Lectures for the course: Advanced Database Systems (IT 60113)

Week 1

Lecture 1 – 21/07/2010

- Introduction to the course
- Expectations
- Evaluation Guideline

Lecture 2 – 22/07/2010

- Introduction to ER Model
- Entity Sets, Relationship Sets, Attributes
- Multivalued Attributes, Derived Attributes, Composite Attributes
- Cardinality, Participation
- Keys

Week 2

Lecture 3 – 26/07/2010

- Keys of relationship sets
- Design issues
- Weak entities
- E-R Diagram
- Ternary relationships

Lecture 4+5 – 28/07/2010

- Reflexive relationships
- Generalization and specialization
- ER Model exercise

Lecture 6 – 29/07/2010

- Mapping ER Model to Tables
- Redundancy of Tables
- Alternative representation of tables mapped from generalization and specialization
Week 3

Lecture 7 – 02/08/2010

• Relational model
• Database schema
• Foreign keys
• Relational algebra

Lecture 8+9 – 03/08/2010

• Basics of SQL
• Simple Select
• Joining of two or more tables
• Aliasing
• Aggregation
• Group By

Lecture 10 – 04/08/2010

• Introduction to Active databases
• STARBURST Rules
• Syntax and Semantics
• Example STARBURST rules
• Rule prioritization

Week 4

Lecture 11 – 09/08/2010

• STARBURST Semantics continued
• Net Effect
• INSERTED, DELETED, OLD_UPDATED and NEW_UPDATED tables
• Multiple rules

Lecture 12+13 – 11/08/2010

• Oracle Triggers
• Syntax and Semantics of Oracle Triggers
• Examples
• Active Rule Design - Termination

Lecture 14 – 12/08/2010
• Confluence
• Observable Determinism
• Applications of Active Rules
• Integrity maintenance
• Derived data maintenance
• Replication

**Week 5**

**Lecture 15 – 16/08/2010**

• Introduction to Temporal databases
• Notion of time and basic SQL support for handling time
• Examples on processing time related data in standard SQL

**Lecture 16+17 – 18/08/2010**

• Class Test 1 held

**Lecture 18 – 19/08/2010**

• Further examples on processing time related data in standard SQL
• Class test 1 scripts shown

**Week 6**

**Lecture 19 – 23/08/2010**

• Time as a database dimension and its interpretation
• Chronon, anchored and un-anchored time
• Valid time and transaction time
• Maintaining history with valid time and transaction time

**Lecture 20+21 – 25/08/2010**

• Bitemporal Conceptual Data Model
• Other temporal data models
• Value equivalent tuples
• Introduction to TSQL2
• CREATE table and basic select queries

**Lecture 22 – 26/08/2010**

• Simple TSQL2 syntax and semantics
• Coalescing at the time of returning query results
• Restructuring
• Partitioning

Week 7

Lecture 23 – 30/08/2010

• VALID clause to specify valid time of tuples in Select query
• Insert, Delete and update
• Effect of update resulting in insert

Lecture 24+25 – 01/09/2010

• Aggregation and group by
• Transaction time support
• Valid event relations
• Review of term paper status

Lecture 26 – 02/09/2010

• Introduction to datalog
• Facts, base predicates and derived predicates
• Rules – Head and Body of rules, Goals
• Conjunction and Disjunction
• Use of wildcard

Week 8

Lecture 27 – 06/09/2010

• More examples of derived predicates
• Negation
• Use of negation for universal quantification – All

Lecture 28+29 – 08/09/2010

• Recursive queries
• Bill of Materials example
• Safe Datalog programs

Lecture 30 – 09/09/2010

• Mapping safe non-recursive datalog programs to relational algebra
• Mapping datalog programs o SQL
• Summary of topics covered up to mid-sem exam
• Clarification to queries on topics covered before mid-sem exam

Week 9

13/09/2010 – 20/09/2010 Mid-sem Exam

Week 10

Lecture 31+32 – 22/09/2010

• Introduction to transactions
• Properties of transactions
• Isolation and concurrency control
• Schedules
• Serial schedules
• Concurrent schedule
• Exam scripts shown and feedback given

Lecture 33 – 23/09/2010

• More examples of concurrent schedule
• Conflict equivalent schedule
• Conflict serializability
• Feedback on term paper given

Week 11

Lecture 34 – 27/09/2010

• View serializability
• Testing for conflict serializability and view serializability
• Recoverable and cascadeless schedules

Lecture 35+36 – 29/09/2010

• Concurrency Control
• Lock based protocols
• Shared and exclusive locks
• Deadlock
• Two phase locking
• Starvation
• S2PL and R2PL
• Lock upgrading
Lecture 37 – 30/09/2010

• Tree based locking protocol
• Deadlock free protocol

Week 12

Lecture 38 – 04/10/2010

• Timestamp based protocol
• Validation based protocol
• Optimistic concurrency control

Lecture 39+40 – 06/10/2010

• Multi-level concurrency control
• Multi-version concurrency control

Lecture 41 – 07/10/2010

• Effect of insert and delete on concurrency control
• Phantom phenomenon
• Index locking scheme

Lecture 42 – 07/10/2010 (Compensatory Lecture)

• Weak Levels of consistency
• Type 2 consistency
• Cursor stability
• Repeatable read
• Read committed
• Read uncommitted

Week 13

Lecture 43 – 11/10/2010

• Introduction to distributed databases
• Replication and fragmentation
• Relative advantages and disadvantages
• Real-life examples of distributed databases

Week 14
Lecture 44+45 – 20/10/2010

- Recap of distributed database architecture
- Two phase commit and three phase commit
- Type of failure
- Effect of failure on two phase and three phase commit protocols
- Writing lock information in log
- Concurrency control in distributed databases
- Centralized and distributed locking
- Primary copy, majority protocol and biased protocol

Lecture 46 – 21/10/2010

- Distributed queries
- Distributed join processing
- Semi join processing

Week 15

Lecture 47 – 25/10/2010

- Indexing multidimensional data
- Nature of multidimensional data
- Multidimensional point data
- Nature of queries in multidimensional data
- Shortcomings of B/B+ tree in handling multidimensional data
- Introduction to R-Tree

Lecture 48+49 – 27/10/2010

- Class Test 2 held

Lecture 50 – 28/10/2010

- R-Tree node structure
- Formal definition of R-tree
- Class Test 2 scripts shown

Week 16

Lecture 51 – 01/11/2010

- Searching on R-Tree
- Insert in R-Tree
- ChooseLeaf and AdjustTree
• SplitNode – exhaustive search

Lecture 52+53 – 03/11/2010

• SplitNode – Quadratic cost algorithm
• Example of building R-tree
• Nearest neighbor search in R-Tree
• MinDist between a query point and a hyper rectangle
• Idea of nearest neighbor hyper sphere

Lecture 54 – 03/11/2010

• MinMaxDist between a query point and a hyper rectangle
• Distance between a query point and an object
• Search ordering by MinDist and MinMaxDist and their impact
• Different pruning strategies

Week 17

Lecture 55 – 08/11/2010

• K-NN search
• Variants of R-Tree – R*-Tree
• Other distance measures like cosine distance
• Multimedia databases – R-Tree for high dimensional point data

Lecture 56+57 – 10/11/2010

• SS-Tree
• Properties of high dimensional data
• Approximate search techniques
• Directions towards indexing data in NDDS and Hybrid data space
• Term project presentations

Lecture 58 – 11/11/2010

• Term project presentations

Week 18

Lecture 59 – 15/11/2010

• Summary of topics covered