INFS7901
Database Principles

Course Summary and Exam Review

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Course Summary

Final Exam Review

Future INFS Courses

Final Thoughts

Course-Level Learning Objectives

The course was designed to use tools and technologies that promote active learning and provide rich feedback to help you learn to

Course Objectives

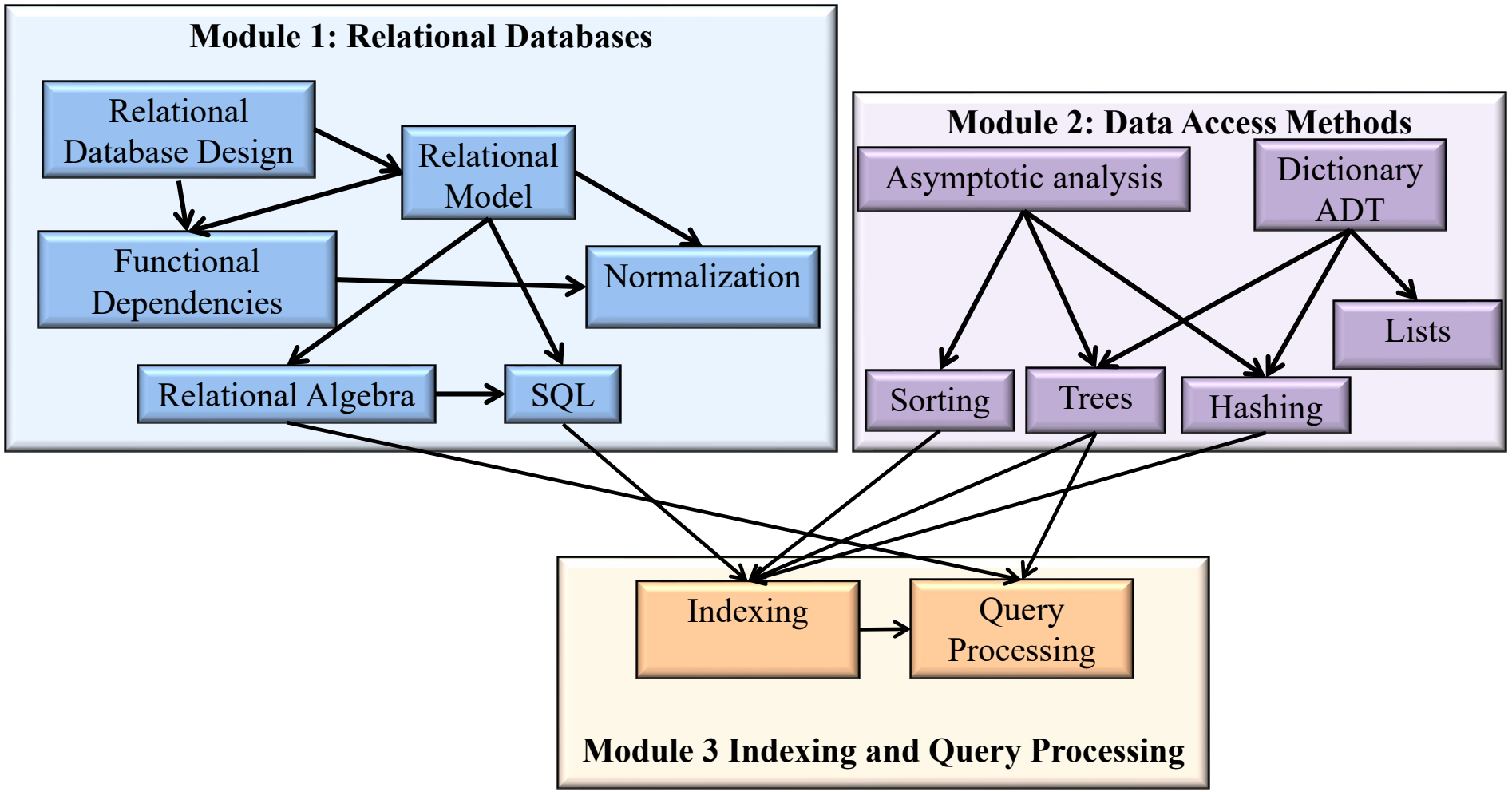
1. Reason with the logical foundation of the relational data model and understand the fundamental principles of correct relational database design.
2. Express natural language queries using relational algebra and SQL.
3. Analyse the fundamental techniques and algorithms applied for sorting, tree manipulation, and hashing on structured data.
4. Reason with the logical foundation on how data is indexed and how a query is executed and optimised.
5. Design relational databases with considerations of data integrity and system performance.

Graduate Attributes

1. In-depth knowledge & skills in the field of study
2. Effective Communication
3. Independence and Creativity
4. Critical Judgement

Active Lectures **Piazza** **RiPPLE** **Jupyter Notebooks** **Project**

INFS7901 Journey



Revision Checklist for ER Diagrams

- **Terminology**
  1. Entity (Weak entity)
  2. Relationship (Degree, Recursive)
  3. Attribute (Key and Partial Key, Composite, Multivalued, Derived)
  4. Constraints (Cardinality ratio, Participation constraints)
  5. Extended ER (Specialization, Generalization)

- **Basic Concepts**
  1. Variation in Notation
  2. Subjectivity (Expressability, Design choices)
  3. Mapping to Relational Model

Revision Checklist for the Relational Model

- **Terminology**
  1. Relations (Is a Set, Table with Rows and Columns)
  2. Domains (Atomicity, Data type)
  3. Attributes (Degree of a relation, Prime or Key attribute)
  4. Tuples
  5. Key (Super key, Minimal key, Primary key, Candidate key, Foreign key)
  6. Mapping

- **Basic Concepts**
  1. Constraints (Domain, Key, Entity, Referential)
  2. Constraint violations, constraints and operations, inconsistent database state
  3. Step by step process for mapping

Revision Checklist for FDs and Normalisation

- **Terminology**
  1. Anomalies
  2. Functional Dependencies
  3. Normal Forms

- **Basic Concepts**
  1. How to determine and how to infer FDs
  2. Closure computation
  3. Definitions of Normal Forms
  4. Normalization is a Process

Revision Checklist for SQL

- **Terminology**
  1. Declarative vs. Procedural
  2. DDL statements (CREATE TABLE, ALTER TABLE, DROP TABLE)
  3. DML statements (INSERT, DELETE, UPDATE, **SELECT)**

- **Basic Concepts**
  1. Selection, Projection, Sorting (WHERE/HAVING, SELECT, ORDER BY)
  2. Aggregation (COUNT, SUM, AVG, MIN, MAX) and Grouping (GROUP BY)
  3. Conditions on groups and aggregates (HAVING)
  4. Multiple relation queries (Joins, Nesting)
  5. When to join and when to nest?
  6. Correlated and non-correlated sub-queries
  7. Sub-query operators (IN, comparison with (or without) ANY/ALL, EXISTS)

Revision Checklist Asymptotic Analysis

- **Terminology**
  1. Input size
  2. Big-O
  3. Tractable and interactable algorithms
  4. Best-, worst- and average case analysis

- **Basic Concepts**
  1. Categorise an algorithm into a common complexity class
  2. Given code, measure number of steps as function of the input size

Revision Checklist for Sorting

- **Terminology**
  1. Time complexity
  2. Space complexity
  3. Stability

- **Basic Concepts**
  1. Understanding how different learning algorithms work
  2. Analyse the complexity of different sorting algorithms
  3. Compare and contrast different sorting algorithms

Revision Checklist for Binary Trees

- **Terminology**
  1. Dictionary data type
  2. Tree terminology
  3. Binary search trees

- **Basic Concepts**
  1. Demonstrate how arrays, linked lists and trees can be used to implement dictionary ADT
  2. Compare and contrast algorithms for storing and retrieving values from a dictionary ADT

Revision Checklist for Hashing

- **Terminology**
  1. Hash functions
  2. The pigeonhole principle
  3. collision in hashing
  4. Chaining and open addressing
  5. Primary and secondary clustering
  6. Linear probing, quadratic probing and double hashing

- **Basic Concepts**
  1. Have the ability to create good hash functions
  2. Demonstrate how hashing can be used to implement dictionary ADT
  3. Compare and contrast hashing algorithms for storing and retrieving values from a dictionary ADT

Revision Checklist for Indexing

- **Terminology**
  1. Primary, secondary and clustering indexing
  2. Sparse and dense indexes
  3. Multi-level indexes
  4. Tree-based and hash-based indexes

- **Basic Concepts**
  1. Explain the benefits of using indexes
  2. Explain how different indexing methods work
  3. Given information about the most common queries in a database, recommend which attributes using which methods should be indexed.

Revision Checklist for Relational Algebra and Query Optimization

- **Terminology**
  1. Relational algebra and its supported operations
  2. Initial query tree and final query tree

- **Basic Concepts**
  1. Write queries in relational algebra
  2. Construct query trees
  3. Apply heuristic rules to transform an initial query tree into a final query tree that is efficient to execute.

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Final Exam

- Date/Time: **Check online**
- Venue: **Blackboard invigilated (proctorU)**
  - Open book, slides.
  - Limited time, so study hard.
  - If you have difficulty understanding a topic, next week come to consultation hour.

Final Exam

- The final exam will address (theoretical) material from the entire semester
- Students are required to pass the final exam i.e. to obtain **at least 50% in the Final Exam** to pass the subject.
- In ECP: *Students must receive a passing grade on the final exam in order to pass this course (i.e., achieve at least 50%). If you fail the exam, your final mark will be capped at 49 and your final grade will be capped at 3. Fractional marks achieved during assessments will be rounded up before calculation of final results.*

Final Exam Questions

1. ER Diagrams, relational model and mapping
2. Functional dependency and normalisation
3. SQL
4. Asymptotic analysis
5. Sorting
6. Trees
7. Hashing
8. Indexing
9. Relational algebra and optimization

Preparing for the Final exam

- Lecture Notes
- Textbook
- Tutorial Questions
- RiPPLE Questions
- Class Exercises & Practice Questions
- Past Final exams

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Celebrations

Final Exam Review

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Core Courses

- **INFS1200 Information Systems** will give you foundations of what a database system does and how to use it

- **INFS2200 Relational Database Systems** on what the database management software does and how to administer it

- What effect multiple computers and huge amounts of data have in **INFS3200 Advanced Database Systems**

Advanced Courses

- **INFS3202 Web Information Systems** (how the Web affects information systems)
- **INFS3204 Service-Oriented Architectures** (how organizations can be tied together using information systems technology).
- **INFS4205 High Dimensional Data** covers techniques on managing spatial and multimedia data
- **INFS4203 Data Mining** covers discovery of patterns and anomalies in large volumes of data, including the Web
- **INFS7410 Information Retrieval** where you can learn how search engines work and are built

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Technology has Revolutionised the Way We Live

What to Expect in Near Future

How are you going to contribute to this vision of the future?

10 tips

1. Learn how to type with two hands
2. Say “yes” to opportunities
3. Learn to use Google search for your problems
4. Memorise and use a few conversation starters to initiate a chat with people
5. Start learning Latex, and write your CV using ModernCV.
6. Each month search for a job you like, and apply for it even if you don’t want to work now
7. Learn how to use Git and put all your projects online.
8. When people talk, listen to them and ask questions about what they say
9. Learn how to write an effective email
10. Always ask for help