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SPARKS

< Student Peer Assistance for Review and Knowledege Sharing />

DATA STRUCTURES AND ALGORITHMS

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TOPICS:

- Algorithms
- Linked Lists
- stacks
- Queues
- sorting ALGORITHMS (intro)
- Searching algorithms (intro)

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INTRODUCTION TO DATA STRUCTURES AND ALGORITHMS

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WHAT IS A DATA STRUCTURE?

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DATA STRUCTURE

- a way of organizing and storing data that allows for efficient execution of operations.

- enables effective data manipulation and retrieval

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IMPORTANCE

- Enhances the performance of algorithms
- Optimizes memory usage
- Improves code reusability and readability
- Real-world problem application and problem-solving

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TYPES

PRIMITIVE

- Integer, Float, Booleans, Character

NON-PRIMITIVE

- Linear - Arrays, LinkedList, Stacks Queues
- Non-Linear - Trees, Graphs

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IMPORTANCE

- Enhances the performance of algorithms
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ALGORITHM

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ALGORITHM

- a finite set of step-by-step instructions to solve a problem or perform a computation.

- algorithms are clear and unambiguous, has a beginning and end and is designed to produce an output.

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ALGORITHM APPLICATIONS:

- Computer Science: Sorting, searching, image processing
- Daily Life: Cooking recipes, routines,
- Security: Detection and prevention of threats
- Finance: Data analysis, predictions

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ALGORITHM REAL LIFE APPLICATION

BREWING A CUP OF COFFEE

1. Boil water
2. Add coffee to the cup
3. Pour hot water
4. Stir
5. Add sugar or milk if preferred
6. Serve and drink

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ALGORITHM IN PROGRAMMING

Finding the smallest of three numbers

```
if ((a < b) && (a < c)) {
    min = a;
} else if (b < c) {
    min = b;
} else {
    min = c;
}
```

This algorithm uses selection logic

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EFFICIENCY IN ALGORITHMS

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EFFICIENCY

- Time complexity - measures the time an algorithm takes to complete
- Space complexity - measurs the amount of memory used

Both depends on the size of the input(n)

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BIG-O NOTATION

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BIG-O NOTATION

- the Big-O Notation helps you pick faster and better programs
- crucial when working with big data
- saves time and memory

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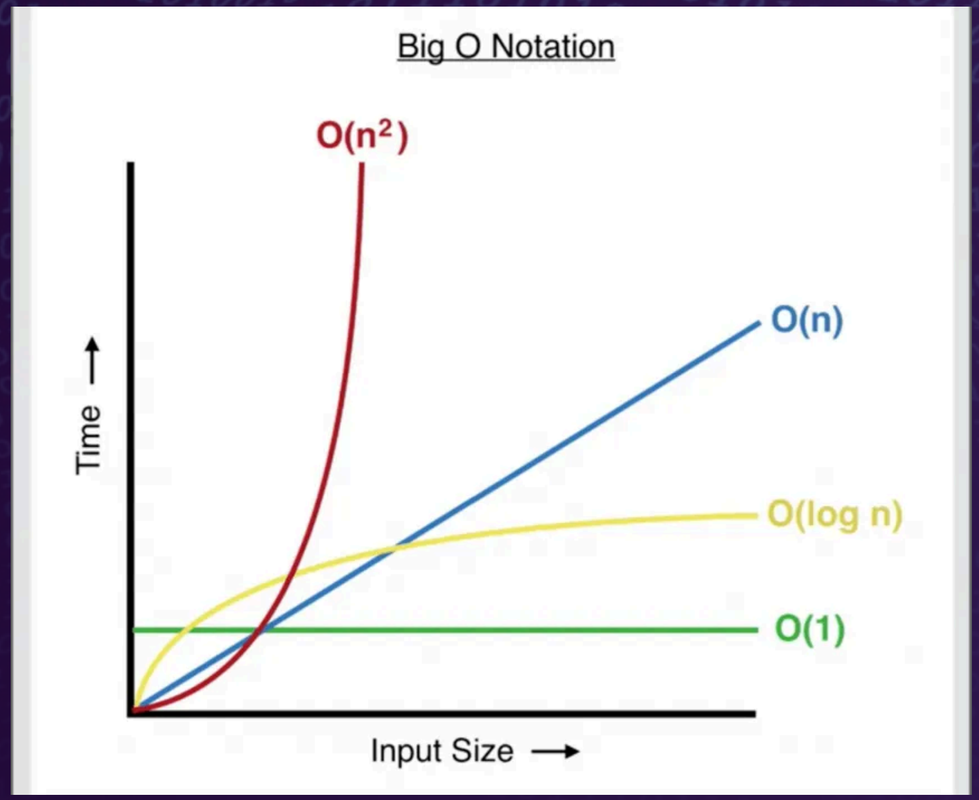
BIG-O NOTATION



BIG-O	WHAT IT MEANS	EXAMPLES
O(1)	CONSTANT	ACCESS ELEMENT
O(N)	LINEAR	ONE FOR-LOOP
O(N^2)	QUADRATIC	NESTED LOOPS
O(LOG N)	LOGARITHMIC	BINARY SEARCH

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LINKED LIST

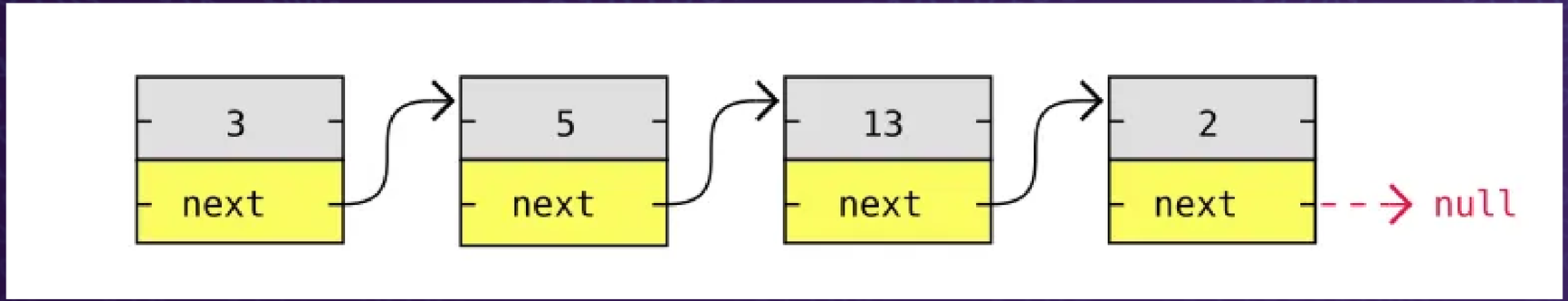
LINKED LIST

- a sequence of nodes where each node points to the next and elements are stored in nodes.

- Each node contains:

Data (value)

Pointer (link to the next and/or previous node)



Unlike arrays, it is not stored in a contiguous memory

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SINGLY LINKED LIST

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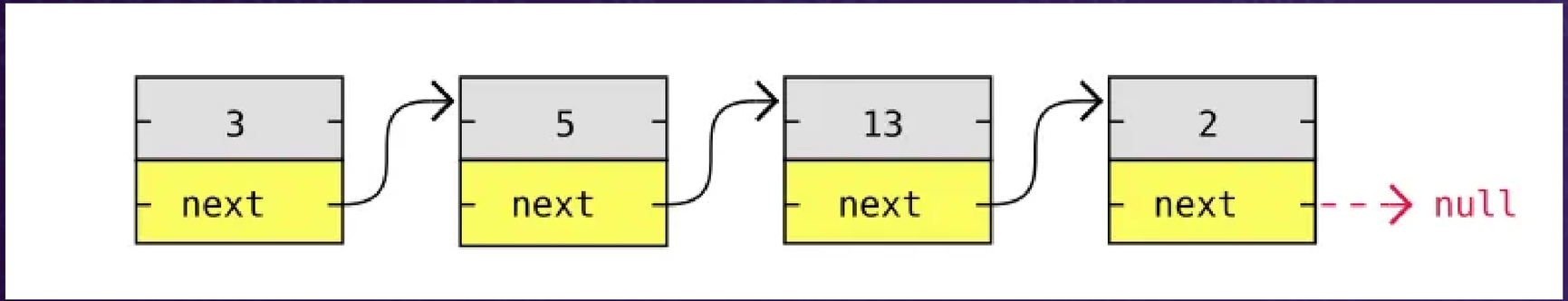
SINGLY LINKED LIST

- this model only contains the data node and pointer node to the next node.



SINGLY LINKED LIST

Operations:

- insertAtBeginning(data)
- insertAtEnd(data)
- insertAtIndex(index, data)
- deleteAtBeginning()
- deleteAtEnd()
- deleteByValue(value)
- search(data)
- display()
- reverse()

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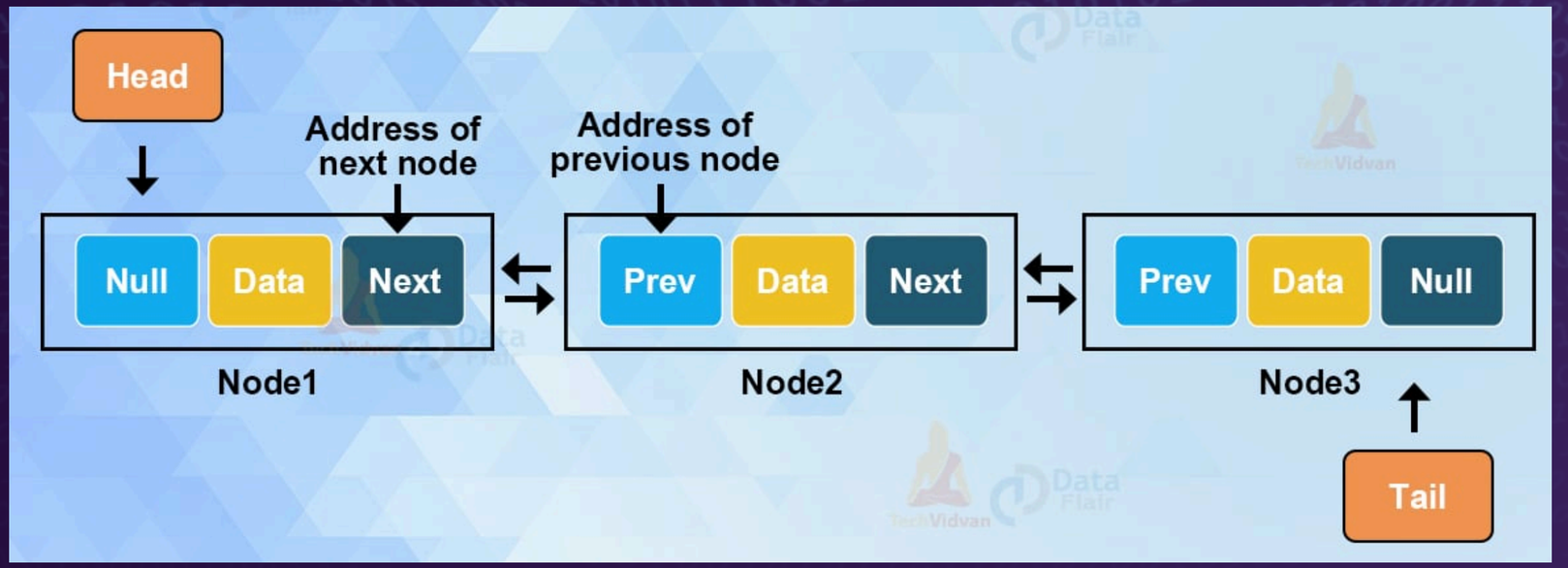
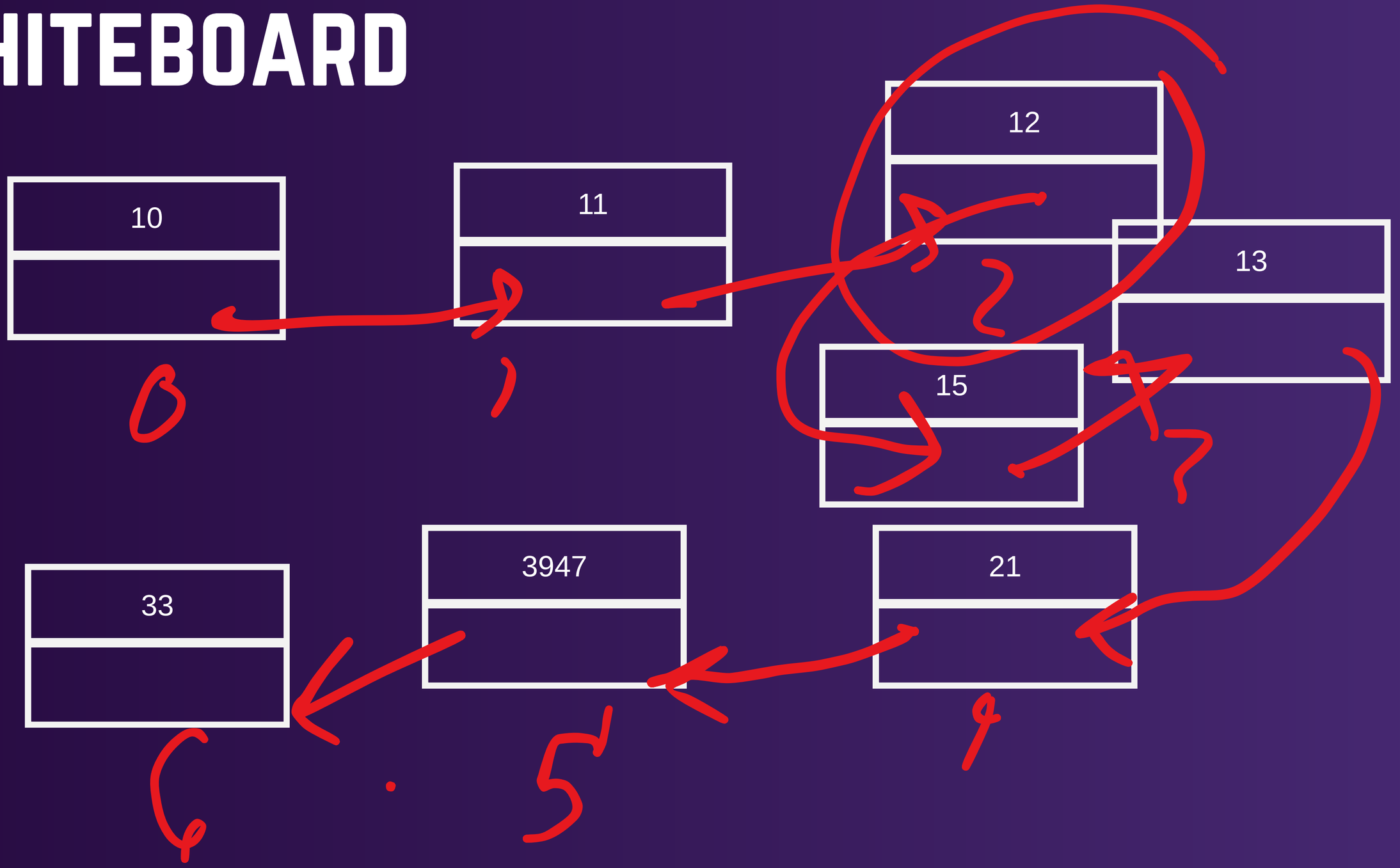
Doubly Linked List

DOUBLY LINKED LIST

- The same as a singly Linked List, but comes with an additional previous node for backtracking.



WHITEBOARD



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PRACTICE:

Implement a basic Linked List that includes these methods:

- insertAtEnd(data)
- InsertAtStart(data)
- insertAtIndex(index, data)
- deleteAtEnd()
- display()
- reverse()

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STACKS

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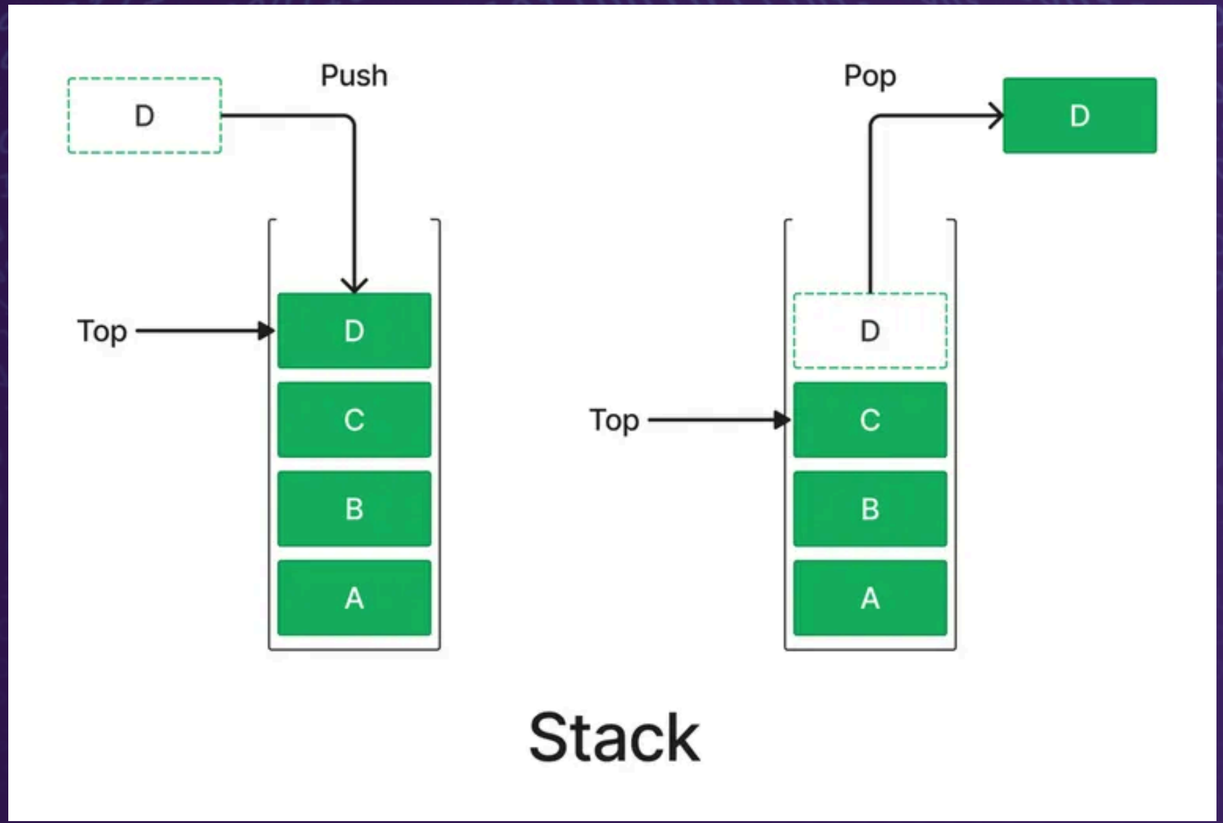
STACKS

- LIFO (Last In, First Out)

OPERATIONS:

- push()
- pop()
- peek()
- size()



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PRACTICE:

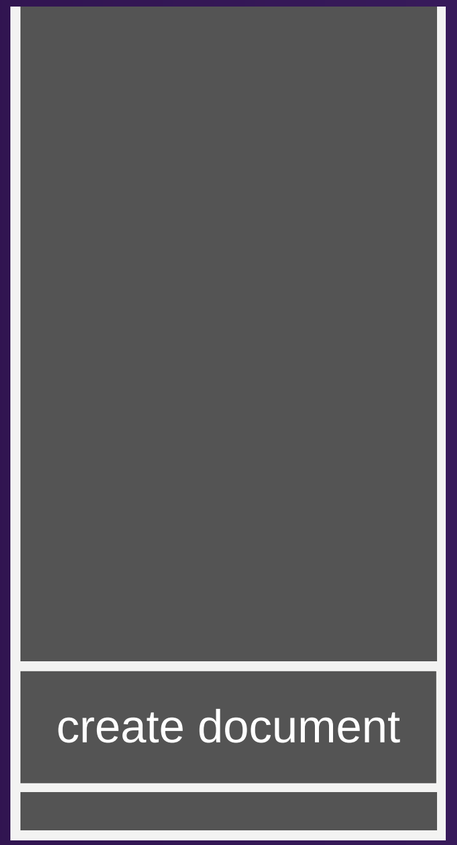
Check for a balanced parentheses using stacks

Example:

Input: ([{}]) ⟶ Output: true

Input: ([)} ⟶ Output: false

WHITEBOARD



hello world

hello joseph

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QUEUES

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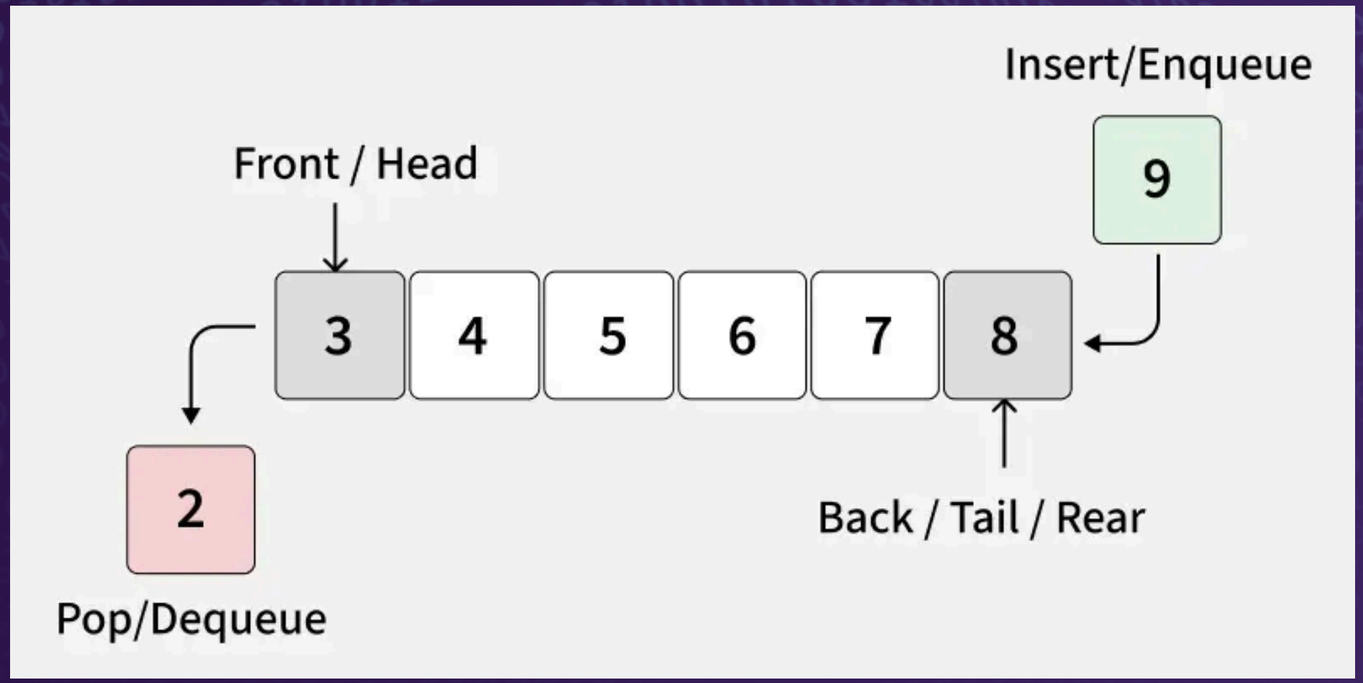
QUEUE

- FIFO (First In, First Out)

OPERATIONS:

- enqueue()
- dequeue()
- peak()
- isEmtpy()
- size()



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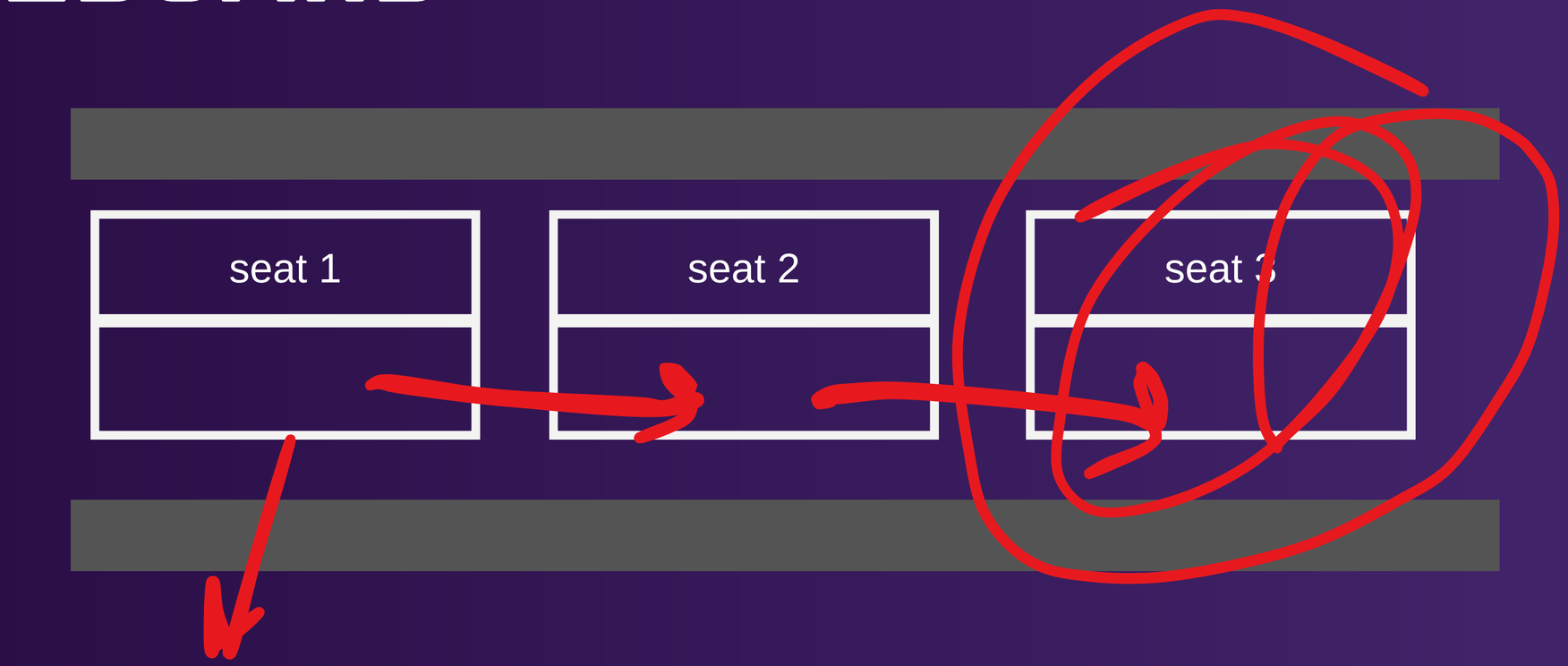
QUEUE

TYPES:

- Simple
- Circular
- Priority
- Double Ended

WHITEBOARD



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PRACTICE:

Reverse a queue (made with array) using stacks

Example:

Input size: 3

input data: 10

input data: 5

input data: 12

Output:

=== Reversed Data ===

12

5

10

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SORTING

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Sorting

Searching means finding the location of a particular element within a data structure.

Example:

- Bubble Sort
- Selection Sort
- Insertion Sort
- Merge Sort
- Quick Sort
- Heap Sort

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SEARCHING

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SEARCHING

Searching means finding the location of a particular element within a data structure.

Example:

- Linear Search
- Binary Search

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PRACTICE:

Given an array of integers (link_here), implement:

- linearSearch(arr, target) → Returns the index if found, else return -1
- binarySearch(arr, target) → Returns the index if found, else return -1

At the end, we shall compare the two in approach and speed.

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SPARKS DSA Materials:

https://github.com/jeiya1/school/tree/main/CC105/SPARKS