Problem 3 [Networking]

Given n=50 people at a networking event. Imagine that **any given unordered pair of two people connect at random and independently with probability p**. Generate and plot sample networks for each value of p={0.02, 0.09}. Briefly discuss the structure of these sample graphs.

You will need to learn to use functions for plotting networks in the next questions. Recent versions of MATLAB have built-in network plotting functions. Python and R have the iGraph library. Python also has the networkx library.

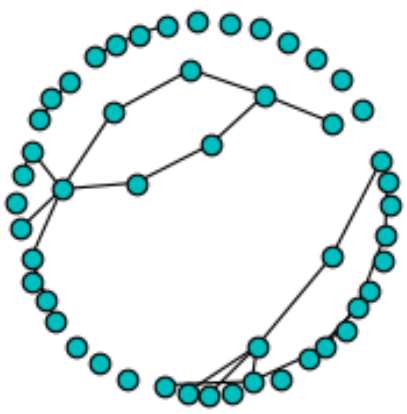
We use a Lower Triangular Matrix to denote the connection of each point. $x_{ij} \in \{1, 0\}$

$$S = \begin{bmatrix} 0 & 0 & 0 & \dots & 0 \\ x_{12} & 0 & 0 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots \\ x_{1n} & x_{2n} & x_{3n} & \dots & 0 \end{bmatrix}$$

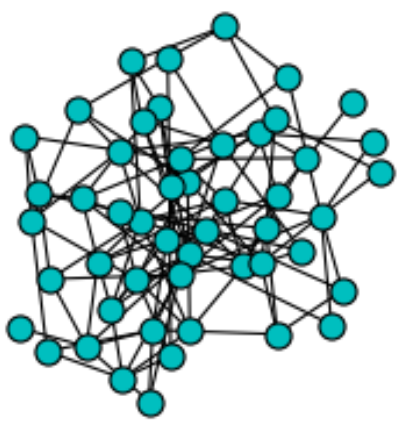
In [6]:

```
%matplotlib notebook
import numpy as np
import matplotlib.pyplot as plt
import networkx as nx
# Initialize the network graph.
G1 = nx.Graph()
G2 = nx.Graph()
# Generate n = 50 points add add them to the graph.
npeople = np.arange(1,50,1)
G1.add_nodes_from(npeople)
G2.add_nodes_from(npeople)
# Generate the connection of points and get the edges
s = np.random.rand(50,50)
s = np.tril(s,k=-1)
edges1 = np.argwhere(s>=1-0.02)
edges2 = np.argwhere(s>=1-0.09)
# The p threshold is log(n)/n
# Add the edges to the graph.
G1.add_edges_from(edges1)
G2.add_edges_from(edges2)
# Plot the network graph.
plt.subplot(121)
nx.draw(G1,node_size=60,edge_color='k', node_color='c')
plt.title('p = 0.02')
plt.axis('equal')
plt.show()
plt.subplot(122)
nx.draw(G2,node_size=100,edge_color='k',node_color='c')
plt.title('p = 0.09')
plt.axis('equal')
plt.show()
```

p = 0.02



p = 0.09



In these graphes, one point can connect to others randomly. When the connect probability increases, the number of edges are also increasing.