

1.1 Some Basic Definitions about Graphs (Graphs 101)

(中文版)

A graph $G = (V, E)$ is a structure used to represent entities and their relations. It consists of two sets – the set of nodes V (also called vertices) and the set of edges E (also called arcs).

An edge $(u, v) \in E$ connecting a pair of nodes u and v indicates that there is a relation between them. The relation can either be undirected, e.g., capturing symmetric relations between nodes, or directed, capturing asymmetric relations. For example, if a graph is used to model the friendships relations of people in a social network, then the edges will be undirected as friendship is mutual; however, if the graph is used to model how people follow each other on Twitter, then the edges are directed. Depending on the edges' directionality, a graph can be *directed* or *undirected*.

Graphs can be *weighted* or *unweighted*. In a weighted graph, each edge is associated with a scalar weight. For example, such weights might represent lengths or connectivity strengths.

Graphs can also be either *homogeneous* or *heterogeneous*. In a homogeneous graph, all the nodes represent instances of the same type and all the edges represent relations of the same type. For instance, a social network is a graph consisting of people and their connections, representing the same entity type.

In contrast, in a heterogeneous graph, the nodes and edges can be of different types. For instance, the graph encoding a marketplace will have buyer, seller, and product nodes that are connected via wants-to-buy, has-bought, is-customer-of, and is-selling edges. The bipartite graph is a special, commonly-used type of heterogeneous graph, where edges exist between nodes of two different types. For example, in a recommender system, one can use a bipartite graph to represent the interactions between users and items. For working with heterogeneous graphs in DGL, see [1.5 Heterogeneous Graphs](#).

Multigraphs are graphs that can have multiple (directed) edges between the same pair of nodes, including self loops. For instance, two authors can coauthor a paper in different years, resulting in edges with different features.