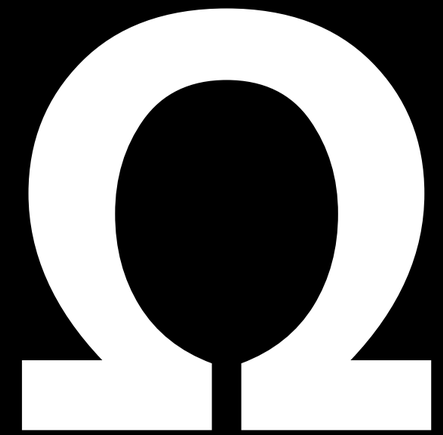
week 4

bubble sort

selection sort

insertion sort

o



$O(n^2)$

$O(n)$

$O(\log n)$

$O(1)$

$$\Omega(n^2)$$

$\Omega(n)$

$\Omega(1)$

$$\Omega(n \log n)$$

$O(n \log n)$

$\Theta(n \log n)$

merge sort

```
On input of n elements:
    If n < 2
        Return.
    Else:
        Sort left half of elements.
        Sort right half of elements.
        Merge sorted halves.
```

4 2 6 1 3 7 5 8

$$T(n) = 0, \text{ if } n < 2$$

$$T(n) = T(n/2) + T(n/2) + n, \text{ if } n > 1$$

$$T(16) = 2 \cdot T(8) + 16$$

$$T(16) = 2 \cdot T(8) + 16$$
$$T(8) = 2 \cdot T(4) + 8$$

$$
\begin{aligned}
T(16) &= 2 \cdot T(8) + 16 \\
T(8) &= 2 \cdot T(4) + 8 \\
T(4) &= 2 \cdot T(2) + 4
\end{aligned}
$$

$$
\begin{aligned}
T(16) &= 2 \cdot T(8) + 16 \\
T(8) &= 2 \cdot T(4) + 8 \\
T(4) &= 2 \cdot T(2) + 4 \\
T(2) &= 2 \cdot T(1) + 2
\end{aligned}
$$

$$
\begin{aligned}
T(16) &= 2 \cdot T(8) + 16 \\
T(8) &= 2 \cdot T(4) + 8 \\
T(4) &= 2 \cdot T(2) + 4 \\
T(2) &= 2 \cdot T(1) + 2 \\
T(1) &= 0
\end{aligned}
$$

$$
\begin{aligned}
T(16) &= 2 \cdot T(8) + 16 \\
T(8) &= 2 \cdot T(4) + 8 \\
T(4) &= 2 \cdot T(2) + 4 \\
T(2) &= 2 \cdot 0 + 2 \\
T(1) &= 0
\end{aligned}
$$

$$
\begin{aligned}
T(16) &= 2 \cdot T(8) + 16 \\
T(8) &= 2 \cdot T(4) + 8 \\
T(4) &= 2 \cdot 2 + 4 \\
T(2) &= 2 \cdot 0 + 2 \\
T(1) &= 0
\end{aligned}
$$

$$
\begin{aligned}
T(16) &= 2 \cdot T(8) + 16 \\
T(8) &= 2 \cdot 8 + 8 \\
T(4) &= 2 \cdot 2 + 4 \\
T(2) &= 2 \cdot 0 + 2 \\
T(1) &= 0
\end{aligned}
$$

$$
\begin{aligned}
T(16) &= 2 \cdot 24 + 16 \\
T(8) &= 2 \cdot 8 + 8 \\
T(4) &= 2 \cdot 2 + 4 \\
T(2) &= 2 \cdot 0 + 2 \\
T(1) &= 0
\end{aligned}
$$

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$16 \log 16$

$n \log n$

recursion

google.com/search?q=recursion

```
void swap(int a, int b)
{
    int tmp = a;
    a = b;
    b = tmp;
}
```

string

coupon codes

- by default, psets are due on Thu at 12pm
- if you start early, finishing part of pset by Wed at 12pm (and receive a coupon code), you can extend your deadline for rest of pset to Fri at 12pm
- coupon-code problem still required even if not completed by Wed at 12pm

25GB

to be continued...