



Graphs

10.1 Graphs and Graph Models

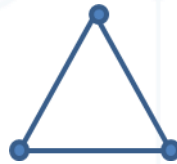
Graphs

DEFINITION 1

- A graph $G = (V, E)$ consists of V , a nonempty set of vertices (or nodes) and E , a set of edges.
- Each edge has either one or two vertices associated with it, called its endpoints.
- An edge is said to connect its endpoints.
- A graph with an infinite vertex set or an infinite number of edges is called an infinite graph.
- a graph with a finite vertex set and a finite edge set is called a finite graph.

The Types of Graphs

- Simple graph: A graph in which each edge connects two different vertices and where no two edges connect the same pair of vertices.



- **Multigraphs**: Graphs that may have multiple edges connecting the same vertices.

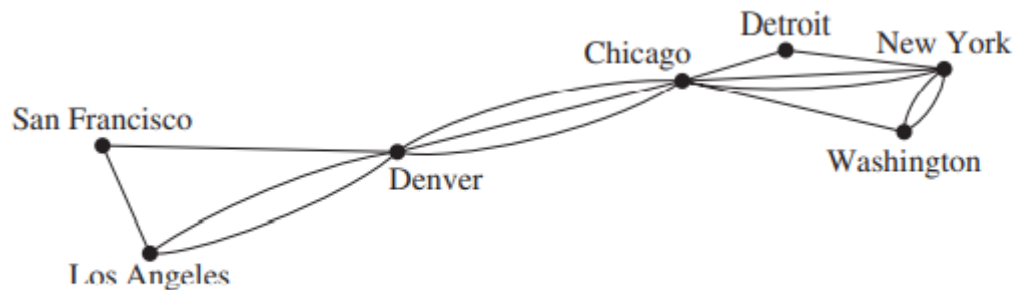
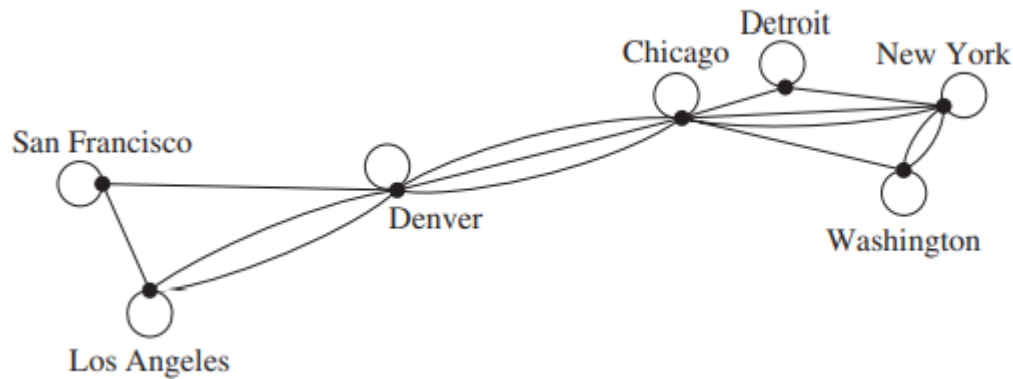
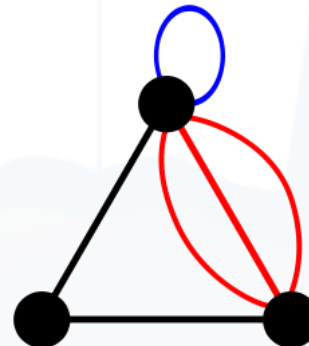
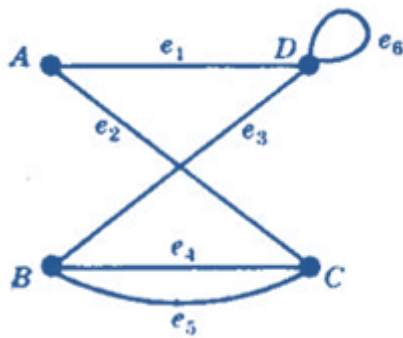
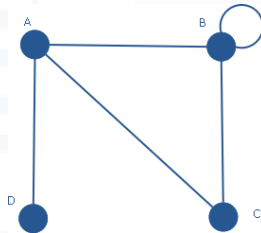


FIGURE 2 A Computer Network with Multiple Links between Data Centers.

- Loop is a closed curve whose initial and final vertices coincide.



- **Pseudographs** : Graphs that may include loops, (and possibly multiple edges connecting the same pair of vertices).



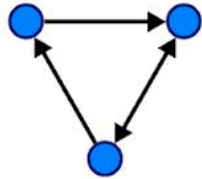
Directed & Undirected Graphs

Definition2

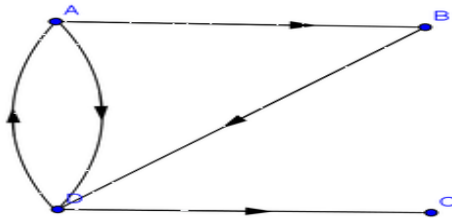
- A **directed graph** (or **digraph**) (V, E) consists of a nonempty set of vertices V and a set of directed edges (or arcs) E .
- Each directed edge is associated with an ordered pair of vertices.
- The directed edge associated with the ordered pair (u, v) is said to start at u and end at v .
- **undirected graphs**. Their edges are also said to be undirected.

Types of Directed & Undirected Graphs

- simple directed graph a directed graph that has no loops and has no multiple directed edges.

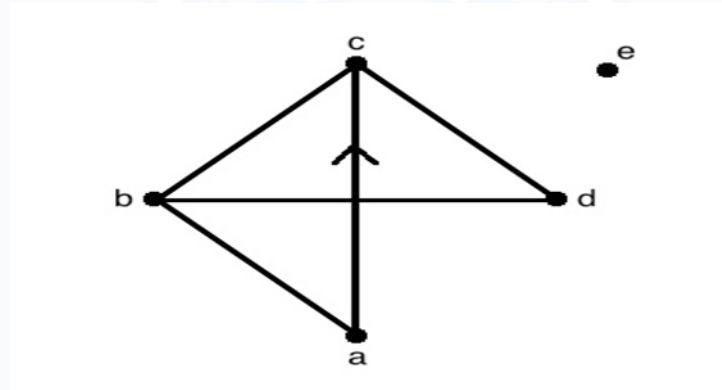


- Directed multigraphs: directed graphs that may have multiple directed edges.



- Edge of multiplicity m When there are m directed edges, each associated to an ordered pair of vertices (u,v) .

Mixed graph: a graph with both directed and undirected edges.



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