

## Multiple Edges



incident on same vertices

## Complement

$$\{G(V, E) \\ \overline{G}(\overline{V}, \overline{E})\}$$

$$V = \overline{V}$$
$$\{u, v\} \in E(G) \Rightarrow \{u, v\} \notin \overline{E}(G)$$

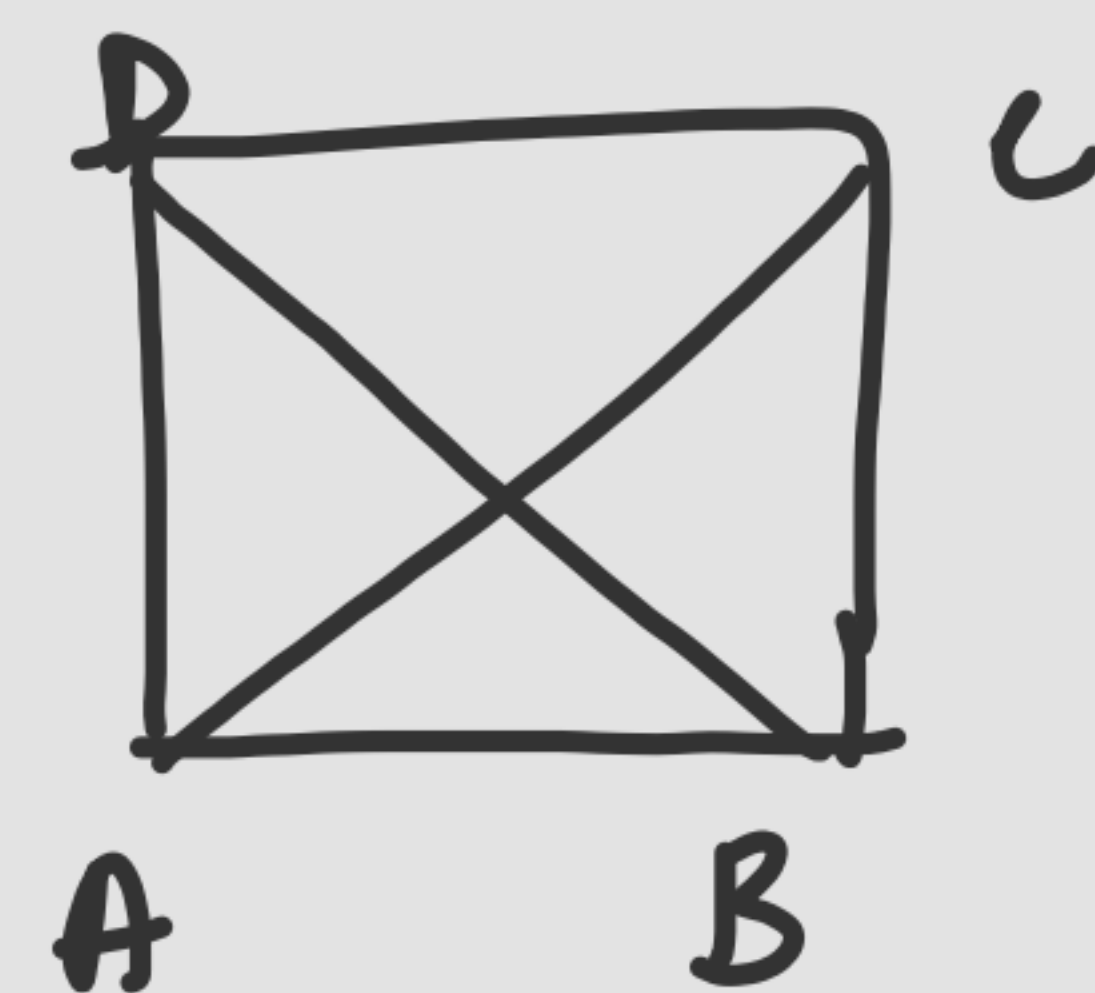
## CLIQUE

pairwise adjacent vertices are called clique

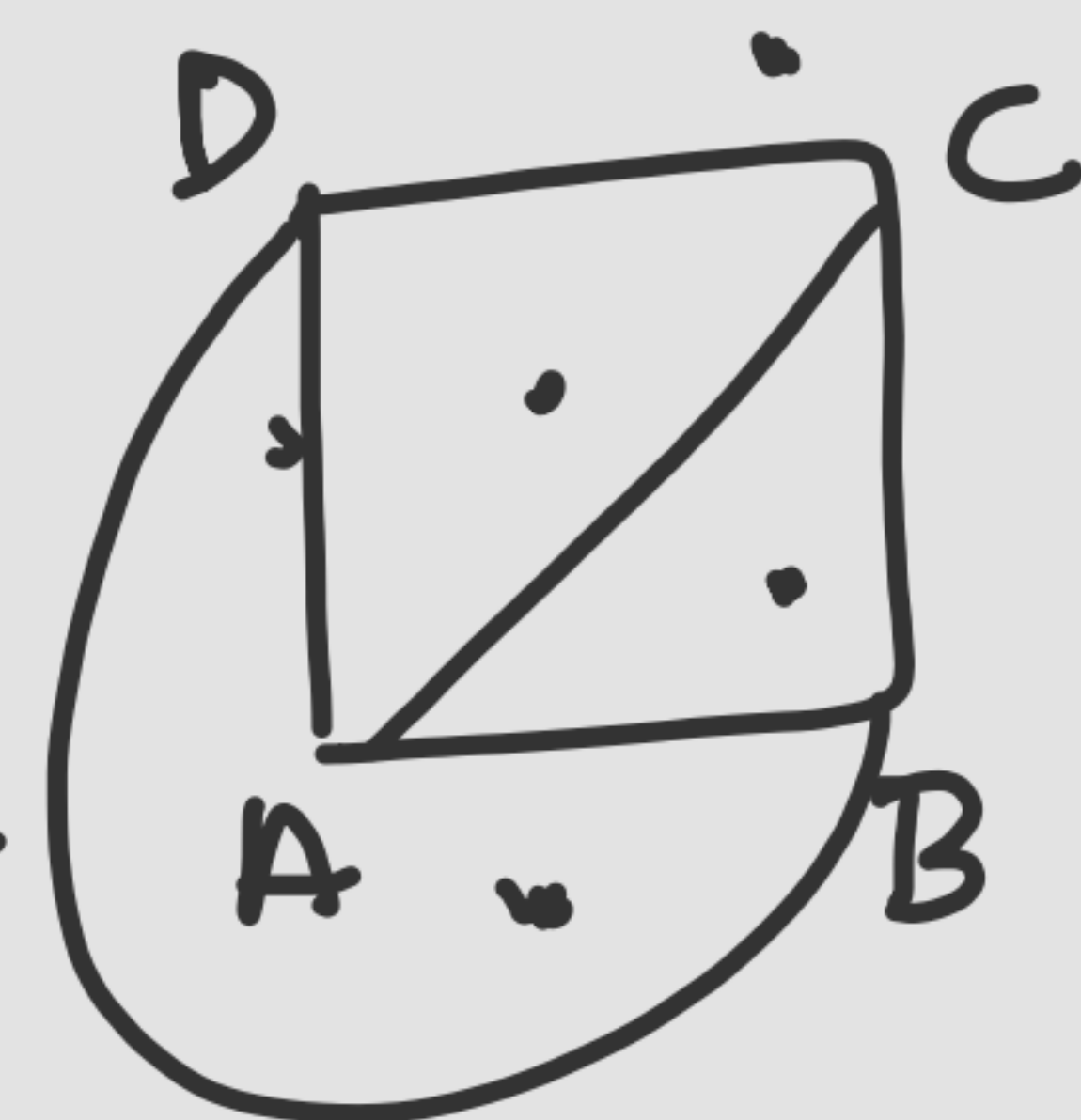
## Independent Set

Pairwise non-adjacent vertices are called independent set.

## planar Graph



$\equiv$



map  
A particular

regions

Euler's formula

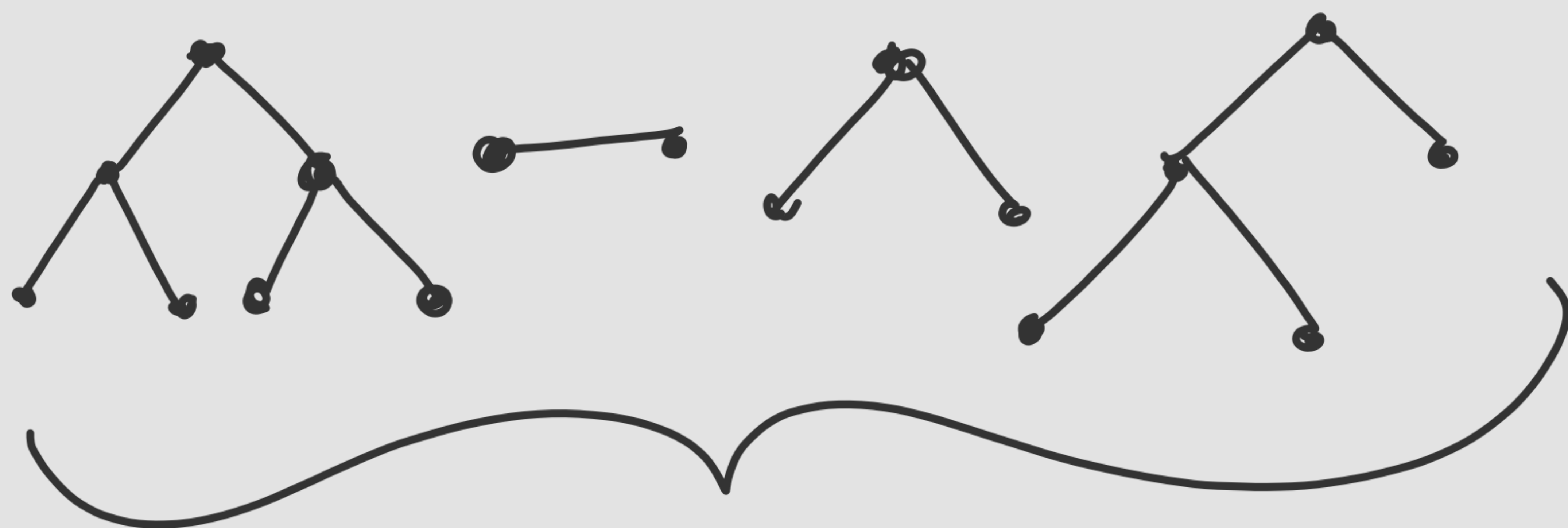
$$V - E + R = 2$$
$$4 - 6 + 4 = 2$$

# Trees

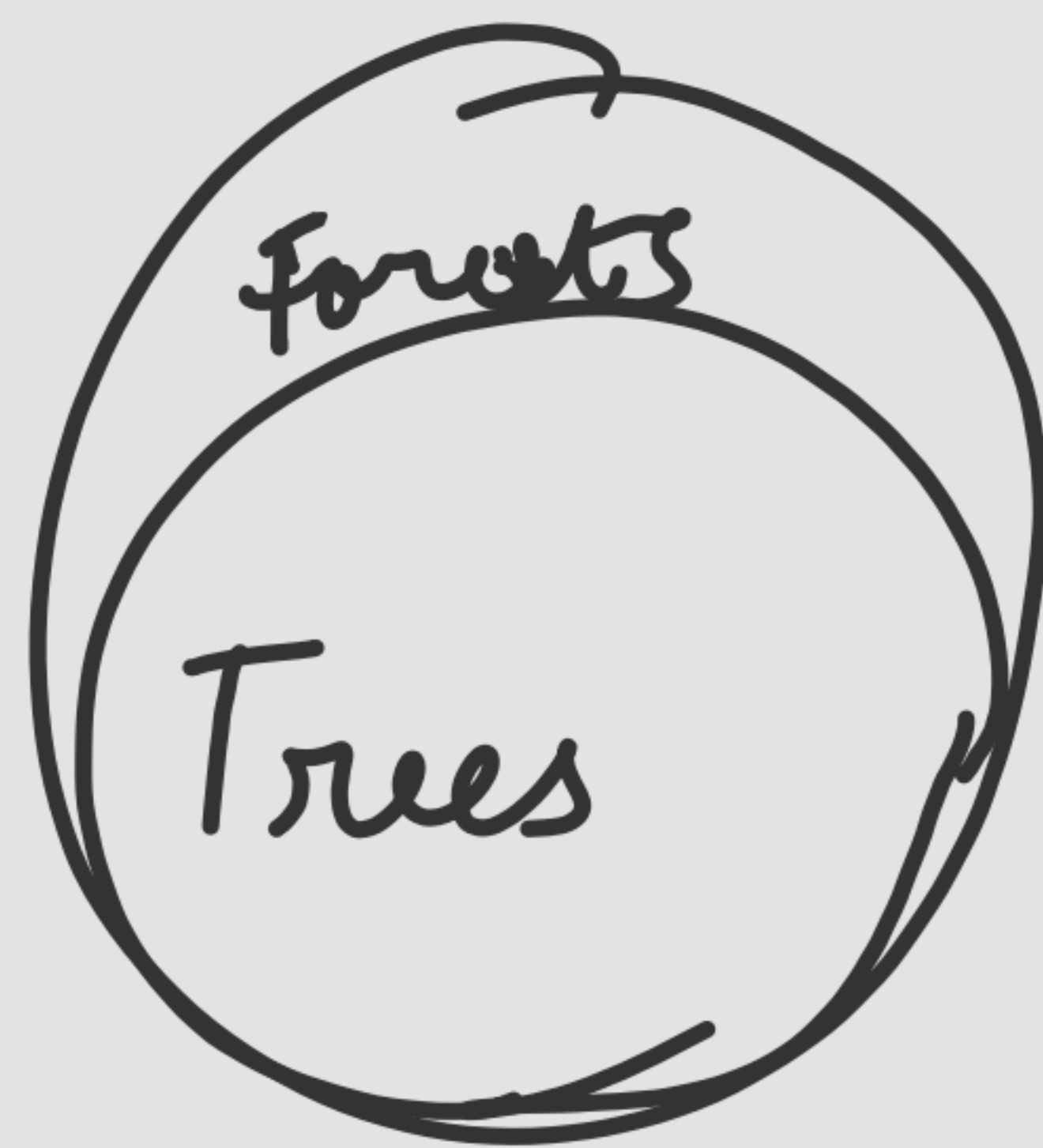
connected acyclic graph

## Forest

acyclic graph



└ Forest  
4 trees



# Spanning Tree

$G$   
graph



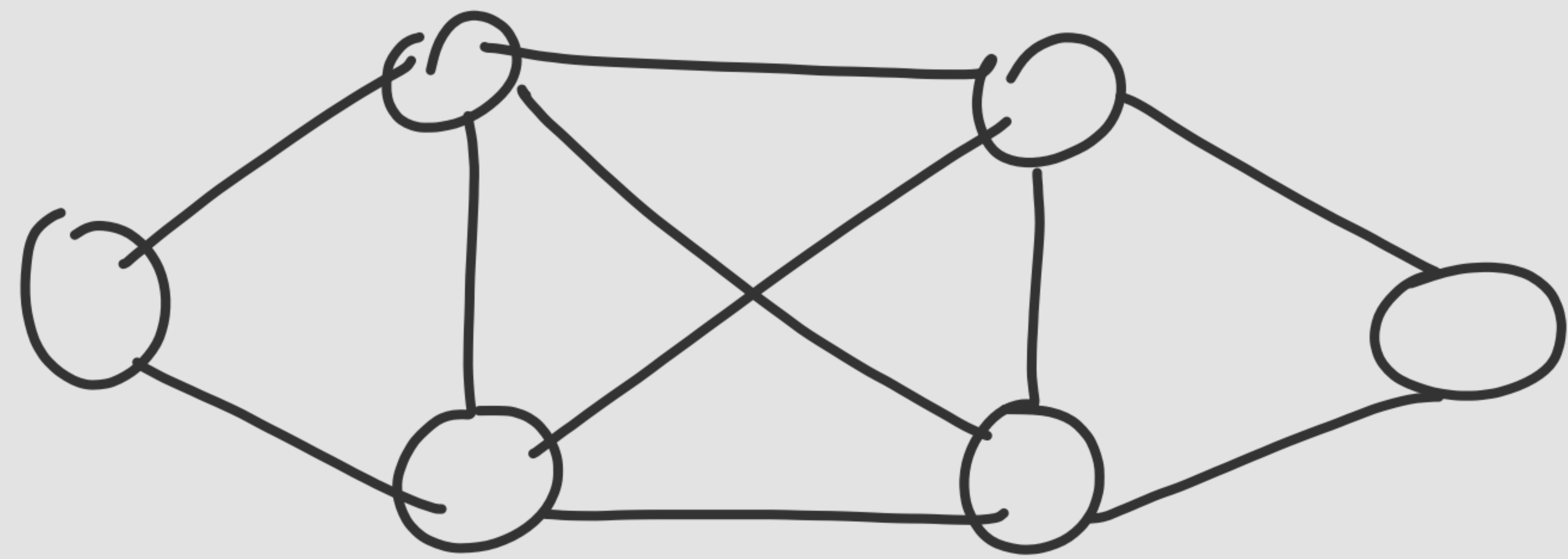
$T$   
tree

all  
vertices  
of  $G$

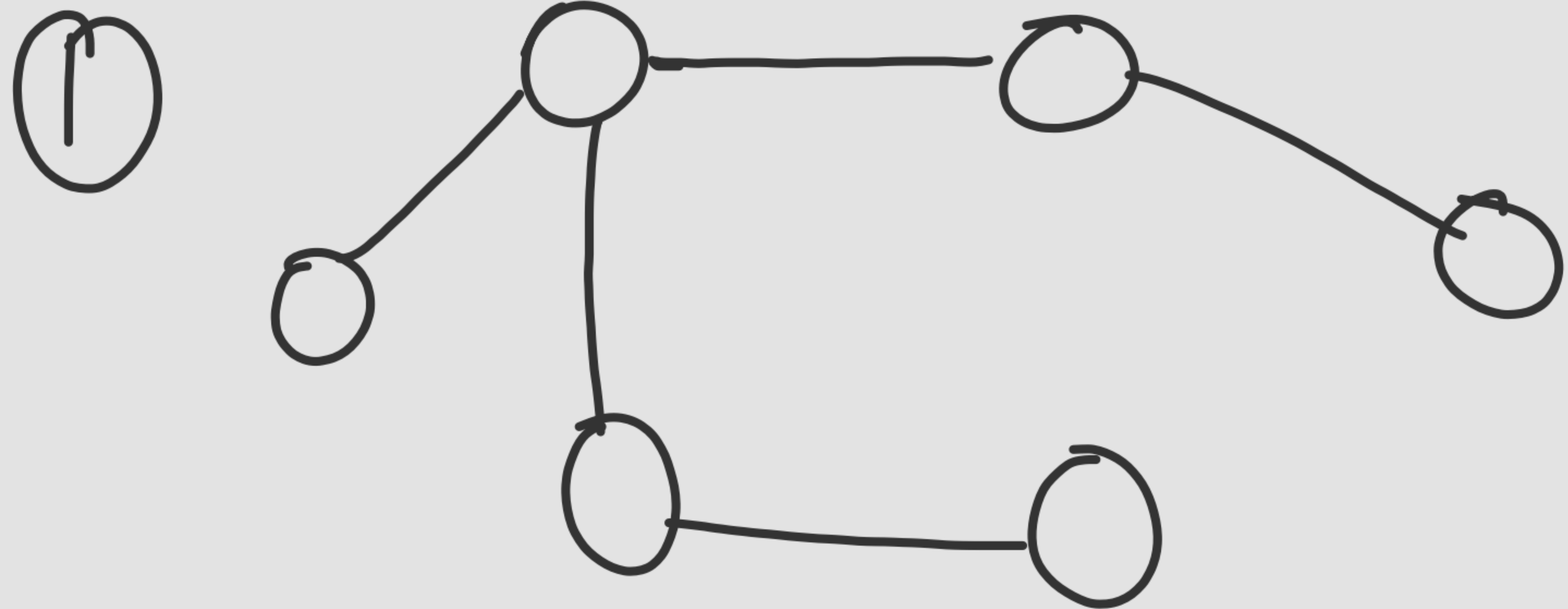
Spanning  
Tree

# Weighted Graph

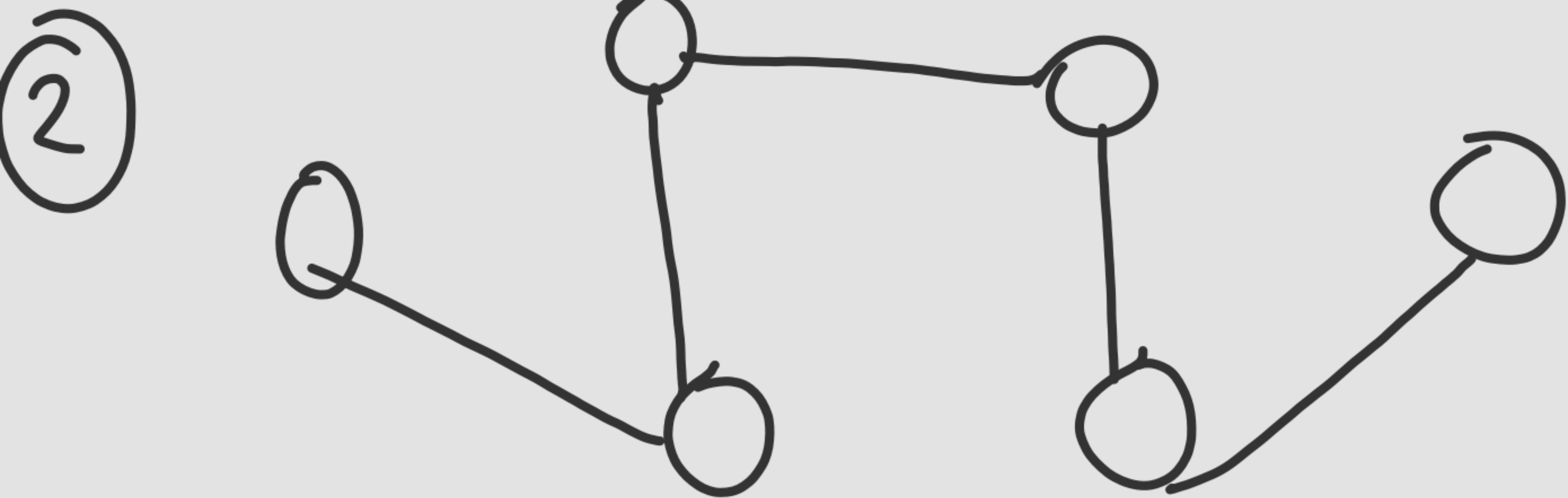
non-negative values  
with each edge



graph



Spanning  
subgraph  
(Tree)



many spanning trees

## Minimum Spanning Tree

Weighted graph

↳  $\sum$  weights is minimum



# Kruskal

↳ greedy

(choose locally optimal to get globally optimal)

