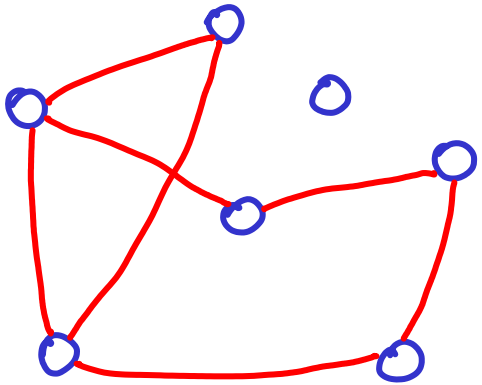
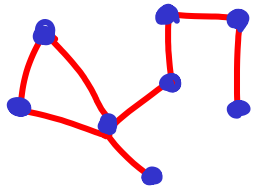
GRAPHS



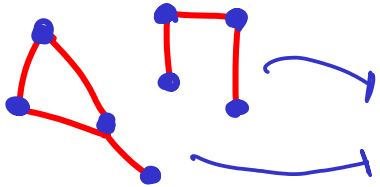
$G = \{V, E\}$

& vertices
edges

connected

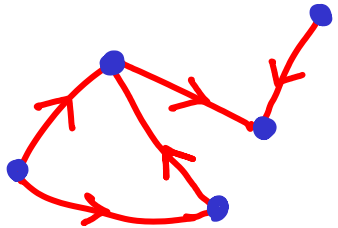


not connected

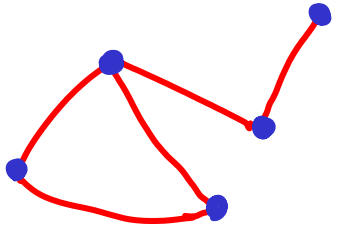


connected components

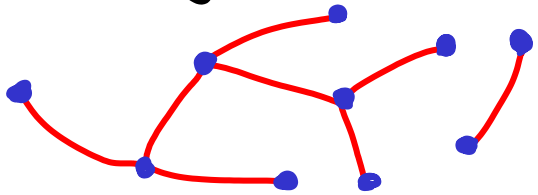
directed



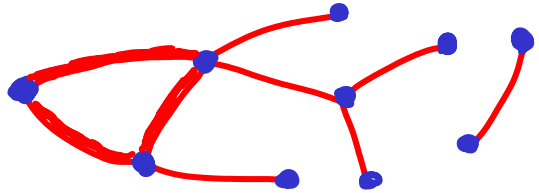
not directed



acyclic

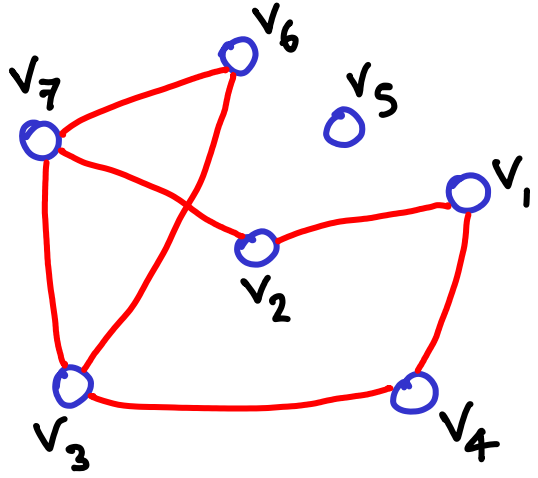


not acyclic



etc

GRAPHS



$G = \{V, E\}$

& vertices edges

	1	2	3	4	5	6	7
1	0	1	0	1	0	0	0
2	1	0	0	0	0	0	1
3	0	0	0	1	0	1	1
4	1	0	1	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	1	0	0	0	1
7	0	1	1	0	0	1	0

Adjacency matrix

size: $|V|^2$

(symmetric for undirected)

Adjacency list

size: $|V| + 2|E|$

(undirected)

1 → 2 → 4

2 → 1 → 7

3 → 4 → 6 → 7

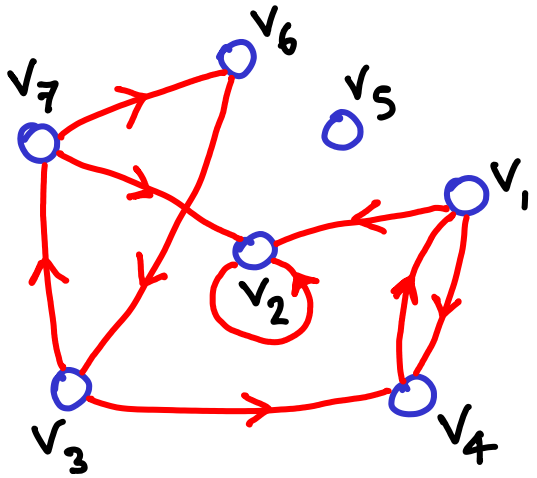
4 → 1 → 3

5

6 → 3 → 7

7 → 2 → 3 → 6

GRAPHS



$G = \{V, E\}$

& vertices edges

	1	2	3	4	5	6	7
1	0	1	0	1	0	0	0
2	0	1	0	0	0	0	0
3	0	0	0	1	0	0	1
4	1	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	1	0	0	0	0
7	0	1	0	0	0	1	0

Adjacency matrix

size: $|V|^2$

(directed or not)

Adjacency list

size: $|V| + |E|$

(directed)

1 → 2 → 4

2 → 2

3 → 4 → 7

4 → 1

5

6 → 3

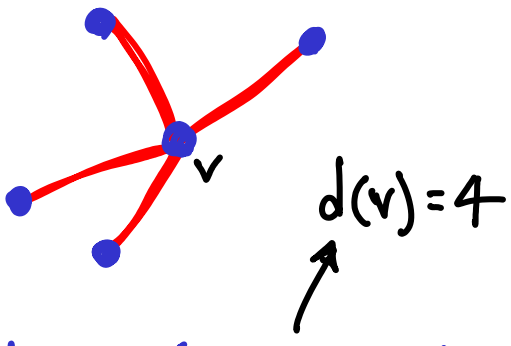
7 → 2 → 6

Adjacency matrix size: $O(|V|^2)$

Adjacency list size: $O(|V|+|E|)$

} directed or not

Same for "dense" graphs, i.e. $|E| \sim |V|^2$



Query adjacency : (is v_j my neighbor ?)

Matrix $O(1)$

List $O(|V|)$ but really $O(\text{degree}(v))$

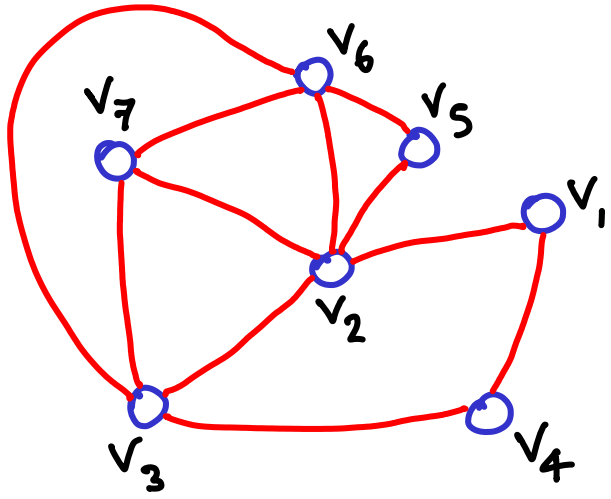
Enumerate neighbors : (of one vertex)

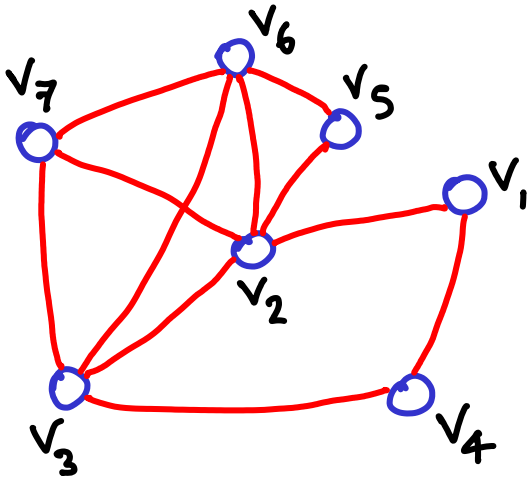
List $O(\text{degree})$

Matrix $O(|V|)$

PLANE GRAPH

no crossings



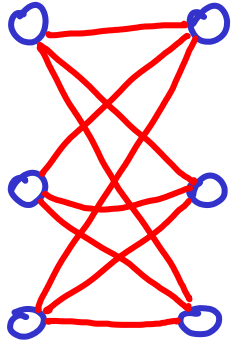


PLANAR GRAPH

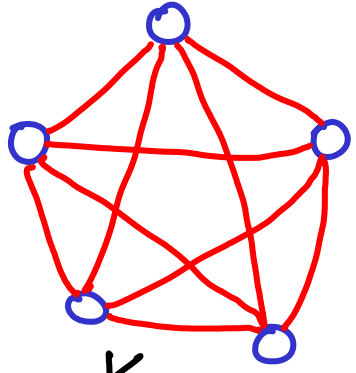
can redraw without crossings

Non-planar graphs

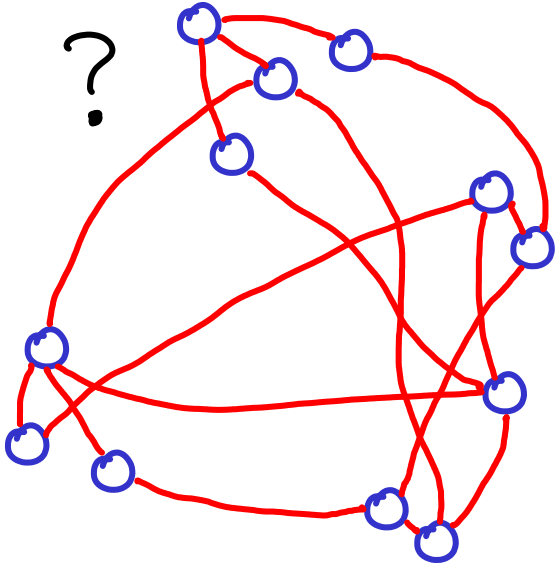
(can't redraw)



$K_{3,3}$

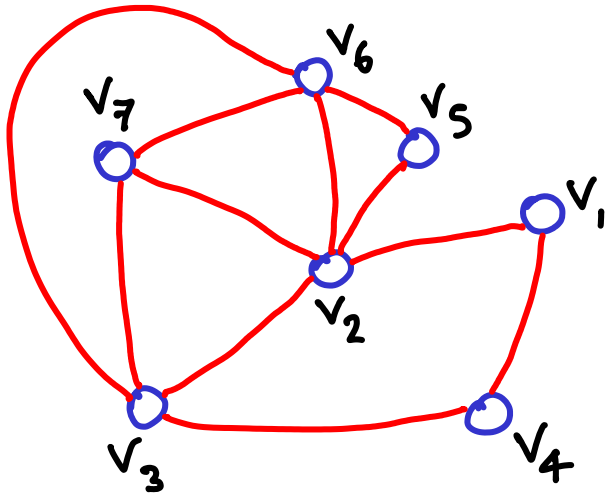


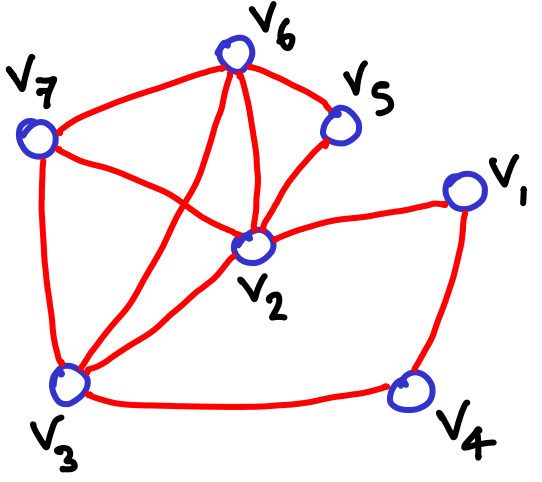
K_5



PLANE GRAPH

no crossings



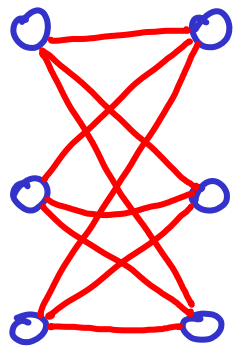


PLANAR GRAPH

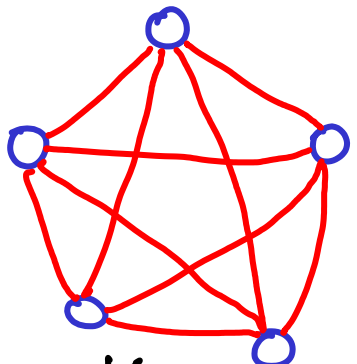
can redraw without crossings

Non-planar graphs

(can't redraw)

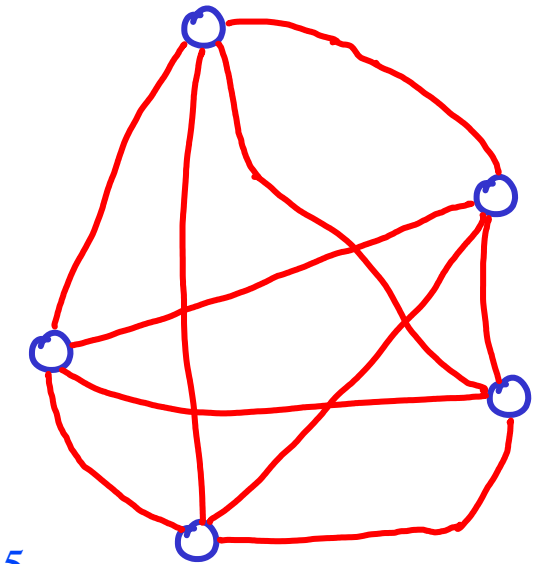


$K_{3,3}$



K_5

obtained by successive contractions



A graph is non-planar if and only if it "contains" a K3,3 or K5