There are three tasks in this exam. It is expected that you do all. The questions are weighted equally.

1. **Explain short but concise the following concepts:**
   a. Euclidean distance
   b. Ecological fallacy
   c. Database management systems (DBMS)
   d. Server GIS
   e. Object Data Model
   f. The Universal Transverse Mercator (UTM) Projection

2. **Vector overlay**

   ![Figure 2.1](image1)
   ![Figure 2.2](image2)
   ![Figure 5.3](image3)
a) The map and its attribute table shown in Figure 2.2 is the result of a GIS function applied on the map shown in Figure 2.1. Name and describe the GIS function used.

b) Based on the maps shown in Figures 2.2 and 2.3, your task is to identify areas where there have been land use changes between 1975 and 2000. Which GIS operation would you apply for this task? Describe the task.

c) Show the result of this operation by drawing the new resulting layer and the content of the corresponding attribute table.

d) Show, for instance, on the sketch from the task 2c), areas where there have been change in land use (i) from forest in 1975 to urban areas in 2000 and (ii) from farming in 1975 to urban in 2000.

e) Formulate SQL statements you could use to identify the areas asked for in task 2d.

3. **Level of measurement, Coordinate Systems and Queries**

A popular “sport” for GPS enthusiasts these days is Geocaching. Geocaching is a worldwide “treasure hunting” community where anybody can become a member and to treasure hunt with their GPS. On the official web page for Geocaching, members can download coordinates to Geocaches in any area of their choice.

The Geocaches can be hidden anywhere, for example, in urban landscape, on mountain peaks, in the forest or along popular hiking routes. The Geocache can be as small as a 35mm film box or larger. All Geocaches contain a log you can sign when you have found it. Some Geocaches contain a small item that you can take, replacing it by a different item.

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Hidden</th>
<th>Type</th>
<th>Diff</th>
<th>Terrain</th>
<th>Country</th>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Rode Lantern</td>
<td>2005</td>
<td>1</td>
<td>1,5</td>
<td>1,5</td>
<td>Norway</td>
<td>Trondheim</td>
<td>N 63° 26.222</td>
<td>E 010° 23.482</td>
</tr>
<tr>
<td>33</td>
<td>The Srock</td>
<td>2006</td>
<td>2</td>
<td>1,5</td>
<td>1 Denmark</td>
<td>Copenhagen</td>
<td>N 55° 40.556</td>
<td>E 012° 33.919</td>
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</tr>
<tr>
<td>56</td>
<td>Bonjour de Paris</td>
<td>2004</td>
<td>4</td>
<td>1</td>
<td>1 France</td>
<td>Paris</td>
<td>N 48° 51.569</td>
<td>E 002° 21.214</td>
<td></td>
</tr>
<tr>
<td>396</td>
<td>Thunder</td>
<td>2003</td>
<td>2</td>
<td>2</td>
<td>2 USA</td>
<td>Seattle</td>
<td>N 47° 39.026</td>
<td>W 122° 50.700</td>
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<tr>
<td>748</td>
<td>Cseum</td>
<td>2005</td>
<td>1</td>
<td>1,5</td>
<td>1 Italy</td>
<td>Rome</td>
<td>N 41° 53.367</td>
<td>E 012° 29.566</td>
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</tr>
<tr>
<td>590</td>
<td>Privi Purse</td>
<td>2006</td>
<td>3</td>
<td>2</td>
<td>1,5 India</td>
<td>Panaji</td>
<td>N 15° 32.279</td>
<td>E 073° 47.114</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1. A subset of a database on Geocache locations.

Table 3.1 presents an excerpt from the Geocache database. In the table, each Geocache is represented by a row. The columns indicate the name of the Geocache (Name), the year when it was first hidden (Hidden), the type of Geocache (Type), the difficulty to find it (Diff) the difficulty of the terrain it is in (Terrain), the country it is hidden in (Country), a more precise location name (Location) and its position (latitude and longitude).
There are several types of Geocaches, and the once represented in the table above are coded from 1 to 4:

1: Micro Geocache (film box size)
2: Small Geocache (larger than a film box)
3: Regular Geocache (any sized box, larger than small Geocache)
4: Puzzle Geocache, Regular size with a puzzle requiring you first to figure out the coordinates as the coordinates listed are not for the actual cache location, but for a general reference point.

a) At what level of measurement (nominal, ordinal, interval, or ratio) is the variable “Type”?

b) The latitude and longitude field make it possible for you to map the content of the table. If you were going to make a map of the types of Geocaches, how would you symbolize them?

c) As you see from the table, the Geocaches are represented by latitude and longitude coordinates. What coordinate system is this? Give a brief description.

d) Discuss whether this is a suitable coordinate system for calculating distances.

In order to make a map from a subset of the database you may use queries.

e) Formulate a SQL expression that results in a selection of all Geocaches hidden in 2004.

f) Formulate a SQL expression that result in a selection of those Geocaches that were hidden at some time during the period from (and inclusive) 2004 to (and inclusive) 2006 and with a Terrain difficulty less than 2.

g) Formulate a SQL expression that results in a selection that includes all Geocaches with Type of 4 and those Geocaches located in Terrain with difficulty of 1.5 or more.