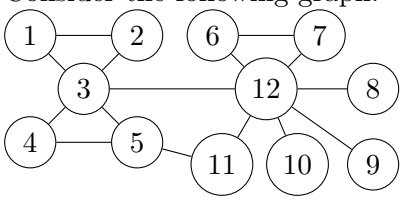
CSCI 347
Homework 03

Show your work. Include any code snippets you used to generate an answer, using comments in the code to clearly indicate which problem corresponds to which code

Consider the following graph:



Answer the following:

1. (3 points) Without using networkx or other graph analysis packages (though you may use them to check your answer), find the closeness centrality of vertices 3 and 12.
   $cc(x_3) = \frac{1}{1+1+0+1+1+2+2+2+2+2+1} = \frac{1}{17}$
   $cc(x_{12}) = \frac{1}{2+2+1+2+2+1+1+1+1+1+0} = \frac{1}{15}$

2. (3 points) Without using networkx or other graph analysis packages (though you may use them to check your answer), find the eccentricity of vertices 3, 12, and 11.
   $e(x_3) = maxdist(x_3, x_i) = 2$
   $e(x_{12}) = maxdist(x_{12}, x_i) = 2$
   $e(x_{11}) = maxdist(x_{11}, x_i) = 3$

3. (3 points) Without using networkx or other graph analysis packages (though you may use them to check your answer), find the clustering coefficient of vertex 3.
   $C(x_3) = \frac{numofedges}{numofpossibleedges} = \frac{2}{10} = \frac{1}{5}$

4. (3 points) Without using networkx or other graph analysis packages (though you may use them to check your answer), find the clustering coefficient of the graph.
   $C(X) = C(x_1) + C(x_2) + C(x_{...}) + C(x_{12})/12$
   $C(x_1) = \frac{1}{1} = 1$
   $C(x_2) = \frac{1}{1} = 1$
   $C(x_3) = \frac{1}{5}$
   $C(x_4) = \frac{1}{1} = 1$
   $C(x_5) = \frac{1}{3}$
   $C(x_6) = \frac{1}{1} = 1$
   $C(x_7) = \frac{1}{1} = 1$
   $C(x_8) = 0$
   $C(x_9) = 0$
   $C(x_{10}) = 0$
   $C(x_{11}) = 0$
   $C(x_{12}) = \frac{1}{21}$
   $C(X) = 5.58/12 = \mathbf{0.465}$

5. (3 points) Find the betweenness centrality of vertices 3 and 12. You may use networkx or other graph analysis packages, but include the code used to generate your answer in your submission.

```
import matplotlib.pyplot as plt
import networkx as nx
G = nx.Graph()
G.add_node(1)
G.add_nodes_from([1,2,3,4,5,6,7,8,9,10,11,12])
G.add_edges_from([(1, 2), (1, 3), (2, 3), (3, 4), (3, 5), (3, 12),
                  (4, 5), (5, 11), (6, 7), (6, 12), (7, 12), (8, 12),
                  (9, 12), (10, 12), (11, 12)])

between = nx.betweenness_centrality(G)
print("betweeness centrality: ", between)


nx.draw(G, with_labels=True)
plt.draw()
plt.show()
```

Returns betweeness centrality $x_3 = 0.491, x_{12} = 0.763$

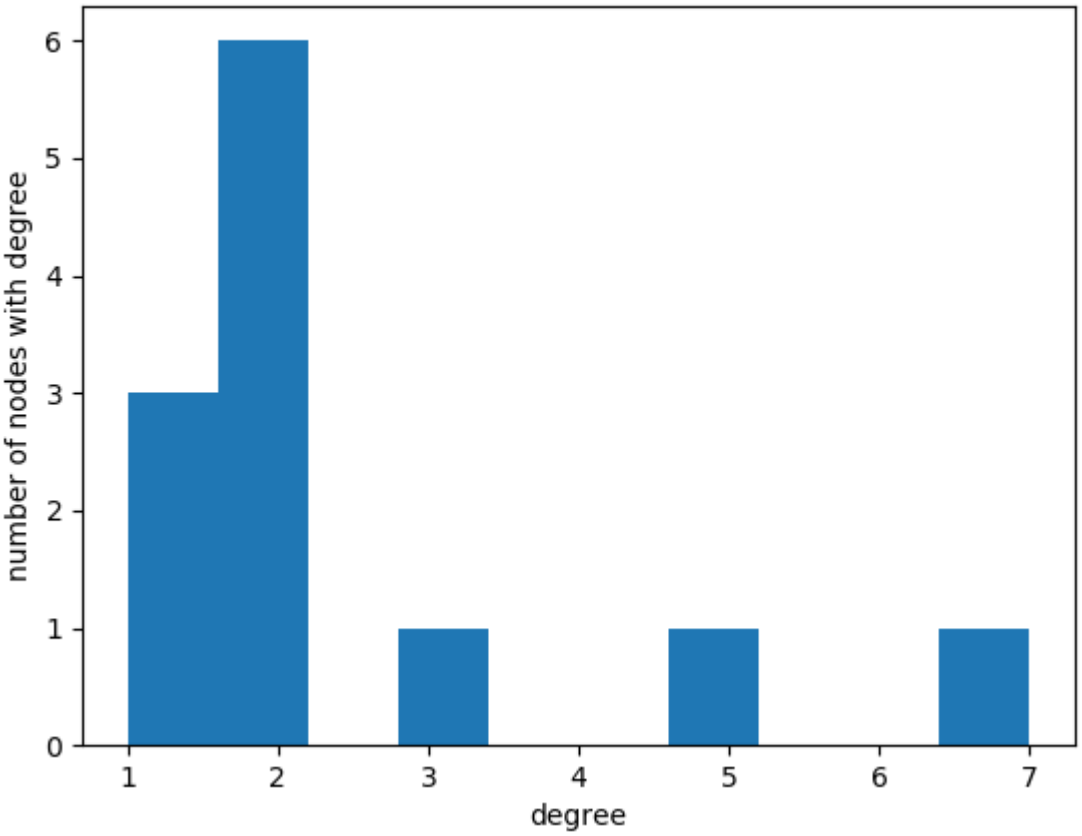
6. (3 points) Using networkx, find the prestige centrality of vertices 3 and 12. Include the code used to generate the answer. (Note that networkx calls the prestige centrality "eigenvector centrality")

```
##Continuing with code from questions #5
prestige = nx.eigenvector_centrality(G)
print(prestige)
```

Returns prestige centrality of $x_3 = 0.465, x_{12} = 0.531$

7. (3 points) Use Python to create a plot for the degree distribution of this graph. Include the code used to generate the plot as well as the plot in your submission.

```
deg_vals = dict(nx.degree(G)).values()
plt.hist(deg_vals)
plt.xlabel('degree')
plt.ylabel('number of nodes with degree')
plt.show()
```



Acknowledgements: Homework problems adapted from assignments of Veronika Strnadova-Neeley.