

Introduction to Computer Engineering (E85)

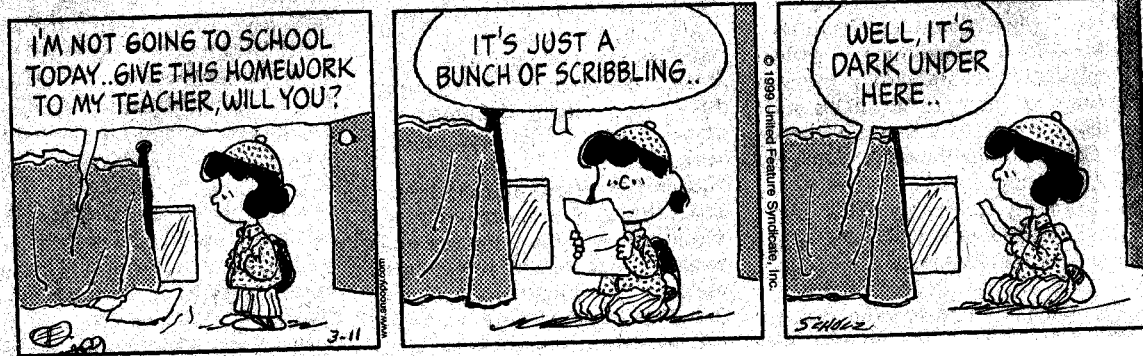
Harris

Spring 2001

Problem Set 5

Due: Friday, February 23

PEANUTS By Charles M. Schulz



1) Metastability

You sample a signal that may be changing 20% of the time. Your synchronizer is a flip-flop with gain of 15 and a time constant of 120 ps.

- What is the probability that the output has not resolved to a valid logic level within 1 ns?
- Suppose the synchronizer output is an input to another flip-flop that uses the same clock. How long must the clock period be for the probability of system failure to be less than 10^{-12} ? Define system failure to occur if the input to the second flip-flop is an invalid logic level at the time the second flip-flop samples.
- Suppose you have achieved a probability of failure P using a clock period T . Your boss wants your system to be 100 times more reliable (i.e. a probability of failure $0.01 \cdot P$). How long must your clock period be?

2) Floating Point Numbers

Write -6.375 as a:

- 8 bit sign/magnitude number with 4 integer bits and 4 fraction bits
- 8-bit 2's complement number with 5 integer bits and 3 fraction bits
- IEEE single-precision floating-point number

3) Binary Characteristics

Ben Bitdiddle and Alyssa P. Hacker are having an argument. Ben says, “All integers greater than zero and exactly divisible by six have exactly two 1’s in their binary representation. Alyssa disagrees. She says, “No, but all such numbers have an even number of 1s in their representation.” Do you agree with Ben or Alyssa or with neither? Explain.

4) 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.