Data Structure Summary

A data structure is an implementation of an [abstract] interface.

- List
- Queue
- Stack
- Deque [double ended queue]
- Unordered Set [set]
- Sorted Set
- Map [set of key-value pairs]
- Sorted Map [sorted set of key-value pairs (kvp)]

Read and Write Times

	get/set	**add/remove**
Arrays	$O(1)$	$O(1 + min(i,n-i))$
LinkedList	$O(1 + min(i,n-i))$	$O(1)$
Skiplist	$O(\log n)$	$O(\log n)$

Set

Efficient for contains().

SortedSet

Efficient for find().

- Does a successor search [closes value ≥ to expected]

Maps

Efficient for contains() [kvp]

SortedMap

Efficient for find() [kvp]

Array-based

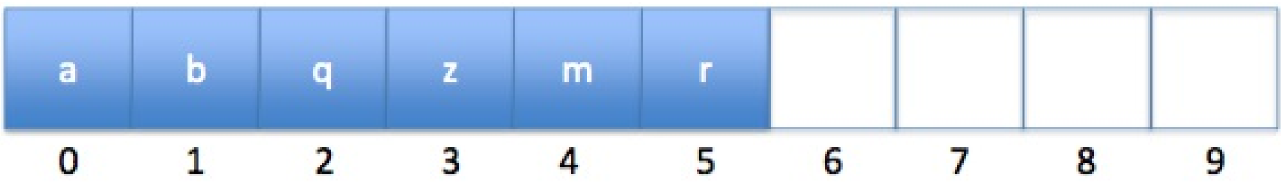
ArrayList / ArrayStack

Efficient access anywhere. Efficient write at back [think stack].

- Implements **List** interface with an array
- superceded by ArrayDeque
- **get(), set() in O(1)**
- **add(), remove() in O(1 + n-i)**
- **resize is O(n)** [amortized]

memorize: for m add / remove operations, resize() will copy at most 2m

the amortized cost of resize() for m calls is 2m/m = O(1)

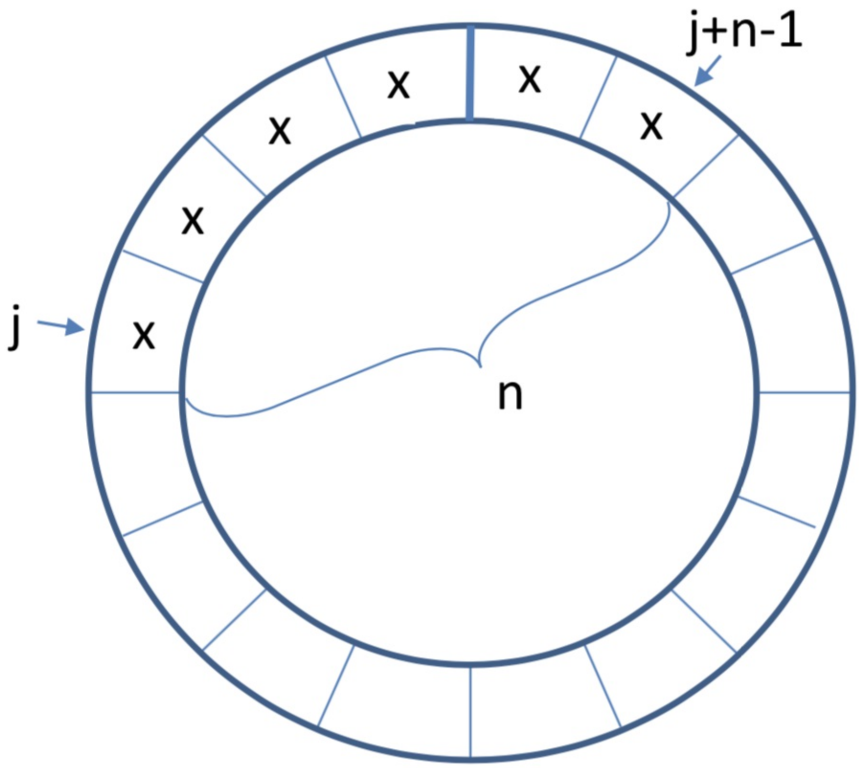


ArrayQueue / ArrayDeque

Efficient access anywhere. Efficient write at front and back [think deque].

- Implements **List** interface with an array
- **get(), set() in O(1)**
- **add(), remove() in O(1 + min(i, n-i))**
- **resize is O(n)** [amortized]

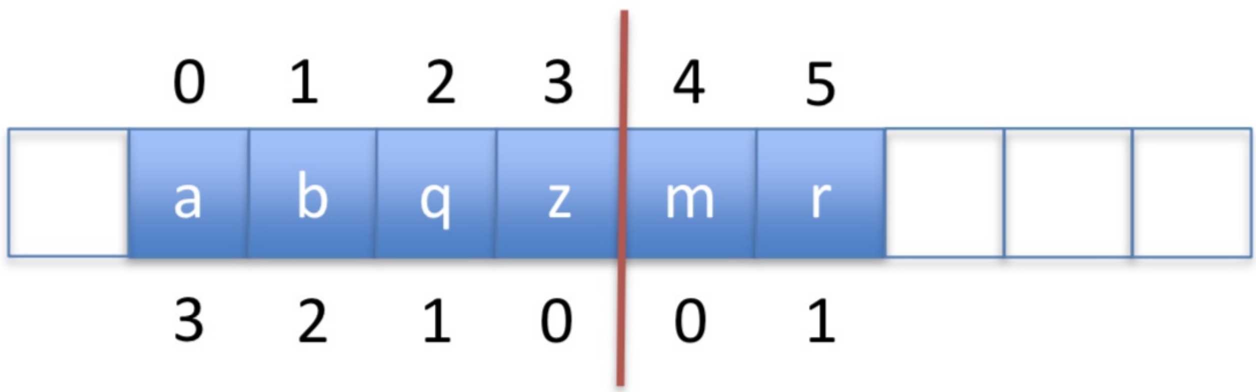
// since ArrayQueue only supports addLast() and removeFirst(), these are O(1)



DualArrayDeque

Efficient access anywhere. Efficient write at front and back [think deque].

- Implements **List** interface
- Uses two **ArrayStacks** front-to-front
- Since arrays are quick to add to the end, this makes front and back operations fast
- May be rebalanced if one array is much larger than the other
- Use Potential Function to decide when to rebalance
- **get(), set() in O(1)**
- **add(), remove() in O(1 + min(i, n−i))**
  - quick to access front or back, but not middle



RootishArrayStack

List of Lists, of increasing size. Efficient space [sqrt(n) wasted space]. Efficient access anywhere. Efficient write at back.

- Implements the **List** interface using multiple backing arrays
- Reduces 'wasted space' [unused space]
- At most: *sqrt(n)* unused array locations
- Good for space efficiency
- **get(), set() in O(1)**
- **add(), remove() in O(1 + n-i)**

memorize: m add() / remove() calls results on O(m) time on resize()

Linked Lists