CMSC 132: OBJECT-ORIENTED PROGRAMMING II

Linear Data Structures - Restricted Abstractions

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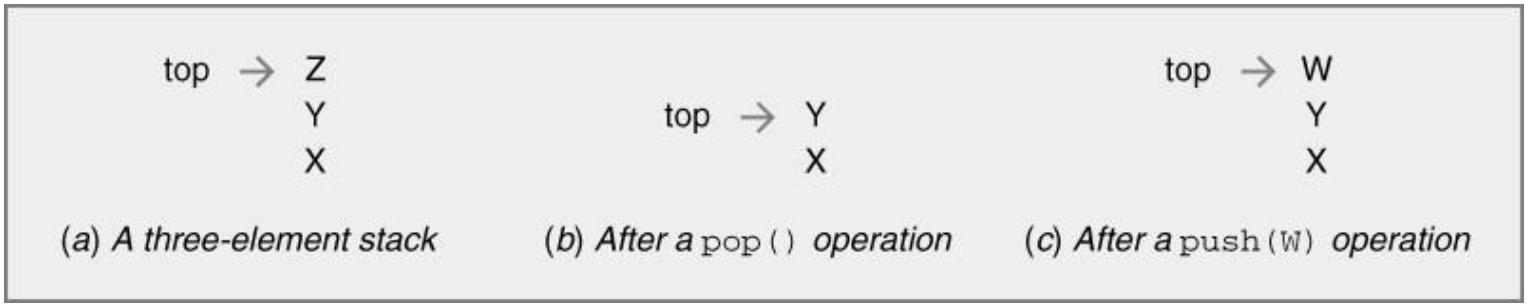
Restricted Abstractions

- Restricting the operations an abstraction supports can be a good thing
  - Efficiently supporting only a few operations efficiently is easier
  - If limited abstraction is sufficient, easier to reason about limited abstraction than a more general one
- Restricted list abstractions
  - **Stack** (aka LIFO queue)
  - **Queue** (aka FIFO queue)
  - **Dequeue** (aka double ended queue)

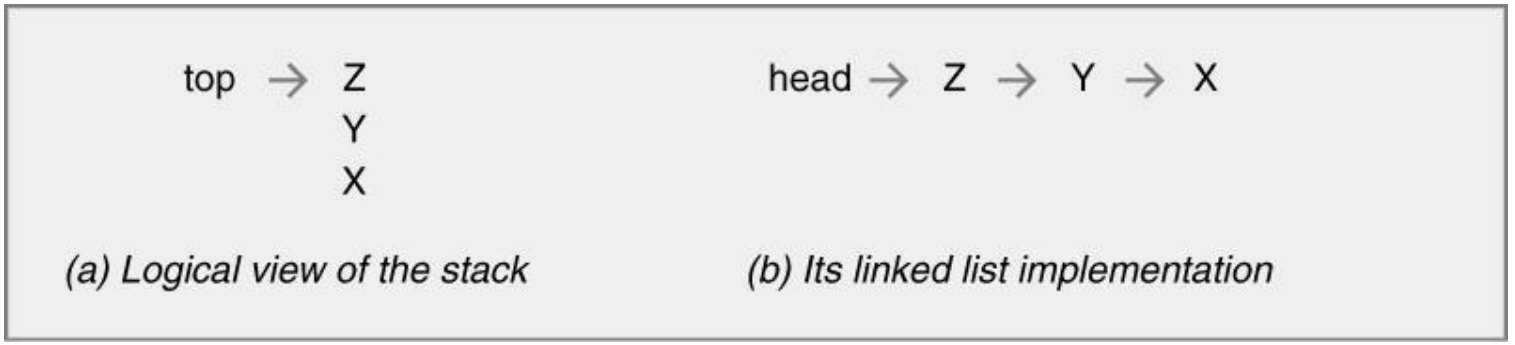
Stack

- Properties
  - Elements removed in opposite order of insertion
  - Last-in, First-out (LIFO)
- A restricted list where:
  - Access only to elements at one end
  - Can add / remove elements only at one end
- Stack operations
  - Push → add element (to top)
  - Pop → remove element (from top)

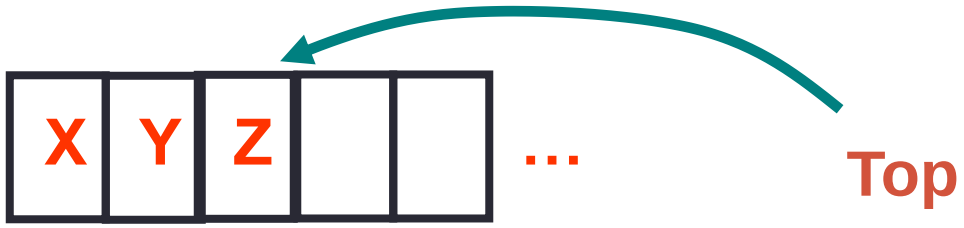


Stack Implementations

- Linked list
  - Add / remove from head of list

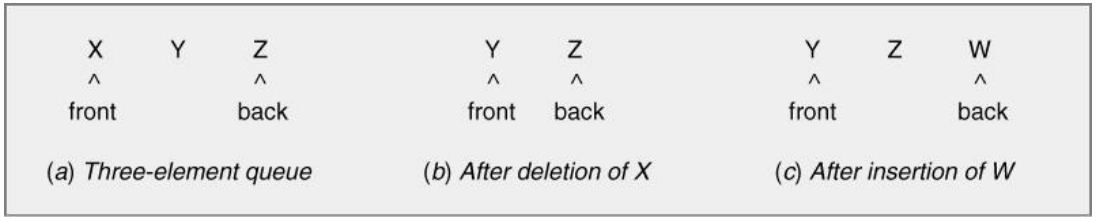


- Array
  - Increment / decrement Top pointer after push / pop



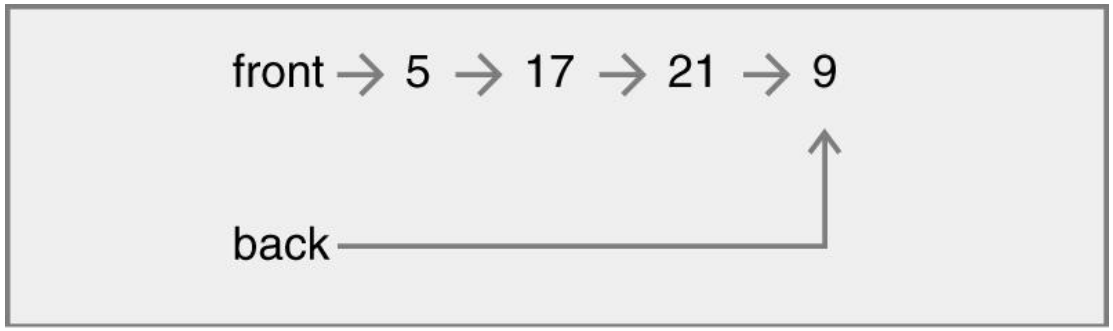
Queue

- Properties
  - Elements removed in order of insertion
  - First-in, First-out (FIFO)
- A restricted list where:
  - Access only to elements at beginning / end of list
    - Add elements only to end of list
    - Remove elements only from front of list
  - Alternatively, can add to front & remove from end
- Queue operations
  - Enqueue = add element (to back)
  - Dequeue = remove element (from front)
- **Example:**



Queue Implementations

- **Linked list**
  - Add to tail (back) of list
  - Remove from head (front) of list



- **Circular array**

Queue – Circular Array Implementation

- Inherent problem for queue of size N
  - Only N possible (Front – Back) pointer locations
  - N+1 possible queue configurations
    - Queue with 0, 1, … N elements
- Solutions
  - Maintain additional state information
    - Use state to recognize empty / full queue
    - Examples
      - Record Size
      - Record QueueEmpty flag
  - Leave empty element in queue
  - Store marker in queue