Models of Distributed Computing:
- Shared-Memory, Message Passing

**Message Passing**
- Asynchronous & Synchronous
  - Asynchronous:
    - no bound on message delivery
    - no bound on how fast a processor runs
  - Synchronous:
    - processors execute in lock step
    - the execution is partitioned into rounds & in each round every processor can send a message to all its neighbors, receive messages from all its neighbors & perform computation based on the messages received.
**Message Complexity**
- is the maximum of the total number of messages sent (in all possible execution) for a given input.

\[ n: \text{number of nodes}, \ d: \text{height of tree} \]

What is the message complexity of broadcasting algorithm?

\[ n - 1 \]

**Time Complexity:**

Under Synchronous Model: maximum number of rounds until the algorithm terminates.

- e.g. Time complexity of broadcast algorithm under synchronous model?
  - depth/height of tree - \( d \)
Time complexity in Async. Model:

- Assumes that the maximum delay in any execution is one unit time and then calculates the running time until termination.

- Time complexity of a AMP algorithm is the maximum time until termination among all possible executions for a given input.

Broadcast protocol under AMP model is still $d!$
Distributed Algorithm for Constructing Spanning Tree

Algorithm:
- Start with "root" node and its neighbors as root.
- Include all its children that are not already in the tree.
- Include children's children which are not already in the tree.