

CSE 2500: Problem Set Seven

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Due October 30th.

Exercise 1

i) Write a circuit that takes two inputs, x, y (one bit each) and returns two outputs d, c so that $d = x - y \bmod 2$ and c is the “carry” of subtraction, i.e., $c = 1$ if and only if $x < y$. Using the above write a circuit that performs subtraction of two 2-bit numbers (with a carry). Use only “not”, “and”, “or” gates. Explain your answer.

ii) Consider $Q(x, y)$ to mean that “ x can fool y .” Write a predicate logic formula expressing the statements:

1. everybody can fool himself,
2. everybody can be fooled by somebody, and
3. there is someone that can fool exactly two people.

Then for each one write the negation both in English and as a formula. In no case you are allowed to start your answer with the negation sign (\neg) or the word “not”.

Exercise 2

In class we have seen a lower bound of $(n/2)^{n/2}$ for $n!$. Improve on this lower bound by employing the lower bound technique we have used for the n -th Harmonic number (grouping the terms of the product/summation according to the number of bits in their binary representation of the product/summation index).