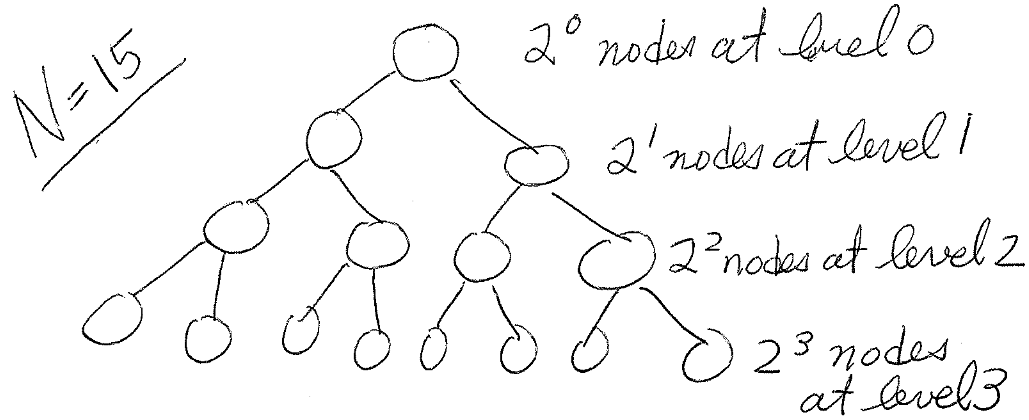
# Binary Tree (Perfect Triangle)




B = 3

$2^k$ nodes at level k.

$$N = \text{total \# of nodes} = \sum_{k=0}^{B} 2^k = 2^{(B+1)} - 1$$

For the above example $2^{(3+1)} - 1 = 15$

How many levels? B+1

$$2^{(B+1)} - 1 = N$$

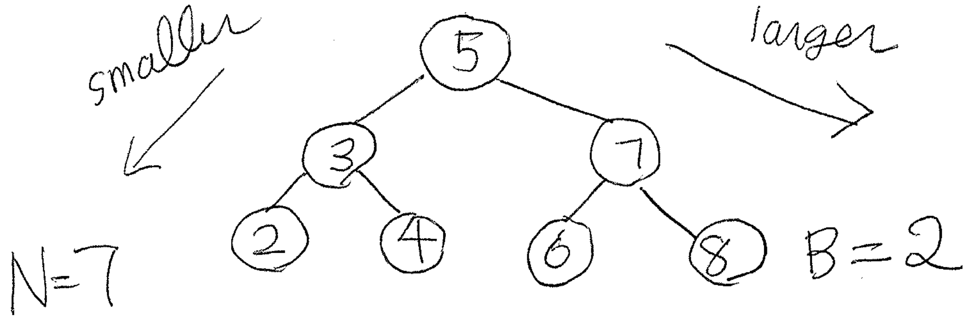
$$2^{(B+1)} = N+1$$

$$\boxed{B+1 = \log_2 (N+1) \text{ levels}}$$

= # comparisons

(2)

# Binary Decision Tree

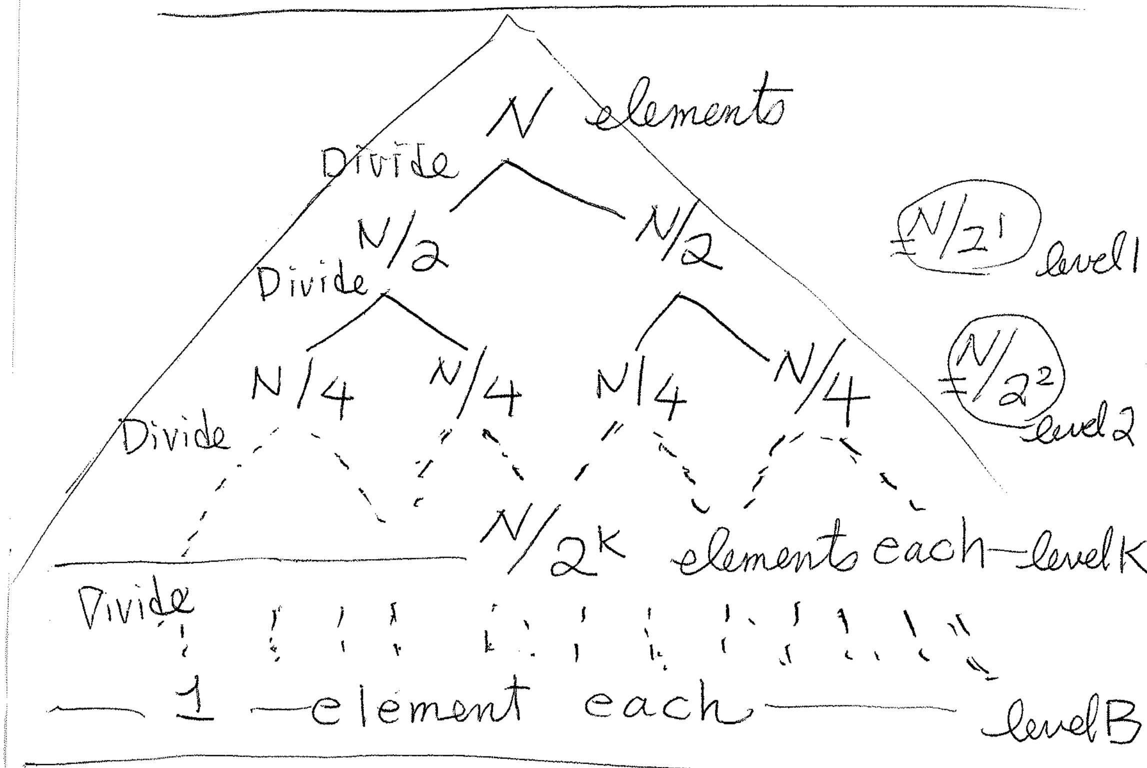



To look for 2, 3 comparisons
To look for 6, 3 comparisons
To look for 5, 1 comparison
To look for 10, 3 comparisons & off the tree

$$\boxed{B+1 = \log_2 (N+1)}$$
$$= \log_2 8 = 3$$
= max number of comparisons

The best possible way to search through an ordered list.

③ Recursion Tree




$N/2^B = 1$

At level B $\quad N/2^B = 1$ element each

$$N = 2^B$$

$$\boxed{B = \log_2 N}$$

@ If $N=8$, $B=3$.

$\Rightarrow$ 4 levels in the tree $(B+1)$

$\Rightarrow$ List was divided in halves via 3 levels $(B)$ of recursion.

@ If $N=1024$, $B=10$. 11 levels in the tree

Draw a 3-nary tree & indicate # of nodes per level

How many paths? = # leaves