Algorithmic Thinking

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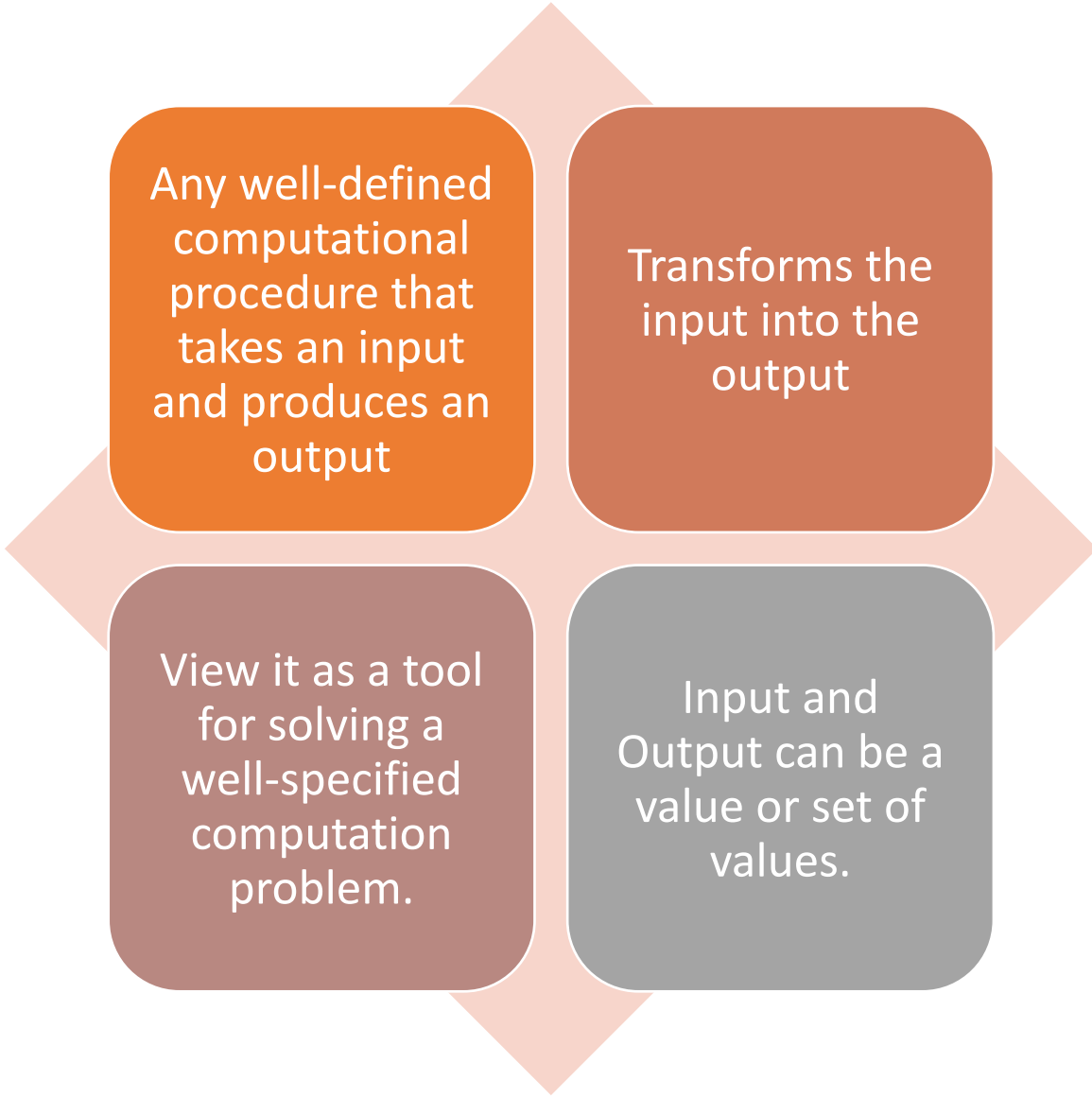
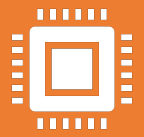
What is an Algorithm?



Algorithms as a Technology



Different algorithms devised to solve the same problem often differ dramatically in their efficiency. These differences can be much more significant than differences due to hardware and software.

Total system performance depends on choosing efficient algorithms as much as on choosing fast hardware.

Insertion Sort

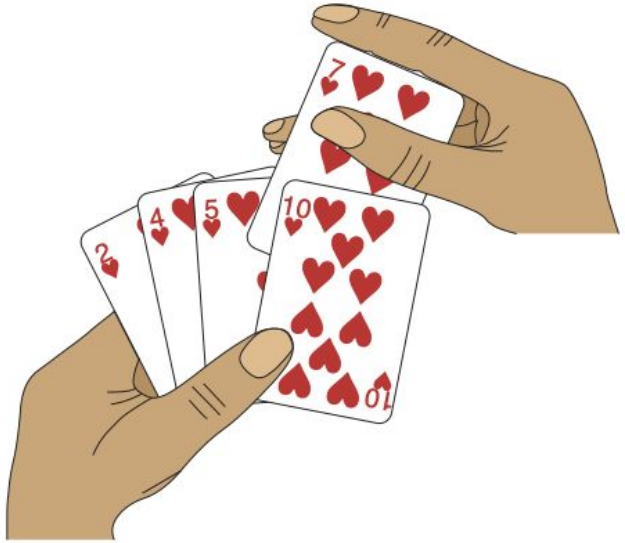


Figure 2.1 Sorting a hand of cards using insertion sort.

```
INSERTION-SORT(A, n)
1  for i = 2 to n
2      key = A[i]
3      // Insert A[i] into the sorted subarray A[1 : i − 1].
4      j = i − 1
5      while j > 0 and A[j] > key
6          A[j + 1] = A[j]
7          j = j − 1
8      A[j + 1] = key
```

Characterizing Run Time

O-Notation - characterizes an upper bound on the asymptotic behavior of a function. In other words, it says that a function grows no faster than a certain rate, based on the highest-order term.

Ω-Notation - characterizes a lower bound on the asymptotic behavior of a function. In other words, it says that a function grows at least as fast as a certain rate

Θ-Notation – characterizes a tight bound on the asymptotic behavior of a function. It says the function grows precisely at a certain rate.

Analyzing Run Time – Insertion Sort

```
INSERTION-SORT(A, n)
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```
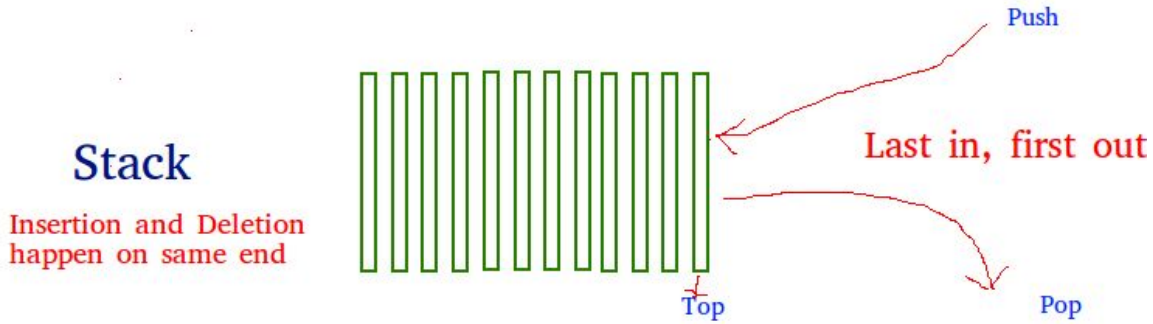
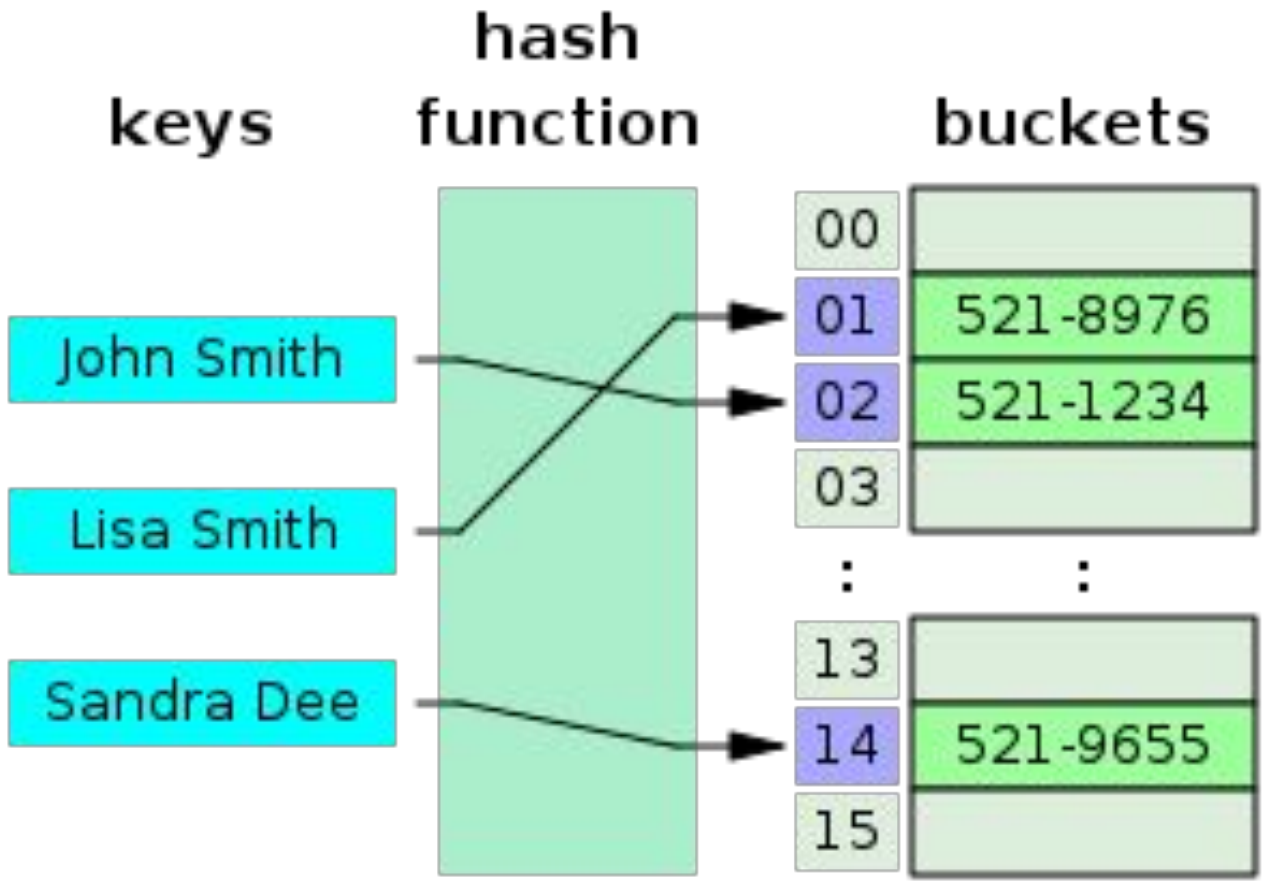

Data Structures

- Arrays
- Matrices – 2D+ Array
- Stacks
- Queues

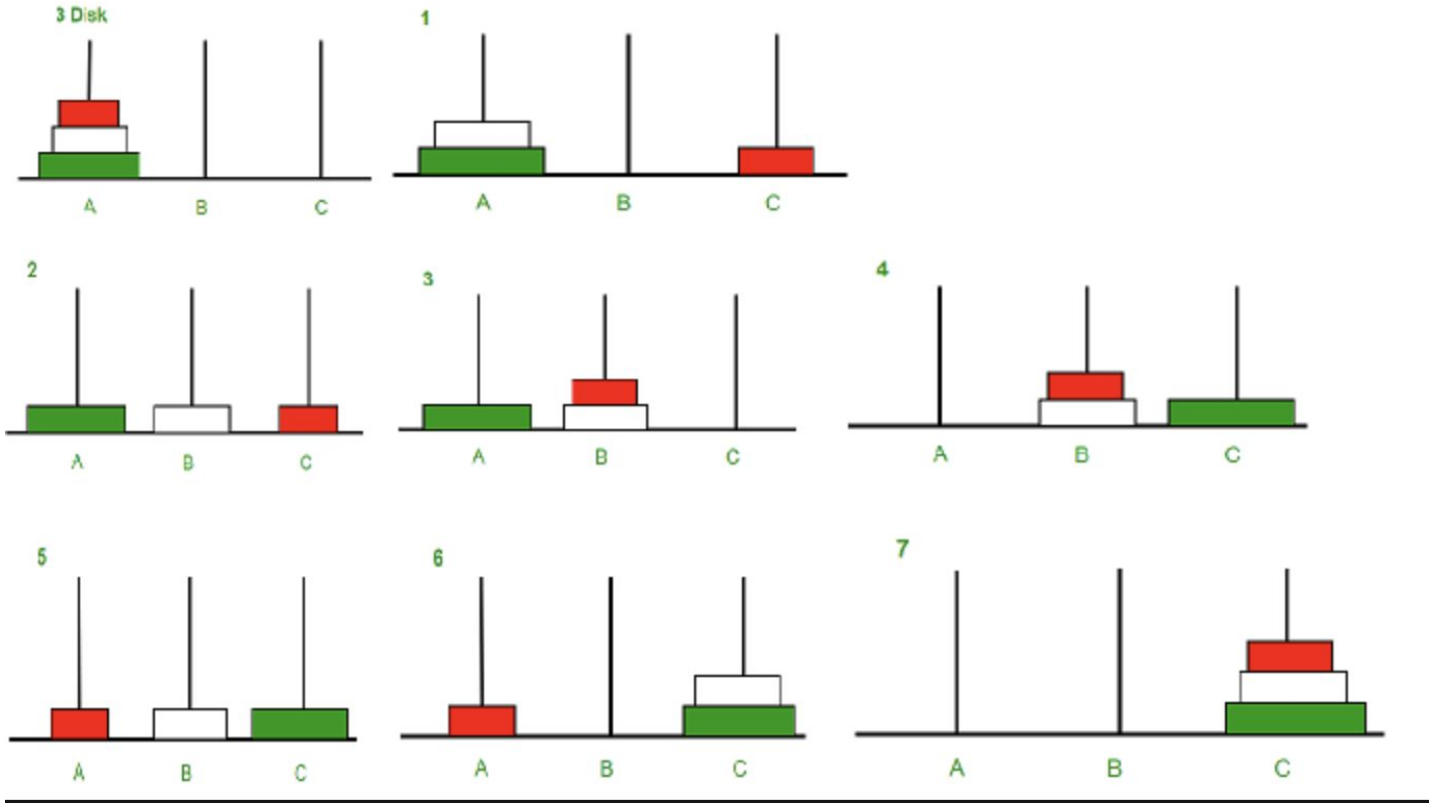


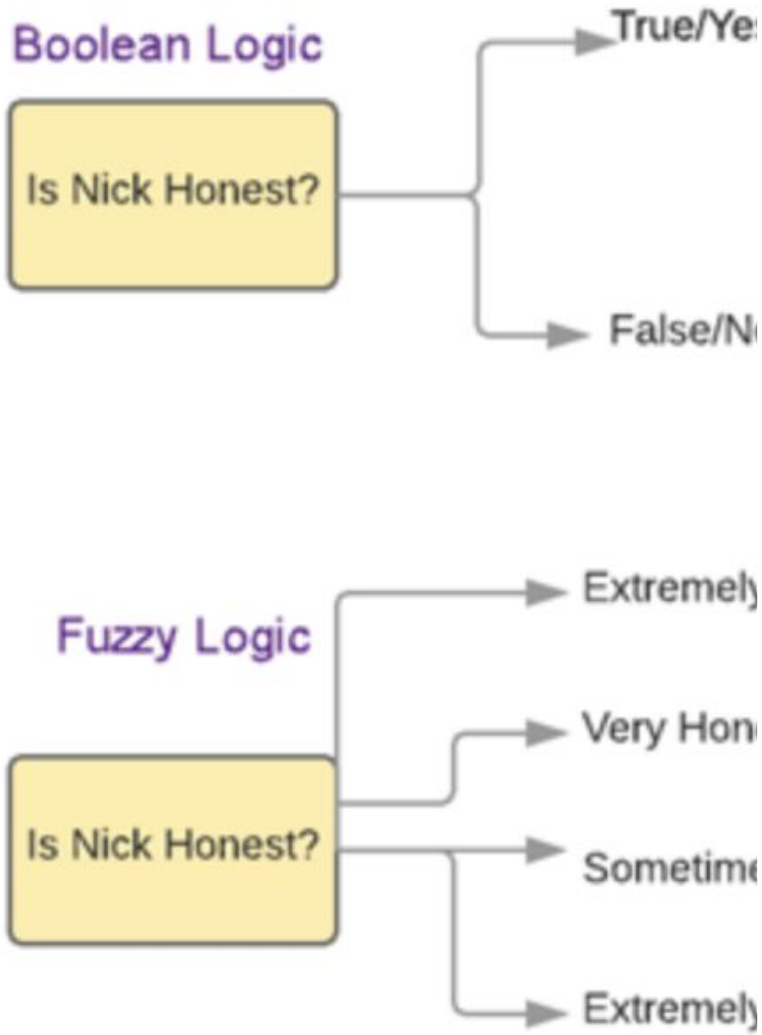
Hash Tables/Map

- Hashing is a technique or process of mapping keys, and values into the hash table by using a hash function.
- It is done for faster access to elements. T
- he efficiency of mapping depends on the efficiency of the hash function used.



Tower of Hanoi Problem

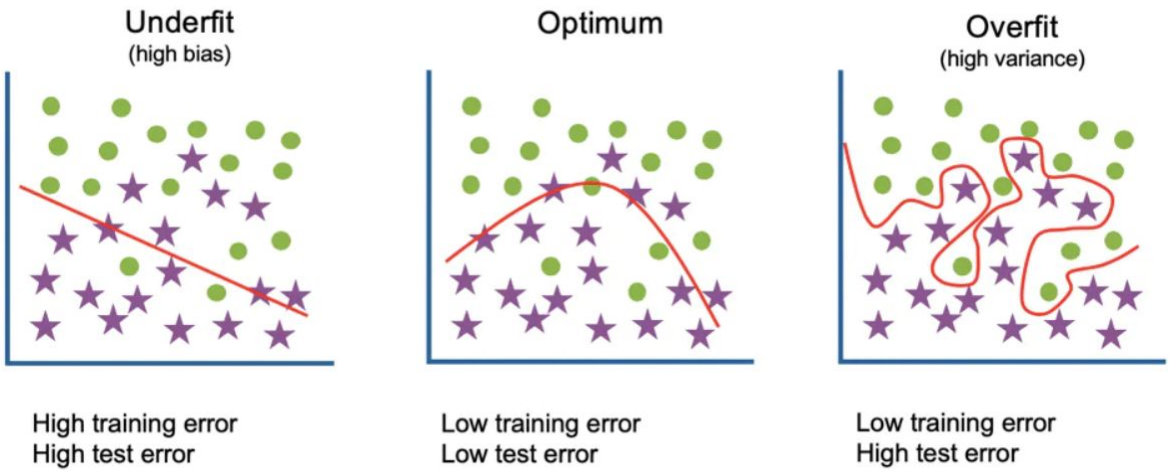




Fuzzy Logic

- Fuzzy logic algorithm helps to solve a problem after considering all available data. Then it takes the best possible decision for the given the input. The FL method imitates the way of decision making in a human which consider all the possibilities between digital values T and F.
- In advanced software trading models, systems can use programmable fuzzy sets to analyze thousands of securities in real-time and present the investor with the best available opportunity. Fuzzy logic is often used when a trader seeks to make use of multiple factors for consideration. This can result in a narrowed analysis for trading decisions. Traders may also have the capability to program a variety of rules for enacting trades. Two examples include the following:
- Fuzzy logic allows a trader to program their own subjective inferences on low and high in these basic examples to arrive at their own automated trading signals.

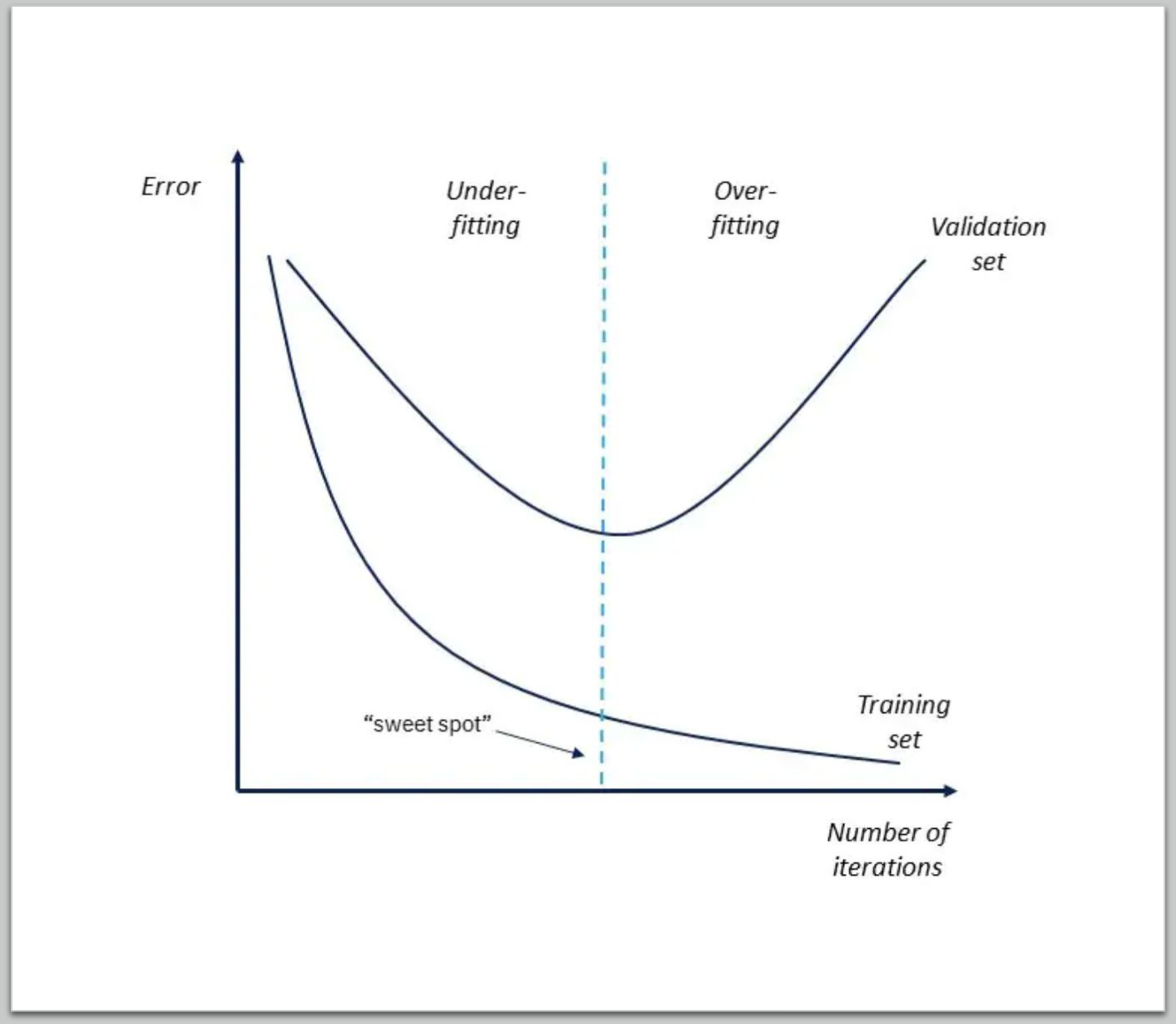
Overfitting and Underfitting



- Overfitting is a concept in data science, which occurs when a statistical model fits exactly against its training data. When this happens, the algorithm unfortunately cannot perform accurately against unseen data, defeating its purpose.
- If overtraining or model complexity results in overfitting, then a logical prevention response would be either to pause training process earlier, also known as, “early stopping” or to reduce complexity in the model by eliminating less relevant inputs. However, if you pause too early or exclude too many important features, you may encounter the opposite problem, and instead, you may underfit your model.
- Underfitting occurs when the model has not trained for enough time or the input variables are not significant enough to determine a meaningful relationship between the input and output variables.

Continued...

- As the model learns, its bias reduces, but it can increase in variance as becomes overfitted. When fitting a model, the goal is to find the “sweet spot” in between underfitting and overfitting, so that it can establish a dominant trend and apply it broadly to new datasets.



Good Resources! (Bookmark it!)

Awesome Algorithms List

Every Algorithm Implemented in Python