Untitled

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1 In-Class Exercise

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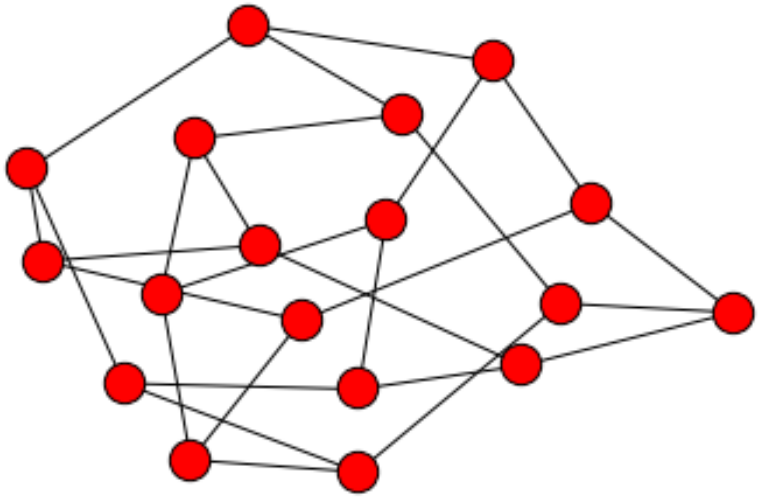
In [2]:
```
import  networkx  as nx
import  matplotlib.pyplot  as plt
F = nx.powerlaw_cluster_graph (9, 1, 0.4)
G = nx.barabasi_albert_graph (100, 2)
H = nx.grid_2d_graph (10, 10)
I = nx.complete_graph (10)
J = nx.cycle_graph (10)
K = nx.erdos_renyi_graph (100,  0.01)
```

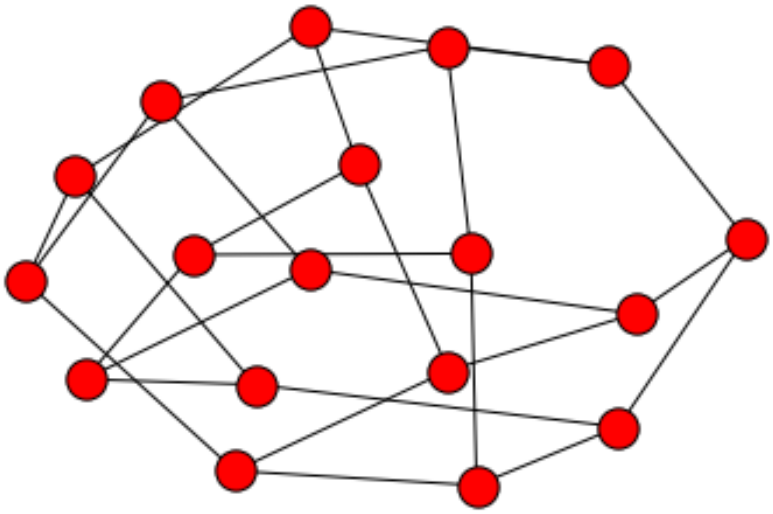
In [3]:
```
import  networkx  as nx
import  matplotlib.pyplot  as plt
import  numpy  as np
%matplotlib inline

L = nx.pappus_graph ()
nx.draw(L)
plt.show()

a = nx.adjacency_matrix(L)
print(a)
l = nx.laplacian_matrix(L)
l = l.todense ()
w, v = np.linalg.eig(l)
print(w)
```



```
(0, 1)        1
  (0, 5)        1
  (0, 17)        1
  (1, 0)        1
  (1, 2)        1
  (1, 8)        1
  (2, 1)        1
  (2, 3)        1
  (2, 13)        1
  (3, 2)        1
  (3, 4)        1
  (3, 10)        1
  (4, 3)        1
  (4, 5)        1
  (4, 15)        1
  (5, 0)        1
  (5, 4)        1
  (5, 6)        1
  (6, 5)        1
  (6, 7)        1
  (6, 11)        1
  (7, 6)        1
  (7, 8)        1
  (7, 14)        1
  (8, 1)        1
  :        :
  (9, 16)        1
```

```
  (10, 3)        1
  (10, 9)        1
  (10, 11)        1
  (11, 6)        1
  (11, 10)        1
  (11, 12)        1
  (12, 11)        1
  (12, 13)        1
  (12, 17)        1
  (13, 2)        1
  (13, 12)        1
  (13, 14)        1
  (14, 7)        1
  (14, 13)        1
  (14, 15)        1
  (15, 4)        1
  (15, 14)        1
  (15, 16)        1
  (16, 9)        1
  (16, 15)        1
  (16, 17)        1
  (17, 0)        1
  (17, 12)        1
  (17, 16)        1
[  6.00000000e+00  -3.53883589e-16   3.00000000e+00   3.00000000e+00
   4.73205081e+00   3.00000000e+00   4.73205081e+00   4.73205081e+00
   3.00000000e+00   1.26794919e+00   1.26794919e+00   4.73205081e+00
   4.73205081e+00   1.26794919e+00   1.26794919e+00   1.26794919e+00
   1.26794919e+00   4.73205081e+00]
```

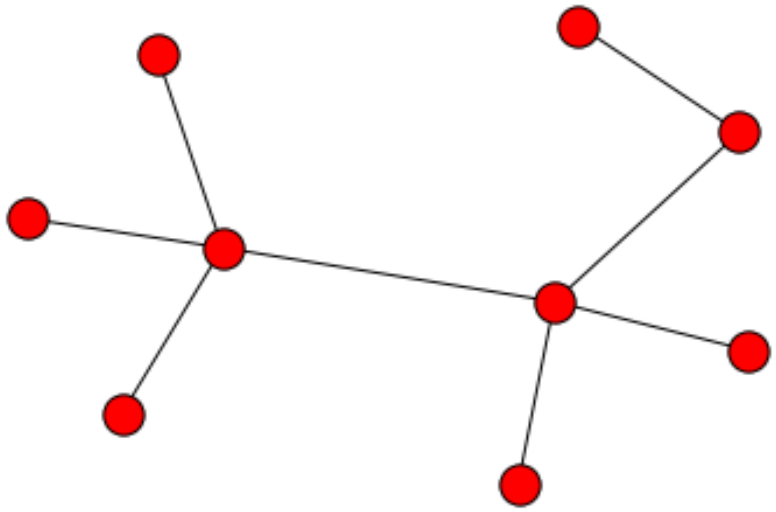
In [25]:
```
import  networkx  as nx
import  matplotlib.pyplot  as plt
import  numpy  as np
%matplotlib inline

L = nx.pappus_graph ()
nx.draw(L)
plt.show()

a = nx.adjacency_matrix(L)

l = nx.laplacian_matrix(L)
l = l.todense ()
w, v = np.linalg.eig(l)

count=0
for i in range(len(w)):
    if(w[i]==0):
        count+=1
print("The number of zeros", count)
```



```
The number of zeros 0
```

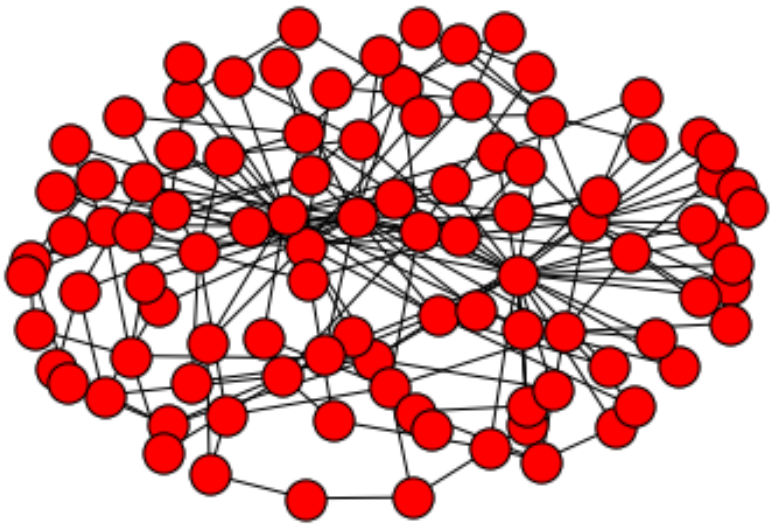
```
In [4]: def draw_comp(L):
            nx.draw(L)
            plt.show()

            a = nx.adjacency_matrix(L)
            print("The Adjacent Matrix")
            print(a)
            l = nx.laplacian_matrix(L)
            l = l.todense ()
            w, v = np.linalg.eig(l)
            print("The Laplacian Matrix")
            print(w)
            count=0
            for i in range(len(w)):
                if(w[i]==0):
                    count+=1
            print("The number of zeros", count)
```

```
In [27]: draw_comp(F)
```



```
The Adjacent Matrix
  (0, 1)        1
  (0, 3)        1
  (0, 4)        1
  (0, 8)        1
  (1, 0)        1
  (1, 2)        1
  (2, 1)        1
  (3, 0)        1
  (3, 5)        1
  (3, 6)        1
  (3, 7)        1
  (4, 0)        1
  (5, 3)        1
  (6, 3)        1
  (7, 3)        1
  (8, 0)        1
The Laplacian Matrix
[  5.67925111e+00   4.08635154e+00   2.37349122e+00   3.34408019e-16
   2.82470428e-01   5.78435710e-01   1.00000000e+00   1.00000000e+00
   1.00000000e+00]
The number of zeros 0
```

In [28]: draw_comp(G)

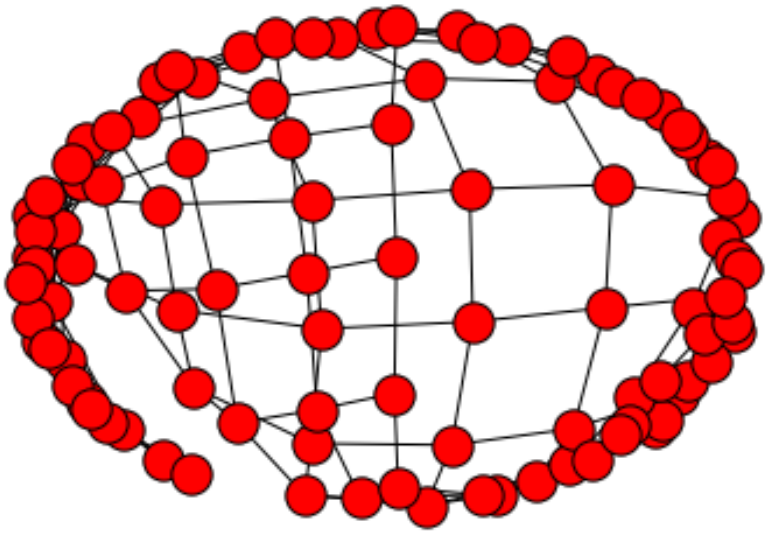


```
The Adjacent Matrix
  (0, 2)        1
  (0, 3)        1
  (0, 4)        1
  (0, 6)        1
  (0, 7)        1
  (0, 12)        1
  (0, 16)        1
  (0, 23)        1
  (0, 41)        1
  (0, 43)        1
  (0, 45)        1
  (0, 54)        1
  (0, 60)        1
  (0, 74)        1
  (0, 76)        1
  (0, 77)        1
  (0, 84)        1
  (0, 86)        1
  (0, 96)        1
  (1, 2)        1
  (1, 7)        1
  (1, 17)        1
  (1, 48)        1
  (1, 50)        1
  (1, 69)        1
  :       :
```

```
  (88, 43)        1
  (89, 2)        1
  (89, 56)        1
  (90, 44)        1
  (90, 55)        1
  (91, 4)        1
  (91, 13)        1
  (92, 13)        1
  (92, 53)        1
  (92, 95)        1
  (92, 97)        1
  (93, 53)        1
  (93, 56)        1
  (94, 41)        1
  (94, 76)        1
  (95, 13)        1
  (95, 92)        1
  (96, 0)        1
  (96, 77)        1
  (97, 18)        1
  (97, 92)        1
  (98, 9)        1
  (98, 37)        1
  (99, 10)        1
  (99, 51)        1
The Laplacian Matrix
[  2.91334650e+01 +0.00000000e+00j   2.09521573e+01 +0.00000000e+00j
   1.92419123e+01 +0.00000000e+00j   1.63040537e+01 +0.00000000e+00j
   1.49420109e+01 +0.00000000e+00j   1.08061380e+01 +0.00000000e+00j
   9.96363774e+00 +0.00000000e+00j   8.97967437e+00 +0.00000000e+00j
   8.02739615e+00 +0.00000000e+00j   7.69883782e+00 +0.00000000e+00j
   7.55317222e+00 +0.00000000e+00j   6.96269794e+00 +0.00000000e+00j
   6.81689628e+00 +0.00000000e+00j   6.62797955e+00 +0.00000000e+00j
   6.35695376e+00 +0.00000000e+00j   5.88139857e+00 +0.00000000e+00j
   5.80699200e+00 +0.00000000e+00j   5.75282787e+00 +0.00000000e+00j
   5.68444233e+00 +0.00000000e+00j   5.62389845e+00 +0.00000000e+00j
   5.51903637e+00 +0.00000000e+00j   5.20662022e+00 +0.00000000e+00j
   5.06938643e+00 +0.00000000e+00j   8.04853255e-15 +0.00000000e+00j
   4.89004814e+00 +0.00000000e+00j   4.61341463e+00 +0.00000000e+00j
   4.66363319e+00 +0.00000000e+00j   4.51864923e+00 +0.00000000e+00j
   4.37599901e+00 +0.00000000e+00j   4.17188051e+00 +0.00000000e+00j
   4.07434893e+00 +0.00000000e+00j   3.97014368e+00 +0.00000000e+00j
   3.90802946e+00 +0.00000000e+00j   3.70786169e+00 +0.00000000e+00j
   5.55965651e-01 +0.00000000e+00j   3.65214130e+00 +0.00000000e+00j
   3.59576030e+00 +0.00000000e+00j   5.91863600e-01 +0.00000000e+00j
   3.53740399e+00 +0.00000000e+00j   3.49944613e+00 +0.00000000e+00j
   3.36147417e+00 +0.00000000e+00j   3.45126251e+00 +0.00000000e+00j
   3.38289548e+00 +0.00000000e+00j   3.13044077e+00 +0.00000000e+00j
   3.05678526e+00 +0.00000000e+00j   2.99011352e+00 +0.00000000e+00j
   7.67818804e-01 +0.00000000e+00j   7.88714691e-01 +0.00000000e+00j
   2.75425769e+00 +0.00000000e+00j   8.33687643e-01 +0.00000000e+00j
   8.72572871e-01 +0.00000000e+00j   8.87214123e-01 +0.00000000e+00j
   2.51801908e+00 +0.00000000e+00j   2.49120049e+00 +0.00000000e+00j
   2.44502007e+00 +0.00000000e+00j   9.88414330e-01 +0.00000000e+00j
```

```
   9.44208675e-01 +0.00000000e+00j   1.06705587e+00 +0.00000000e+00j
   1.10252109e+00 +0.00000000e+00j   2.15889469e+00 +0.00000000e+00j
   1.15755715e+00 +0.00000000e+00j   1.18883126e+00 +0.00000000e+00j
   1.21863127e+00 +0.00000000e+00j   1.23613048e+00 +0.00000000e+00j
   1.29236334e+00 +0.00000000e+00j   1.31935600e+00 +0.00000000e+00j
   1.98422751e+00 +0.00000000e+00j   1.32925062e+00 +0.00000000e+00j
   1.36626044e+00 +0.00000000e+00j   1.44180540e+00 +0.00000000e+00j
   1.95951863e+00 +0.00000000e+00j   1.47490733e+00 +0.00000000e+00j
   1.92731384e+00 +0.00000000e+00j   1.55079308e+00 +0.00000000e+00j
   1.58311090e+00 +0.00000000e+00j   1.90394125e+00 +0.00000000e+00j
   1.64990976e+00 +0.00000000e+00j   1.68331756e+00 +0.00000000e+00j
   1.60948535e+00 +0.00000000e+00j   1.87272331e+00 +0.00000000e+00j
   1.85894952e+00 +0.00000000e+00j   1.81361103e+00 +0.00000000e+00j
   1.78522698e+00 +0.00000000e+00j   1.71400018e+00 +0.00000000e+00j
   1.53914223e+00 +0.00000000e+00j   1.83198552e+00 +0.00000000e+00j
   1.76872368e+00 +0.00000000e+00j   1.70817988e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   2.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   2.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   2.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   2.00000000e+00 +7.19506754e-16j
   2.00000000e+00 -7.19506754e-16j   2.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   2.00000000e+00 +0.00000000e+00j]
The number of zeros 0
```

In [29]: `draw_comp(H)`

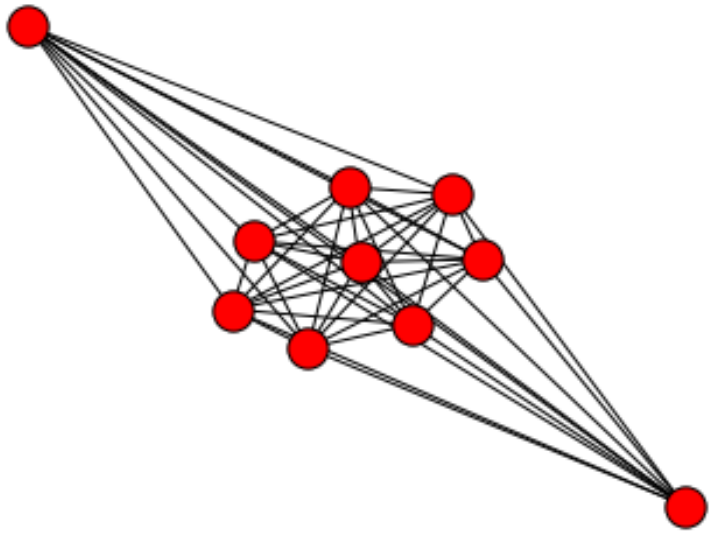


```
The Adjacent Matrix
  (0, 61)        1
```

```
  (0, 69)        1
  (0, 86)        1
  (0, 92)        1
  (1, 41)        1
  (1, 50)        1
  (1, 84)        1
  (2, 30)        1
  (2, 32)        1
  (2, 60)        1
  (2, 62)        1
  (3, 14)        1
  (3, 51)        1
  (3, 63)        1
  (3, 64)        1
  (4, 15)        1
  (4, 42)        1
  (4, 93)        1
  (5, 63)        1
  (5, 66)        1
  (5, 85)        1
  (5, 94)        1
  (6, 43)        1
  (6, 71)        1
  (6, 76)        1
  :        :
  (92, 77)        1
  (93, 4)        1
  (93, 56)        1
  (93, 82)        1
  (94, 5)        1
  (94, 33)        1
  (94, 45)        1
  (94, 83)        1
  (95, 63)        1
  (95, 64)        1
  (95, 66)        1
  (96, 35)        1
  (96, 38)        1
  (96, 65)        1
  (96, 68)        1
  (97, 13)        1
  (97, 36)        1
  (97, 58)        1
  (98, 9)        1
  (98, 35)        1
  (98, 38)        1
  (98, 59)        1
  (99, 39)        1
  (99, 60)        1
  (99, 62)        1
The Laplacian Matrix
[  7.80422607e+00   7.52014702e+00   7.23606798e+00  -2.52966051e-15
   1.95773935e-01   7.52014702e+00   6.52014702e+00   7.07768354e+00
   9.78869674e-02   6.79360449e+00   6.35114101e+00   6.23606798e+00
```

```
   7.07768354e+00   4.79852979e-01   3.81966011e-01   6.79360449e+00
   9.78869674e-02   8.24429495e-01   4.79852979e-01   3.81966011e-01
   6.52014702e+00   5.90211303e+00   6.23606798e+00   7.63932023e-01
   8.24429495e-01   9.22316463e-01   5.90211303e+00   1.64885899e+00
   1.20639551e+00   5.61803399e+00   5.79360449e+00   5.79360449e+00
   5.28407904e+00   9.22316463e-01   1.38196601e+00   5.61803399e+00
   1.20639551e+00   5.28407904e+00   1.47985298e+00   1.38196601e+00
   5.17557050e+00   1.47985298e+00   5.00000000e+00   5.23606798e+00
   5.17557050e+00   2.00000000e+00   1.76393202e+00   1.76393202e+00
   5.00000000e+00   2.09788697e+00   2.20639551e+00   4.61803399e+00
   4.72654253e+00   2.76393202e+00   2.00000000e+00   4.72654253e+00
   2.09788697e+00   4.55753652e+00   4.44246348e+00   2.38196601e+00
   4.28407904e+00   4.61803399e+00   2.20639551e+00   4.55753652e+00
   2.38196601e+00   4.28407904e+00   2.61803399e+00   2.82442950e+00
   4.44246348e+00   2.61803399e+00   4.00000000e+00   2.82442950e+00
   3.27345747e+00   3.90211303e+00   4.00000000e+00   3.17557050e+00
   3.55753652e+00   3.71592096e+00   3.71592096e+00   3.61803399e+00
   3.44246348e+00   3.38196601e+00   3.17557050e+00   2.71592096e+00
   2.71592096e+00   3.90211303e+00   3.38196601e+00   3.44246348e+00
   3.61803399e+00   3.27345747e+00   3.55753652e+00   3.00000000e+00
   4.00000000e+00   3.00000000e+00   4.00000000e+00   4.00000000e+00
   4.00000000e+00   4.00000000e+00   4.00000000e+00   4.00000000e+00]
The number of zeros 0
```

In [30]: `draw_comp(I)`

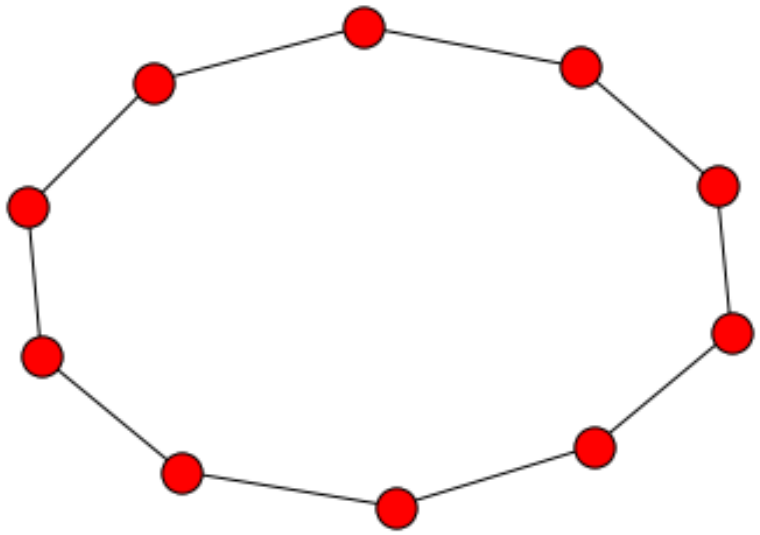


```
The Adjacent Matrix
  (0, 1)        1
```

```
  (0, 2)        1
  (0, 3)        1
  (0, 4)        1
  (0, 5)        1
  (0, 6)        1
  (0, 7)        1
  (0, 8)        1
  (0, 9)        1
  (1, 0)        1
  (1, 2)        1
  (1, 3)        1
  (1, 4)        1
  (1, 5)        1
  (1, 6)        1
  (1, 7)        1
  (1, 8)        1
  (1, 9)        1
  (2, 0)        1
  (2, 1)        1
  (2, 3)        1
  (2, 4)        1
  (2, 5)        1
  (2, 6)        1
  (2, 7)        1
  :       :
  (7, 2)        1
  (7, 3)        1
  (7, 4)        1
  (7, 5)        1
  (7, 6)        1
  (7, 8)        1
  (7, 9)        1
  (8, 0)        1
  (8, 1)        1
  (8, 2)        1
  (8, 3)        1
  (8, 4)        1
  (8, 5)        1
  (8, 6)        1
  (8, 7)        1
  (8, 9)        1
  (9, 0)        1
  (9, 1)        1
  (9, 2)        1
  (9, 3)        1
  (9, 4)        1
  (9, 5)        1
  (9, 6)        1
  (9, 7)        1
  (9, 8)        1
The Laplacian Matrix
[  1.00000000e+01  -2.22044605e-16   1.00000000e+01   1.00000000e+01
   1.00000000e+01   1.00000000e+01   1.00000000e+01   1.00000000e+01
   1.00000000e+01   1.00000000e+01]
```

```
The number of zeros 0
```

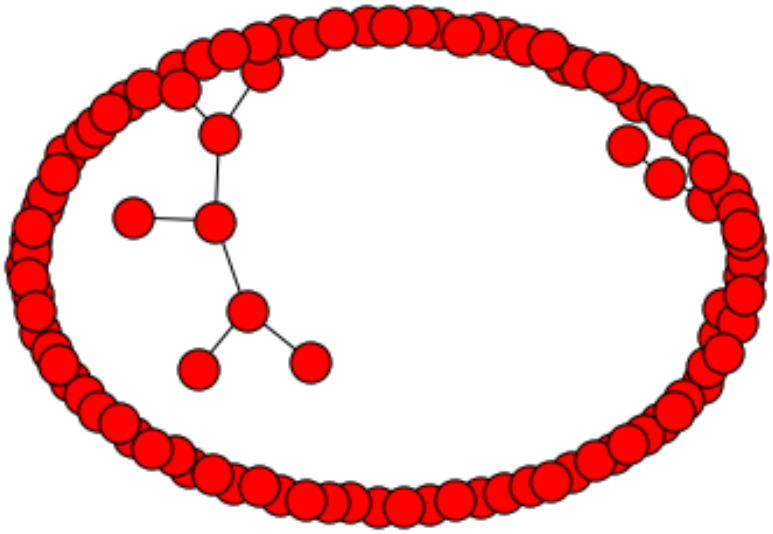
```
In [31]: draw_comp(J)
```



```
The Adjacent Matrix
  (0, 1)        1
  (0, 9)        1
  (1, 0)        1
  (1, 2)        1
  (2, 1)        1
  (2, 3)        1
  (3, 2)        1
  (3, 4)        1
  (4, 3)        1
  (4, 5)        1
  (5, 4)        1
  (5, 6)        1
  (6, 5)        1
  (6, 7)        1
  (7, 6)        1
  (7, 8)        1
  (8, 7)        1
  (8, 9)        1
  (9, 0)        1
  (9, 8)        1
The Laplacian Matrix
[ -2.22044605e-16   3.81966011e-01   1.38196601e+00   2.61803399e+00
```

```
   4.00000000e+00   3.61803399e+00   3.61803399e+00   3.81966011e-01
   2.61803399e+00   1.38196601e+00]
The number of zeros 0
```

In [32]: `draw_comp(K)`



```
The Adjacent Matrix
  (0, 23)        1
  (1, 5)        1
  (3, 33)        1
  (3, 94)        1
  (5, 1)        1
  (6, 29)        1
  (6, 43)        1
  (8, 62)        1
  (9, 64)        1
  (10, 48)        1
  (11, 57)        1
  (11, 98)        1
  (18, 39)        1
  (18, 51)        1
  (19, 50)        1
  (20, 83)        1
  (22, 64)        1
  (22, 91)        1
  (23, 0)        1
  (23, 49)        1
```

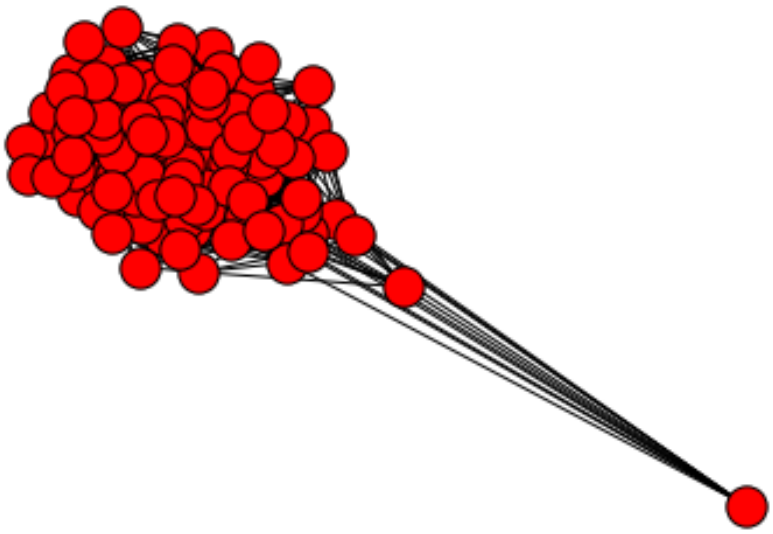
```
  (23, 90)        1
  (27, 59)        1
  (29, 6)        1
  (29, 94)        1
  (30, 46)        1
  :       :
  (65, 87)        1
  (66, 49)        1
  (67, 56)        1
  (70, 32)        1
  (76, 98)        1
  (78, 61)        1
  (78, 84)        1
  (79, 32)        1
  (81, 55)        1
  (81, 82)        1
  (82, 81)        1
  (83, 20)        1
  (84, 78)        1
  (87, 58)        1
  (87, 65)        1
  (89, 62)        1
  (90, 23)        1
  (91, 22)        1
  (91, 61)        1
  (94, 3)        1
  (94, 29)        1
  (94, 52)        1
  (98, 11)        1
  (98, 49)        1
  (98, 76)        1
The Laplacian Matrix
[  4.84677823e+00 +0.00000000e+00j   3.85252385e+00 +0.00000000e+00j
   4.43828324e+00 +0.00000000e+00j   2.73378014e+00 +0.00000000e+00j
   2.07824830e+00 +0.00000000e+00j   3.13856427e+00 +0.00000000e+00j
   2.61803399e+00 +0.00000000e+00j   7.22292395e-01 +0.00000000e+00j
   5.54591229e-01 +0.00000000e+00j   3.80193774e+00 +0.00000000e+00j
   3.24697960e+00 +0.00000000e+00j   1.17975075e+00 +0.00000000e+00j
   2.11785864e-01 +0.00000000e+00j   2.44504187e+00 +0.00000000e+00j
   3.41421356e+00 +0.00000000e+00j   3.00000000e+00 +0.00000000e+00j
   3.81966011e-01 +0.00000000e+00j   1.55495813e+00 +0.00000000e+00j
   3.00000000e+00 +0.00000000e+00j   2.43401746e-01 +0.00000000e+00j
   7.53020396e-01 +0.00000000e+00j   3.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   3.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   1.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   1.98062264e-01 +0.00000000e+00j
   1.00000000e+00 +0.00000000e+00j   1.00000000e+00 +0.00000000e+00j
   5.85786438e-01 +0.00000000e+00j   1.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   1.00000000e+00 +0.00000000e+00j
   3.00000000e+00 +0.00000000e+00j   1.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   3.00000000e+00 +0.00000000e+00j
   2.00000000e+00 +0.00000000e+00j   1.00000000e+00 +0.00000000e+00j
  -7.22701989e-16 +0.00000000e+00j  -2.27194446e-16 +0.00000000e+00j
  -2.25871106e-16 +4.57122035e-16j  -2.25871106e-16 -4.57122035e-16j
```

```
  -3.05554625e-16 +1.81640644e-16j  -3.05554625e-16 -1.81640644e-16j
  -9.85457256e-17 +0.00000000e+00j   2.77123852e-16 +3.19206680e-16j
   2.77123852e-16 -3.19206680e-16j   2.14862021e-16 +0.00000000e+00j
   1.11110753e-16 +2.67081667e-17j   1.11110753e-16 -2.67081667e-17j
   2.73323198e-16 +1.38833862e-16j   2.73323198e-16 -1.38833862e-16j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j
   0.00000000e+00 +0.00000000e+00j   0.00000000e+00 +0.00000000e+00j]
The number of zeros 46
```

2 ER with other propabilities

In [33]:
```
K = nx.erdos_renyi_graph (100,  0.2)
```

In [34]:
```
draw_comp(K)
```

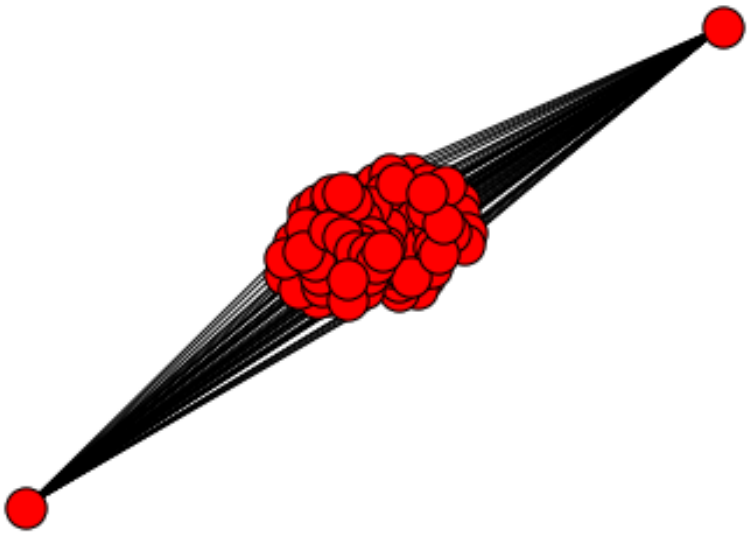


```
The Adjacent Matrix
  (0, 7)        1
  (0, 8)        1
  (0, 12)        1
  (0, 18)        1
  (0, 19)        1
  (0, 24)        1
  (0, 28)        1
  (0, 41)        1
  (0, 49)        1
  (0, 57)        1
  (0, 58)        1
  (0, 59)        1
  (0, 60)        1
  (0, 73)        1
  (0, 82)        1
  (0, 86)        1
  (0, 97)        1
  (0, 98)        1
  (1, 2)        1
  (1, 3)        1
  (1, 5)        1
  (1, 6)        1
  (1, 10)        1
  (1, 23)        1
  (1, 30)        1
  :       :
```

```
  (98, 63)        1
  (98, 66)        1
  (98, 69)        1
  (98, 80)        1
  (98, 96)        1
  (98, 97)        1
  (99, 3)        1
  (99, 5)        1
  (99, 11)        1
  (99, 12)        1
  (99, 18)        1
  (99, 26)        1
  (99, 29)        1
  (99, 38)        1
  (99, 42)        1
  (99, 43)        1
  (99, 52)        1
  (99, 61)        1
  (99, 63)        1
  (99, 69)        1
  (99, 70)        1
  (99, 78)        1
  (99, 80)        1
  (99, 86)        1
  (99, 96)        1
The Laplacian Matrix
[ -1.80860837e-15   3.27976360e+01   7.66213812e+00   3.14378484e+01
   3.10828355e+01   3.01028691e+01   2.99795091e+01   2.92326962e+01
   9.77506512e+00   1.03914876e+01   2.90404336e+01   2.87293397e+01
   2.88161397e+01   2.80890578e+01   1.07525921e+01   1.10472147e+01
   2.74283312e+01   2.74415941e+01   2.72014889e+01   2.68130051e+01
   1.15416329e+01   1.21560522e+01   1.22457898e+01   2.65758256e+01
   2.62251663e+01   2.63778571e+01   2.58331295e+01   1.25346531e+01
   1.26369030e+01   2.56908191e+01   2.55766631e+01   1.28845285e+01
   2.53535411e+01   2.50135134e+01   1.30448338e+01   2.47312654e+01
   1.33088839e+01   2.46387624e+01   1.36688143e+01   1.37957033e+01
   2.43581575e+01   2.41454590e+01   2.40491857e+01   2.36932021e+01
   1.39808994e+01   1.41554152e+01   2.34315105e+01   1.42866113e+01
   1.45299422e+01   1.47701404e+01   1.45758280e+01   2.31936751e+01
   1.50401966e+01   2.30924344e+01   2.28260960e+01   2.26411985e+01
   1.51832596e+01   2.23458744e+01   2.21910140e+01   1.55432826e+01
   1.56172755e+01   1.56632572e+01   2.20079769e+01   2.18679534e+01
   1.58704567e+01   2.17131248e+01   1.61202290e+01   1.62868010e+01
   1.59537502e+01   1.65449211e+01   1.65336158e+01   2.14049825e+01
   2.12073656e+01   1.69938917e+01   1.70714673e+01   1.71660221e+01
   1.74202860e+01   1.75426209e+01   2.10321262e+01   2.09119115e+01
   1.77360499e+01   1.79994515e+01   1.82810491e+01   2.07805420e+01
   1.96935262e+01   1.96046910e+01   1.78274159e+01   1.98770923e+01
   1.92378794e+01   2.04643686e+01   1.87081801e+01   1.89202354e+01
   1.99972227e+01   1.90481712e+01   1.87812208e+01   2.00913266e+01
   2.03093196e+01   2.03601865e+01   1.85384306e+01   1.91246025e+01]
The number of zeros 0
```

```
In [35]: K = nx.erdos_renyi_graph (100,  0.5)
```

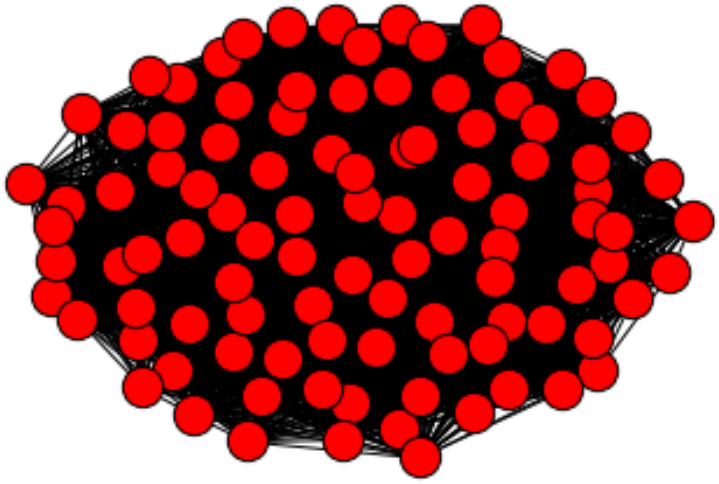
```
draw_comp(K)
```



```
The Adjacent Matrix
  (0, 1)        1
  (0, 3)        1
  (0, 6)        1
  (0, 8)        1
  (0, 10)        1
  (0, 11)        1
  (0, 12)        1
  (0, 17)        1
  (0, 18)        1
  (0, 21)        1
  (0, 22)        1
  (0, 24)        1
  (0, 25)        1
  (0, 26)        1
  (0, 27)        1
  (0, 31)        1
  (0, 33)        1
  (0, 34)        1
  (0, 35)        1
  (0, 37)        1
  (0, 38)        1
  (0, 40)        1
  (0, 41)        1
  (0, 42)        1
```

```
  (0, 44)        1
  :        :
  (99, 59)        1
  (99, 60)        1
  (99, 62)        1
  (99, 63)        1
  (99, 64)        1
  (99, 65)        1
  (99, 66)        1
  (99, 67)        1
  (99, 69)        1
  (99, 70)        1
  (99, 71)        1
  (99, 73)        1
  (99, 75)        1
  (99, 76)        1
  (99, 78)        1
  (99, 80)        1
  (99, 82)        1
  (99, 83)        1
  (99, 84)        1
  (99, 85)        1
  (99, 89)        1
  (99, 91)        1
  (99, 93)        1
  (99, 94)        1
  (99, 97)        1
The Laplacian Matrix
[  2.68661538e-14   3.37224622e+01   3.61702641e+01   6.37307471e+01
   3.69100220e+01   3.77670853e+01   6.23261187e+01   6.17281833e+01
   6.14847443e+01   6.03461747e+01   6.01717683e+01   6.02197813e+01
   3.86090309e+01   3.90601781e+01   5.95787835e+01   5.93614652e+01
   3.94083424e+01   5.89707039e+01   3.97643732e+01   5.87201772e+01
   3.99510947e+01   4.02743764e+01   5.83216658e+01   5.80541703e+01
   5.78159545e+01   5.76673504e+01   4.10219459e+01   5.72456917e+01
   5.69757106e+01   5.68265166e+01   4.09614297e+01   4.14896006e+01
   4.16175900e+01   4.17819544e+01   5.62522657e+01   4.22647606e+01
   5.60894310e+01   4.24482965e+01   5.58782068e+01   4.26071990e+01
   5.55446152e+01   5.55066932e+01   4.28954071e+01   5.52448477e+01
   5.50290372e+01   4.31426140e+01   4.35535627e+01   4.34341176e+01
   4.37856473e+01   5.46633580e+01   5.45177075e+01   4.40925614e+01
   4.44073146e+01   5.44445701e+01   5.41209669e+01   5.39216726e+01
   4.45674614e+01   4.47877643e+01   4.46939258e+01   4.50969866e+01
   5.34781310e+01   5.34030620e+01   5.32514246e+01   4.55216545e+01
   5.30996669e+01   4.57146021e+01   5.26383567e+01   4.61238985e+01
   5.24029939e+01   4.62902504e+01   4.65006188e+01   5.21179315e+01
   5.19923831e+01   5.16796306e+01   5.14048246e+01   4.65616330e+01
   5.13176870e+01   5.20531676e+01   4.69168481e+01   4.68322561e+01
   5.09538398e+01   4.73492923e+01   5.06931187e+01   4.94557163e+01
   5.02240684e+01   4.78736593e+01   4.80567188e+01   4.81706146e+01
   4.76535306e+01   4.99793154e+01   4.91149225e+01   5.03846083e+01
   4.75680744e+01   4.87195277e+01   4.99484768e+01   4.91986815e+01
   5.04444948e+01   4.85610400e+01   4.86439075e+01   4.86589239e+01]
The number of zeros 0
```

```
In [5]: K = nx.erdos_renyi_graph (100,  0.7)
        draw_comp(K)
```

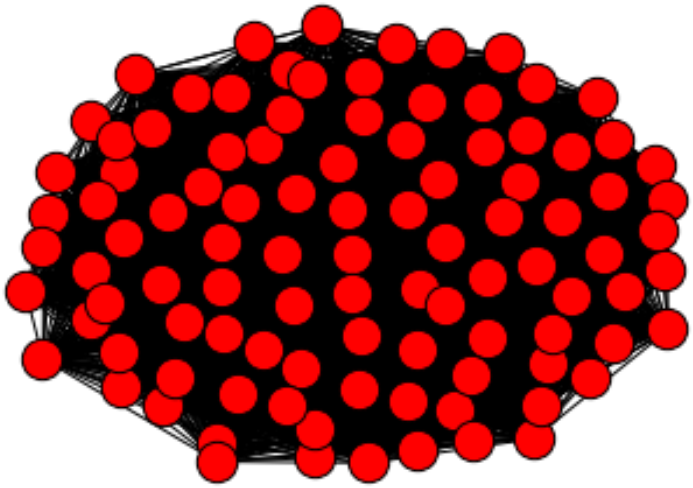


```
The Adjacent Matrix
  (0, 1)        1
  (0, 2)        1
  (0, 3)        1
  (0, 5)        1
  (0, 7)        1
  (0, 8)        1
  (0, 10)        1
  (0, 11)        1
  (0, 12)        1
  (0, 14)        1
  (0, 15)        1
  (0, 16)        1
  (0, 17)        1
  (0, 21)        1
  (0, 22)        1
  (0, 24)        1
  (0, 27)        1
  (0, 28)        1
  (0, 30)        1
  (0, 32)        1
  (0, 33)        1
  (0, 34)        1
  (0, 37)        1
```

```
  (0, 38)        1
  (0, 39)        1
  :        :
  (99, 70)        1
  (99, 71)        1
  (99, 73)        1
  (99, 74)        1
  (99, 75)        1
  (99, 77)        1
  (99, 78)        1
  (99, 79)        1
  (99, 80)        1
  (99, 81)        1
  (99, 82)        1
  (99, 83)        1
  (99, 84)        1
  (99, 86)        1
  (99, 88)        1
  (99, 89)        1
  (99, 90)        1
  (99, 91)        1
  (99, 92)        1
  (99, 93)        1
  (99, 94)        1
  (99, 95)        1
  (99, 96)        1
  (99, 97)        1
  (99, 98)        1
The Laplacian Matrix
[  3.81040686e-14   5.61745660e+01   8.40385579e+01   5.72253283e+01
   5.81745896e+01   5.87131797e+01   5.95084540e+01   8.22085002e+01
   8.15212326e+01   8.12101382e+01   8.10097383e+01   6.02266349e+01
   8.08222179e+01   8.05556154e+01   8.00226625e+01   6.05374900e+01
   6.08735259e+01   6.10891827e+01   6.13574945e+01   7.90488010e+01
   7.89026760e+01   7.87385021e+01   6.17428859e+01   6.18592913e+01
   6.21374431e+01   6.22478092e+01   7.83568353e+01   7.82491839e+01
   6.25692821e+01   7.78886898e+01   7.75742551e+01   7.73736280e+01
   7.70242775e+01   6.32261464e+01   6.34610693e+01   6.37956489e+01
   7.68162727e+01   6.39569036e+01   7.65836562e+01   7.64740991e+01
   7.63940560e+01   7.58957007e+01   6.44685306e+01   6.43058161e+01
   6.43492642e+01   6.48301604e+01   7.57393440e+01   6.50410097e+01
   7.56016788e+01   6.53519158e+01   7.53076336e+01   7.52712990e+01
   6.54767695e+01   7.50834947e+01   7.49561478e+01   7.46712929e+01
   6.61953117e+01   6.61830279e+01   6.64799536e+01   7.41541555e+01
   7.41081064e+01   6.66723167e+01   6.68023810e+01   7.38677600e+01
   7.37340423e+01   6.69558051e+01   7.35033829e+01   6.73950922e+01
   6.76412121e+01   7.32331787e+01   7.36176870e+01   6.73431172e+01
   6.77636050e+01   6.80136131e+01   6.84238460e+01   6.85552617e+01
   7.27378727e+01   7.26654014e+01   6.89567278e+01   6.90642816e+01
   6.94307622e+01   7.17799795e+01   7.16967804e+01   7.20154094e+01
   6.96590324e+01   7.13249287e+01   7.00676707e+01   7.10857290e+01
   7.03257656e+01   7.22657771e+01   7.24937795e+01   7.07222582e+01
   6.98612459e+01   6.81736068e+01   6.72121568e+01   7.23245673e+01
   7.04457032e+01   7.06072852e+01   6.91892367e+01   7.12106074e+01]
```

```
The number of zeros 0
```

```
In [6]: K = nx.erdos_renyi_graph (100,  0.9)
        draw_comp(K)
```



```
The Adjacent Matrix
  (0, 1)        1
  (0, 2)        1
  (0, 4)        1
  (0, 5)        1
  (0, 6)        1
  (0, 7)        1
  (0, 8)        1
  (0, 9)        1
  (0, 10)        1
  (0, 11)        1
  (0, 12)        1
  (0, 14)        1
  (0, 15)        1
  (0, 16)        1
  (0, 17)        1
  (0, 19)        1
  (0, 20)        1
  (0, 21)        1
  (0, 22)        1
  (0, 23)        1
  (0, 24)        1
```

```
  (0, 25)        1
  (0, 26)        1
  (0, 27)        1
  (0, 28)        1
  :        :
  (99, 70)        1
  (99, 71)        1
  (99, 72)        1
  (99, 73)        1
  (99, 74)        1
  (99, 75)        1
  (99, 76)        1
  (99, 77)        1
  (99, 78)        1
  (99, 79)        1
  (99, 80)        1
  (99, 81)        1
  (99, 85)        1
  (99, 86)        1
  (99, 87)        1
  (99, 88)        1
  (99, 89)        1
  (99, 90)        1
  (99, 92)        1
  (99, 93)        1
  (99, 94)        1
  (99, 95)        1
  (99, 96)        1
  (99, 97)        1
  (99, 98)        1
The Laplacian Matrix
[  3.43771508e-14   7.95556597e+01   8.00544626e+01   9.91293352e+01
   8.14268760e+01   9.71829214e+01   8.20344632e+01   8.22118313e+01
   8.27658602e+01   8.30201071e+01   8.32802357e+01   8.33877362e+01
   8.37102962e+01   9.67580188e+01   9.66962199e+01   9.65678616e+01
   8.42184424e+01   8.42696282e+01   9.62750799e+01   8.44541270e+01
   8.46270914e+01   9.60309024e+01   9.60632126e+01   9.60719338e+01
   8.50043154e+01   8.51605038e+01   9.56455403e+01   9.54782454e+01
   8.53809356e+01   9.53368538e+01   8.54489113e+01   8.58280854e+01
   8.57930936e+01   8.61074994e+01   9.51231629e+01   9.50494680e+01
   9.49259840e+01   9.48886061e+01   8.63953150e+01   9.46724528e+01
   9.44808658e+01   9.42345695e+01   8.65121889e+01   8.65943033e+01
   8.66766328e+01   8.68352757e+01   9.41372732e+01   9.40554426e+01
   8.70266916e+01   8.72964413e+01   9.39551674e+01   9.37931595e+01
   9.36313633e+01   9.39129572e+01   8.74590610e+01   9.33838796e+01
   9.32339798e+01   9.31732708e+01   8.76125187e+01   8.77333490e+01
   8.78290532e+01   8.79856848e+01   8.80825764e+01   9.29582862e+01
   9.29007418e+01   9.27537756e+01   8.83078662e+01   9.26611191e+01
   8.84066253e+01   8.82252191e+01   9.25044664e+01   9.24263251e+01
   8.86659271e+01   8.88411429e+01   9.23043281e+01   9.21096530e+01
   8.89929724e+01   8.90759705e+01   8.92842087e+01   8.92296694e+01
   9.17712801e+01   9.17641503e+01   8.95405781e+01   9.04681356e+01
   9.03591980e+01   8.99307557e+01   9.14190262e+01   9.00679363e+01
   9.13584764e+01   9.06088138e+01   8.97663018e+01   8.98157587e+01
```

```
   9.01482448e+01   9.16116978e+01   9.12409518e+01   9.08186978e+01
   9.11478704e+01   9.09185456e+01   9.07475516e+01   9.11807512e+01]
The number of zeros 0
```

As we can see, Erdos Renyi graph takes into argument the probability of connection between nodes. The higher probability, the connections gets more, this can be seen in previous plotted graphs.

In [ ]: