Lecture 04
Complexity of Algorithms

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What is complexity

- Consider a sorting program that runs on a data set
- Try multiplying the size of the data set and continue to experiment
  - What happens??
  - Demo

Types of Complexity

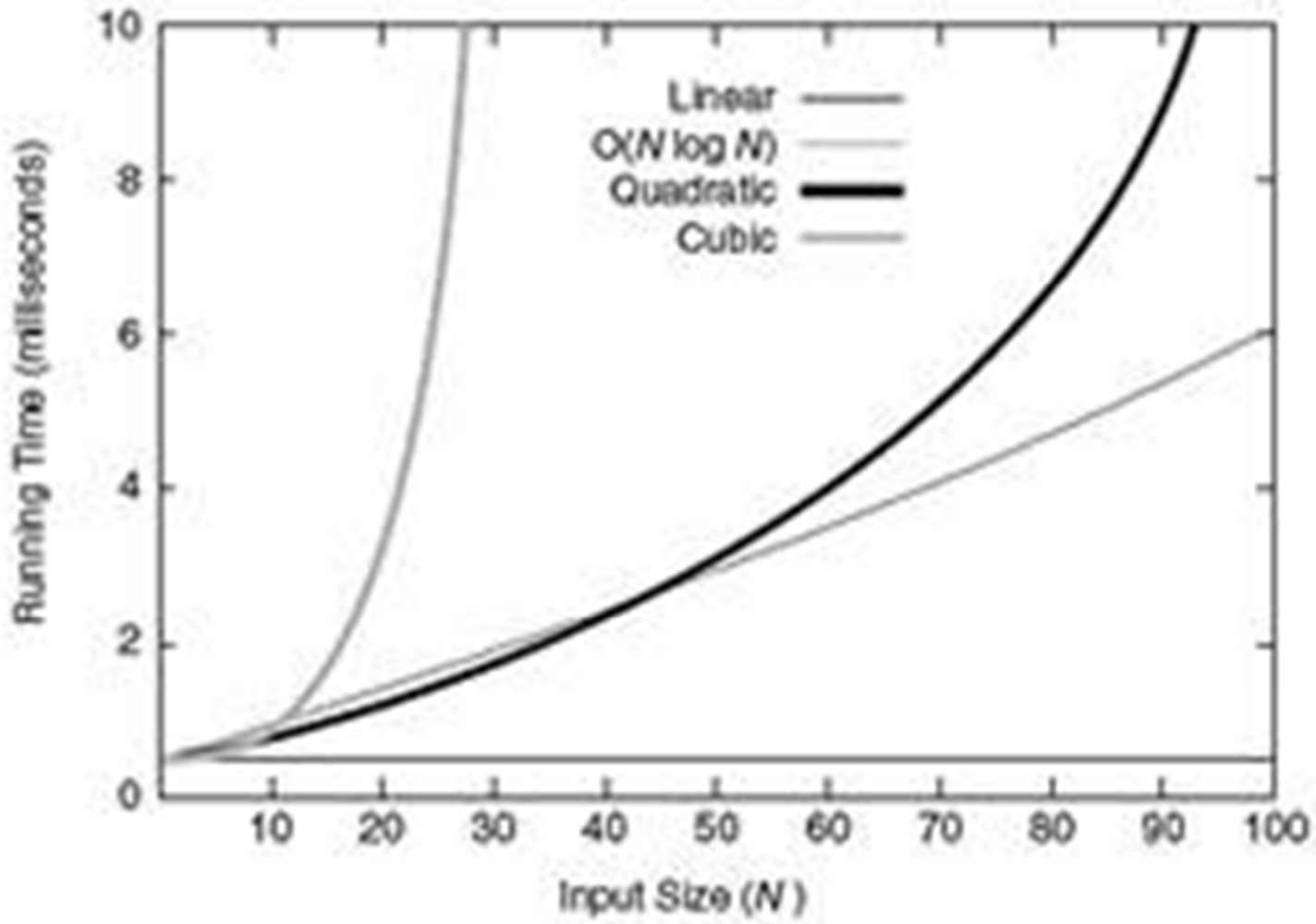
- Space Complexity
  - How much memory is used by the program
- Runtime complexity
  - How fast does it run

What Factors Determine the runtime of a program?

Among all those factors

- Size of the data set is one factor that we can analyze
- That is, we can describe the runtime as a function of n (size of the data set)
- Example:
  - for (int i=0; i<n ; i++)
    - Do_something
  - for (int i=0; i<n ; i=i/2)
    - Do_something

Some known functions



Definition of Big O

- **Formal Definition:** f(n) = O(g(n)) means there are positive constants c and k, such that o ≤ f(n) ≤ cg(n) for all n ≥ k. The values of c and k must be fixed for the function f and must not depend on n.
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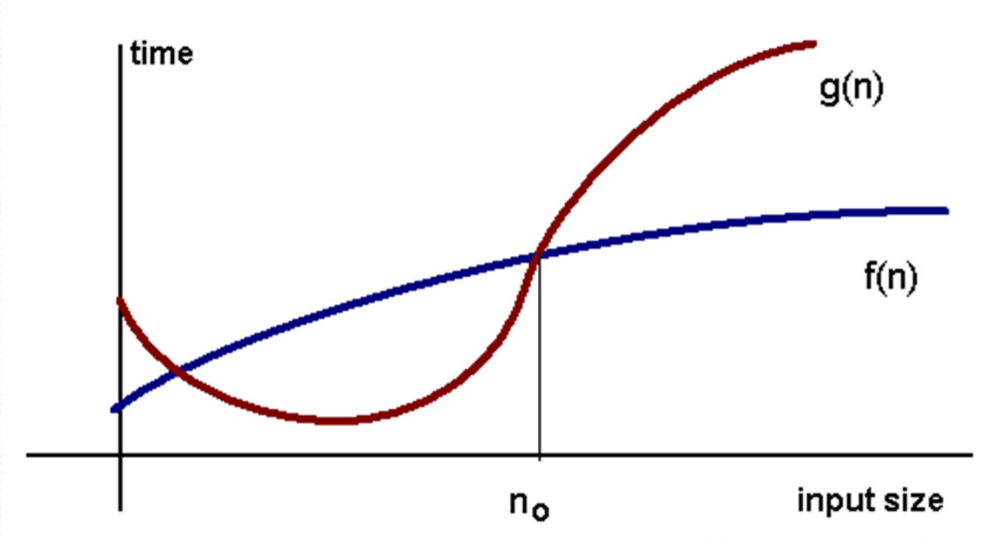

Complexity of basic algorithms

- Finding an element in an unsorted array of size n
- Finding an element in a sorted array of size n
- Reversing an array of size n
- Sorting an array of size n

Algorithms

- Constant time
- Logarithm time
- Linear time
- Quadratic time
- Exponential time

Determining big O

Final Thoughts

- Asymptotic analysis is a way to determine the performance of an algorithm
- However, it is not the only factor that affects performance
- For the most part other factors also have a significant impact on performance of systems
  - Network latency
  - Language efficiency
  - Data Structures
  - Many many other factors