1. Explain the difference index and storage structures.

2. When encoding the 16 german states with the numbers from 1-16 in lexicographic order, how would a standard bitmap index, a multi-component bitmap index (4+4), a range-encoded bitmap-index, a range-encoded multi-component bitmap index, and an interval-encoded bitmap index (interval length = 5) look like? States: Baden-Württemberg, Bayern, Berlin, Brandenburg, Bremen, Hamburg, Hessen, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz, Saarland, Sachsen, Sachsen-Anhalt, Schleswig-Holstein, Thüringen

How could you answer the following query with the bitmap indexes:

- Find the state Sachsen-Anhalt.
- All states lexicographic after Hessen.
- The states from Hessen to Thüringen.

3. State the difference between the UB-Tree and the traditional B-Tree? How suitable is the UB-Tree for similarity queries?

4. The $R^*_a$-tree is a variant of the R-tree for data warehouse applications. What are the benefits of $R^*_a$-tree and which a priori knowledge must be available to build the tree? How does the inclusion of additional aggregates influence the query processing and depth of the tree?

5. How can index structures help in the execution of the following database operations?

- Selections
- Projections
- Aggregations and groupings
- Sorting
- Duplicate elimination
- Joins