CS330 Recitation 10 *

Questions

1. Compilers often try to rearrange code using precedence graphs: Vertices are statements and a directed edge $S \rightarrow T$ indicates that you need to evaluate $S$ before you can evaluate $T$. Construct a precedence graph for the following program:

- $S_1$ $x := 0$
- $S_2$ $x := x + 1$
- $S_3$ $y := 2$
- $S_4$ $z := y$
- $S_5$ $x := x + 2$
- $S_6$ $y := x + z$
- $S_7$ $z := 4$

2. Does there exist a simple graph with five vertices of these degrees? If so, draw such a graph. If not, give an argument as to why not. Be as rigorous as you can.
   a. 3, 3, 3, 3, 2
   b. 1, 2, 3, 4, 5
   c. 1, 2, 3, 4, 4

3. Are either of the graphs below bipartite? If so, redraw it in bipartite form.

4. Draw a graph from the following adjacency matrix.

\[
\begin{bmatrix}
0 & 0 & 1 & 1 \\
0 & 0 & 1 & 0 \\
1 & 1 & 0 & 1 \\
1 & 1 & 1 & 0 \\
\end{bmatrix}
\]

5. Consider an adjacency matrix for an undirected graph.
   a. What does the sum of a column indicate? Sum of a row?
   b. Repeat (a) but for a directed graph’s adjacency matrix.

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6. Write out adjacency matrix and adjacency list representations of the following graph.

7. Are the two graphs below isomorphic? If so, exhibit an isomorphism (show the correspondence between vertices). Otherwise, provide an argument for why they can’t be isomorphic. Be as rigorous as you can.

8. Repeat the previous question on these two graphs.

9. An Euler path traverses all of the edges exactly once. A Hamiltonian path visits each vertex once. (Not every graph has such paths, but this one does.) Draw Euler and Hamiltonian paths for this multigraph.

10. Repeat the previous problem for this graph:
11. Find the strongly-connected components of each of these graphs.

   a) 
   b) 

12. For the directed graph below, find the number (≥ 0) of paths from a to e of the following lengths.
   a. 2  b. 3  c. 4  d. 5  e. 6  f. 7

12. A communications link in a network should be provided with a backup link if its failure makes it impossible for some message to be sent. What links should be backed for this network? Also, give a rephrasing of the problem in terms of connected components.