Practice Midterm

24 October 2012

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 • bit • Boolean • byte • hexadecimal • pixel • pseudo-code • Python • unicode

   (a) _____ is base 16 notation, which uses digits 0–9 and letters A–F.

   (b) _____ is an encoding of characters used in all the world's languages.

   (c) _____ is a way of describing a computational technique to other humans using carefully structured English.

   (d) _____ is a high-level programming language used to instruct computers.

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!)

   `0 0 1 1 1 0 =` _____ `0 0 1 0 1 0 =` _____

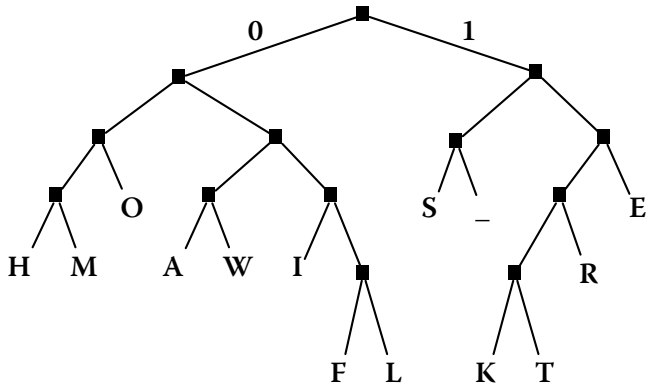
   `1 1 1 1 0 0 =` _____ `1 0 1 0 0 0 =` _____

   `0 1 1 0 1 1 =` _____ `1 1 0 1 0 0 =` _____

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

```
  0 0 1 0 0        1 1 1 1 1        0 1 1 0 0
+ 1 1 1 0 0      + 1 0 1 1 0      + 0 1 1 0 0
------------     ------------     ------------
```

4. Below is a tree representing a variable-width encoding.



(a) Use the tree to encode the following message in binary:

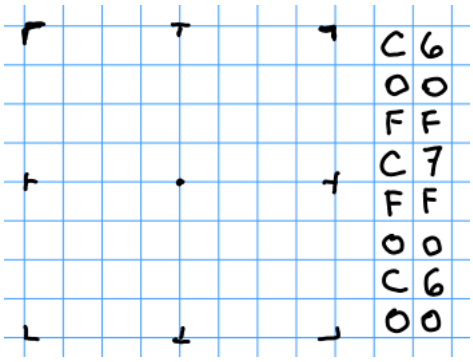
T R E E _ F L O W

(b) The tree contains 14 distinct characters. If we were using a *fixed-width* encoding of the same characters, how many bits per character would we need? _____

(c) The message in part (a) is 9 characters. How many bits did we save by using a variable-width encoding instead of a fixed-width one?_____

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

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



7. 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 1
3. If K > 4 then output N and stop.
4. Set N to N + K
5. Set K to K + 1
6. Go back to step 3.
```

8. What is the output of the following algorithm?

```
1. Set N to 13
2. Output N
3. If N = 1 then stop
4. If N is even, then set N to N/2
5. If N is odd, then set N to 3*N + 1
6. Go back to step 2.
```

9. What is the output of the following Python program?

```
alpha = 6
beta = 2
print "alpha + beta"
print alpha - beta
gamma = alpha - 1
print gamma*2
```