Data Structures

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Who am I?

- Master of Engineering: Computer Science (KUL)
  - Computational informatics
- RealdoImen: acADDemICT in 09/2015
- Current project: Planning infrastructure @ Infrabel

Outline

1. Introductory Data Structures
   - Array
   - Linked List
   - Hash Table
   - Tree
2. Java Collection API & Map API
   - Java Collection API
   - Java Map API
3. Advanced Data Structures
   - Stuff...

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What are Data Structures?

Data Structure[1]

A way in which data are stored for efficient search and retrieval. Different data structures are suited for different problems.

- Data type $\neq$ data structure
- `java.util.HashSet` vs. hash table
- `array` vs. array

[1] Encyclopædia Britannica

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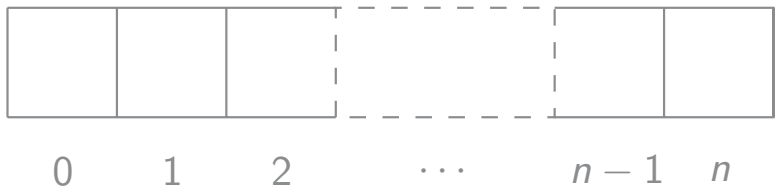
Array

Definition

- An indexed set of related elements.[2]
- An assemblage of items that are randomly accessible by integers, the index.[3]

- Example: linear array

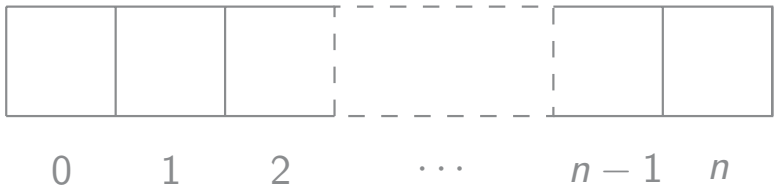


[2] Oxford Dictionary
[3] National Institute of Standards & Technology

Array

Operations

- `get`
- `set`
- `indexOf`



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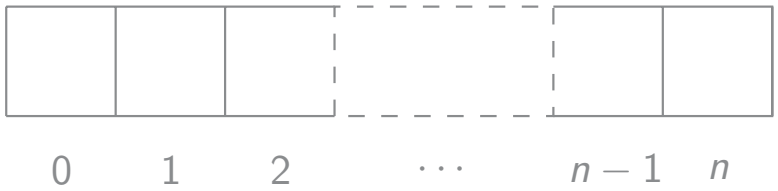
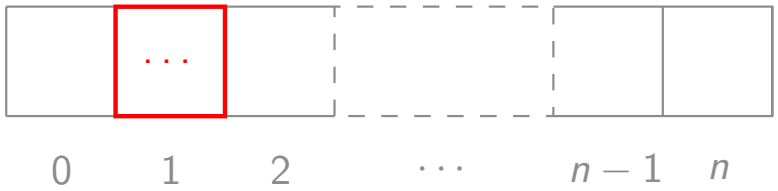


`get(1)`

Array

Operations

- `get`
- `set`
- `indexOf`

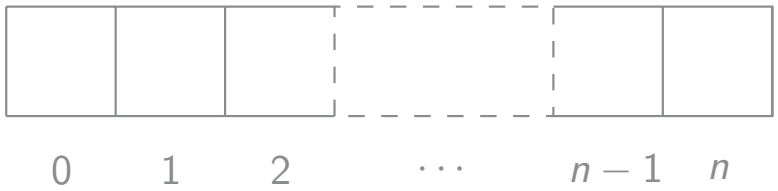


`get(1)`

Array

Operations

- `get` $O(1)$
- `set`
- `indexOf`



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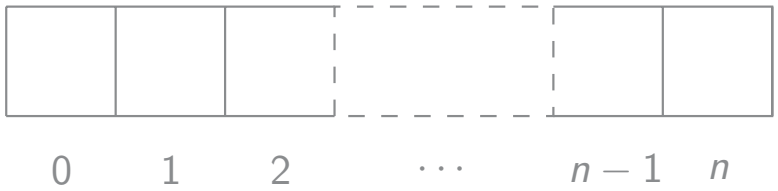

`set(2)`

Array

Operations

- `get` $O(1)$
- `set`
- `indexOf`

`set(2)`

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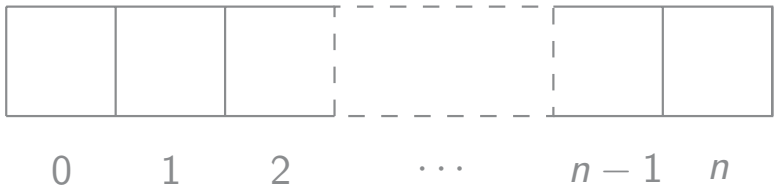

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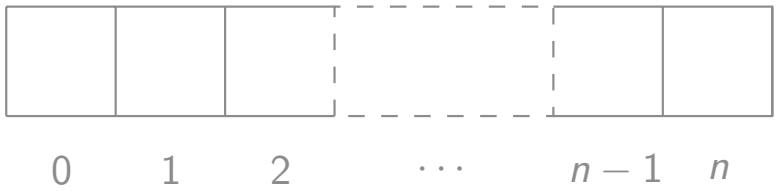

`indexOf(object)`

Array

Operations

- `get` $O(1)$
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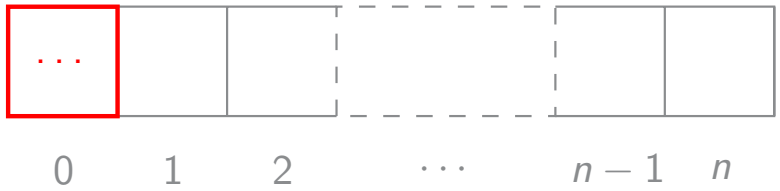
- `indexOf`



`indexOf(object)`

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Operations

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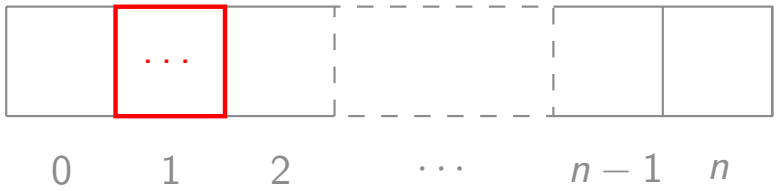

`indexOf(object)`

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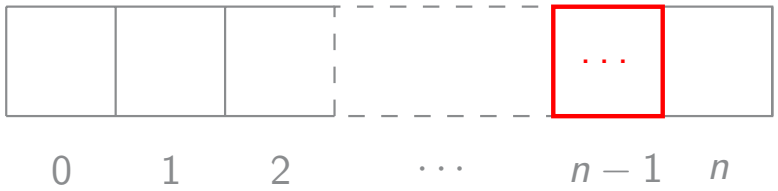

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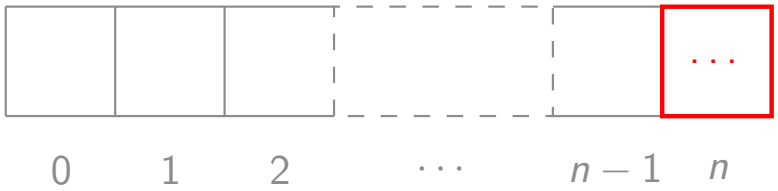

`indexOf(object)`

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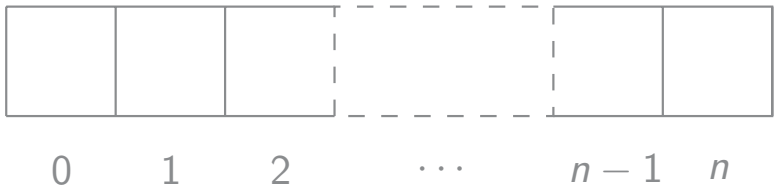

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Linked List

Definition

A linked list is a data structure in which the objects are arranged in a linear order. Unlike arrays in which the linear order is determined by indices, the order is determined by a pointer in each object.[4]

- Different types: singly, doubly, multiply, circular, ...
- Example: doubly linked list

[4] Introduction to Algorithms By Cormen, Leierson, Rivest & Stein

Linked List

Operations

- `add/remove first/last`
- `get/insertAt`
- `indexOf`

Linked List

Operations

- `add/remove first/last`
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`addFirst(`O_4`)`

Linked List

Operations

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- `get/insertAt`
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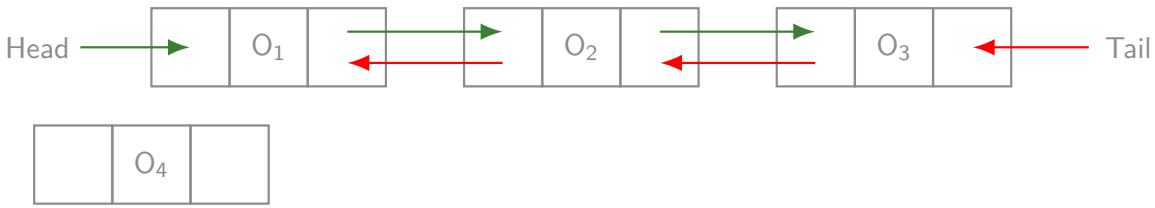

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Linked List

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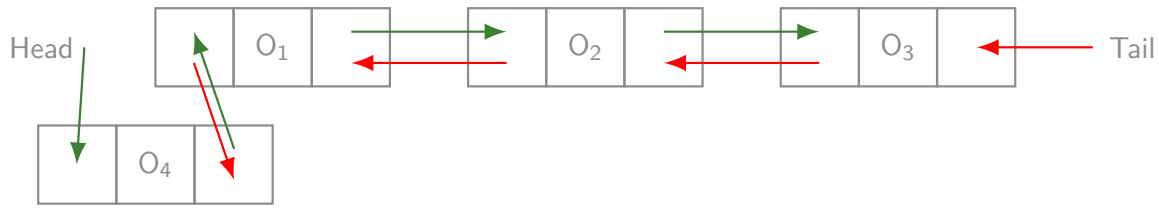

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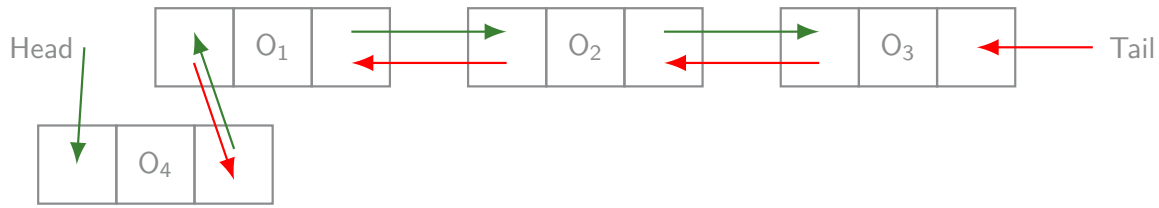


`addFirst(`O_4`)`

Linked List

Operations

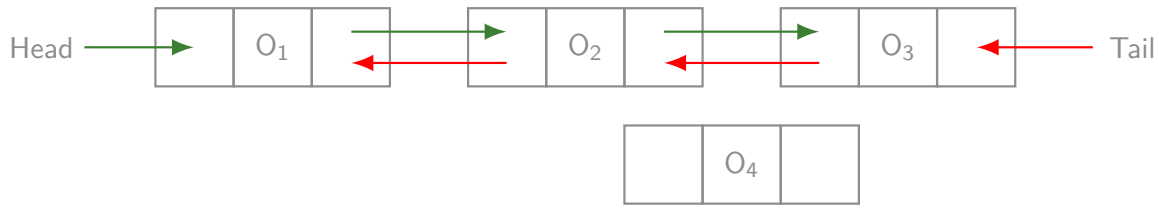
- `add/remove first/last` $O(1)$
- `get/insertAt`
- `indexOf`

`insertAt(2)`

Linked List

Operations

- `add/remove first/last` $O(1)$
- `get/insertAt`
- `indexOf`



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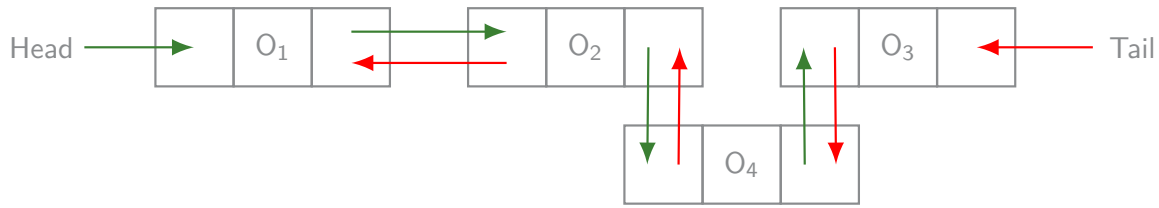

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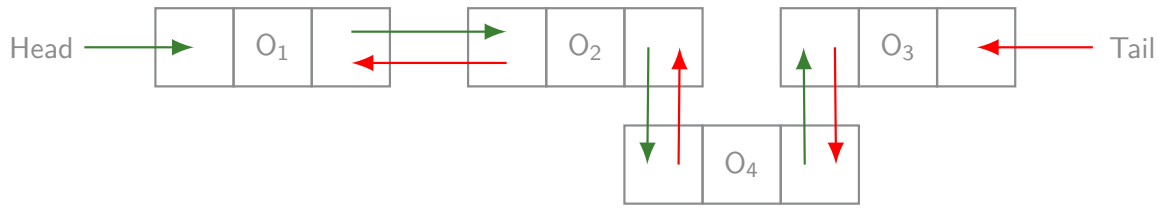

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Hash Table

Definition

A dictionary in which keys are mapped to array positions by hash functions.[5]

- Collisions resolution: chaining, open addressing, ...
- Example:

[5] National Institute of Standards & Technology

Hash Table

. . .

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     - Heap
     - Red-Black Tree
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Tree

. . .

Binary Heap

. . .

Binary Min-Heap

. . .

Red-Black Tree

. . .

Red-Black Tree

. . .

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Java Collection API

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Java Map API

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