
Complex Network

# Quiz 3

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December 6, 2018

## Code

```
#2. Make a program of computing average degree, density, and L3 of K6 and
   K3,3. Show the code and its results.

# Average Degree
avg_degree_k6 = 2 * m1 // n1
avg_degree_k33 = 2 * m2 // n2
print ("The average degree of K6 is ", avg_degree_k6)
print ("The average degree of K3,3 is ", avg_degree_k33)

# Density
rho_k6 = nx.density(G1)
rho_k33 = nx.density(G2)
print("The density of K6 is ", int(rho_k6))
print("The density of K3,3 is ", rho_k33)

# L3
L3_k6 = sum(nx.triangles(G1).values())
L3_k33 = sum(nx.triangles(G2).values())
print ("The L3 for K6 is ", L3_k6)
print ("The L3 for K3,3 is ", L3_k33)
```

## Results

1. Write down the formulas of average degree and density of graph G=(V,E) (|V|=n, |E|=m).

$$\begin{aligned}
\textbf{Total number of degrees: } & \sum_{i=1}^{n} k_i = \sum_{i=1}^{n}\sum_{j=1}^{n} A_{ij} = 2m \\
\textbf{Average degree: } & c = \frac{1}{n}\sum_{i=1}^{n} k_i = \frac{2m}{n} \\
\textbf{Maximum possible number of edges: } & \binom{n}{2} = \frac{n(n-1)}{2} \\
\textbf{Density: } & \rho = \frac{m}{\binom{n}{2}} = \frac{2m}{n(n-1)} = \frac{c}{n-1} \approx \frac{c}{n}, \text{ when n is very large}
\end{aligned} \tag{1}$$

where n is the number of vertices, m is the number of edges.

2. Make a program of computing average degree, density, and L3 of K6 and K3,3. Show the code and its results.

```
The average degree of K6 is  5
The average degree of K3,3 is  3
The density of K6 is  1
The density of K3,3 is  0.6
The L3 for K6 is  60
The L3 for K3,3 is  0
```

Figure 1: Upper: A subset of vertices in the form of UG is indicated by red lines. Lower: Rearrangement of K3,3 results in a UG form.

3. Is K6 planar? Why?
K6 is non planar because it contains a subset of vertices in the form of UG as indicated by the red lines in the upper plot of Figure 2.

4. Is K3,3 planar? Why?
K3,3 is also non planar because when we rearrange its vertices as shown in the lower plot of Figure 2, it is a UG structure itself.

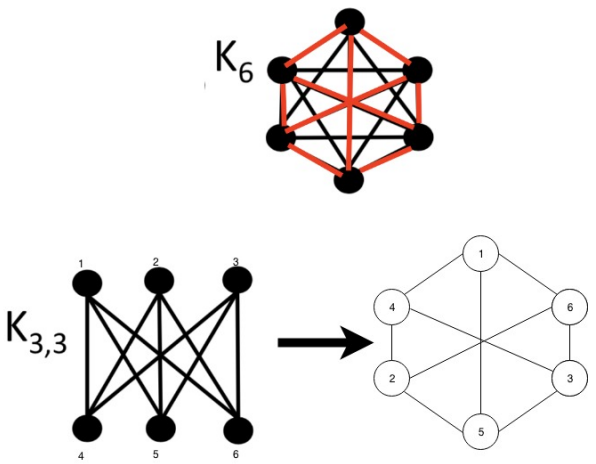


Figure 2: Upper: A subset of vertices in the form of UG is indicated by red lines. Lower: Rearrangement of K3,3 results in a UG form.