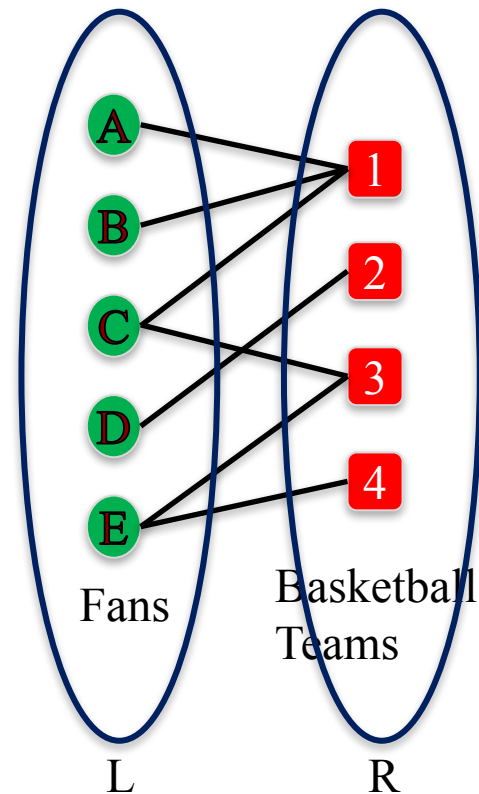


# Bipartite Graphs

**Bipartite Graph:** a graph whose nodes can be split into two sets  $L$  and  $R$  and every edge connects an node in  $L$  with a node in  $R$ .

```
from networkx.algorithms import bipartite
B = nx.Graph() #No separate class for bipartite graphs
B.add_nodes_from(['A','B','C','D', 'E'], bipartite=0) #label one
set of nodes 0
B.add_nodes_from([1,2,3,4], bipartite=1) #label other set of
nodes 1
B.add_edges_from([('A',1), ('B',1), ('C',1), ('C',3), ('D',2), ('E',3),
('E', 4)])
```



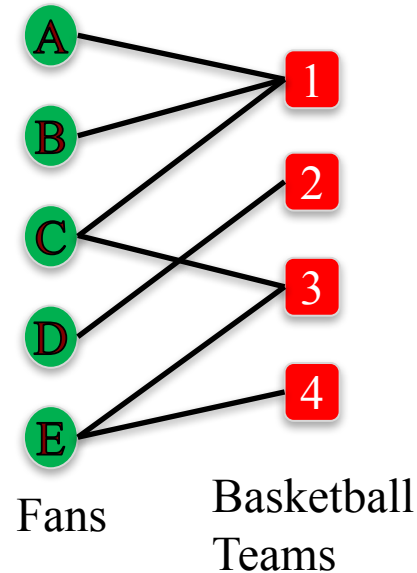
# Bipartite Graphs

Checking if a graph is bipartite:

```
In: bipartite.is_bipartite(B) # Check if B is bipartite  
Out: True
```

```
In: B.add_edge('A', 'B')  
In: bipartite.is_bipartite(B)  
Out: False
```

```
B.remove_edge('A', 'B')
```



# Bipartite Graphs

Checking if a set of nodes is a bipartition of a graph:

```
In: X = set([1,2,3,4])
```

```
In: bipartite.is_bipartite_node_set(B,X)
```

```
Out: True
```

```
X = set(['A', 'B', 'C', 'D', 'E'])
```

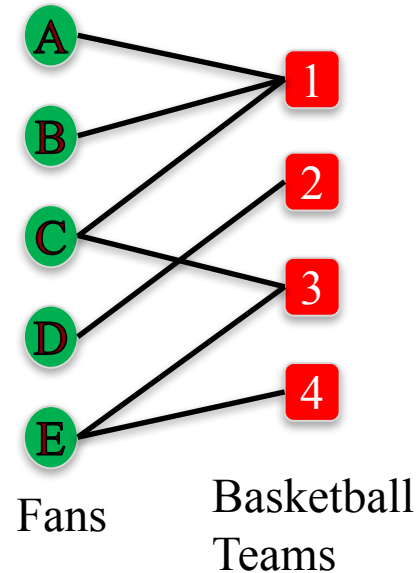
```
In: bipartite.is_bipartite_node_set(B,X)
```

```
Out: True
```

```
X = set([1,2,3,4, 'A'])
```

```
In: bipartite.is_bipartite_node_set(B,X)
```

```
Out: False
```



# Bipartite Graphs

Getting each set of nodes of a bipartite graph:

```
In: bipartite.sets(B)
```

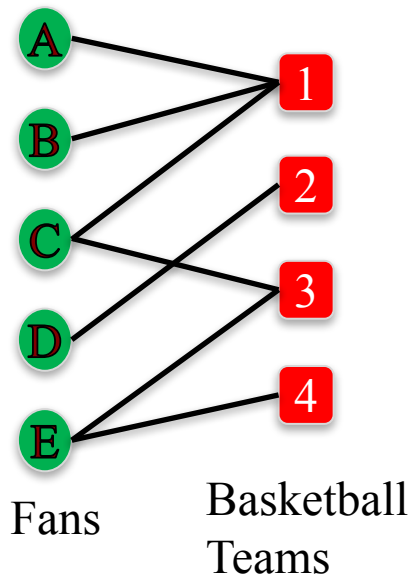
```
Out: ({'A', 'B', 'C', 'D', 'E'}, {1, 2, 3, 4})
```

```
In: B.add_edge('A', 'B')
```

```
In: bipartite.sets(B)
```

```
Out: NetworkXError: Graph is not bipartite.
```

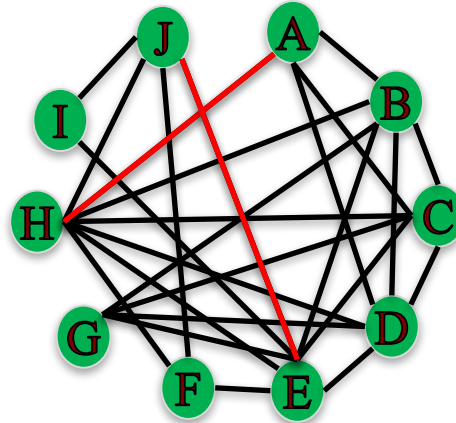
```
B.remove_edge('A', 'B')
```



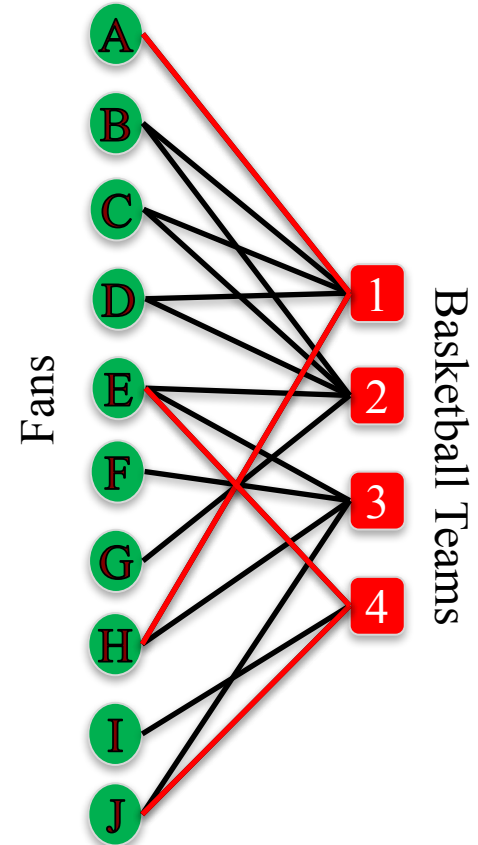
# Projected Graphs

**L-Bipartite graph projection:** Network of nodes in group  $L$ , where a pair of nodes is connected if they have a common neighbor in  $R$  in the bipartite graph.

Similar definition for  $R$ -Bipartite graph projection



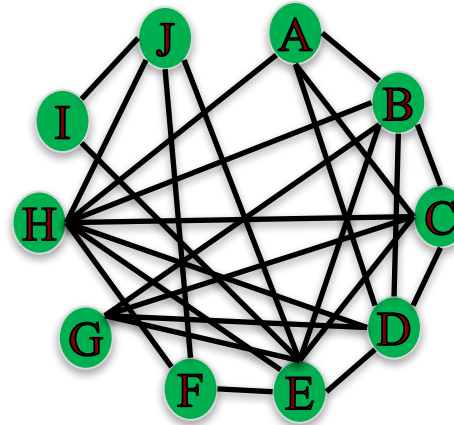
Network of fans who have a team in common



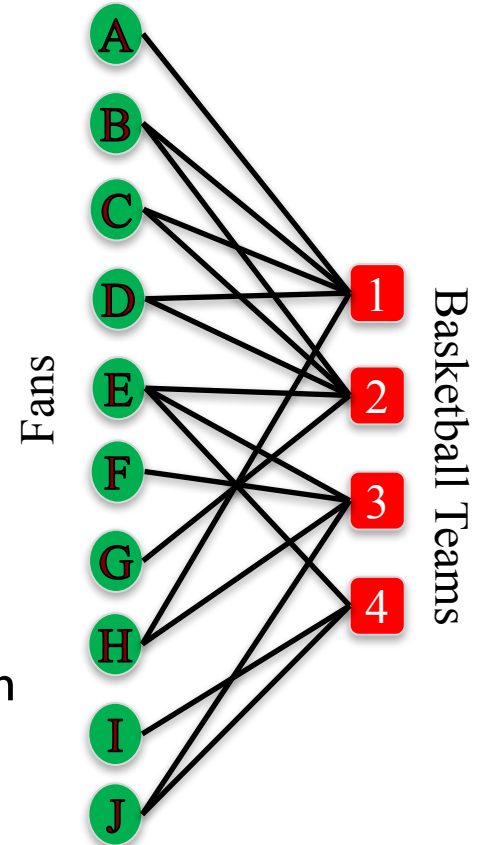
# Projected Graphs

```
B = nx.Graph()
B.add_edges_from([('A',1), ('B',1),
('C',1),('D',1),('H',1), ('B', 2), ('C', 2), ('D',
2),('E', 2), ('G', 2), ('E', 3), ('F', 3), ('H', 3),
('J', 3), ('E', 4), ('I', 4), ('J', 4) ])

X = set(['A','B','C','D', 'E', 'F','G', 'H', 'I','J'])
P = bipartite.projected_graph(B, X)
```



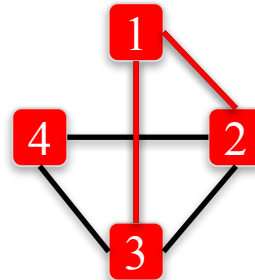
Network of fans who  
have a team in common



# Projected Graphs

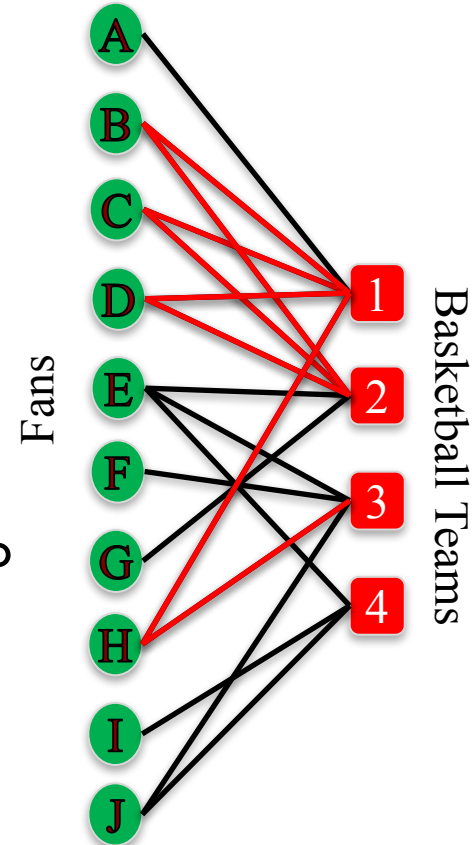
```
B = nx.Graph()
B.add_edges_from([('A',1), ('B',1),
                  ('C',1), ('D',1), ('H',1), ('B', 2), ('C', 2), ('D',
                  2), ('E', 2), ('G', 2), ('E', 3), ('F', 3), ('H', 3),
                  ('J', 3), ('E', 4), ('I', 4), ('J', 4) ])
```

```
X = set([1,2,3,4])
P = bipartite.projected_graph(B, X)
```



Network of teams who  
have a fan common

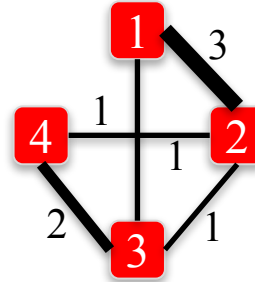
**We need weights on the edges!**



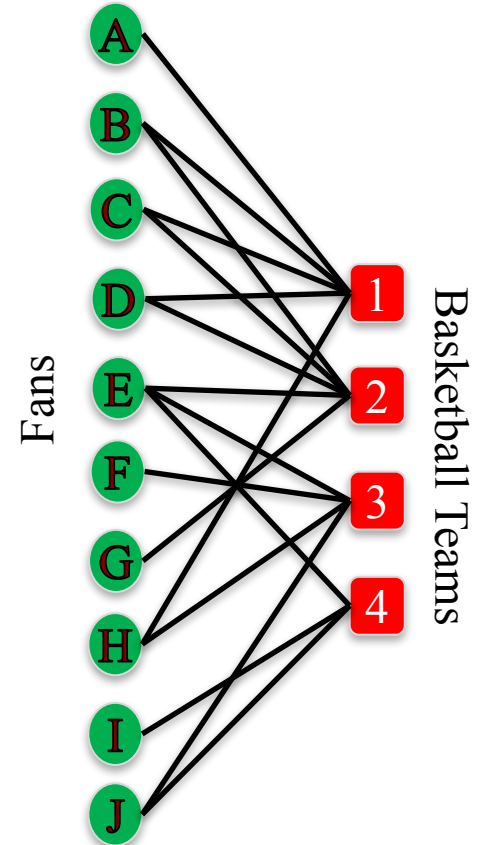
# Projected Graphs

**L-Bipartite weighted graph projection:** An L-Bipartite graph projection with weights on the edges that are proportional to the number of common neighbors between the nodes.

```
X = set([1,2,3,4])  
P = bipartite.weighted_projected_graph(B, X)
```



Weighted Network of  
teams who have a fan  
common





# Summary

No separate class for bipartite graphs in NetworkX

Use `Graph()`, `DiGraph()`, `MultiGraph()`, etc.

Use `from networkx.algorithms import bipartite` for bipartite related algorithms (Many algorithms only work on `Graph()`).

- `nx.bipartite.is_bipartite(B)` # Check if B is bipartite
- `bipartite.is_bipartite_node_set(B,X)` # Check if node set X is a bipartition
- `bipartite.sets(B)` # Get each set of nodes of bipartite graph B
- `bipartite.projected_graph(B, X)` # Get the bipartite projection of node set X
- `bipartite.weighted_projected_graph(B, X)` # Get the weighted bipartite projection of node set X

