COMP-352 Tutorial #3

May 22nd, 2023

Abstract Data Types

ADT is a type of objects whose behaviour is defined by the set of values and operations.

- **ADT** vs **In-built data types**
- **Only Definition:** ADTs are implementation-independent
- **Examples:** List, Stack, Queue…etc.
- **Case:** Implementation of Queue ADT based on **LL** vs **Arrays**
- https://www.geeksforgeeks.org/abstract-data-types/

Some ADTs

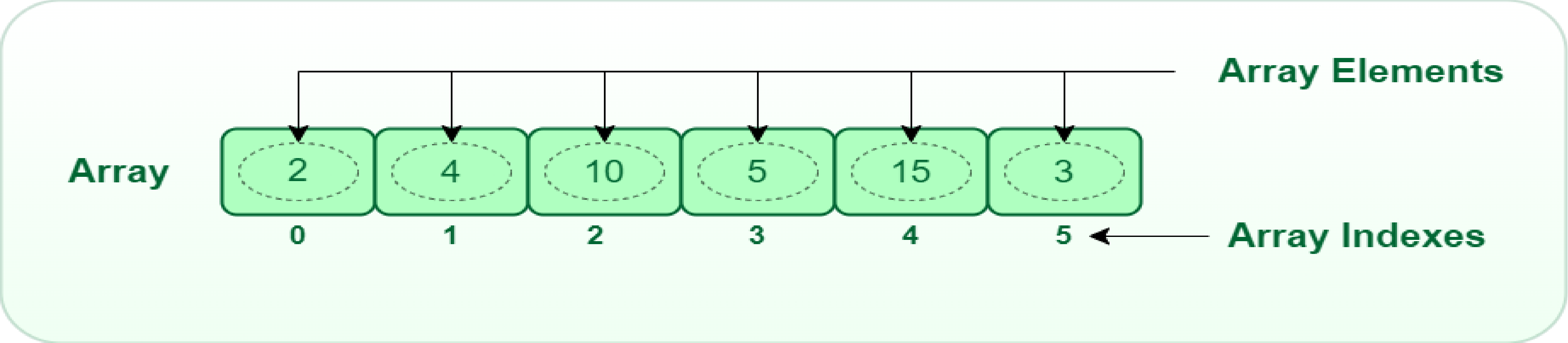
ARRAYS:

- Elements are stored in sequential memory addresses, thus INDEXES
- Faster access to Element
- Really good in Arithmetic operations
- Defined Size, allocated during compile time

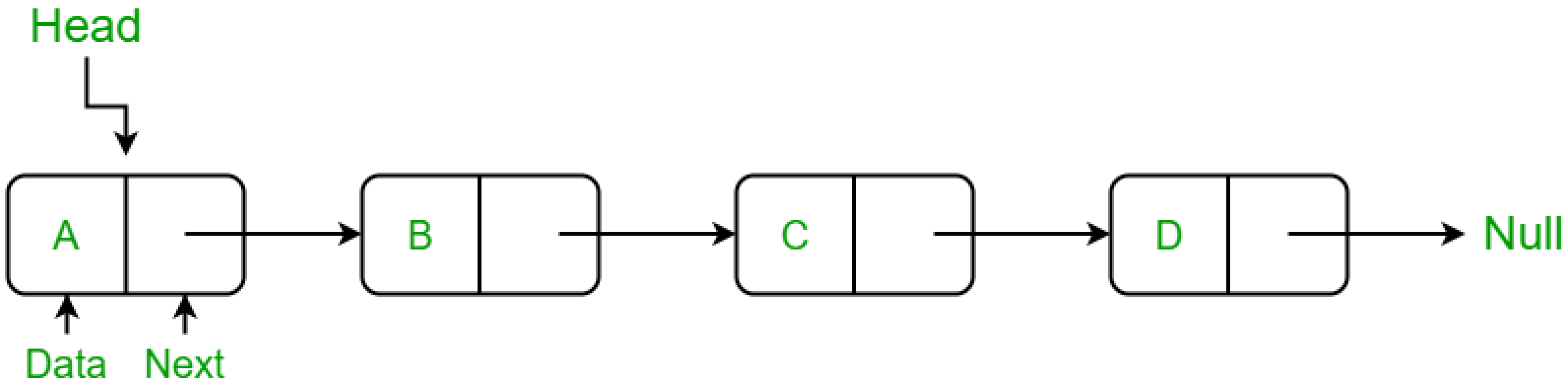
LISTS:

- Elements are not contiguous stored, they point to the next elements
- Elements are usually composed of pointers, one to the next and the other to a DS
- Really good with Insertions
- Dynamic Size, allocated during the run time

Arrays & Linked Lists



ARRAYS: https://www.geeksforgeeks.org/array-data-structure/



LINKED LISTS: https://www.geeksforgeeks.org/what-is-linked-list/

Some ADTs (cont’d)

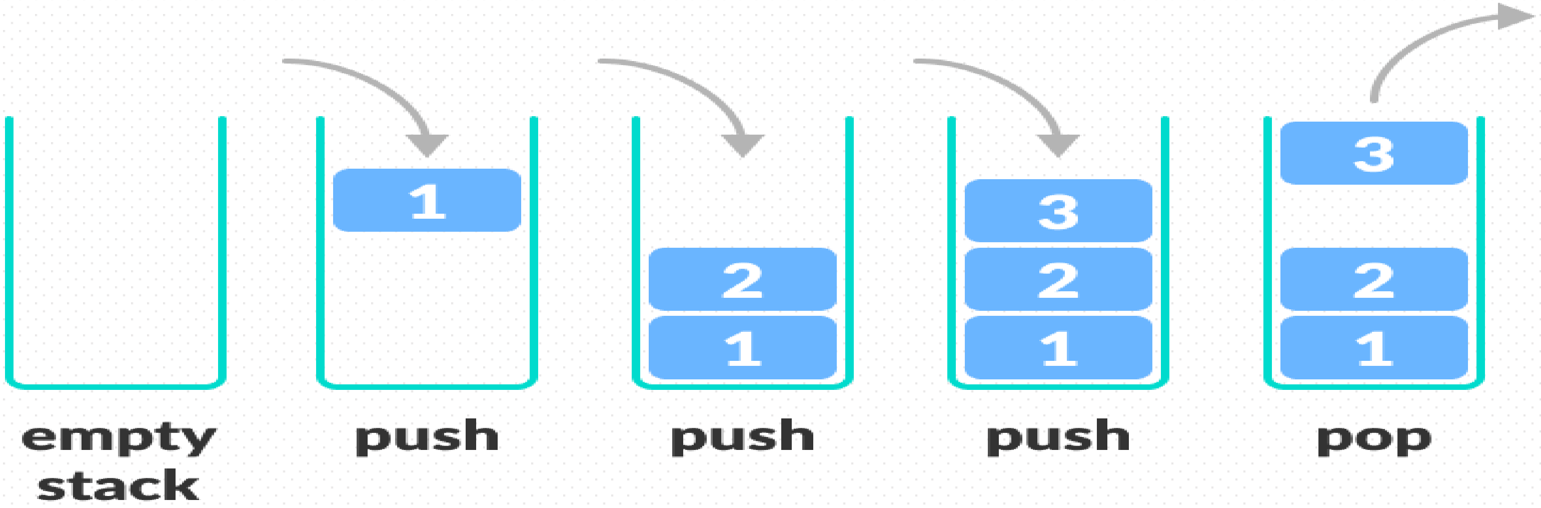
STACKS:

- Elements are stored on top of each other
- It follows the LIFO (Last In, First Out) ordering
- Really good for recursion, hence it is used by the OS for return calls
- Can be based on an array or linked list
- Operations: push(), pop(), peek(), size(), isEmpty(), isFull()

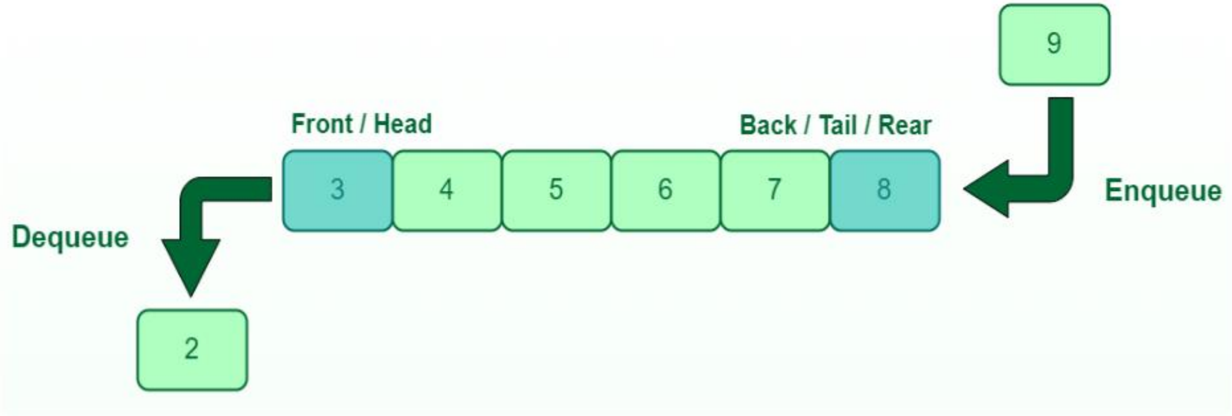
QUEUES:

- Elements are stored similar to the Stack DS
- It follows the FIFO (First In, First Out) ordering – open at both ends
- Really good with first come first served cases
- Can be based on an array or linked list
- Operation: enqueue(), Dequeue(), peek(), size(), isEmpty(), isFull()

STACKS & QUEUES

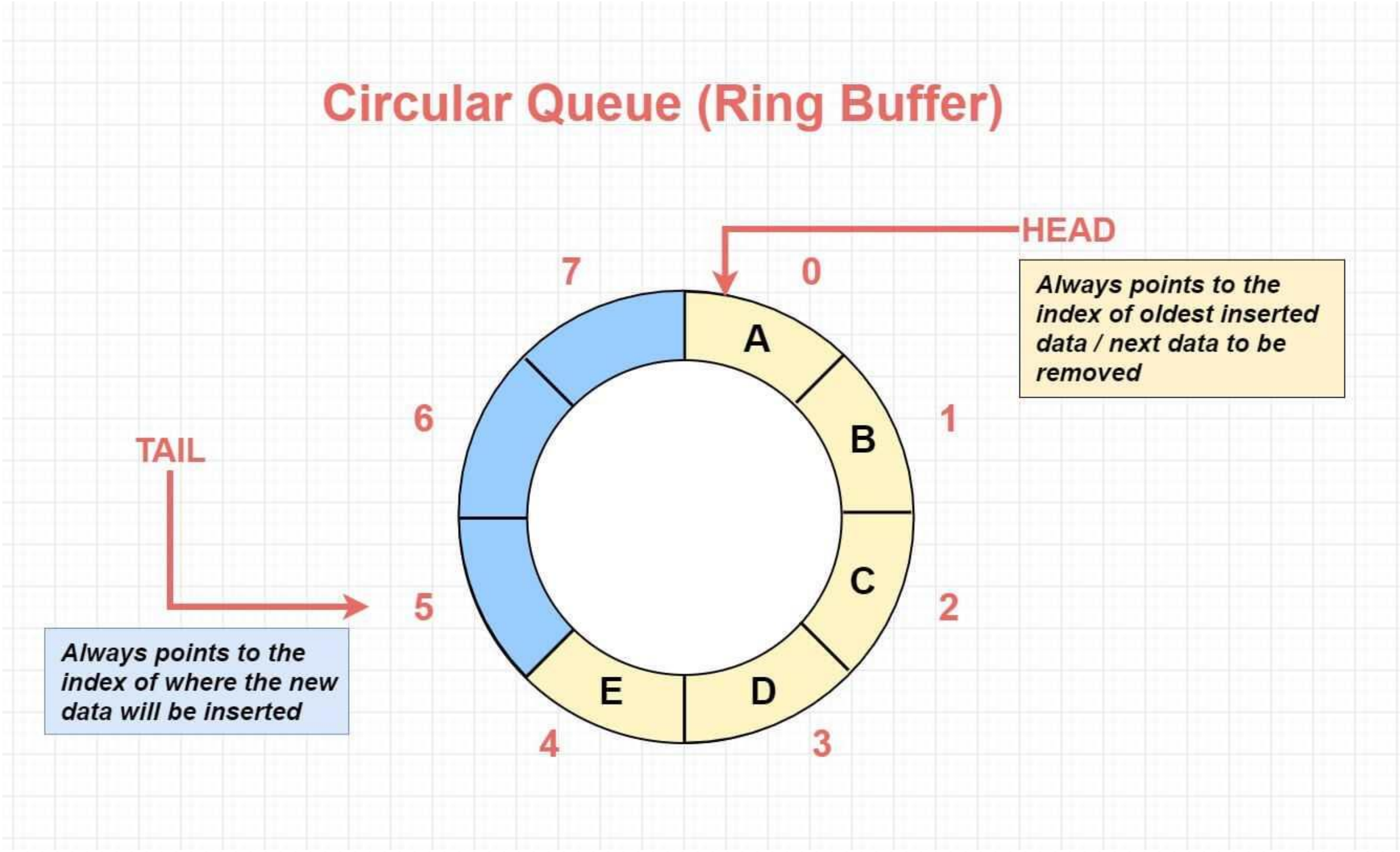


STACK: https://www.programiz.com/dsa/stack



QUEUE: https://www.geeksforgeeks.org/queue-data-structure/

Circular QUEUE

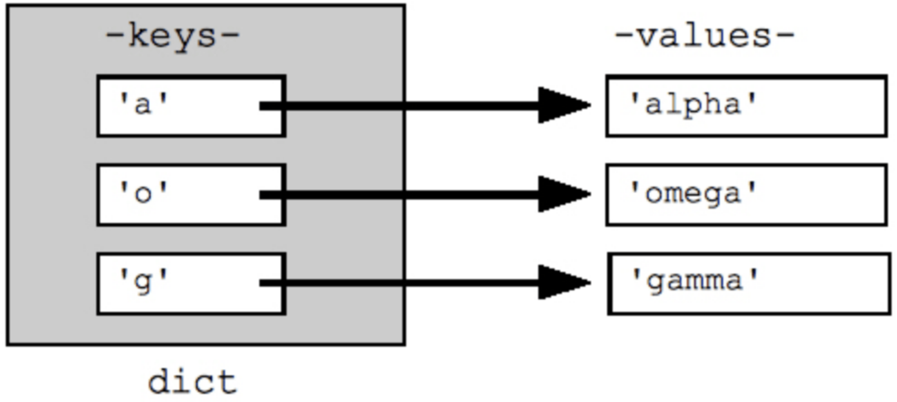

Circular Queue (Ring Buffer)
HEAD
Always points to the index of oldest inserted data / next data to be removed
TAIL
Always points to the index of where the new data will be inserted
0
1
2
3
4
5
6
7
A
B
C
D
E

CIRCULAR QUEUE: https://www.sahinarslan.tech/posts/deep-dive-into-data-structures-using-javascript-circular-queue-ring-buffer

Some ADTs (cont'd)

DICTIONARIES:

- Similar to arrays but elements are stored based on a key
- Given a key, some value or data is returned – keys are associated with a value
- Can be though of as mapping
- Can be based on an array or linked list
- Operations: search(), insert(), delete(), isEmpty(), isFull()

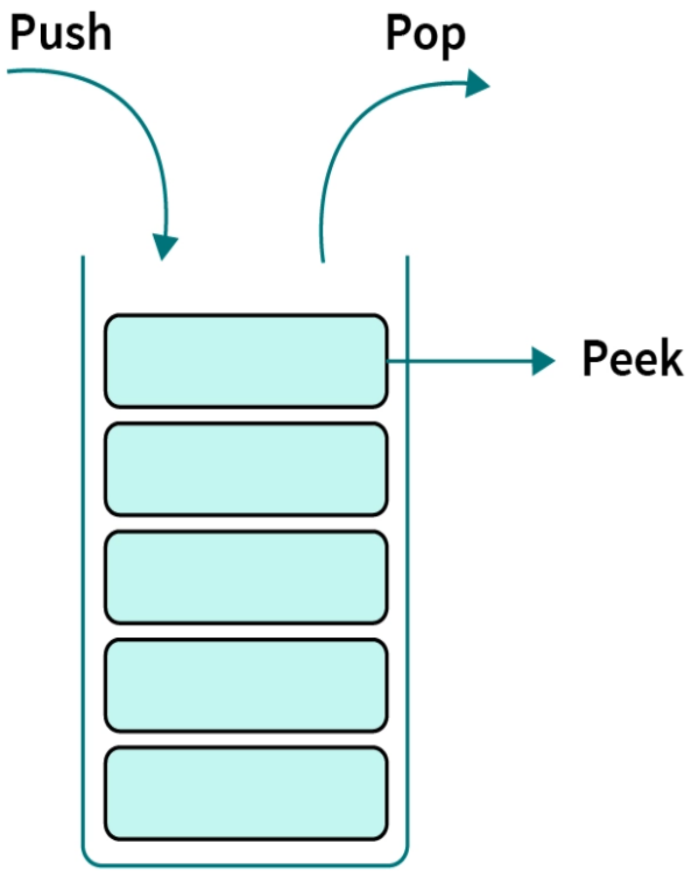


DICTIONARIES: https://www.datacamp.com/tutorial/python-dictionaries

OTHER ADTs

- **BAGS**
- **TREE**
- **GRAPH**
- **HASH TABLE/MAP**
- TABLE
- VECTOR
- MAP
- MATRICES

EXERCISE: Stack Implementation



TASK: Provide a simple implementation of the Stack Data Structure for **Integers**:

- The functions `push()` and `pop()` are required to be implemented.
- Next, try to implement `peek()`[*similar to* `pop()` *but no items are removed*].
- Implement either based on Array or LinkedList ADTs
- **Bonus:** *Make it generic.*

THANK YOU