

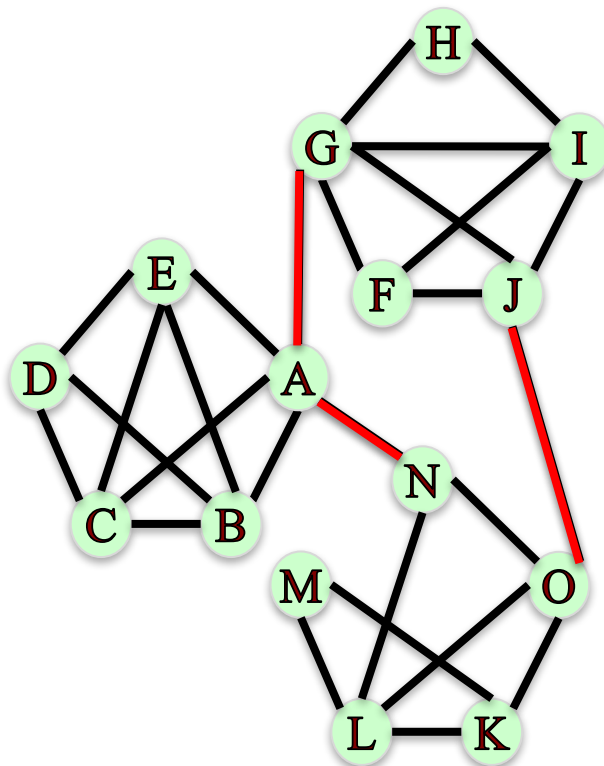
Connected Graphs

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

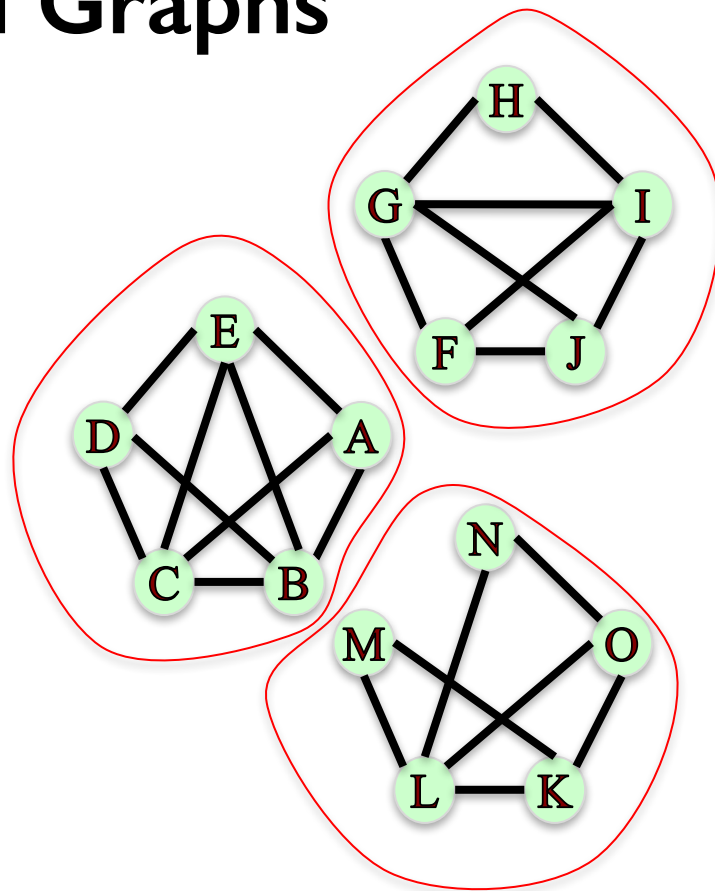
An undirected graph is **connected** if, for every pair nodes, there is a path between them.

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

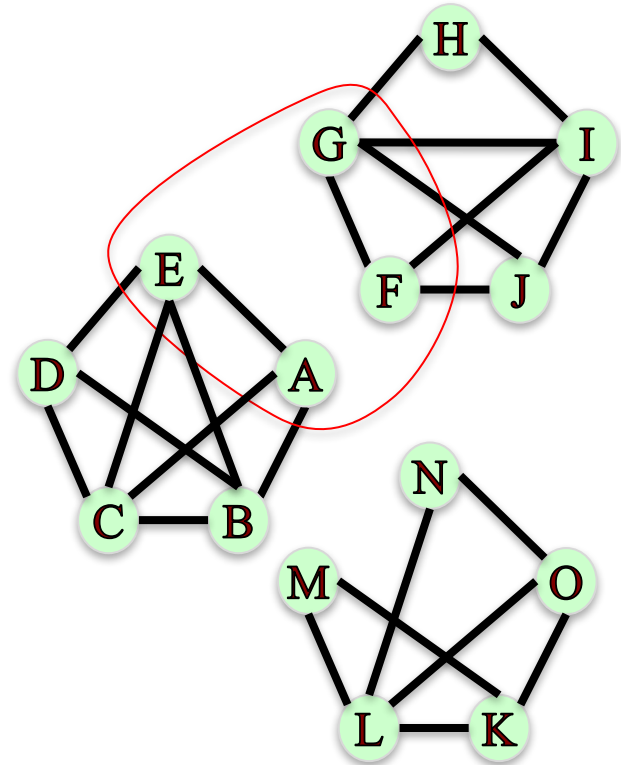
Connected component:

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

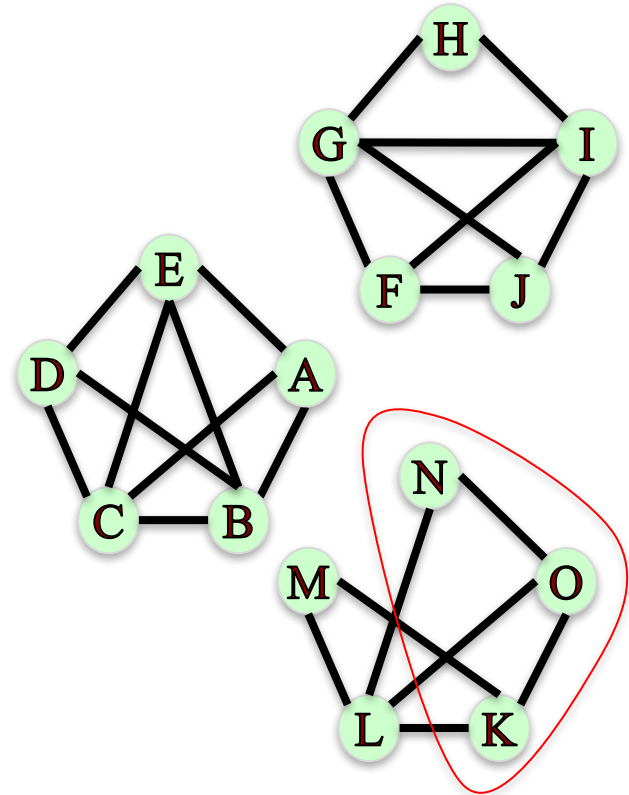
Connected component:

A subset of nodes such as:

- Every node in the subset has a path to every other node.
- 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

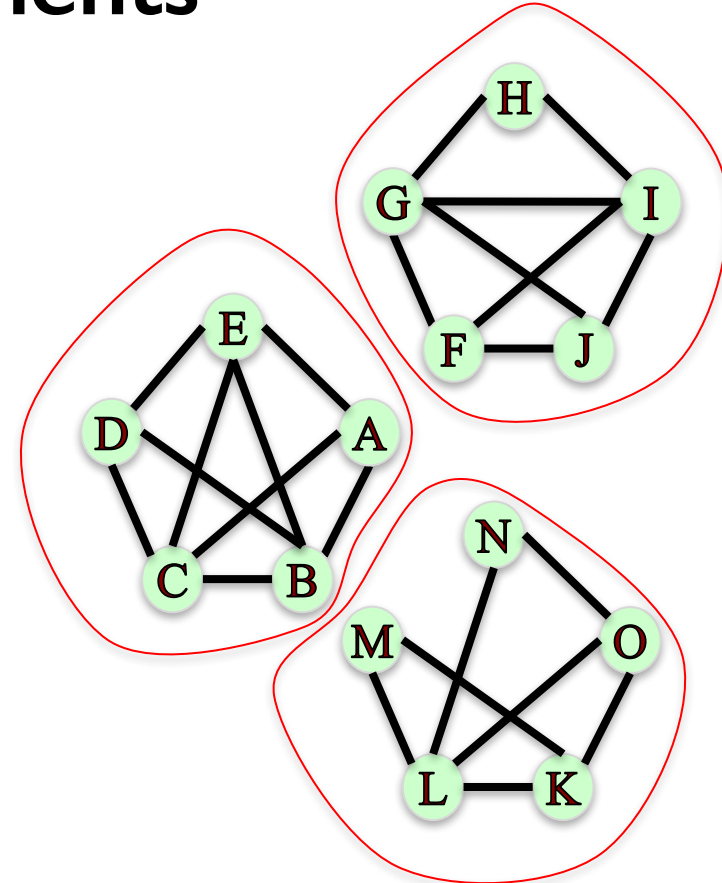
Connected component:

A subset of nodes such as:

- Every node in the subset has a path to every other node.
- 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)
```

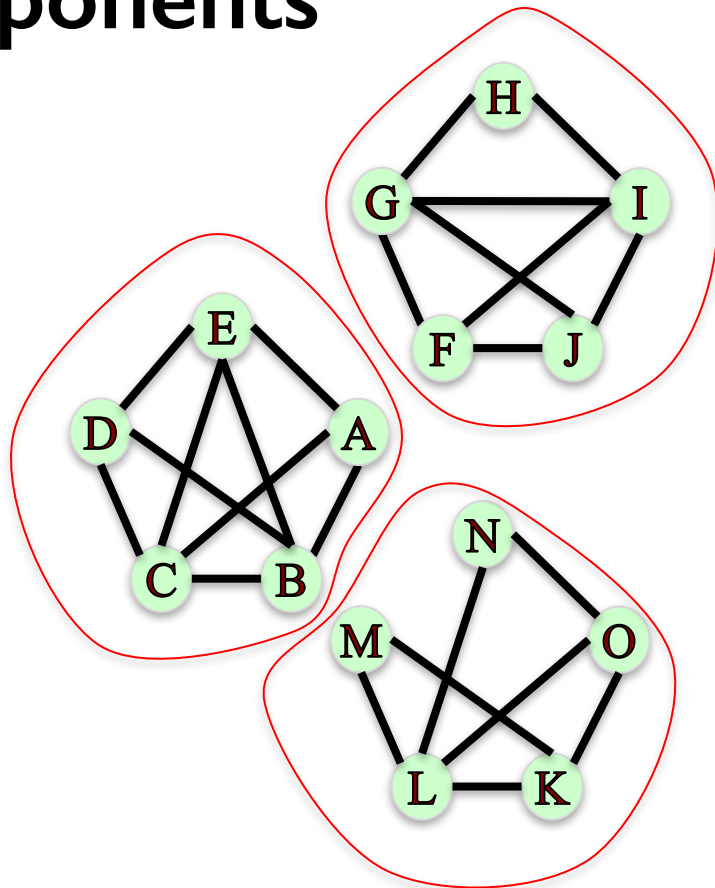
```
Out: 3
```

```
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'}
```



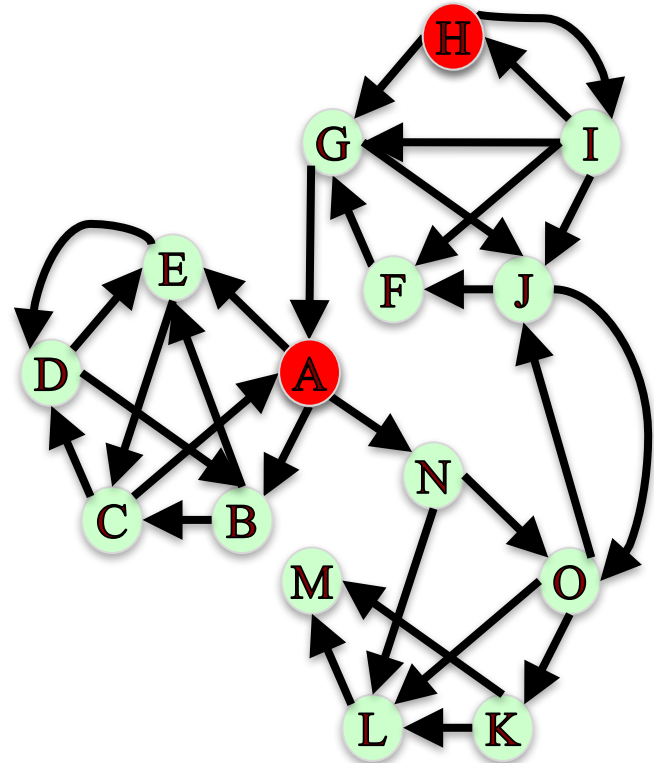
Connectivity in Directed Graphs

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)`

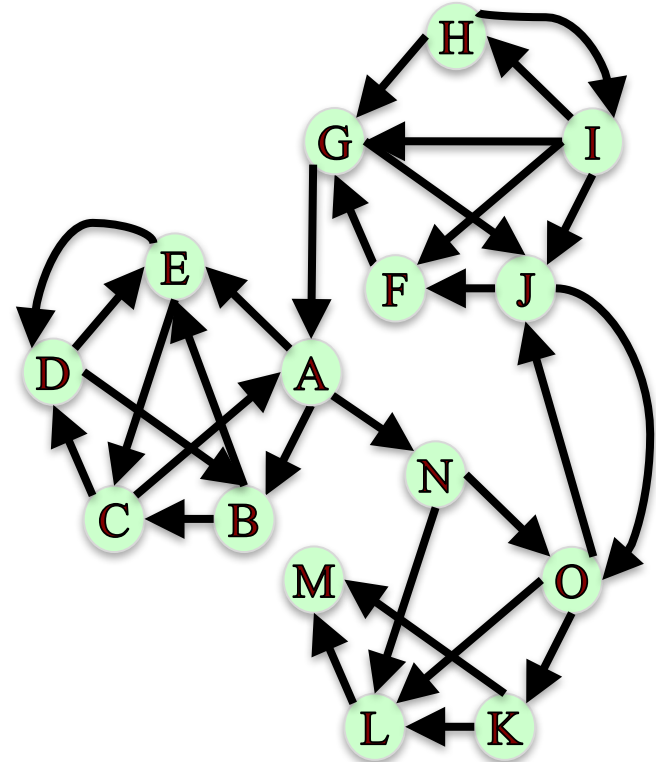
Out: False

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.

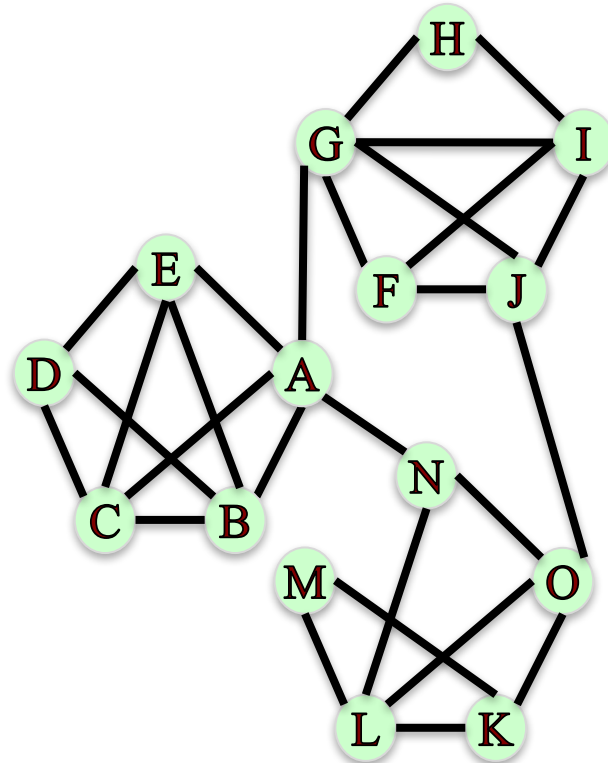


Connectivity in Directed Graphs

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:

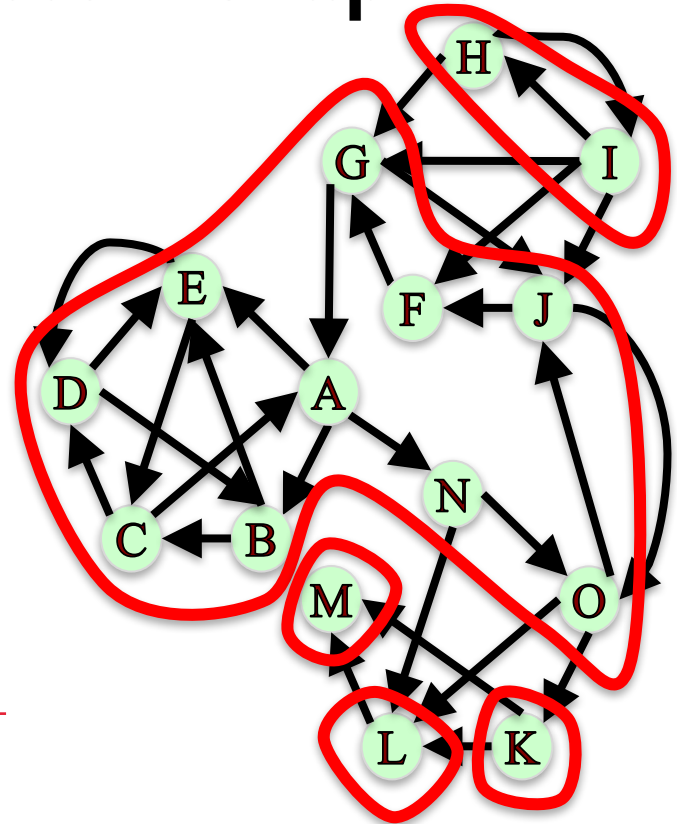
A subset of nodes such as:

- Every node in the subset has a **directed** path to every other node.
- 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

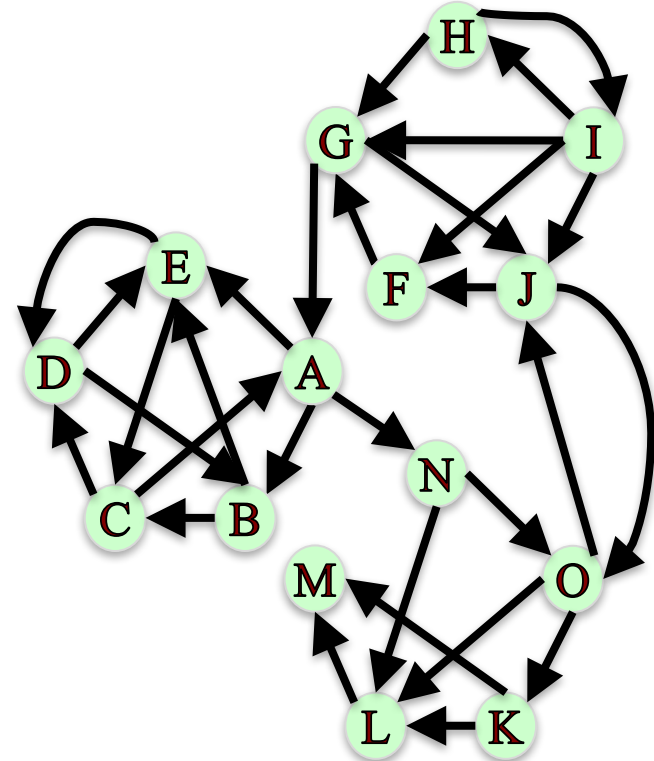
Weakly connected component:

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.



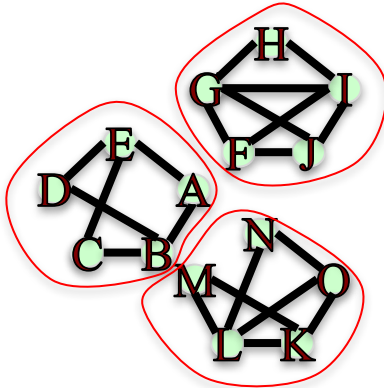
Summary

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))`

