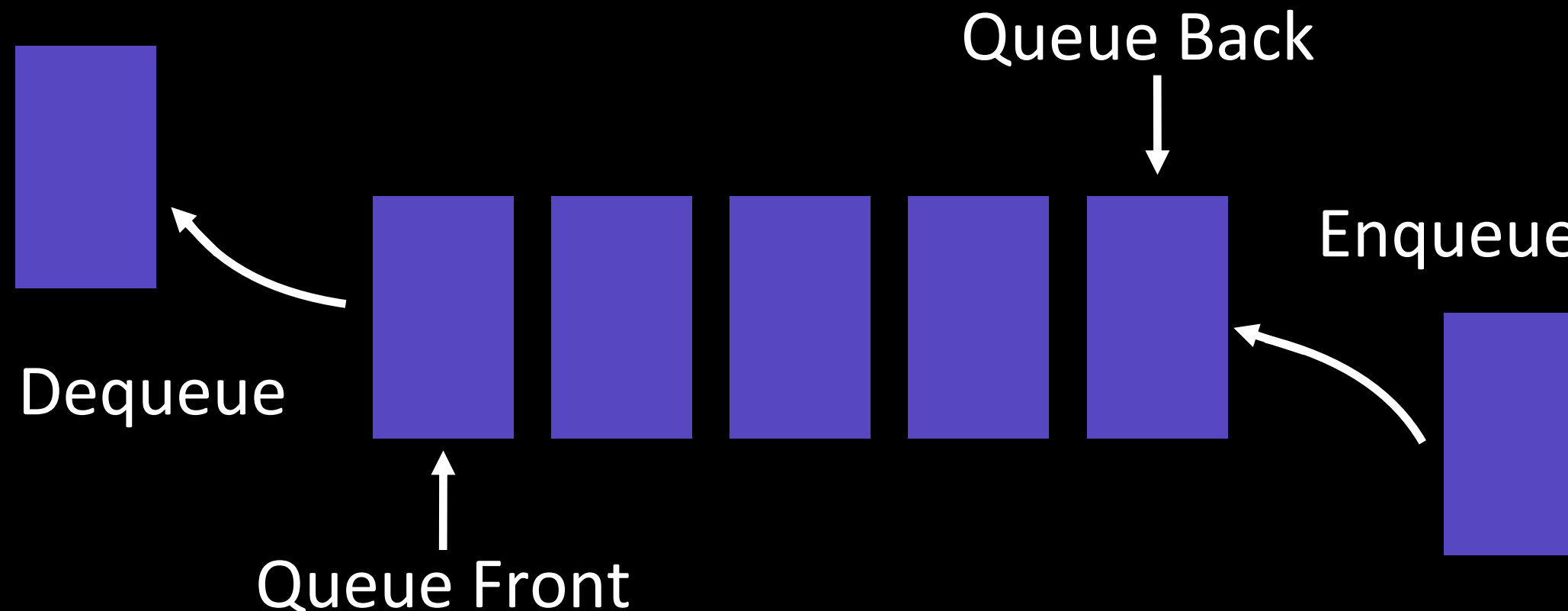
Outline

- Discussion About Queues
 - What is a queue?
 - Terminology
 - When and where is a queue used?
 - Complexity Analysis
 - Queue Breadth First Search (BFS) example
- Implementation Details
 - How to enqueue (add) elements to a queue
 - How to dequeue (remove) elements from a queue
- Code Implementation

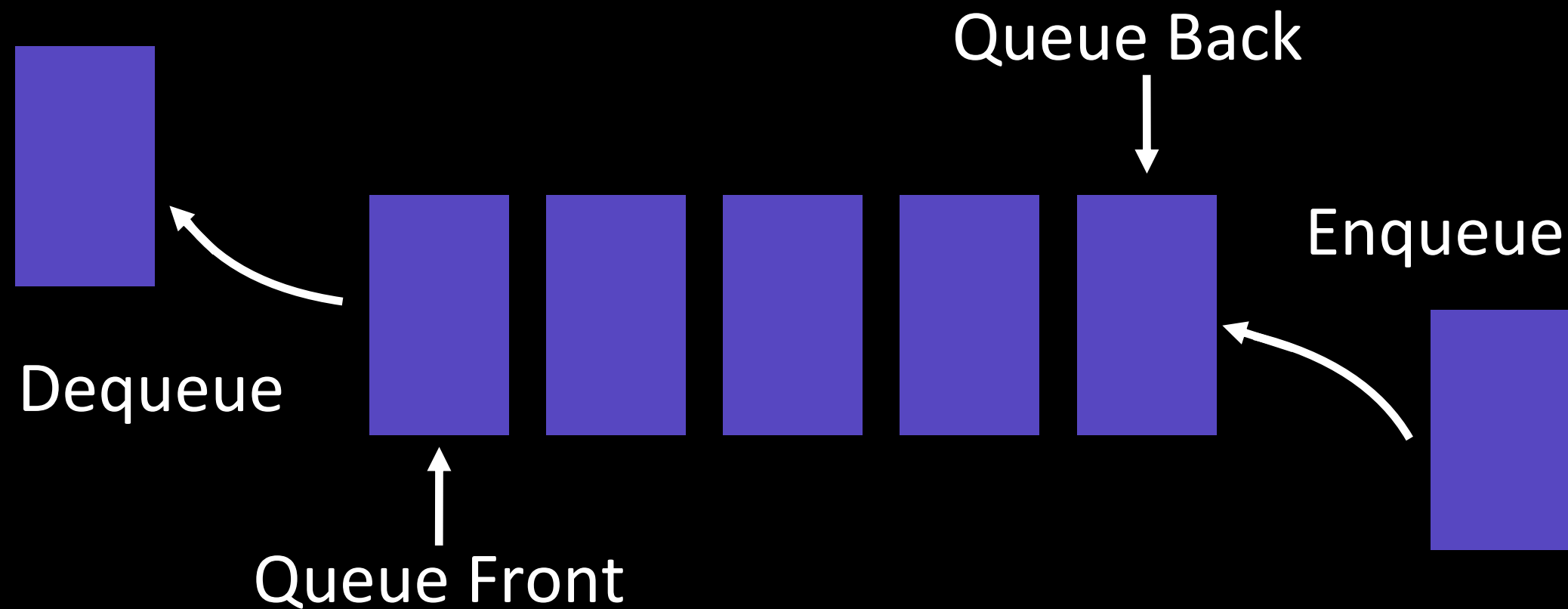
Discussion

What is a Queue?

A queue is a linear data structure which models real world queues by having two primary operations, namely **enqueue** and **dequeue**.



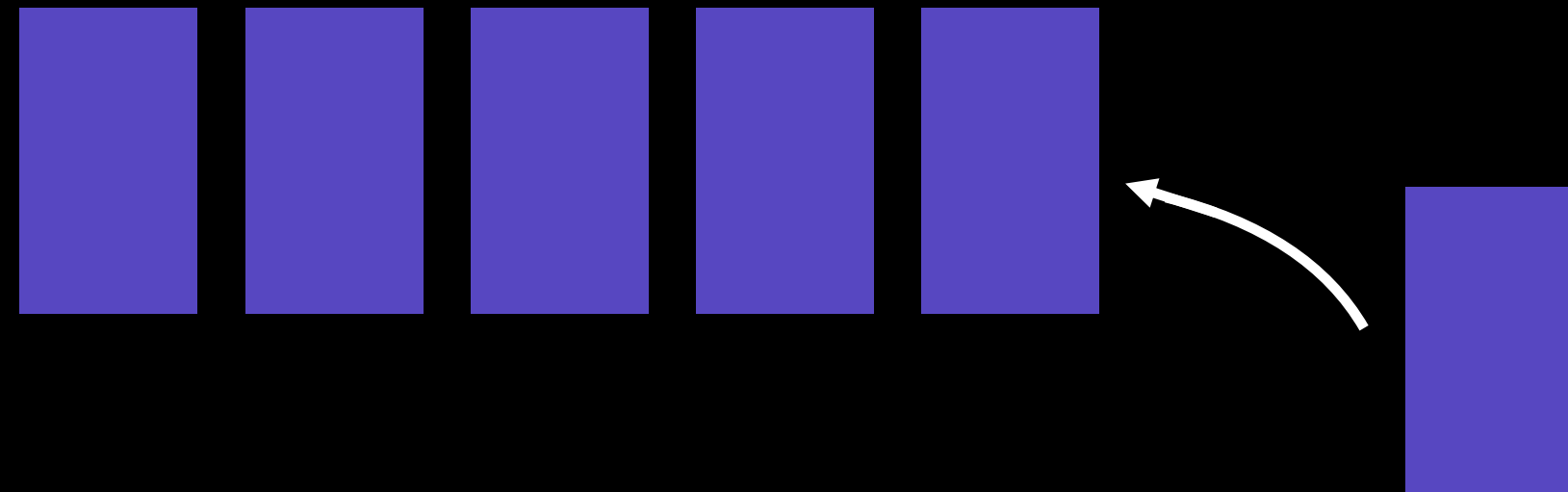
Queue Terminology



Queue Terminology

There does not seem to be consistent terminology for inserting and removing elements from queues.

Enqueue = Adding = Offering

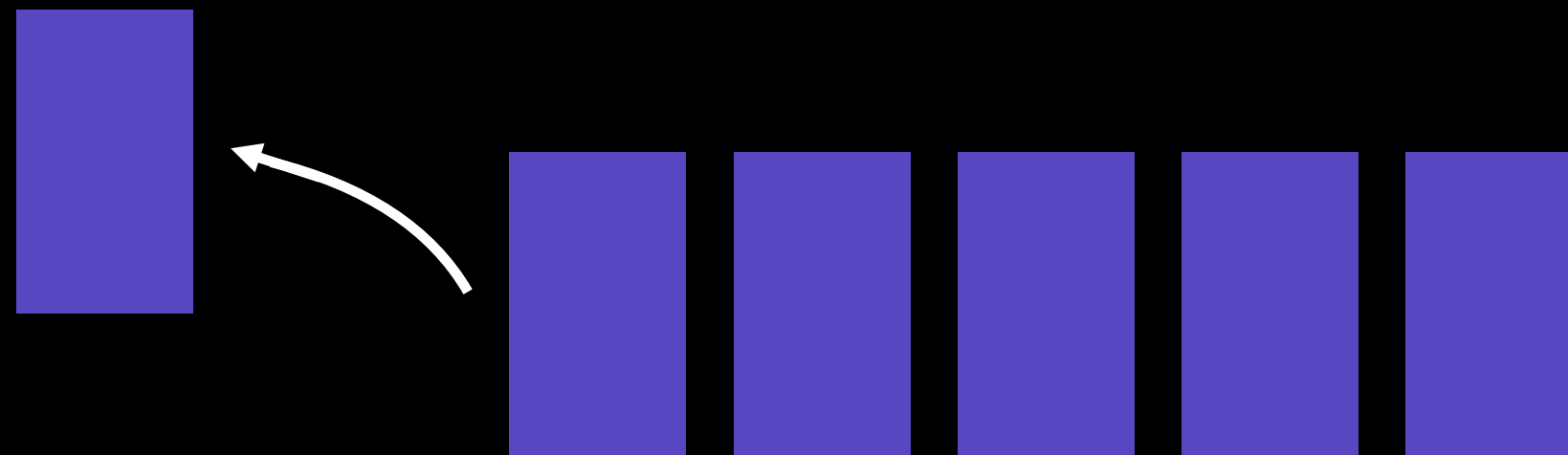


Queue Terminology

There does not seem to be consistent terminology for inserting and removing elements from queues.

Dequeue = Polling

(These are also sometimes called *removing*, but I find this ambiguous)



Queue Example

Instructions:

Enqueue(12)

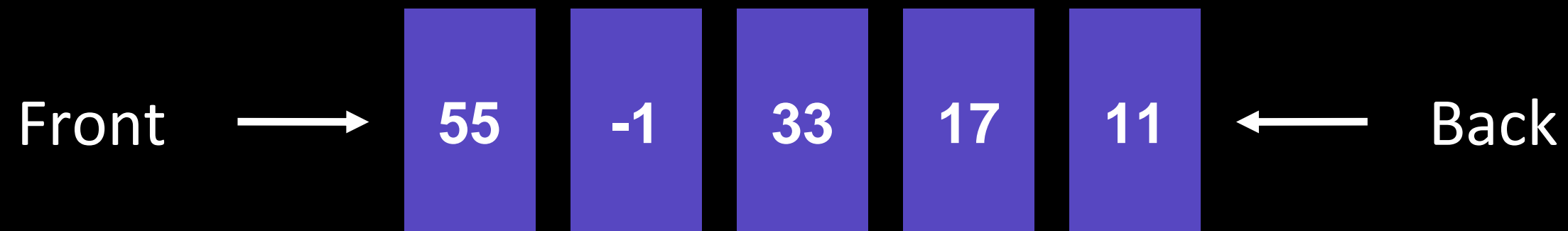
Dequeue()

Dequeue()

Enqueue(7)

Dequeue()

Enqueue(-6)



Queue Example

Instructions:

Enqueue(12)

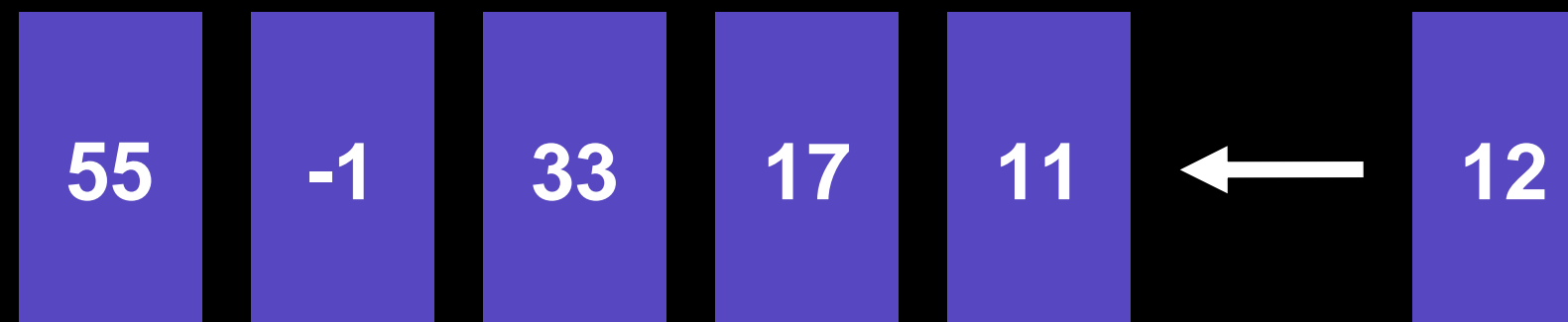
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Queue Example

Instructions:

Enqueue(12)

Dequeue()

Dequeue()

Enqueue(7)

Dequeue()

Enqueue(-6)

55

-1

33

17

11

12

Queue Example

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Enqueue(12)

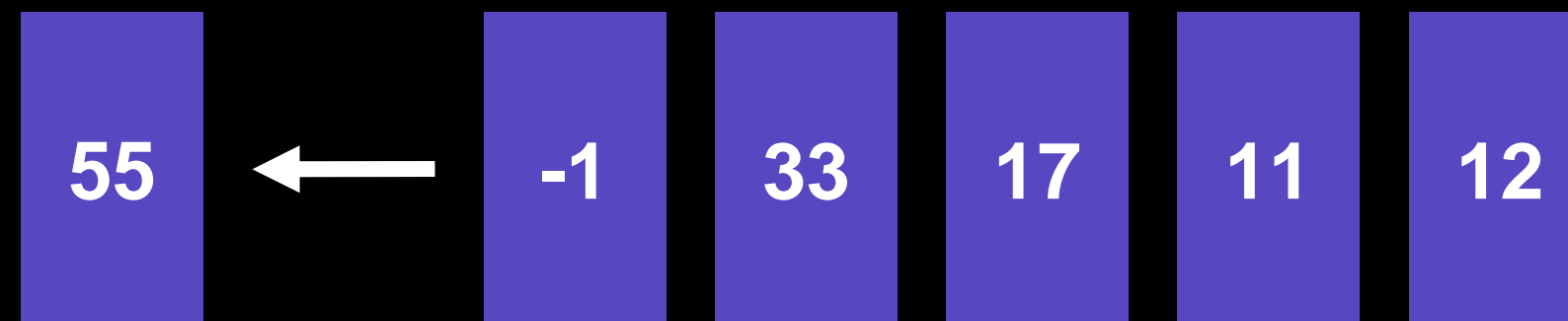
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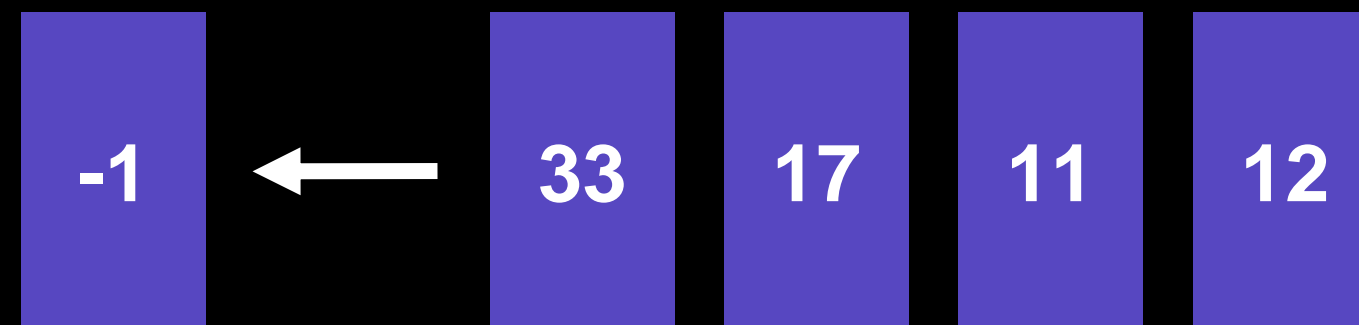
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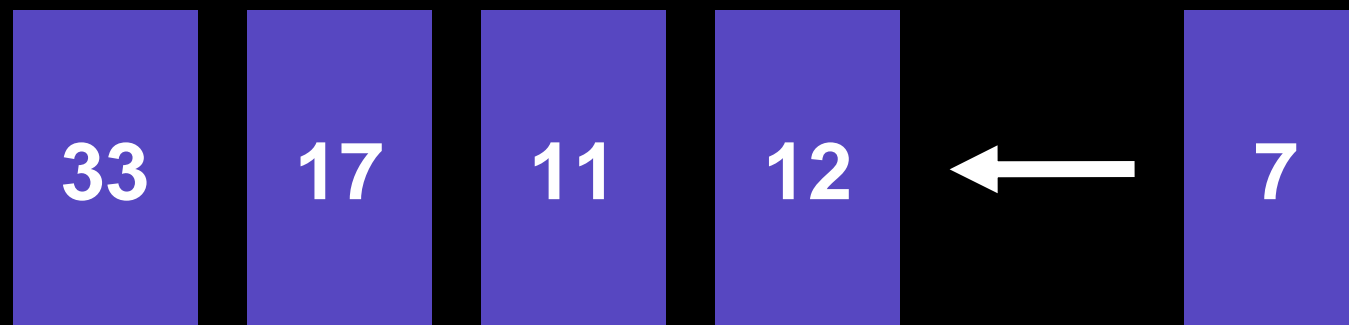
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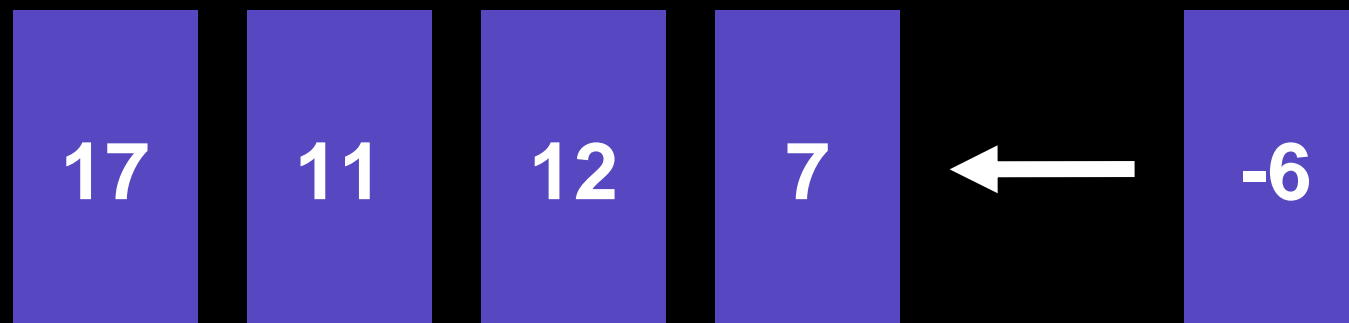
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When and where is a Queue used?

- Any waiting line models a queue, for example a lineup at a movie theatre.
- Can be used to efficiently keep track of the x most recently added elements.
- Web server request management where you want first come first serve.
- Breadth first search (BFS) graph traversal.

Complexity Analysis

Complexity

Enqueue	$O(1)$
Dequeue	$O(1)$
Peeking	$O(1)$
Contains	$O(n)$
Removal	$O(n)$
Is Empty	$O(1)$

Enqueuing & Dequeuing

Enqueuing

Instructions:

Enqueue(5)

Enqueue(1)

Enqueue(6)

Enqueue(17)

Enqueue(8)

Enqueuing

Instructions:

Enqueue(5)

Enqueue(1)

Enqueue(6)

Enqueue(17)

Enqueue(8)

Tail



Head

Enqueuing

Instructions:

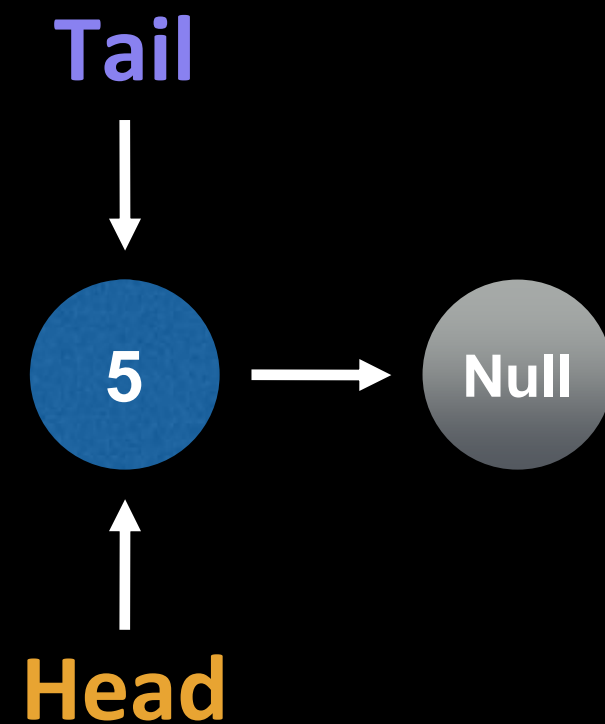
Enqueue(5)

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Enqueuing

Instructions:

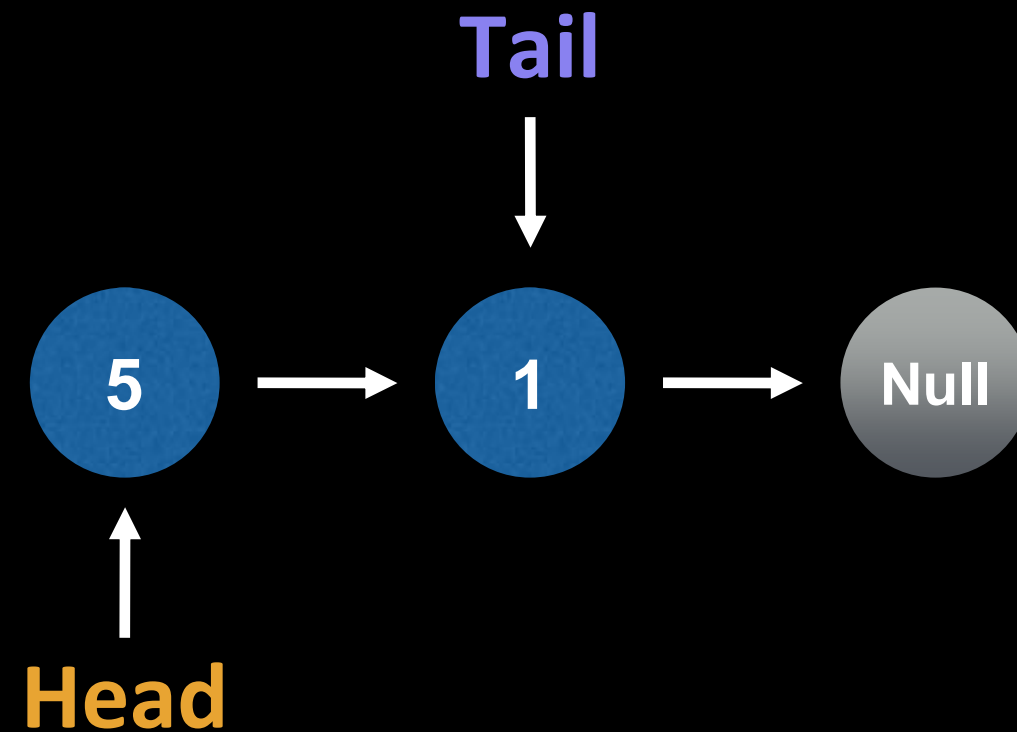
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Enqueuing

Instructions:

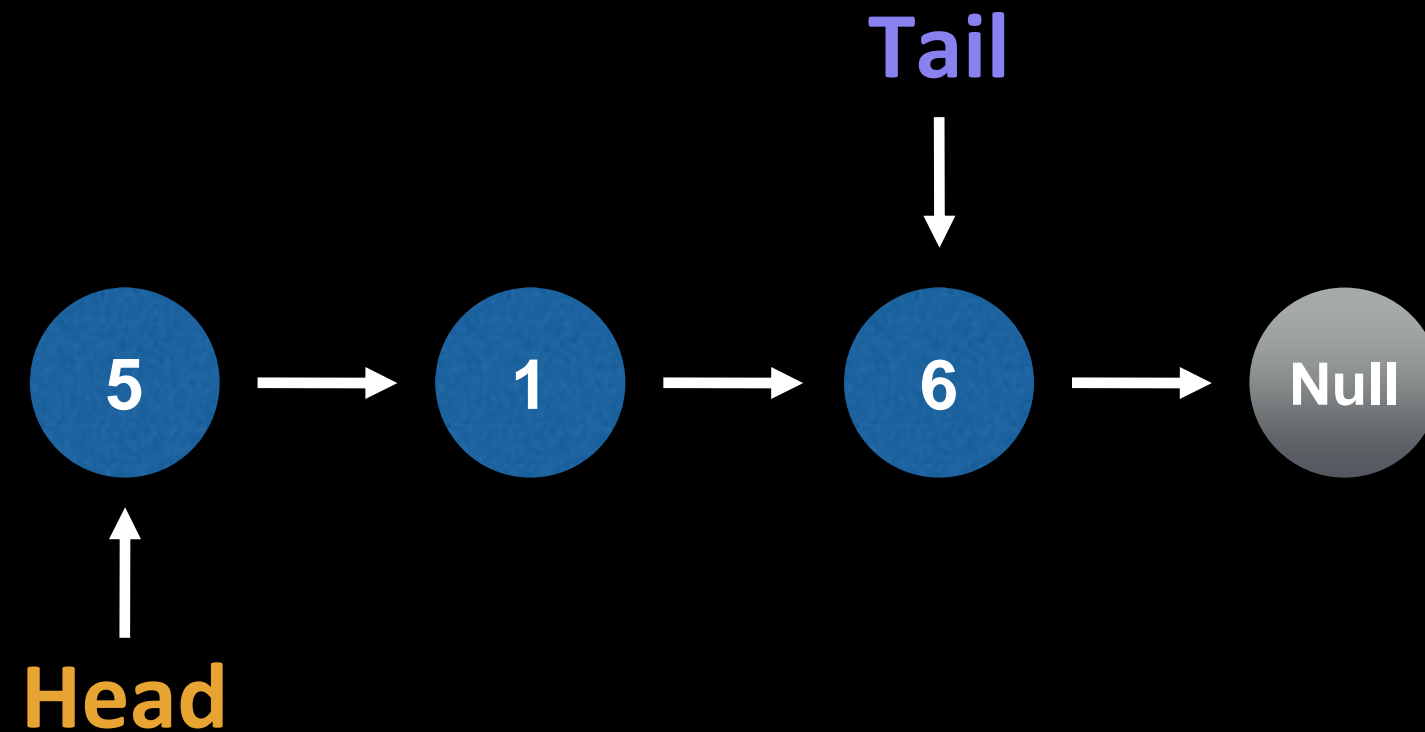
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Enqueuing

Instructions:

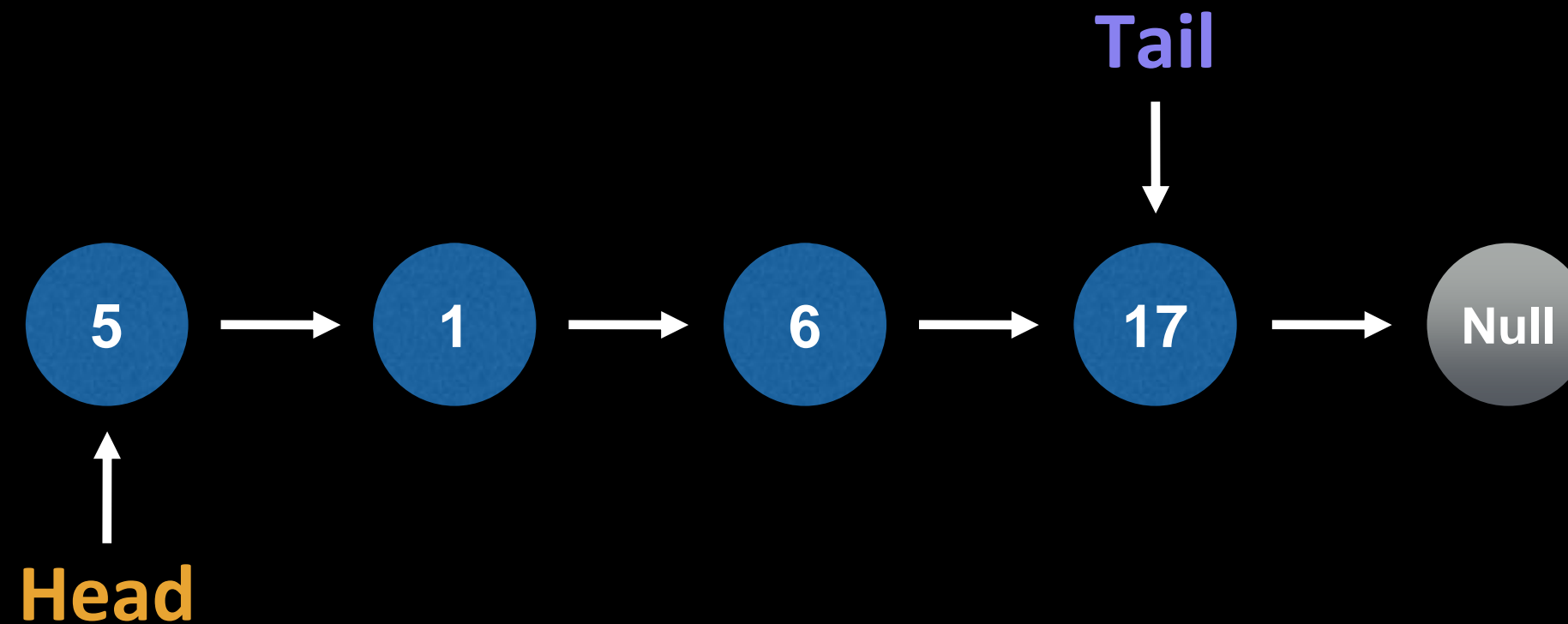
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Enqueuing

Instructions:

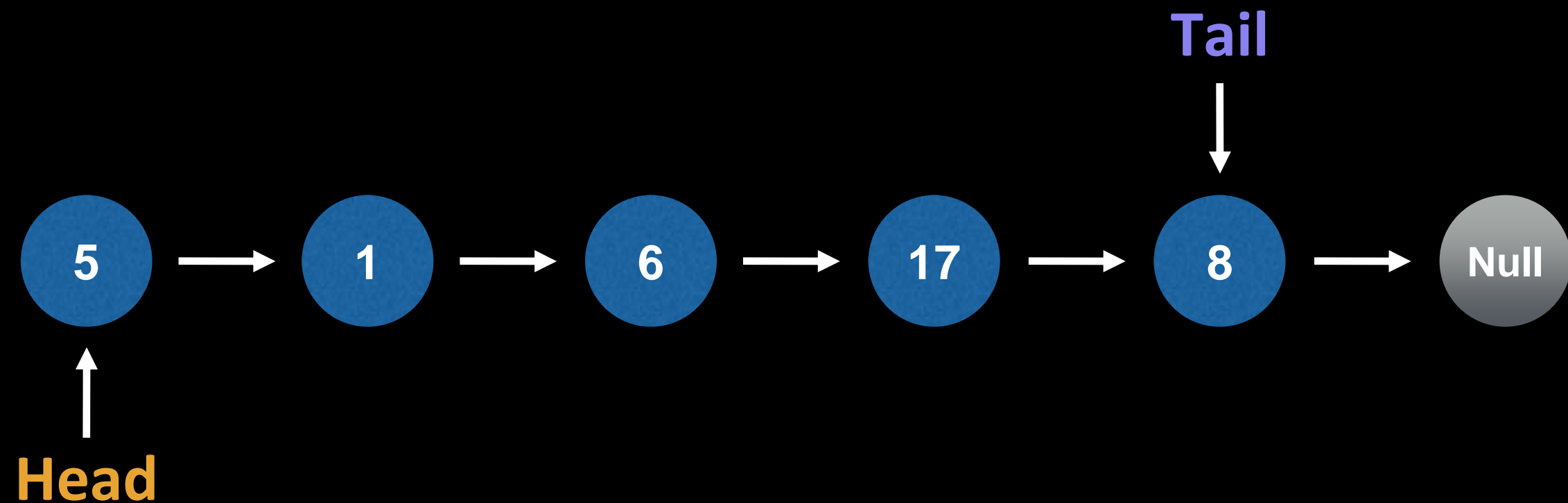
Enqueue(5)

Enqueue(1)

Enqueue(6)

Enqueue(17)

Enqueue(8)



Dequeuing

Instructions:

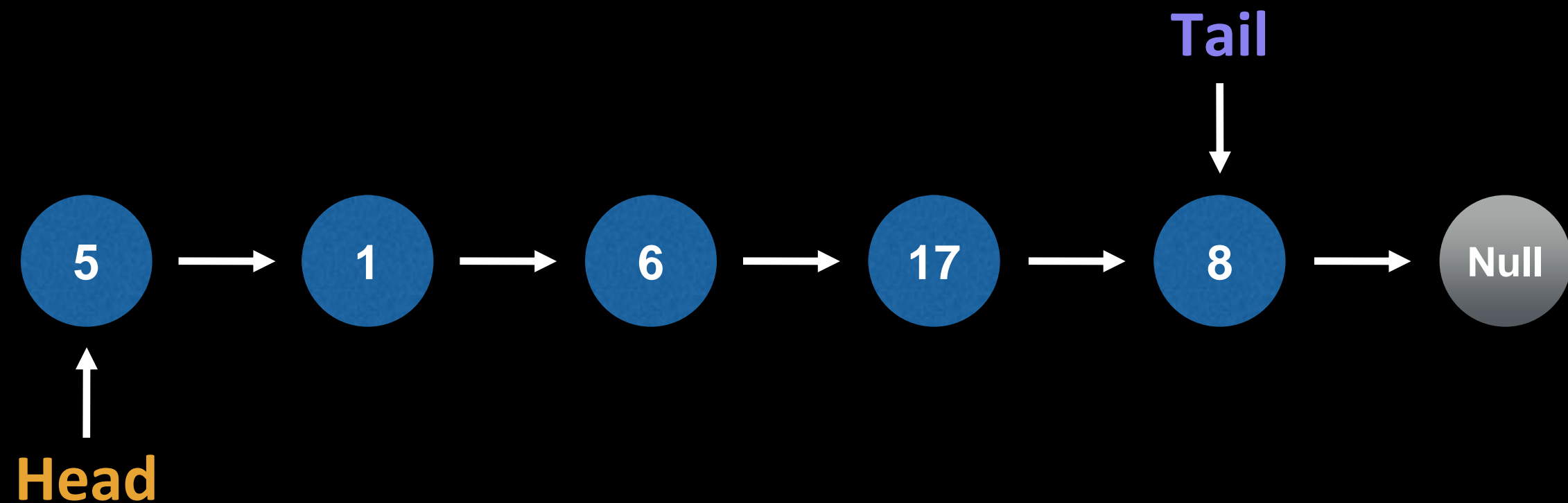
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Dequeuing

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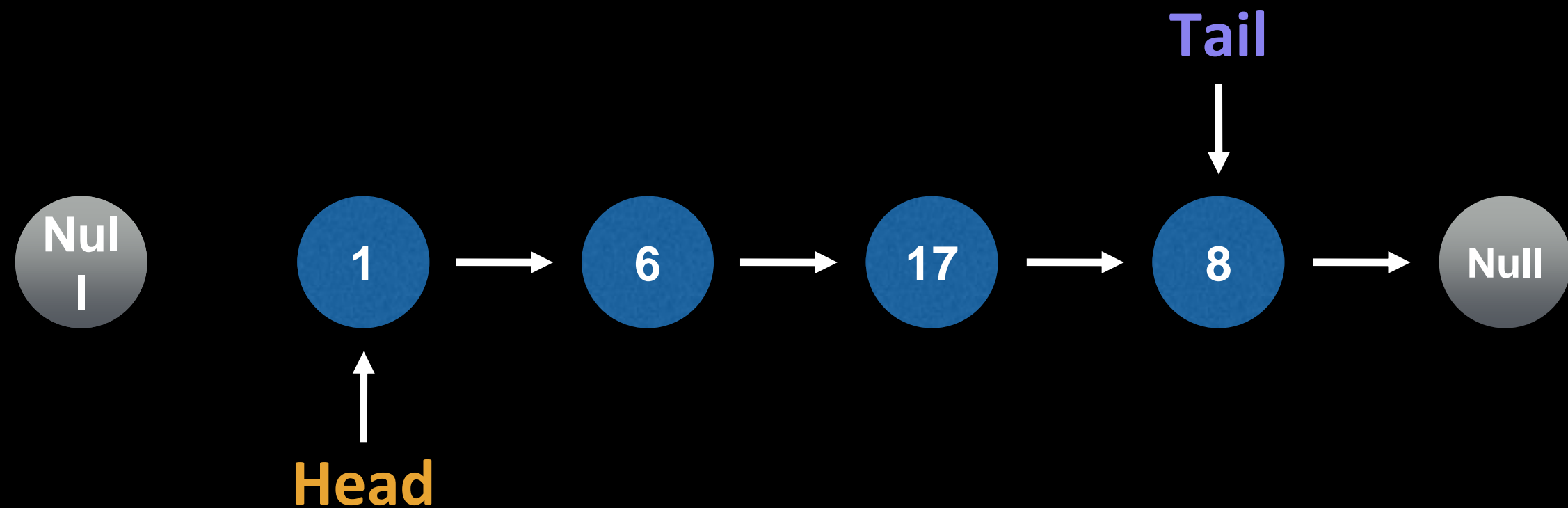
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Dequeuing

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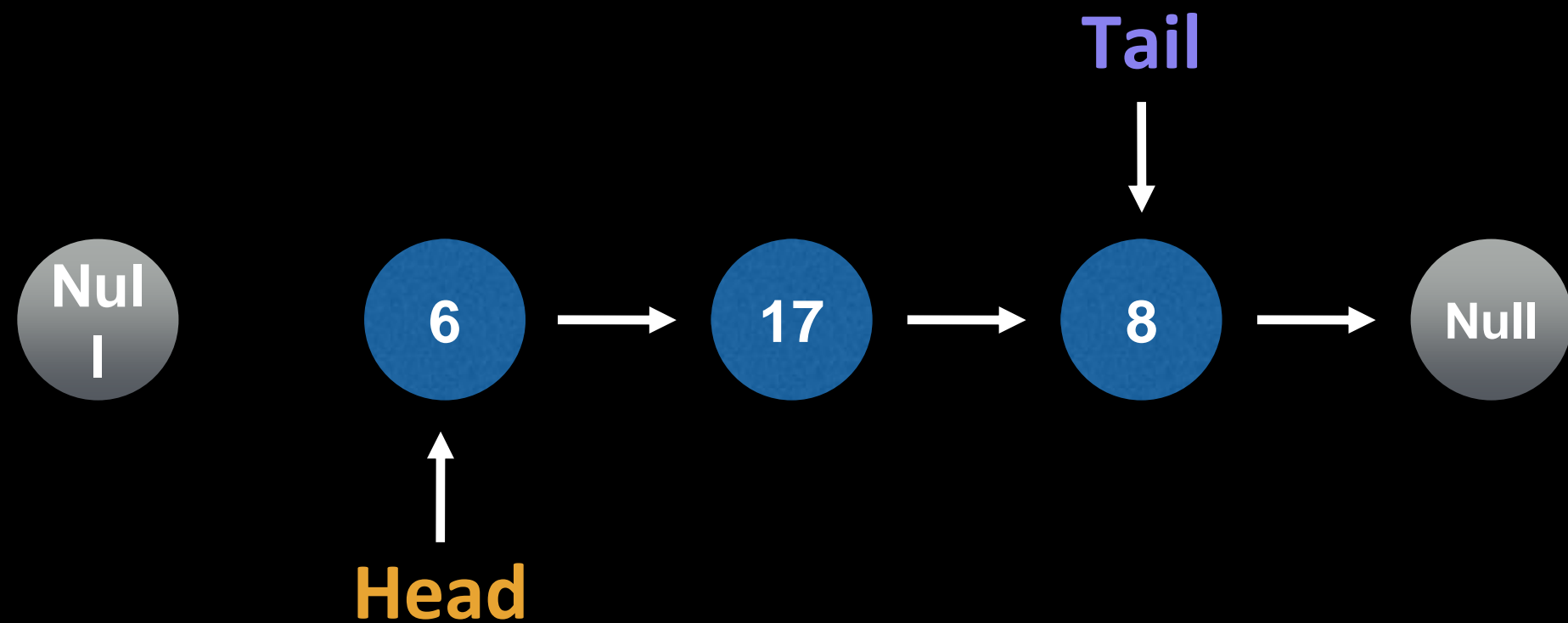
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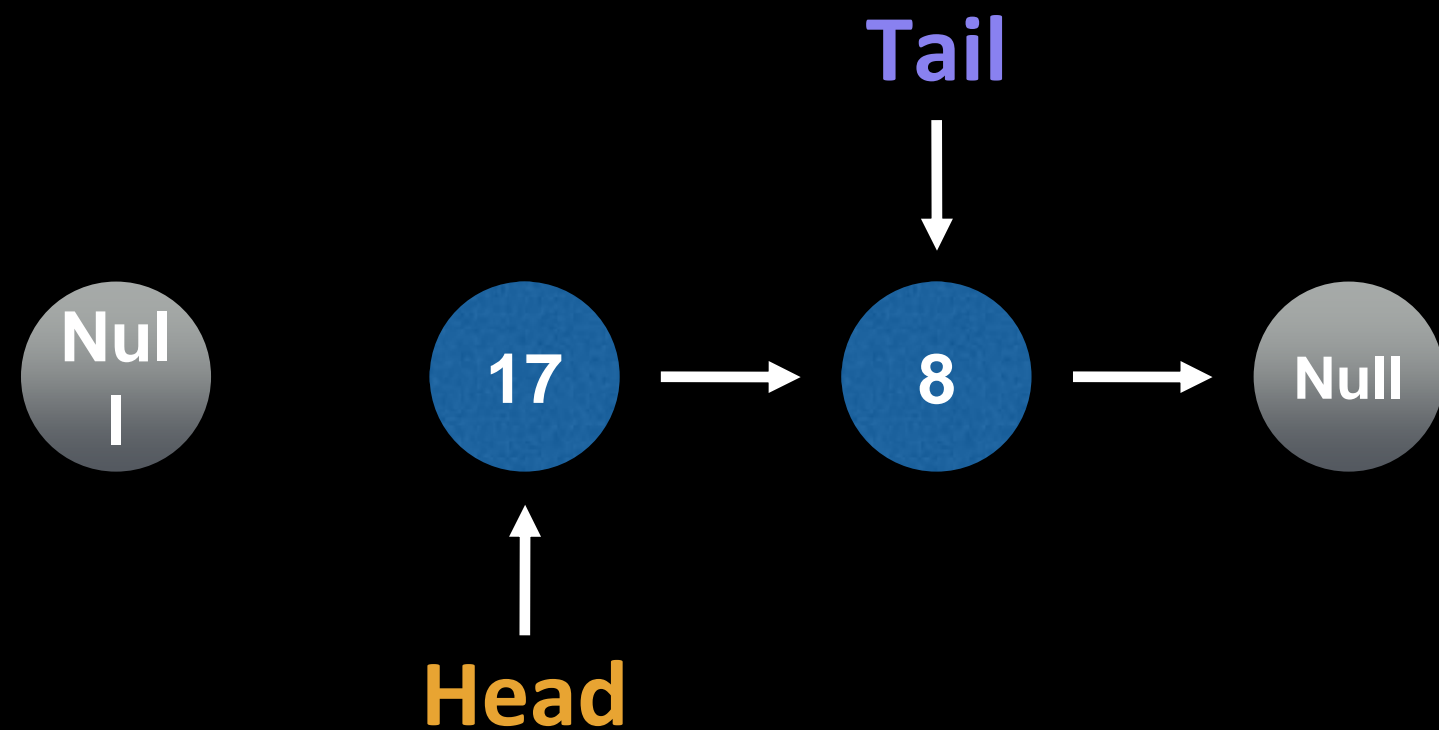
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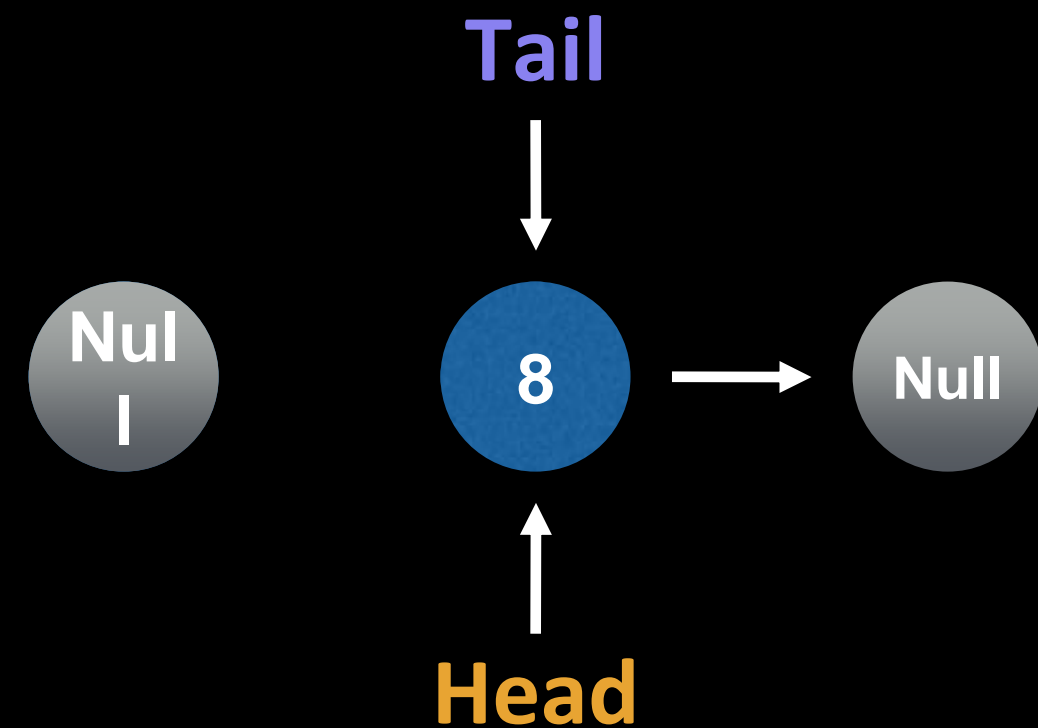
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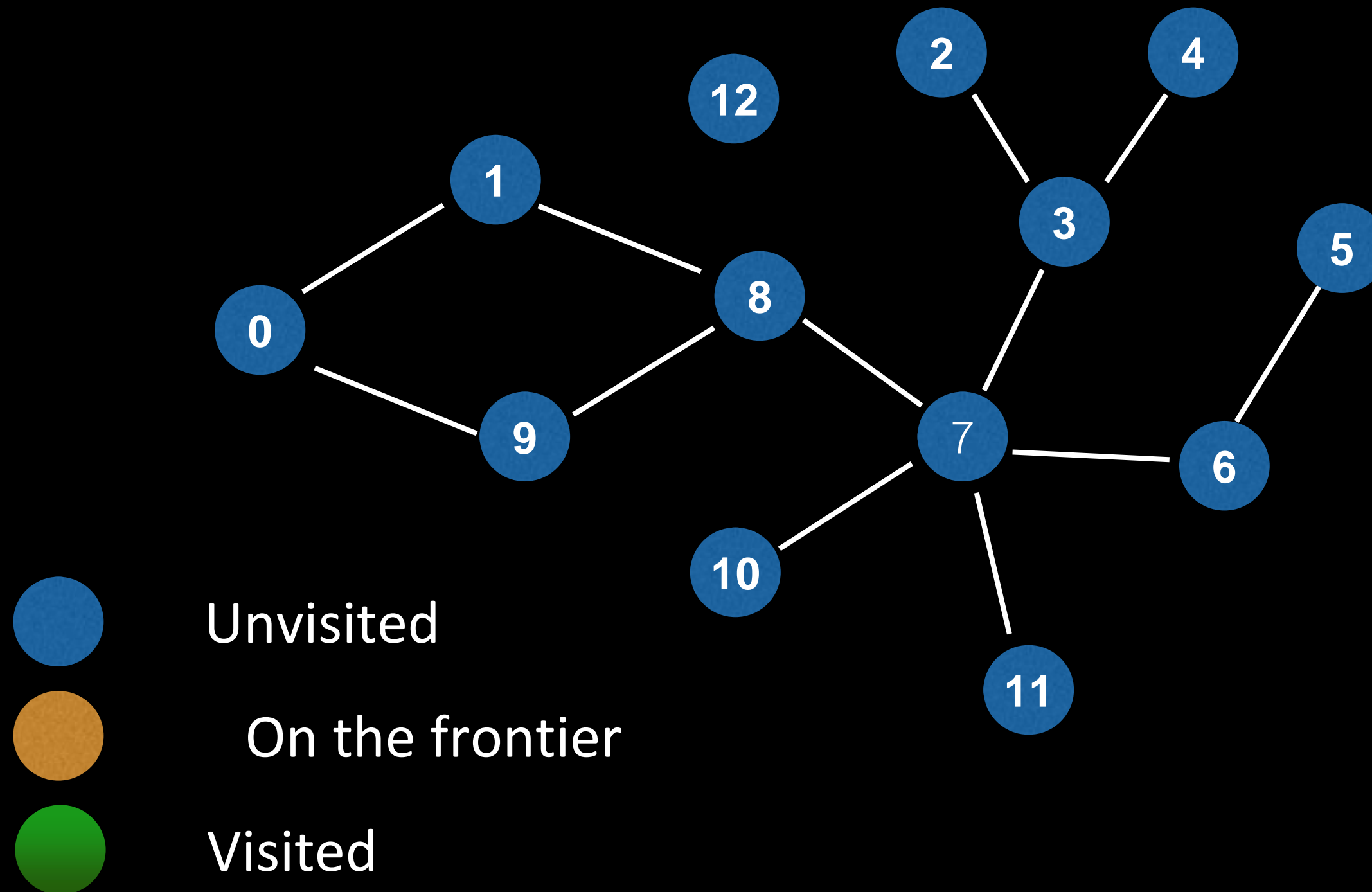
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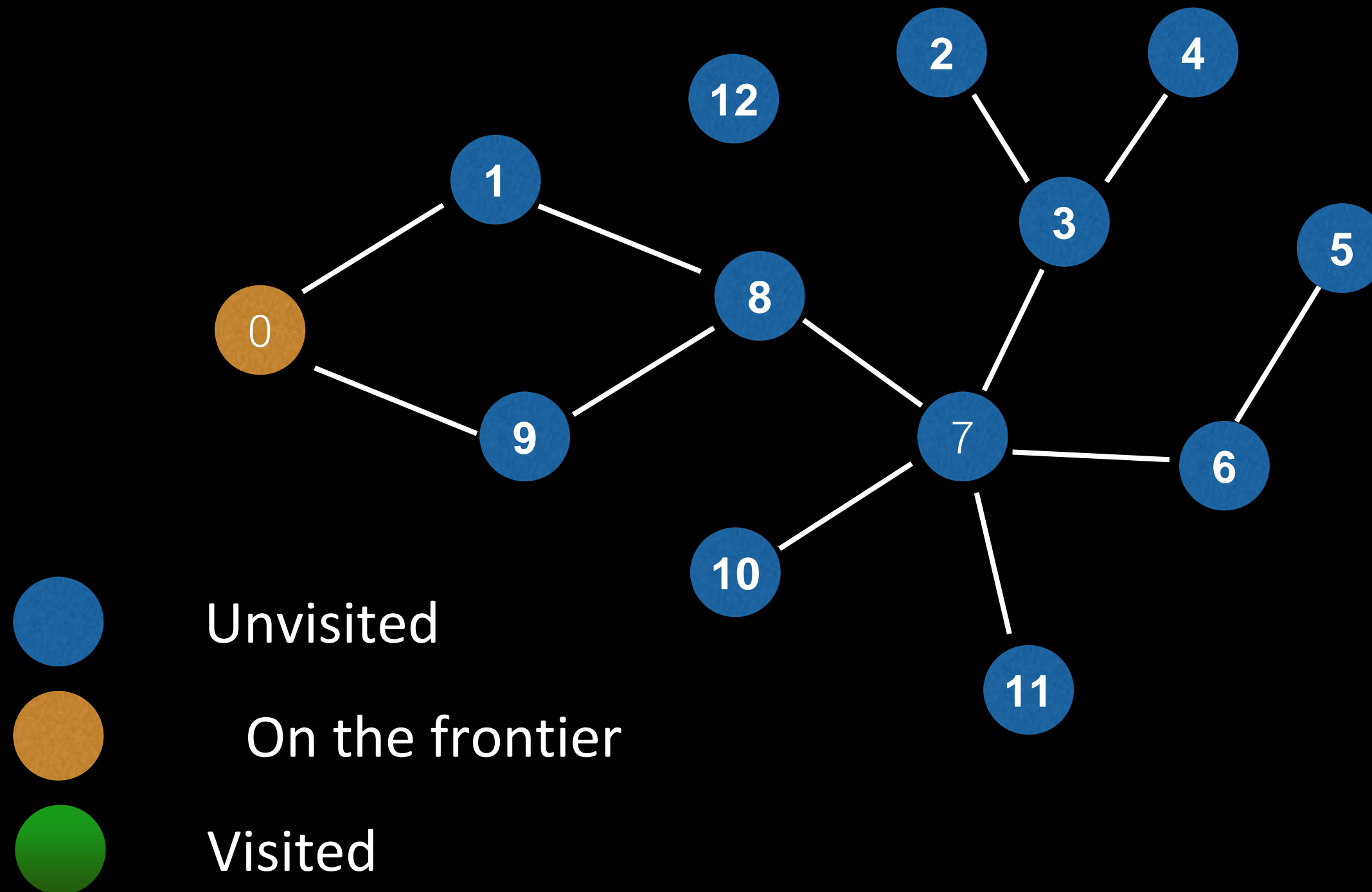
Dequeue()



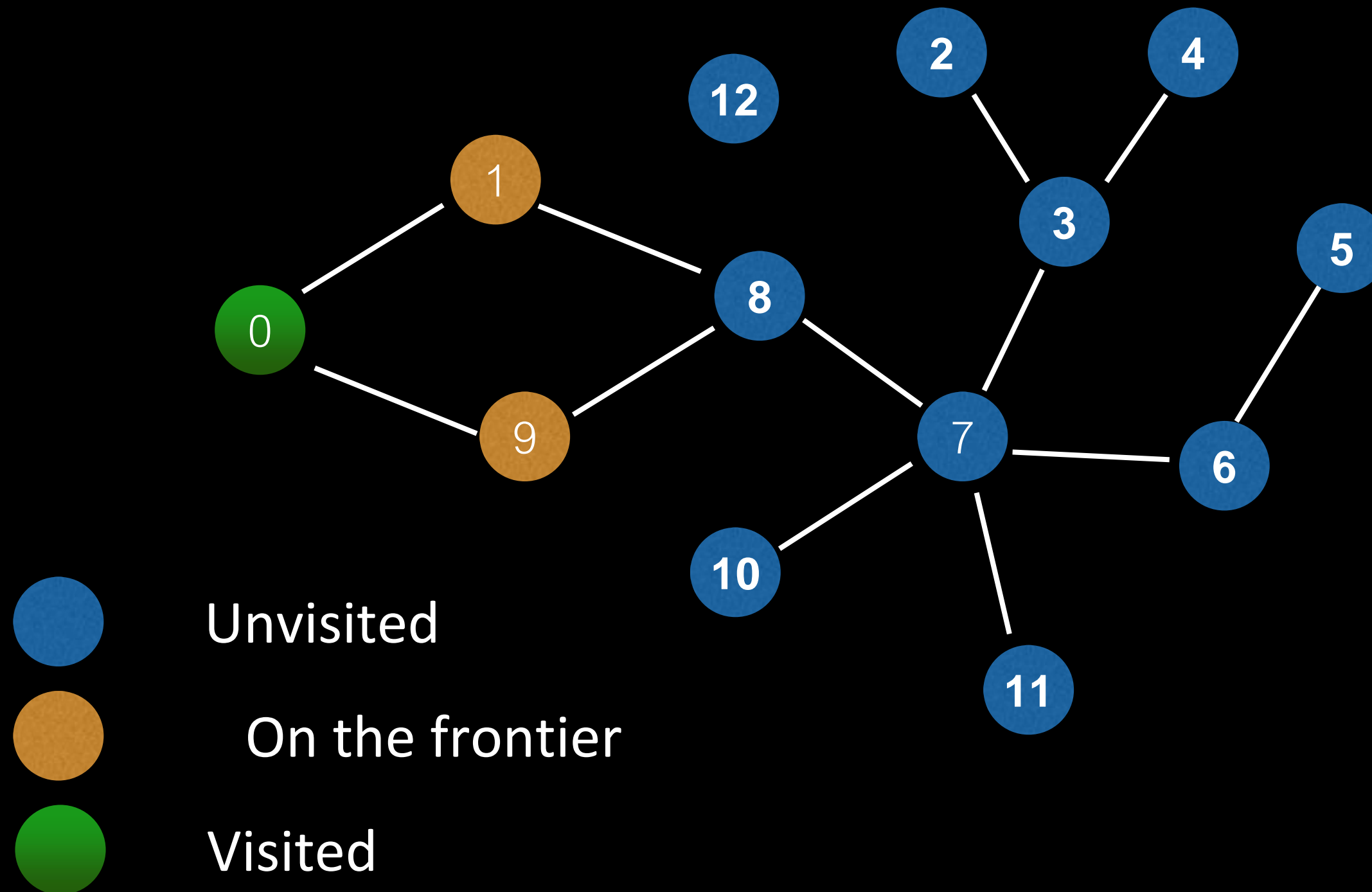
Queue Example - BFS



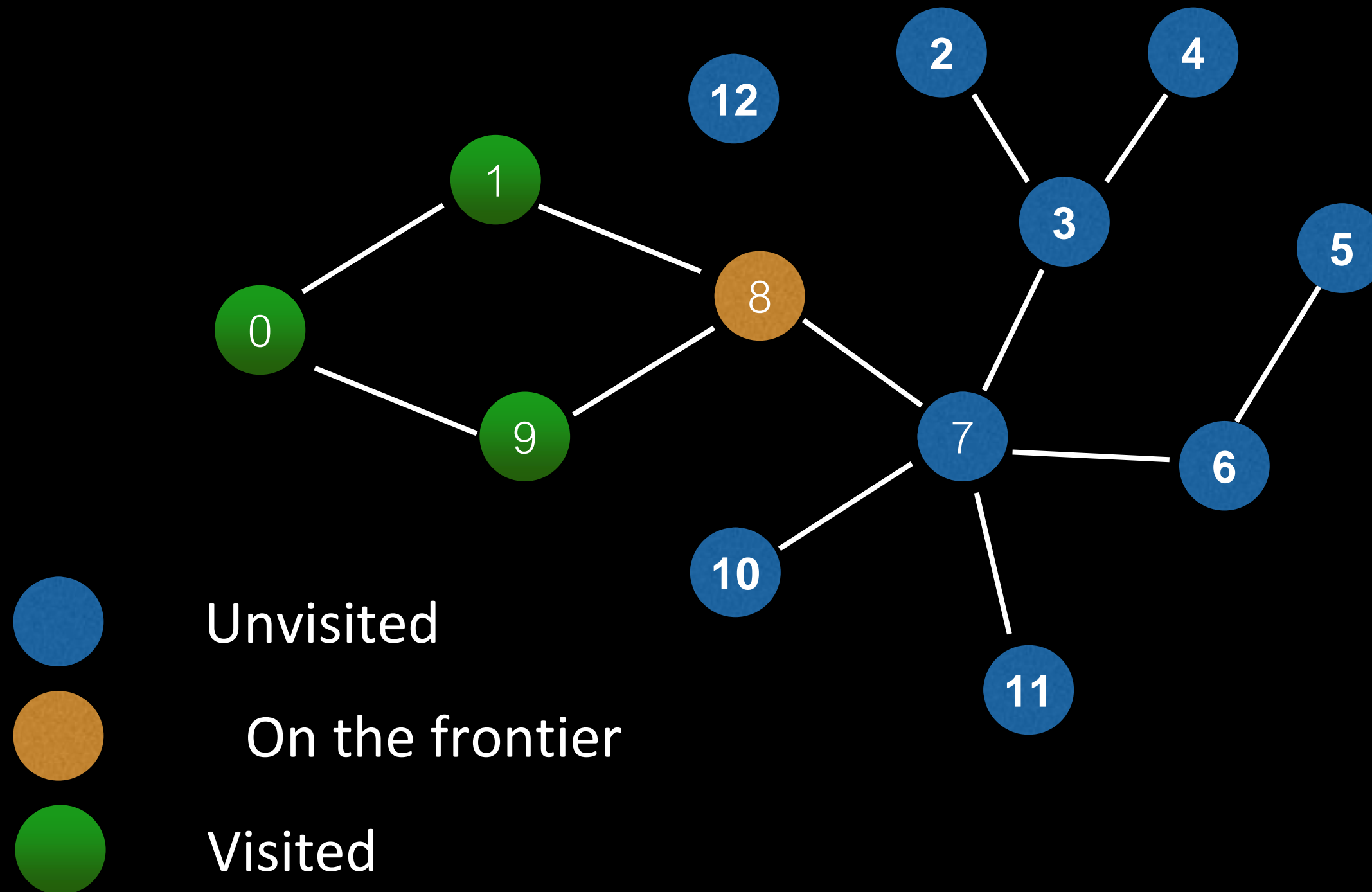
Queue Example - BFS



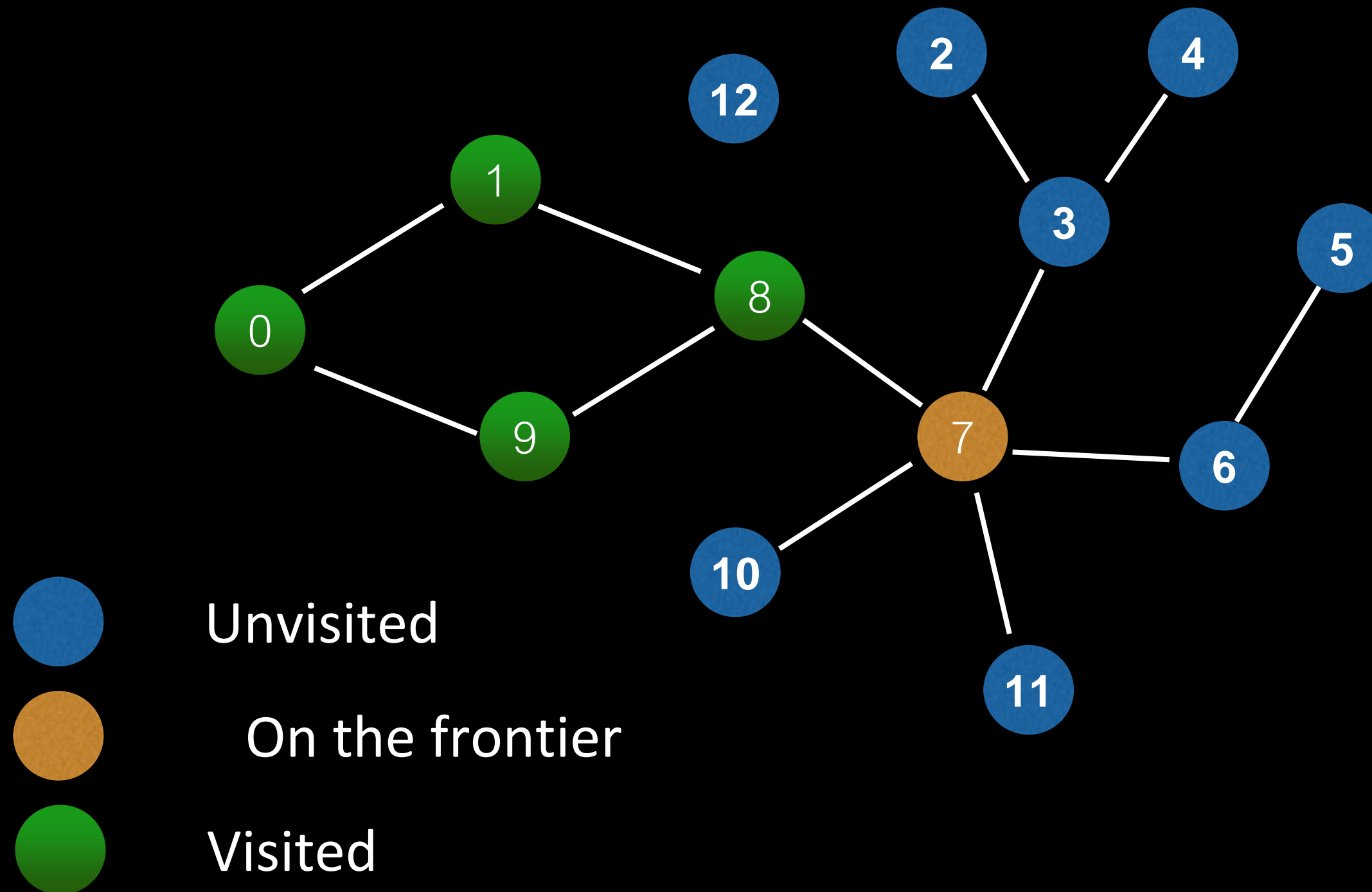
Queue Example - BFS



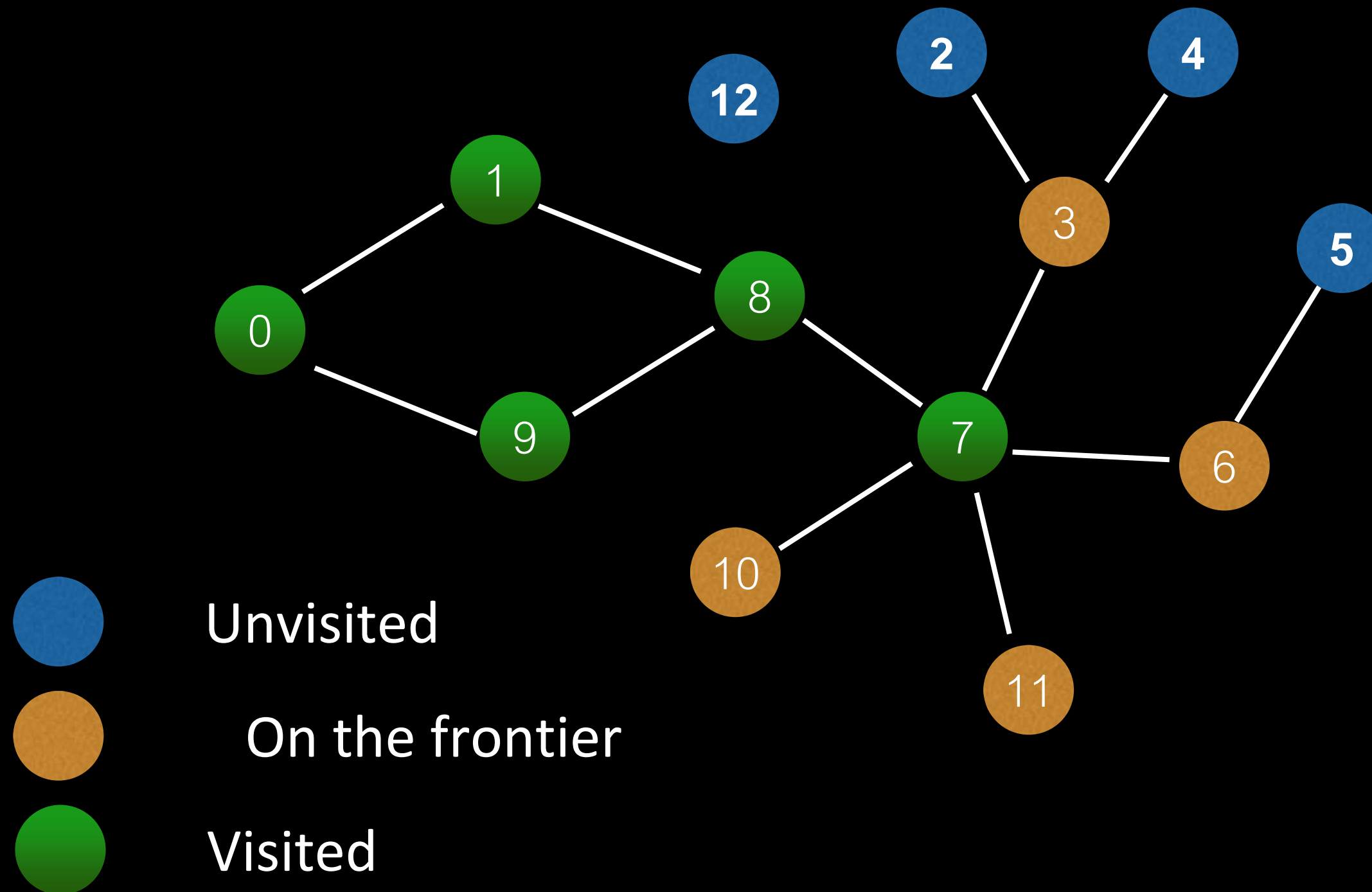
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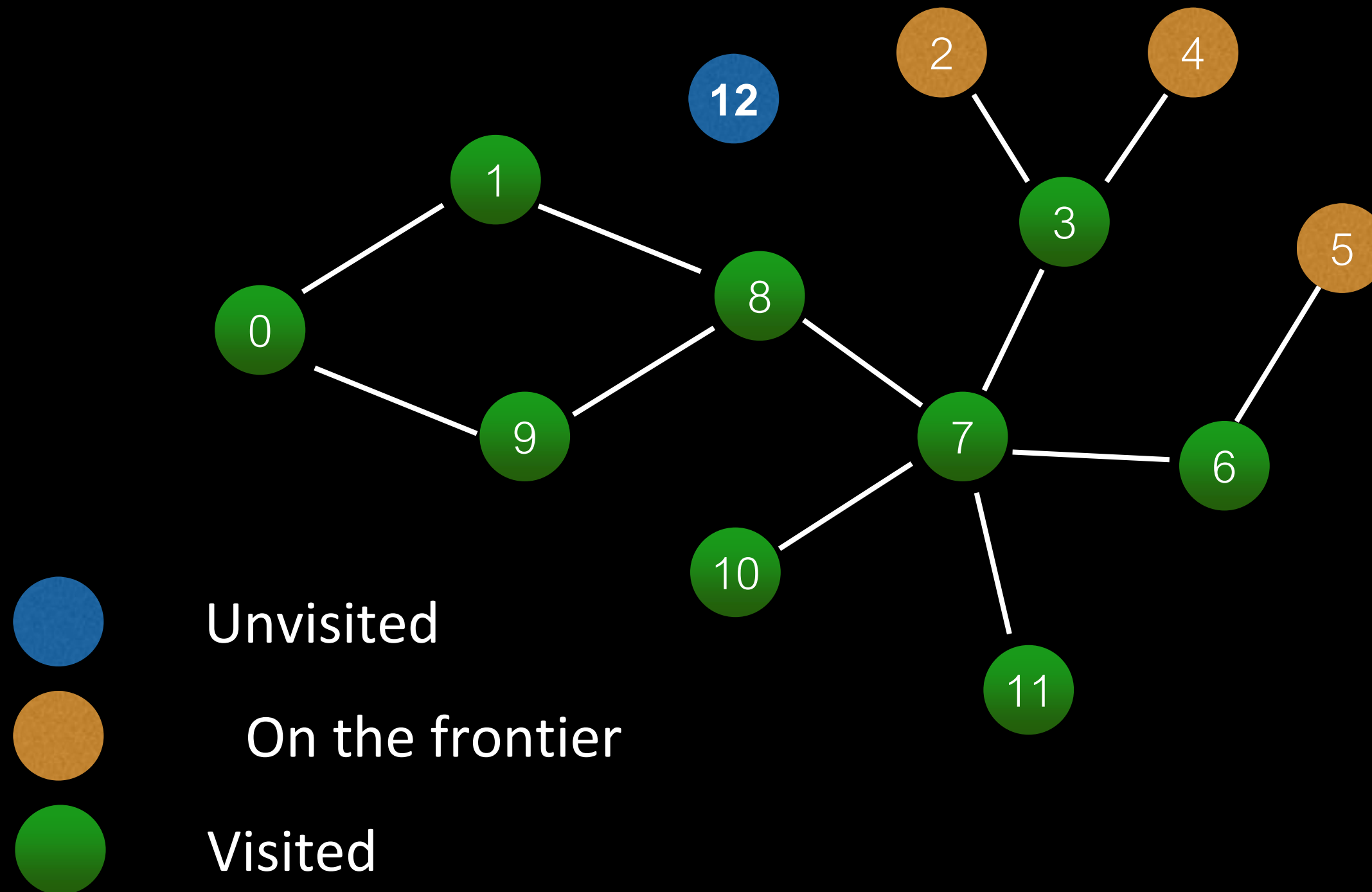
Queue Example - BFS



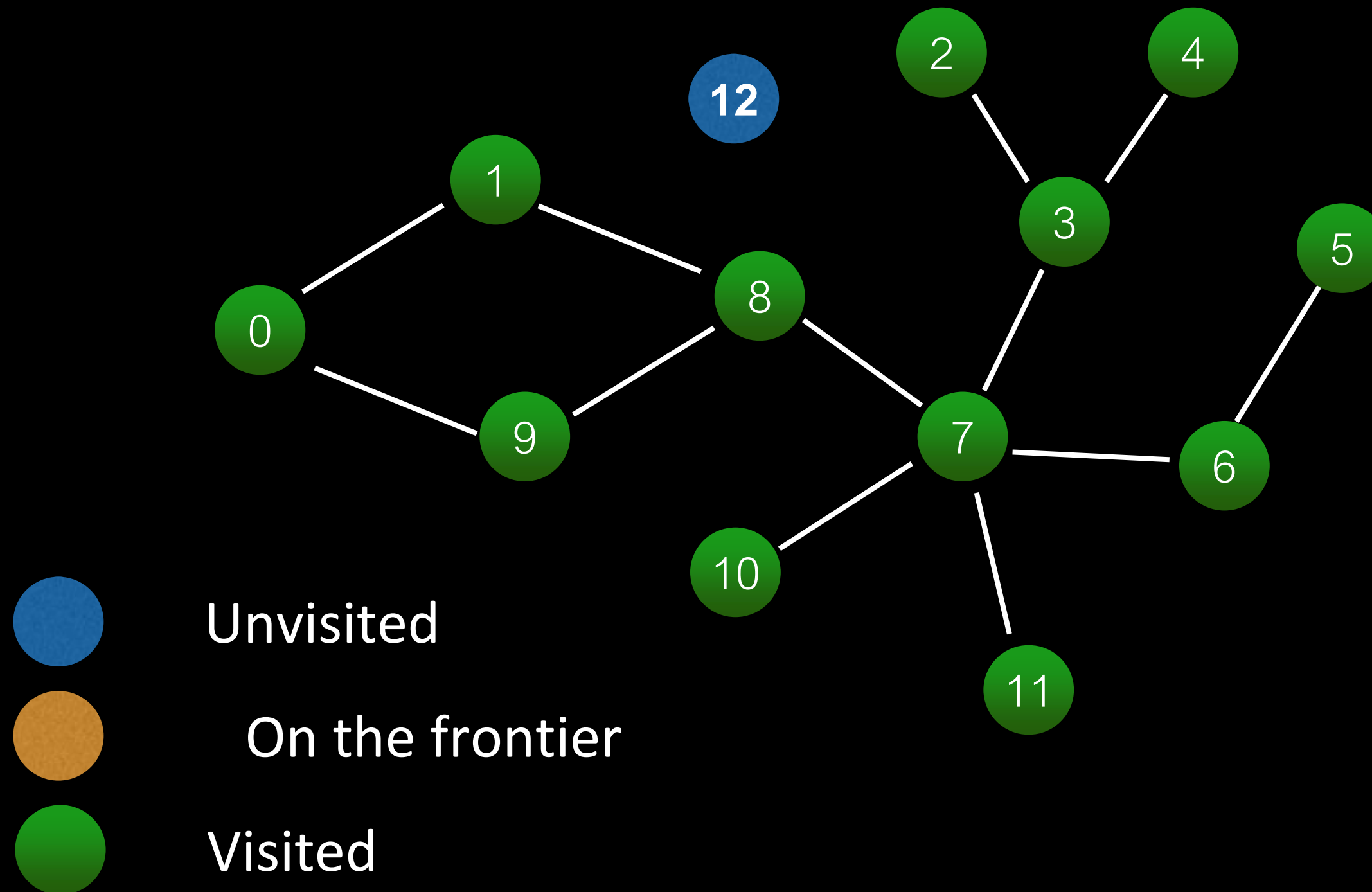
Queue Example - BFS



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Queue Example - BFS



Queue Example - BFS

Let Q be a Queue

Q.enqueue(starting_node)

starting_node.visited = **true**

While Q is not empty **Do**

node = Q.dequeue()

For neighbour **in** neighbours(node):

If neighbour has not been visited:

neighbour.visited = **true**

Q.enqueue(neighbour)