CS 201 (David Gerhard): Introduction to Digital Systems


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SOLUTION NOTES FOR ASSIGNMENT 1

Question 1
a: 1110 = 8+4+2+0 = 14
b: 11011 = 16+8+0+2+1 = 27
c: 101010= 32+0+8+0+2+0 = 42

Question 2
a: 2^12 = 2^10 * 2^2 = about 1000 * 4 = about 4000.
Actual anser = 4096.
% difference = (4096 - 4000) / 4096 = 2.34%

b: 2^16 = 2^10 * 2^6 = about 1000 * 64 = about 64000.
Actual anser = 65536.
% difference = (65536 - 64000) / 65536 = 2.34%

c: 2^32 = 2^30 * 2^2 = about 1,000,000,000 * 4 = about 4 billion.
Actual anser = 4,294,967,296.
% difference = (4,294,967,296 - 4,000,000,000) / 4,294,967,296 = 6.87%

Question 3
a:
NAND gate produces (AB)'
AND gates produce A(AB)' and B(AB)'
OR gate produces final result A(AB)' + B(AB)'

b: simplify using logic rules
A(AB)' + B(AB)'
A(A'+ B') + B(A'+B') demorgan
AA'+AB' + BA'+ BB' distribution
    AB' + BA'   inverse

This is the minimum 2-level SOP. it is also sum of minterms, as it turns out.
Note that the function can be further simplified to A XOR B

c:
from part B, we can see that the function is ∑m(1,2)
therefore, the function is equivalently equal to ∏M(0,3)
this is equivalent to (A+B)(A'+B')

to do the same using logic, we can take:
F' = ((AB')+(A'B))'
  = (A+B')'(A'+B)' demorgan
  = (A'+B)(A+B') demorgan
  = AA'+AB+A'B'+BB' distribution
  = AB+A'B' inverse
then F = (AB+A'B')'
      = (AB)'(A'B')' demorgan
      = (A'+B')(A+B) demorgan

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