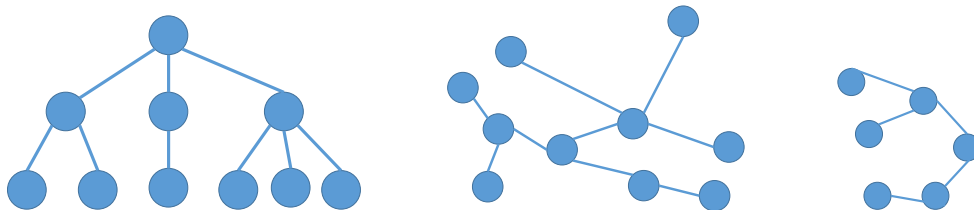


- **ALL WORK THAT YOU HAND IN MUST BE YOUR OWN. THE PENALTIES FOR PLAGIARISM CAN BE SERIOUS.**
  - Please submit your homework solution on the Canvas site as a single PDF file. If you write out your solution on paper, you may scan it in to generate an electronic document – but I need one PDF file, not a collection of JPEGs.
  - All solutions must be accompanied by adequate explanations
  - If you use material from an external source, you should (a) convince me that you have understood the material, rather than just repeating it (b) cite a reference to the external source
  - It is implicit that you must always provide the best possible solution to a problem
  - See the web page for policies related to late submissions
- 1- Consider the graph of Slide 23 (Algorithms). How many breadth-first search traversals of the graph are possible? You do not need to draw all of them, but state your methodology for answering the questions.
  - 2- What properties should a graph have to ensure it has one and only one BFS traversal, assuming we fix the starting node?
    - a. Assume the graph is undirected.
    - b. Assume the graph is directed.
  - 3- A tree is defined as a graph in which there is exactly one path between any two nodes. If the degree of each node is bounded by K, how many BFS traversals does the tree have? An upper bound answer is OK.

Examples of trees are shown below:



(Psst! Did you notice that the left graph and the middle graph were the same?)

- a. Assume the tree is balanced
  - b. Assume the tree is unbalanced
- 4- Prove that it would be impossible to see nodes from more than two “generations” in the queue used by the BFS algorithm. Node  $v_i$  has generation number  $X$ , if its shortest distance from the root node is  $X$  (assuming all edges have weight 1).
  - 5- What is the tightest  $O()$  complexity for the following functions? Provide proofs.

a.  $53 + 2n^3 + 4n^2 \log n$

b.  $T(n) = 2T(n/2) + n^3$

- 6- Show a topological traversal of the following graph. How many other topological traversals does it have? Show your analysis.

