Backend

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You see here kid? You gotta just go for it; don't think about what comes after or what came before. You just gotta bend your knees, take a deep breath, and jump. And you might think; what if I fall? Well, what if you don't? what if you fly?

Contents

Algorithms

1.1 XOR Swap

Given two values **a** and **b**, they can be swaped without the need of an temporary variable using the **xor**, exclusive or, operator. This works by changing the bits of the values. The caret symbol '^' is the most common operator for the XOR operation in many programming languages like c, c++, Java and Javascript .The process is the following:

Listing 1.1: XOR swap

```
1  Algorithm swapValuesXOR(a, b){
2    a = a ^ b
3    b = a ^ b
4    a = a ^ b
5  }
```

XOR only returns true (*1*) if the compared values are in an *or* state, otherwise returns false (*0*).

There are three steps that involve the operation between **a** and **b** using **xor**. In the first step the result is stored in a, then in b in the second and lastly in the third in a again.

This method is used in low level languages such as assembly.

Example:

a = 5 and b = 7, in binary a = 101 and b = 111.

First step, the result is stored in a:

$$a = 101$$
$$b = 111$$

$$\boxed{a = 010}$$

Second step, the result is stored in b:

$$a = 010$$
$$b = 111$$

$$\boxed{b = 101}$$

Third step, the result is stored in a again:

$$a = 010$$
$$b = 101$$

$$\boxed{a = 111}$$

a = 111 and b = 101, in other terms a = 7 and b = 5. The values have been swaped.

1.2 Sum of Arithmetic Series

The sum of an arithmetic series is is given by the expression:

$$\boxed{S_n = \frac{n}{2}(a_i + a_f)}$$

Computers process multiplications faster, so the division $n/2$ can be replaced by the product $n * 0.5$.

Elements:

- S_n = sum of series.
- n = number of terms.
- a_i = initial term.
- a_f = final term.

To find n, the formula for the n^{th} term of an arithmetic progression can be used:

$$\boxed{a_f = a_i + (n-1)d}$$

Where d is the step, the standard difference between each term.

By isolating n, the formula ends up like this:

$$\boxed{n = \left(\frac{a_f - a_i}{d}\right) + 1}$$

The algorithm has the following structure:

```
// if n is unknown
n = ((af - ai) /d) + 1

Algorithm sumArithmeticSeries(n, ai, af){
  s = n * 0.5 * (ai + af)
}
```

This algorithm is $O(1)$, constant.

Example:

The sum of odd numbers (1, 3, 5, 7, ...) between 1 and 100. The range of odd values is 1-99, the first term is 1 and the last is 99. The step between eaxh term is 2, with n can be found.

$$
\begin{aligned}
n &= \left(\frac{99-1}{2}\right)+1 \\
n &= \left(\frac{98}{2}\right)+1 \\
n &= 49+1 \\
n &= 50
\end{aligned}
$$

The sum of the arithmetic series with $n = 50$ is:

$$
\begin{aligned}
S_{50} &= 50 * 0.5\,(1+99) \\
S_{50} &= 25 * 100 \\
S_{50} &= 2500
\end{aligned}
$$

1.3 Sort

1.3.1 Bubble Sort

1.3.2 Selection Sort

1.3.3 Insertion Sort

1.3.4 Quick Sort

1.3.5 Merge Sort

1.3.6 Tim Sort

1.4 Search

1.4.1 Linear Search

1.4.2 Binary Search

1.4.3 Hash Table Search

Protocols

A protocol is a set of rules for data communication in a netwotk. It allows devices to send and receive data in packets. Data packets are adressed, routed and sent across networks.

2.1 IP

IP stands for *Internet Protocol*.

There are two main versions of the Internet Protocol: the older, but still widely used, **IPv4** and the more recent and scalable **IPv6**.

An IP Adress is a unique numerical label assigned to every device, such as a computer, phone or server; that is connected to a computer network or the internet.

When information is sent online, it is broken into smaller pieces calles data packets. The IP adress acts as the "electronic return adress" for these packets, ensuring they arrive at the correct destination.

IP adresses can be public or private.

2.1.1 Public IP Adress

2.1.2 Private IP Adress

192.186.0.0

2.2 TCP

2.3 TLS

2.4 UDP

2.5 DNS