New Trends in Database Systems

Ahmed Eldawy
Welcome (back!)

Introduction
Class Information

- Classes: Tuesday & Thursday 11:10 – 12:30
- Instructor: Ahmed Eldawy
- Office hours: Tuesday & Thursday 12:30 – 1:30 @357 WCH. Conflicts?
- Website: http://www.cs.ucr.edu/~eldawy/F16CS267/
- No textbook

9/22/2016
Database Research

- Database systems Vs RDBMS

- Database users
  - Casual users
  - Database designers
  - Application developers
  - Database administrators
  - Database developers
Layers of a database

User Applications
- Language (SQL)
- Query Optimization
- Query Execution
- Storage and Indexes

Catalogues
Recovery
Logging
Course goals

› Learn about state-of-the-art research in database
› Read and review papers
› Present research papers
› Get hands-on experience in a quarter-long research project
› Judge other research ideas

› Bonus: Publish a paper

9/22/2016
Covered Topics

Database on new hardware  Big data management

Emerging applications  Spatial and spatio-temporal data
Presentations

- Presenter
  - Read the paper
  - Contact authors with any questions
  - Judge the papers (pros and cons)
  - Present (apparently)
  - Find interesting open questions

- Audience
  - Read the paper
  - Engage with the presenter
  - Provide a feedback on the presentation
Reading Material

- A list is compiled on the website
- Papers not in the list?
- Papers
  - First-come first-served
- Presentation slots
  - First-come first-served
- Papers and presentation slots are mutually exclusive
Projects

› Individuals or groups of two

› Project ideas
  › New research idea
  › Benchmark
  › Experimental study
  › Survey
  › Other
Grades

- Project: 60%
- Presentations: 20%
- Participation: 10%
- Presentation feedback: 10%
Database on New Hardware

Challenges and Opportunities
New Hardware

- Why do we have to worry about new hardware?
- New features
  - e.g., GPU, HTM, and multicore
- Different characteristics
  - e.g., different read/write speeds in SSD
- Limitations
  - e.g., SSD wear out
Solid State Drives (SSD)

- Very fast read throughput
- Asymmetric read/write speeds
- Erase blocks before write
- Wear leveling
Multicore Processors

- High opportunity of parallelization
- Shared-nothing architecture Vs shared-memory architecture
- High contention over shared resources, e.g., logging
- Utilize all the cores

9/22/2016
GPU

- Higher opportunity of parallelism e.g., thousands of threads
- Different programming model e.g., CUDA and OpenCL
- Generally slower clock rate
- More susceptible to
  - Load imbalance
  - Irregular access patterns
  - Branches
  - Data movement between CPU and GPU
Main memory

- Main memory prices are declining
- What if the whole database can fit in main-memory?
- IO bottleneck is completely eliminated
- New bottlenecks rise to the surface
  Concurrency control
Hardware Transactional Memory (HTM)

- A completely new feature that simplifies concurrency control
- Different characteristics
  - Not guaranteed to finish
  - Susceptible to long transactions
  - Affected by external conditions
Non-uniform Memory Access (NUMA)

- Reduce the gap between CPU speed and memory speed
- Reduce the contention over the main memory
In-storage Computing

- Utilize the processor inside storage units
- Reduce the amount of IO for IO-bound applications
- Limited power of Storage Processing Unit (SPU)
Summary

- Research and database systems
- Check the reading material
- Select your papers and presentation slots
- Think about your project
- Database on new hardware
Thank You!

Questions?