

Grau e Transitividade

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Disciplina: Redes Complexas (SME0130)

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```
In [1]: from numpy import *
import numpy as np
import matplotlib.pyplot as plt
import networkx as nx
```

```
In [15]: def degree_distribution(G):
    vk = np.array(list(dict(G.degree()).values()))
    maxk = np.max(vk)
    mink = np.min(vk)
    kvalues = np.arange(0, maxk + 1) ## arranjo de valores possíveis de k (tipo range())
    Pk = np.zeros(maxk + 1)
    for k in vk:
        Pk[k] = Pk[k] + 1
    Pk = Pk/sum(Pk) ### sum(Pk) == 1
    return kvalues, Pk

def momment_of_degree_distribution(G, m):
    k, Pk = degree_distribution(G)
    M = sum((k**m)*Pk)
    return M

def coef_complexity(G):
    k2 = momment_of_degree_distribution(G, 2)
    k1 = momment_of_degree_distribution(G, 1)
    return k2/k1

def shannon_entropy(G):
    k, Pk = degree_distribution(G)
    H = 0
    for p in Pk:
        if (p > 0):
            H = H - p*math.log(p, 2)
    return H
```

Questão 1

Para a base lesmis, calcule o terceiro e o quarto momentos da distribuição do grau.

```
In [9]: lesmis = G= nx.read_edgelist("data/lesmis.txt", nodetype=int, data= (('weight', float),))

k3 = moment_of_degree_distribution(lesmis, 3)
k4 = moment_of_degree_distribution(lesmis, 4)

print('Terceiro momento:', k3)
print('Quarto momento:', k4)
```

Terceiro momento: 1408.025974025974
Quarto momento 33592.72727272728

Questão 2

Calcule o coeficiente de complexidade da power grid.

```
In [12]: power_grid = nx.read_edgelist("data/powergrid.txt", nodetype=int, data= (('weight', float),))

complexity_pg = coef_complexity(power_grid)

print('Coeficiente de complexidade:', complexity_pg)
```

Coeficiente de complexidade: 3.8712465878070974

Questão 3

Calcule a entropia de Shannon da rede Euro road.

```
In [29]: euro_road = nx.read_edgelist("data/euroroad.txt", nodetype=int, data= (('weight', float),))

shannon_euroroad = shannon_entropy(euro_road)

print('Entropia de Shannon:', shannon_euroroad)
```

Entropia de Shannon: 2.0033103874527756

Questão 4

Para a rede de aeroportos dos Estados Unidos, obtenha:

- a) transitivity;
- b) the average clustering coefficient.

```
In [24]: usairport = nx.read_edgelist("data/usairport.txt", nodetype=int,
data= (('weight', float),))

tr = nx.transitivity(usaairport)
print('Transitivity:', tr)

acc = nx.average_clustering(usaairport)
print('The average clustering coefficient:', acc)
```

Transitivity: 0.38414344664491556

The average clustering coefficient: 0.5041525392095769

Questão 5

Calcule o coeficiente de complexidade e a entropia de Shannon para a rede US airport.

```
In [28]: ## usairport

complexity_us = coef_complexity(usaairport)
print('Coeficiente de complexidade:', complexity_us)

shannon_airport = shannon_entropy(usaairport)

print('Entropia de Shannon:', shannon_airport)
```

Coeficiente de complexidade: 112.22224803950044

Entropia de Shannon: 4.985977646539227