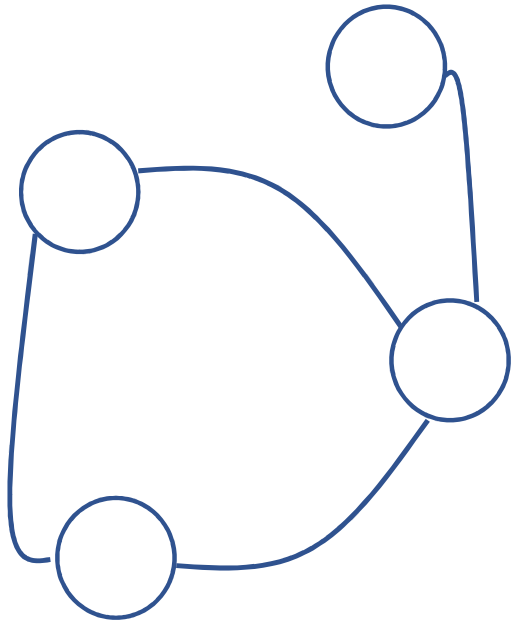
Module II: Graph Basics

10:30 am - 11:15 am

Module 2 Overview

Graph basics



Why

- Importance of graph

Understanding Graph

- Graph representation
- Nodes, edges and structure
- Temporal and spatial dynamics

Lab 2 – Graph properties in *MAG*

- Degree centrality
- Temporal dynamics – AI trends analytics

Why is Graph Important

- Computer
- People
- IoT (things / devices)

THE ERA OF (DIGITALLY)
CONNECTED WORLD

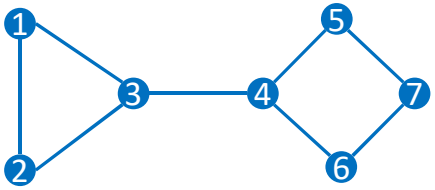
Graph Representation

The *graph* G can be represented as a *matrix*

James J Sylvester

(1814--1897)

The term “graph” (1878)
The term “matrix” (1850)



G = (V, E), where *V* is the node set and *E* denotes the edge set.

- V: $v_1, v_2, v_3, v_4, v_5, v_6, v_7$
- E: $e_{12}, e_{13}, e_{23}, e_{34}, e_{45}, e_{46}, e_{57}, e_{67}$
- $E \subseteq V \times V$

Adjacency matrix $\boldsymbol{A} = \{a_{ij}\}_{n \times n}$

- $a_{ij} = \begin{cases} 1 & if\ e_{ij} \in E \\ 0 & otherwise \end{cases}$

$$\begin{bmatrix} 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \end{bmatrix}$$

Understanding nodes

- Importance of nodes
  - Degree centrality
  - Eigenvector centrality
  - HITS centrality
- Similarity of nodes
  - Node label classification
  - Node clustering / community detection

Understanding edges and structure

- Edges
  - Missing link prediction
    - in homogeneous networks
    - in heterogeneous networks
  - Clustering coefficient – "edge density"

- Structure
  - Network similarity (structural similarity)

Understanding the graph evolution

- Temporal dynamics
  - When node / edge has a birthdate
- Spatial dynamics
  - When node has a geo-location

Lab 2: Graph properties in MAG

- Task 1: Degree Centrality
- Task 2: Temporal Dynamics