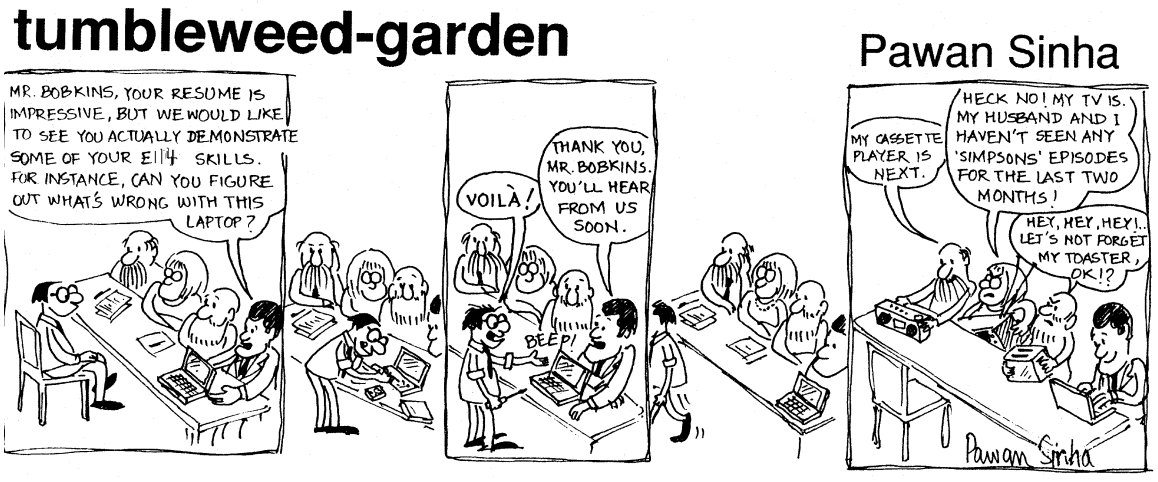
Introduction to Computer Engineering (E85)

Harris Spring 2001

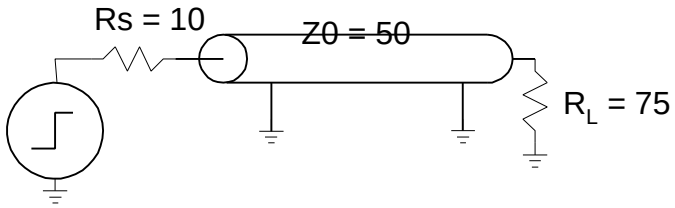
Problem Set 6 **Due: Friday, March 23**



Interview Season at Harvey Mudd

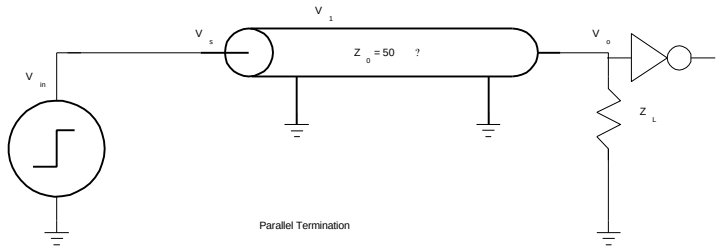
1) Transmission Lines

Consider the coaxial cable shown below. Let the characteristic impedance of the line be 50 ohms. The cable is 10 meters long. Assume waves propagate along the cable at the speed of light. Make plots of voltage vs. time at the start, 1/3 point, 2/3 point, and end of the cable for 105 ns. What voltage does the system converge toward at each point?

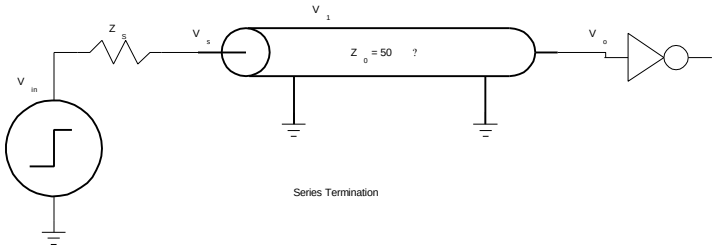


2) Transmission Line Termination

Transmission lines are usually terminated with a resistance equal to the line impedance to prevent oscillations. Two common approaches are parallel termination and series termination, shown below. In each situation, the line driver is represented as a 0-to-5 volt step on a voltage source. The receiver at the end of the line is a logic gate with an infinite input impedance. Point V_1 is 1/3 of the way along the line and the flight time down the line is T.



Parallel Termination



Series Termination

a) Sketch the voltages at V_s, V_1, and V_o for each of the designs. Assume the termination resistor (Z_L or Z_S) is equal to the line impedance of 50 ohms.

b) Given your sketches, is one approach better than the other in terms of time to drive a valid logic level to V_o? How about to V_1?

c) How much power do each of the systems dissipate in the steady state when Vin is at 5 volts?

d) Suppose you built a board with a microprocessor connected to a cache along a backside bus with 256 wires. If half the wires were high at any given time, what is the power dissipation of the board from termination in each case? Given your power calculation, would you prefer parallel or series termination when power is a concern?

e) Suppose you use an inexpensive termination resistor that has a value of Z_0 +/- 5%. What is the maximum overshoot you might see at V_0 in the case of parallel termination? Can you get away with such tolerances on your termination?

3) Assembly to Machine Language

Convert the assembly language program on page 127 into machine language. Write your instructions in hexadecimal. Assume that the first instruction is located at memory location 00400000 (in hex).

4) Interpreting Assembly Language

Do problem 3.2 from the textbook.

5) Time

Please indicate how many hours you spent on this problem set. This will not affect your grade, but will be helpful for calibrating the workload for next semester's class.