Arrays: Operations

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Agenda

- What are arrays?
- How are arrays allocated?
- What operations can be performed on arrays?
- How are array operations implemented?
- Summary

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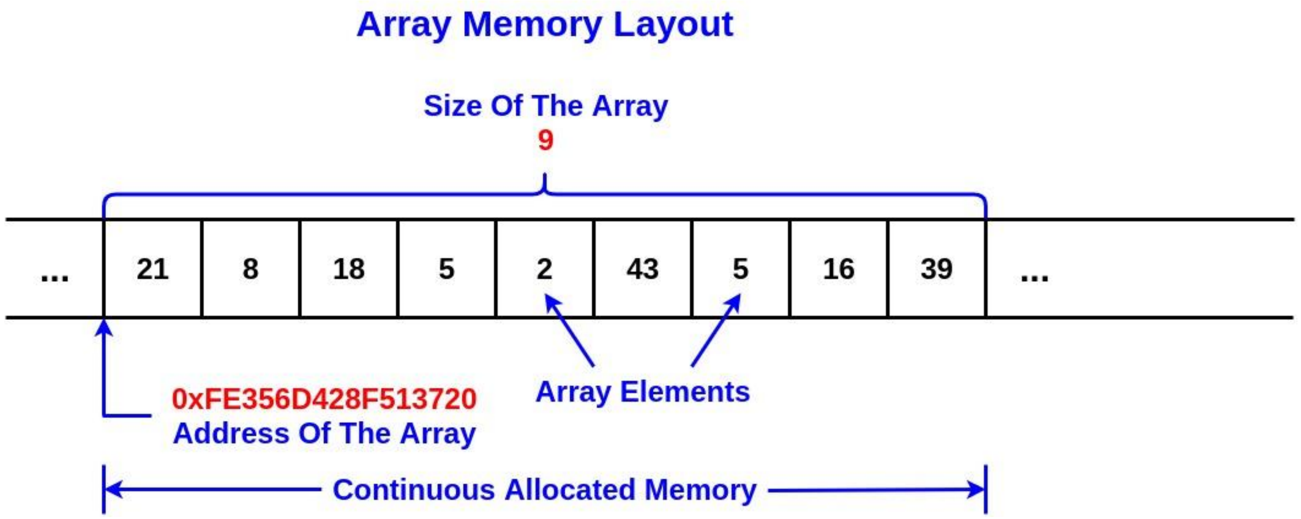
What is an array?

- An array:
  - is a basic data structure to organize a set of elements.
  - has a fixed size - at initial allocation.
  - has a hardware implementation support.



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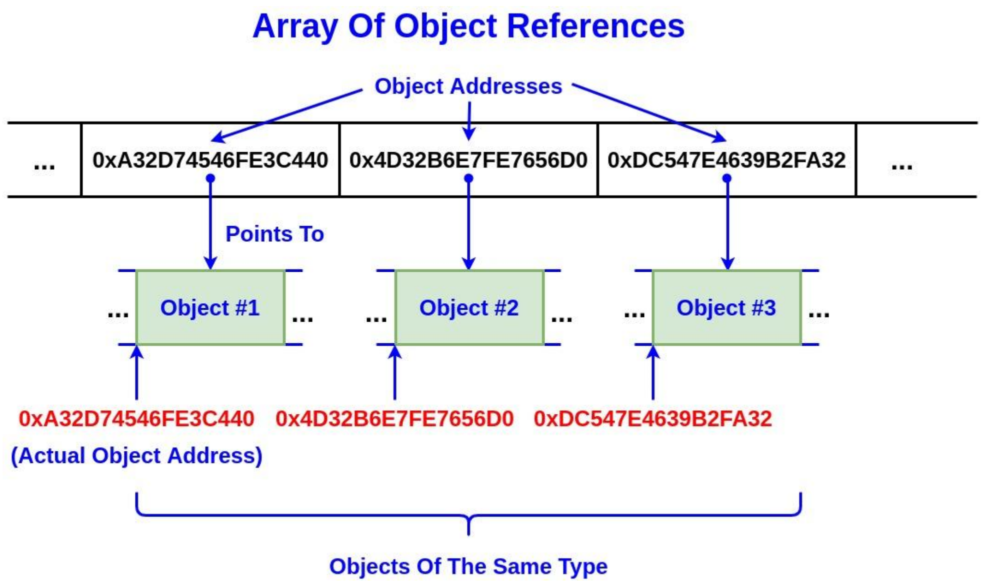
What is an array?

- Some more properties of an array:
  - Homogenous: holds elements of same type.



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What is an array?

- Some more properties of an array:
    - Random access: Elements can be accessed directly
        - Constant-time operation
        - Made possible by Indexing

- Indexing
    - Directly access any element with the [] operator
    - Manipulates element addresses
    - Relies on array being homogeneous

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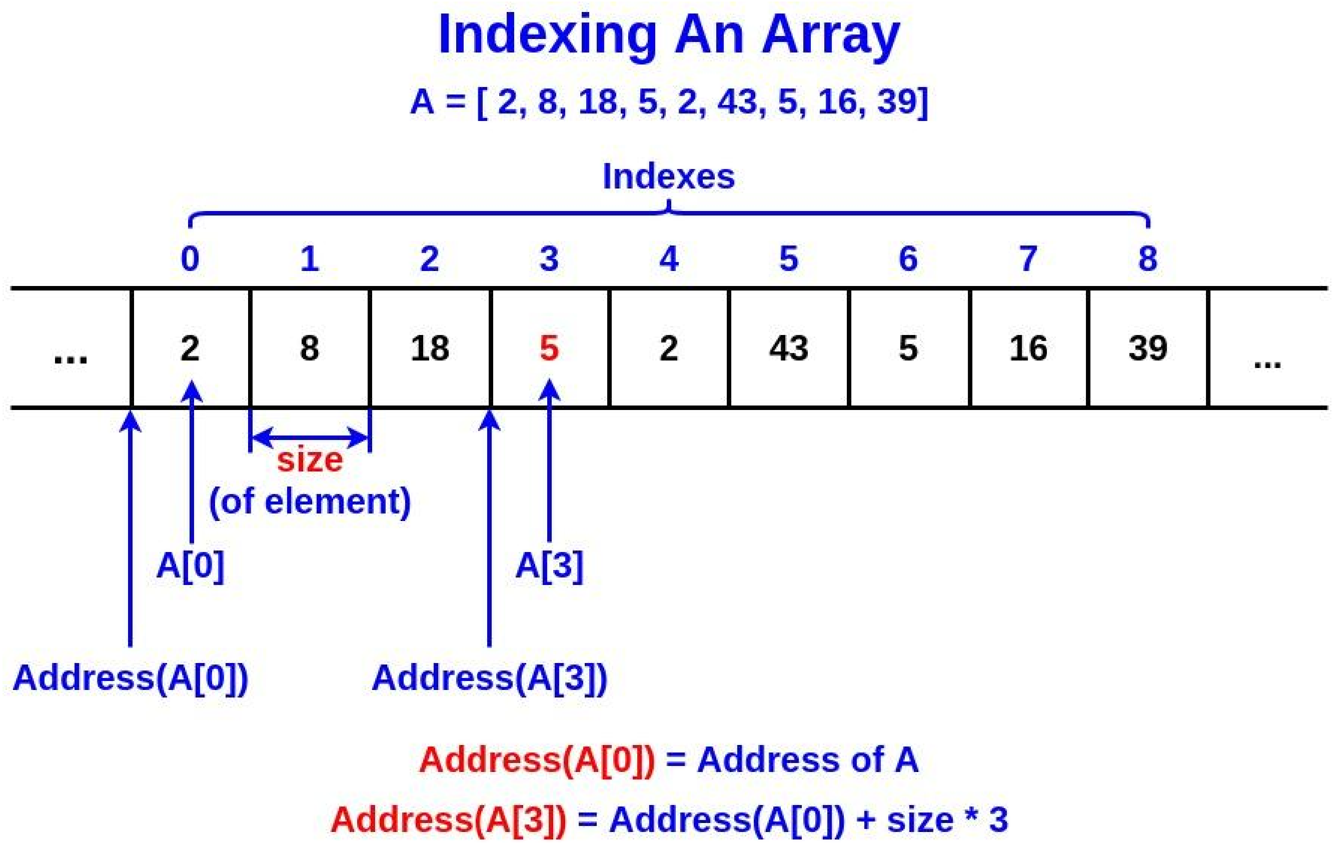
Array operations: Indexing



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Array operations: Indexing

- How indexing works
    - Start address of the array: the base reference
    - Individual elements have addresses relative to base
    - Simple address arithmetic

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Array operations: Indexing

- Indexing is a constant time operation
    - If an array was not homogeneous, indexing arithmetic would not make sense.
- Indexing is used by all other array operations.

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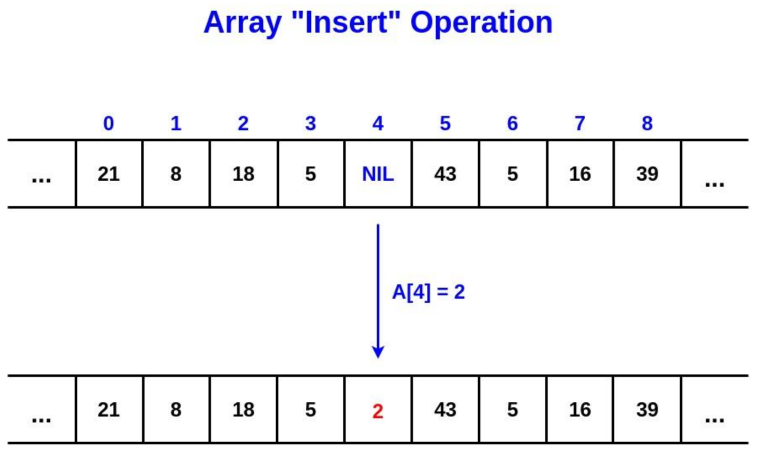
Array operations: “Insert”

- “Insertion” only means assigning a value to an array element (slot)
  - Is the same as update.
  - Uses indexing for the assignment.



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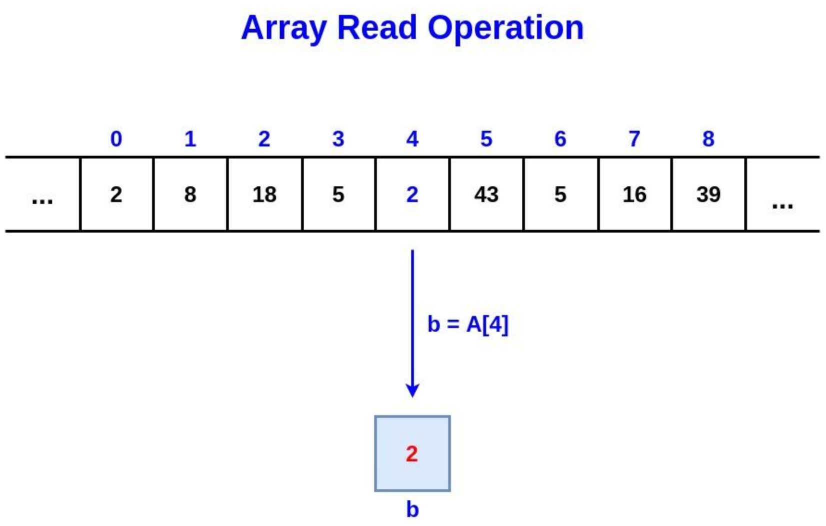
Array operations: Read

- A Read is the opposite of an “Insert”
    - Get the element value at a slot.
    - Uses indexing.



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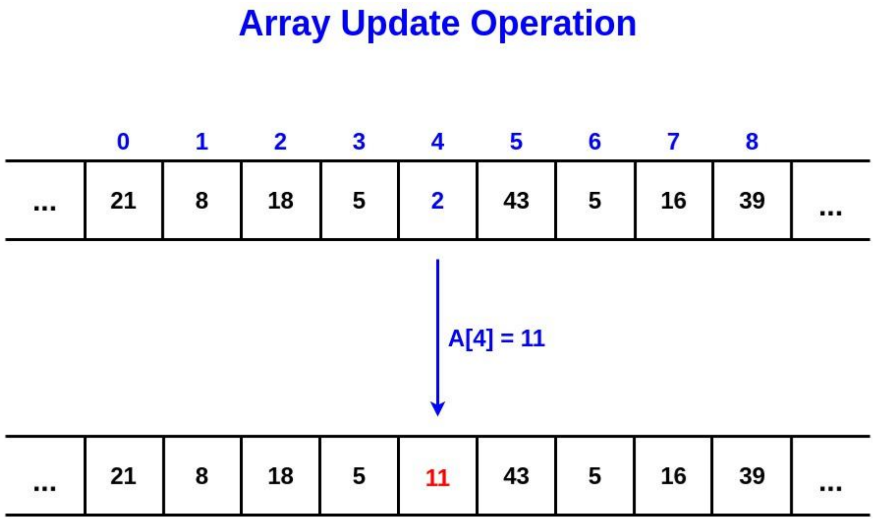
Array operations: Update

- An Update is similar to an “Insert”.
  - Changes the element value at a slot.
  - Uses indexing.



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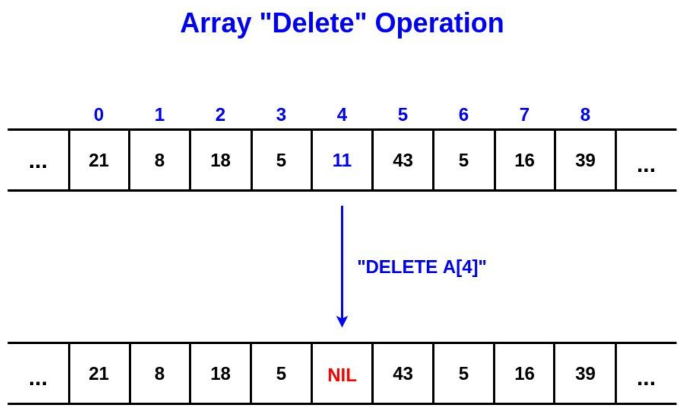
Array operations: “Delete”

- A “Delete” is logically just marking data in a slot INVALID, or NULL.
  - The slot storage remains where it is.
  - The slot can get a new element from an “Insert” later.
  - Uses Indexing.



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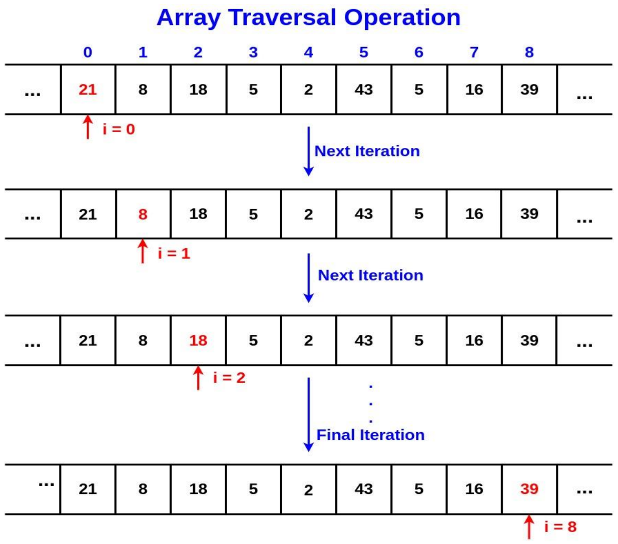
Array operations: “Traversal”

- Since an array is random-access:
  - It can be traversed in any manner imaginable.
  - Depends only on the needs of the application.



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Array operations: Complexity

- Analyzing time complexity
  - Create: Constant time (allocated as a block)
  - Insert: Constant time
  - Read: Constant time
  - Update: Constant time
  - Traversal: Proportional to N (size of the array)

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Array operations: Complexity

- Analyzing space complexity:
  - Create: Proportional to N (one-time)
  - Insert: Constant space
  - Read: Constant space
  - Update: Constant space
  - Traversal: Constant space (in-place operation)

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Summary

- We understood the concept of an array.
- We saw important properties of arrays.
- We saw the advantages array indexing offers.
- We explored the standard array operations.

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Thank You

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