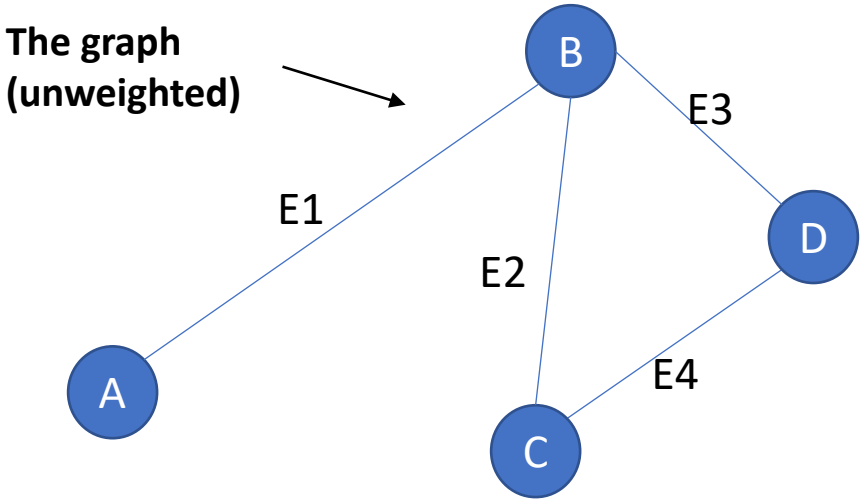
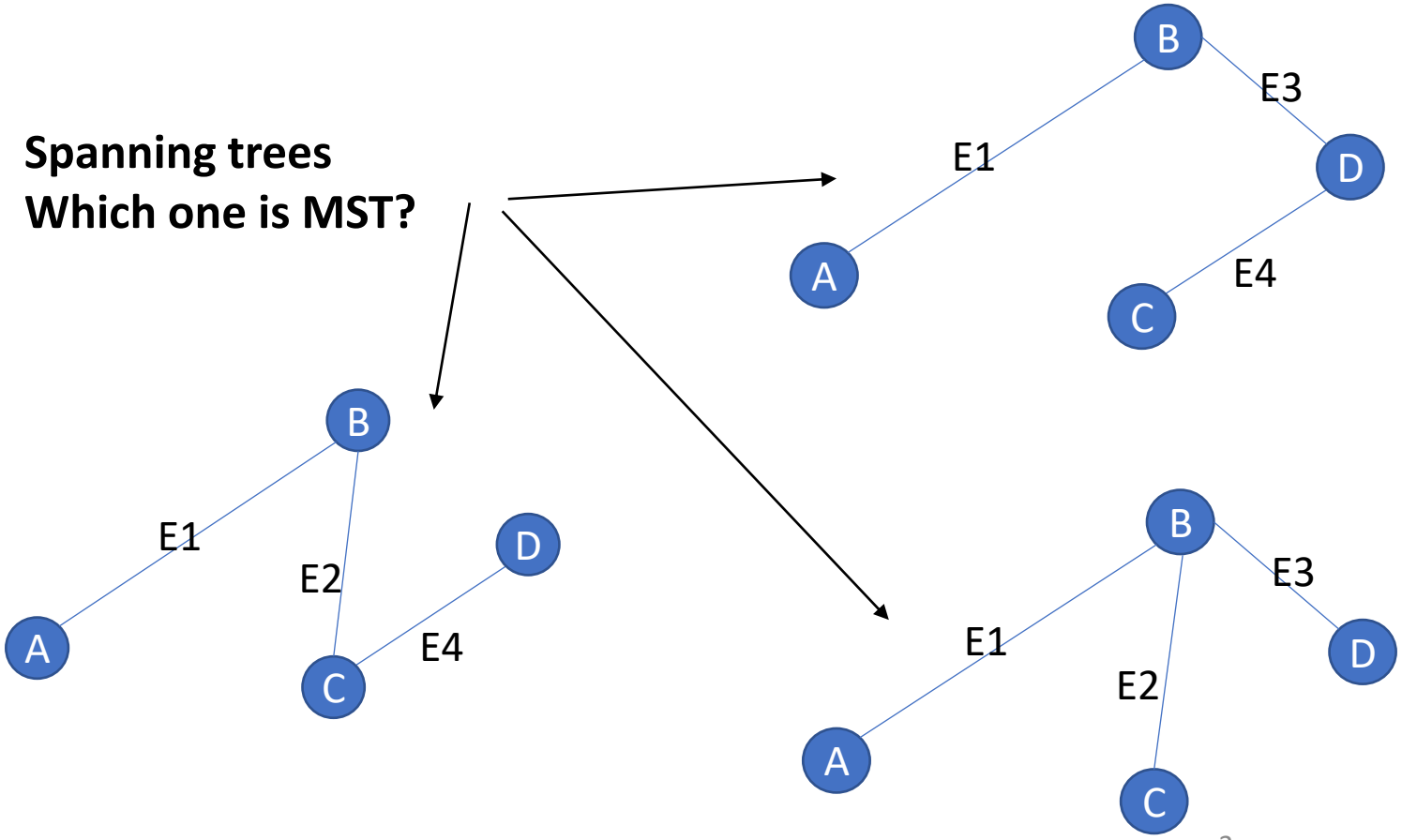
Spanning Tree - short intro

- Spanning tree of an undirected graph is
    - A tree that contains all nodes of the graph, but not necessarily all edges.
    - No cycles (since it's a tree ☺)
    - Connected ← Inference: if a graph is not connected, it does not have a spanning tree.
    - Think of it as an acyclic sub graph of the original graph.
        - And its "spanning" since it spans all the vertices.
    - A given graph may have multiple spanning trees.

- Now, a graph can have multiple spanning trees, since u can start at any vertex.
  - This starting vertex will then be the root of the spanning tree.
  - If a graph has N vertices, its spanning tree will have N-1 edges.





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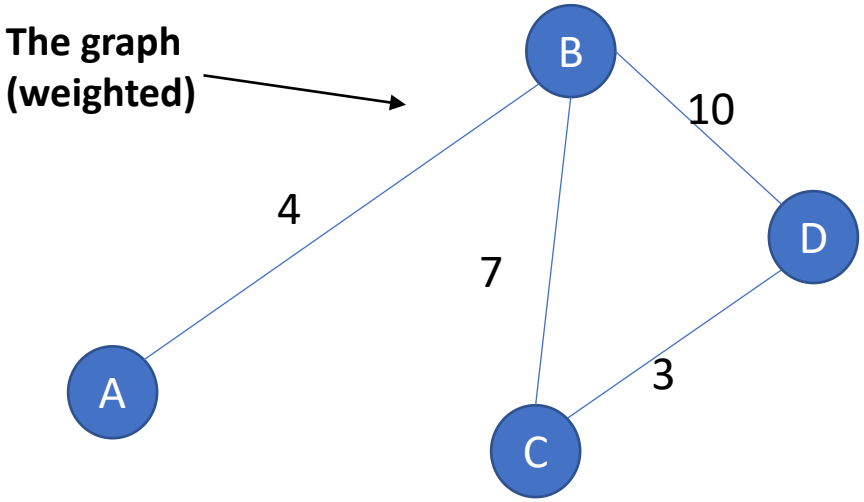

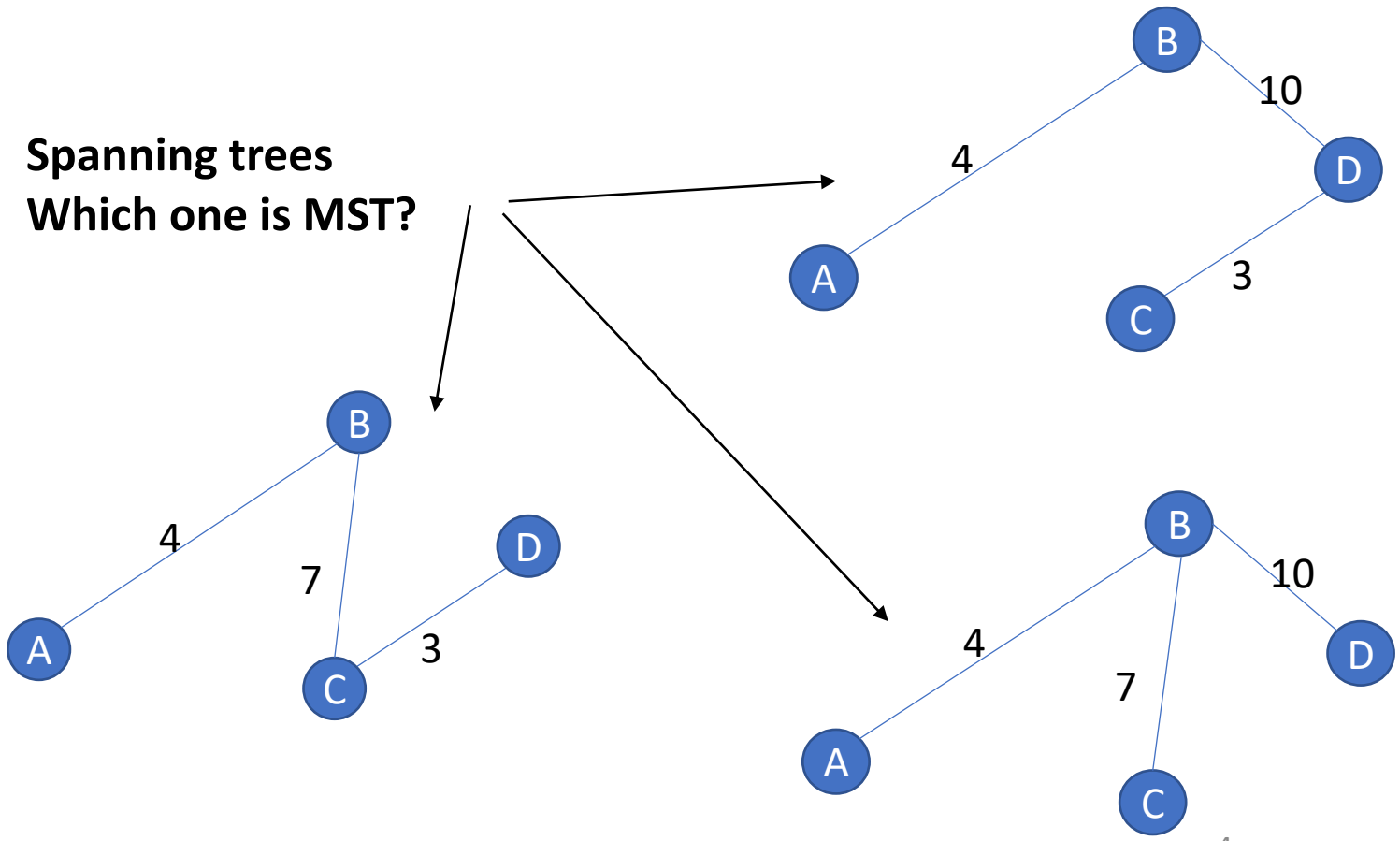

- Now, what we said is that a graph with N vertices will have a spanning tree with N-1 edges.

- If this graph is a weighted graph, then the different spanning trees (all with N-1 edges) may have different total weight (sum of weights of all the edges in the spanning tree).

    - Minimum spanning tree is the one with the lowest cost

- If the graph is unweighted, then all the spanning trees will have the same cost (since they all have N-1 edges and each edge cost can be assumed to be the same).
    - Hence, the MST for an unweighted graph is not unique.

- Minimum spanning tree (aka MST) is a spanning tree with the least cost(cost refers to the edge cost in the MST).
    - This is the shortest path for visiting all nodes from a starting node.
    - Uses:
        - Laying telecom cables.
        - Routing for mail or packages delivery.
            - e.g.: UPS or FedEx.
                - Just an example, not making any statement about either of these companies.

MST algorithms that u can look up:

Prim's algorithm

Kruskal's algorithm