香港中文大學（深圳）
The Chinese University of Hong Kong, Shenzhen
SCHOOL OF DATA SCIENCE
數據科學學院

CSC3170
Final Review

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SCHOOL OF DATA SCIENCE

Final Exam

- **December 12, 2024 (Thursday)**
- Time: **8:20 AM – 10:20 AM**
- Location: **SHAW F302 & F301 (逸夫F302、F301)**
- **Seat Numbers:** Please check BB

Final Exam

- The exam is **closed-book**.

- **One A4-sized cheat sheet** is allowed:
  - You may write on both sides of the sheet.
  - Handwritten notes only; printed materials are not permitted.

- **No electronic devices** (e.g., calculators, phones, or smartwatches) are allowed.

General advice

- Arrive early to find your assigned seat.
- Bring all necessaries, including pens and student ID.
- Manage your time wisely during the exam.

Key points

The key points may not include all the exam content, and not all of them will necessarily be tested.

- Relational Model
  - Relational Algebra
- SQL (basic usage + advanced usage)
- Storage
  - File Storage
  - Page Layout
  - Tuple Layout
  - OLAP + OLTP
  - Row store + column store
  - Compression

Key points

- Buffer pool
  - Buffer pool manager
  - Optimizations
    - Multiple buffer pools, prefetching, scan sharing, buffer pool bypass
  - Replacement policies
- Hash Tables
  - Static + Dynamic Hashing Schemes
- B+Tree
  - Insert + Delete
  - Clustered / Unclustered

Key points

- Index Concurrency Control
  - Hash table latching
  - B+Tree Latching (basic + better algorithm)
- Sorting & Aggregations
  - External merge sort
  - Aggregations
- Join Algorithms
  - Nested Loop Join (naïve, block, index)
  - Sort-merge Join
  - Hash Join (GRACE)
  - Cost analysis

Key points

- Query execution
  - Processing models
  - Access methods
  - Expression evaluation
  - Parallel (inter- / intra- query)
- Query optimization
  - Logical vs Physical Plans
  - Search Space of Plans
  - Cost Estimation of Plans
- DB Design
  - E-R Diagram
  - Functional Dependency

Key points

- Transactions
  - ACID
  - Dependency graph

Sample questions

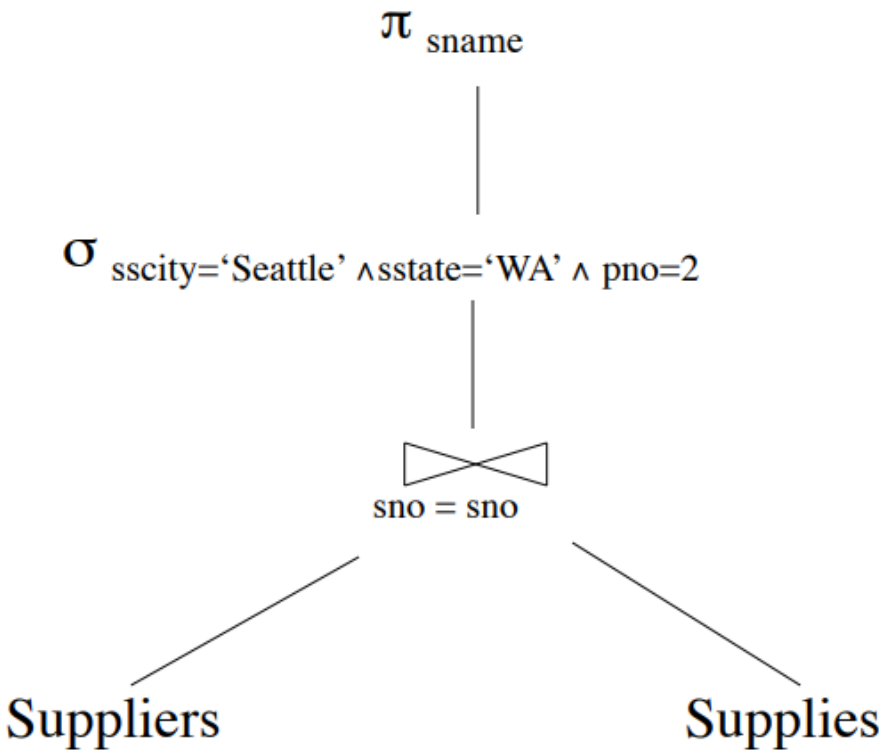
- Show the result of inserting 12, 10, 15, 4, 1, 17, 3, 13, and 8 into an initially empty 5-way search B+tree one-by-on. To maintain consistency in answers, please follow the following rules: You should split nodes whenever there is an overflow due to insertion. When splitting a leaf node due to insertion overflow, keep half (rounded up) in the left node and half (rounded down) in the right.

Sample questions

- For the hash table using linear probing, insert the following values in order: 4371, 1323, 6173, 4199, 4344, 9679 and 1989. Assume the table size is 10 and that the primary hash function is h(k) = k % 10. You do not need to resize the tables. If an element cannot be successfully inserted, state why. You need only show the final table.

Sample questions

- Assume sno in supplies is a foreign key.
- suppliers have 2,000 tuples and 200 pages.
- supplies have 10,000 tuples and 1,000 pages.
- What is the cost of different join algorithms?
  - Partitioned hash join
  - Sort-Merge
  - Block-nested
- The size of the join output?



Sample questions

- **What is the average time complexity of a hash table lookup operation?**
  - A) $O(n)$
  - B) $O(\log n)$
  - C) $O(1)$
  - D) $O(n^2)$

Sample questions

- What does the following SQL statement do?
- `SELECT * FROM Employees WHERE Age BETWEEN 30 AND 40;`
  - A) Retrieves employees exactly 30 years old
  - B) Retrieves employees under 30 and over 40 years old
  - C) Retrieves employees aged 30 to 40, inclusive
  - D) Throws an error because of incorrect syntax