Due Date: Oct. 7, 2005 (in class)

Problem 1. (Space Filling Curves)

a) Compute the Z-values of regions A and B in the figure below, assuming that $K = 3$ bits ($2^3 = 8$ values per coordinate) and $A1=(5.5, 6.5)$, $A2=(8.5, 5)$, $A3=(9.1, 9.2)$, $A4=(7, 10)$, $B1=(0.4, 1.8)$, $B2=(1.2, 0.6)$, $B3=(4, 0.8)$, $B4=(4.5, 2.3)$ and $B5=(0.9, 3.2)$. 

![Diagram of regions A and B]

b) Write a program that computes the z-value and the hilbert-value of a 2-d pixel, as well as the inverses. The program should take as input the order of the curve and the $x$ and $y$ values, or the z- or hilbert-value of the pixel. A small test file will be provided to you for testing the correctness of your program. Note that you should hand in the source code of your program via email.

HINT: Methods to compute z- and hilbert-values can be found in the following paper:
H. V. Jagadish: Linear Clustering of Objects with Multiple Attributes. ACM SIGMOD Conference 1990, pages 332-342.

Problem 2. (R-trees)

Let $D$ be a 2-dimensional point dataset and $p = (x, y)$ a point in that set. The coordinates of all points are positive. Consider the function: $f(p) : D \rightarrow R$, where $f(p) = a_1 x + a_2 y$ and $a_1 + a_2 = 1$. The values for $a_1$ and $a_2$ are given by the user. The idea is that each user gives different importance (weight) to different attributes. We want to find the point (or points) that maximize this function. This type of queries are called preference queries. Now, assume that an R-tree is used to store the dataset $D$.

(a) Design a search procedure that uses the R-tree to find the point(s) that maximize the function $f$. Give the pseudocode of the algorithm and explain how it works.

(b) What is the property that allows the design and guarantees the correctness of your algorithm?