**CS 49995 & CS 63016 ST: Big Data Analytics**

**Homework 2**

**Instructor:** Xiang Lian

**Due Date:** Please refer to the course website

1. Please list at least 2 differences between B+-tree and R-tree. [10 points]

2. For Z-ordering curve, with 16 × 16 pixels (or cells), please use the bit-shuffling method to find the mappings between cell locations and Z-values below. [20 points]

2a. Please illustrate how to calculate the Z-value for the cell with the 2D location (6, 15) ***[note: cell locations start from 0 on each dimension]***. [10 points]

2b. Given a Z-value 101 (decimal number), please identify the 2D location of the cell corresponding to this Z-value. [10 points]

3. Given two 4-dimensional *minimum bounding rectangle* (MBRs) in an R-tree, *A* = (2, 10; 40, 60; 32, 40; -2, 11) and *B* = (3, 4; 30, 50; 30, 40; 20, 23), please use an MBR, *E* to minimally bound both MBRs *A* and *B*. [20 points]

 *E* =

4. Given two *d*-dimensional MBRs, *E*1 = (x1min, x1max; x2min, x2max; …; xdmin, xdmax) and *E*2 = (y1min, y1max; y2min, y2max; …; ydmin, ydmax) (note: both E1 and E2 are represented by an array in the code), please give the pseudo code to check whether or not two MBRs are intersecting with each other. If yes, please return true; otherwise, return false. [20 points]

5. Write an algorithm to perform a range query (with rectangular shape, *Q*) in a quad-tree (please write comments to explain the meaning of your pseudo code). [30 points]

**Bonus Question [20 extra points]**

6. Read Sections 1 and 2 of the following paper and write a short survey about the formal definition of *reverse nearest neighbor* (RNN) query and solutions of RNN processing (including KM, YL, MVZ, SAA, and SFT). Use one paragraph for each solution (*note: please use your own words to describe the problem definition and solutions;* ***DO NOT*** *copy any sentences from the paper*).

Yufei Tao, Dimitris Papadias, and Xiang Lian. Reverse *k*NN Search in Arbitrary Dimensionality. In *Proceedings of the Very Large Data Bases Conference* (VLDB'04), pages 744-755, Toronto, Canada, Aug. 30-Sept. 3, 2004. <http://www.cs.kent.edu/~xlian/papers/VLDB04-RNN.pdf>

**Submission**

Submit an electronic copy of your homework solution to the [Blackboard](https://learn.kent.edu/).