General Notes

What is an algorithm ?

An algorithm is a set of well defined rules or a recipe to solve a well defined problem . for example if we have a set of task that need to be completed according to their deadline , an algorithm would solve that problem.

Routing and Comunication depends on the shortest path algorithim

Algorithms are used in quantum mechanics and finance

Pattern for Pseudocode

* Define a computation probelm
* Define Input
* Define outoput
* Solution that transform input to output

The algorithm Designer's Mantra

"Perhaps the most important principle for the good algorithm designer is to refuse to be content" Aho , Hopcroft and Ullman (the Design and analysis of computer algorithm, 1974)

Simply Can we do better ?

\*\* What is a mathematical proof?

A proof is verifying that a proposition is true thourgh a series of steps called "logical deductions" from a base set of axioms ( set of self evident truth) , they are the starting point of logical reasoning . poor axioms (shaky truth) can lead to unreliable mathematical reasoning. (paraphrased from Mathematics for Computer Science, Eric Lehman and Tom Leighton)

\*\*\* Propositions

In our logic system Propostions are binary statements that are true or false .however in other system a likelehood can be attached to the proposition ( completely true of completely false). a special case of propostion are called predicate whose truth depends on the value on one or more variable.

implications (==>) has the following truth tables

P Q P ==> Q

T T T

T F F

F T T ( accepted mathematical convention)

T T T

for if and only ( <==>)

P Q P==>Q Q ==> P P<==>Q

T T T T T

T F F T F

F T T F F

F F F F T

\*\* Axioms

an axioms is a proposition that you believe is true . Axioms should be consistent and complete

* Consistent , no proposition is self contradictory
* Complete, if every proposition can proved or disproved .

\*\* Logical deductions

Also called inference rules, combines axioms and true proposition to generate more true propositions

* **Modus Ponens ,**if P is true and P==> Q is true it means Q is true
  + **Tautology** is one true proposition and , each tautological proposition there is an associated inference rule

\*\* Concepts

\*\*\*loop invariant

a loop invariant is a property of an algorithm or functionilty that satisfied the following conditions

Initialization: is true prio to the first iterations of the loop

Maintenance : is true before the loop iterations and before the next iterations

Termination : When the loop terminate, the invariant should help establish the correctness of the algorithm ( as an example reduce ( inclusive sum of array's element is a loop invarient)