Riley Payung

CDS 292

04/22/2020

Homework 9

Imports

In [98]:

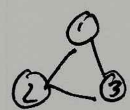
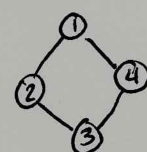
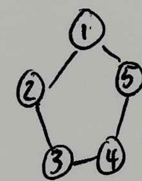
```
import networkx as netx
import matplotlib.pyplot as plt
import numpy as np
```

Q1

Depends on size

n = 1 n = 2 n = 3 n = 4 n = 5



tris: 0 tris: 0 Ltri: 3 Gtri: 1 Ltri: 0 Gtri: 0 tris: 0

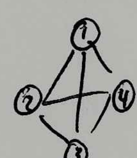
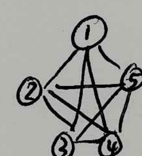
Only a triangular (n=3) ring network has anything ≥ 0 triangles.

Q2

Depends on size:

n=1 n=2 n=3 n=4 n=5



Local triangles and global.

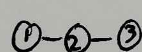
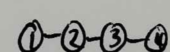
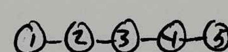
tris=0 tris: 0 Ltri: 3 Gtri: 1 Ltri: 12 Gtri: 4 Ltri: 30 Gtri: 10

Q3

Depends on size

n=1 n=2 n=3 n=4 n=5



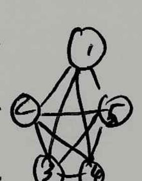




v=0 v=0 v=1 v=2 v=3

$v = \text{ceil}(\frac{1}{2}n)$ Both Local & global since its not possible to create anything greater than the number of nodes divided in half v-shapes.

Q4

n = 5

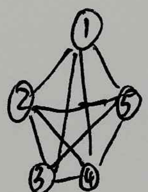


$$\sum_{i=1}^{5}\binom{k_i}{2} = \binom{4}{2}5 \Rightarrow 5\,\frac{4\cdot 3}{2} = 5\left(\frac{12}{2}\right) = 5(6) = 30$$

There are 30 total v-shapes. This is local count. Both local & global can be done.

Q5

$n=5$



\# local: 30

\# global: 10

globals calculated w/

$$T(G) = \frac{1}{6}\left(\sum_{i=1}^{n} A^3_{ii}\right) = 30$$

$$\frac{1}{6}(12+12+12+12+12) = \frac{1}{6}(60) = \cancel{3}10 \checkmark$$

or by using local triangles:

$$\frac{1}{3}\left(\frac{1}{2}\left(\sum_{i=1}^{n} A^3_{ii}\right)\right) =$$

$$\frac{1}{3}\left(\frac{1}{2}(12+12+12+12+12)\right) =$$

$$\frac{1}{3}\left(\frac{1}{2}(60)\right) = \frac{1}{3}(30) =$$

$$10 \checkmark$$

Q6

A) The sum of diagonals divided by 2 of A^3.

$$\frac{1}{2}\sum_{i=1}^{n} A^3_{ii}$$

B) The sum of diagonals divided by 6 of A^3 or sum of local divided by 3

$$\frac{1}{6}\sum_{i=1}^{n} A^3_{ii} \qquad \frac{1}{3}\sum_{i=1}^{n} t_i$$

C) If we chose the first column, we would have the first 3 column rows be 1, after that they'd all be 0s, since $q = i, j,$ or h.

Q7

A) $n=4$ Dimension is 4

B) Dimension is $\binom{4}{3} = 4$.

C)
$T_1 = \sigma_{1;1,2,3} + \sigma_{1;1,2,4} + \sigma_{1;1,2,5} + \sigma_{1;1,2,6} = T_{1,2,3}$
$T_2 = \sigma_{2;1,2,3} + \sigma_{2;1,2,4} + \sigma_{2;1,2,5} + \sigma_{2;1,2,6} = T_{1,2,4}$
$T_3 = \sigma_{3;1,2,3} + \sigma_{3;1,2,4} + \sigma_{3;1,2,5} + \sigma_{3;1,2,6} = T_{1,2,5}$
$T_4 = \sigma_{4;1,2,3} + \sigma_{4;1,2,4} + \sigma_{4;1,2,5} + \sigma_{4;1,2,6} = T_{1,2,6}$

D)
$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \\ 1 \\ 1 \end{bmatrix}$$

E)
$$\begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$$

Q18

u = 20

v = 30

In [19]:

```
G = netx.Graph();
```

In [20]:

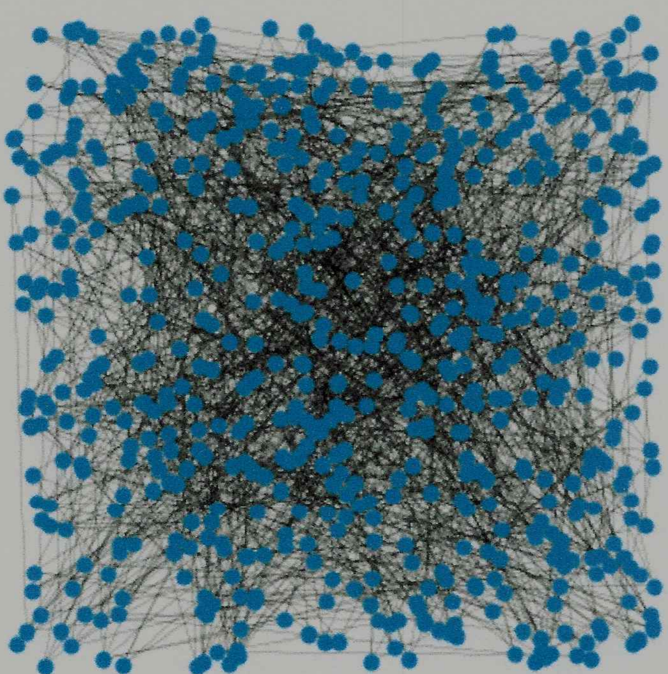
```
for u in range(1,21):
    for v in range(1,31):
        G.add_node((u,v));
```

In [27]:

```
for u in range(1,21):
    for v in range(1,31):
        G.add_edge((u,v),(u+1,v));
        G.add_edge((u,v),(u,v+1));
        if (u == v):
            if (G.has_node((u,v)) and G.has_node((u+1,v+1))):
                G.add_edge((u,v),(u+1,v+1));
```

In [167]:

```
options = {'node_size':50,'width':0.2};
plt.figure(figsize=(5,5));
netx.draw_random(G, **options)
```



In [153]:

```
h = {};

for u in range(1,21):
    for v in range(1,31):
        if (G.degree((u,v)) in h):
            h[G.degree((u,v))] += 1;
        else:
            h[G.degree((u,v))] = 1;
```

In [154]:

```
print(h)
```

```
{3: 49, 6: 18, 4: 532, 5: 1}
```

In [164]:

```
plt.bar(h.keys(),h.values());
plt.xticks(np.arange(1,7,1))
plt.title("Degree Histogram");
plt.xlabel("Degree");
plt.ylabel("# of Nodes of Degree K")
plt.show()
```