## CS186: Introduction to Databases

- 1. Lecture 01 Introduction
- 2. Lecture 02 Sorting and Hashing
- 3. Lecture 03 Single-Table Queries
- 4. Lecture 04 Join Algorithms
- 5. Lecture 05 Sorting Data: Disks and Files
- 6. Lecture 06 File Organizations and Indexing
- 7. Lecture 07 Tree-Structured Indexes
- 8. Lecture 08 Relational Algebra
- 9. Lecture 09 SQL: The Query Language
- 10. Lecture 10 SQL: Constraints, SQL Embedded in Other Languages
- 11. Lecture 11 SQL (Cont.), Entity-Relationship Diagrams and the Relational Model
- 12. Lecture 12 Entity-Relationship Diagrams and the Relational Model (Cont.)
- 13. Lecture 13 Functional Dependencies and Schema Refinement
- 14. Lecture 14 Functional Dependencies and Schema Refinement
- 15. Lecture 15 Relational Query Optimization I
- 16. Lecture 16 Relational Query Optimization II
- 17. Lecture 17 Elementary IR: Scalable Boolean Text Search
- 18. Lecture 18 Ranking and Crawling, Data Visualization
- 19. Lecture 19 Data Visualization (Cont.), Transactions and Concurrency Control
- 20. Lecture 20 Transactions and Concurrency Control (Cont.)
- 21. Lecture 21 Big Data Analytics Systems (Guest Lecture by Reynold Xin)
- 22. Lecture 22 Advanced Topics in Concurrency Control
- 23. Lecture 23 Advanced Topics in Concurrency Control (Cont.), Crash Recovery
- 24. Lecture 24 A Perspective on Data Science (Guest Lecture by Tye Rattenbury)
- 25. Lecture 25 Crash Recovery (Cont.)
- 26. Lecture 26 Crash Recovery Wrap-up; Distributed Data, Replication and NoSQL

- 27. Lecture 27 Review I
- 28. Lecture 28 Review II

- 1. 1
  - 1.1. Lecture 1 Part 1 Intro and Why
  - 1.2. Lecture 1 Part 2 What
  - 1.3. Lecture 1 Part 3 Who
  - 1.4. Lecture 1 Part 4 How
- 2. 2
- 3. 3
- 4. 4
  - 4.1. Lec 4 Part 1 Architecture
  - 4.2. Lec 4 Part 2 Storage Hierarchy
  - 4.3. Lec 4 Part 3 Components of a Disk
  - 4.4. Lec 4 Part 4 Flash
  - 4.5. Lec 4 Part 5 Storage Pragmatics and Trends
  - 4.6. Lec 4 Part 6 Disk Space Management
- 5. 4.5
  - 5.1. Lec 4 5 Part 1 Files
  - 5.2. Lec 4 5 Part 2 Pages for Fixed Length
  - 5.3. Lec 4 5 Part 3 Pages for Variable Length
  - 5.4. Lec 4 5 Part 4 Record Layout
  - 5.5. Lec 4 5 Part 5 Summary
- 6. 5
  - 6.1. Lecture 5 Part 1 Review and Goals
  - 6.2. Lec 5 Part 2 Model and Assumptions
  - 6.3. Lec 5 Part 3 Scan
  - 6.4. Lec 5 Part 4 Equality
  - 6.5. Lec 5 Part 5 Range Search
  - 6.6. Lec 5 Part 6 Insert
  - 6.7. Lec 5 Part 7 Delete
  - 6.8. Lec 5 Part 8 Summary
- 7. 6
  - 7.1. Lec 6 Part 1 Intro to Indexes
  - 7.2. Lec 6 Part 2 High Fan out Search Tree
  - 7.3. Lec 6 Part 3 Search and Insertion in ISAM
  - 7.4. Lecture 6 Part 4 B+ Tree Intro
  - 7.5. Lecture 6 Part 5

```
7.6.
             Lecture 6 Part 6
      7.7.
             Lecture 6 Part 7
      7.8.
             Lecture 6 Part 8 B+ Tree Deletion
      7.9.
             Lecture 6 Part 9
    7.10.
             Lecture 6 Part 10
 8.
      7
      8.1.
             Lec 7 Part 1 Lecture Introduction
      8.2.
             Lec 7 Part 2 Query Support Overview
             Lec 7 Part 3 Composite Search Keys in One Dimension
      8.3.
      8.4.
             Lec 7 Part 4 Three Alternatives for Data Entry Storage
      8.5.
             Lec 7 Part 5 Clustered vs Unclustered Indexes
      8.6.
             Lec 7 Part 6 Variable Length Keys: Occupancy and Compression
      8.7.
             Lec 7 Part 7 Clustered B+ Tree Cost Model, Lec 7 Part 7 Clustered B+ Tree Cost
             Model **REVISED**
      8.8.
             Lec 7 Part 8 Lecture Summary
 9.
      8
      9.1.
             Lec 8 Part 1 Intro to Buffer Management
      9.2.
             Lec 8 Part 2 Mapping Pages
      9.3.
             Lec 8 Part 3 Dirty Pages
      9.4.
             Lec 8 Part 4 Buf Mgr State
      9.5.
             Lec 8 Part 5 Page Replacement
      9.6.
             Lec 8 Part 6 LRU
      9.7.
             Lec 8 Part 7 Clock
      9.8.
             Lec 8 Part 8 LRU and Sequential Flooding
      9.9.
             Lec 8 Part 9 MRU and Repeated Scans
     9.10.
             Lec8 Part 10 Additional Topics
     9.11.
             Lec 8 Part 11 Summary
10.
      9
     10.1.
             Lec 9 Part 1 Out of Core Algs
     10.2.
             Lec 8 Part 2 Mapping Pages
     10.3.
             Lec 9 Part 3 Sort Hash Specs
     10.4.
             Lec 9 Part 4 Two Way Sorting
     10.5.
             Lecture 9 Part 5 External Sort
     10.6.
             Lec 9 Part 6 External Hashing
     10.7.
             Lec 9 Part 7 Recursive Partitioning for External Hash
     10.8.
             Lec 9 Part 8 Sort Hash Duality
     10.9.
             Lec 9 Part 9 parallel hashing
    10.10.
             Lec 9 Part 10 parallel sort
    10.11.
             Lec 9 Part 11 Sort v Hash
    10.12.
             Lec 9 Part 12 Summary
      10
11.
     11.1.
             Lec 10 Part 1 Intro
```

```
11.2.
             Lec 10 Part 2 Unary Operators
     11.3.
             Lec 10 Part 3 Set Operators
     11.4.
             Lec 10 Part 4 Joins
     11.5.
             Lec 10 Part 5 GroupBy and Summary
12.
     12
     12.1.
             Lecture 11 Part 1 Intro and Select
     12.2.
             Lecture 11 Part 2 HeapScan and Sort Iterators
     12.3.
             Lecture 11 Part 3 Group By Iterator
     12.4.
             Lecture 11 Part 4 Cost Model for Subsequent Analysis
     12.5.
             Lecture 11 Part 5 Nested Loops Join
     12.6.
             Lecture 11 Part 6 Index Nested Loops Join
     12.7.
             Lecture 11 Part 7 Sort Merge Join
     12.8.
             Lecture 11 Part 8 Sort Merge Refinement, Lecture 11 Part 8 Sort Merge Cost and
             a Refinement
     12.9.
             Lec 11 Part 9
    12.10.
             Lecture 11 Part 10. Lecture 11 Part 10 Grace Hash Animation
   12.11.
             Lecture 11 Part 11 Hash Join Costs
   12.12.
             Lecture 11 Part 12 Conclusion
13.
      13
    13.1.
             Lecture 13 Part 1 Intro
     13.2.
             Lecture 13 Part 2 Big Picture
     13.3.
             Lecture 13 Part 3 Algebra Equivalences
     13.4.
             Lecture 13 Part 4 Heuristics
     13.5.
             Lecture 13 Part 5 Physical Equivalences
     13.6.
             Lecture 13 Part 6 Running Example
     13.7.
             Lecture 13 Part 7 Selection Pushdown
     13.8.
             Lecture 13 Par 8 Join Orders
    13.9.
             Lecture 13 Part 9 Join Algs
    13.10.
             Lecture 13 Part 10 Projection Pushdown
   13.11.
             Lecture 13 Part 11 Indexes
   13.12.
             Lecture 13 Part 12 Conclusion
14.
      14
     14.1.
             Lecture 14 Part 1 Introduction
     14.2.
             Lecture 14 Part 2 Background Query Blocks and Physical Properties
     14.3.
             Lecture 14 Part 3 Plan Space
     14.4.
             Lecture 14 Part 4 Selectivity Estimation
     14.5.
             Lecture 14 Part 5 Selectivity in More Depth
     14.6.
             Lecture 14 Part 6 Using Histograms for Selectivity Estimation
     14.7.
             Lecture 14 Part 7 Selectivity for Join Queries
     14.8.
             Lecture 14 Part 8 Summary of Cost Estimation
     14.9.
             Lecture 14 Part 9 Single Table Plans
    14.10.
             Lecture 14 Part 10 Dynamic Programming
    14.11.
             Lecture 14 Part 11 Example Query
```

	14.12.	Lecture 14 Part 12 Summary of Query Optimization
15.	15	
	15.1.	Lecture 15 Part 1 Intro to Text Search
	15.2.	Lecture 15 Part 2 Bag of Words
	15.3.	Lecture 15 Part 3 Inverted Files and Single-Term Queries
	15.4.	Lecture 15 Part 4 Inverted Indexes and Boolean Logic
	15.5.	Lecture 15 Part 5 Phrase Queries and Content Results
	15.6.	Lecture 15 Part 6 Updating Text Indexes, Lecture 15 Part 6 Updating Text Indexes
	15.7.	Lecture 15 Part 7 Text Search Summary
16.	16	
	16.1.	Lecture 16 Introduction
	16.2.	Lecture 16 Part 2 Overview of DB Design
	16.3.	Lecture 16 Part 3 Data Models and Relational Levels of Abstraction
	16.4.	Lecture 16 Part 4 Data Independence
	16.5.	Main Sub 05
	16.6.	Lecture 16 Part 6 Basics of Entities and Relationships
	16.7.	Lecture 16 Part 7 Key and Participation Constraints
	16.8.	Lecture 16 Part 8 Weak Entities
	16.9.	Lecture 16 Part 9 Alternative Notation and Terminology
	16.10.	Lecture 16 Part 10 Binary vs Ternary Relationships
	16.11.	Lecture 16 Part 11 Aggregation and Ternary Relationships
	16.12.	Lecture 16 Part 12 Entities vs Attributes
	16.13.	Lecture 16 Part 13 Entities vs Relationships
	16.14.	Lecture 16 Part 14 Converting ER to Relational
	16.15.	Lecture 16 Part 15 Translating Weak Entity Sets
	16.16.	Lecture 16 part 16 Summary
17.	17	
	17.1.	Lecture 17 Part 1 Functional Dependencies
	17.2.	Lecture 17 Part 2 Anomalies
	17.3.	Lecture 17 Part 3 Armstrongs Axioms
	17.4.	Lecture 17 Part 4 Attribute Closures
	17.5.	Lecture 17 Part 5 BCNF and other Normal Forms
	17.6.	Lecture 17 Part 6 Lossless Join Decompositions
	17.7.	Lecture 17 Part 7 Dependency Preservation and BCNF Decomposition
	17.8.	Lecture 17 Part 8 Conclusion
18.	18	
	18.1.	Lec 18 Part 1 Intro to Transactions
	18.2.	Lec 18 Part 2 Examples and Problems
	18.3.	Lec 18 Part 3 The Transaction Model
	18.4.	Lect 18 Part 4 ACID Properties of Transactions
	18.5.	Lec 18 Part 5 Serializability
	18.6.	Lec 18 Part 6 Conflict Serializability

	18.7.	Lec 18 Part 7 Conflict Dependency Graphs
	18.8.	Lecture 18 Part 8 View Serializability
19.	19	
	19.1.	Lecture 19 Part 01 Two Phase Locking
	19.2.	Lecture 19 Part 2 Strict 2PL
	19.3.	Lecture 19 Part 3 Concurrency Examples
	19.4.	Lecture 19 Part 04 Lock Manager Implementation
	19.5.	Lecture 19 Part 5 Deadlock Scenarios and Prevention
	19.6.	Lecture 19 Part 6 Deadlock Avoidance
	19.7.	Lecture 19 Part 7 Deadlock Detection and Resolution
	19.8.	Lecture 19 Part 8 Intro to Multigranularity LockingLecture 19 Part 9 Intent Locks
		and Hierarchical Lock Protocol
	19.9.	Lecture 19 Part 9 Intent Locks and Hierarchical Lock Protocol
	19.10.	Lecture 19 Part 10 FYI: Index Latching and Phantoms
	19.11.	Lecture 19 Part 11 Conclusion
20.	20	
	20.1.	Lecture 20 Part 1 Recovery Intro
	20.2.	Lecture 20 Part 2 Need for Atomicity and Durability, SQL support for
		Transactions
	20.3.	Lecture 20 Part 3 Strawman Solution
	20.4.	Lecture 20 Part 4 STEAL / NO FORCE, UNDO and REDO
	20.5.	Lecture 20 Part 5 Intro to Write-Ahead Logging
	20.6.	Lecture 20 Part 6: ARIES Logging
	20.7.	Lecture 20 Part 7: ARIES Logging Simple Case
	20.8.	Lecture 20 Part 8 ARIES Abort and Checkpointing
	20.9.	Lecture 20 Part 9 ARIES Recovery: Overview and Analysis Phase
	20.10.	Lecture 20 Part 10: ARIES Recovery, REDO Phase
	20.11.	Lecture 20 Part 11: ARIES Recovery, UNDO Phase
	20.12.	Lecture 20 Part 12: Example Scenarios, Additional FAQs
	20.13.	Lecture 20 Part 13: Recovery Conclusion
21.	21	
	21.1.	Lecture 21 1 Cosine Similarity
	21.2.	Lecture 21 2 TFxIDF
	21.3.	Lecture 21 3 Precision and Recall
	21.4.	Lecture 21 4 Parallelization and Zipf Distributions
	21.5.	Lecture 21 5 n-grams, q-grams and other tricks
	21.6.	Lecture 21 6 PageRank
	21.7.	Lecture 21 7 Notes from the Real World
	21.8.	Lecture 21 8 Webcrawler Intro
	21.9.	Lecture 21 9 Webcrawler Refinements
	21.10.	Lecture 21 10 Conclusion
22.		
	22.1.	Lecture 22 Part 1 Introduction to Distributed Transactions

- 22.2. Lecture 22 Part 2 Distributed Locking
- 22.3. Lecture 22 Part 3 Distributed Deadlock Detection
- 22.4. Lecture 22 Part 4 Intro to Distributed Commit
- 22.5. Lecture 22 Part 5 Simple 2PC: Messaging Only
- 22.6. Lecture 22 Part 6 Full 2PC Including Logging (Presumed Abort)
- 22.7. Lecture 22 Part 7 The Recovery Processes
- 22.8. Lecture 22 Part 8 2PC, Locking and Availability
- 22.9. Lecture 22 Part 9: Summary of Distributed Transactions
- 23. SQL1
  - 23.1. SQL 1 Clip 1
  - 23.2. SQL 1 Clip 2
  - 23.3. SQL 1 Clip 3
  - 23.4. SQL 1 Clip 4
  - 23.5. SQL 1 Clip 5
  - 23.6. SQL 1 Clip 6 7
- 24. SQL2
  - 24.1. SQL II 1 4
  - 24.2. SQL II 6 10
  - 24.3. SQL II 11 12
  - 24.4. SQL II 13 15 slides
  - 24.5. SQL II 17 21
  - 24.6. SQL II 23 28
  - 24.7. SQL II 30 34
  - 24.8. SQL II 35
  - 24.9. SQL II 37 39
  - 24.10. SQL II 41 46
  - 24.11. SQL II 48 53
  - 24.12. SQL II 55 56
  - 24.13. SQL II 58 66
  - 24.14. SQL II 68 69
- 25. Misc
  - 25.1. A Bit of History
  - 25.2. Kinds of Query Parallelism
  - 25.3. Parallel Hash Join
  - 25.4. Parallel Grouping/Aggregation
  - 25.5. One-Sided and Broadcast Join Patterns
  - 25.6. Symmetric Hash Join
  - 25.7. Intro to Parallelism
  - 25.8. Parallel Architectures and Software Structures
  - 25.9. Parallel Data Acceess
  - 25.10. Parallel Sort-Merge Join
  - 25.11. Summary of Parallel Query Execution