$O(1)$

$O(\log n)$

$O(n)$

$O(n \log n)$

$O(n^2)$

$\vdots$

$O(\underline{\log}\, n) + O(\underline{n})$

$\nearrow$

$O(n)$

Prove n^2 is not $O(1)$

Try it. If n^2 was $O(1)$, that means I could find a C so that

$$n^2 \le C \cdot 1$$ (at least for $n \geq N$)

Can I find a C where

$$n^2 \le C \quad ?$$

No, because any C I pick will eventually be smaller than n^2 for some n big enough

---

Show that

$$10n^3 + 6n + 9 \text{ is } O(\underline{n}^3)$$

Find C so that

$$10n^3 + 6n + 9 \le C\underline{n}^3 \quad /n^3$$

$$/n^3$$

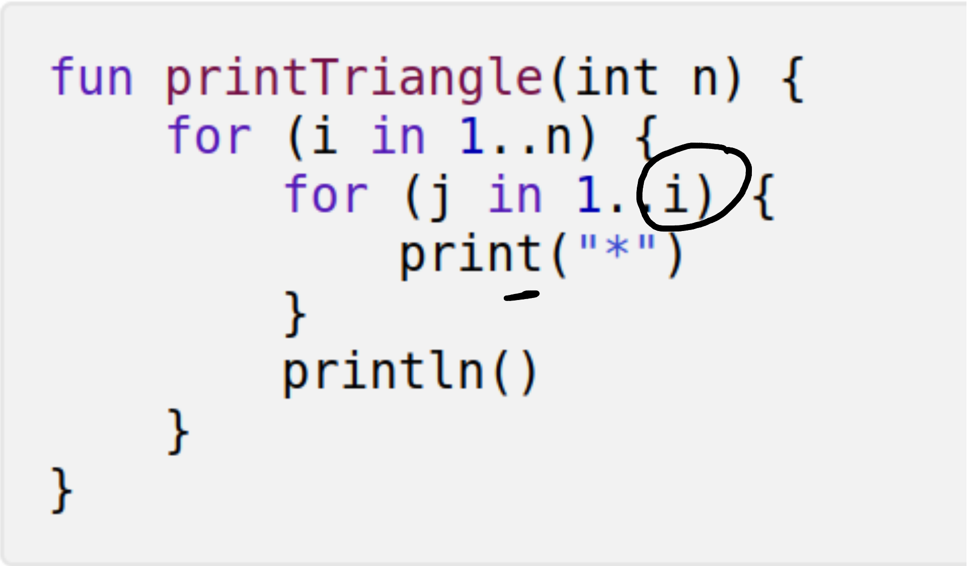
$$10 + \frac{6}{n^2} + \frac{9}{n^3} \le C$$

When = 1, the left side is

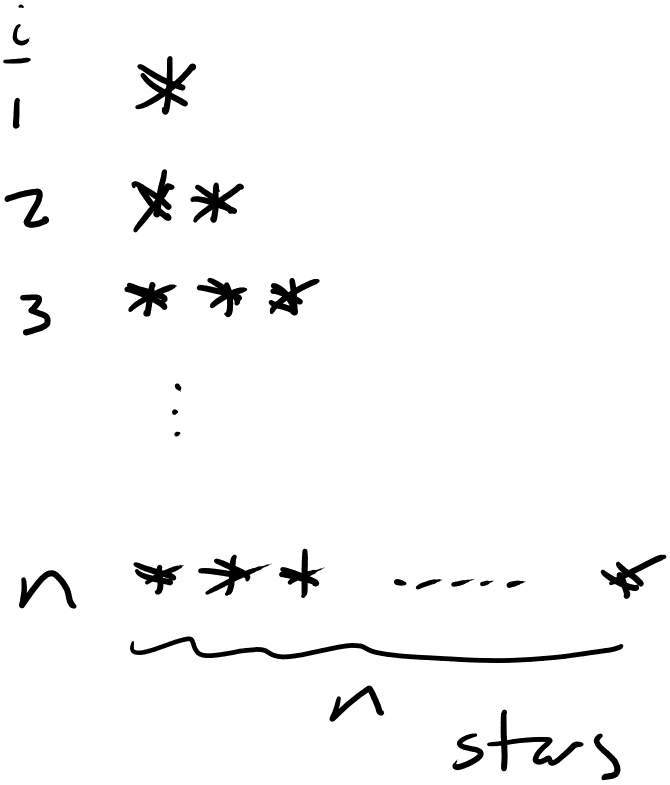
$$10 + \frac{6}{1^2} + \frac{9}{1^3} = 25$$

If N=3, ~~the~~ try n=3

~~$10 + \frac{6}{\ }$~~



```
fun printTriangle(int n) {
    for (i in 1..n) {
        for (j in 1..i) {
            print("*")
        }
        println()
    }
}
```



How many *s get printed?

How many times does the inner print happen?

$$\overset{n+1}{}$$

$$1 + 2 + 3 + \ldots\ldots + (n-2) + (n-1) + n$$

$$n+1$$

$$n+1$$

$$= \underbrace{(n+1)}_{\text{common sum}} \underbrace{\frac{n}{2}}_{\text{\# of pairs}}$$

$$= \frac{n^2}{2} + \frac{n}{2} \rightarrow O(n^2)$$

$$\overset{101}{}$$

$$1 + 2 + 3 + \text{---} + 98 + 99 + 100$$

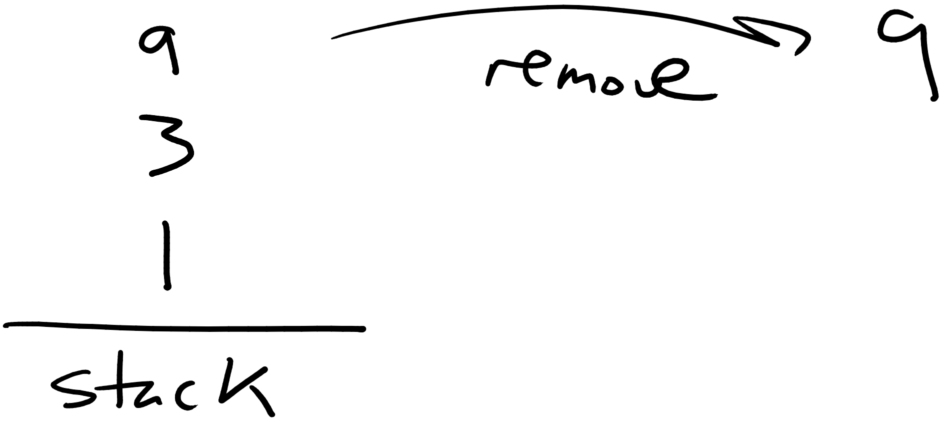
$$101$$

$$101$$

$$= 101(50)$$

$$\begin{array}{r} 101 \\ 50 \\ \hline \boxed{5050} \end{array}$$

Stacks



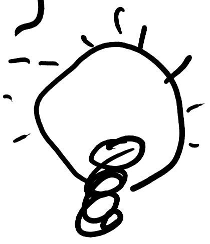
ADT ✓

Stack

- push - add onto stack
- pop - remove from stack
- peek - look at what is on top
- isEmpty - true/false

A stack is an example of an Abstract Data Type (ADT)

↳ a description of a way of storing and manipulating data, but w/o the details of



how you implement it

There are lots of ways to implement a stack.

1. List
2. Linked List (coming)
3. Array

Two most common approaches I would try in Kotlin

↑ less helpful but it's a nice example

Today. I am going to code a Stack w/ an array

In Kotlin, an array is a lot like a list, but its size is fixed. Can't be changed. (So if array fills, you need to make a new bigger array and copy everything from the old array in.)

- inside, all lists really use arrays (Python, Kotlin, ...)