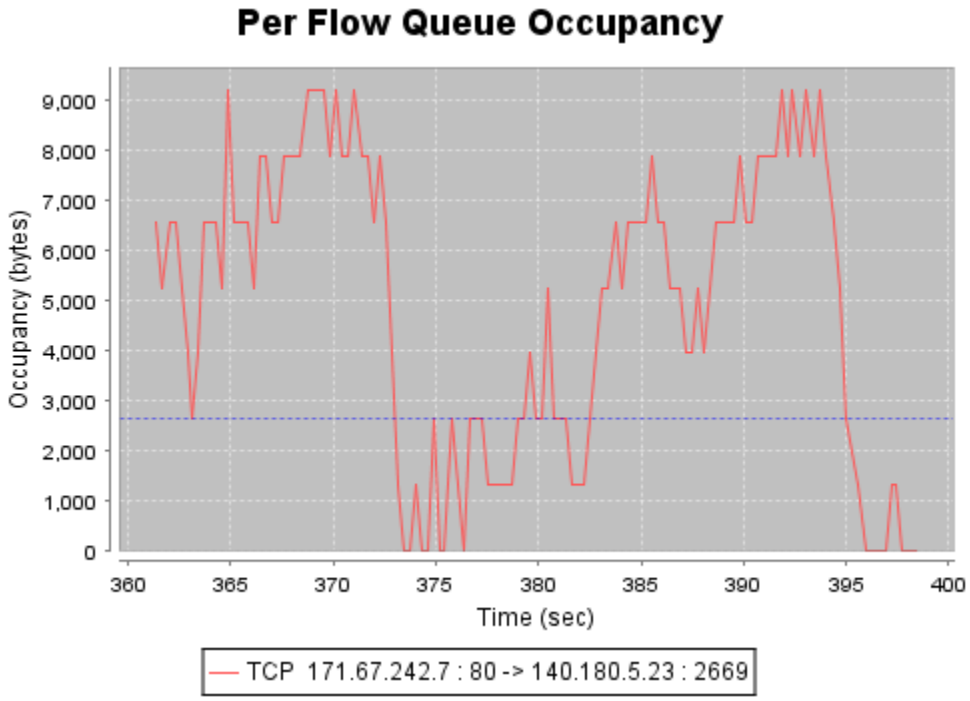
COS 116
The Computational Universe
Homework 6
Due: April 24 at start of lecture

Q1) Look up the following numbers (approximate, of course) by web search and list them. Use a consistent unit (e.g, meters) (a) Width of human hair (b) Size of the Silicon atom (c) Size of the smallest feature in current silicon chips.

The current technologies can put about a billion transistors/gates on a square inch. Assuming the smallest feature of the silicon chip cannot be smaller than an atom, in approximately in how many years will Moore's Law stop applying? (Note that Moore's Law was phrased in terms of *area,* whereas the above numbers may be linear units.)

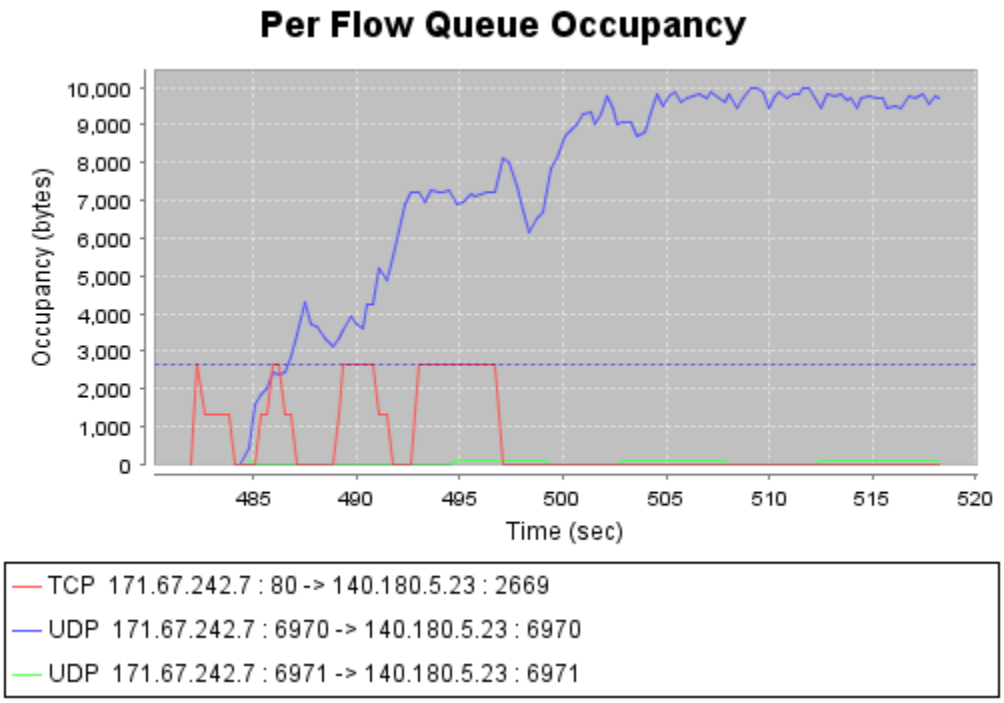
Q2) Mention 3 things (technical or nontechnical) that you learnt from the lecture about the insides of an iPod remote.

Q3) All communication on the Internet is using packets, but the Internet makes no uarantees on actually delivering the packets, or delivering them in order. A typical graph of the network traffic for a certain router might look like the following:



Explain in a few lines why the shape of the graph is like this, and how it is related to Internet congestion control.

A different but also common graph might look like the following



We saw in lab an example of this kind of traffic pattern. Explain in a few words why this is different from the previous pattern, and why both occur on the Internet.

Q5) Moore's law states that number of transistors per square inch of silicon doubles every 18 months. In real life the increase we actually see is in terms of clock speeds. Explain clearly why this is so, including an explanation of what limits clock speed in sequential circuits.

Q6) Consider the problem of determining, given a Boolean formula, that it is not satisfiable (i.e. has no satisfying assignment). Is this problem in NP? In what way is this problem different from the problem of determining that the formula is satisfiable?

Q7) You have a friend who is color blind and cannot distinguish between Red and Green. She has a sock of each color and can't be convinced that they are distinct. How can you convince her?