Section 4.3: Logarithmic Growth

Thursday, February 13, 2020 2:17 PM

suppose you need to find the position of a particular entry in an ordered list

[12, 13, 27, 35, 52, 71, 89]

where is 52?

method #1: start at the left and look at each entry in order until you get to the entry of interest

→ this method is $O(n)$

method #2: look at entry in the middle of the list. If it's the entry of interest, stop! If it's not, is the entry to the left or the right of the middle one?

If to the left, then look at the entry halfway through that part of the list, and repeat.

[12, 13, 27, 35, 52, 71, 89] where is 52?

↑ is 52 = 35? no!

is 52 > 35 yes

[52, 71, 89]

is 52 = 71? no!

52 > 71? no

[52]

is 52 = 52? yes! STOP

for method #2, if your list has one million entries, you need a maximum of 20 searches

→ essentially, you are solving

$$2^n = 1000\,000$$

this requires a new function called a logarithm

$$2^n = 1\,000\,000$$

$$n = \log_2 1000\,000$$

on a calculator,

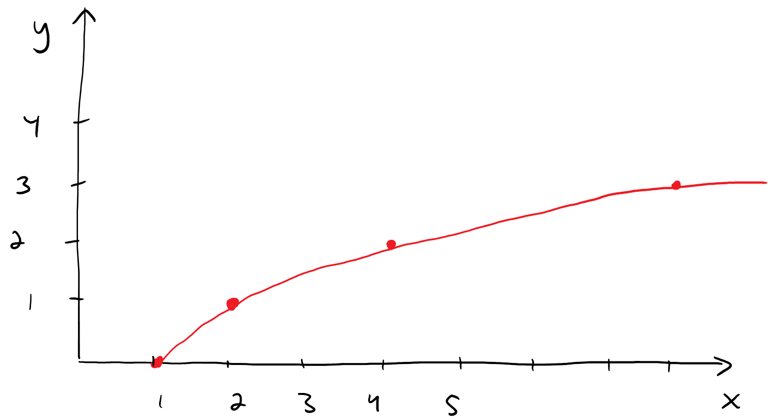
if no base, default is base 10

$$n = \frac{\log 1000\,000}{\log 2}$$

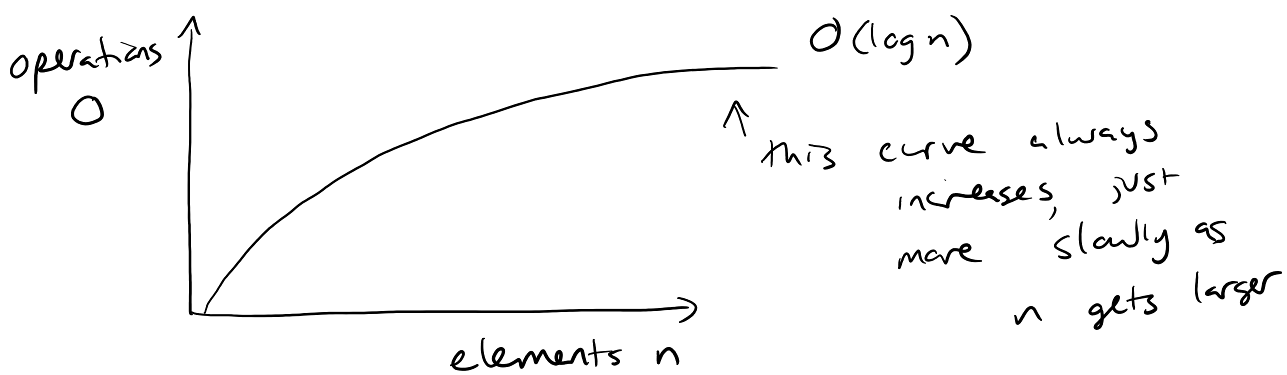
method #2 is called a binary search and has $O(\log n)$

so what does the shape of the graph look like?

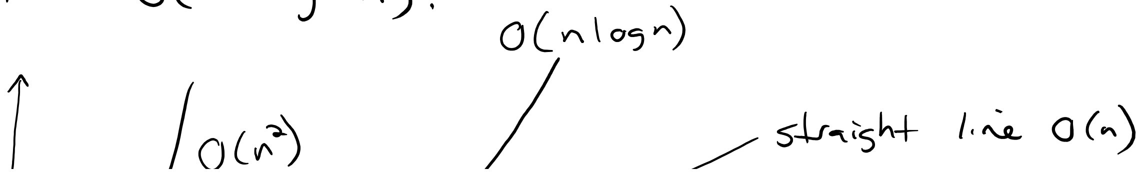
x	$y = \log_2 x$
1	0
2	1
4	2
8	3

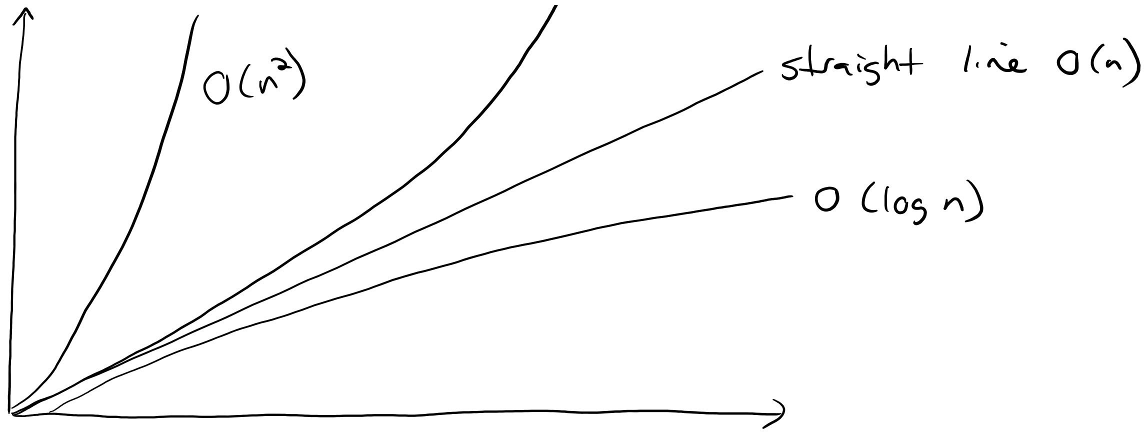


what you need to know for this course:



what about $O(n \log n)$?




O(n²)
straight line O(n)
O (log n)