Lecture 10 Graph Algorithms 1 Depth First Search

Wednesday, February 19, 2020 1:56 PM

- graph

  Graph $G = (V, E)$, V is the set of vertices

  E is a subset of edges $(E \subseteq V \times V)$

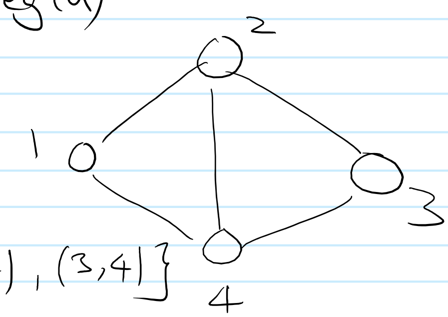
  - directed graph: E contains ordered pairs
  - undirected graph: E contains unordered pairs
  - notation: $\underline{n} = |V|$ number of vertices

    $\underline{m} = |E|$ number of edges
  - degree of vertex $u \in V$, is the number of edges that u is adjacent to $\deg(u)$

$G = (V, E)$

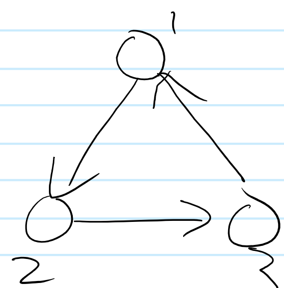
$V = \{1, 2, 3, 4\}$

$E = \{(1,2), (2,3), (1,4), (2,4), (3,4)\}$



$V = \{1, 2, 3\}$

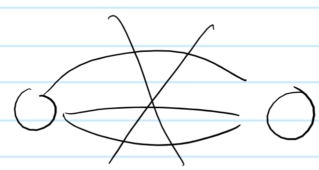
$E = \{(1,2), (2,3), (3,1)\}$

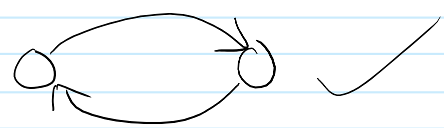


- in many cases

  ① there are no "parallel edges"

  $m \leq n^2$



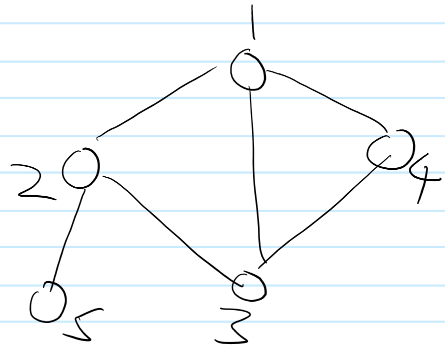


  ② if graph is connected

  $m \geq n-1$

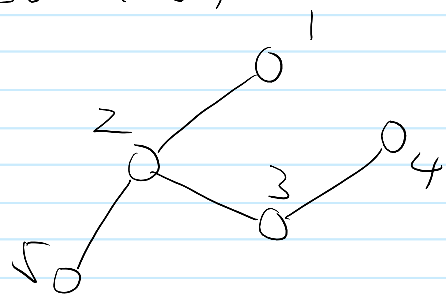
in particular $\Theta(\log m) = \Theta(\log n)$

- DFS

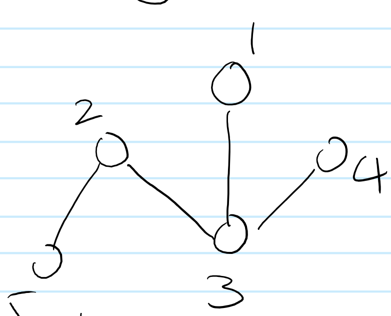


DFS_visit(1)
- DFS_visit(2)
  - DFS_visit(3)
    - DFS_visit(4)
  - DFS_visit(5)

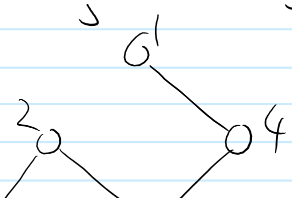
- DFS tree

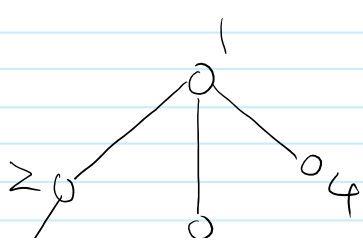


- DFS tree is not unique
  1. starting vertex can be different
  2. can choose different neighbours in different order.

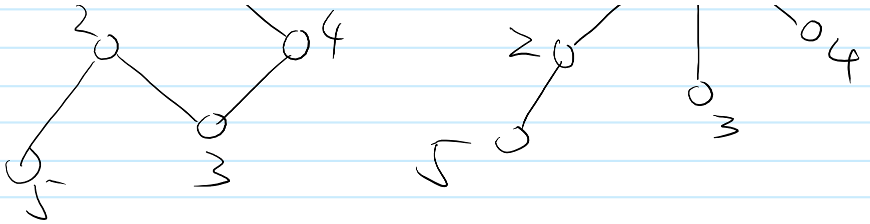


also a valid DFS tree if we take (1, 3) first.



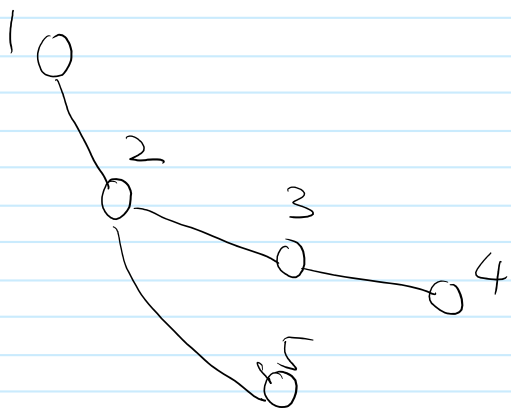


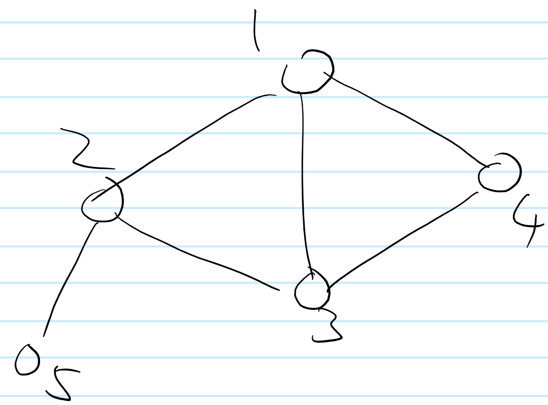
cannot be a DFS tree for the original graph

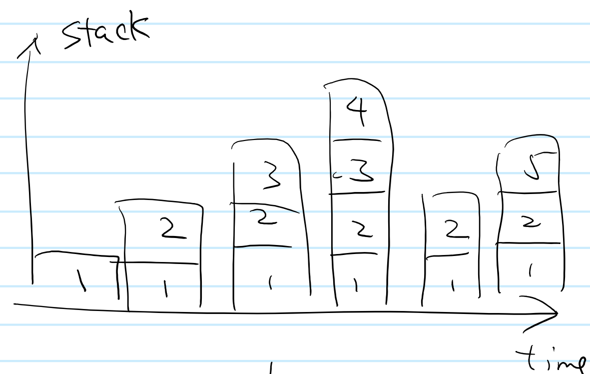


for the original graph

- pre-order and post-order



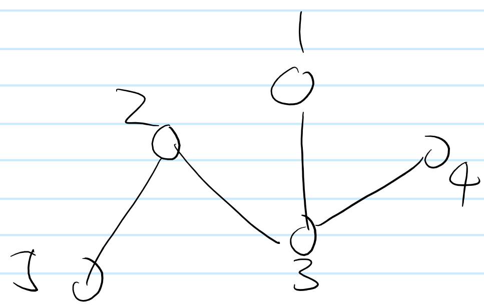




- Pre-order: 1 2 3 4 5
- post-order: 4 3 5 2 1

- ordering are also not unique

$\boxed{\begin{array}{l}\text{pre-order: 1 3 2 5 4}\\ \text{post-order: 5 2 4 3 1}\end{array}}$



pre-order: 1 3 4 2 5

post-order: 4 5 2 3 1

- combine preorder and post order

1 enter

3 enter

2 enter

2 enter
5 enter
5 leave
2 leave
4 enter
4 leave
3 leave
1 leave