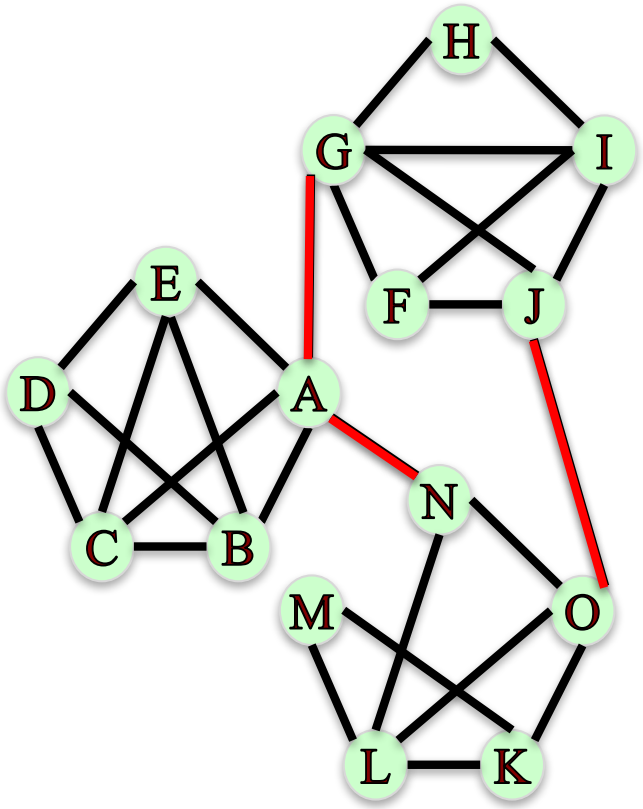
Connected Graphs

An undirected graph is **connected** if, for every pair nodes, there is a path between them.

In: nx.is_connected(G)
Out: True

However, if we remove edges A—G, A—N, and J—O, the graph becomes disconnected.



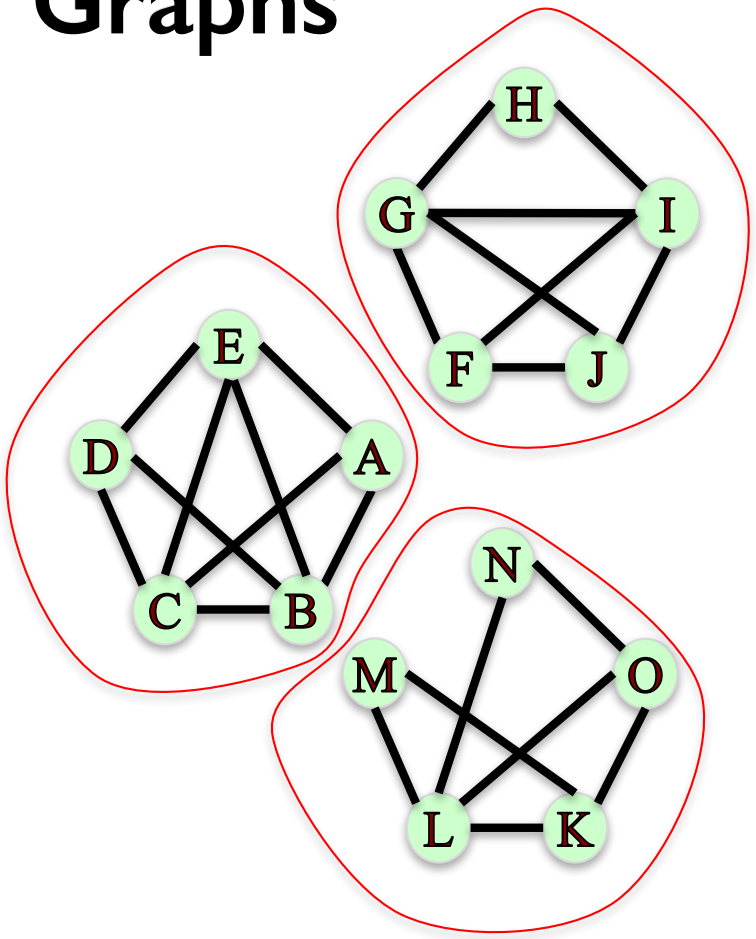
Connected Graphs

An undirected graph is **connected** if, for every pair nodes, there is a path between them.

In: nx.is_connected(G)
Out: True

However, if we remove edges A—G, A—N, and J—O, the graph becomes disconnected.

There is no path between nodes in the three different "communities".



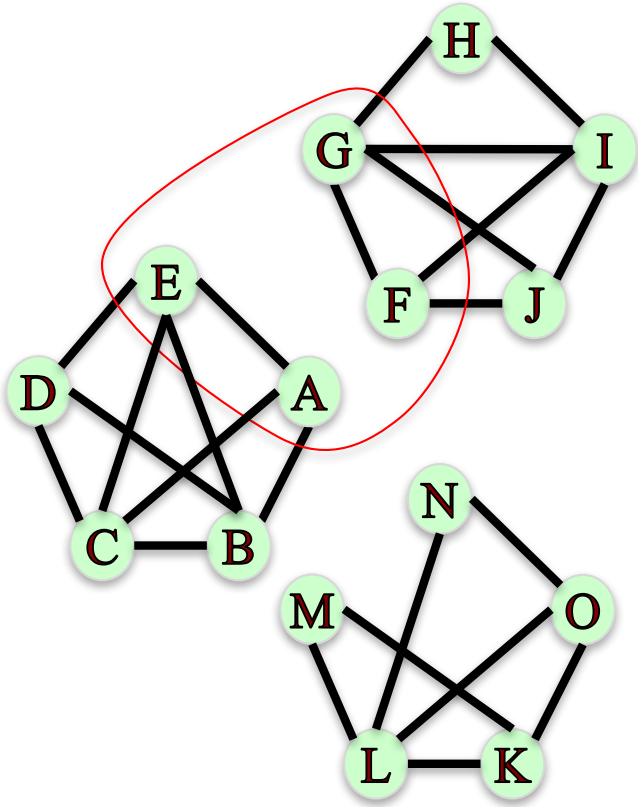
Graph Components

Connected component:
A subset of nodes such as:

i. Every node in the subset has a path to every other node.
ii. No other node has a path to any node in the subset.

Is the subset {E, A, G, F} a connected component?

No, there is no path between nodes A and F.



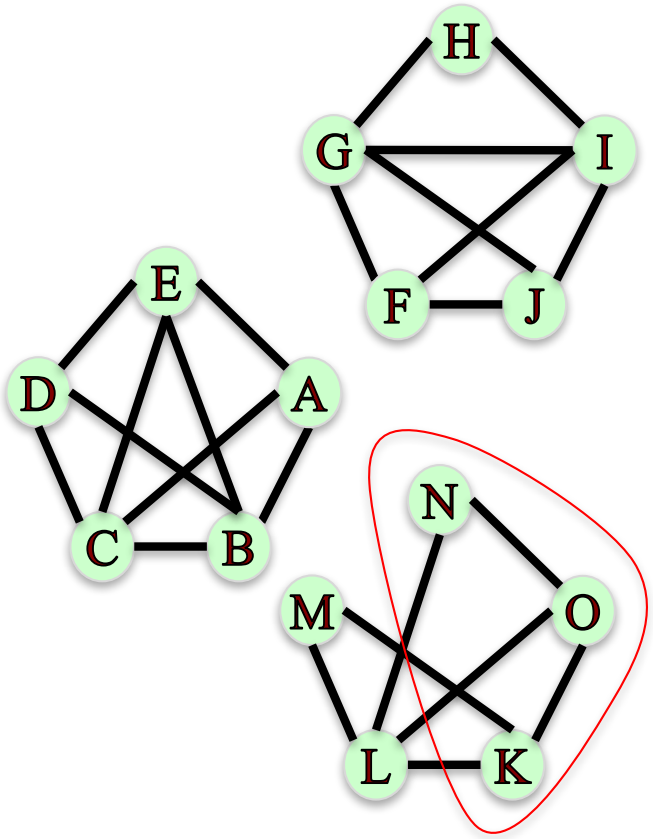
Graph Components

Connected component:
A subset of nodes such as:

i. Every node in the subset has a path to every other node.
ii. No other node has a path to any node in the subset.

Is the subset {N, O, K} a connected component?

No, node L has a path to N, O, and K.



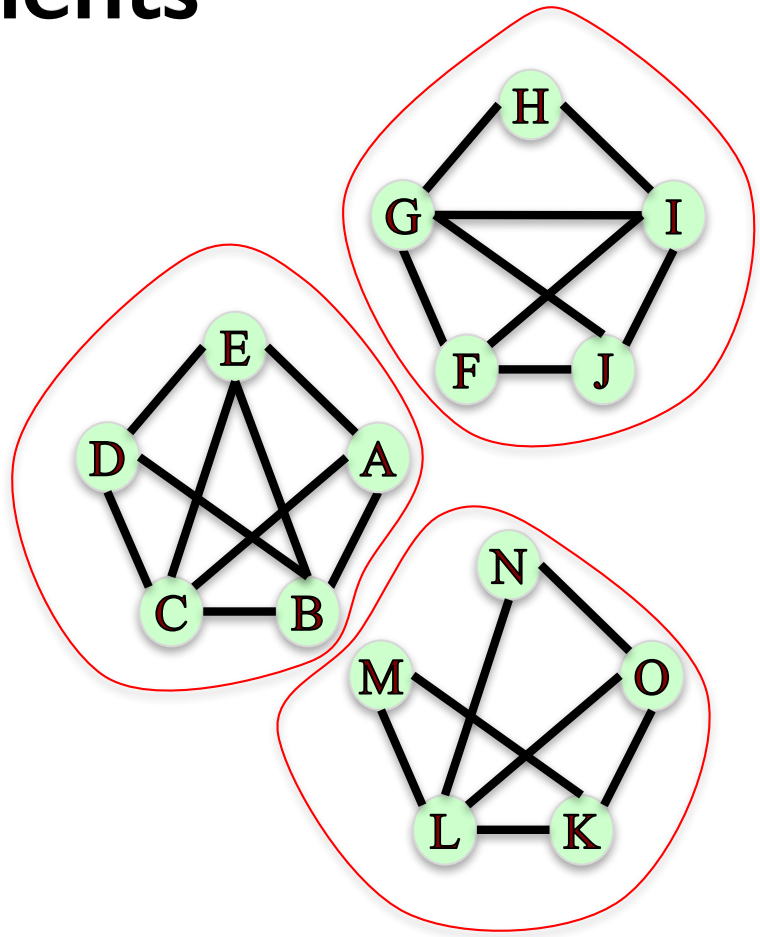
Graph Components

Connected component:
A subset of nodes such as:

i. Every node in the subset has a path to every other node.
ii. No other node has a path to any node in the subset.

What are the connected components in this graph?

{A, B, C, D, E}, {F, G, H, I, J}, {K, L, M, N, O}

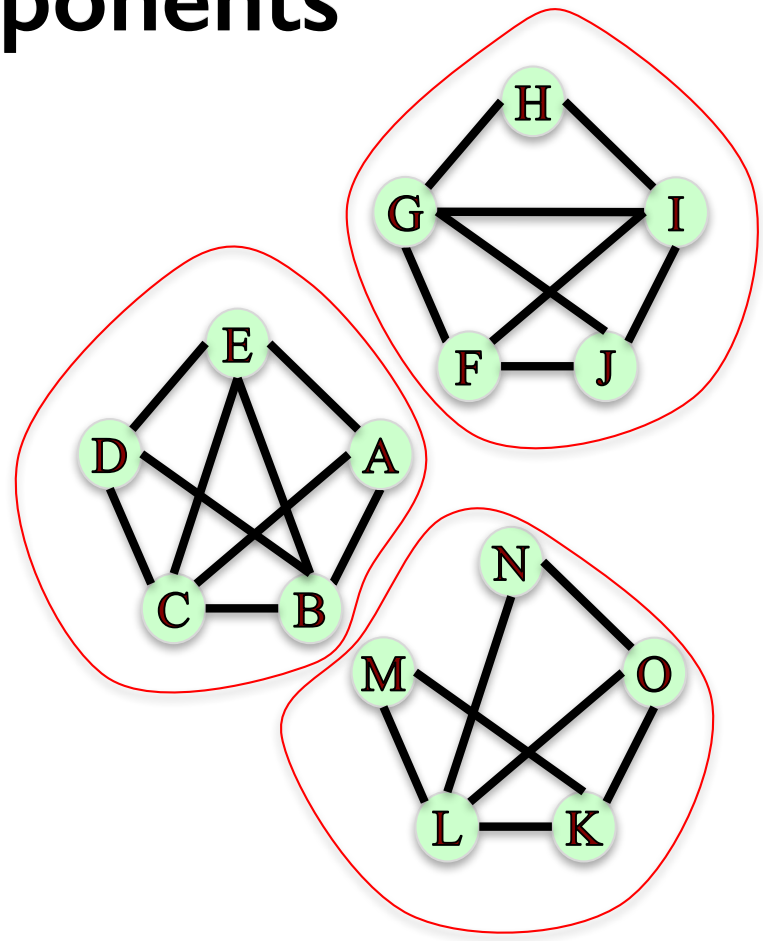


Graph Components

In: nx.number_connected_components(G)
Out: 3

In: sorted(nx.connected_components(G))
Out: [{'A', 'B', 'C', 'D', 'E'},
{'F', 'G', 'H', 'I', 'J'},
{'K', 'L', 'M', 'N', 'O'}]

In: nx.node_connected_component(G, 'M')
Out: {'K', 'L', 'M', 'N', 'O'}

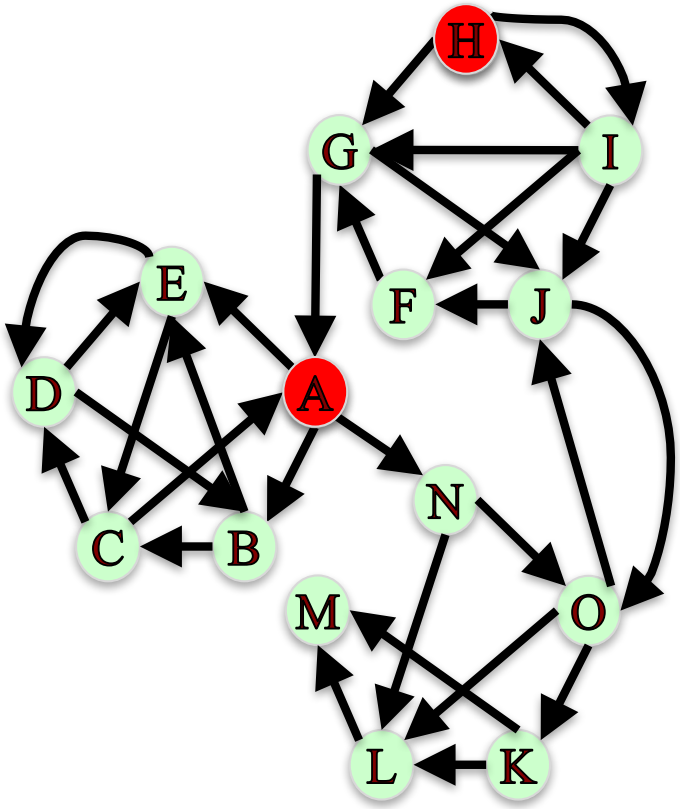


Connectivity in Directed Graphs

A directed graph is **strongly connected** if, for every pair nodes *u* and *v*, there is a directed path from u to v and a directed path from *v* to *u*.

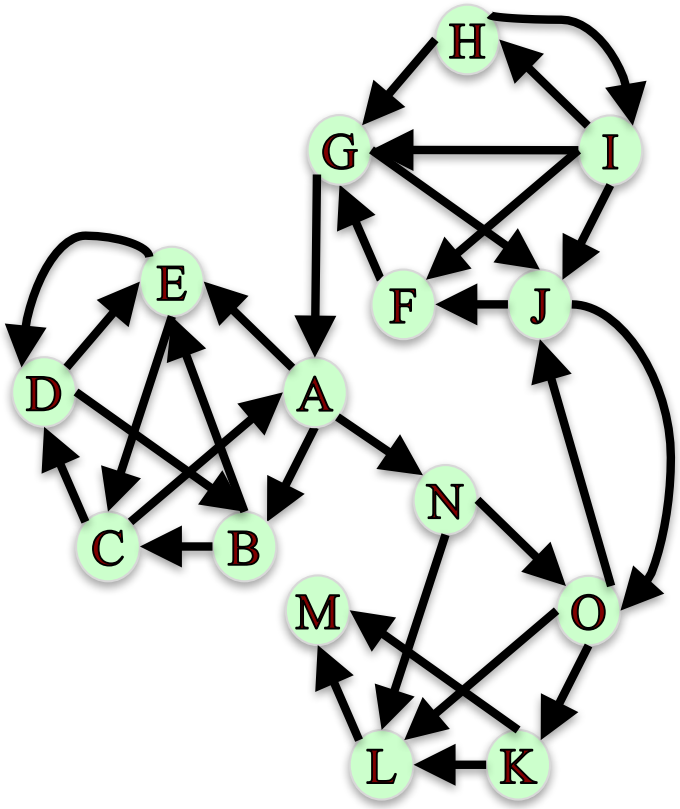
In: nx.is_strongly_connected(G)
Out: False

Note: There is no directed path from A to H



Connectivity in Directed Graphs

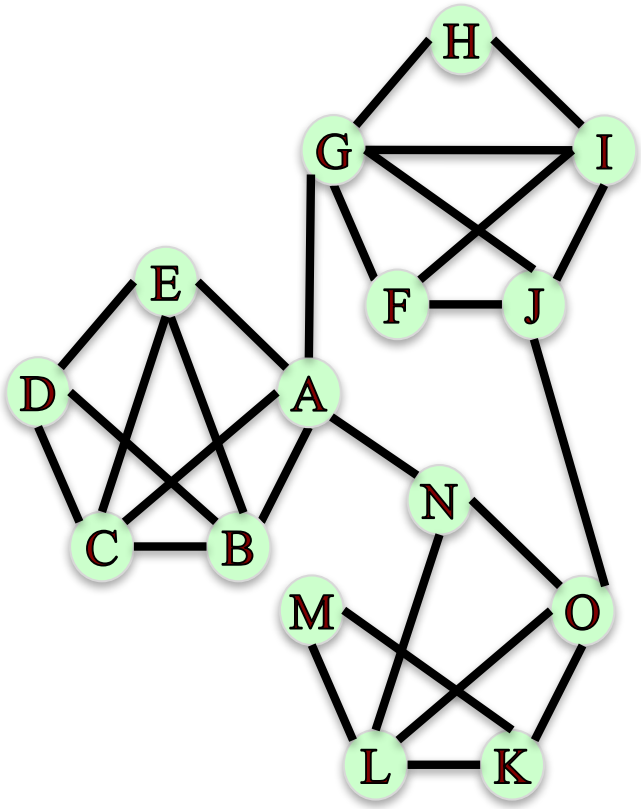
A directed graph is **weakly connected** if replacing all directed edges with undirected edges produces a connected undirected graph.



Connectivity in Directed Graphs

A directed graph is **weakly connected** if replacing all directed edges with undirected edges produces a connected undirected graph.

In: nx.is_weakly_connected(G)
Out: True



Connectivity in Directed Graphs

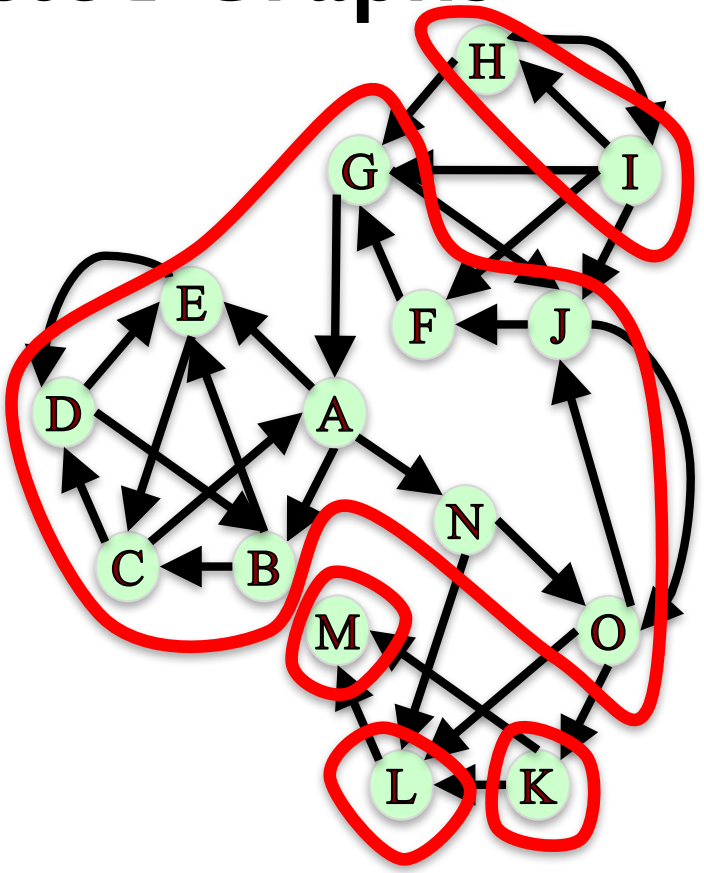
Strongly connected component:
A subset of nodes such as:

i. Every node in the subset has a **directed** path to every other node.
ii. No other node has a **directed** path to every node in the subset.

What are the strongly connected components in this graph?

In: sorted(nx.strongly_connected_components(G))

Out: [{M}, {L}, {K}, {A, B, C, D, E, F, G, J, N, O}, {H, I}]



Connectivity in Directed Graphs

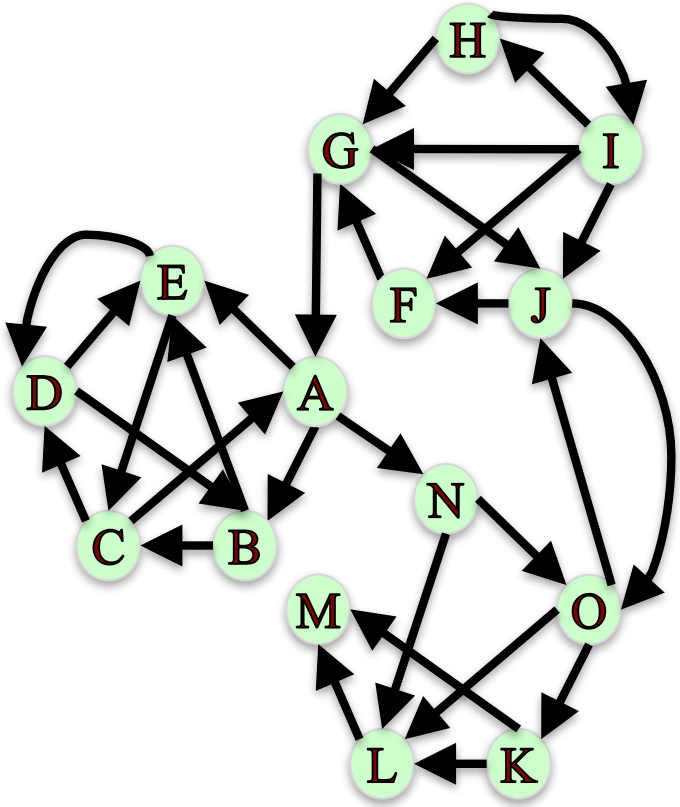
Weakly connected component:

The connected components of the graph after replacing all directed edges with undirected edges.

In: sorted(nx.weakly_connected_components(G))

Out: [{'A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O'}]

Since the graph is weakly connected it only has one weakly connected component.



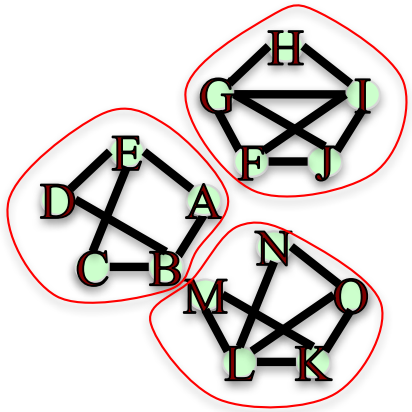
Summary

Undirected Graphs

Connected: for every pair nodes, there is a path between them.

Connected components

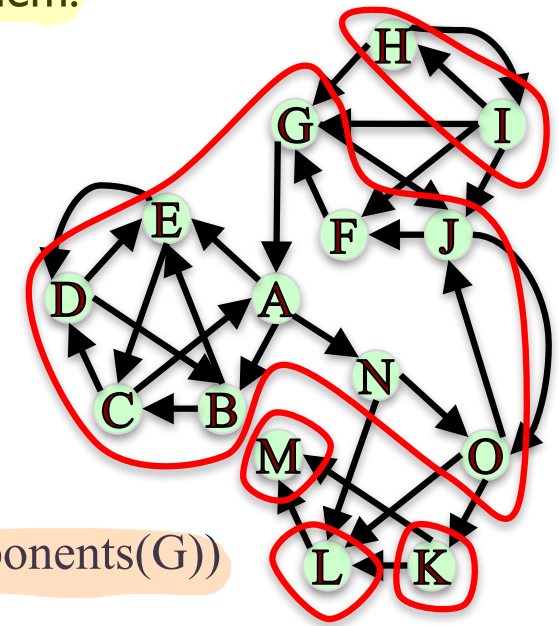
nx.connected_components(G)



Directed Graphs

Strongly connected: for every pair nodes, there is a *directed* path between them.

Strongly connected components



nx.strongly_connected_components(G))