Graphs - Basic Notions

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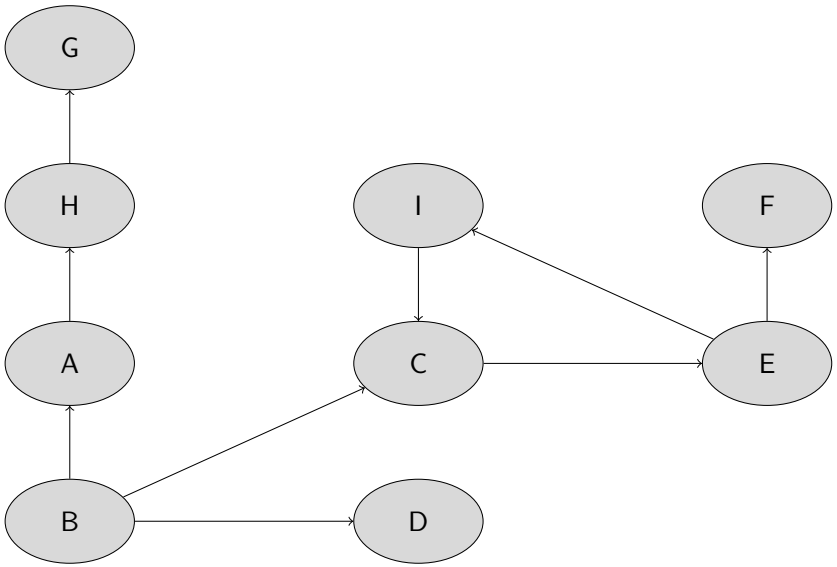
Graphs

A (di)graph is a tuple $G = (V, E)$ where

- V is a set of vertexes
- $E \subseteq V \times V$ is a set of edges (a binary relation on V)



$$V = \{A, B, C, D, E, F, G, H, I\}$$

$$E = \{(B, A), (A, H), (H, G), (B, C), (B, D), (C, E), (E, F), (E, I), (I, C)\}$$

$$|G| = 9$$

If E is symmetric, we say that G is undirected, directed otherwise
The size $|G|$ of G is given by its number of vertexes

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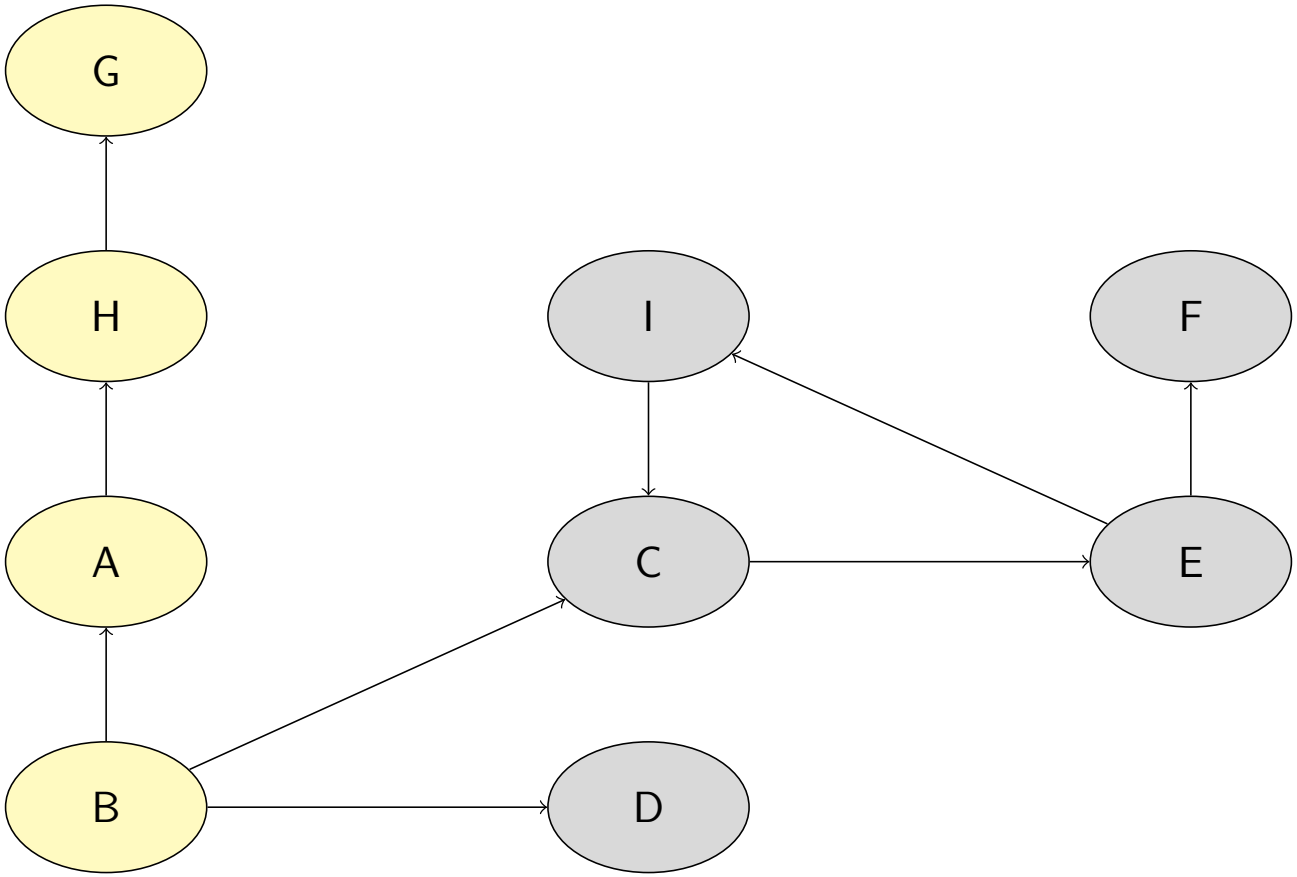
Paths

A path is a sequence of vertexes $v_1, \ldots, v_k$ connected by edges: $(v_i, v_{i+1}) \in E$, for $i = 1, \ldots, k$



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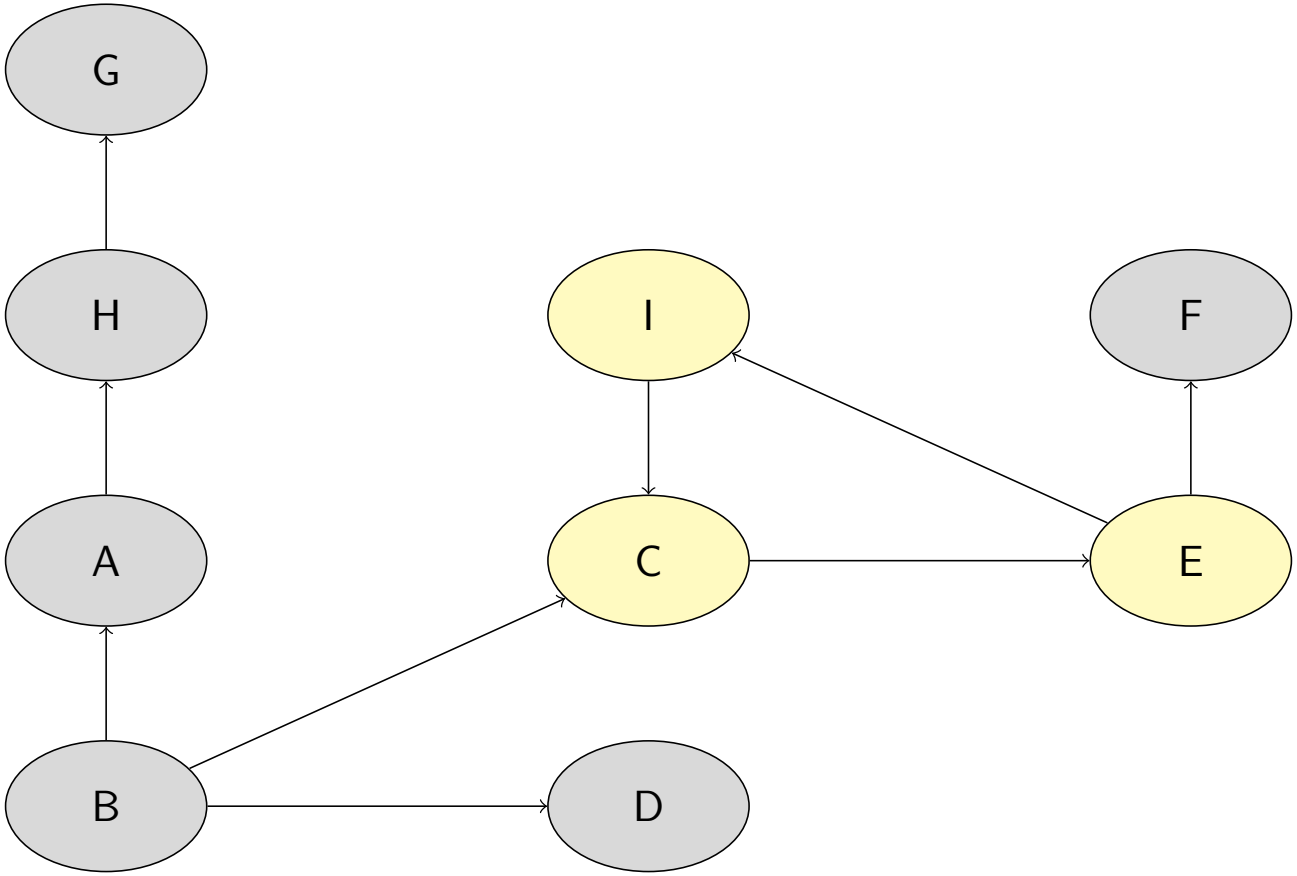
Cycles

If in a path $v_1, \ldots, v_k$ a vertex repeats, i.e., $v_i = v_j$, for $1 \leq i < j \leq k$, we call it a cycle or loop



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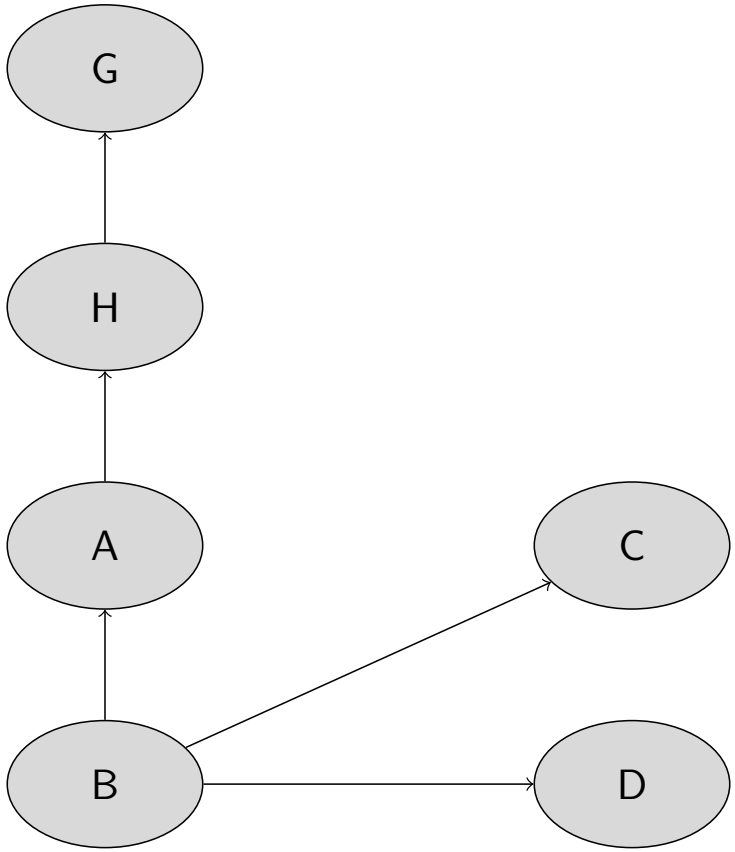
Trees

If a graph contains no cycles and is directed, it is called a tree



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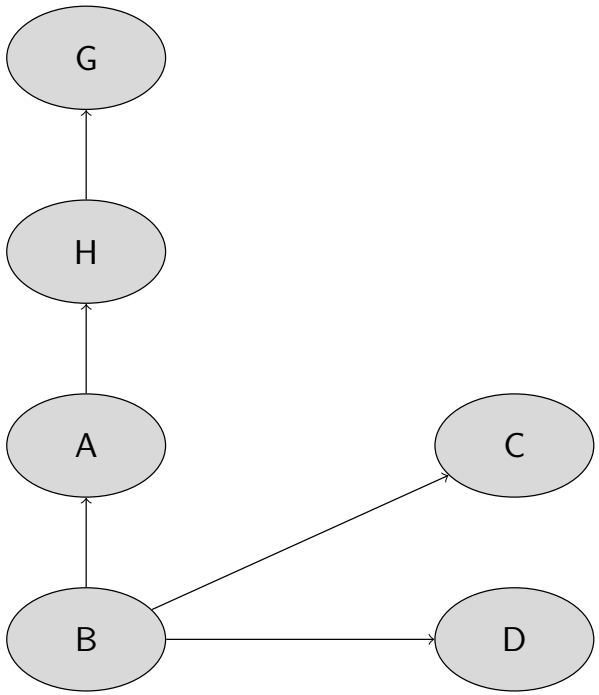
Child, Parent, Ancestor, Sucessor

If $(v, v') \in E$, we say that v is the parent of v' and v' is the child of v

An ancestor of v is any parent of a vertex v' occuring in a path ending at v

A successor of v is any child of a vertex v' occuring in a path starting at v



A, C, D are the children of B
H, G are the successors of A
H is the parent of G
H, A, B are the ancestors of G

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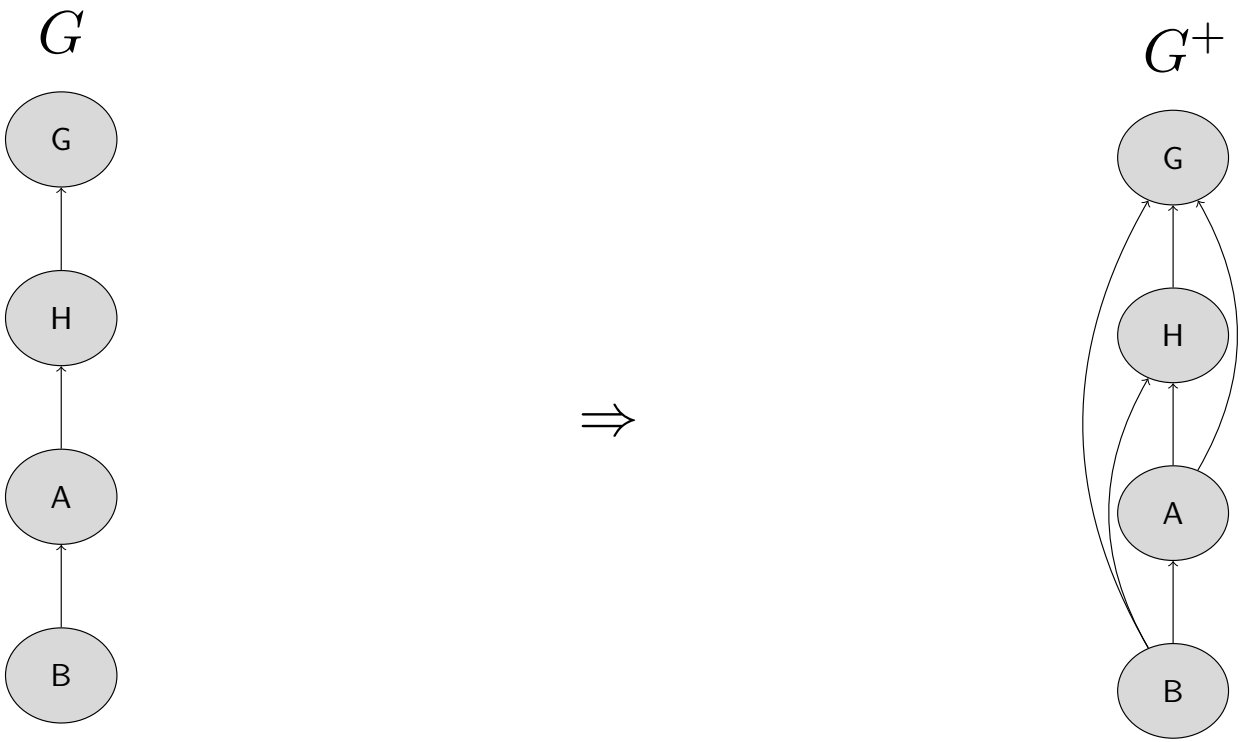
Transitive Closure

The transitive closure $G^+ = (V, E^+)$ of $G = (V, E)$ is the graph derived from G by computing the transitive closure E^+ of E, defined by:

1. if $(v, v') \in E$, $(v, v') \in E^+$
2. if $(v, v') \in E^+$ and $(v', v'') \in E^+$, then $(v, v'') \in E^+$
3. nothing more is in E^+



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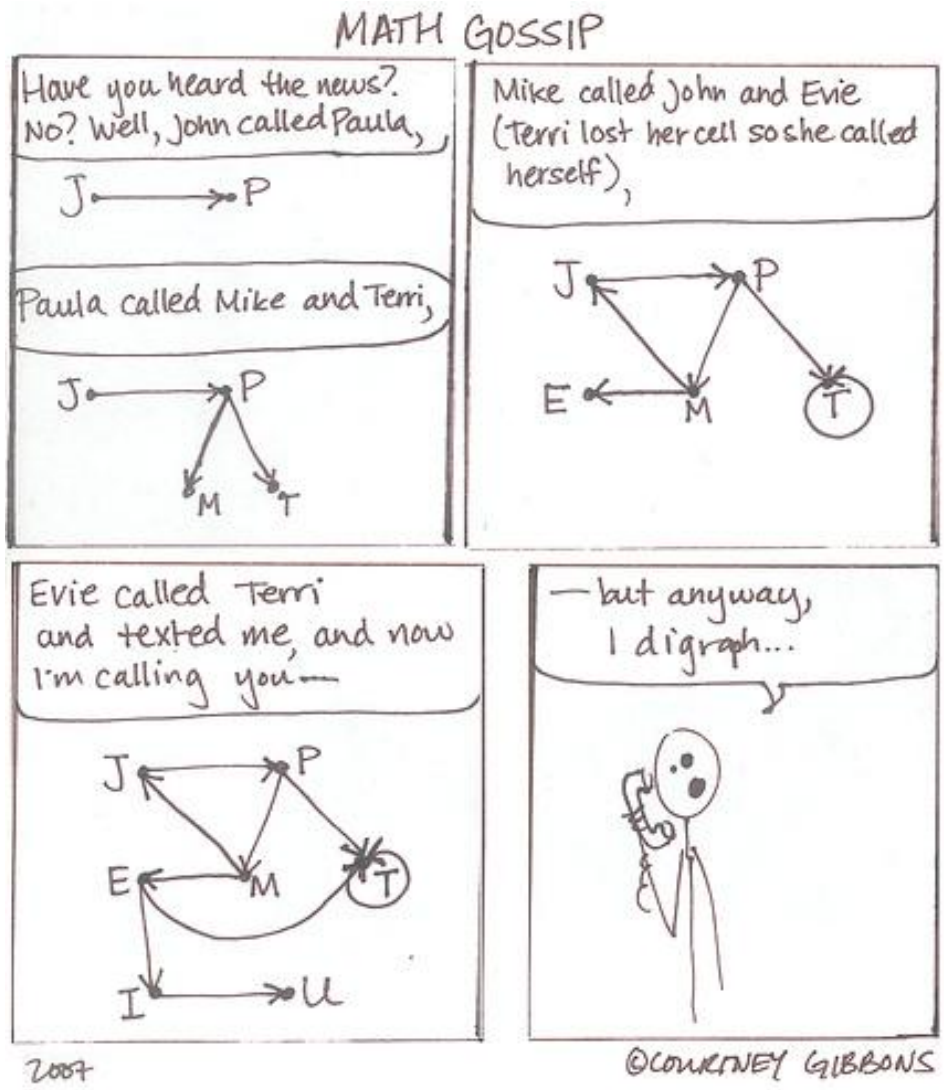
MATH GOSSIP
Have you heard the news? No? Well, John called Paula,
J
P
Paula called Mike and Terri,
J
P
M
T
Mike called John and Evie (Terri lost her cell so she called herself),
J
P
E
M
T
Evie called Terri and texted me, and now I'm calling you—
J
P
E
M
T
I
U
—but anyway, I digraph...
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