

# Homework Assignment #2

## CS 410/584 Algorithm Design & Analysis: Spring 2009

This assignment is due Wednesday, 15 October, at the beginning of class. You should work alone on this assignment. However, you are free to discuss the problems on the class mailing list, with the TA or with me. (Or you can send me or the TA email questions directly; please put “CS 584” at the beginning of the subject line.)

**Reading:** 15.1-15.4, 16.1-16.3.

**Office Hours:** Tuesdays 3:30-5p or by appointment. (Note that I am coming from off-campus at that hour; if I am not in my office right at 3:30, I will be there shortly.)

**Recall:** On any homework exercise where you are asked to give an algorithm, you must also provide an English description of how it works and at least one example execution.

Exercises: 15.3-2 (5 points), 15.3-5 (10 points), 15.4-5 (5 points), 16.1-4 (15 points).

2A (10 points): Construct two different Huffman codes for the set of symbols below, with their relative frequencies.

Frequency	9	4	4	3	2	3	2
Symbol	A	B	C	D	E	F	G

Give the encoding for “ACEBAG” in each of your codes.

[584 only] (20 points): Find a dynamic programming algorithm with worst-case  $O(n^3)$  time complexity that tests membership of a string in a context-free language. Specifically, it determines if a string  $w = a_1 a_2 \dots a_n$  is generated by a context-free grammar  $G = (V, T, P, S)$ . ( $V$  = non-terminals,  $T$  = terminals,  $P$  = productions,  $S$  = start symbol.) You may preprocess the grammar if you want, and can assume no empty productions.

**Hint 1:** Let  $w[i, j]$  be everything in  $V$  that can derive  $a_i a_{i+1} \dots a_j$ .

**Hint 2:** Review normal forms for context-free grammars.