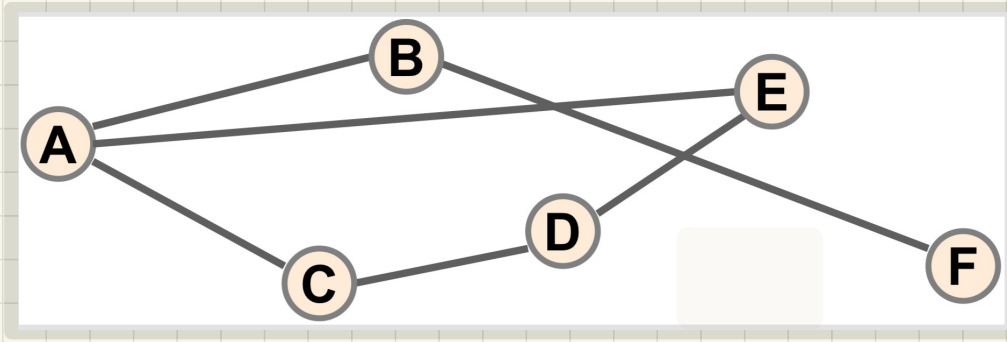


Graph: Definition

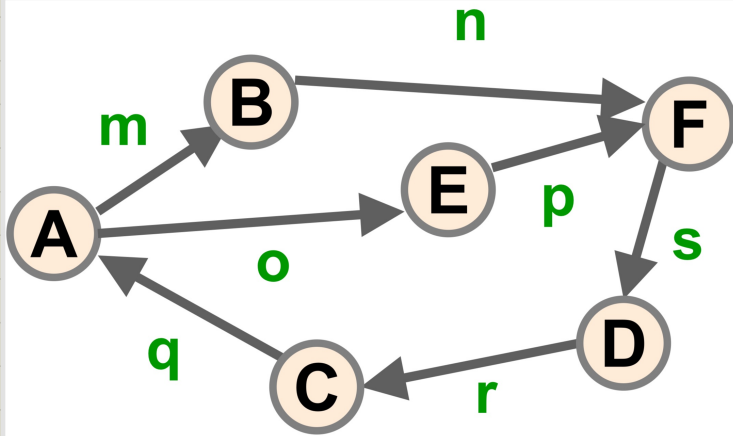


Edges: Directed vs. Undirected

Examples:

- Control Flow/Data Flow Diagrams
- Social Network of Friendships
- Road Map of GPS
- Collaboration Network (Co-authorship)
- Degree Requirement
- Web Pages (Hyperlinked)
- Protein-Protein Interaction Network

Vertices: Degree



Exercises:

End vertices of m ?

Outgoing Edges of A?

Incoming Edges of A?

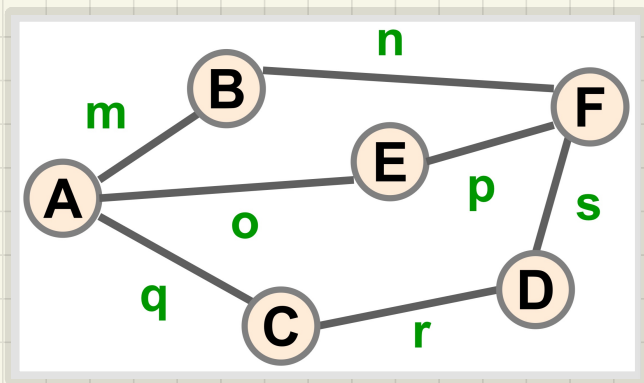
Edges incident on A?

Degree of A?

Properties: Sum of Degrees for Undirected Graphs

Given a simple, undirected graph $G = (V, E)$ with $|E| = m$:

$$\sum_{v \in V} \text{degree}(v) = 2 \cdot m$$



Properties: Sum of Degrees for Undirected Graphs

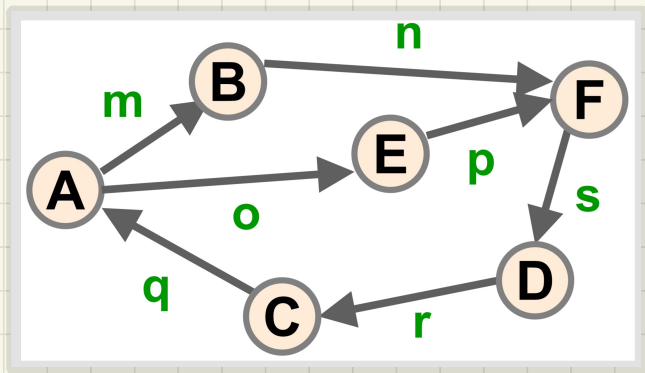
Given a simple, undirected graph $G = (V, E)$ with $|E| = m$:

$$\sum_{v \in V} \text{degree}(v) = 2 \cdot m$$

Properties: Sum of Degrees for Directed Graphs

Given a simple, directed graph $G = (V, E)$ with $|E| = m$:

$$\sum_{v \in V} \text{in-degree}(v) = \sum_{v \in V} \text{out-degree}(v)$$



Properties: Sum of Degrees for Directed Graphs

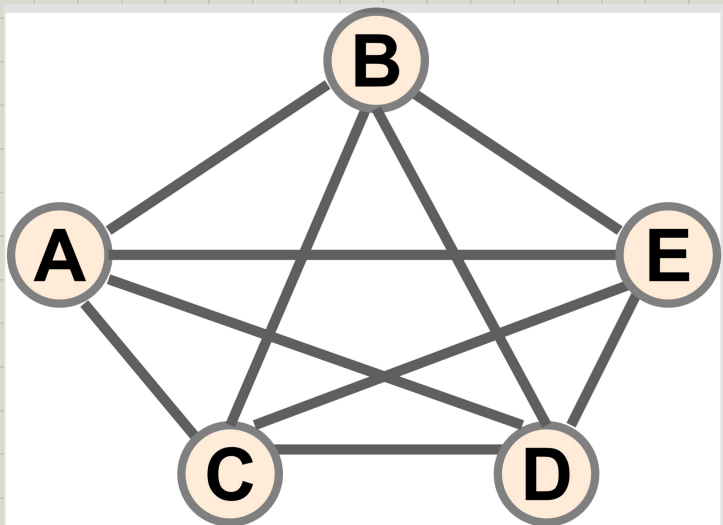
Given a simple, directed graph $G = (V, E)$ with $|E| = m$:

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Properties: Sum of Degrees for Directed Graphs

Given a simple, undirected graph $G = (V, E)$, $|V| = n$, $|E| = m$:

$$m \leq \frac{n \cdot (n - 1)}{2}$$



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