Assignment 3

Please note that we have different deadline for each question. Please make sure you have submitted each question by its own deadline:

Question 1 : Fri 12 May, 5:00 pm

Questions 2, 3 : Fri 26 May, 5:00 pm

Please make sure that you always use notations comply with lecture notes. We are not going to accept different notations.

Question 1 (~~10~~ 8 marks)

1) (~~5~~ 4 marks) Mathematically speaking, a set X is called a metric space if for any pair of points x and y of X, there is an associated real number $d(x, y)$, called the distance (also called a metric) from x to y, with the following properties:

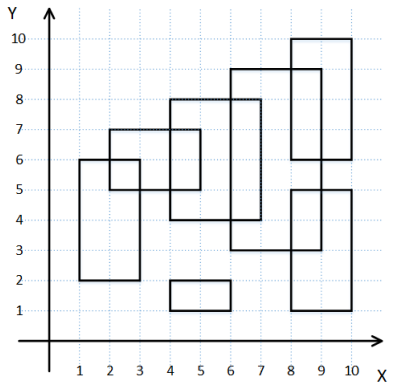
- $d(x, y) \geq 0 \; and \; d(x, x) = 0$
- $d(x, y) = d(y, x)$
- $d(x, y) \leq d(x, z) + d(z, y)$

for all x, y, z in X. Any function that satisfies these properties is called a metric on X.

The road network in Sydney can be modelled as a directed graph with both bidirectional and unidirectional edges. Let x and y be two points on the road network, not necessarily on intersections, and let $d(x, y)$ be the shortest distance from x to y.

According to this definition of metric space, is the road network in Sydney a metric space? Justify your answer.

2) (~~5~~ 4 marks) Given a relation $R(x1, x2, y1, y2)$ where each tuple represents a rectangle with lower left corner $(x1, y1)$ and upper right corner $(x2, y2)$ as follows:



$x1$	$x2$	$y1$	$y2$
1	3	2	6
2	5	5	7
4	6	1	2
4	7	4	8
6	9	3	9
8	10	1	5
8	10	6	10

Given a query

```
SELECT *
FROM R r, R s
WHERE GREATEST(r.x1, s.x1) < LEAST(r.x2, s.x2)
      AND GREATEST(r.y1, s.y1) < LEAST(r.y2, s.y2)
      AND ( r.x1 < s.x1 OR ( r.x1 = s.x1 AND r.y1 < s.y1 ) )
```

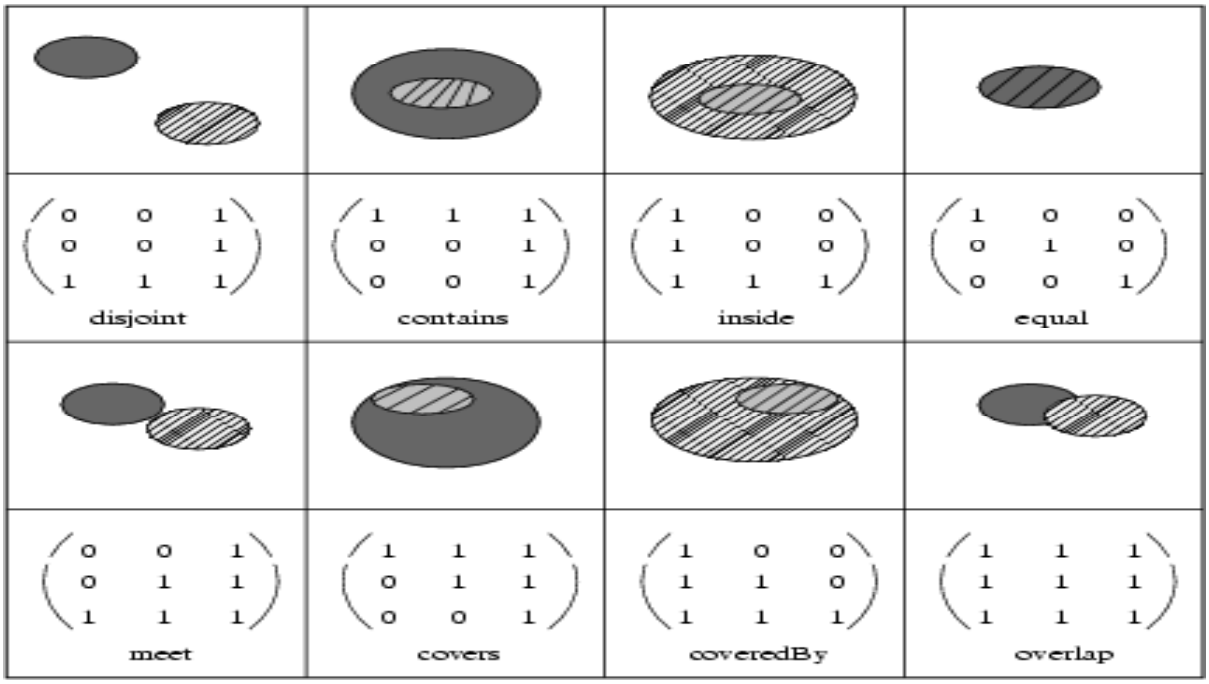
What is the result of this query?

Question 2 (~~5~~ 4 marks)

The binary topological relationship between two objects, A and B, in a plane $\Re^2$ is based upon the intersection of A's interior (A°), boundary (∂A), and exterior (A^-) with B's interior (B°), boundary (∂B), and exterior (B^-). The *nine-intersection* matrix between the six object parts defines a topological relationship and can be concisely represented using the following matrix:

$$\Gamma_9(A,B) = \begin{pmatrix} A^\circ \cap B^\circ & A^\circ \cap \partial B & A^\circ \cap B^- \\ \partial A \cap B^\circ & \partial A \cap \partial B & \partial A \cap B^- \\ A^- \cap B^\circ & A^- \cap \partial B & A^- \cap B^- \end{pmatrix}$$

For a two-dimensional region embedded in $\Re^2$, eight relations can be realized, and they provide mutually exclusive complete coverage. These relations are *disjoint*, *meet*, *overlap*, *equal*, *contains*, *inside*, *covers*, and *covered by*. The following figure shows how topological relations can be represented using the nine-intersection matrix.



However, to distinguish the eight relations, not all the nine intersections are necessary. For example, $A^- \cap B^-$ takes identical values for all the eight relations. Another example is that $A^- \cap B^\circ$ and

$A^{-} \cap \partial B$ always take the same values for each of the eight relations, at least one of them is unnecessary.

If we are going to use a subset of the nine intersections to distinguish the eight relations, what is the minimum size of the subset we have to choose? List the ones in the subset that you have chosen.

Question 3 (~~10~~ 8 marks)

Given the schema of UNSW campus dataset:

HelpPoint(CODE: char, NAME: char, GEOMETRY: point)

Road(NAME: char, TYPE: char, GEOMETRY: linestring)

Building(NAME: char, CODE: char, GEOMETRY: polygon)

Express the following queries in SQL, using the OGIS specified datatype and functions.

(1) (2 marks) Name all the roads that cross building named Computer Science and Engineering.

(2) (2 marks) A help point could cover points that are within 1km. List the names of buildings that can be totally covered by help point whose code is 001.

(3) (~~3~~ 2 marks) List all the names of isolated buildings. A building is isolated if it does not share a boundary with any other building.

(4) (~~3~~ 2 marks) Name code of the closest help point to the building named Computer Science and Engineering.

Assignment Submission

We accept electronic submissions only. Please submit your assignments as follows:

- Ensure that you are in the directory containing the file to be submitted. (note: we only accept files with .pdf extension)
- For question 1, type "give cs9311 ass3q1 ass3q1.pdf" to submit.
- For questions 2 and 3, type "give cs9311 ass3q23 ass3q23.pdf" to submit.
- Please keep a screen capture (including **timestamp** and the **size** of submitted file) for your submissions as proof in case that the system is not working properly. If you are not sure how, please have a look here.

Note:

1. We do not accept e-mail submissions, and the submission system will be immediately closed after the deadline.
2. If the size of your pdf file is larger than 2MB, the system will not accept the submission. If you face this problem, try converting to compressed pdf.

3. If you have any problems in submissions, please email to swan398@cse.unsw.edu.au or xwang@cse.unsw.edu.au.

Late Submission Penalty

Zero mark