**ALGORITHMICS NOTES**

**ONLY THE MOST IMPORTANT BITS**

*Lesson 1:*

Travelling salesman problem:

To check **all** **possible** tours (N) (**brute** **force**) it would take:

**(N/2)^(N/2) < N! < N^N**

**Time complexity**:

The **worst-case** time complexity of an algorithm is a function T : N → N where:

* T(n) is the **maximum** **number** of **elementary** **operations** the algorithm uses on inputs of size n
* The input size is problem-dependent (something countable).

The **average-case** complexity is similar: replace maximum by **average** in the above.

**Precise Definitions:**

**f(n)** is **O(g(n))** if **f(n) ≤ cg(n)** for n ≥ N, where **c > 0** and N ∈ N are constants

**f(n)** is **Ω(g(n))** if **f(n) ≥ cg(n)** for n ≥ N, where **c > 0** and N ∈ N are constants

**f(n)** is **Θ(g(n))** if **f(n) = O(g(n))** and **f(n) = Ω(g(n))** i.e. the lower bound is **identical** to the upper bound

Note that an O(n^2) algorithm is also a O(n^3) algorithm.

A O(n^2) algorithm may not be faster than a O(n^3) algorithm when n becomes larger.

A Θ(n^2) algorithm will be faster than a Θ(n^3) algorithm when n becomes larger.

*Lesson 2:*

**Stacks – last in first out.**

* Reduces the access to memory – **no** longer **random** **access**.
* For fixed size array, the time complexity is **O(1)** for both the **push** and **pop** operations as you only have to **move** the **last** **pointer** **left** or **right**.
* **Uses** of Stacks:
  + **Reversing** an **array.**
  + **Parsing** **expressions** for compilers.

**Queues – first in first out.**

* Uses – **job** **queues** in OS.
* **Queues** **with** **priorities** – insert (element, priority).

**Lists**

* **Ordering** of elements is **important**.
* **Repetitions** are **allowed**.
* Implementations: **Arraylist**, **Linkedlist**.

**Sets**

* **No** **ordering** or **repetitions**.
* Implementations: **Hashset**, **Treeset**.

**Maps**

* A map provides a content addressable memory for pairs key:data.
* It provides fast access to the data through the key (no duplicate keys).
* Multimaps allow each key to be associated with multiple values.