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

$\ln n$, $\lg n$ and $\log n$ are the usual notations for $\log$ to base $e$, 2 and 10 respectively. This is to show that log functions to different constant bases differ only by constant factors.

Exercise 0.2. Set up the ipython notebook on a system of your choice with networkx. Try it out.

Exercise 0.3. Write code to create plots showing the threshold phenomenon for existence of isolated vertices.

Exercise 0.4. Coupon collector problem. Suppose they are giving out one coupon in each cereal boxes. There are $n$ different types of coupons. You have to collect all $n$ types to win a prize. Show that in expectation you need to buy $n \ln n$ boxes to win the prize.

Exercise 0.5. Show that for a suitable constant $c$, buying $cn \ln n$ boxes suffices to guarantee that you get at least one coupon of each type with high probability.

Exercise 0.6. Random graphs are connected. In class, we showed that above the threshold $p = \ln n/(n - 1)$, isolated vertices are unlikely. However, this does not say that the graph overall is connected. It is possible that the graph itself stays in to two (or more) different connected components with no edge bridging them.

In this exercise, show that this is also unlikely. That is, above the threshold, with high probability, the graph has only a single connected component. [Hint: Formulate the problem to show that for a partition of the graph into multiple subsets, it is unlikely that there will be no edge out of any of them.]

Exercise 0.7. Show that a connected graph has at least $\Omega(n)$ triads.