VirginiaTech

CS 4604: Introduction to Database Management Systems

B. Aditya Prakash

Final Review

Final Exam

- **30% of the grade**
- **No** books, no notes, no laptops
- **Allowed:**
  - **Only** 2 letter-size pages
    - You can use both sides
    - Must be **hand-written**
  - **And** a calculator (recommended)
- Duration: 2 hours. 7:45-9:45am, May 11 2015
  Location: regular classroom

Syllabus

- **Comprehensive** exam
  - But main focus towards and emphasis on post-midterm stuff (= starting from lecture 10)
  - Will cover all material in all lectures
  - **EXCEPT (i.e. things NOT in exam)**

1. **NoSQL/MapReduce**
2. **Semi-structured data/XML**
3. **Data Mining/Warehousing**

(No PHP too of course)

Office Hours this week

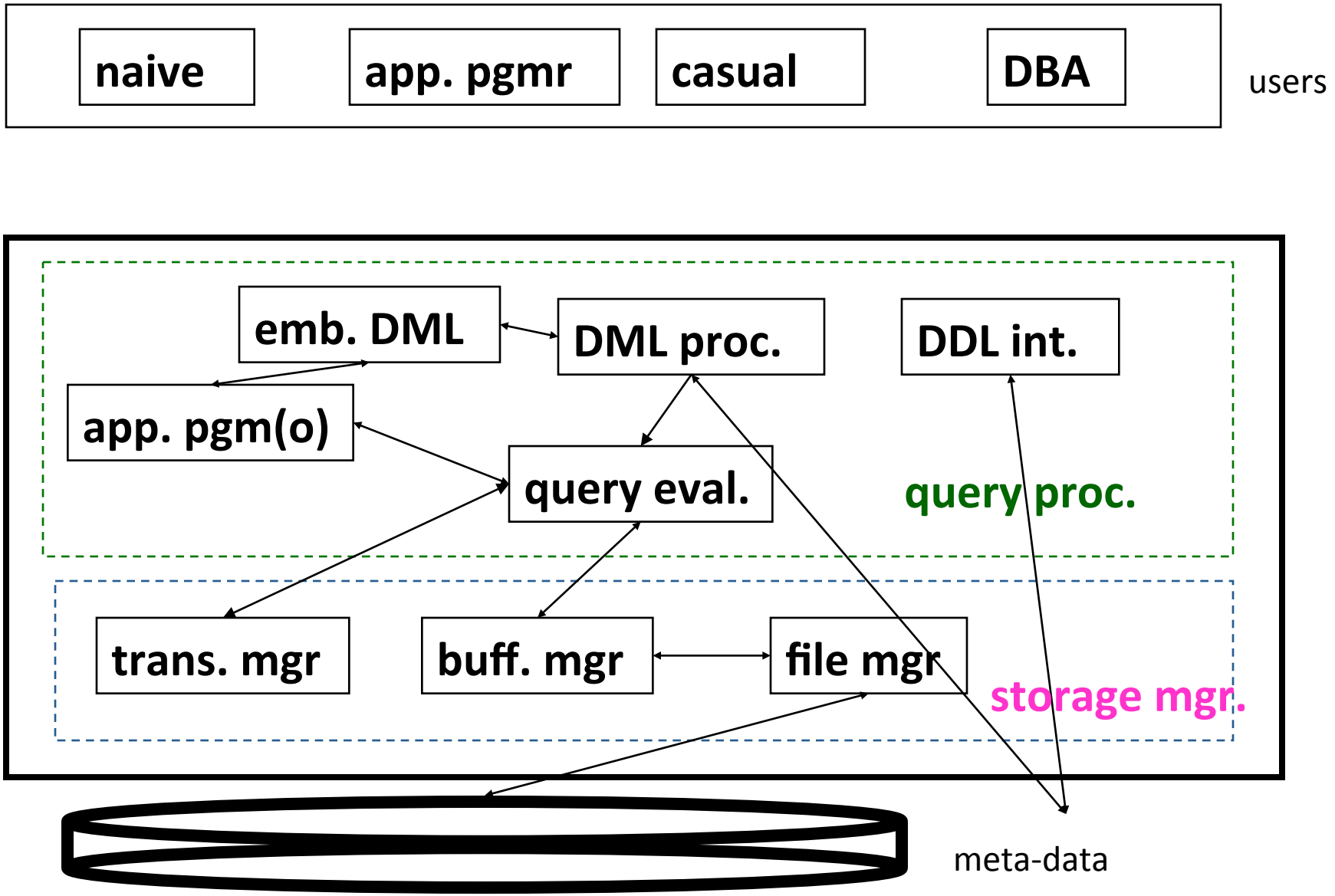
- By Aditya:
  - Monday: 2:30-3:45pm
  - Friday: 2-3:30pm
  - By appointment. (all at my office)
- By Elaheh:
  - Tuesday: 9-11:00am
  - Thursday: 2-3:30pm
  - Friday: 9-10:00am AND 4:30-5:30pm
  - (all at McB 106)
- By Yao:
  - Saturday: 2-4pm at McB 106

Also posted on Piazza

OVERVIEW

What you learnt in the course

- Weeks 1–4: Query/ Manipulation Languages and Data Modeling
  - Relational Algebra
  - Data definition
  - Programming with SQL
  - Entity-Relationship (E/R) approach
  - Specifying Constraints
  - Good E/R design
- Weeks 5–8: Indexes, Processing and Optimization
  - Storing
  - Hashing/Sorting
  - Query Optimization
  - NoSQL and Hadoop
- Week 9-10: Relational Design
  - Functional Dependencies
  - Normalization to avoid redundancy
- Week 11-12: Concurrency Control
  - Transactions
  - Logging and Recovery
- Week 13–14: Students' choice
  - Practice Problems
  - XML
  - Data mining and warehousing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app. pgmr
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DBA
users
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DML proc.
DDL int.
app. pgm(o)
query eval.
query proc.
trans. mgr
buff. mgr
file mgr
storage mgr.
data
meta-data

SQL/RA

- Make sure you know all the operators for SQL and RA
  - Select, From, Where, Group-by, Having, Order-by
  - Set-semantics/Bag-semantics
- The base for DB

ER

- You should already have enough practice!

FDs

- Definitions of FDs, closures (Attributes vs FDs), cover, normal forms, decompositions etc. etc.
  - Pay attention to multiple ways of defining the same thing!
  - E.g. 'Key': multiple ways of defining and understanding
- Various procedures to compute the above

Indexing and Hashing

- Know your basic structure, and definitions
- Less emphasis (as we have covered this in the midterm)

Query Processing

- Estimating costs
  - What are you estimating? = #disk accesses
  - How to estimate?
    - sorting
    - Different types of joins (NLJ, Block-NLJ, SMJ, HJ)
    - Don't just memorize the formulae, understand how they are derived, the 'best-case' 'worst-case' scenarios

Query Optimization

- Algebraic manipulation
- Selectivity estimation
  - Many cases
  - How to use selectivities to get the output size

Transactions

- ACID
- Problems with concurrency and Serializability concept
- Conflict-Serializability, how to detect
- 2PL, when, why, what, how, limitations
- Strict 2PL, when, why, what, how, limitations
- Know your venn diagrams!
- Deadlocks, how to detect and avoid them
- Dependency graph vs Waits-for graphs

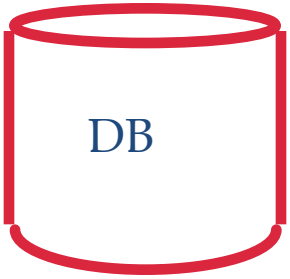
Logging and Recovery: Big Picture

LogRecords

prevLSN
XID
type

update CLR
- pageID
- length
- offset
- before-image
- after-image

CLR
- ***undoNextLSN***



Data pages
each with a pageLSN

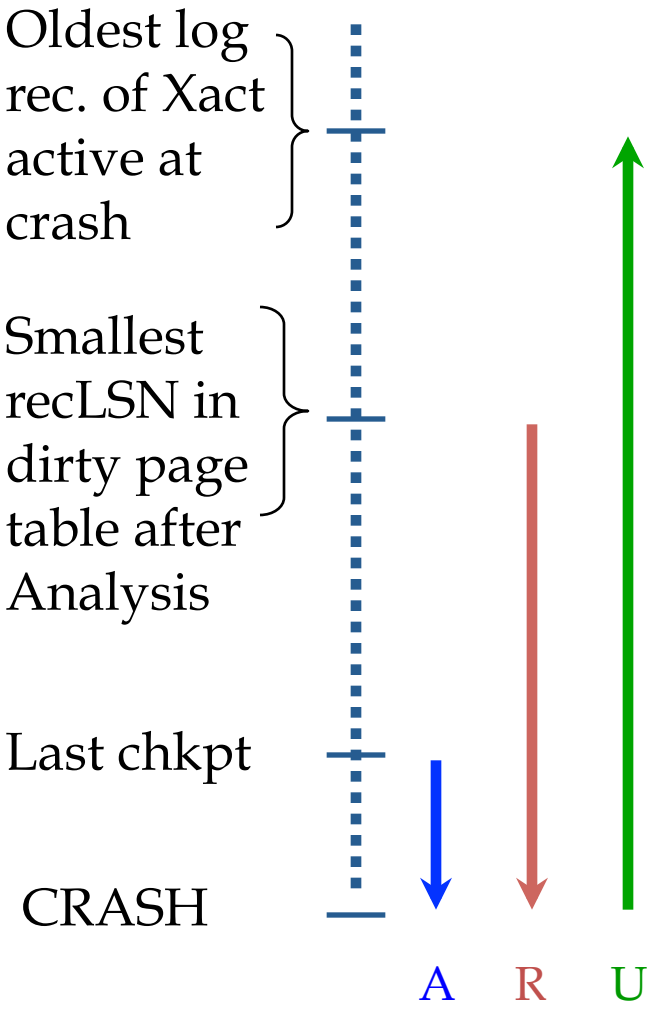
master record
LSN of most recent checkpoint

Xact Table
lastLSN
status

Dirty Page Table
recLSN

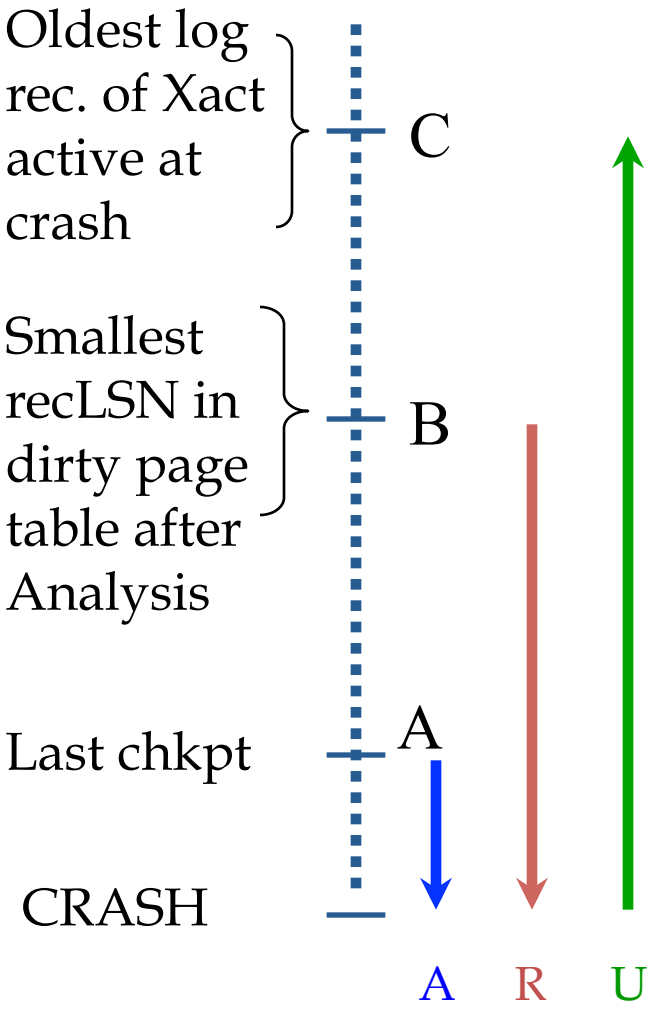
flushedLSN

Crash Recovery: Big Picture



- Start from a checkpoint (found via master record).
- Three phases.
  - Analysis - Figure out which Xacts committed since checkpoint, which failed.
  - REDO all actions (repeat history)
  - UNDO effects of failed Xacts.

Crash Recovery: Big Picture



- Notice: relative ordering of A, B, C may vary!

Logging and Recovery

- Make sure you know *exactly* how recovery takes place, and what is logged
  - Practice, practice
  - Check out problems in lectures, practice problems and hws
  - Be comfortable with small conceptual questions (see practice problems)

Tips

- Know your definitions!
  - Different ways of defining same thing e.g. keys
- Go through the slides
  - Checking the textbook if you are unclear
- **Go through HWs, Handouts, Exams, and Practice problems**
  - Textbook also has good problems! Even numbered problems have solutions on-line
  - Take advantage of our office hours
- Make use of your 2 allowed written notes!
- Bring a calculator

More

- There will be negative marking for some questions
- Read the whole question carefully before answering
- Raise your hand if you need any clarification

Data Management

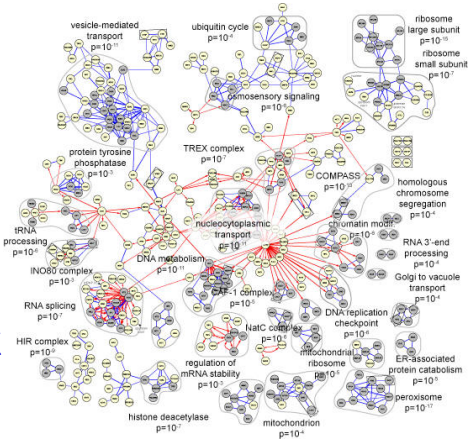
- Is a really exciting field ('BIG-Data')
- High commercial *and* academic research interest

Lots more stuff we did not cover

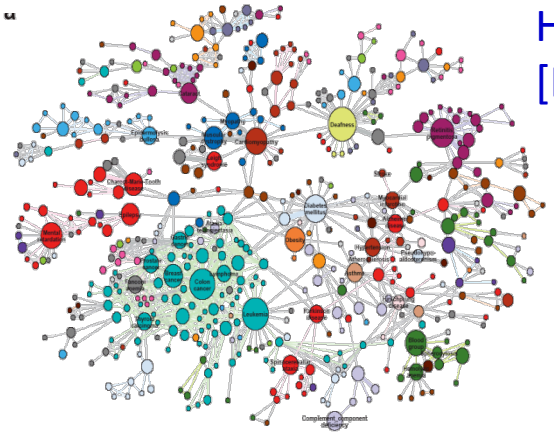
- Storage Manager
  - File organization
- More details about query processing
  - Fine-tuning Join algorithms
- Other powerful query languages
  - Datalog etc.
- More sophisticated locking, concurrency control
  - E.g. Hierarchical locking, time-stamped CC
- Spatial Data Management
- Distributed Databases
- More advanced data mining
- More details on NoSQL/Map Reduce etc.
- ……..

Course Plug: Data Mining Large Networks

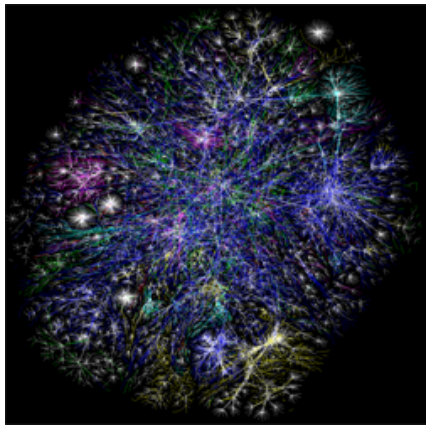
Facebook Network [2010]



Gene Regulatory Network [Decourty 2008]



Human Disease Network [Barabasi 2007]



The Internet [2005]

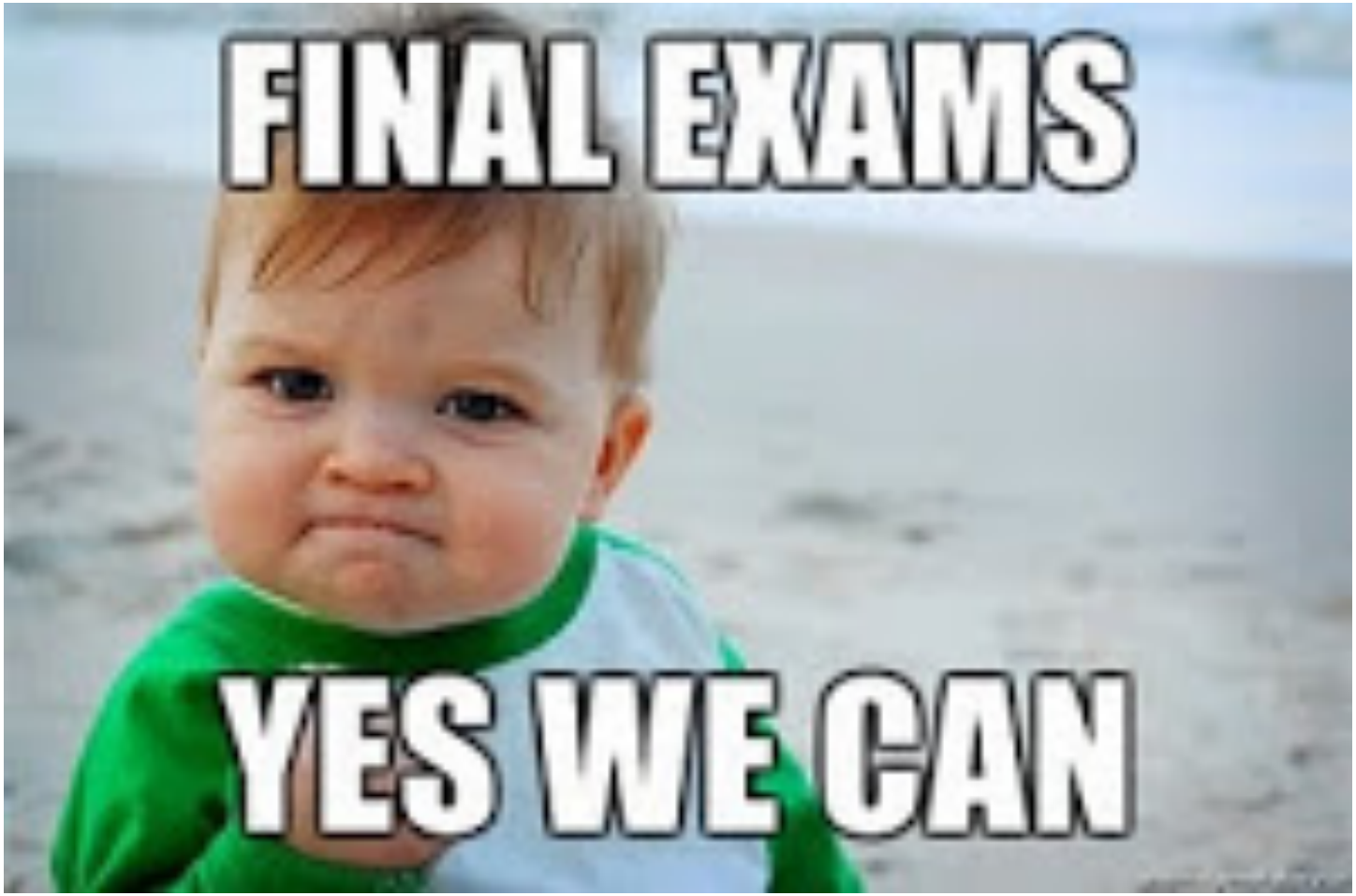
Course Plug

- CS 6604: Data Mining Large Networks in Fall 2015
  - Graduate level course
  - Project, research papers
  - Would be exciting and fun!
  - Good way to get exposed to the state-of-the-art in network analysis, graph databases etc.

Good Luck!

- Especially for those of you will graduate!

- Feel free to keep in touch ☺


FINAL EXAMS
YES WE CAN