Module 3 Notes

Analysis of Algorithms

* Scientific basis to understand the deployment of algorithms
* Important in understanding the algorithms from diff perspectives
  + Programmer = creating the algo
  + Client = use the program to complete a task
  + Theoretician = wants to understand what is going on
  + Team = basic blocking and tackling to understand the solution
  + Student sometimes plays all roles
* Running time – Charles Babbage
  + Created the analytic engine
  + “As soon as an analytic engine exists, it will necessarily guide the future course of science. Whenever any result is sought by its aid the question will arise – By what course of calculation can these results be arrived at by the machine in the shortest time”
  + Babbage’s machine had a crank on it and his concern was how many times will he have to crank the machine to complete the algorithm
* Reasons for algorithm analyzation
  + Predict performance
  + Compare algorithms
  + Provide guarantees
  + Understand theoretical basis
  + Main reason is to avoid performance bugs
    - Confidence the algorithm will complete the task in the time we believe
  + Challenge: will my program be able to solve a large practical input
    - Why is my program so slow? Time Complexity
    - Why does it run out of memory? Space Complexity
  + Knuth 1970s use scientific method to understand performance
    - Observe some feature of the natural world
    - Hypothesize a model that is consistent with the observations
    - Predict events using the hypothesis
    - Verify the predictions by making further observations
    - Validate by repeating until the hypothesis and observations agree
  + Principles
    - Experiments must be reproducible
    - Hypotheses must be falsifiable