Homework 2

CS 252, Semester II, 2005

Due on **Monday May 2, 2005 at 3:00 pm**

Hand-in Instructions:

- Hand in the assignment as a stapled hardcopy at the beginning of class to the TA.
- The assignment should be typed using your favorite program to edit text and create drawings. E.g., you can use LaTeX or Word for text and Visio, Xfig, LaTeX or PowerPoint for drawings.

Late Policy:

- Hand in this homework by **3:00 pm, Monday, May 2, 2005** to receive **full credit**.
- You can also hand in this homework after the deadline. However, you will be assessed a **5% penalty for each late day**.

Problem 1 (points)

1. Draw the fractional cascading data structure for efficiently searching in the following catalogs of integers: $C_1 = \{-5, 0, 5, 11, 16\}$, $C_2 = \{-6, -4, 2, 10, 19\}$, $C_3 = \{-6, -3, 1, 4, 16, 20\}$, $C_4 = \{-37, 20\}$, $C_5 = \{-5, -3, 2, 5, 13, 17\}$ and $C_6 = \{-4, -2, 6, 8, 14, 20\}$. Assume that the catalogs are organized such that search is first performed in C_1, then in C_2, C_3 and so on. Include all the necessary information stored in the augmented catalogs.
2. On copy of your drawing, illustrate the execution of two *locate(x)* queries of integers of your choice and the execution of query *locate(9)*. Operation *locate(x)* should return, for each original catalog C, the minimum integer $y \in C$, such that $y \leq x$.

Problem 2 (points)

1. Compute and draw the **Voronoi diagram** for the following set S of points in the plane: $S = \{(0, 8), (3, 2), (5, 14), (6, 8), (10, 12), (12, 0), (15, 8), 17, 16), (18, 0), (19, 6), (20, 11), (20, 15)\}$.
2. What is the minimum and what is the maximum complexity (in terms of number of edges or vertices) of the Vonoroi diagram of a set of n points? Explain.
3. Draw a **Delaunay triangulation** $\mathcal{T}$ of S. Is this triangulation unique? Explain.

Problem 3 (points)

1. Draw the flow network associated with the planar orthogonal drawing of Figure 1. Show that the flow is not of minimum cost by identifying an augmenting cycle of negative cost. Draw the graph after a bend-reducing transformation that corresponds to the augmenting cycle.
2. Show an elementary transformation that reduces the number of bends in the planar orthogonal drawing of Figure 2. Draw the closed curve associated with the transformation and the drawing after the transformation.

Problem 4 (points)

Using Figure 3, draw a straight-line dominance representation of the graph (the dominance variation that allows for horizontal and vertical lines), adding temporary nodes as needed. Include a drawing of the original graph with the left and right orderings of the vertices.

Problem 5 (points)

For the graph in figure 4 and the cycle identified, run the planarity testing algorithm (Algorithm 3.5, page 80 of *Graph Drawing*). Describe the steps of the algorithm and draw the appropriate figures. Say whether or not the graph is planar. If it is planar, draw a planar embedding.

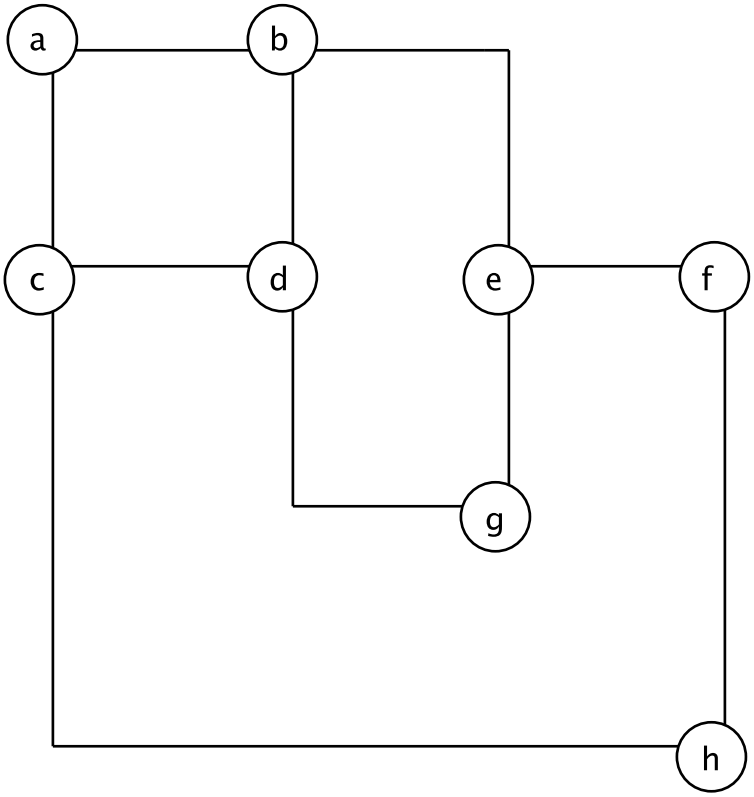

Figure 1: Planar orthogonal drawing for Problem 3.

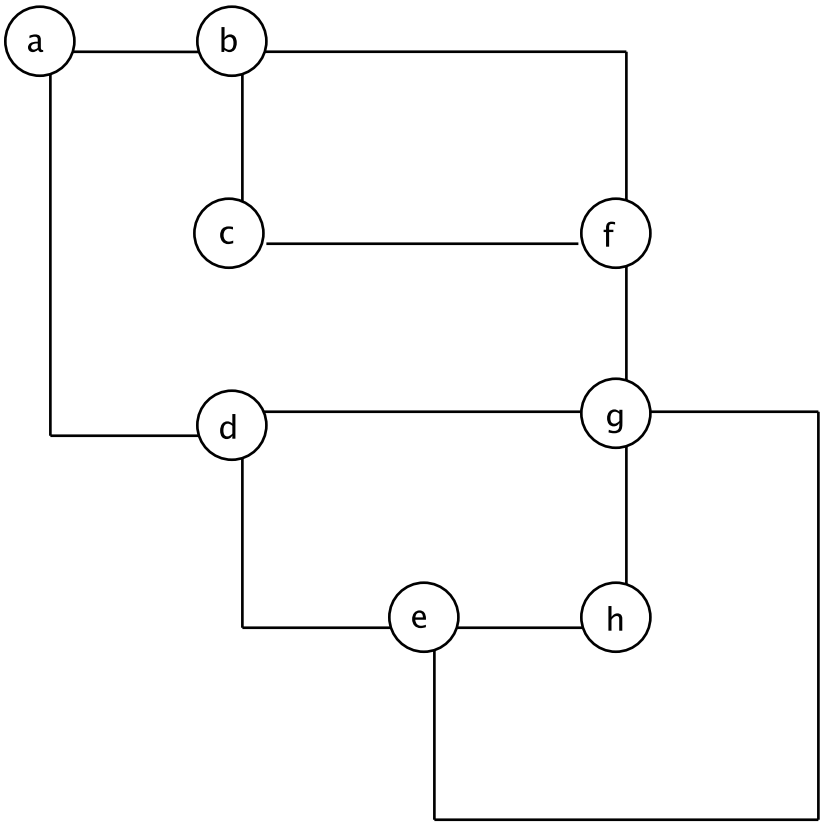

Figure 2: Planar orthogonal drawing for Problem 3.

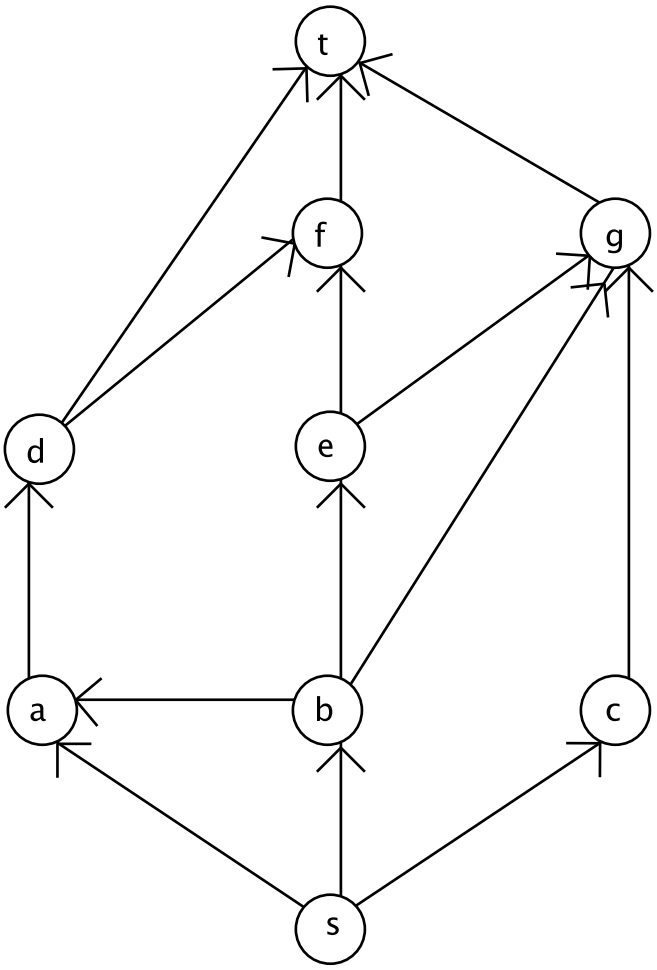

Figure 3: Dominance graph for Problem 4.

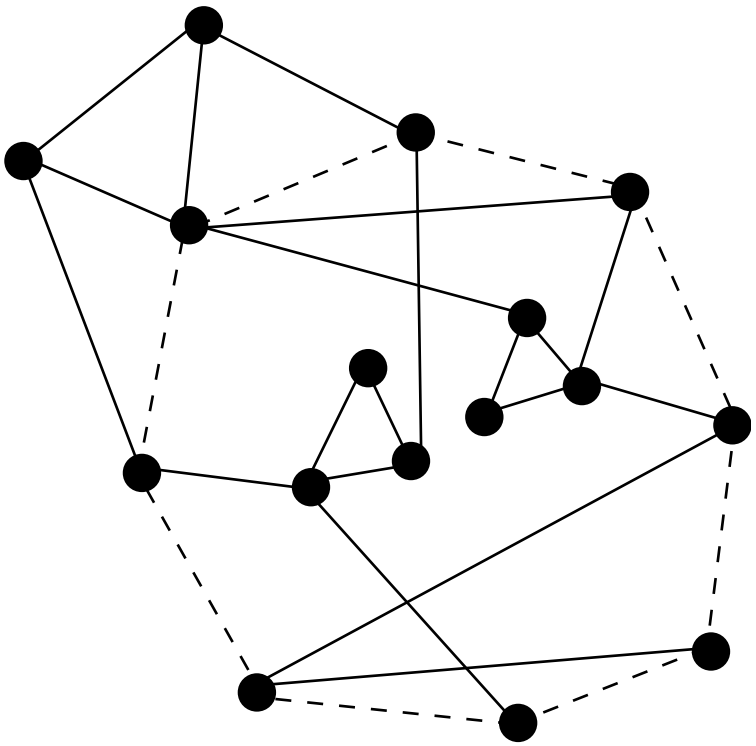

Figure 4: Graph with separating cycle (indicated by dashed edges) for Problem 5.