

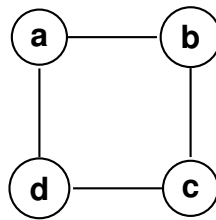
10.1 Graphs and Graph Models

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.

Simple Graph

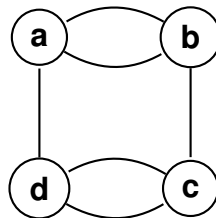
A simple graph $G = (V, E)$ consists of a set V of *vertices* or *nodes* and a set E of *edges* (or *arcs* or *links*) connecting unordered pairs of distinct elements $u, v \in V$.

- No arrows
- No loops
- Can't have multiple edges joining vertices



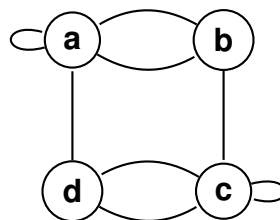
MultiGraph

Like simple graphs, but there may be *more than one edge* connecting two given nodes.



Pseudographs

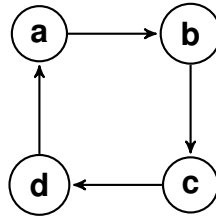
Like multigraphs, but edges connecting a node to itself are allowed (i.e. loops are allowed).



Simple Directed Graph

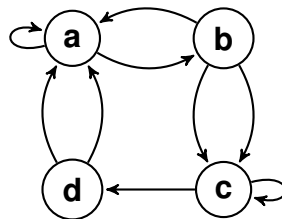
A *simple directed graph* $G = (V, E)$ consists of a set of vertices V and a set of edges E that are ordered pairs of elements of V .

- Directed edges
- No loops
- No multiple directed edges (i.e. at most one edge can be associated to each ordered pair of vertices)



Directed Multigraph

Like a simple directed graph but there may be *more than one edge* connecting two given nodes and loops are allowed.

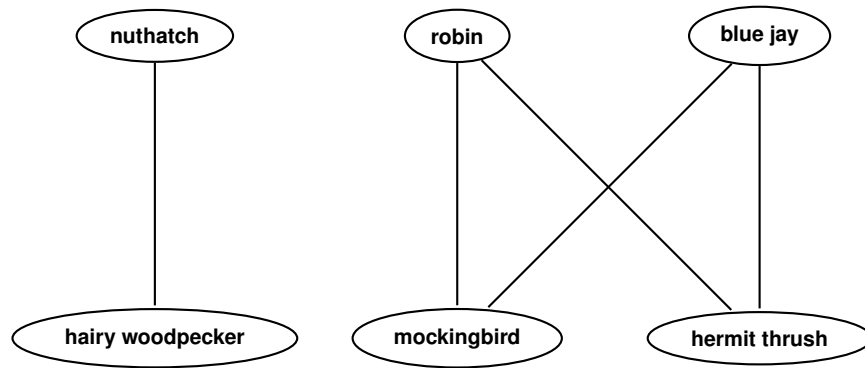


Types of Graphs

Type	Edges	Multiple Edges Allowed?	Loops Allowed?
Simple graph	Undirected	No	No
Multigraph	Undirected	Yes	No
Pseudograph	Undirected	Yes	Yes
Simple directed graph	Directed	No	No
Directed multigraph	Directed	Yes	Yes
Mixed graph	Directed and undirected	Yes	Yes

10.1 pg. 650 # 15

Construct a niche overlap graph for six species of birds, where the hermit thrush competes with the robin and with the blue jay, the robin also competes with the mockingbird, the mockingbird also competes with the blue jay, and the nuthatch competes with the hairy woodpecker.



10.1 pg. 650 # 19

Construct an influence graph for the board members of a company if the President can influence the Director of Research and Development, the Director of Marketing, and the Director of Operations; the Director of Research and Development can influence the Director of Operations; the Director of Marketing can influence the Director of Operations; and no one can influence, or be influenced by, the Chief Financial Officer.

