

COP 3502 10/16/23

Drives me nuts $3 \times 2^n \neq 6^n$

This is bad \rightarrow

$$2 \times 2^n = 2^{n+1}$$

$$4 \times 2^n = 2^2 \times 2^n = 2^{n+2}$$

} OK

Exams graded Thursday

\Rightarrow back in recitation

Fri \Rightarrow Grade estimate (formula + approx grade lines)

SORTING

- Bubble

M

- Insertion

- Selection

}
}
}

$O(n^2)$ sorts

W, F

- Merge

- Quick

}
}

$O(n \lg n)$ on avg.

Bubble Sort

8, 3, 2, 7, 5, 4, 6, 1

3 8 2 7 5 4 6 1

3 2 8 7 5 4 6 1

3 2 7 8 5 4 6 1

3 2 7 5 8 4 6 1

3 2 7 5 4 8 6 1

3 2 7 5 4 6 8 1

3 2 7 5 4 6 1 | 8 after 1 iteration

After one iteration largest item is in correct slot

2 3 5 4 6 1 7 8 after 2 iterations

2 3 4 5 1 6 7 8 = 3rd iter

2 3 4 1 5 6 7 8 = 4th iter

2 3 1 4 5 6 7 8 = 5th iter

2 1 3 4 5 6 7 8 = 6th iter

1 2 3 4 5 6 7 8 = 7th

Run-time

1st loop n-1 times

2nd loop n-2 times

...

n-3

...

1

$$\sum_{i=1}^{n-1} i = \frac{(n-1)n}{2} = O(n^2)$$

Insertion Sort

3, 7, 2, 9, 1, 4, 8, 5, 6

3 7 2 9, 1 4 8, 5, 6 after 1st iter

2 3 7 9 1 4 8, 5, 6 after 2nd iter

2 3 7 9 1 4 8 5 6 after 3rd iter

1 2 3 7 9 4 8 5 6 = 4th iter

1 2 3 4 7 9 8 5 6 = 5th iter

1 2 3 4 7 8 9 5 6 = 6th iter

1 2 3 4 5 7 8 9 6 = 7th iter

1 2 3 4 5 6 7 8 9 = 8th iter

OUTER LOOP - counts up

INNER LOOP - counts down

$$\text{WORST CASE } 1+2+3+\dots+(n-1) = \frac{(n-1)n}{2} = O(n^2)$$

$$\text{BEST CASE } 1+1+1+\dots+1 = O(n)$$

AVG CASE - on avg we'll swap $n/2$ elements

$$\frac{1}{2} + 1 + \frac{3}{2} + 2 + \frac{5}{2} + \dots + \frac{n-1}{2} = \frac{(n-1)n}{4} = O(n^2)$$

Selection Sort

3, 5, 1, 8, 2, 7, 6, 4

3 5 1 4 2 7, 6 8

3 5 1 4 2 6 7 8

3 5 1 4 2 6 7 8

3 2 1 4 5 6 7 8

3 2 1 4 5 6 7 8

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

① loop through

② find where largest item is

③ swap with last element

Outer loop: ^{COUNTS} DOWN

Inner loop: COUNT UP

↓
trade index w/max

loop structure is always same

$$n-1 + n-2 + n-3 + \dots + 1 = \frac{(n-1)(n)}{2} = O(n^2)$$