OCR Computer Science AS Level

2.3.1 Algorithms for the Main Data Structures

Concise Notes

Specification:

- Stacks
- Queues

Algorithms for the Main Data Structures

- Each data structure has its own algorithms associated with it
- These allow data to be manipulated in useful ways
- All data structures mentioned are covered in greater detail in 1.4.2 Data Structures

Stacks

- Example of a first in, last out (FILO) data structure
- Often implemented as an array
- Use a single pointer which keeps track of the top of the stack (called the top pointer)
    - Points to the element which is currently at the top of the stack
    - Is initialised at -1, as the first element in the stack is in position 0
- Algorithms for stacks include adding to the stack, removing from the stack and checking whether the stack is empty/full
- All of the operations have their own special names, as shown in the table below

Operation	Name
Check size	`size()`
Check if empty	`isEmpty()`
Return top element (but don't remove)	`peek()`
Add to the stack	`push(element)`
Remove top element from the stack and return removed element	`pop()`

`size()`

- Returns the number of elements on the stack
- Returns the value of the top pointer plus one

```
size()
    return top + 1
```

isEmpty()

- Returns True if the stack is empty, otherwise returns False
- Works by checking whether the top pointer is less than 0

```
isEmpty()
    if top < 0:
        return True
    else:
        return False
    endif
```

peek()

- Returns the item at the top of the stack, without removing it
- Returns the item at the position indicated by the top pointer
- Important to check that the stack has data in it before attempting to return anything

```
peek()
    if isEmpty():
        return error
    else:
        return A[top]
    endif
```

push(element)

- Adds an item to a stack
- The new item must be passed as a parameter
- Firstly, the top pointer is updated accordingly
- Then the new element can be inserted at the position of the top pointer

```
push(element)
    top += 1
    A[top] = element
```

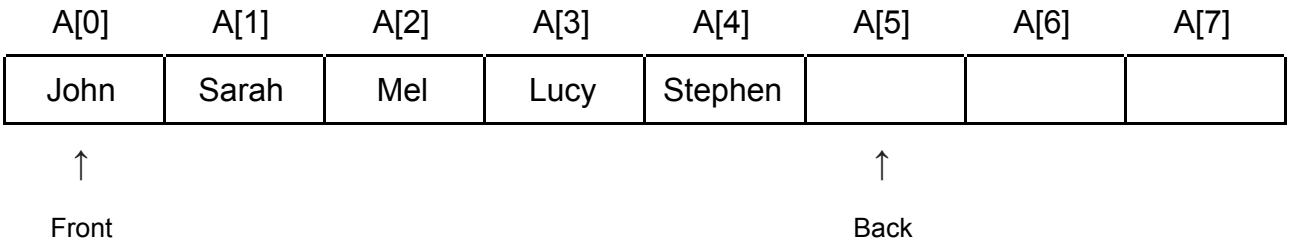
pop()

- Removes an item from a stack
- Element at the position of the top pointer is recorded before being removed
- Top pointer decremented by one
- The removed item is returned
- As with `peek()`, it's important to first check that the stack isn't empty

```
pop()
     if isEmpty():
          return error
     else:
          toRemove = A[top]
          A[top] = “”
          top -= 1
          return toRemove
     endif
```

Queues

- A type of first in, first out (FIFO) data structure
- Just like stacks, queues are often represented as arrays
- Unlike stacks, queues make use of two pointers:
    - Front holds the position of the first element
    - Back stores the next available space
- Operations which can be carried out on queues are similar to those of stacks



Operation	Name
Check size	`size()`
Check if empty	`isEmpty()`
Return top element (but don’t remove)	`peek()`
Add to the queue	`enqueue(element)`
Remove element at the front of the queue and return removed element	`dequeue()`

size()

- Returns the number of elements in a queue
- Simply subtracts the value of front from back

```
size()
    return back - front
```

isEmpty()

- Returns True if a queue is empty, and False otherwise
- When a queue is empty, front and back point to the same position

```
isEmpty()
    if front == back:
        return True
    else:
        return False
    endif
```

peek()

- Returns the element at the front of the queue without removing it

```
peek()
    return A[front]
```

enqueue(element)

- Adds an element to the back of a queue
- The new element is placed in the position of back
- Back is incremented by one

```
enqueue(element)
    A[back] = element
    back += 1
```

dequeue()

- Removes the item at the front of the queue
- Items are removed from a queue from the position of the front pointer
- Just as with stacks, it's important to check that the queue isn't empty
- After the element has been removed, the front pointer must be incremented

```
dequeue()
    if isEmpty():
        return error
    else:
        toDequeue = A[front]
        A[front] = ""
        front += 1
        return toDequeue
    endif
```