Reflection 9 Part 1 Video 13

Denotation:

G = (V, E)

V = {v1, v2, v3, v4}

E = {{v1,v2}{v2,v3}{v3,v4}}

note: use “{}” or “()” properly

deg(v) = k. (e.g. deg(v1) = 2, meaning that node v1 is connected to 2 edges).

incident 相交

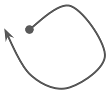
We say that *one edge* is incident to *one node*.

Definition of Graph:

adjacent相邻: two nodes connected to each other

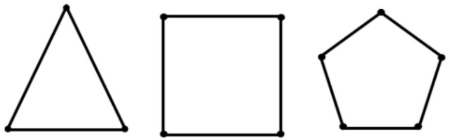
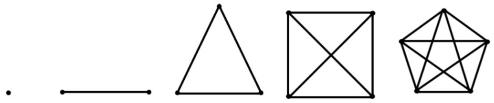
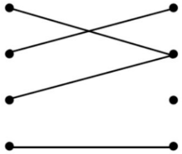
V (vertices 顶点) or nodes

E (edges 边): every edge has one or two nodes connected to it.

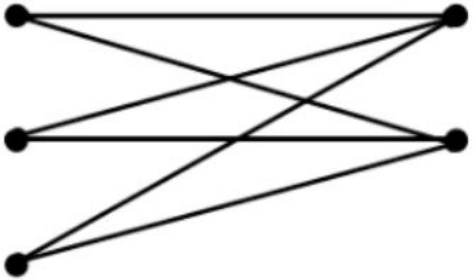
- In normal cases, an edge is connected to 2 nodes, e.g.: 
- However, if one node is tied to itself, then there’s only one node connected to the edge. e.g.: 

degree 度: the number of edges connected to it.

Three Kinds of Graphs

	Examples	Definition	Note
Cycle Graph	 C_3 C_4 C_5	Cn has n vertices (v1,v2…vn) and n edges ({v1v2},{ v2v3}…{vnv1})	Cn
Complete Graph	 K_1 K_2 K_3 K_4 K_5	There's one edge between every pair of vertices.	Kn
Bipartite Graph 二分圖		1. every edge in the graph connects a vertex in V1 and a vertex in V2 2. no edge in G connects either 2 vertices in V1 or 2 vertices in V2	can also be complete

Bipartite Graph + Complete



$K_{3,2}$

K3,2 is COMPLETE

Question 1: why is this graph denoted as “K3,2”? Normally there’s only one number after the “K”.

Question 2: this bipartite graph looks very similar to what we learned in functions (onto, bijection, etc.) . In what cases should we use functions or bipartite graphs to model a problem?

Handshake Theorem

If we sum up deg(v1), deg(v2),..., until deg(vn), then we have to divide the result by 2. This is because we've counted every edge twice.

Handshaking Theorem

Let $G = (V, E)$ be a graph. $\boxed{2|E| = \sum_{v \in V} deg(v)}$

Isomorphism 同构

Isomorphism

Graphs G and H are isomorphic if there is a bijection f from V the vertex set of G to W the vertex set of H, such that if (a,b) is an edge in G then (f(a),f(b)) is an edge in H, for all edges

It’s like twisting some molecules in the space. The shape changes but the structure stays the same.

Subgraph: a tool to examine if two graphs are isomorphic

G1 and G2 are not isomorphic if H is a subgraph of G2 but not a subgraph of G1.

Perfect Matching

Perfect Matching

A perfect matching of a graph is a set of edges such that every node is associated with exactly one of these edges

Looking for a set of edges that can form a **bijection** from vertices set A to vertices set B?

video 14: tree

- Tree: an undirected graph with a root
- Root: every node is connected to it by exactly on path
- Parent and Child
- Leaf and Internal Node: has No children vs. has child(ren)
- Levels and Height (starts from 0)
- Subtree: pick a node X to be the root

- Binary tree: each note has **at most 2** children
- M-ary tree: each node has **at most m** children
- Full: each node either has **0 or m** children
- Complete: **m-ary tree** with all leaves that are the **same height**