Wearable and Ubiquitous Computing, Spring 2005
Homework #1
Assigned 2/22. Due 3/1.

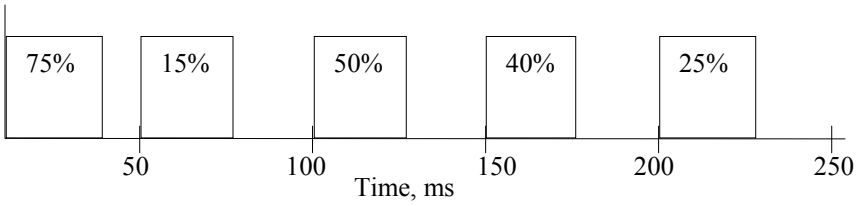
1. Your boss, Dr. Wehr A. Bull, would like to know the difference between a thick client and a thin client, and which is better than the other. What would you tell him?

2. Suppose a processor dissipates 4 W, and on average, 10 percent of the circuit nodes toggle on every clock cycle:

a) Calculate the total capacitance of all the circuit nodes if the clock frequency is 600 MHz and V_{dd} = 1.3 V. Assume there is no leakage current.

b) If there are 100 I/O pins driving an average of 20 pF load off-chip at an average frequency of 400 MHz, what is the power dissipation due to the I/O pins, assuming the I/O voltage is 1.3V? What is the power dissipation due to the I/O pins if the voltage for the I/O pins is 3.3 V?

3. Given the trace of periods of activity vs. time below, find the energy savings using (a) Weiser's OPT policy, (b) Weiser's FUTURE policy and (c) the DOH policy used in the example in class (the activity at the maximum CPU speed in the next interval is predicted to be the same as the activity in the previous interval). Assume the minimum CPU speed for (b) and (c) is 25% of the maximum CPU speed (f_{max}) and that the interval is 50 ms. For part (c), assume that the prediction for the first interval is 100%.
The percentages in the boxes represent the fraction of time the CPU would be active at f_{max}.



(d) How would the results change for DOH if the period of activity at time 50 ms started at time 85 ms instead? If the period of activity at time 150 ms started time 180 ms instead?

4. Weiser's main issues for ubiquitous computing were location and scale, while Satya's main issues were smart spaces, invisibility, localized scalability, and uneven conditioning. Are Weiser's issue of "scale" and Satya's issue of "localized scalability" the same issue? Describe why or why not.

5. According to Weiser's paper on CPU speed-setting, reducing the CPU clock frequency without also reducing the voltage does not save energy: It reduces the power by some factor of X, but it increases the execution time by the same factor of X, so that the energy consumed is the same. But Weiser was only considering CPU-intensive programs, i.e. programs where most of the execution time is due to the CPU. Some programs are I/O-intensive, where most of the time the CPU is waiting for some I/O subsystem to complete an operation, e.g. a disk read, and the operation does not depend on CPU frequency. If a program is I/O intensive, is it necessary to reduce both CPU frequency and voltage to save energy? State any assumptions you make.