Due by Wed, May 7.

Please use lots of space and explain your answers, showing clearly any work you had to do. Each question is worth 5 points.

Section 11.2 Applications of trees

- (1) Which of these codes are prefix codes?
 - (a) a: 11 e: 00 t: 10 s: 01
 (b) a: 0 e: 1 t: 01 s: 001
 (c) a: 101 e: 11 t: 001 s: 011 n: 010
 (d) a: 010 e: 11 t: 011 s: 1011 n: 1001 i: 10101
- (2) From the coding scheme

a: 001 b: 0001 e: 1 r: 0000 s: 0100 t: 011 x: 01010

find the words represented by

- (a) 01110100011
- **(b)** 0001110000

(3) Build a binary search tree for the following words using alphabetical order:

- purple
- green
- violet
- red
- pink
- blue
- yellow
- orange
- (4) For the sentence "ones on soon":
 - (a) Find the frequency of each of the letters e, n, o, s in the sentence.
 - (b) Then make a Huffman code for these letters.
 - (c) Use your Huffman code to encode the sentence as a bit string.
 - (d) Show that the average number of bits to encode a letter is 1.9

(5) Use Huffman coding to encode these letters with the frequencies

A: 0.1, B: 0.25, C: 0.05, D: 0.15, E: 0.3, F: 0.07, G: 0.08

What is the average number of bits needed to encode a letter?

These next two questions are about the game of *nim*. For the version of the game we discussed in class, the player taking the last pebble wins.

(6) Take the game of nim starting with one pile of 3 stones.

- (a) Draw the game tree. (It should have 8 vertices.)
- (b) Starting with the leaves, label all the vertices with +1 for winning positions for player 1 and -1 for winning positions for player 2.
- (c) Does the first or second player have a winning strategy for this game?
- (d) If the first player has a winning strategy, what is the winning first move?
- (7) Take the game of nim starting with three piles each containing 2 stones, 1 stone and 1 stone.
 - (a) Draw the game tree. (It should have 18 vertices.)
 - (b) Label all the vertices with +1 or -1.
 - (c) Does the first or second player have a winning strategy for this game?
 - (d) If the first player has a winning strategy, what is the winning first move?

If you get stuck on a question or aren't sure if you understand it:

- Go over the relevant class notes or section in the textbook.
- Ask me about it after class.
- Come to my office hours: Mon 2:00 3:00, Wed 2:00 3:00 in CP 317.
- Go to the Math Tutorial Lab in-person in CP 303 or online.