1. Is eBay’s bidding mechanism closer to a second price auction or a first price auction? Explain very briefly.

It is closer to a second price auction.

2. Suppose there are \( m \) web pages of type 1 and \( n \) web pages of type 2. Let the type 1 web pages be \( A_1, A_2, \ldots, A_m \) and let the type 2 web pages be \( B_1, B_2, \ldots, B_n \). Each web page of type 1 has a link to a web page of type 2. Also, each web page of type 2 has a link to a web page of type 1. What is the naive PageRank of each page in terms of \( m \) and \( n \)?

By symmetry, all type 1 pages will have the same PageRank, say \( \pi(A) \), and all type 2 page will have the same PageRank, say \( \pi(B) \).

\[
\pi(A) = \frac{n}{m} \pi(B)
\]

\[
m\pi(A) + n\pi(B) = 1
\]

Thus, \( \pi(A) = 1/(2m) \) and \( \pi(B) = 1/(2n) \).

3. Which of the following Bernoulli random networks are connected with high probability as \( N \) goes to infinity?

   (a) The probability \( p \) is 0.1
   (b) The average degree is 10
   (c) The average degree varies as \( \sqrt{N} \).

We use the fact that the graph is connected with high probability if \( p > \log N/N \) or equivalently \( p \cdot N > \log N \), where \( p \cdot N \) is the average degree. Thus, (a) and (c) will be connected with high probability, while (b) will not.

4. Consider a line network with \( N \) nodes in which each node knows its two neighbors. Further, there is an edge between the \( i \)-th and \( j \)-th nodes with probability \( 1/|j - i| \). Describe a simple message forwarding protocol on this network such that the expected time for a message to get delivered from node \( a \) to node \( b \) is proportional to \( \log N \) (again, rough order of growth is all that is required). Explain your reasoning.

Each node \( k \) that gets the message forwards it to closest node on the left of \( b \) that \( k \) is directly connected to. It was shown in class that the average path length is \( \log N \).

5. Which of the following are likely to benefit from network neutrality? Which are not? Explain very briefly.

   (a) AT&T
   (b) Comcast
   (c) Amazon
   (d) Netflix
   (e) Skype
   (f) BitTorrent

AT&T and Comcast would not benefit (as Internet Service Providers). Amazon, Netflix, Skype, and BitTorrent would benefit.