Name:

CSE 1400 Applied Discrete Mathematics

Spring 2015 Week 1 Practice

1. The are two bits: 0 and 1 (other names are: `False` and `True`, no and yes, off and on, low and high). Write down all bit strings of length:
   (a) 1
   (b) 2
   (c) 3
2. Tell me the number of bit strings of length:
   (a) 4.
   (b) 8.
   (c) n, where n is a natural number, that is $n \in \mathbb{N} = \{0, 1, 2, 3, \ldots\}$
   (d) Does your formula (function $n \mapsto$ number of bit strings) make sense at the boundary where $n = 0$?
3. Most computers have 32-bit or 64-bit words. How many different binary words can be written using:
   (a) 32 bits?
   (b) 64 bits?
4. Do you see how to generalize your answers from above? How many different:
   (a) Decimal strings can be written using n digits?
   (b) Hexadecimal strings can be written using n hexadecimal numerals?
   (c) Lowercase English strings can be written using n letters?
5. The <u>range</u> of natural numbers that can be represented using 1 bit is 0 to 1. What range of natural numbers that can be represented using:
   (a) 2 bits?
   (b) 3 bits?
   (c) 4 bits?
   (d) 8 bits?
   (e) What function maps the number of bits n to the largest (top) natural number in the range?
   (f) Does you formula (function $n \mapsto$ top of the range) make sense at the boundary where $n = 0$?
6. Do you see how to generalize your answers from above? What is the range of natural numbers that can be written using:
   (a) n digits?
   (b) n hexadecimal numerals?
7. Computers have a memory address register (MAR) that holds the address of a location in memory. If the MAR is 14 bits wide, how many memory locations can be addressed?

8. Binary addition is straightforward: $0 + 0 = 0$, $0 + 1 = 1 + 0 = 1$ and $1 + 1 = 0$ with a carry of 1. Compute the following binary sums:

$$\begin{array}{rcccc} & 1 & 1 & 1 & 0 \\ + & 0 & 1 & 1 & 0 \\ \hline \end{array} \qquad \begin{array}{rcccccccc} & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ + & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ \hline \end{array}$$

9. Binary multiplication is straightforward too: $0 \cdot x = x \cdot 0 = 0$ and $1 \cdot x = x \cdot 1 = x$. Compute the following binary products.

$$\begin{array}{rcccc} & 1 & 1 & 1 & 0 \\ \times & & 1 & 0 & 0 \\ \hline \end{array} \qquad \begin{array}{rcccccccc} & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ \times & & & & & & & 1 & 1 \\ \hline \end{array}$$

Total Points: 0 2015-01-12 to 2015-01-16