

## ICS 161 — Algorithms — Spring 2005 — Second Midterm

Please answer the following seven questions on the answer sheets provided. Answers written on other pages or on the wrong sheet will not be scored. Be sure to write your name and student ID on all three answer sheets. You may continue your answers on the back of the same answer sheet. No books, notes, or calculators may be used during the exam.

1. (40 points)

- Draw a directed graph, having as its eight vertices the strings 'ape', 'ate', 'eat', 'era', 'pea', 'rap', 'rat', and 'tea', and including an edge from word  $x$  to word  $y$  whenever the last two letters of  $x$  are the same as the first two letters of  $y$ ; for instance, you should include an edge from 'ape' to 'pea'.
- Write down a sequence in which the vertices of this graph could be visited by breadth first search, starting from 'era'.
- Does this graph have a topological ordering? Explain why or why not.
- Draw an adjacency matrix representation of this graph, including a separate table describing which array index is associated with which vertex.

2. (20 points) Draw a suffix tree for the word 'senses'.

3. (10 points) Suppose that the KMP algorithm is searching for the pattern 'senses' in some larger text, and that at some point in the search it has matched the first five characters 'sense' but finds a mismatch in the next position. How many units would the algorithm shift?

4. (15 points) In the dynamic programming algorithms described in the lectures, do all the algorithms have a worst-case running time proportional to the size of the matrix in which the answers are stored? Explain why or why not.

5. (15 points) Suppose your job is to sell advertising space on a web page. At most half the screen can be filled with ads, and for each potential ad buyer we can associate a pair of numbers  $(f, p)$  where  $f$  is the fraction of a screen the buyer's ad would take and  $p$  is the price he's willing to pay for his ad. Your job is to choose a subset of the ads that maximizes your total profit. Ads can not be resized; you must take them at the given size or not take them at all. Would this problem be more naturally modeled as a fractional knapsack problem, or a 0-1 knapsack problem? Explain your answer.

6. (10 points) Yes or no: does the Prim-Dijkstra-Jarník algorithm work correctly for graphs that may have negative length edges?

7. (10 points) Suppose you wish to find shortest paths in a directed graph that has some negative length edges but has no cycles. Would it be better to apply the DAG shortest path algorithm or the Bellman-Ford algorithm for this problem? Explain your answer.

**ICS 161 W05 — Answer Sheet 1**

Name:

Student ID:

Please answer question 1 in the space below.

1:          2:          3:          4:          5:          6:          7:          total:

**ICS 161 W05 — Answer Sheet 2**

Name:

Student ID:

Please answer question 2 in the space below.

Please answer question 3 in the space below.

Please answer question 4 in the space below.

**ICS 161 W05 — Answer Sheet 3**

Name:

Student ID:

Please answer question 5 in the space below.

Please answer question 6 in the space below.

Please answer question 7 in the space below.