Queues

Part ⅓

William Fiset

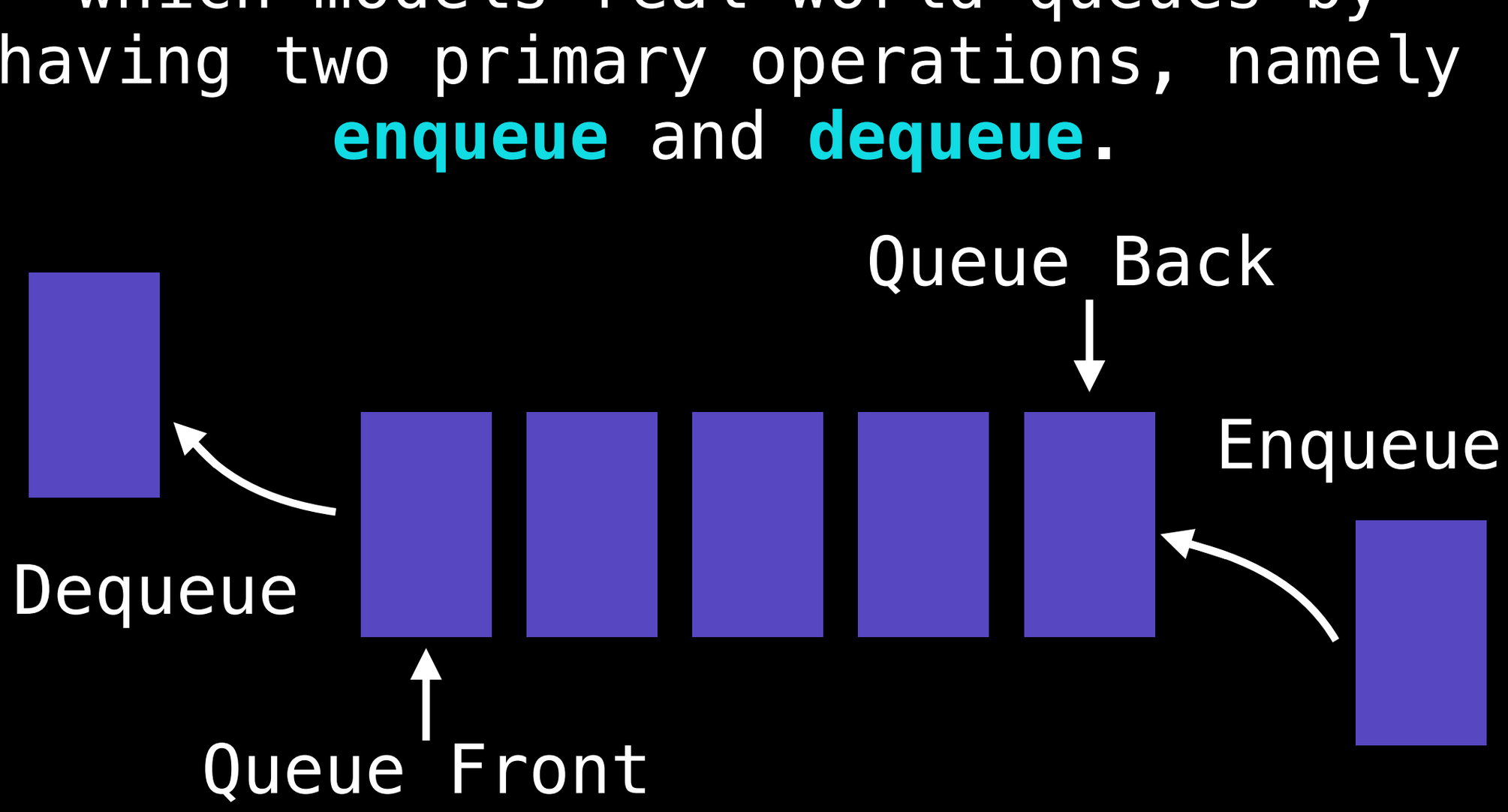
Outline

- 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

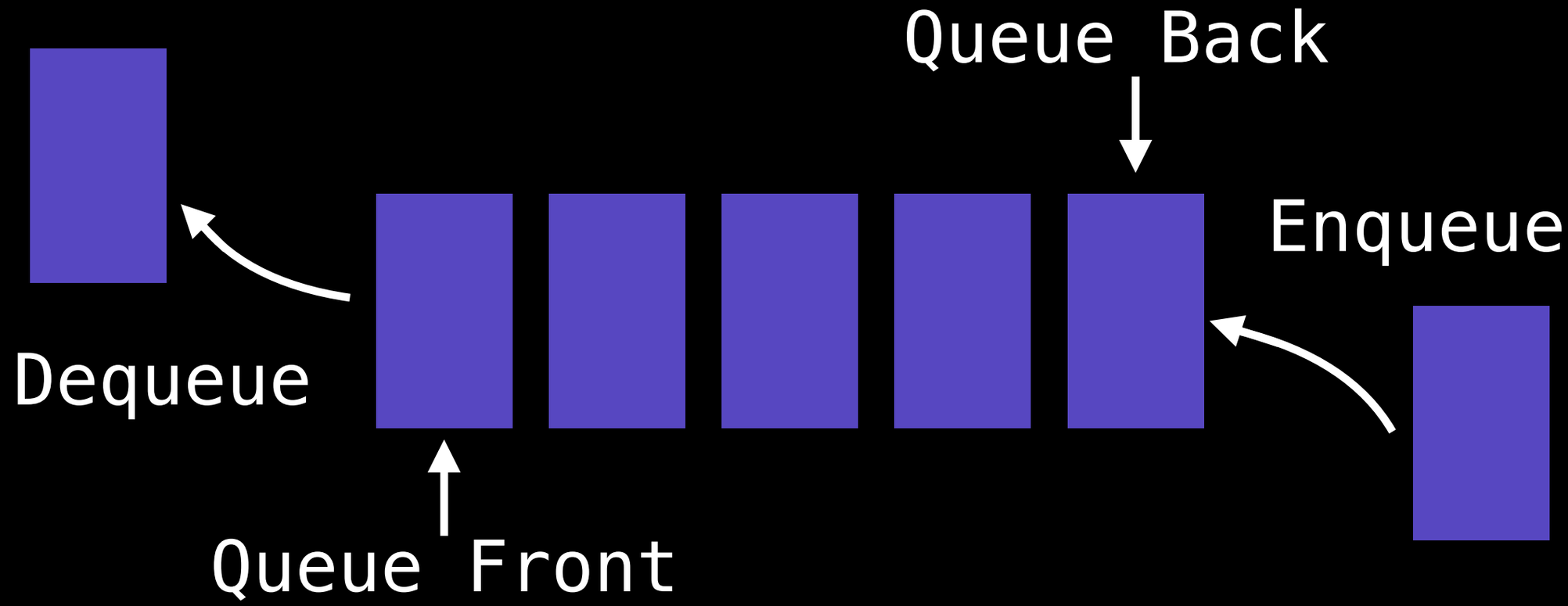
Discussion

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**.



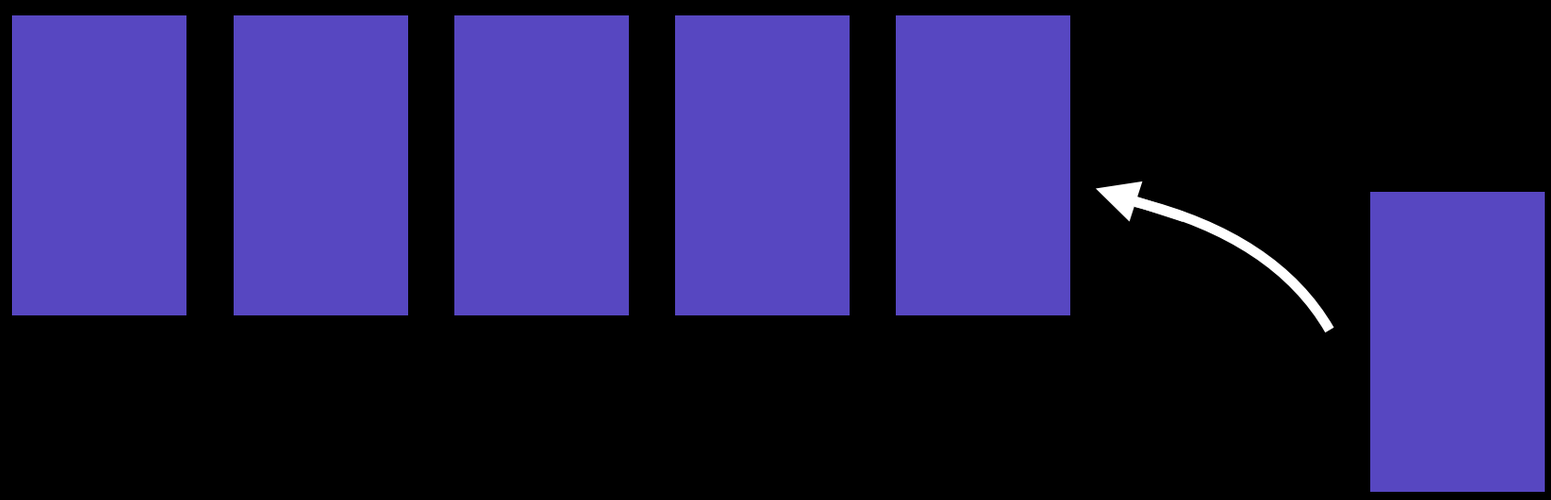
Queue Terminology



Queue Terminology

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

Enqueue = Adding = Offering



Queue Terminology

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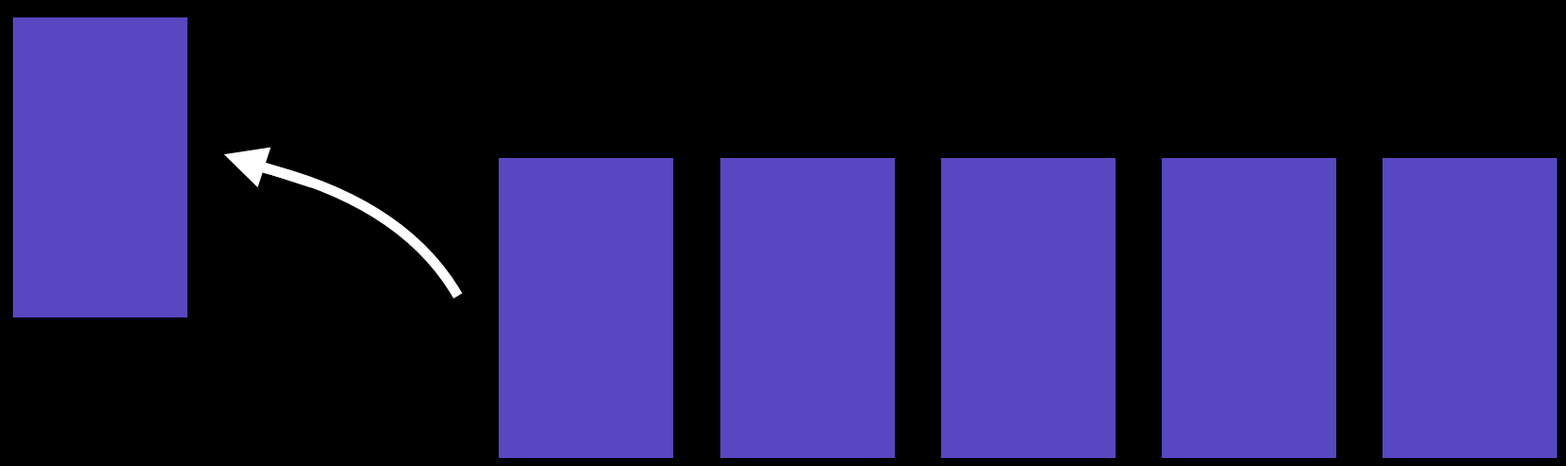
Dequeue = Polling

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



Queue Example

<u>Instructions</u>:

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Dequeue()
Enqueue(7)
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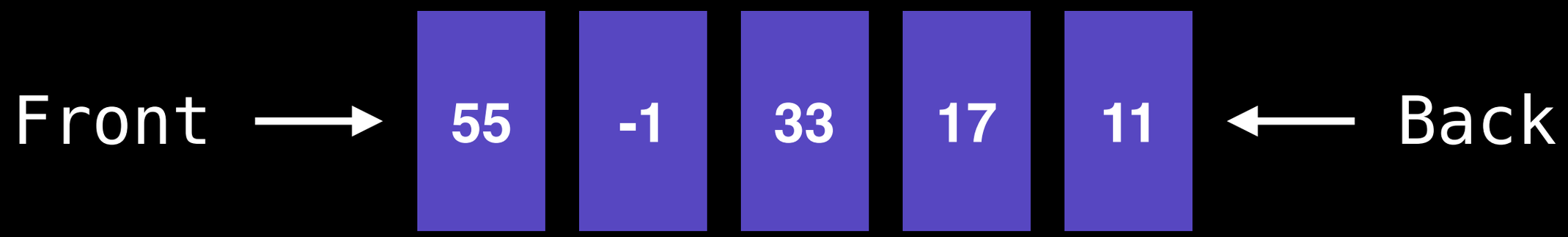

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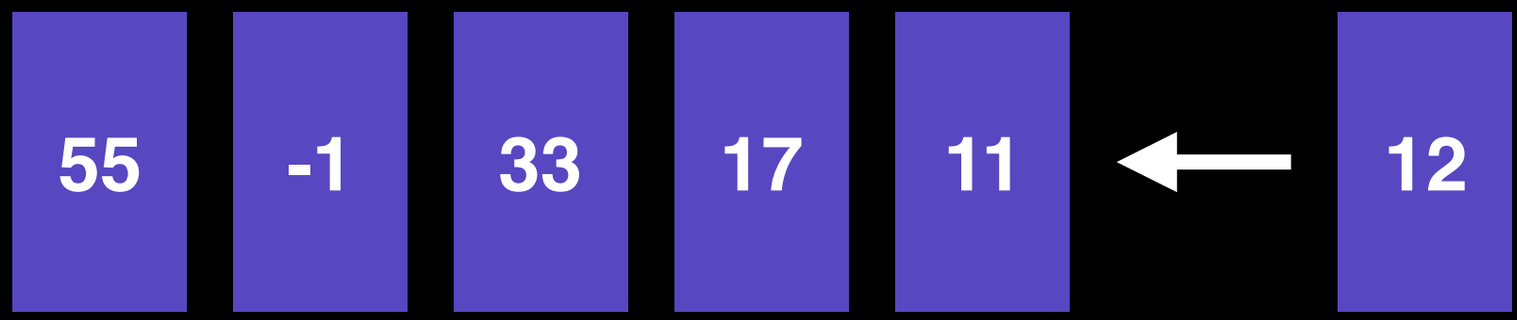

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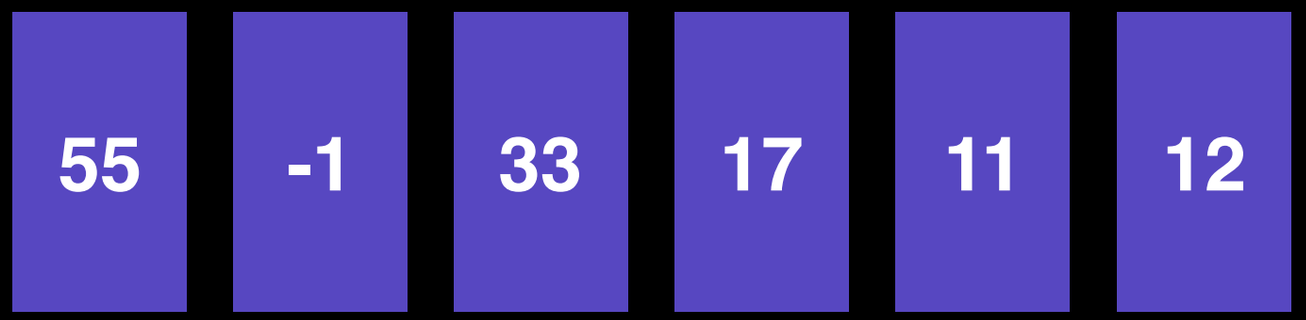

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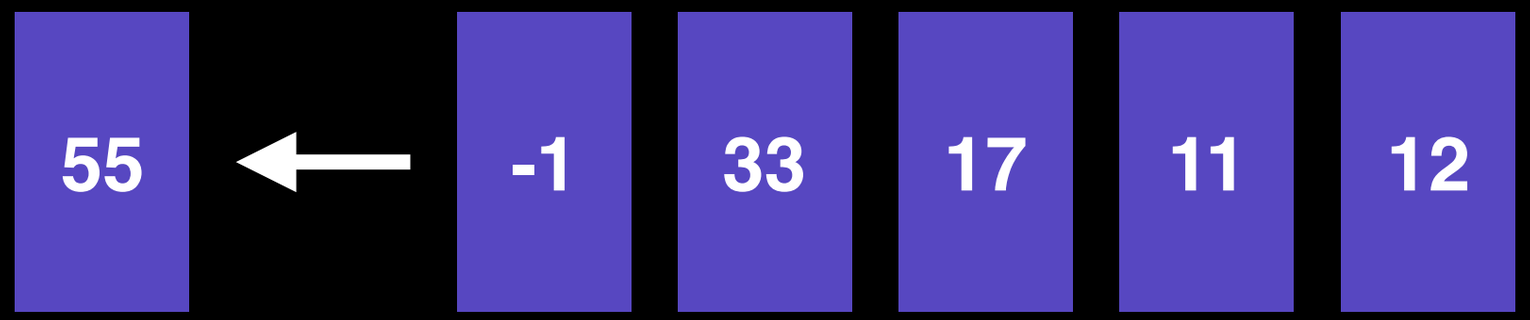

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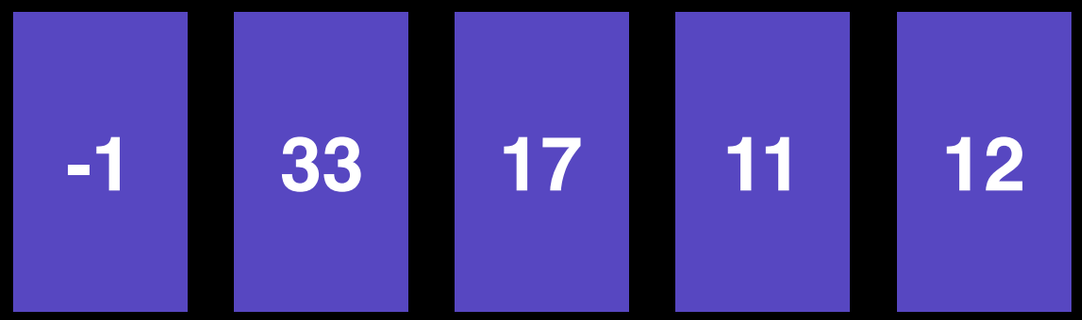

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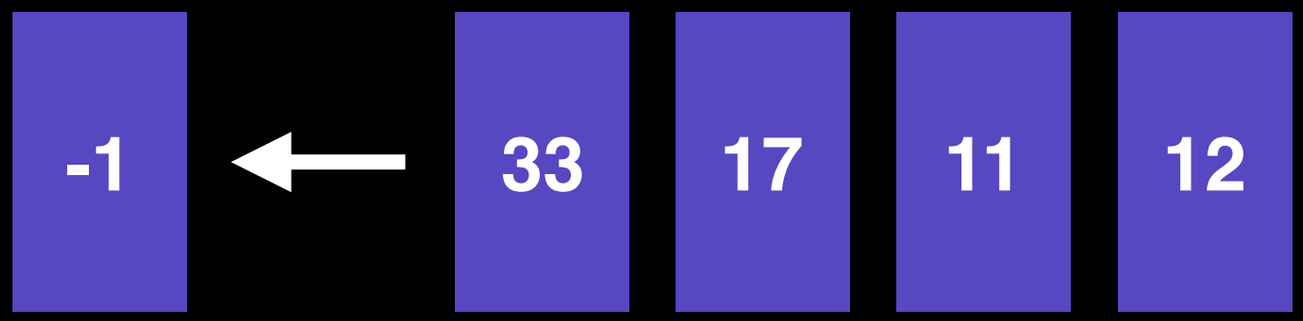

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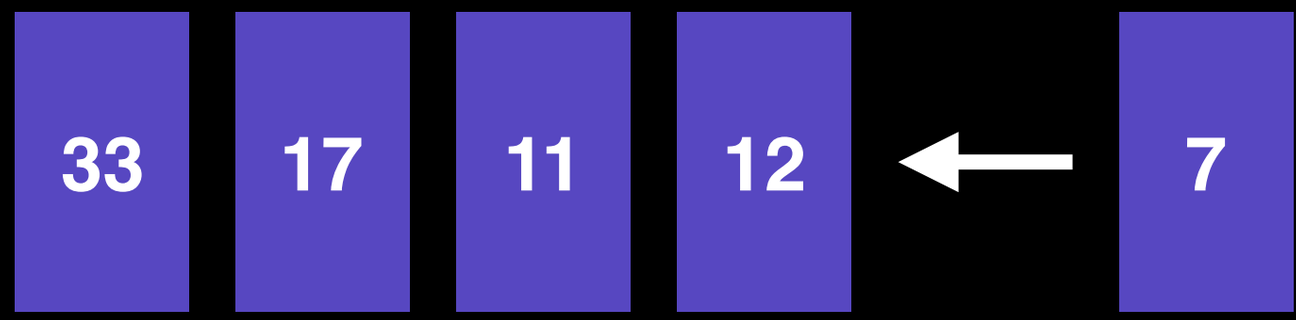

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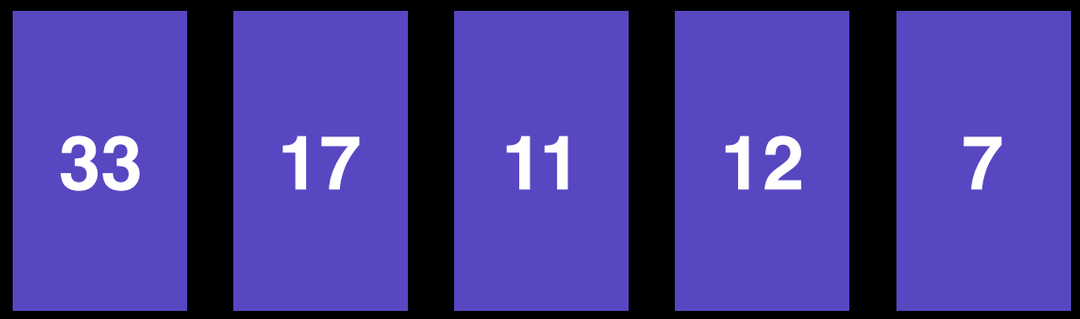

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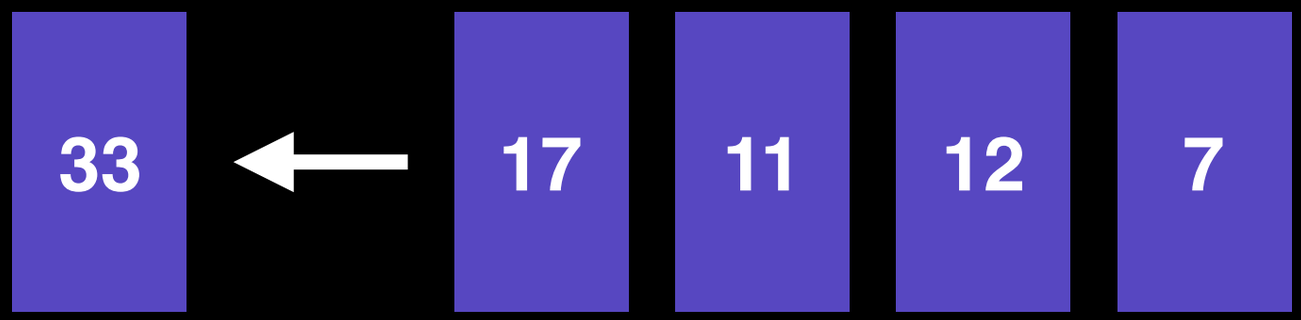

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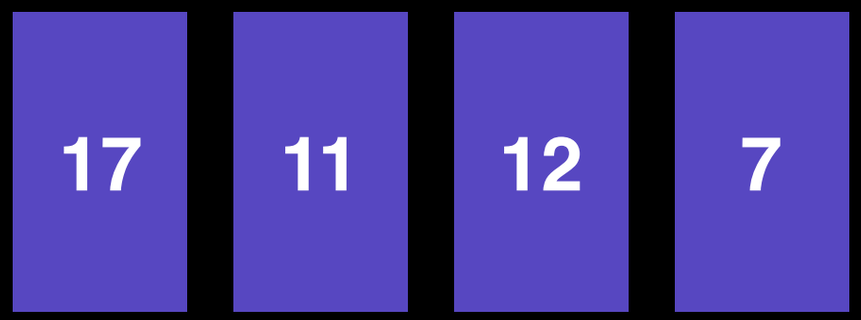

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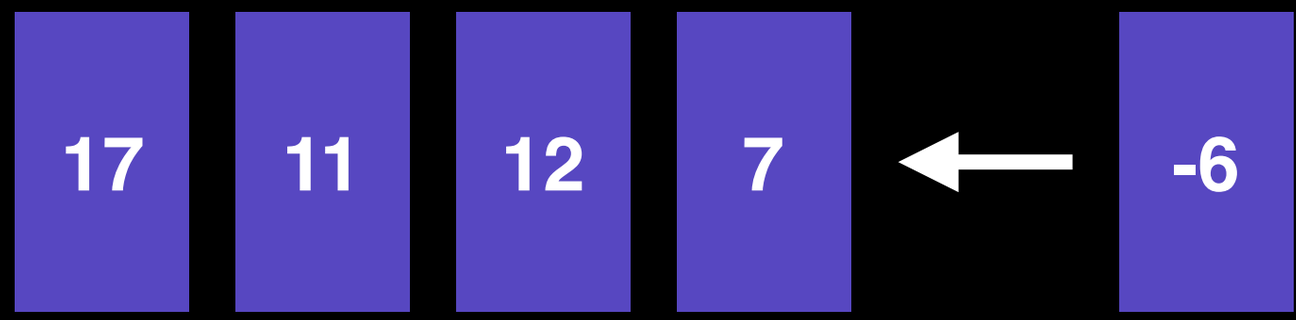

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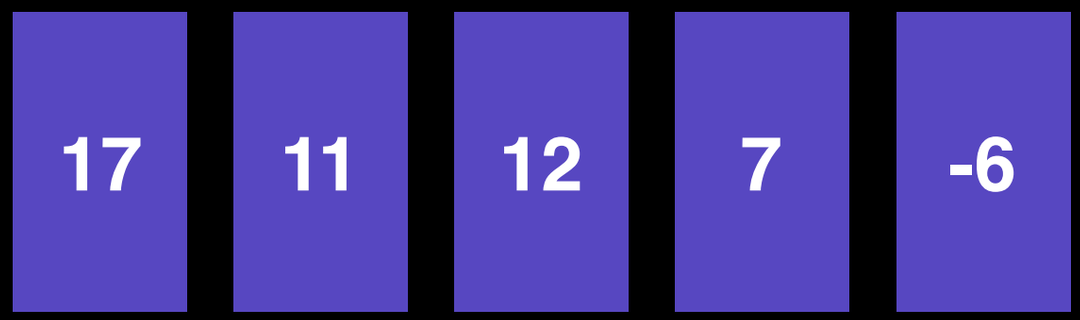


When and where is a Queue used?

- 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)

Queue implementation details in next video

Implementation source code and tests can all be found at the following link:

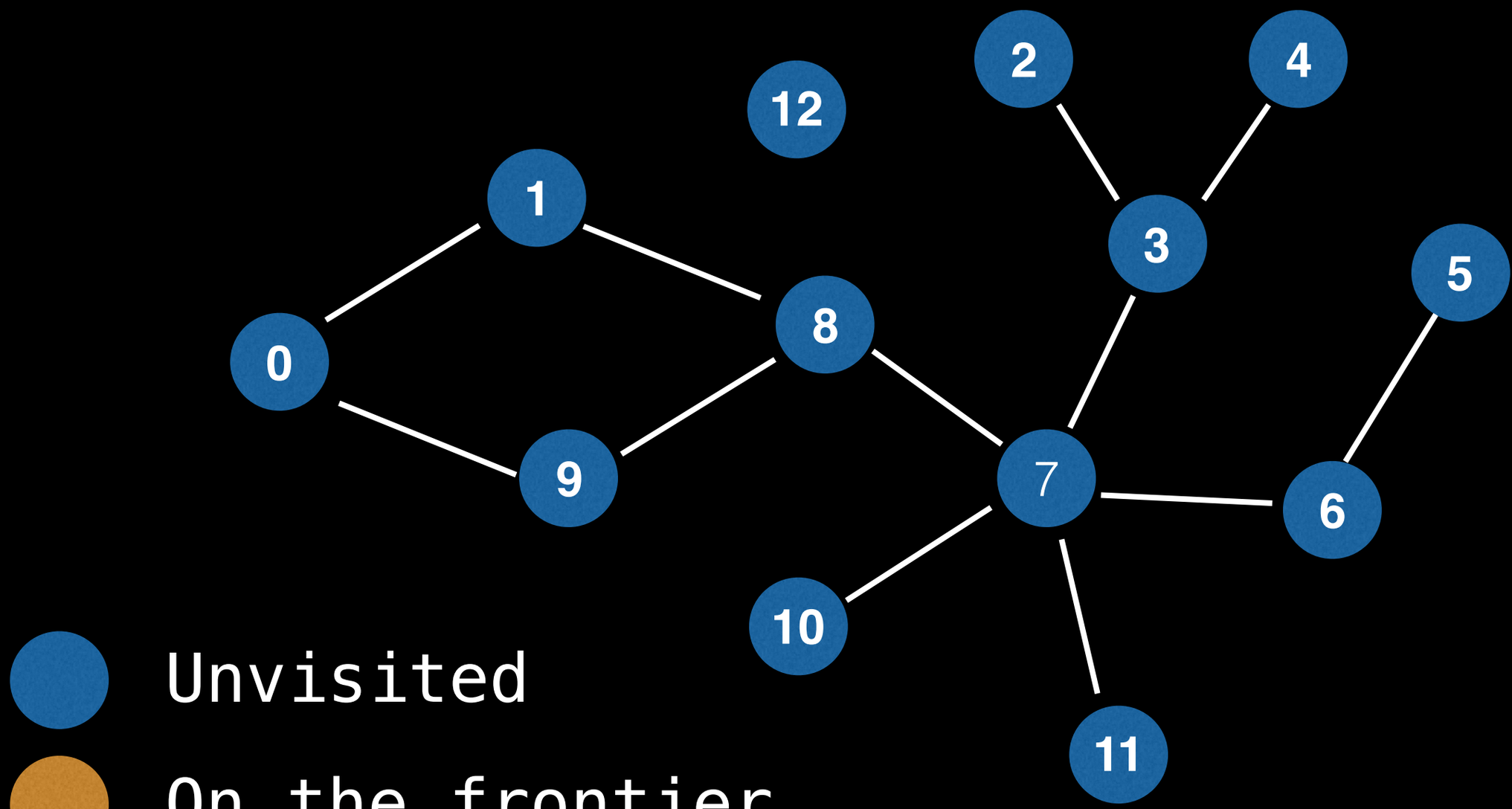
github.com/williamfiset/data-structures

Queues

Part ⅔

William Fiset

Queue Example – BFS

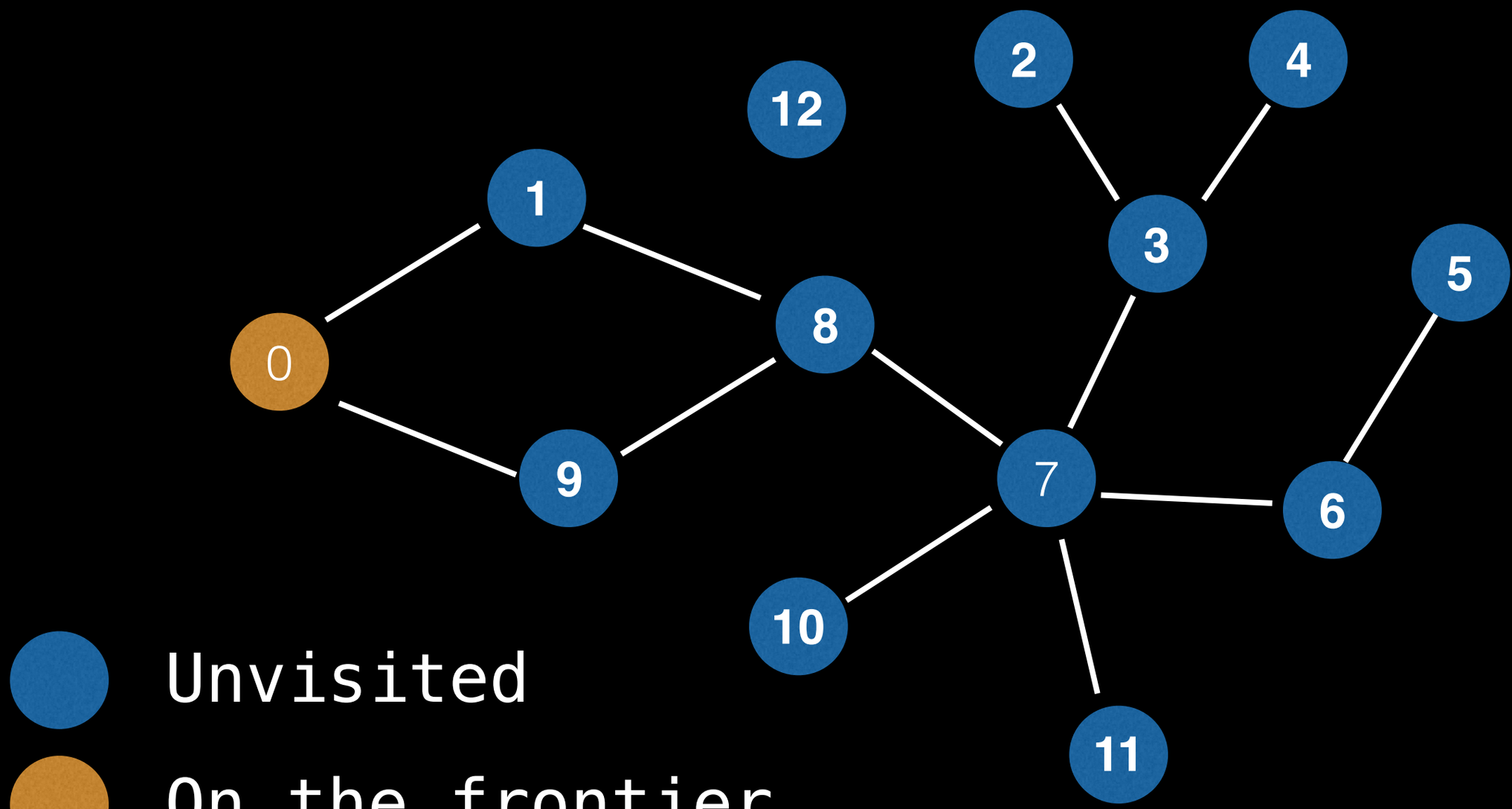


Unvisited

On the frontier

Visited

Queue Example – BFS



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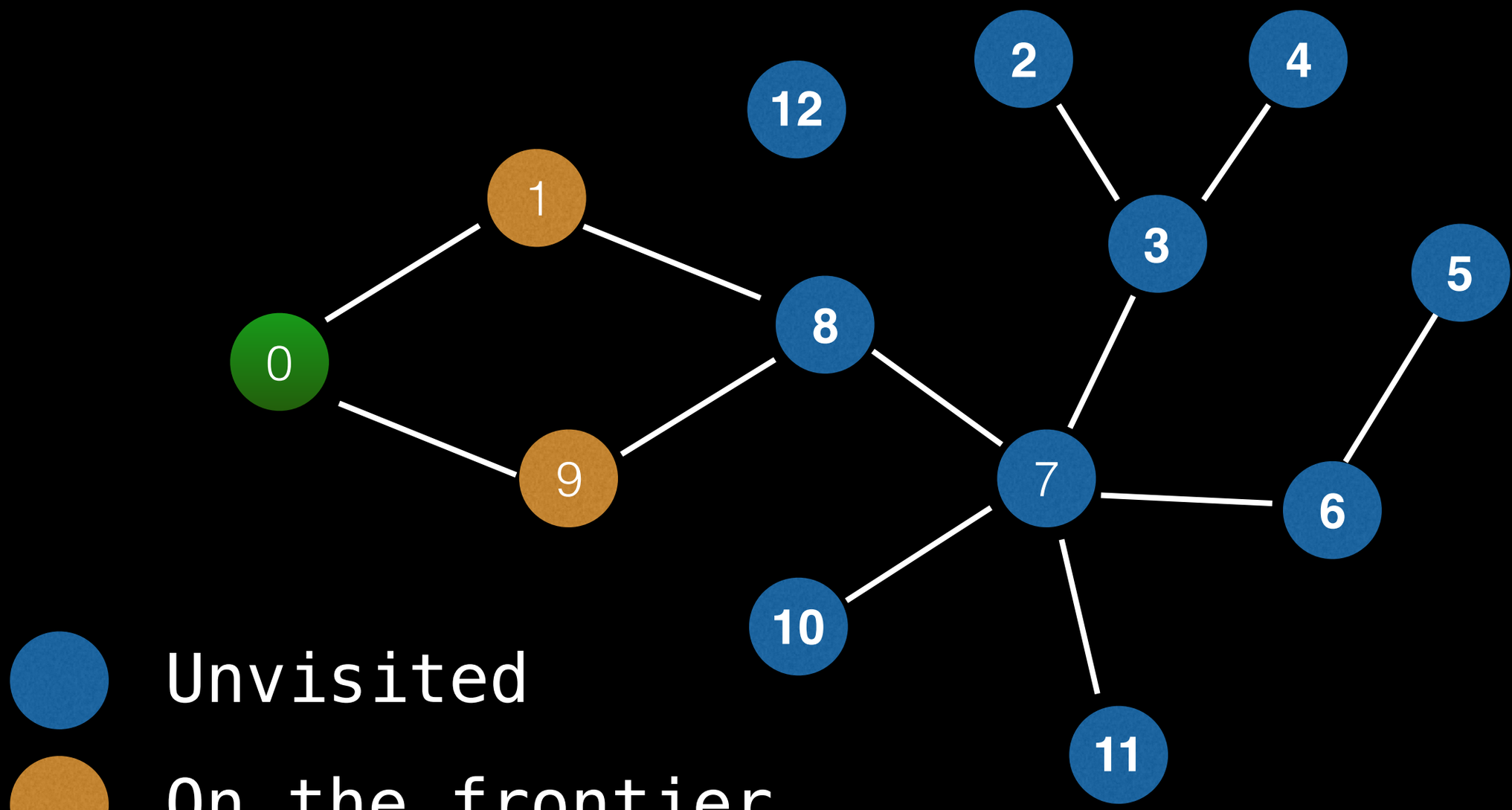

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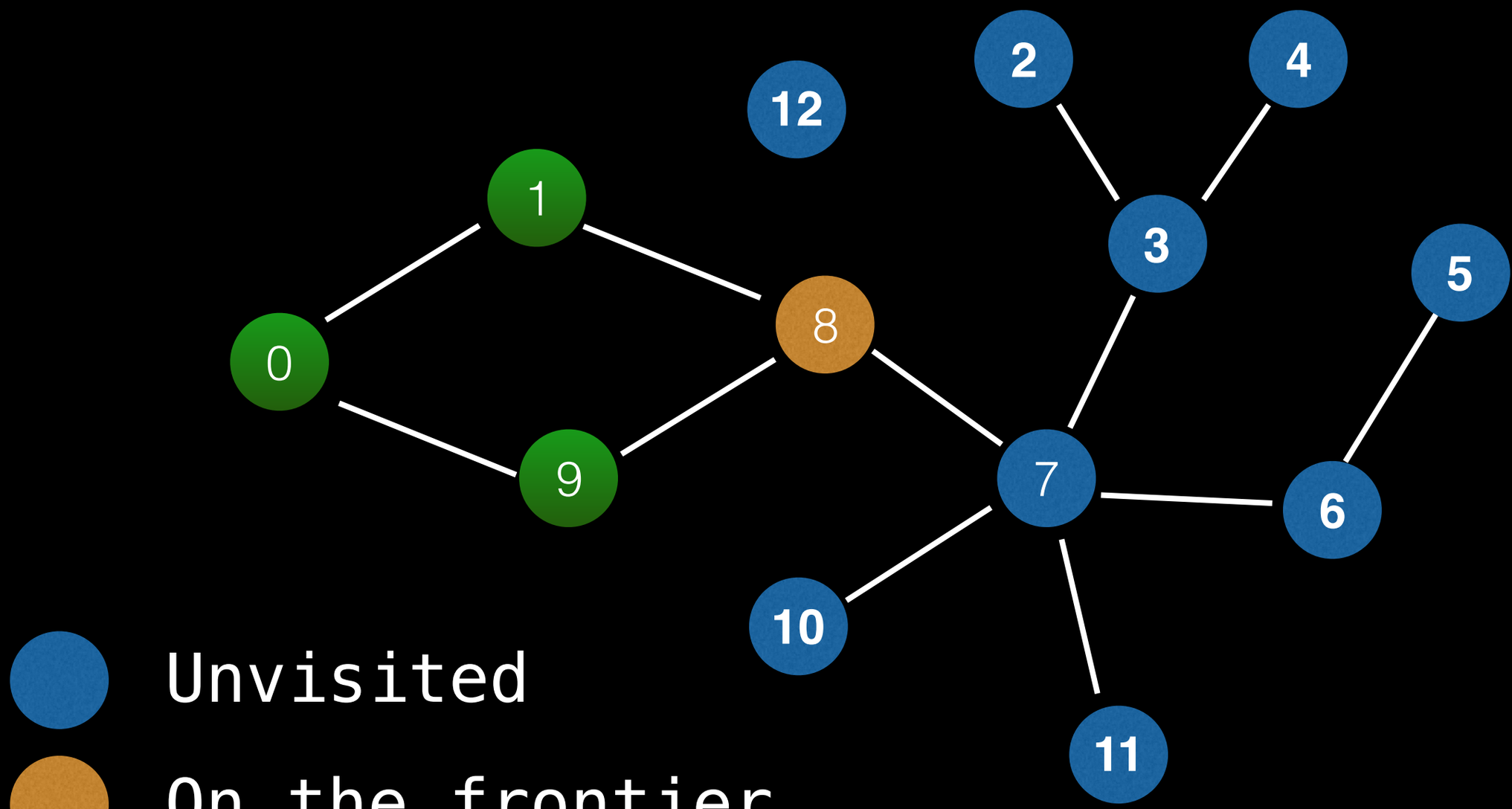

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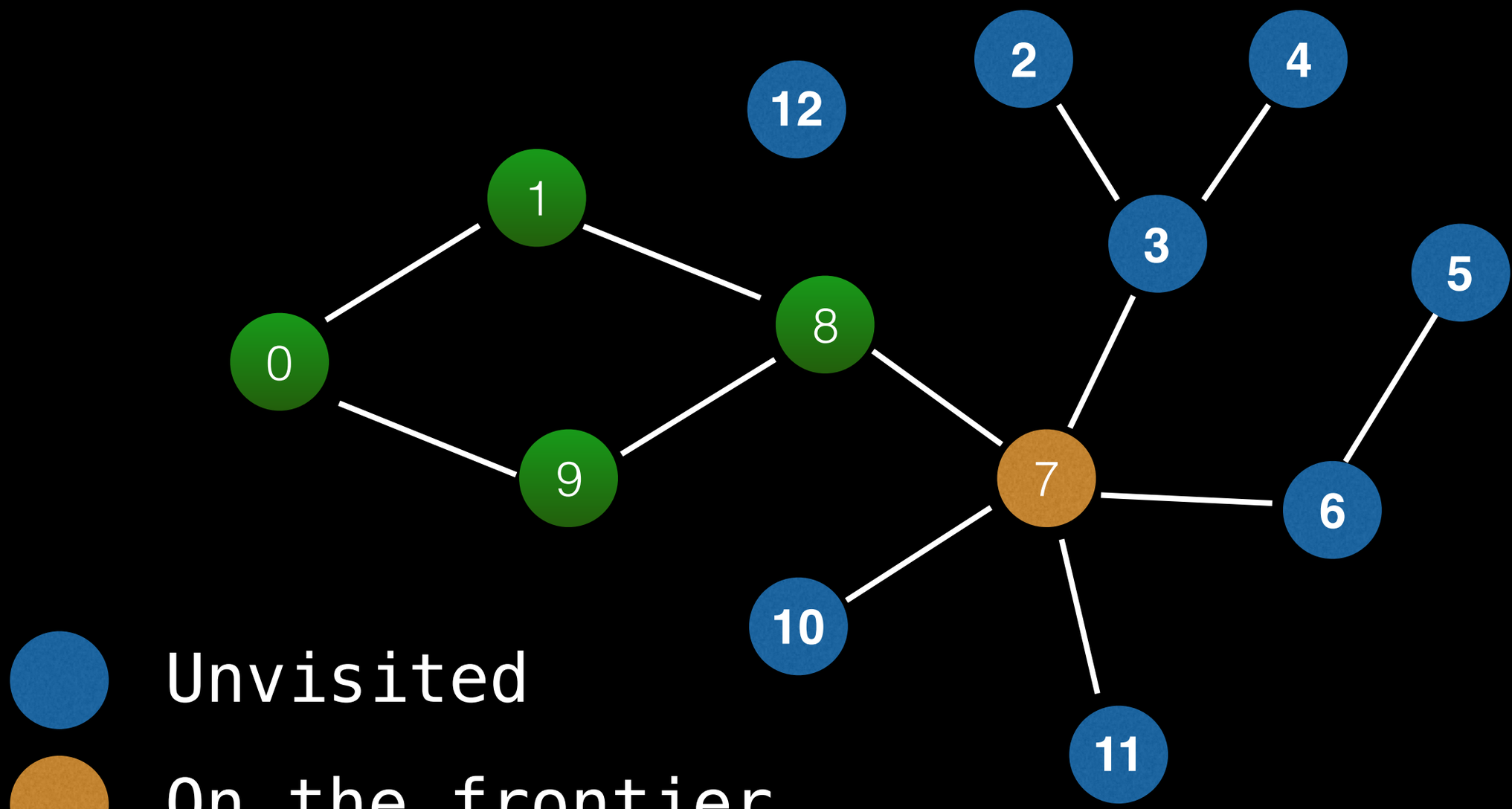

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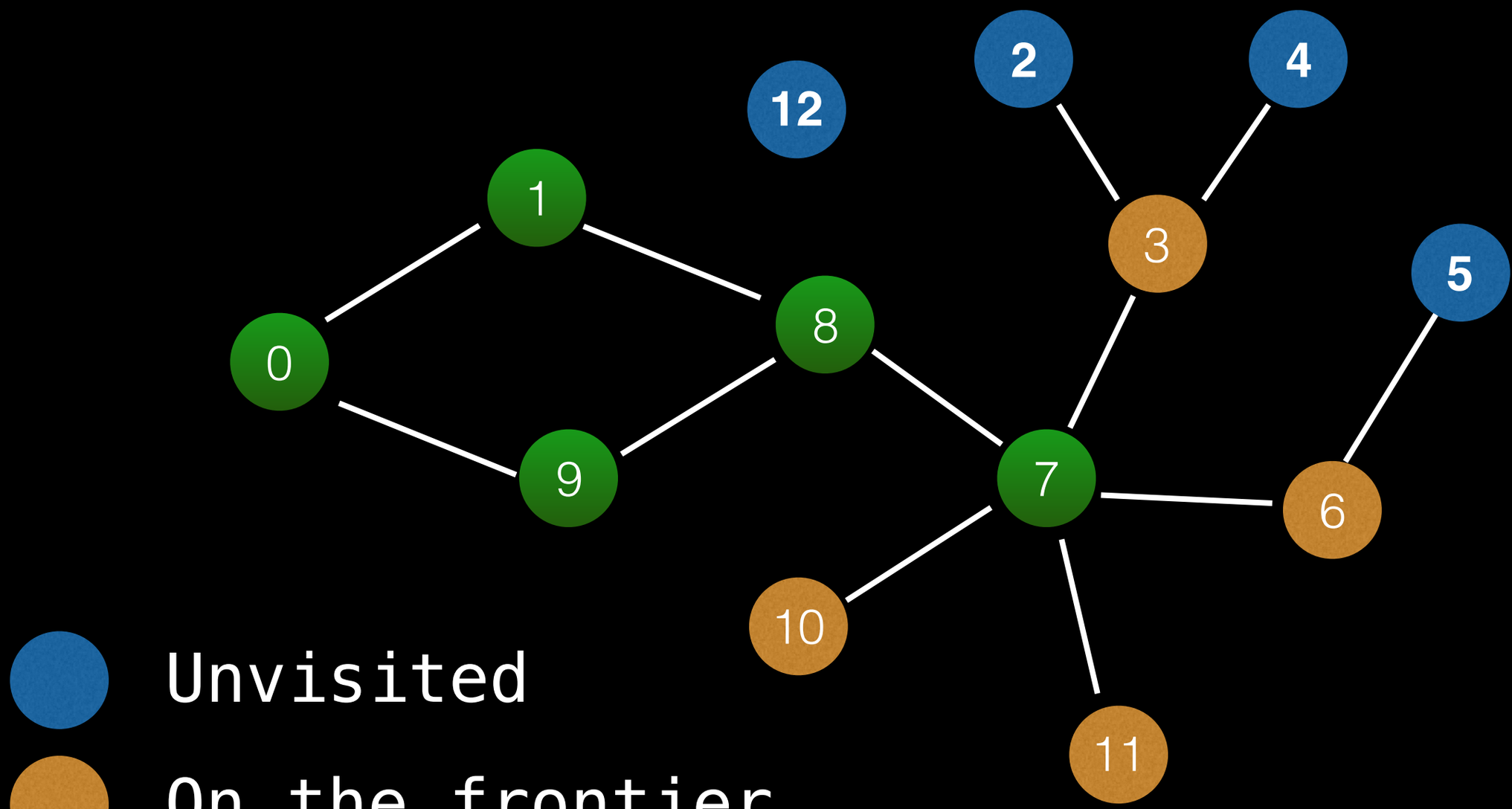

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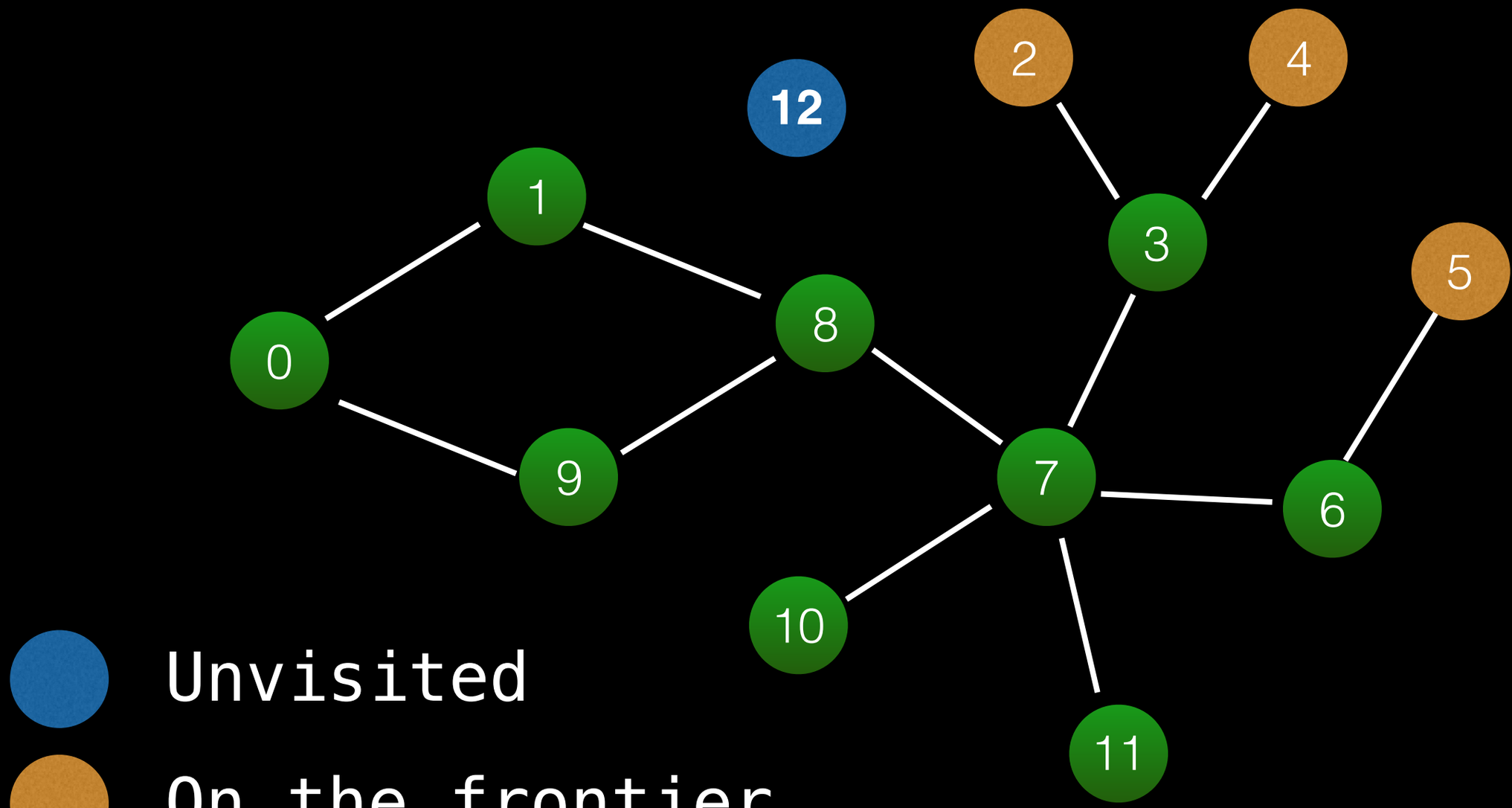

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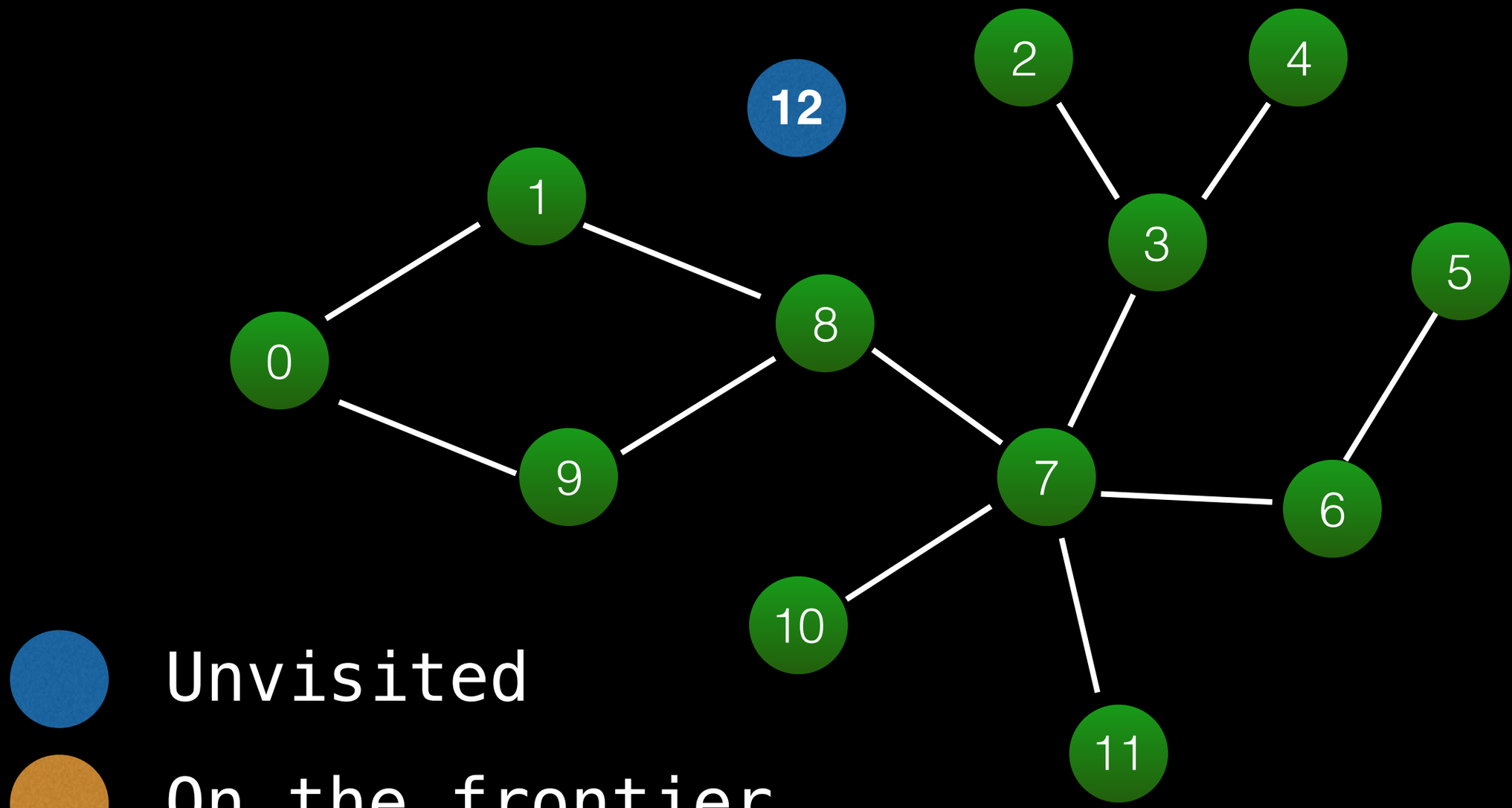

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On the frontier

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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)
```

Queue Implementation Details

Enqueuing

Instructions:

Enqueue(5)
Enqueue(1)
Enqueue(6)
Enqueue(17)
Enqueue(8)

Enqueuing

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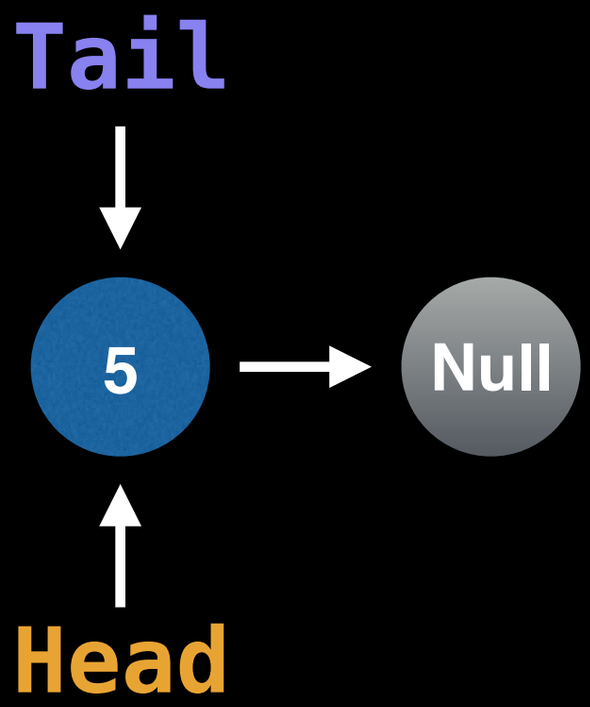

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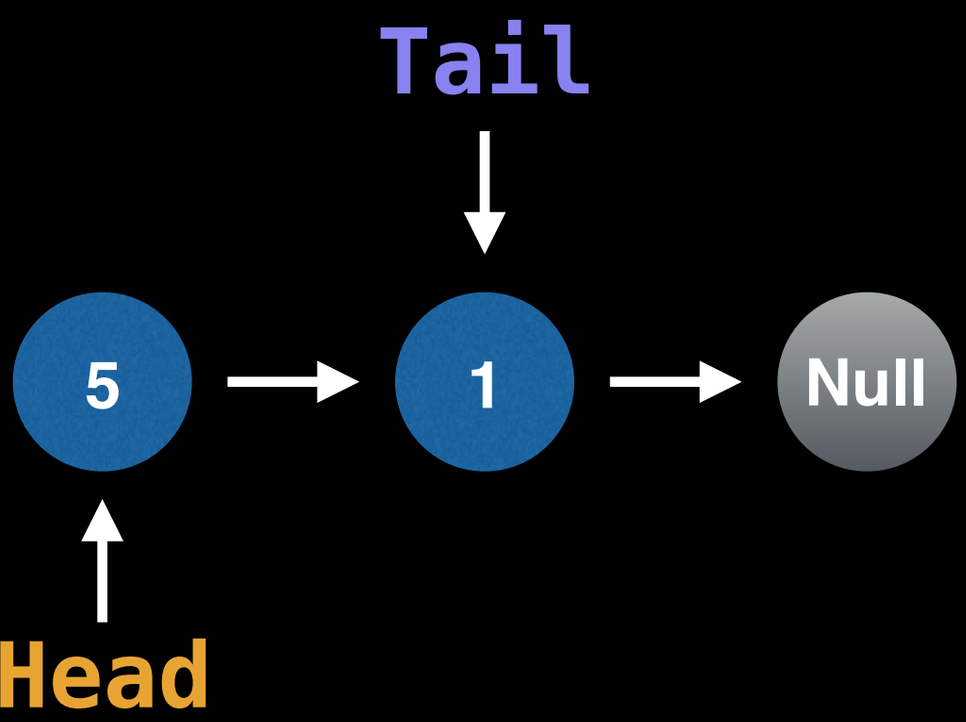

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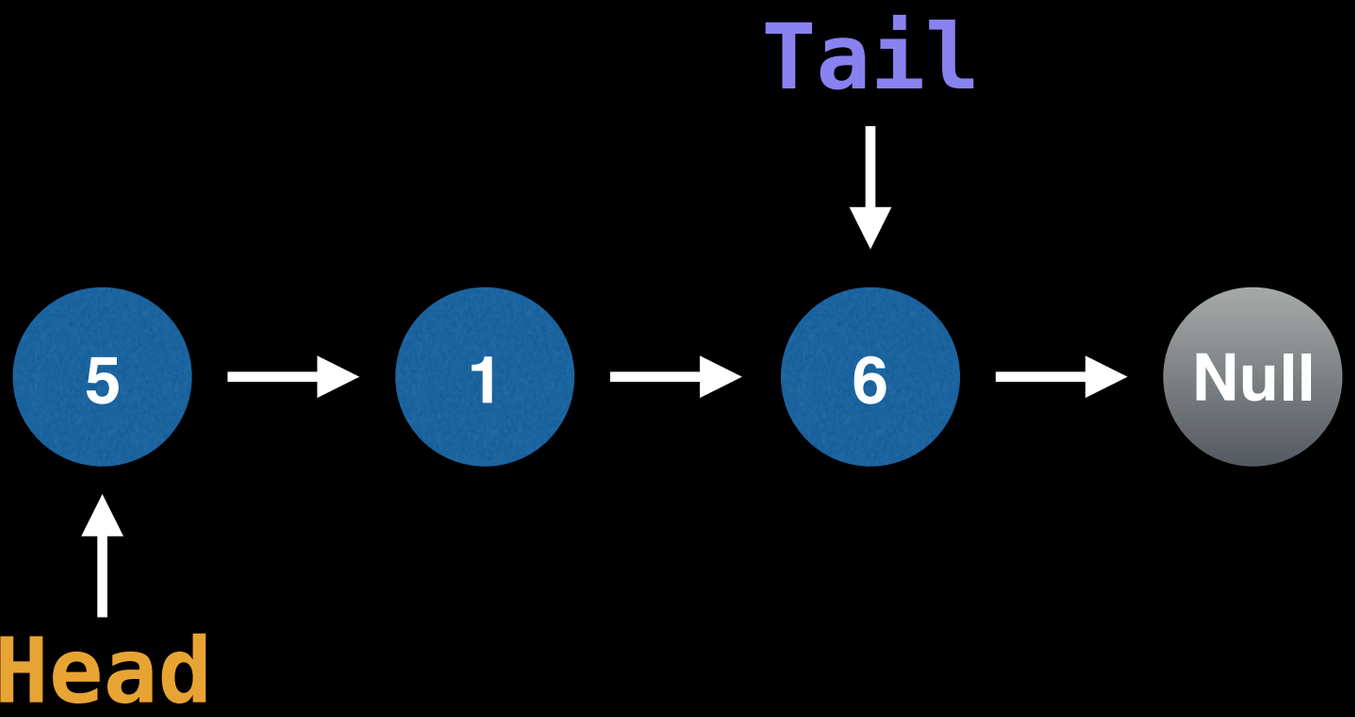

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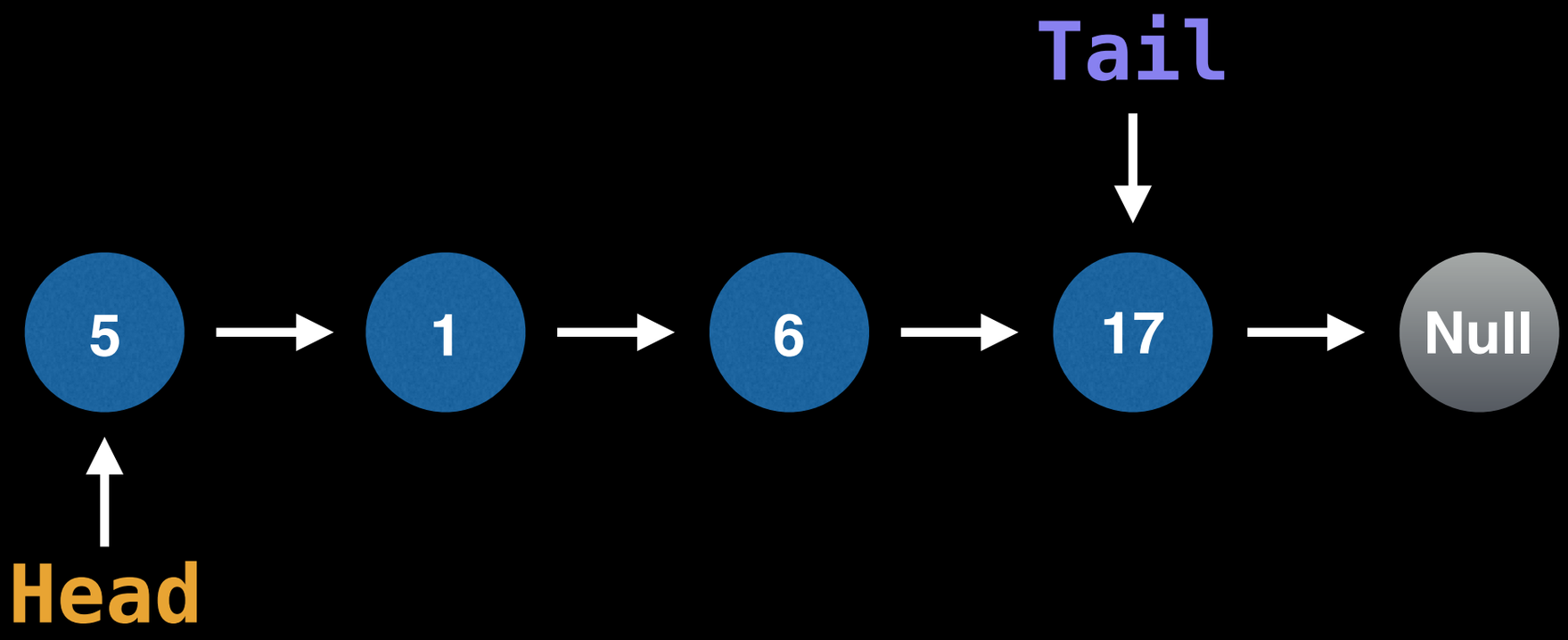

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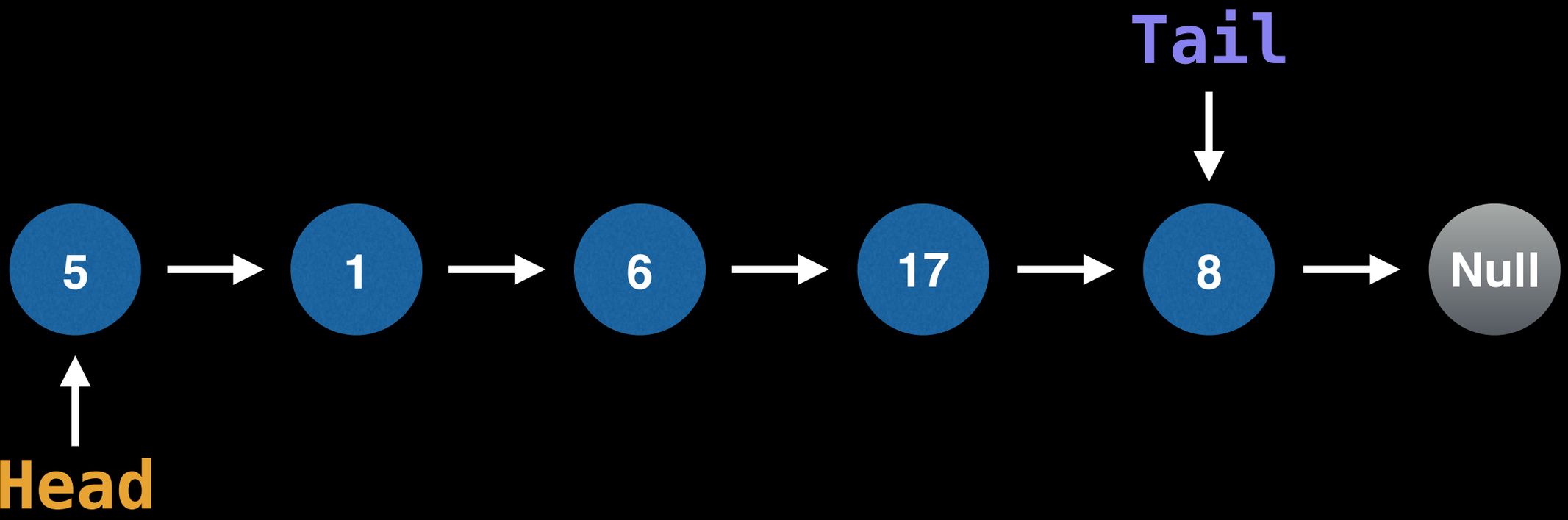

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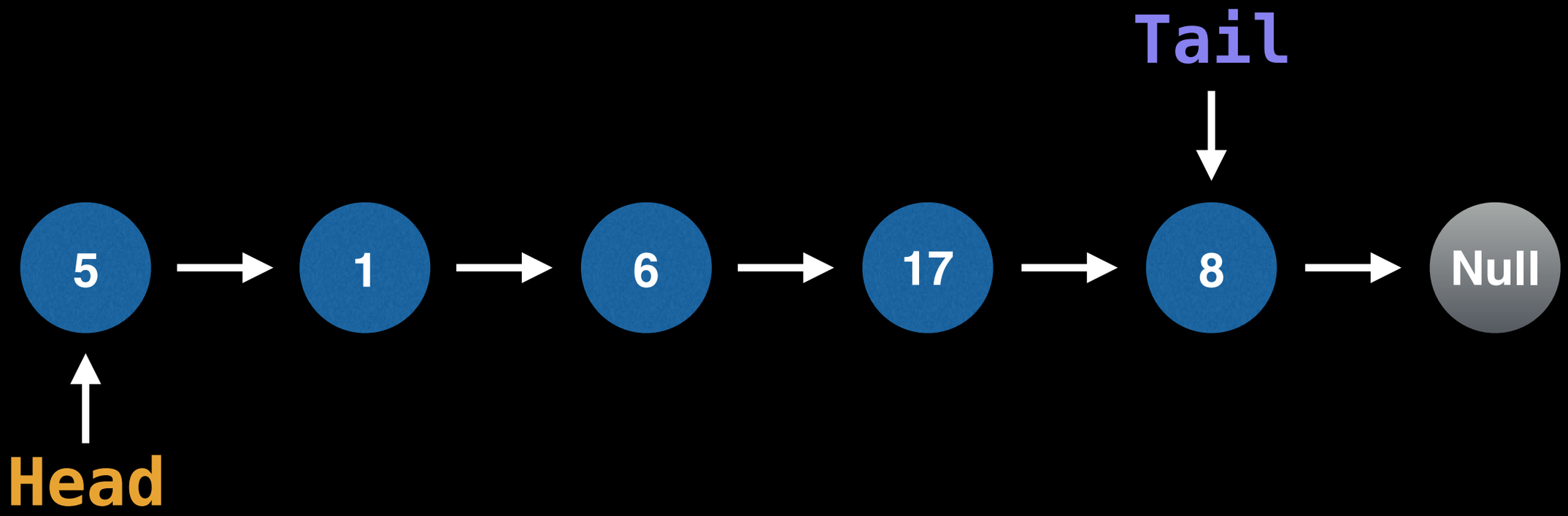

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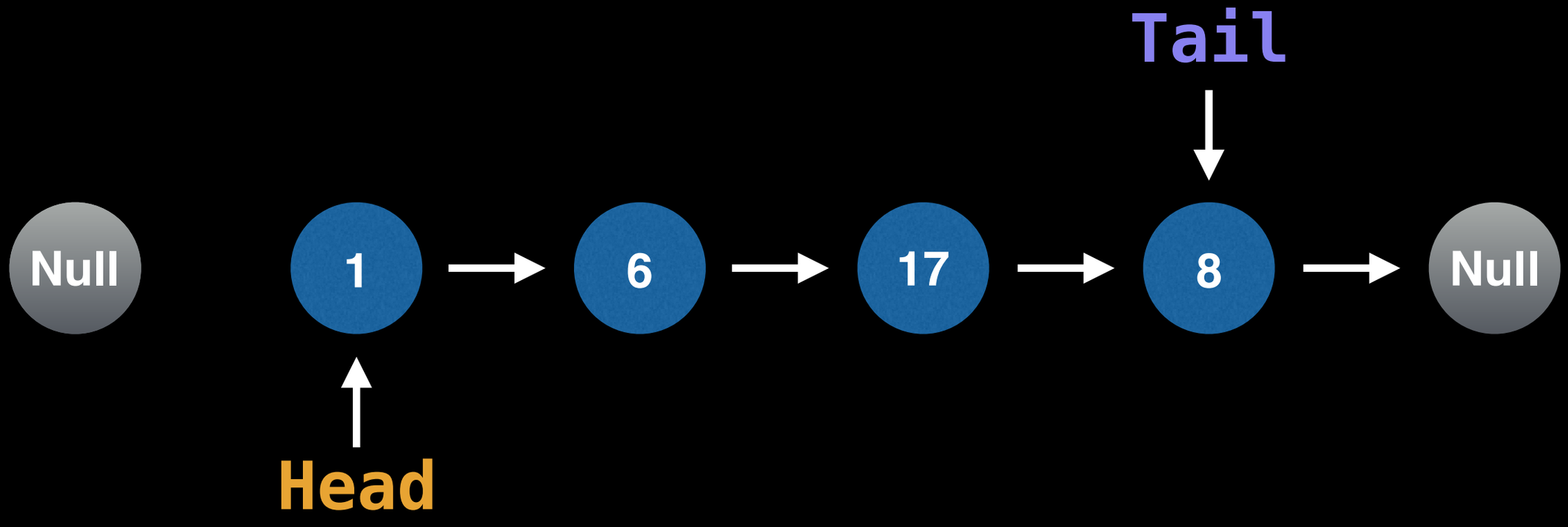

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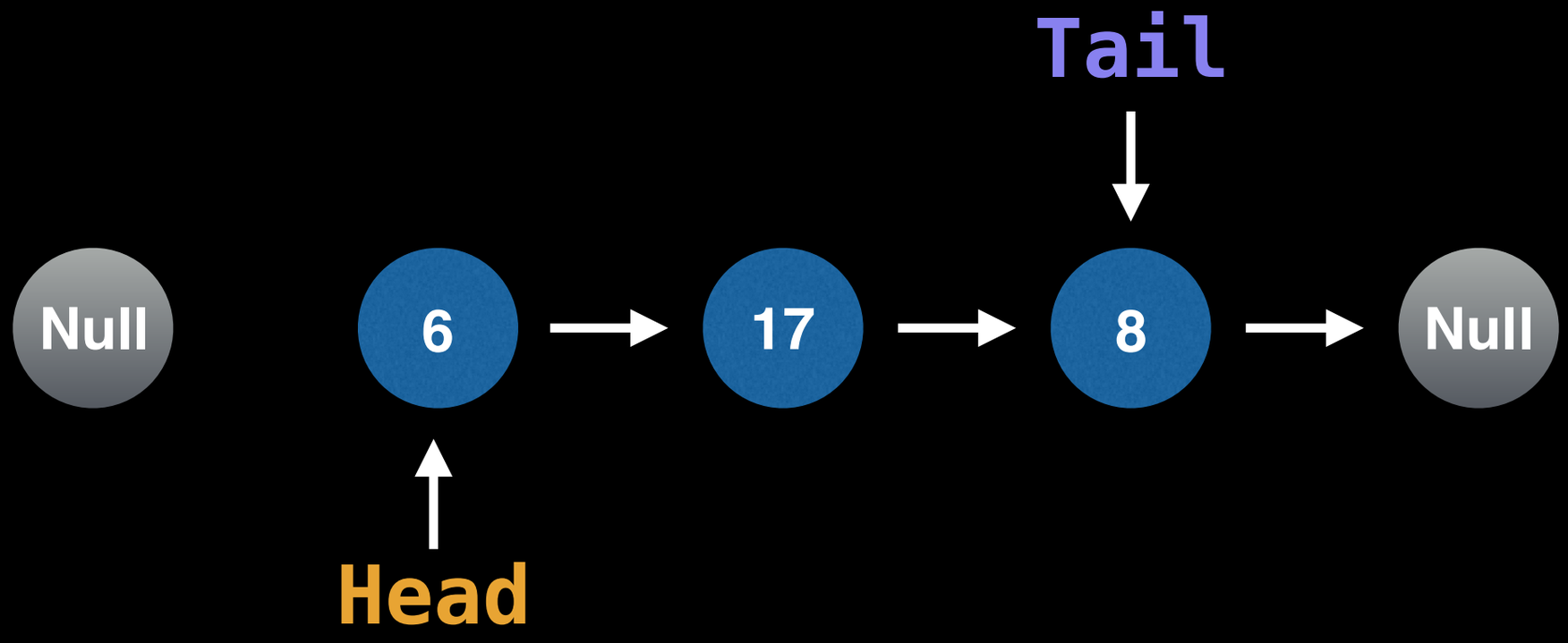

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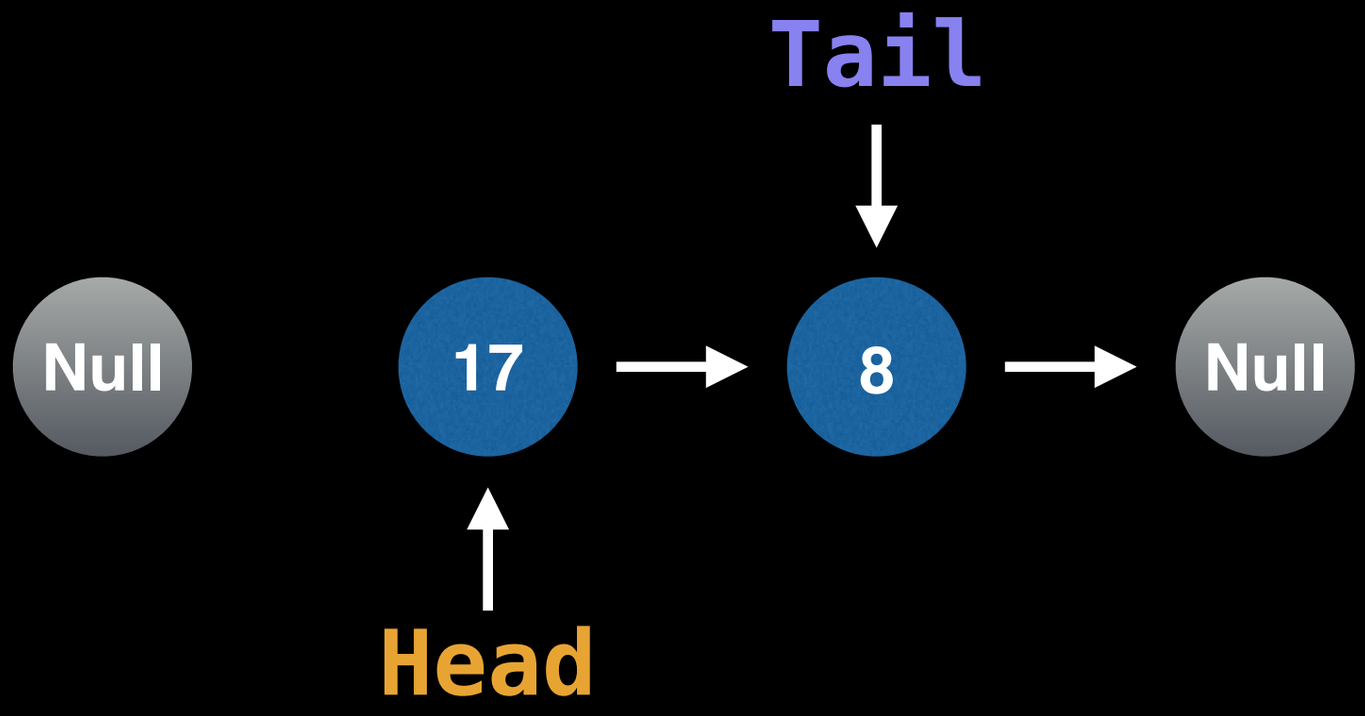

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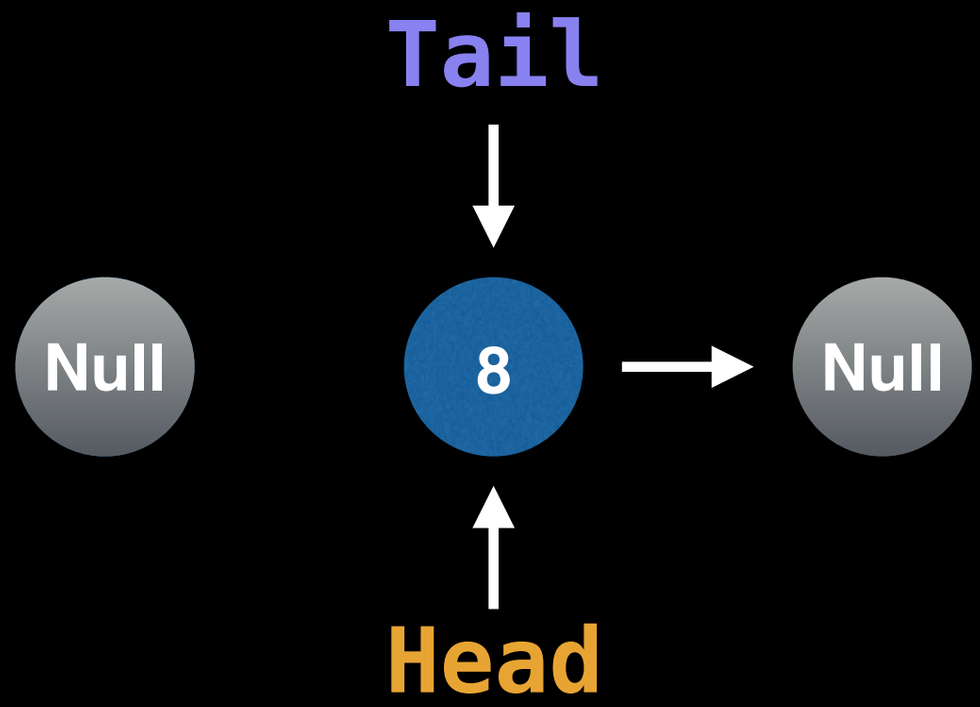

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Code in next video

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Queue Source Code

Part 3/3

William Fiset

Source Code Link

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NOTE: Make sure you have understood part 1 & 2
from the Queue series before continuing!