Ch1: Introduction

305233, 305234

Algorithm Analysis and Design

Jiraporn Pooksook
Naresuan University

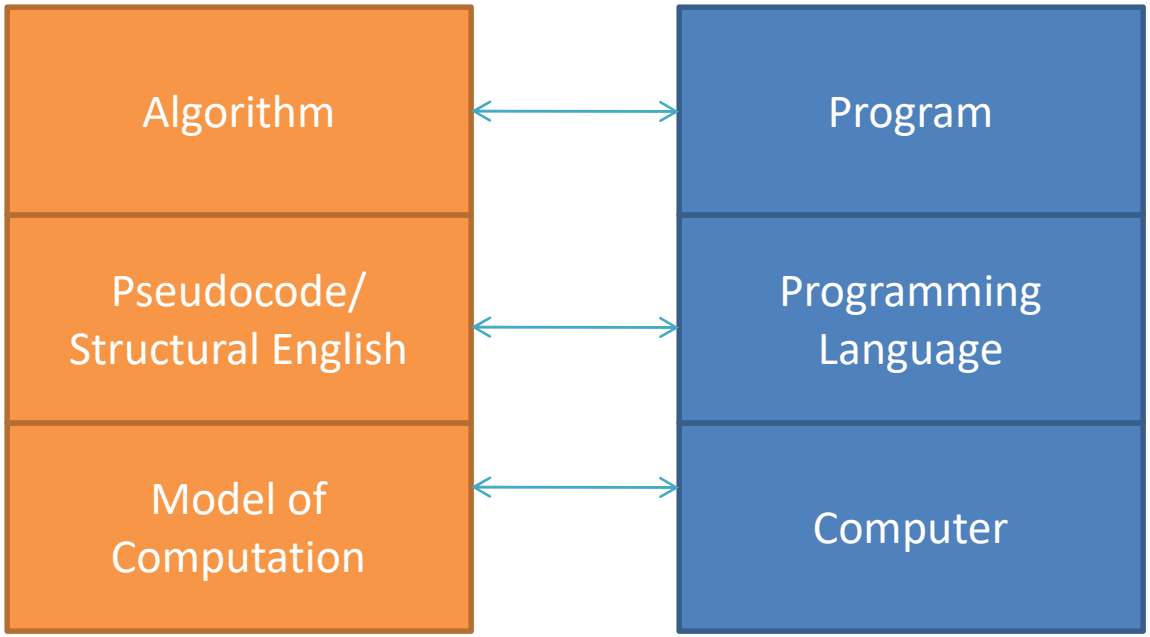
Experiences

- https://mahasak.com/5-ehtuphlthiiphmaenanamaih-developer-chaawaithyl-ngaipthamngaanthii-agoda/
- https://itopstory.com/what-why-and-type-big-o-notation-90a1a1d43596

What is an Algorithm?

- An **algorithm** is any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output for solving a particular problem.
- An algorithm is said to be **correct** if, for every input instance, it ***halts*** with the correct output.

Theory vs Implementation



Efficiency of an algorithm

- Accuracy
  - Giving a correct output for every input
- Running time
  - Taking fewest amount of time for finishing the running process

Example: Efficiency of algorithms

- Insertion sort takes time around $c_1 n^2$
- Merge sort takes time around $c_2 n \lg n$ ($\lg = \log_2$)

Computer A
10^9 instructions/sec

$$\frac{2(10^6)^2 \, instructions}{10^9 \, instructions / \sec} = 2000 \sec$$

Computer B
10^7 instructions/sec

$$\frac{50 \times 10^6 \lg 10^6 \, instructio \, ns}{10^7 \, instructio \, ns / \sec} = 100 \sec$$

Example: Efficiency of algorithms

Computer B runs 20 times faster than computer A because of applying faster algorithm.

nd c_1n^2

$c_2$nlgn (lg=$\log_2$)

Computer A	Computer B
10^9 instructions/sec	10^7 instructions/sec

$$\frac{2(10^6)^2 \, instructions}{10^9 \, instructions/\sec} = 2000 \sec$$

$$\frac{50 \times 10^6 \lg 10^6 \, instructio\, ns}{10^7 \, instructio\, ns/\sec} = 100 \sec$$

Algorithm Analysis

- Analyze the correctness of an algorithm
  - Using loop Invariants
- Analyze the running time of an algorithm
  - The upper bound on the running time for any input, using the growth of functions.