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Department of Mathematics

NC STATE UNIVERSITY

MA 351 Intro Discrete Math Models, second mid-semester examination, Nov 8, 2007

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www.math.ncsu.edu/~kaltofen/courses/DiscreteModels/Fall07/index.html (URL)

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Your Name: _____

For purpose of anonymous grading, please do **not** write your name on the subsequent pages.

    This examination consists of 6 problems, which are subdivided into 12 questions, where each question counts for the explicitly given number of points, adding to a total of **49 points**. Please write your answers in the spaces indicated, or below the questions, using the **back of the sheets** for completing the answers and **for all scratch work,** if necessary. You are allowed to consult **two** 8.5in × 11in sheets with notes, but **not** your book or your class notes. If you get stuck on a problem, it may be advisable to go to another problem and come back to that one later.

    You will have **75 minutes** to do this test.

Good luck!

Problem 1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

Total _____

**Problem 1** (14 points) Consider the following mathematical formula:

$$a + (b * c - d)/e - (f + g * h) \tag{1}$$

(a, 5pts) Please draw an expression tree for (1) that complies with the usual operator precedence rules and left-to-right tie-breaking for operators of equal precedence.

(b, 5pts) Please draw the parse tree for (1) using the context-free grammar given in class.

(c, 4pts) Please give both a **prefix** string and a **postfix** string of only variables and operators that represent the tree given under part (a).

2

**Problem 2** (13 points): Consider the following graph:
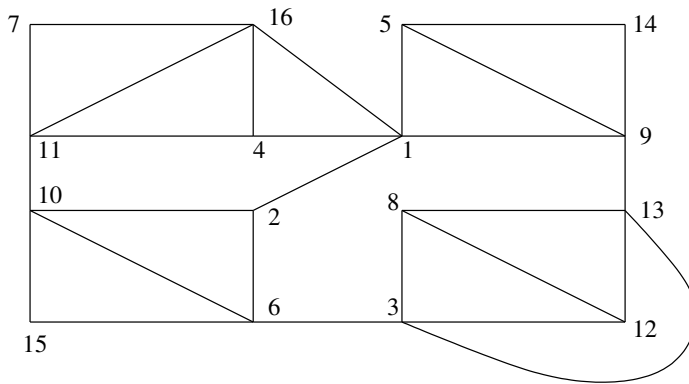
(a, 5pts) Please draw the depth-first search tree for the above graph, processing the neighboring vertices of each vertex **in numerical order**, starting at vertex **1**.

(b, 5pts) Using the tree in part (a), find a one-way street assignment for the above graph, i.e., please orient the edges so that the resulting digraph is strongly connected.

(c, 3pts) What is the maximum degree in the above graph? Please explain.

Problem 3 (5 points):
Consider the 4-dimensional
hypercube (with the given
vertex labeling):
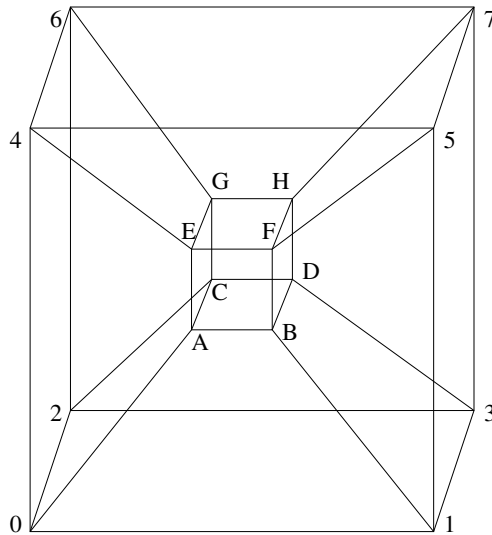
Please draw a subgraph that is homeomorphic to K_5 (the complete graph with **five** vertices).

Problem 4 (5 points):
Please draw a graph with 6 vertices, clique number 2 and chromatic number 3.

Problem 5 (8 points):

(a, 3pts) Please describe the construction of Koch's snowflake.

(b, 3pts) Please derive the area of Koch's snowflake, assuming that the initial triangle has area 1.

(c, 2pts) Please derive the length of the boundary of Koch's snowflake.

Problem 6 (4 points): Consider the following Lindenmeyer system: $A \rightarrow BA$, $B \rightarrow CB$, $C \rightarrow DC$, $D \rightarrow A\alpha$, $\alpha \rightarrow \alpha$. Please write down the first 4 new generations of strings starting with A.