

Practice midterm

26 October 2016

You have up to 1 hour, 45 minutes. You may use a calculator, but no text book or notes.

1. For each statement below, fill in the blank with the *best* term from the following list. Some terms might be used more than once; some might not be used at all.

• algorithm • ASCII • binary • bit • Boolean • byte • compression • CPU
• hexadecimal • input • lossless • lossy • octal • output • persistent • pixel
• resolution • tree • two's complement • Unicode • volatile

- (a) _____ describes a type of storage device that *loses* its contents when the power is cut.
- (b) _____ is the name of a numbering system in which each digit corresponds to exactly four bits.
- (c) _____ describes a type of compression in which the original data cannot be recovered with complete accuracy.
- (d) _____ describes a device in the von Neumann architecture that provides data to the CPU.
- (e) _____ is the name we use for the base-two numbering system.

2. Write down the decimal (base 10) equivalents for the following 6-bit signed (two's complement) binary numbers. (That means the answers might be negative!)

$$1\ 1\ 0\ 0\ 1\ 0 = \underline{\hspace{2cm}} \qquad 1\ 1\ 1\ 1\ 0\ 1 = \underline{\hspace{2cm}}$$

$$1\ 1\ 0\ 1\ 1\ 0 = \underline{\hspace{2cm}} \qquad 0\ 1\ 0\ 0\ 0\ 1 = \underline{\hspace{2cm}}$$

$$0\ 0\ 0\ 1\ 0\ 1 = \underline{\hspace{2cm}} \qquad 1\ 1\ 1\ 1\ 1\ 1 = \underline{\hspace{2cm}}$$

3. Add the following pairs of 5-bit signed (two's complement) binary numbers. Your answers must be in binary, but you should check your work by converting to decimal. Remember, values can be negative!

$$\begin{array}{r} 0\ 0\ 1\ 0\ 0 = \\ +\ 0\ 1\ 1\ 0\ 0 = \\ \hline \end{array}$$

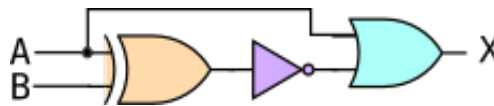
$$\begin{array}{r} 1\ 0\ 1\ 0\ 1 = \\ +\ 0\ 0\ 1\ 0\ 0 = \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 0\ 1\ 1\ 0 = \\ +\ 1\ 0\ 0\ 0\ 1 = \\ \hline \end{array}$$

4. Suppose we want to design encodings just for the five letters A, H, M, N, and T.
- How many bits would we need to represent each letter in a **fixed-width** encoding? _____
 - Using the fixed-width encoding in the previous question, how many bits would we need to represent the nine-letter word MANHATTAN? _____
 - Draw a tree to represent a **variable-width** encoding of these five letters. Use your tree to encode the word MANHATTAN. How many bits did you need? _____ How many bits did you *save*, compared to the fixed-width encoding? _____

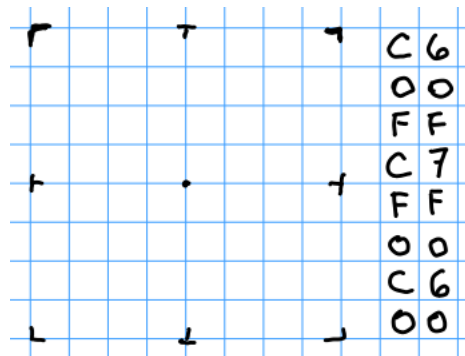
5. Create a truth table to show the value of $X' + (X \cdot Y)$ for all possible inputs of X and Y.

6. Which Boolean expression is equivalent to the following circuit diagram?



- (a) $X = A' + (A \oplus B)$
- (b) $X = A + (A \oplus B)'$
- (c) $X = A \oplus (A + B)'$
- (d) $X = A + (A \oplus B)'$

7. Decode the following hexadecimal notation into an 8×8 icon, using 1 bit per pixel.



8. Convert the following binary number into hexadecimal and octal.

1 0 1 0 1 1 1 0 0 1 1 0 0 1 0 0

9. It's important that the steps in an algorithm are **unambiguous**. What does that mean?
10. What is the output of the following algorithm? Remember to indicate clearly what is *output* and what is scratch work.
1. Set N to 0
 2. Set K to 5
 3. If $K > 10$ then output N and stop.
 4. Set N to $N + K$
 5. Set K to $K + 1$
 6. Go back to step 3.