

Logarithms and Search

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1 Logarithms

What are logarithms? If you understand exponents, then these equations help you understand what a logarithm is by relating these two equations.

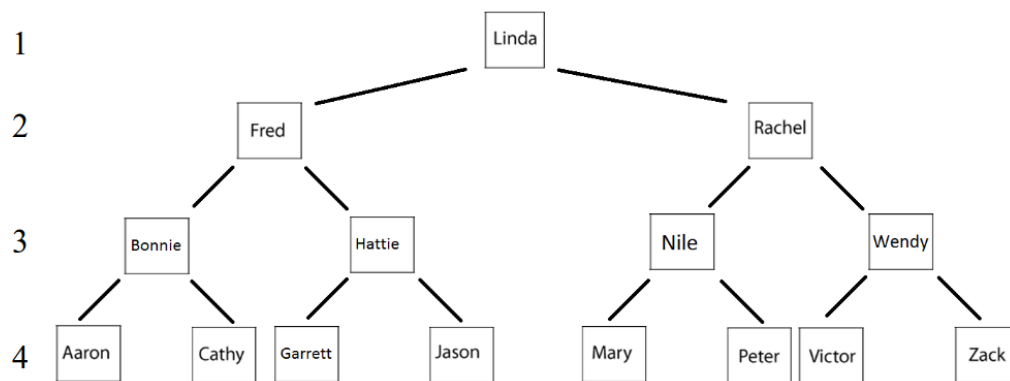
$$b^x = y \quad (1)$$

$$\log_b y = x \quad (2)$$

If you spend some time with it, you'll see that a logarithm “undoes” what an exponent does to a function. Today, we'll talk about an idea every computer scientist knows and show you that you can use it to understand logarithms better.

2 Search

Search Time



$$height = \log_2(n)$$

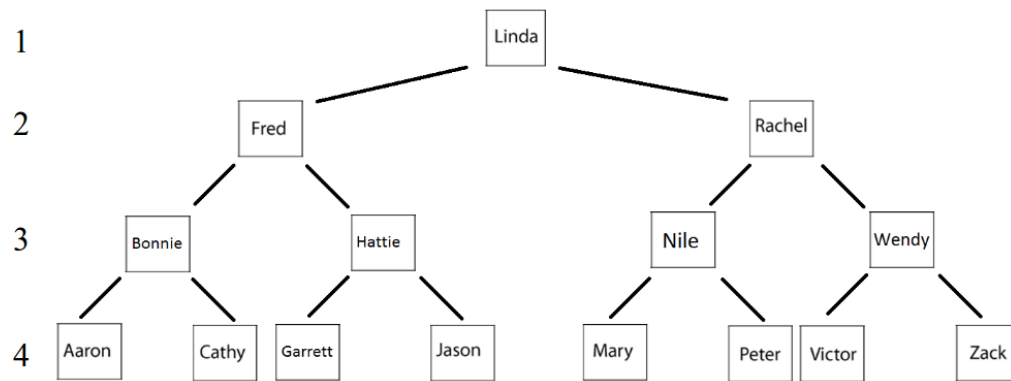
2 (base) = number of halves

height = checks it will take to search

n = the number of names.

Figure 1: Logs

Search Time



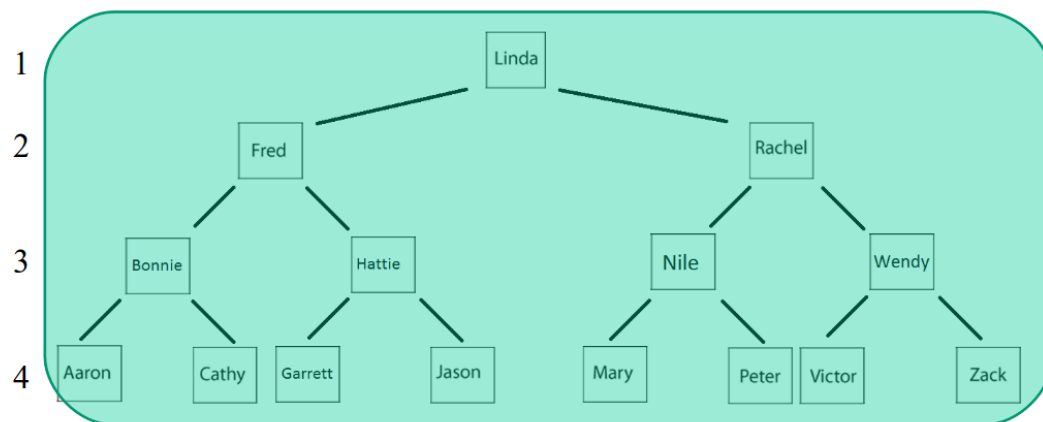
15 names (n)

Height (h) of 4

How is height (search time) related to # of names?

Figure 2: Logs

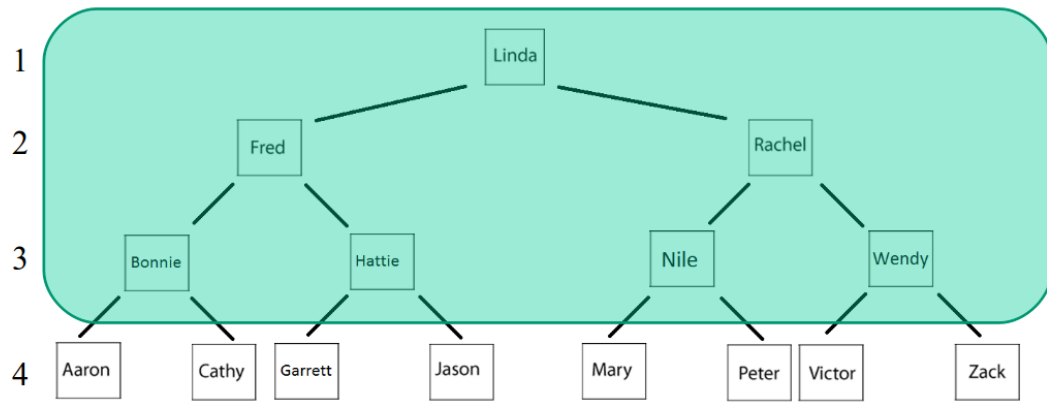
Binary Trees



$$2^4 - 1 = 15$$

Figure 3: Logs

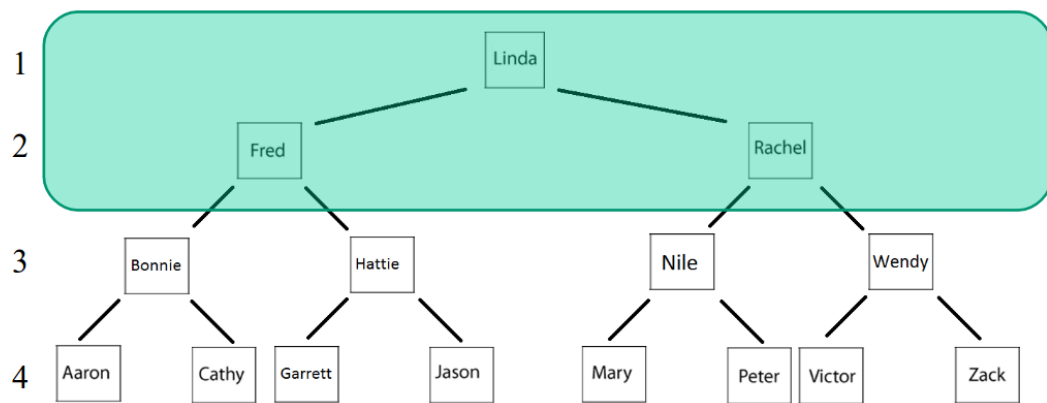
Binary Trees



$$2^3 - 1 = 7$$

Figure 4: Logs

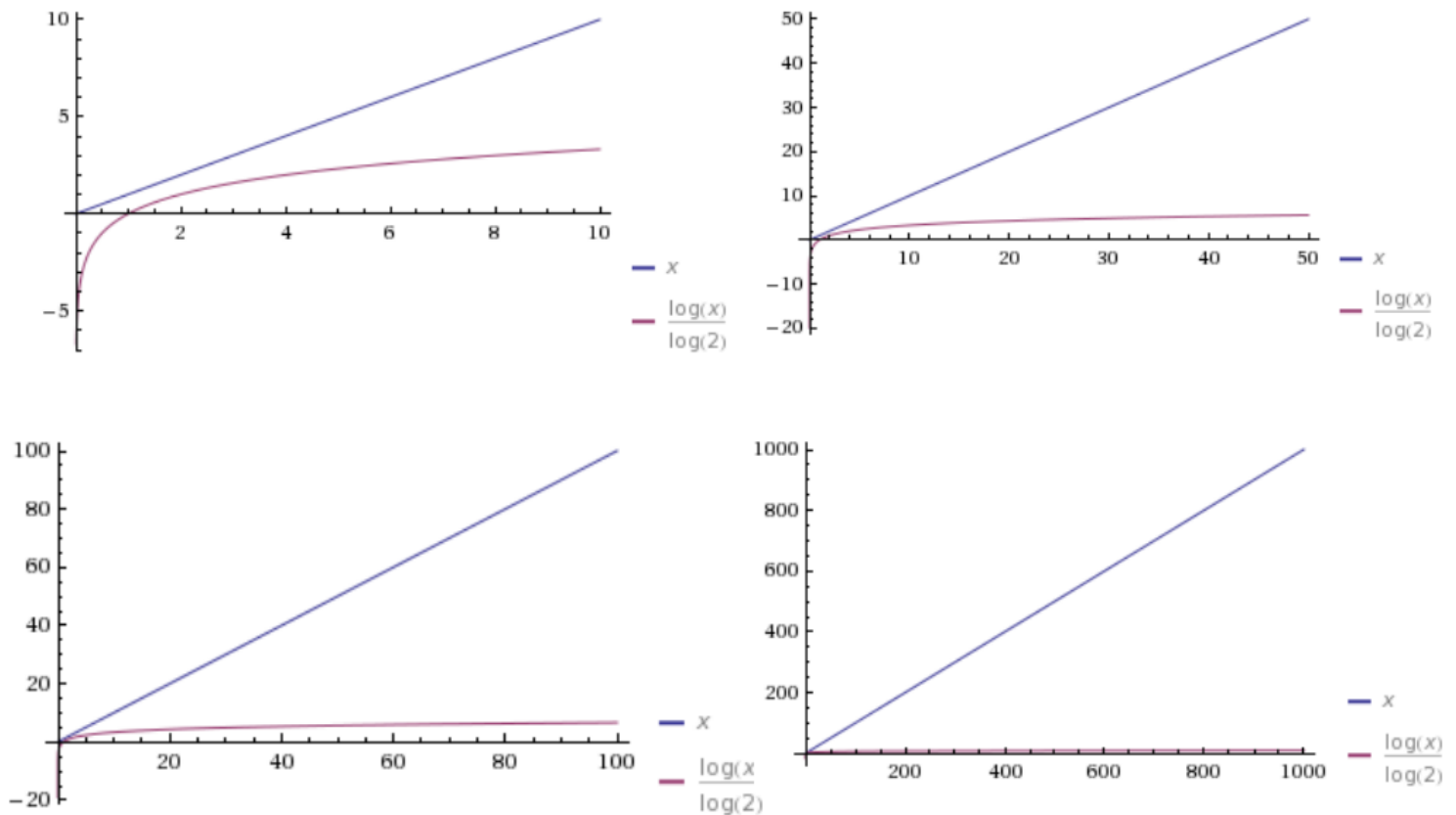
Binary Trees



$$2^2 - 1 = 3$$

Figure 5: Logs

Comparing Linear and Binary Searches



$y = \text{time}$
 $x = \text{number of names}$

Figure 6: Logs