# Computer Science & IT

## ALGORITHMS

**Algorithms**

**Lecture No. 05**

By- Ravindra Sir

# Recap of Previous Lecture

Topic TC & SC

Topic

Topic

# Topics to be Covered

Topic — RT method

Topic

Topic

# Inspiring Stories : Girish Badragond

***Background:*** A farmer from rural Karnataka. Wanted to help visually impaired people work the land.

***Education:*** B. Tech. from a local college.

***Achievements:*** Created the Blind Farming Technology, a tool with sensors that tells you soil moisture, nutrition, and temperature via audio.

***Impact:*** Lets blind farmers grow crops confidently, bringing dignity and independence back to their fields.

# Inspiring Stories : Ashok Gorre

***Background:*** From a poor farming family in Telangana, saw how hard planting and weeding was.

***Achievements:*** Built simple, low-cost tools for sowing, reaping, and weeding. Co-founded Rural Rise Agrinery to scale his tools.

***Impact:*** Helped small farmers save labor and time, making farming easier and cheaper.

# Inspiring Stories : Pradeep Kumar

***Background:*** A farmer in Haryana worried about his solar panels being stolen.

***Education:*** Local farmer, hands-on inventor.

***Achievements:*** Invented a mobile solar panel trolley, so panels can be moved and stored safely. Offers free servicing for a year through his startup TG Solar Pumps.

***Impact:*** Makes solar energy safer and easier for poor farmers, lowering their risk and maintenance burden.

$$T(n) = \begin{cases} 1 \; ; n=1 \\ T(n/2) + T(n/2) + n \end{cases}$$

Problem of Size n

Problem of Size n/2

Problem of Size n/2

Time taken for dividing

let us assume k levels

$T(n) = n$

$T(n/2) = n/2$ $\quad$ $T(n/2) = n/2$ —— $n$

$T(n/4) = n/4$ $\quad$ $T(n/4) = n/4$ $\quad$ $T(n/4) = n/4$ $\quad$ $T(n/4) = n/4$ —— $n$

$T(n/2^k)$

$n/2^k = 1 \Rightarrow k = \log n$

$TC = O(n \log n)$

$= \Omega(n \log n)$

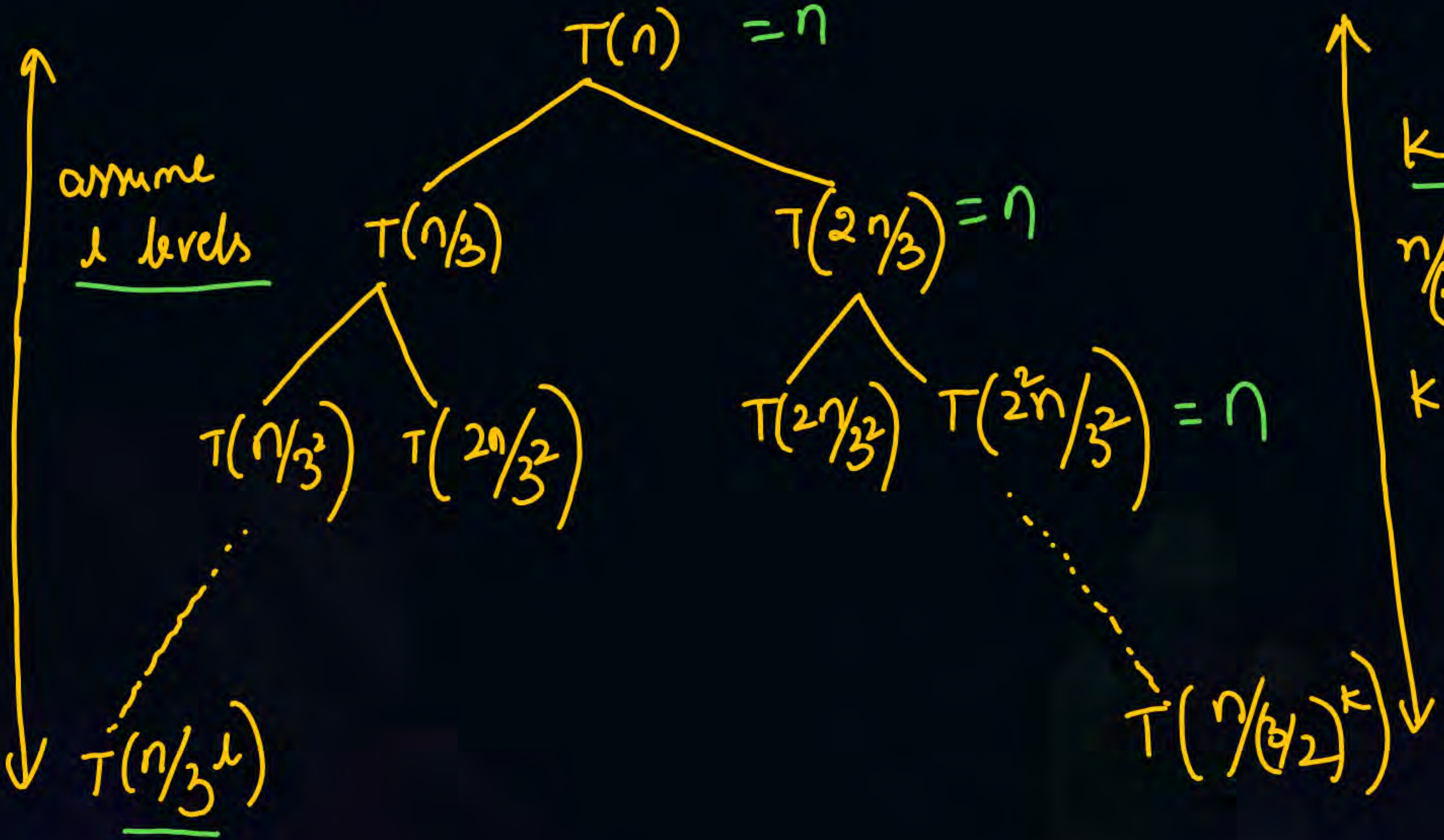
$= \Theta(n \log n)$

$SC = O(\log n)$ ✗

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ T(n/3) + T(2n/3) + n & \text{if } n > 1 \end{cases}$$

$n/3^l = 1$

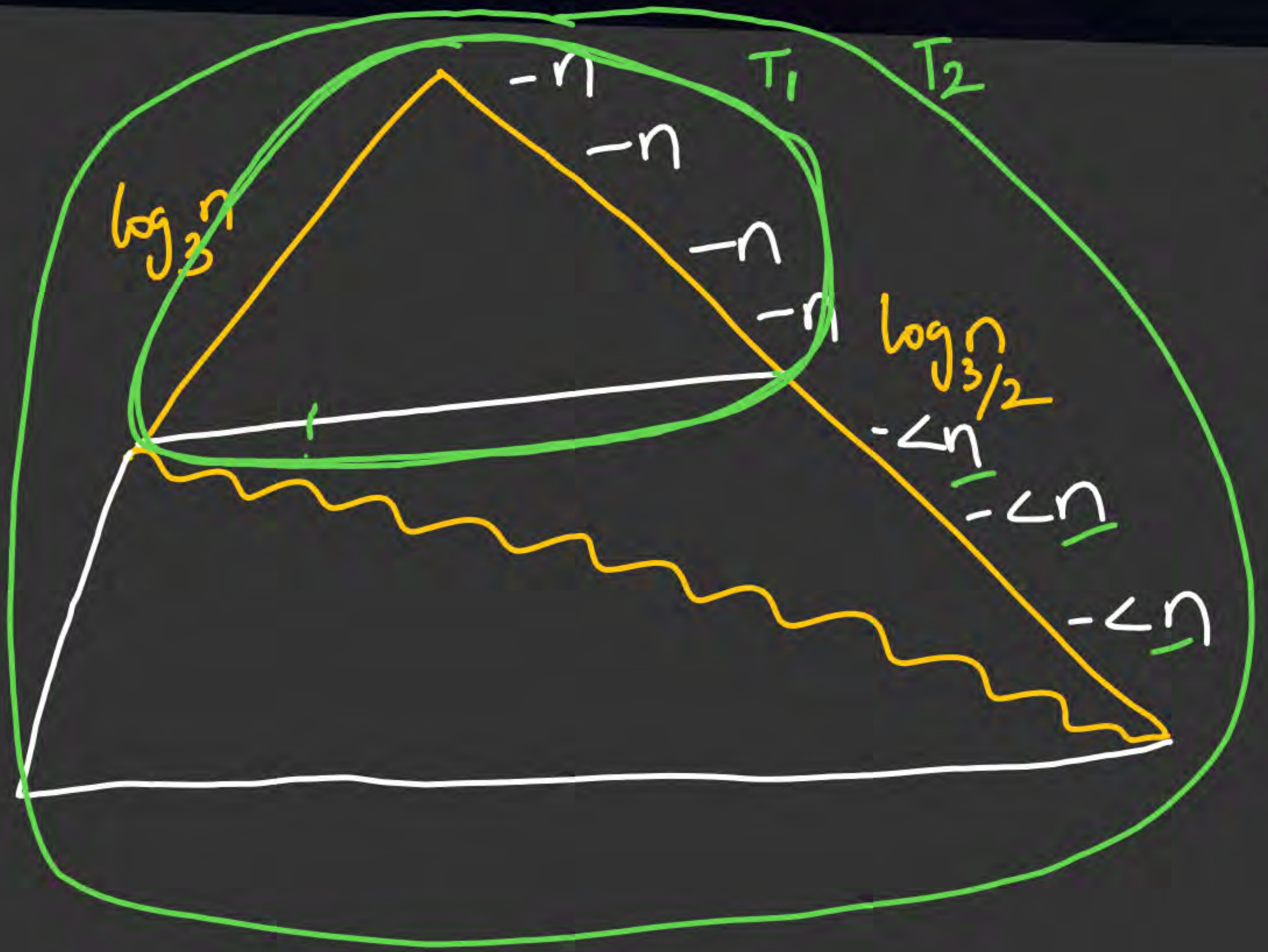
$\underline{l = \log_3 n}$




$\underline{k \text{ levels}}$

$n/(3/2)^k = 1$

$k = \log_{3/2} n$




$$T(n) \geq n\log_3 n = \Omega(n\log_3 n)$$

$$T(n) \leq n\log_{3/2} n = O(n\log_{3/2} n)$$

$$T_1 \leq T(n) \leq T_2$$

$$n\log_3 n \leq T(n) \leq n\log_{3/2} n$$

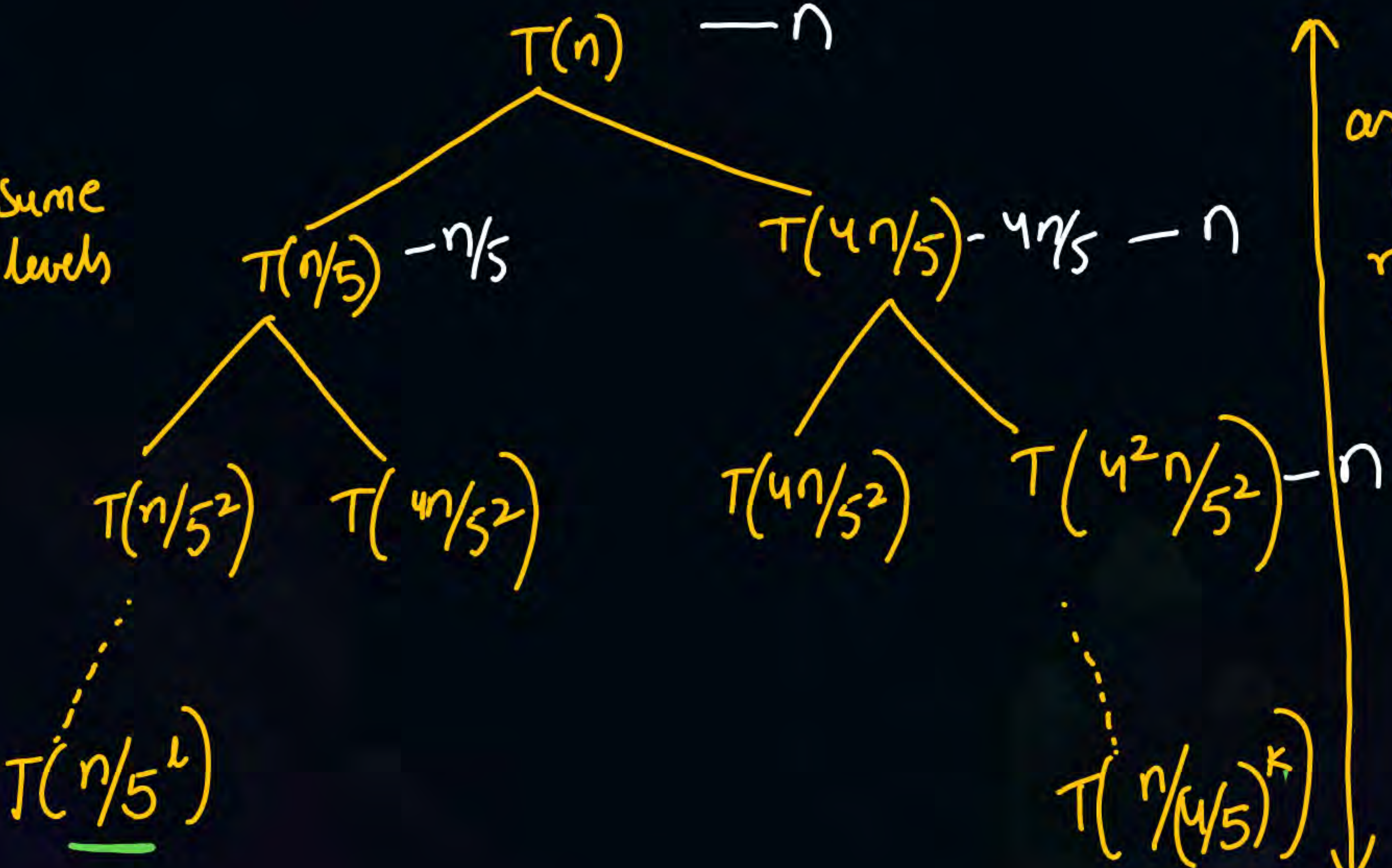
$$T(n) = \Theta(n\log n)$$

$$T(n) = \begin{cases} 1 & ; n=1 \\ T(n/5) + T(4n/5) & ; n>1 \end{cases}$$

$$\frac{n}{5^l} = 1$$

$$l = \log_5 n$$

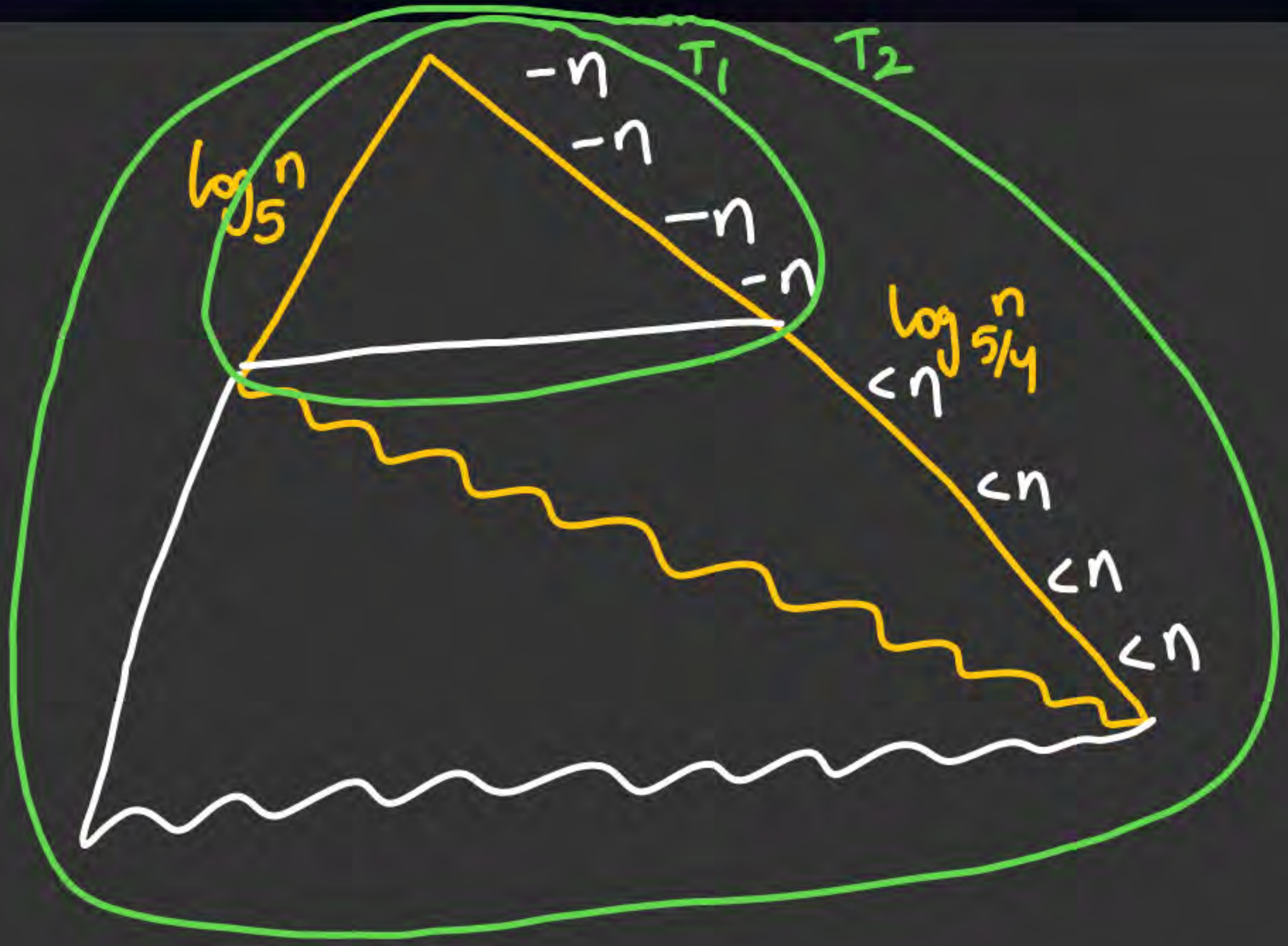
assume
$l$ levels




assume
k levels

$$n/(4/5)^k = 1$$

$$k = \log_{4/5} n$$




$$T_1 \le T(n) \le T_2$$

$$n\log_5 n \le T(n) \le n\log_{5/4} n$$

$$T(n) = O(n\log_{5/4} n)$$

$$T(n) = \Omega(n\log_5 n)$$

$$T(n) = \Theta(n\log n)$$

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ T(n/10) + T(9n/10) + n & \text{if } n > 1 \end{cases}$$


$$T(n) = O(n \log_{10/9} n)$$

$$T(n) = \Omega(n \log_{10} n)$$

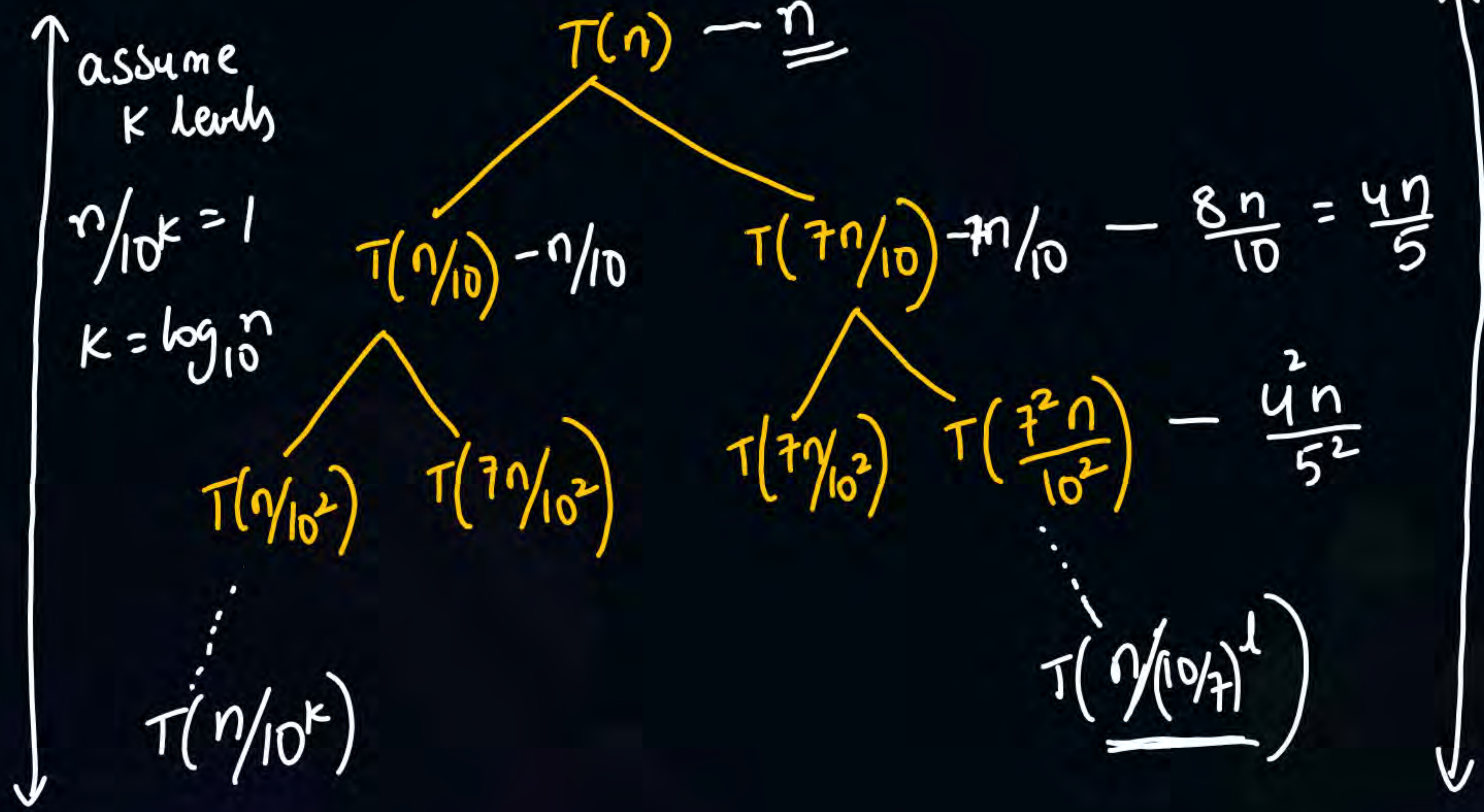
$$T(n) = \Theta(n \log n)$$

$$T(n) = \begin{cases} 1 & \text{if } n=1 \\ T(n/10) + T(7n/10) + n & \text{if } n>1 \end{cases}$$

assume $k$ levels

$n/10^k = 1$

$k = \log_{10} n$




assume $l$ levels

$n/(10/7)^l = 1$

$\Rightarrow l = \log_{10/7} n$


$$T(n) \leq (4/5)^0 n + (4/5)^1 n + \cdots\cdots + (4/5)^{\log_{10/7} n} n$$

$$\leq n\left((4/5)^0 + (4/5)^1 + \cdots\cdots + (4/5)^{\log_{10/7} n}\right)$$

$$\leq n\left(\frac{1-(4/5)^{\log_{10/7} n + 1}}{1-(4/5)}\right) \text{ as } n \to \infty = O(n)$$

$$T(n) \geq (4/5)^0 n + (4/5)^1 n + \cdots + (4/5)^{\log_{10} n}$$

$$\geq n\left((4/5)^0 + (4/5)^1 + \cdots\cdots + (4/5)^{\log_{10} n}\right)$$

$$\geq n\left(\frac{1\left(1-(4/5)^{\log_{10} n + 1}\right)}{1-4/5}\right) \text{ as } n \to \infty = \Omega(n)$$

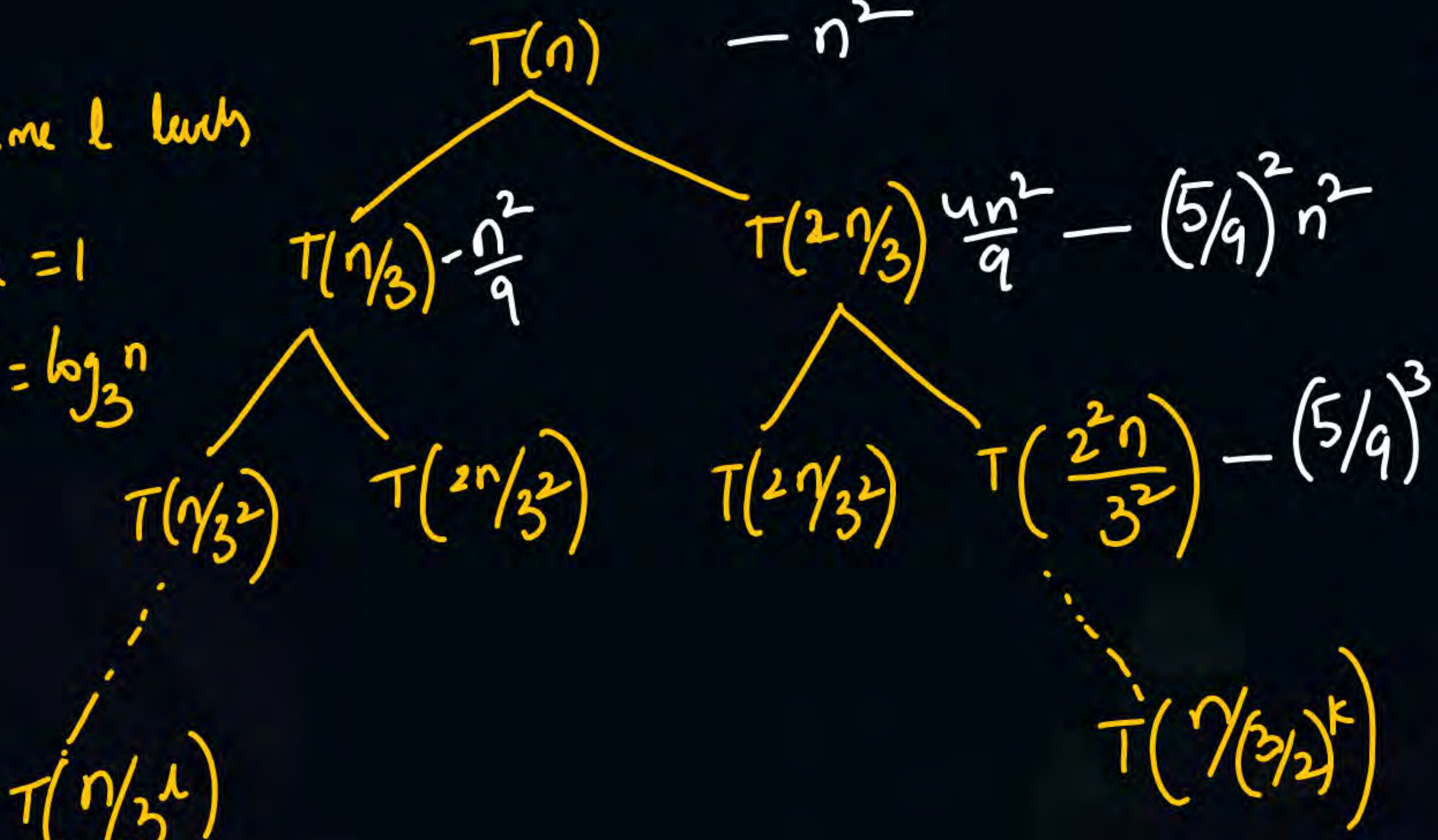
$$\Theta(n)$$

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ T(n/3) + T(2n/3) + n^2 & \text{if } n > 1 \end{cases}$$

assume $l$ levels

$n/3^l = 1$

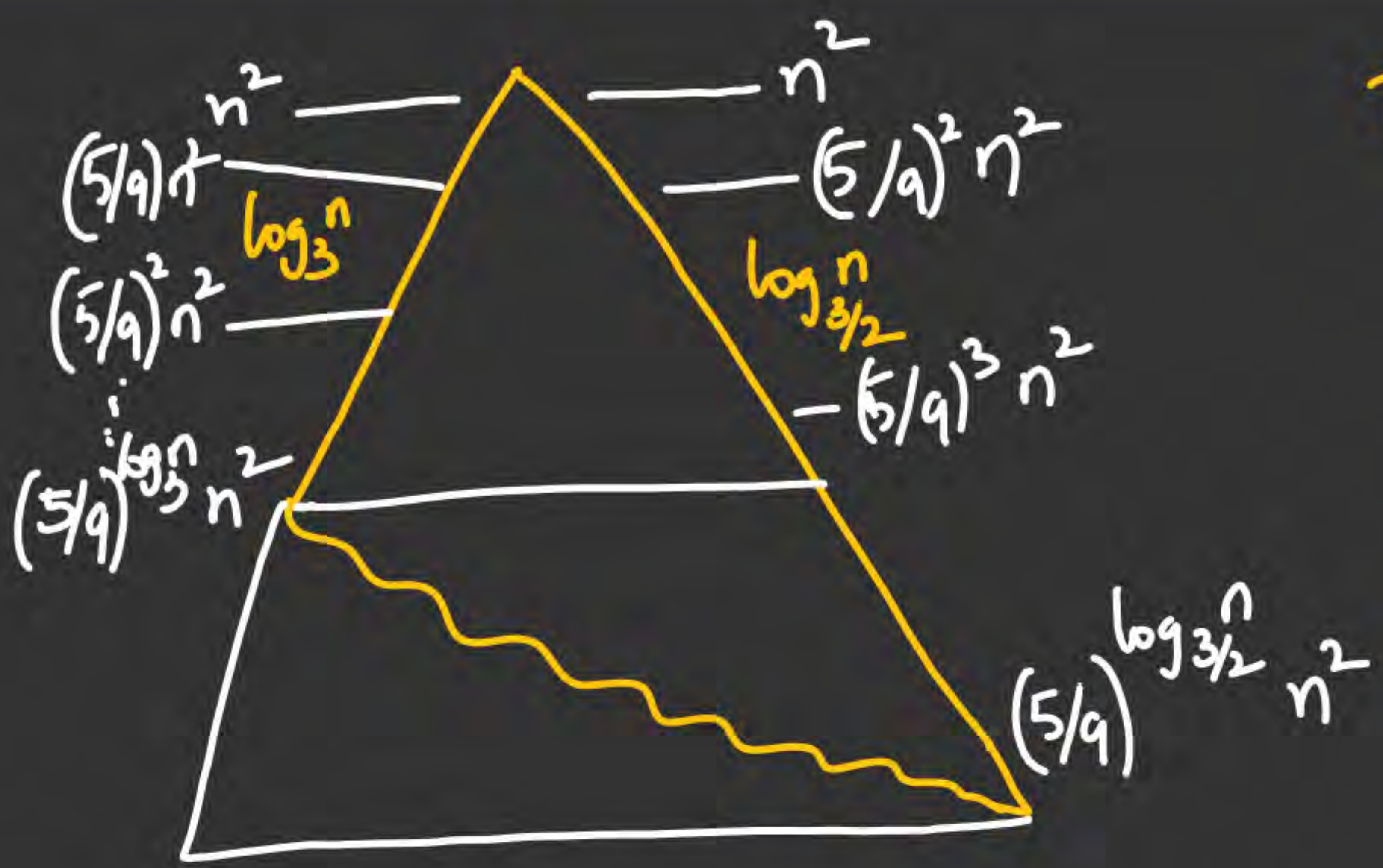
$\Rightarrow l = \log_3 n$




assume $k$ levels

$n/(3/2)^k = 1$

$k = \log_{3/2} n$




$$T(n) \le n^2\left(\left(5/9\right)^0 + \left(5/9\right)^1 + \cdots + \left(5/9\right)^{\log_{3/2} n}\right)$$

$$\le n^2\left(\frac{1\left(1-\left(5/9\right)^{\log_{3/2} n + 1}\right)}{1-5/9}\right) \quad 0$$

$$= O(n^2)$$

$$T(n) \ge n^2 \cdot \left(\left(5/9\right)^0 + \left(5/9\right)^1 + \cdots + \left(5/9\right)^{\log_3 n}\right)$$

$$\ge n^2\left(\frac{1\left(1-\left(5/9\right)^{\log_3 n + 1}\right)}{1-5/9}\right)$$

$$= \Omega(n^2)$$

$$\Theta(n^2)$$

$$T(n) = \begin{cases} 1 & \text{if } n=1 \\ T(n-1)+T(n-2)+T(n-3)+\underline{c} & \text{if } n>1 \end{cases}$$

assume K levels

$n-K=1$

$\Rightarrow K=n-1$

$T(n)$ — $c$

$T(n-1)$ $T(n-2)$ $T(n-3)$ — $3c$

— $9c$

$O(3^n)$

$T(n-K)$

— $3^K c$

$$T(n) \le 3^0 c + 3^1 c + 3^2 c + \cdots + 3^{n-1} c$$

$$\le c\left(1 + 3^1 + 3^2 + \cdots + 3^{n-1}\right)$$

$$\le c\left(\frac{1(3^n - 1)}{3-1}\right) = O(3^n) \checkmark$$

THANK - YOU