BTEC Level 3 Computing

Unit 1 - Principles of Computer Science

Common Algorithms

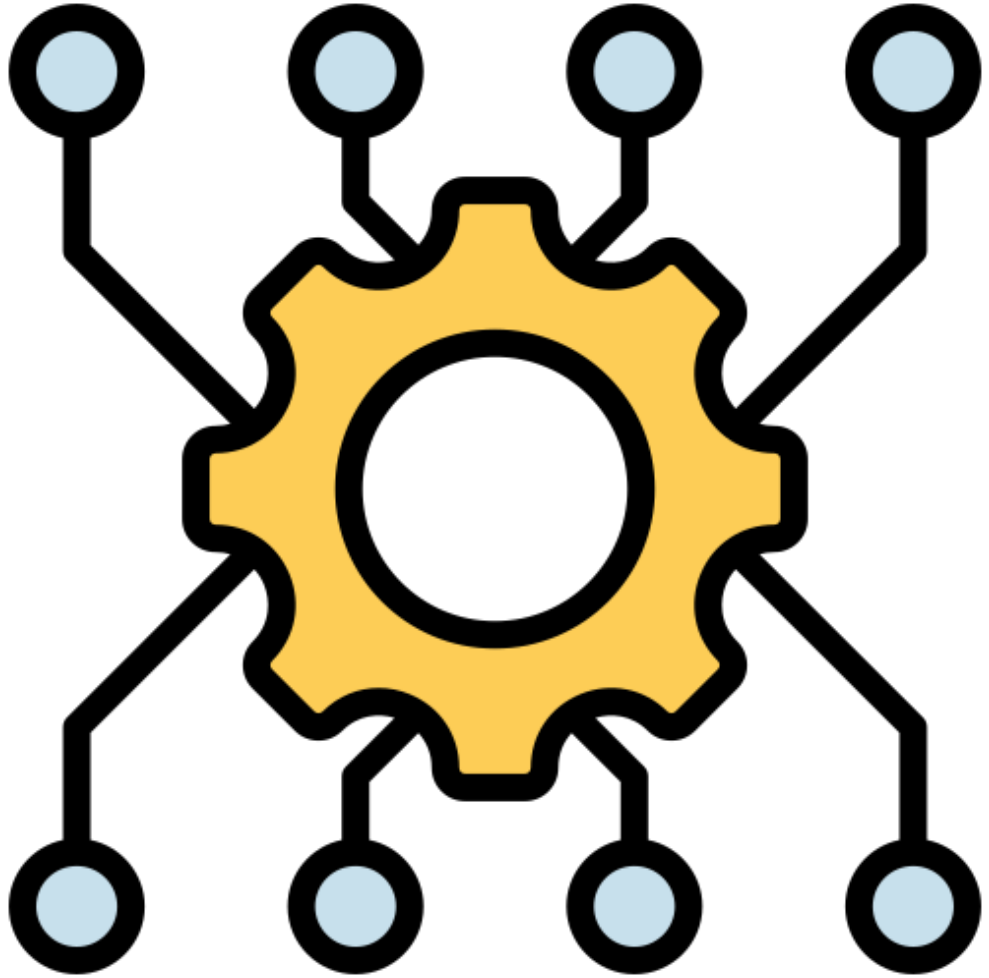
Selecting, applying, using and interpreting standard algorithms within a computer program to store and process data.

Common Algorithms

What is an algorithm?

- An algorithm is like a recipe or a set of step-by-step instructions that a computer follows to solve a problem or accomplish a specific task.

- It's a precise sequence of operations that, when executed, will always produce the correct output for a given input.

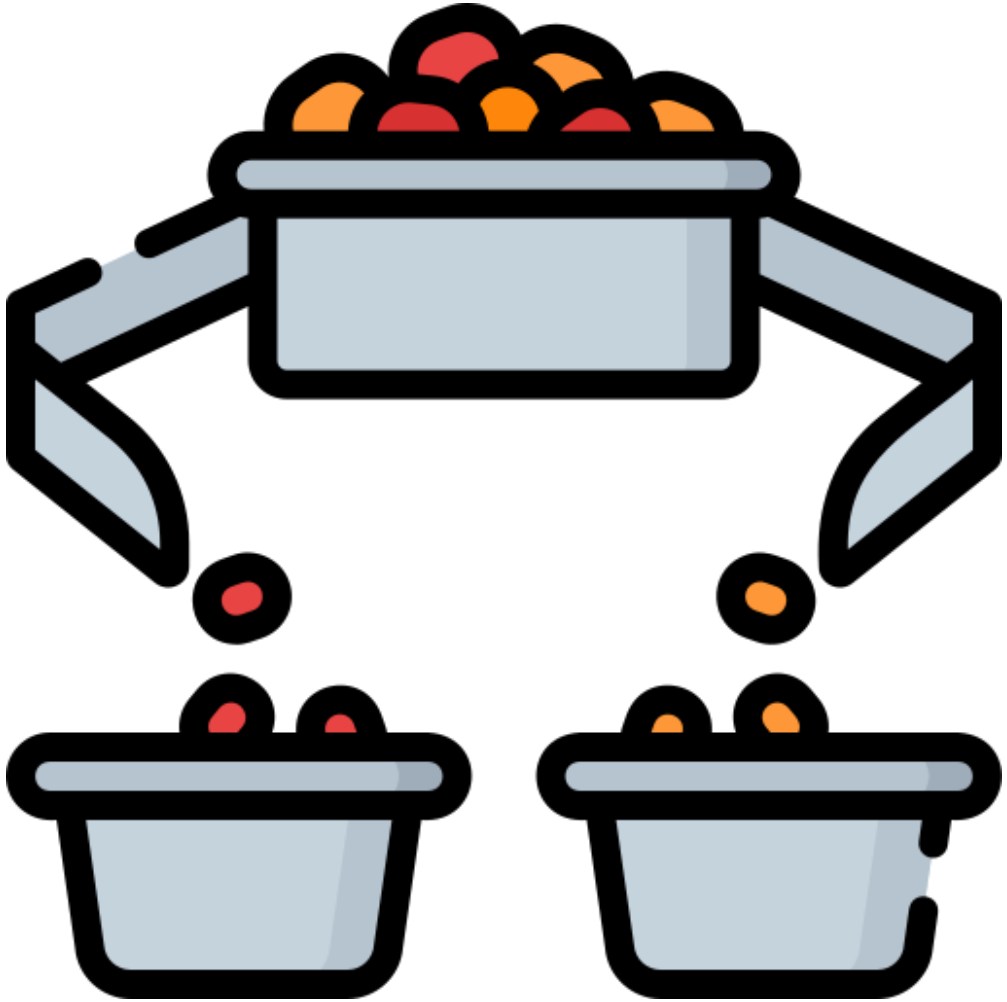


Main Algorithm Categories

- Sorting.
- Searching.
- Other: Count and Input Validation (already shown in some capacity).
- Stacks or Queues: LIFO and FIFO.

Sorting Algorithm

- A sorting algorithm is a set of step-by-step instructions that a computer uses to arrange a list of items into a specific order.
- Think of it like alphabetizing a list of names or arranging numbers from smallest to largest.
- Different algorithms exist, each with its own way of sorting, some faster or more efficient than others.



Types of Sorting Algorithms

- Bubble Sort.
- Quick Sort.
- Insertion Sort.

Bubble Sort

- Imagine you have a row of numbers, and you want to sort them from smallest to largest.
- Bubble sort works by repeatedly going through the list, comparing each pair of adjacent numbers, and swapping them if they are in the wrong order (if the first number is larger than the second).
- This process "bubbles" the largest unsorted number to the end of the list in each pass until the whole list is sorted.

Bubble Sort Animation

Bubble Sort Explainer (AI Created This)

Quick Sort

It picks a number from the list (called the "pivot") and then rearranges the list so that all the numbers smaller than the pivot are on one side, and all the numbers bigger than the pivot are on the other side.

Then, it does the same thing for each of those smaller and bigger groups. It keeps doing this until everything is sorted.

It's usually much faster than bubble sort, especially for larger lists.

Quick Sort Animation

Insertion Sort

Insertion sort works by taking one card at a time and inserting it into the correct place in the cards you've already sorted.

So, you start with one card (which is sorted!), then take the next card and put it in the right place, then the next, and so on. It's good for small lists or lists that are already mostly sorted.

Insertion Sort Animation

Searching Algorithm

Searching algorithms are methods used to find a specific item in a list or a collection of data.

Think of it like looking for a person's name in a phone book or finding a book in a library.

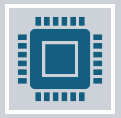
There are different ways to search, depending on how the data is organized.

The two main types are: linear search and binary search.

Serial/Linear Search

Imagine you are looking for a specific name in a phone book.

Linear search is like going through the phone book page by page, name by name, until you find the one you are looking for.



The computer does the same thing, checking each item in the list one at a time, from the beginning to the end, until it finds a match or reaches the end of the list.

It is simple, but it can be slow if the list is very long.

Linear Search Animation

Binary Search

Imagine you're guessing a number between 1 and 100. Binary search is like this: You guess 50.

If the answer is "higher," you know the number is between 51 and 100.

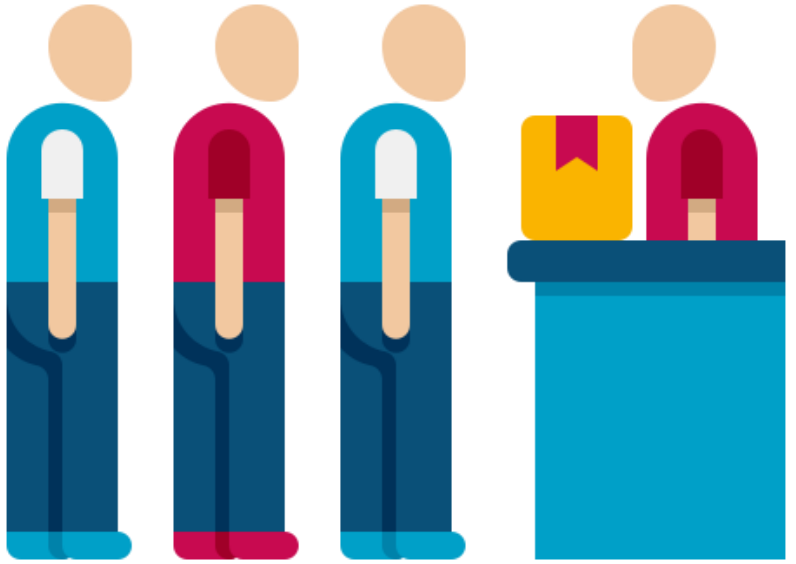
If it's "lower," it's between 1 and 49.

You keep guessing the middle number of the remaining range, cutting the possibilities in half each time.

It's super efficient, but only works if the numbers are already in order.

Stacks or Queues

- Stacks and queues are two fundamental data structures in programming that help organize and manage collections of items.
- They're like specialised containers with specific rules about how you can add or remove items.
- The two most used kinds are: LIFO – Last In First Out and FIFO – First In First Out.

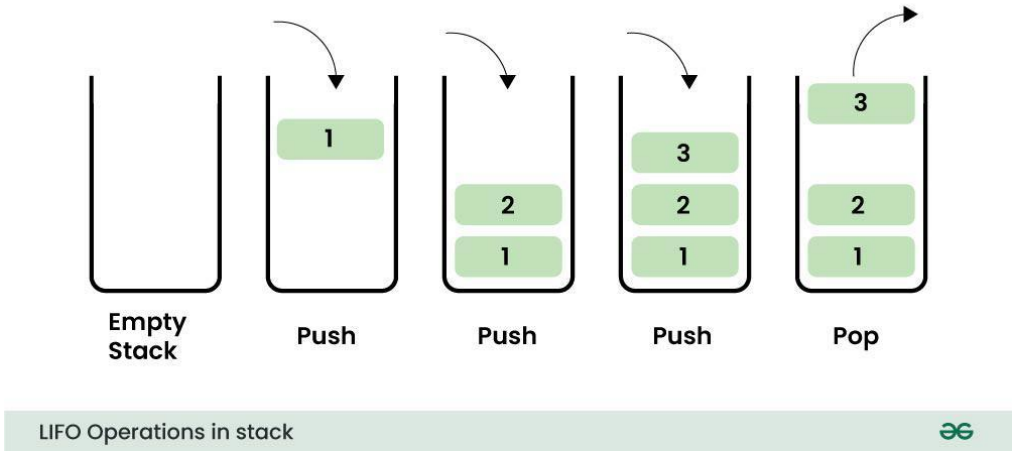


LIFO – Last In First Out

- There's no such thing as a "Last-In, First-Out queue." Queues are *always* First-In, First-Out (FIFO). Last-In, First-Out (LIFO) describes a *stack*.

- A queue is like a line of people waiting for a bus. The first person who arrived (First-In) is the first person who gets on the bus (First-Out). That's the fundamental principle of a queue.

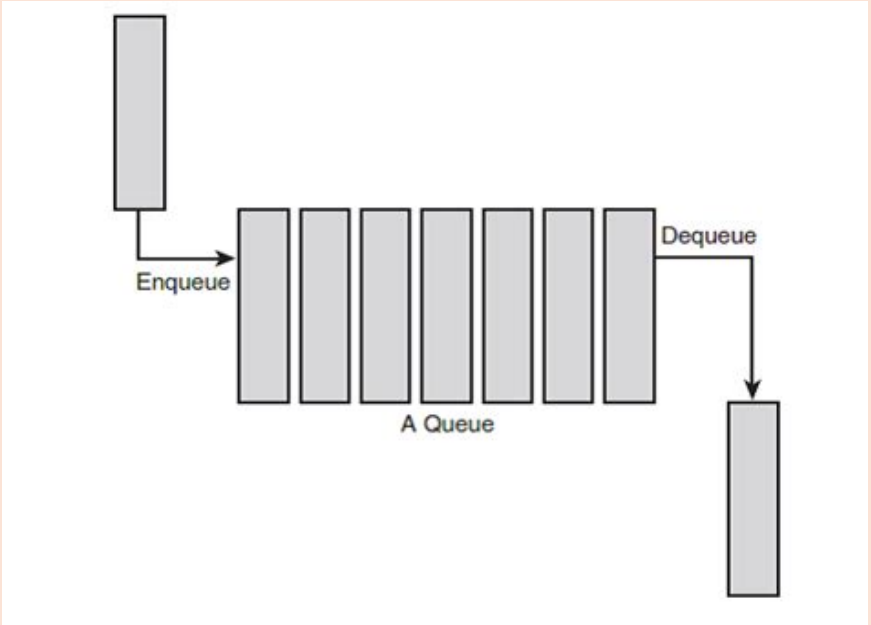
- If you want the *last* person in line to be the *first* one served, that's not a queue; that's a *stack* (LIFO). It's like a stack of plates – the last plate you put on top is the first one you take off.



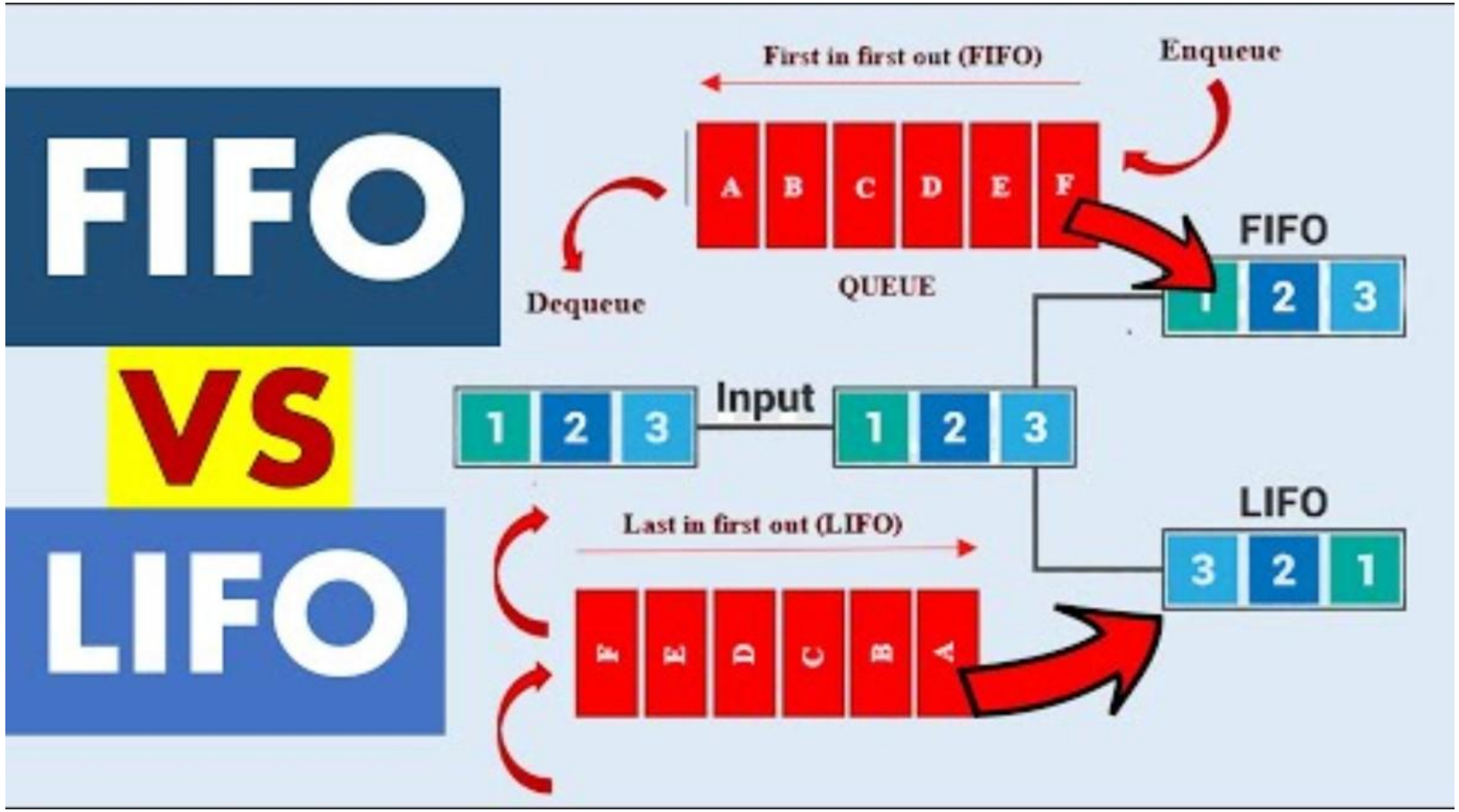
LIFO Operations in stack

FIFO – First In First Out Queue

- FIFO (First-In, First-Out) is a way of organizing items where the first item that enters a collection is the first one that leaves.
- Think of it like a line at a store: the first person in line is the first person served.
- In programming, a FIFO queue is a data structure that follows this principle. Items are added to the back of the queue and removed from the front.



LIFO and FIFO Animation with Explanation



Next Time

Types of programming and mark-up languages