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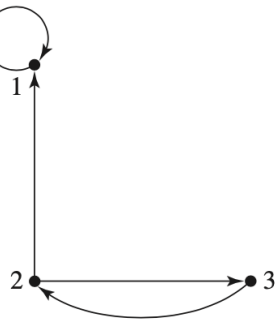
### CSCI-3080 Discrete Structure
### OLA 5: Chapter 7 -- Graphs and Algorithms
### Name:
### Student ID:
### Date:
```

1. Find the adjacency matrix and adjacency relation (binary relation) for the following graph.



In [ ]:

2. Find the corresponding directed graph and adjacency relation (binary relation) for the following adjacency matrix.

$$\mathbf{A} = \begin{bmatrix} 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \end{bmatrix}$$

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3. Given the adjacency relation ρ = {(1, 4), (1, 5), (1, 6), (6, 2), (6, 3), (6, 5)} on the set of nodes {1, 2, 3, 4, 5, 6,} find the corresponding directed graph and adjacency matrix.

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4. Let A be the following matrix. Find the products A^2 and $A^{(2)}$

$$\mathbf{A} = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

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5. Compute the reachability matrix R using the formula R = A ∨ $A^{(2)}$ ∨ ⋯ ∨ $A^{(n)}$ for exercise 2.

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6. Compute the reachability matrix R using Warshall's algorithm for exercise 2.

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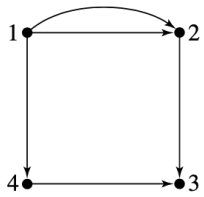
7. For the following graph, count the number of paths of length 2 from node 1 to node 3. Check by computing A^2 (The solution is given)



In [6]:
```
import numpy as np
A = np.array([[0,2,0,1],[0,0,1,0],[0,0,0,0],[0,0,1,0]])
A
```

Out[6]:
```
array([[0, 2, 0, 1],
       [0, 0, 1, 0],
       [0, 0, 0, 0],
       [0, 0, 1, 0]])
```

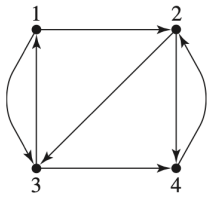
In [4]:
```
A2 = np.matmul(A,A)
A2
```

Out[4]:
```
array([[0, 0, 3, 0],
       [0, 0, 0, 0],
       [0, 0, 0, 0],
       [0, 0, 0, 0]])
```

There are three paths of length 2 from node 1 to node 3.

8.

(1) Determine whether this graph has an Euler path. If so, list the nodes in such a path.
(2) Determine whether this graph has a Hamiltonian circuit. If so, list the nodes in such a circuit.



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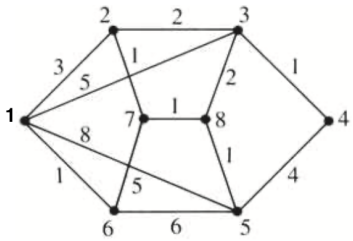
9. Apply Dijkstra's algorithm for the following graph. Show the values for p and IN and the d values and s values for each pass. Write out the nodes in the shortest path from 2 to 5 and the distances of the path.

Hint: p is the current node that has the shortest d that you will include in your current IN set.



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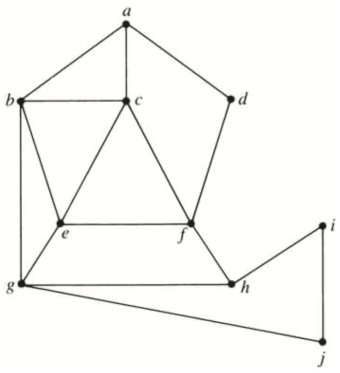
10.

(1) Write the nodes in a depth-first search of the following graph, beginning with the node a.
(2) Write the nodes in a breadth-first search of the following graph, beginning with the node a.



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