Please print out this form (two-sided, if you can) and write your answers legibly in the spaces provided. If you can’t write legibly, type.

1. Consider the longest circuit path in a ripple-carry adder with 32 bits. How many gates of each type are present in this path. If AND gates and OR gates have a delay of 100 ps and an XOR gate has a delay of 200 ps, what is the worst-case delay through this circuit. Answer the same questions assuming a carry-lookahead adder.

2. In its presentation of the ripple-carry adder, the text asserts that

\[ a_i b_i + a_i c_i + b_i c_i = a_i b_i + (a_i \oplus b_i) c_i \]

Show that this is true. Why is it useful?
3. Add the decimal values 392+481 together using the standard long-addition algorithm. Consider the standard BCD adder block described in the text. Show what happens when this circuit is used to add the middle two digits (9 and 8), by drawing the circuit below and labeling the output of the binary adder and the output of the “minus-10” circuit, with the 4 bit binary values that they would produce.