【DS】Day2

☰ Tags	
🗓 Date	@May 21, 2022
☰ Summary	Observation: Empirical Analysis, and Data Analysis

【Week1】Analysis of Algorithms

1.5 Analysis of Algorithms Introduction

Reasons to analyze algorithms:

- Predict performance
- Compare algorithms
- Provide guarantees
- Understand theoretical basis
- **Avoid performance bugs.**

1.6 Observations

Example: 3-Sum. Given N distinct integers, how many triples sum to exactly zero?

Measuring the Running Time

```
public static void main(String[] args) {
  int[] a = In.readInts(args[0]);
  Stopwatch stopwatch = new Stopwatch();
  StdOut.println(ThreeSum.count(a));
  double time = stopwatch.elapsedTime();
}
```
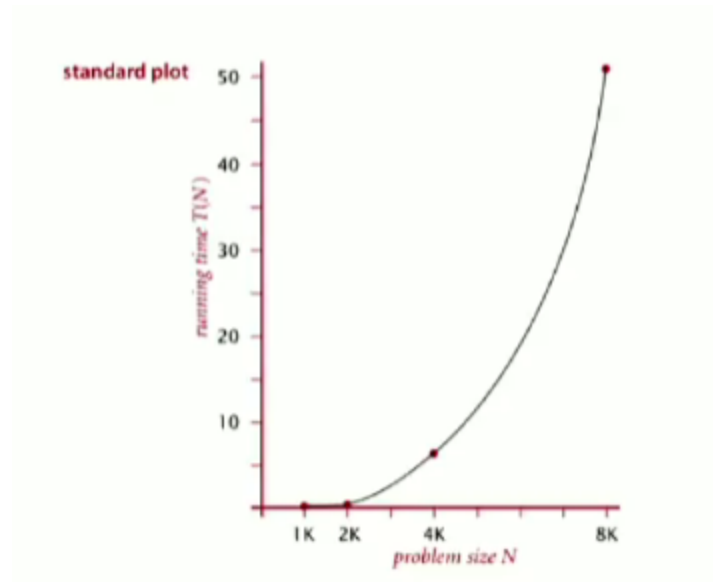
Empirical Analysis

Run the program for various input sizes and measure running time.

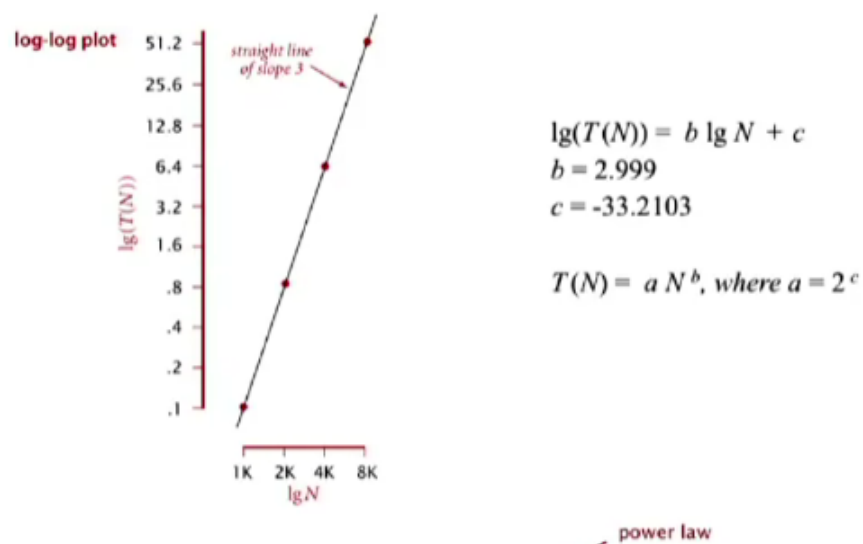| N	time (seconds) †
250	0.0
500	0.0
1,000	0.1
2,000	0.8
4,000	6.4
8,000	51.1
16,000	?

Data Analysis

Standard plot. Plot running T(N) vs. input size N.

standard plot 50

running time T(N)

40

30

20

10

1K 2K   4K   8K
problem size N

Log-log plot. Plot running time `T(N)` vs. input size `N` using log-log scale.

Regression. Fit straight line through data points : aN^b, where b is the slope of the line

log-log plot   51.2
                25.6   straight line of slope 3

                12.8

                6.4

lg(T(N))   3.2
                1.6

                .8

                .4

                .2

                .1

1K 2K 4K 8K
lg N

$\lg(T(N)) = b \lg N + c$
$b = 2.999$
$c = -33.2103$

$T(N) = a N^b$, where $a = 2^c$

power law

Double Hypothesis

Quick way to estimate b in a power-law relationship.

Run program, doubling the size of the input. Take the ratio of `T(2N) : T(N)`. The ratio will converge to a number, and the lg of that number will be b.