

CS 245: Database System Principles

Notes 01: Introduction

Hector Garcia-Molina

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Isn't Implementing a Database System Simple?

Relations \Rightarrow Statements \Rightarrow Results

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Introducing the MEGATRON 3000 Database Management System

- The latest from Megatron Labs
- Incorporates latest relational technology
- UNIX compatible

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Megatron 3000 Implementation Details

! First sign non-disclosure agreement !

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Megatron 3000 Implementation Details

- Relations stored in files (ASCII)
e.g., relation R is in /usr/db/R

```
Smith # 123 # CS
Jones # 522 # EE
:
```

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Megatron 3000 Implementation Details

- Directory file (ASCII) in /usr/db/directory

```
R1 # A # INT # B # STR ...
R2 # C # STR # A # INT ...
:
```

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Megatron 3000 Sample Sessions

```
% MEGATRON3000
Welcome to MEGATRON 3000!
&
:
& quit
%
```

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Megatron 3000 Sample Sessions

```
& select *
from R #

Relation R
A      B      C
SMITH  123    CS
&
```

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Megatron 3000 Sample Sessions

```
& select A,B
from R,S
where R.A = S.A and S.C > 100 #

A      B
123    CAR
522    CAT
&
```

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Megatron 3000 Sample Sessions

```
& select *
from R | LPR #
&
```

Result sent to LPR (printer).

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Megatron 3000 Sample Sessions

```
& select *
from R
where R.A < 100 | T #
&
```

New relation T created.

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Megatron 3000

- To execute "**select * from R where condition**":
 - (1) Read dictionary to get R attributes
 - (2) Read R file, for each line:
 - (a) Check condition
 - (b) If OK, display

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Megatron 3000

- To execute "`select * from R where condition | T`":
 - (1) Process select as before
 - (2) Write results to new file T
 - (3) Append new line to dictionary

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Megatron 3000

- To execute "`select A,B from R,S where condition`":
 - (1) Read dictionary to get R,S attributes
 - (2) Read R file, for each line:
 - (a) Read S file, for each line:
 - (i) Create join tuple
 - (ii) Check condition
 - (iii) Display if OK

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What's wrong with the Megatron 3000 DBMS?

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What's wrong with the Megatron 3000 DBMS?

- Tuple layout on disk
- e.g.,
- Change string from 'Cat' to 'Cats' and we have to rewrite file
 - ASCII storage is expensive
 - Deletions are expensive

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What's wrong with the Megatron 3000 DBMS?

- Search expensive; no indexes
- e.g.,
- Cannot find tuple with given key quickly
 - Always have to read full relation

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What's wrong with the Megatron 3000 DBMS?

- Brute force query processing
- e.g.,
- ```
select *
from R,S
where R.A = S.A and S.B > 1000
```
- Do select first?
  - More efficient join?

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## What's wrong with the Megatron 3000 DBMS?

- No buffer manager
- e.g., Need caching

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## What's wrong with the Megatron 3000 DBMS?

- No concurrency control

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## What's wrong with the Megatron 3000 DBMS?

- No reliability
- e.g., - Can lose data  
- Can leave operations half done

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## What's wrong with the Megatron 3000 DBMS?

- No security
- e.g., - File system insecure  
- File system security is coarse

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## What's wrong with the Megatron 3000 DBMS?

- No application program interface (API)
- e.g., How can a payroll program get at the data?

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## What's wrong with the Megatron 3000 DBMS?

- Cannot interact with other DBMSs.

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## What's wrong with the Megatron 3000 DBMS?

- Poor dictionary facilities

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## What's wrong with the Megatron 3000 DBMS?

- No GUI

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## What's wrong with the Megatron 3000 DBMS?

- Lousy salesman!!

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## Course Overview

- File & System Structure  
Records in blocks, dictionary, buffer management,...
- Indexing & Hashing  
B-Trees, hashing,...
- Query Processing  
Query costs, join strategies,...
- Crash Recovery  
Failures, stable storage,...

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## Course Overview

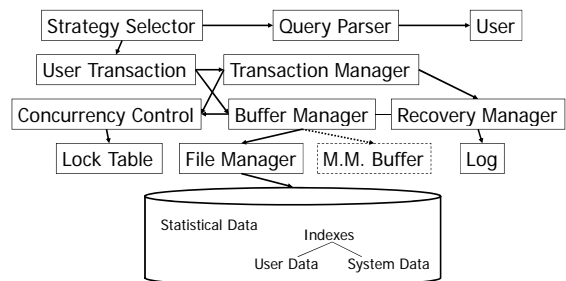
- Concurrency Control  
Correctness, locks,...
- Transaction Processing  
Logs, deadlocks,...
- Security & Integrity  
Authorization, encryption,...
- Distributed Databases  
Interoperation, distributed recovery,...

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## System Structure

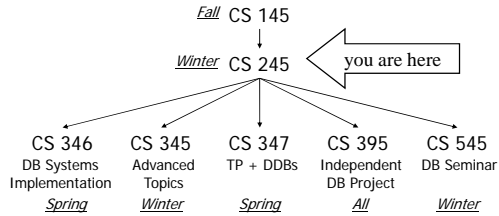


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## Stanford Database Courses



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## Some Terms

- Database system
- Transaction processing system
- File access system
- Information retrieval system

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## Mechanics

- <http://www.stanford.edu/class/cs245/>

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## Staff

- INSTRUCTOR: Hector Garcia-Molina Office: Gates 434 Email: hector@cs.stanford.edu
- Office Hours: Tuesdays, Thursdays 11am to 11:55am
- (Try to make an appointment with Marianne Siroker to ensure I can see you.)

- TEACHING ASSISTANTS:

See course web page for office location & hours.

- SECRETARY: Marianne Siroker Office: Gates 436; Email: siroker@cs.stanford.edu
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## Details

- LECTURES: Tuesday, Thursday 12:50pm to 2:05pm, Gates B03
- TEXTBOOK: Garcia-Molina, Ullman, Widom "DATABASE SYSTEMS, THE COMPLETE BOOK" [First or Second edition]
- ASSIGNMENTS: Seven written homework assignments. No programming. Also readings in Textbook.
- GRADING: Homeworks: 20%, Midterm: 30%, Final: 50%.
- WEB SITE: All handouts & assignments will be posted on our Web site at <http://www.stanford.edu/class/cs245>
- Please check it periodically for last minute announcements.

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## Tentative Syllabus 2010

| DATE                               | CHAPTER (2nd Ed) | TOPIC                     |
|------------------------------------|------------------|---------------------------|
| • Tuesday January 5                |                  | Introduction              |
| • Thursday January 6               | Ch. 11 [13]      | Hardware                  |
| • Tuesday January 12               | Ch. 12 [13]      | File and System Structure |
| • Thursday January 14              | Ch. 12 [13]      | File and System Structure |
| • Tuesday January 19               | Ch. 13 [14]      | Indexing and Hashing      |
| • Thursday January 21              | Ch. 13 [14]      | Indexing and Hashing      |
| • Tuesday January 26               | Ch. 14 [14]      | Indexing and Hashing      |
| • Thursday January 28              | Ch. 15 [15]      | Query Processing          |
| • Tuesday February 2               | Ch. 15 [16]      | Query Processing          |
| • Thursday February 4              | Ch. 16 [16]      | Query Processing          |
| • Tuesday February 9               |                  | <b>MIDTERM</b>            |
| • Thursday February 11             | Ch. 17 [17]      | Crash Recovery            |
| • Tuesday February 16              | Ch. 17 [17]      | Crash Recovery            |
| • Thursday February 18             | Ch. 18 [18]      | Concurrency Control       |
| • Tuesday February 23              | Ch. 18 [18]      | Concurrency Control       |
| • Thursday February 25             | Ch. 18 [18]      | Concurrency Control       |
| • Tuesday March 2                  | Ch. 19 [19]      | Transaction Processing    |
| • Thursday March 4                 | Ch. 19 [19]      | Transaction Processing    |
| • Tuesday March 9                  | Ch. 20 [21,22]   | Information Integration   |
| • Thursday March 11                |                  | Review                    |
| • Wednesday March 17, 7:00-10:00pm |                  | <b>FINAL EXAM</b>         |

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## Read: Chapters 11-20 [13-22 in Second Edition]

- Except following optional material [brackets for Second Edition Complete Book]:
  - Sections 11.7.4, 11.7.5 [13.4.8, 13.4.9]
  - Sections 14.3.6, 14.3.7, 14.3.8 [14.6.6, 14.6.7, 14.6.8]
  - Sections 14.4.2, 14.4.3, 14.4.4 [14.7.2, 14.7.3, 14.7.4]
  - Sections 15.7, 15.8, 15.9 [15.7, 15.8]
  - Sections 16.6, 16.7 [16.6, 16.7]
  - In Chapters 15, 16 [15, 16]: material on duplicate elimination operator, grouping, aggregation operators
  - Section 18.8 [18.8]
  - Sections 19.2 19.4, 19.5, 19.6 [none, i.e., read all Ch 19]
  - [In the Second Edition, skip all of Chapter 20, and Sections 21.5, 21.6, 21.7, 22.2 through 22.7]

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## Next time:

- Hardware
- Read chapter 11 [13.1 through 13.4]

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