Graph Algorithms

CS3104

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Plan for Today

- Introduction: Undirected and Directed Graphs
- Representation of Graphs

Simple Graph

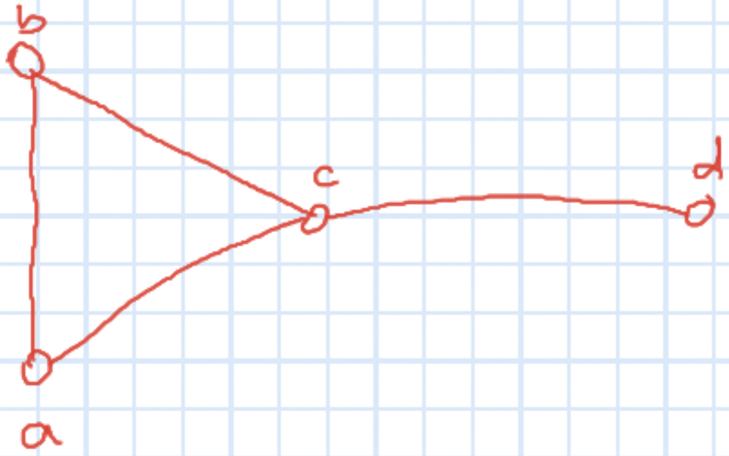
- A *simple graph* consists of
  - a nonempty set of *vertices* called *V*,
  - a set of edges (unordered pairs of **distinct elements of *V***) called *E*
- Notation: $G = (V,E)$
- A **graph** with no loops and no parallel edges is called a **simple graph**.

Graph theory is the study of graphs which are mathematical structures used to model pairwise relations between objects.

Example

$$V = \{a, b, c, d\}$$

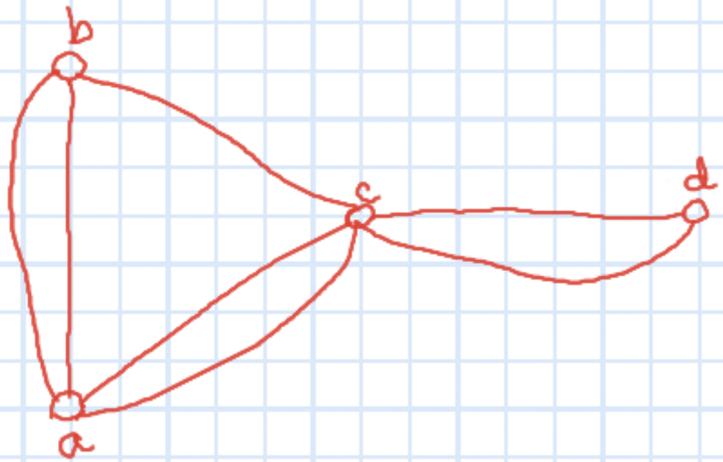
$$E = \{\{a,b\}, \{a,c\}, \{b,c\}, \{c,d\}\}$$



Multigraph

- A *multigraph* can have *multiple edges* (two or more edges connecting the same pair of vertices).

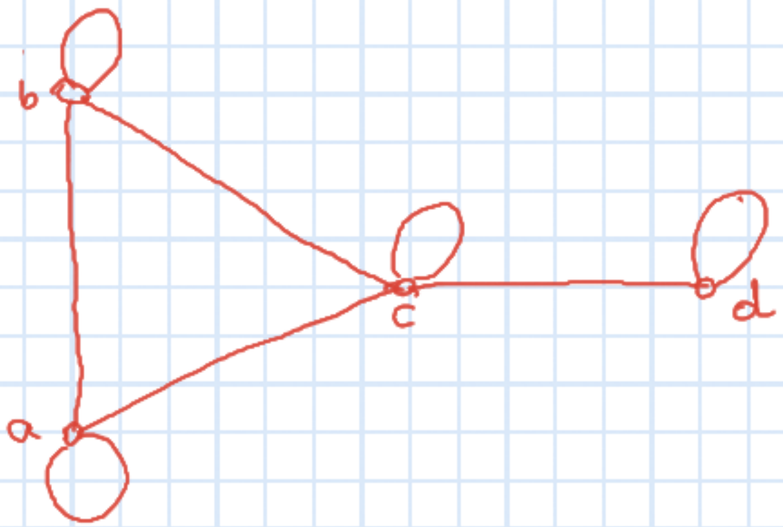
- Application Example: There can be multiple telephone lines between two computers in a network.


b
c
d
a

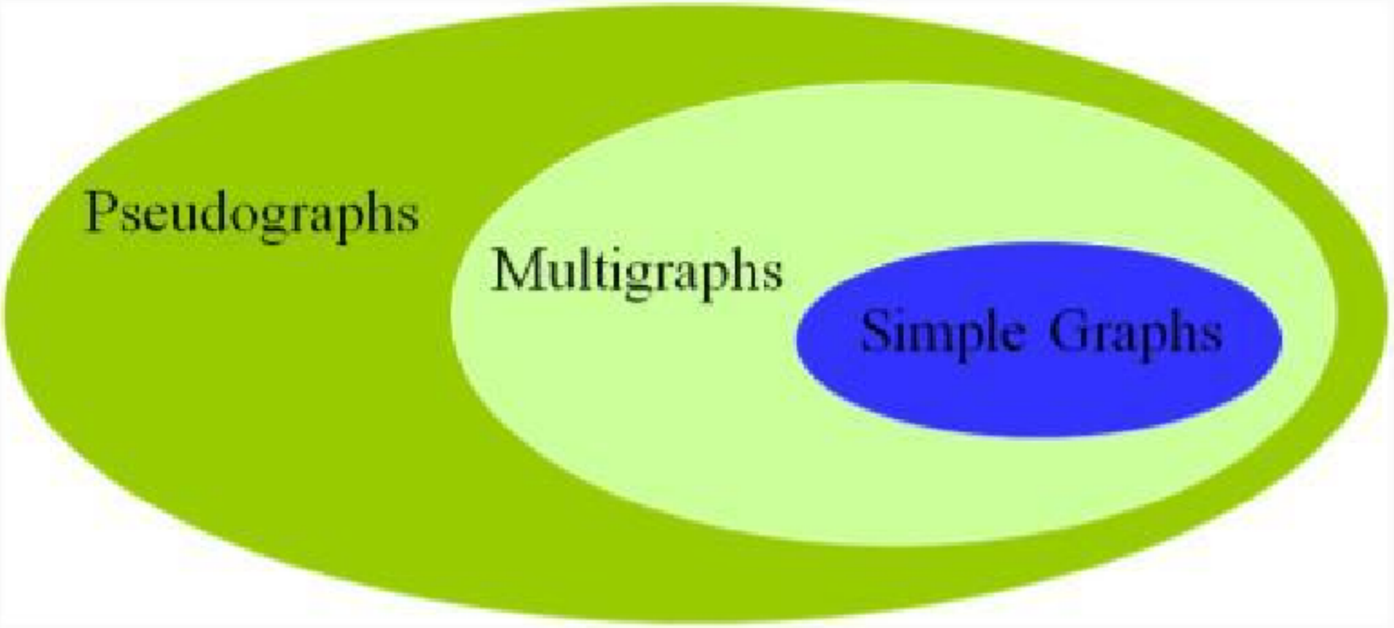
Pseudograph

- A *Pseudograph* can have multiple edges and *loops* (an edge connecting a vertex to itself).

- Example: There can be telephone lines in the network from a computer to itself.


b
c
d
a

Types of Undirected Graph

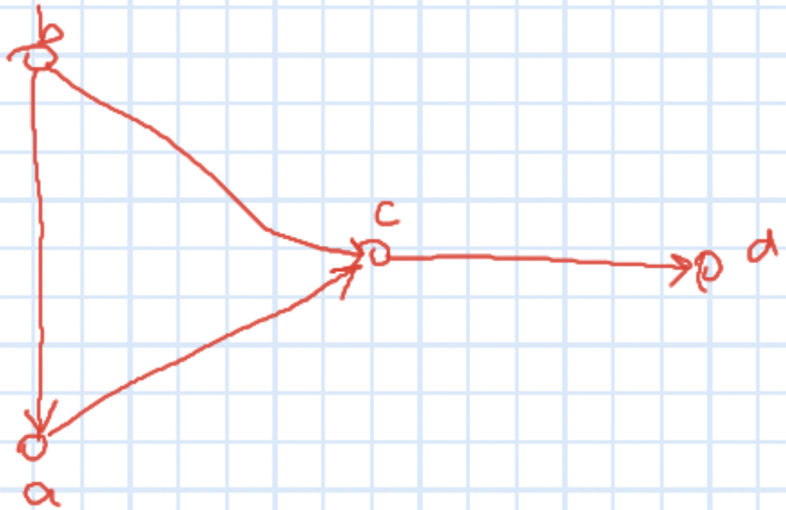


Directed Graph

- The edges are ordered pairs of (not necessarily distinct) vertices.

Digraph

- Example: Some telephone lines in the network may operate in only one direction. Those that operate in two directions are represented by pairs of edges in opposite directions.

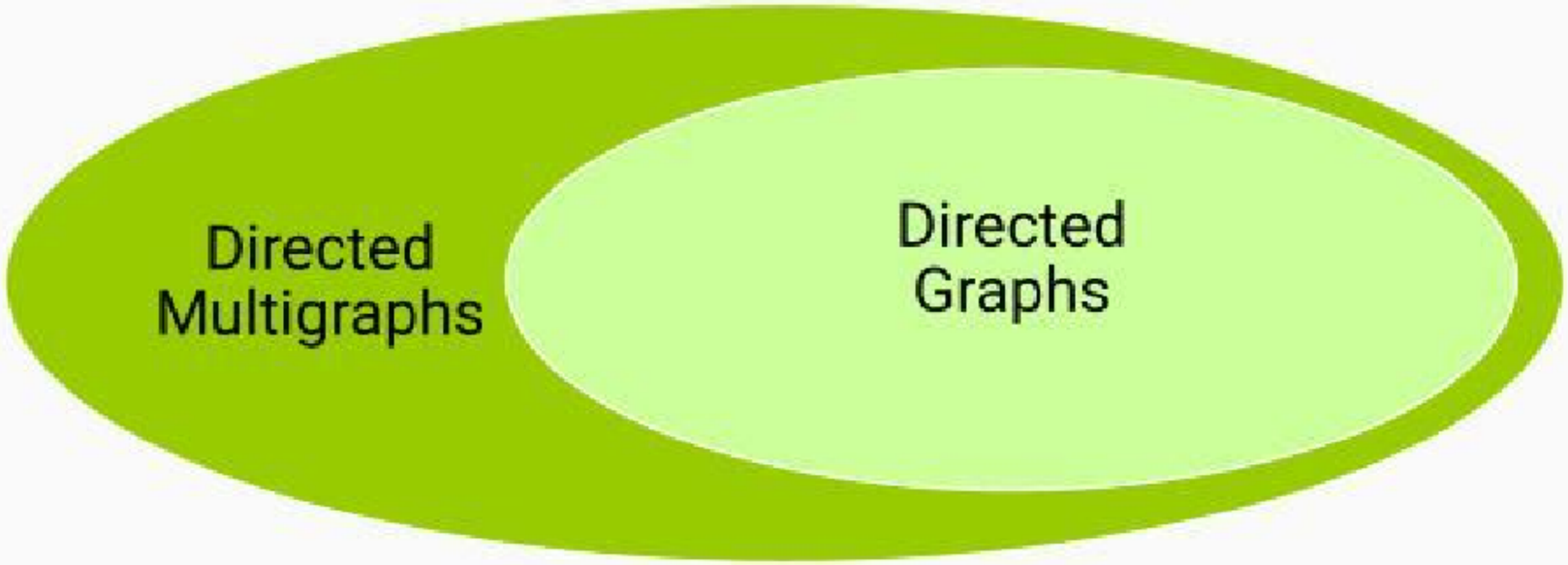

b
c
d
a

Directed Multigraph

- A directed multigraph is a directed graph with multiple edges between the same two distinct vertices.

- There may be several one-way lines in the same direction from one computer to another in the network.

Types of directed Graph



Summary

Type	Edges	Loops	Multiple Edges
Simple Graph	Undirected	NO	NO
Multigraph	Undirected	NO	YES
Pseudograph	Undirected	YES	YES
Directed Graph	Directed	YES	NO

References

1. *Narsing Deo, "Graph Theory with applications to Engineering and Computer Science", Prentice Hall Inc*
2. *Douglas B West, "Introduction To Graph Theory", Pearson Education Inc,*
3. *R. Diestel, "Graph Theory", Springer Verlag*
4. *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", The MIT Press*