Social and Technological Networks Edinburgh, 2015

Lecture 2. Graph Properties & Random Graphs

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Exercise 0.1. *Show that* $\ln n = \Theta(\lg n)$*, and* $\lg n = \Theta(\log n)$.

Answer. From the change of base formula $\log_e n = \frac{\log_2 n}{\log_2 e}$, therefore $\ln n = \frac{1}{\lg e} \lg n$. Similarly, $\lg n = \frac{1}{\log e} \log n$. Since both $\frac{1}{\lg e}$ and $\frac{1}{\log e}$ are constants, it follows that $\ln n = \Theta(\lg n)$ and $\lg n = \Theta \log(n)$.

Exercise 0.2. *Write code to create plots showing the threshold phenomenon for existence of isolated vertices.*

Answer. The code plots the average number of isolated vertices taken over 100 Erdos Renyi graphs each with 100 nodes and p = $0.00, 0.01, \ldots, 0.99$. The average is close to 0 starting with $p = 0.05 \approx (\ln 100)/100$.

```
import networkx as nx
import matplotlib.pyplot as plt
n = 100
probabilities = []
averageIsolates = []
for i in range(0,100):
    p = float(i)/100
    probabilities.append(p)
    isolated = float(0)
    for j in range(1,101):
        er = nx.erdos_renyi_graph(n,p)
        isolated += len(nx.isolates(er))
    isolated /= j
    averageIsolates.append(isolated)
plt.scatter(probabilities,averageIsolates)
plt.show()
plt.semilogx(probabilities,averageIsolates)
plt.show()
```