Trees Problem Solving 1

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Problem 1

Kuro and Walking Route:
https://codeforces.com/contest/979/problem/C

Main Idea

- Consider the node **y** as the root of the tree.
- Now all the paths that start from the subtree of node **x** (including **x**) and do not end at any ancestor of **x** (except **y**) are not safe.
- Subtract all these paths from the value **n * (n - 1)**.
- This will give you the final answer.

$(n) \times (n-1)$

$(u, v) \rightarrow u != v$

$(n) \times (n-1)$

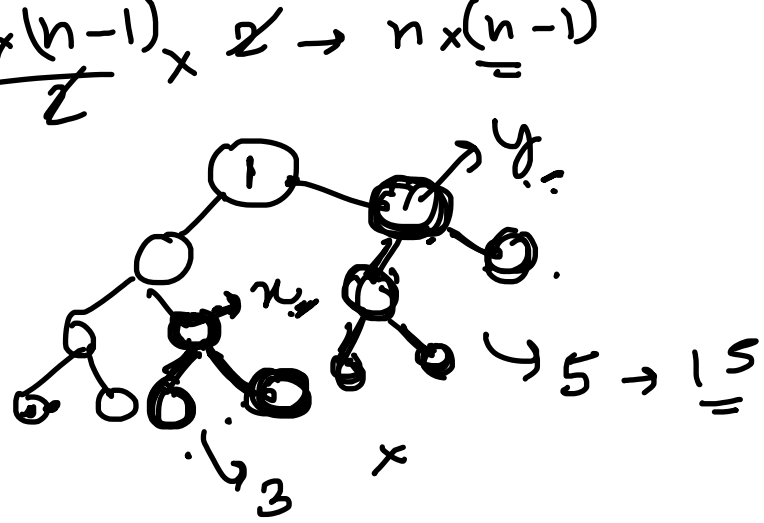
$(u, v) \rightarrow \boxed{n_{C_2}} \times 2$

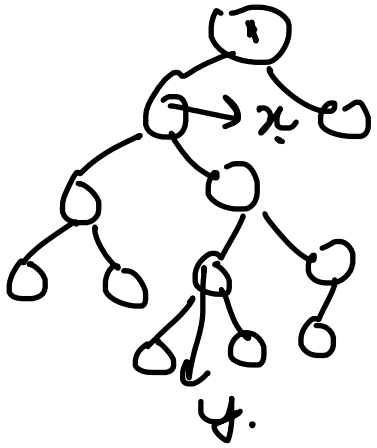
(v, u)

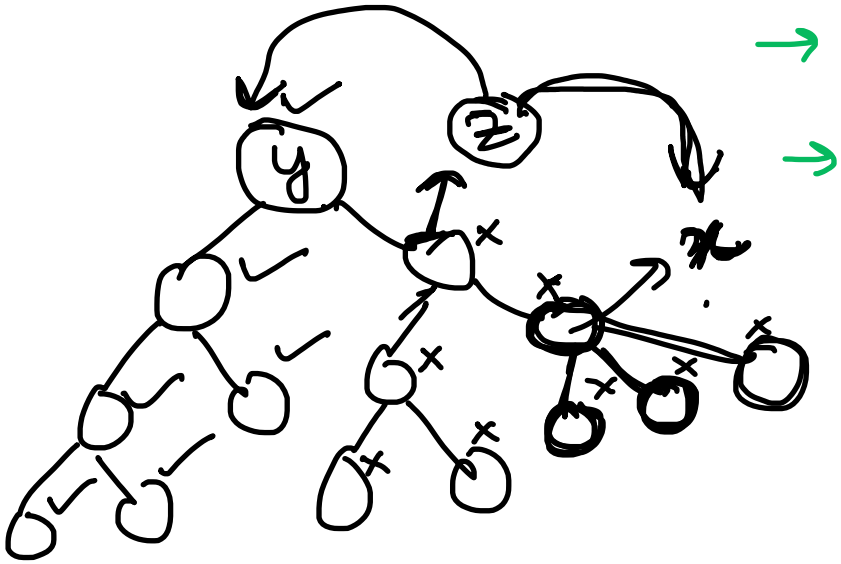
$\frac{n \times (n-1)}{2} \times 2 \rightarrow n \times (n-1)$

(x, y)

(u, v)





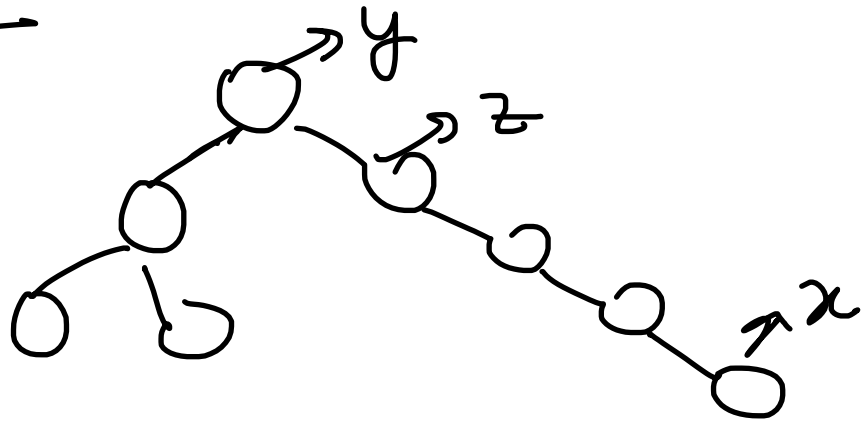


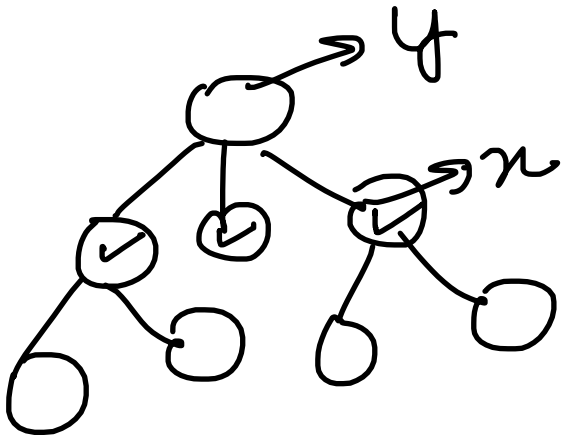
→ z is direct child of y.

→ z is an ancestor of x.

z, x

$sub[x] \times (n - sub[z])$



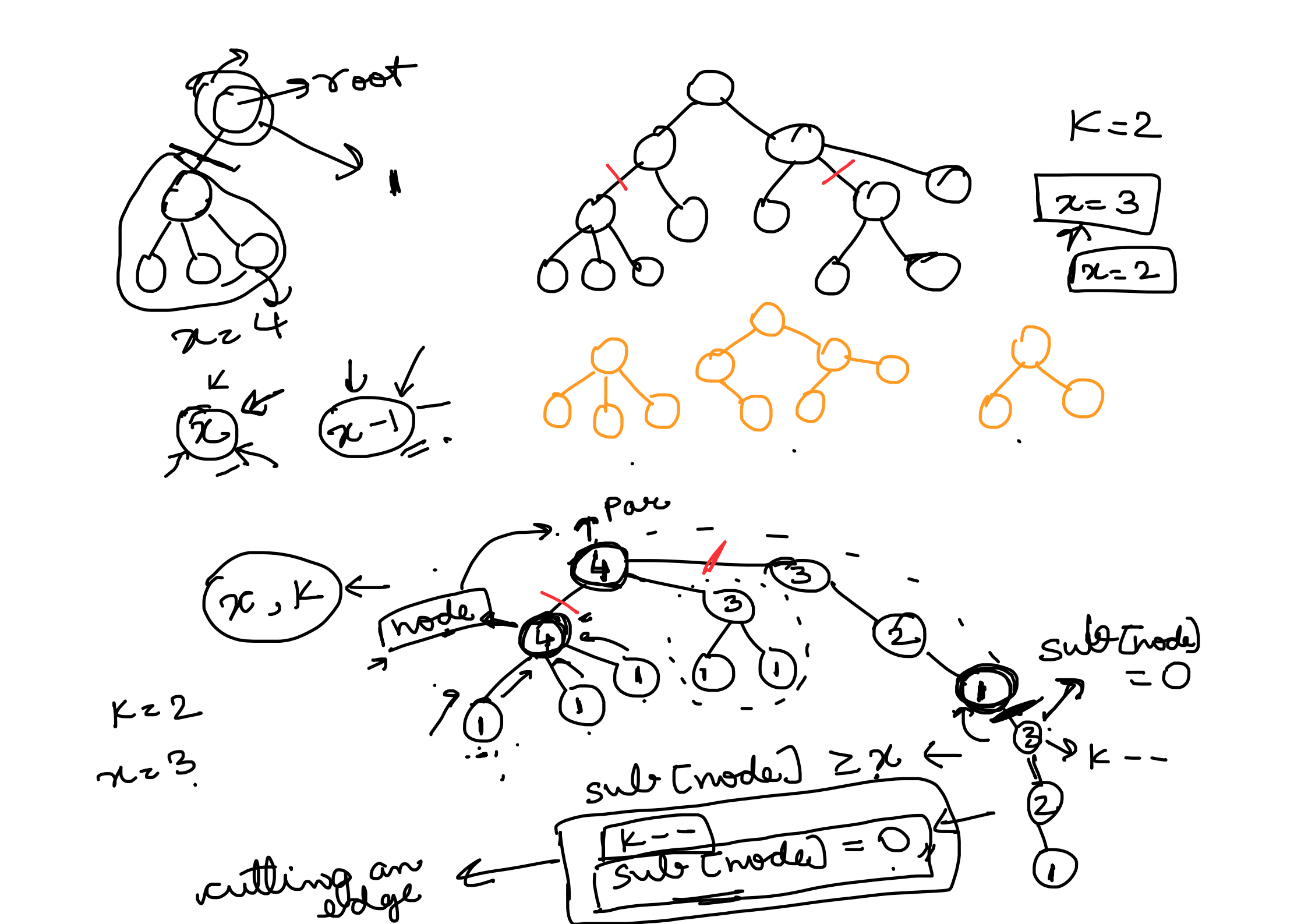


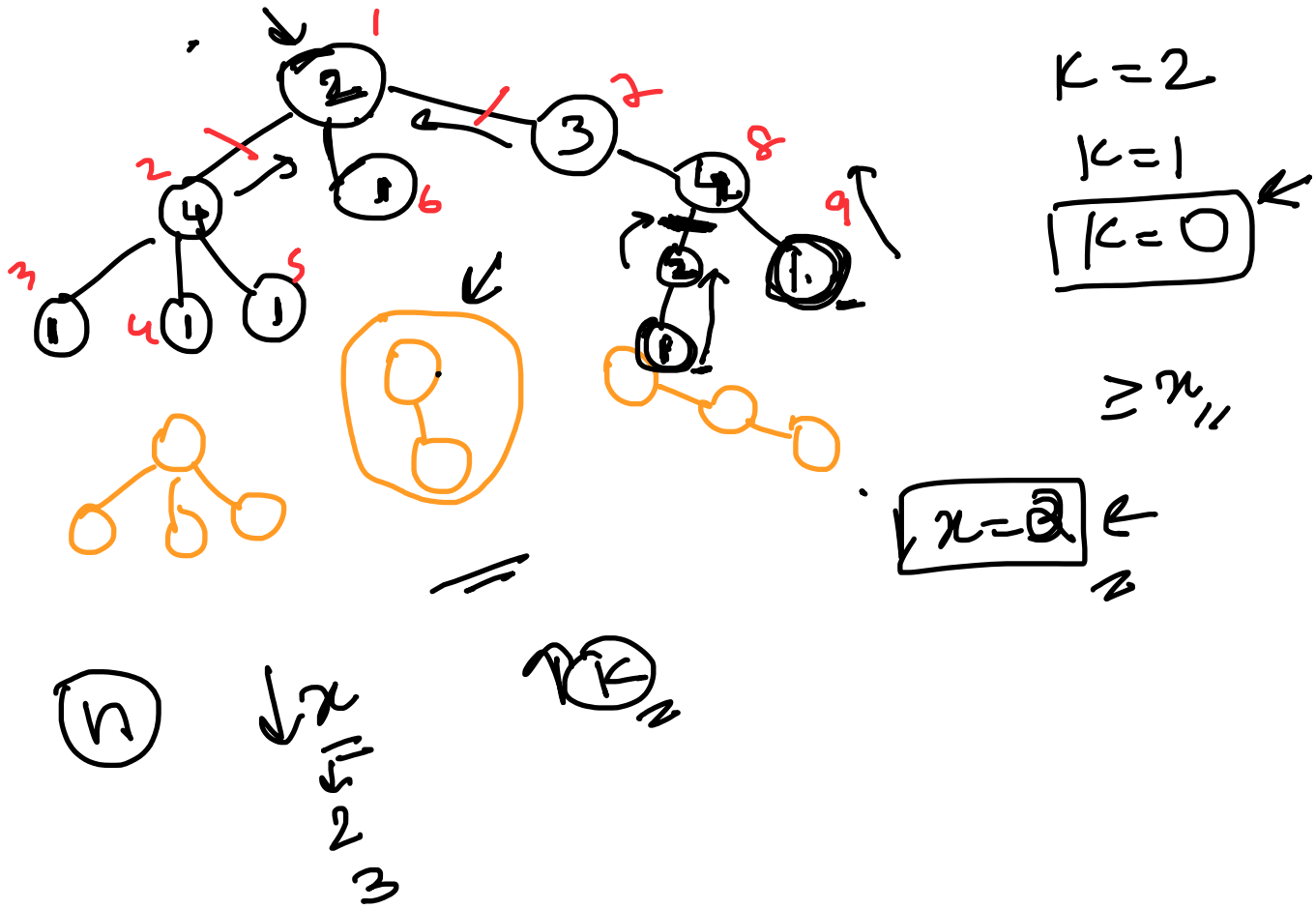
Problem 2

Tree Cutting:
https://codeforces.com/problemset/problem/1946/C

Main Idea

- We will binary search over the value of **x**.
- For a given value of **x**, take an arbitrary root node and start calculating the subtree sizes of the nodes from leaf nodes to root.
- At any point of time, if the subtree size of a node is greater than the given **x**, then we can remove the edge from the given node to its parent.
- Just be careful about the calculations for root node.


root
x = 4
K
x
x-1
K=2
x=3
x=2
Par
(x, K)
node
4
3
2
1
sub[node]
= 0
K--
sub[node] ≥ x
K--
sub[node] = 0
cutting an edge
K=2
x=3


1
2
3
2
6
7
8
9
3
4
5
K=2
K=1
K=0
≥ x
x=2

Problem 3

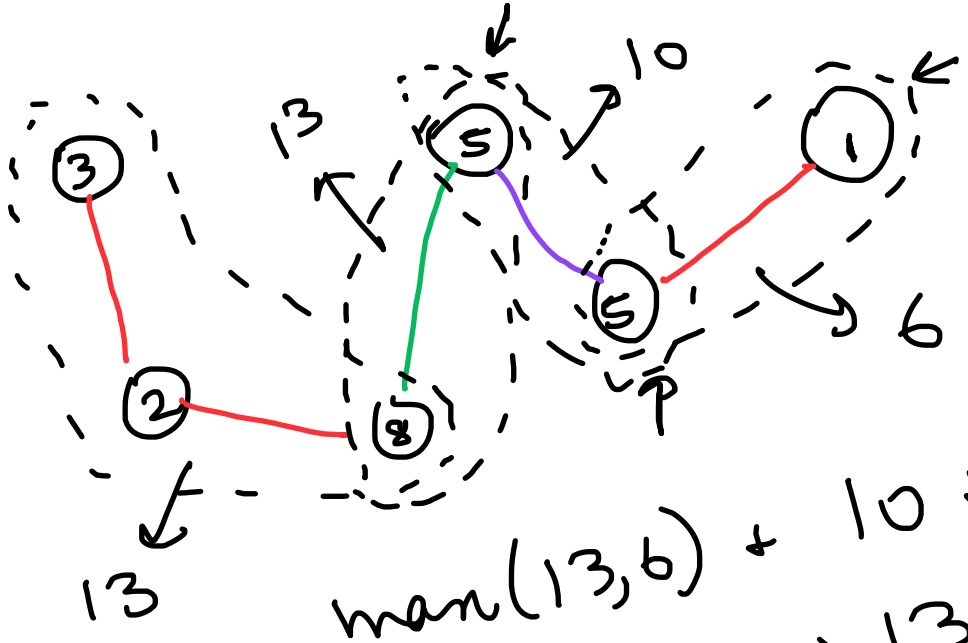
13th Labour of Heracles:
https://codeforces.com/problemset/problem/1466/D

Main Idea

- Each node’s weight can be considered in the sum for at max the number of times equal to its degree.
- Also, it is always possible to configure the colour of the edges for any **k** such that a given node is considered again.
- Hence, at every step, colour the edges in such a way that the node with maximum weight is counted again in the current step.

K → no. of colours.
edges.

atmost K colours in edges.



3 colours,,

K = 5,,

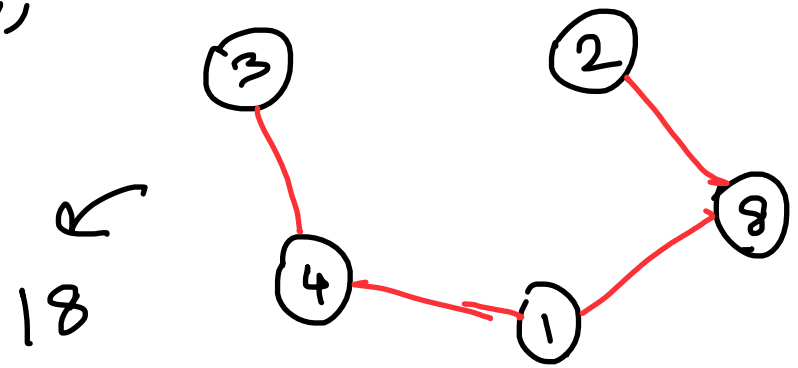
max(13,6) + 10 + 13

13 + 10 + 13

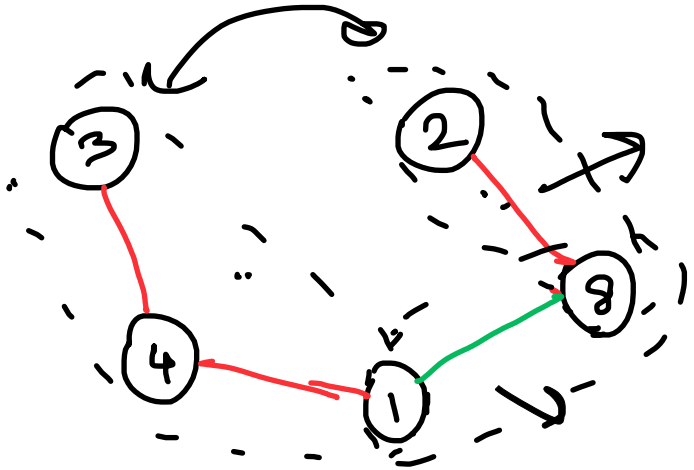
K = 3,,

n-1 = 5,,

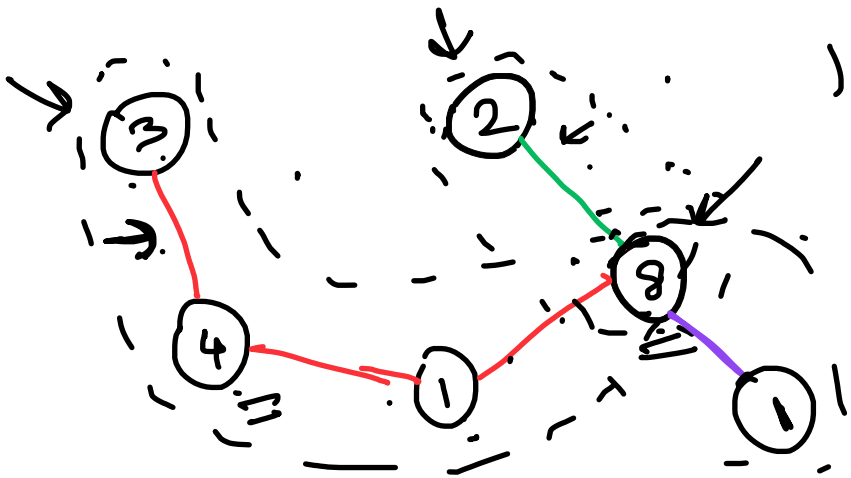
K → 1 to n-1,,



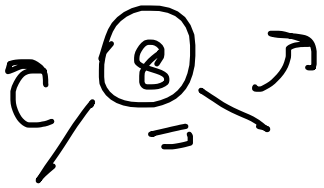
K=2



10+9=19



16+10=26



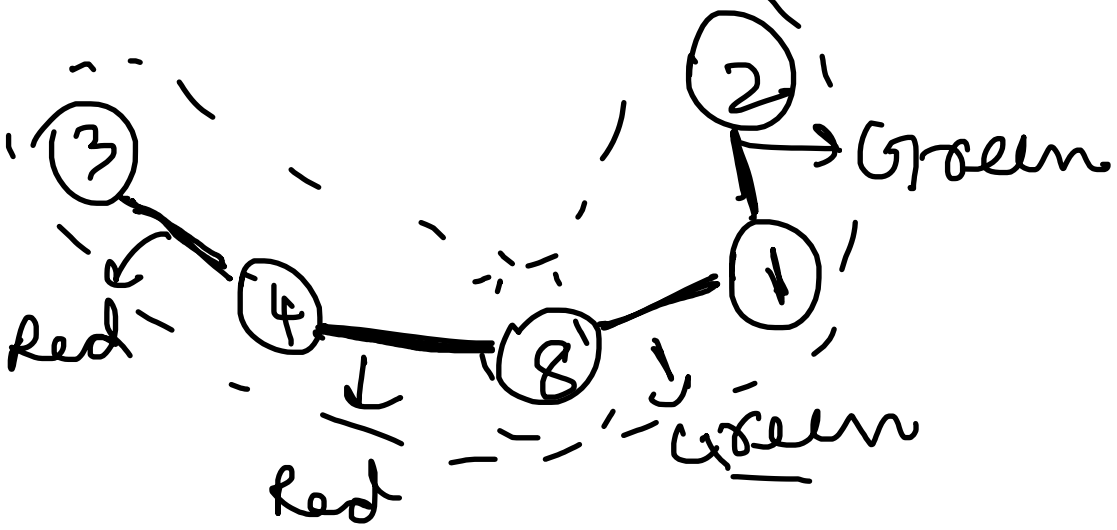
K=2

K=1

K=3

K=4

Val → Val+8 → Val+4+8


2
Green
3
1
Red
4
8
Red
Green