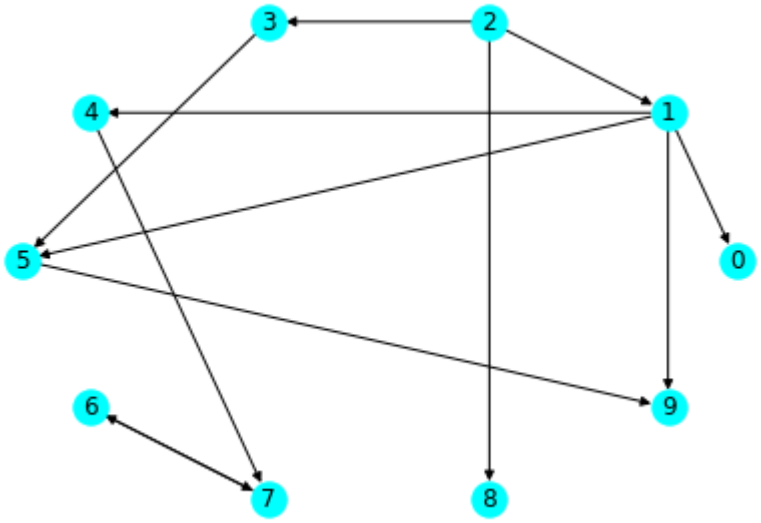
DR.1: I can determine information about a directed graph and its individual vertices and edges using different representations.

Using the directed graph below: Label the in- and out-degrees of each vertex. Then write this digraph as an edge list and as an adjacency matrix.



Additional question: What if there were self-loops?

DR.2: I can give examples of relations on a set that have combinations of the properties of reflexivity, symmetry, antisymmetry, and transitivity.

DR.3: I can determine if a relation is an equivalence relation; I can determine the equivalence class of an element under an equivalence relation and determine whether two elements belong to the same equivalence class.

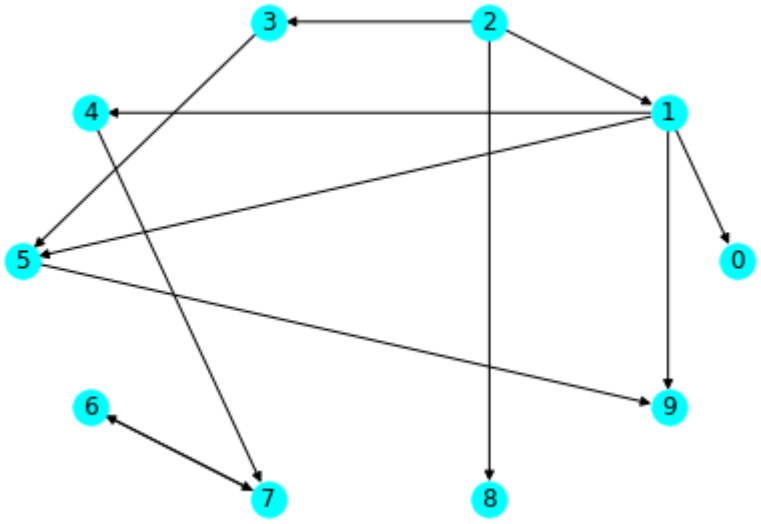
- There are $2^4 = 16$ ways for a relation to have the possible combinations of the reflexive, symmetric, antisymmetric, and transitive properties. Give an example of each, using the set $\{0, 1, 2, 3\}$. (Yes, they are all possible.)
- Decide if each of the following relations on $\mathbb{N} = \{0, 1, 2, 3, \ldots\}$ is an equivalence relation. If it is, pick a number and write out all the elements in its equivalence class.
  - $a \sim b$ if and only if a divides b
  - $a \sim b$ if and only a and b have the same number of `1` bits in their binary representation
  - $a \sim b$ if and only if $ab \leq 10$
  - $a \sim b$ if and only if $a^2 = b^2$

DR.4: I can find the nth order composition of a relation with itself.

DR.5: I can sketch the transitive closure of a relation as a directed graph.

Given the relation r below:

- Draw, then write both the edge list and adjacency matrix, for r^2.
- Draw, then write both the edge list and adjacency matrix, for r^3.
- Draw the directed graph for its transitive closure.



DR.6: I can determine when a set with a relation is a partially ordered set; I can draw the Hasse diagram of a poset and identify maximal/minimal elements and/or greatest/least elements, if they exist.

Generate a random list of integers between 1 and 100 using this website: https://www.random.org/integers/

Put a relation on this list by saying $a \sim b$ if a divides b.

The set of numbers with this relation is a partially ordered set. Draw its Hasse diagram, then identify the maximal, minimal, greatest, and least elements if they exist.