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CIS 450 A

CIS 450 – Computer Organization and Architecture
Homework #1
Due: Monday, Feb. 5, 2018, by 11:59 pm - upload via K-State OnLine

(25 points) Problems:

1. (2.43/2.61) – Using only bit-level and logic operations, write C expressions that yield 1 for the described condition, and 0 otherwise. Assume that `x` is of type `int`. You may not use any equality (==) or inequality (!=) tests.

   a. Any bit of `x` equals 1. `!(!x)`
   b. Any bit of `x` equals 0. `!!(~x)`
   c. Any bit in the least significant byte of `x` equals 1. `!!(x & 0xFF)`
   d. Any bit in the least significant byte of `x` equals 0. `!!(~x & 0xFF)`

   Hint: One solution to part (a.) is: `!!x` (and, yes, you can use this as your solution :-).

2. (2.81) – Write C expressions to generate the bit patterns that follow, where a^k represents k repetitions of symbol a. Assume a w-bit data type. Your code may contain references to j and k, representing the values of j and k, but not a parameter representing w.

   a. $1^{w-k}0^k$ `-1 << k`
   b. $0^{w-k-j}1^k0^j$ `(~(-1 << j+k)) & (-1 << k)`

   For example, if we are dealing with chars, an 8-bit data type, and k = 3, then for a. we want an expression that results in 11111000.

3. (2.50/2.76/2.77) – Suppose we are given the task of generating code to multiply integer variable `x` by various different constant factors `K`. To be efficient, we want to use only the operations `+`, `-`, and `<<`. For the following values of `K`, write C expressions to perform the multiplication using at most three operations per expression.

   a. K = 31: `(x << 5) - x`
   b. K = -7: `x - (x << 3)`
   c. K = 80: `x<<4 + x<<6`
   d. K = 144: `x<<7 + x<<4`

   Hint: One solution to part (a.) is: `(x<<5) - x`.