COP3502 10/14/23

1. Put up Study Group Guidelines
2. Test Out run time prediction
3. Examples to judging run-times of code segments
4. Start w/ recurrence relations

$O(n^2)$ $\quad n = 50{,}000 \quad t = 6$

100,000

150,000

$$T(n) = cn^2$$

$$T(50000) = c(50000)^2 = 6 \text{ sec}$$

$$c = \frac{6 \text{ sec}}{50000^2}$$

$$T(100{,}000) = \frac{6 \text{ sec}}{50000^2} \times (100000)^2$$

$$= 6 \text{ sec} \times \left(\frac{100000}{50000}\right)^2 = 24 \text{ sec} \left.\right]^{27}_{21}$$

$$T(150{,}000) = \frac{6 \text{ sec}}{50000} \times (150{,}000)^2 = 6 \text{ sec} \times \left(\frac{150000}{50000}\right)^2 = 54 \text{ sec}$$

$O(n\sqrt{n})$ $\quad n = 2 \times 10^6 \quad t = 6$

$$T(n) = cn\sqrt{n}$$

$$T(2 \times 10^6) = c \; 2 \times 10^6 \sqrt{2 \times 10^6} = 6 \text{ sec}$$

$$c = \frac{6 \text{ sec}}{2\sqrt{2} \times 10^9}$$

$\cancel{\text{to}}\ n = 5\times10^6$

$$T(5\times10^6) = \frac{6\text{ sec}}{2\sqrt{2}\ \cancel{\times10^9}} \times \overbrace{5\cancel{\times10^6}}^{n} \times \overbrace{\sqrt{5}\times\cancel{10^3}}^{\sqrt{n}}$$

$$= \frac{6\cdot5\sqrt{5}}{2\sqrt{2}} = \sim 22\text{ sec}$$

More Code Segment Analysis

```
int x=1
while (x<n)
    x=2*x;
```

```
int x=n
while (x>0) {
    printf("%d", x%2);
    x=x/2;
}
```

```
int low=0, high=n-1;
while (low < high) {
    int mid=(low+high)/2;
    if (      )
        low = mid+1;
    else if (      )
        high=mid-1;
    else
        return;
}
```

$2^k = n$

$k = \log_2 n \quad O(\lg n)$

$$\log_7 n = \frac{\log_2 n}{\log_2 7} = c\log_2 n$$

const

$\left.\begin{array}{l} O(\log_{b_1} n) \\ O(\log_{b_2} n) \end{array}\right\}$ Same

It's accurate to say an algorithm runs in $O(3n^2-7n)$ time, but it's unconventional because $O(n^2)$ describes the same thing.