

CS425 – Fall 2017 Boris Glavic Course Information


Modified from:
Database System Concepts, 6th Ed.
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Hi, I am Boris Glavic,
Assistant Professor in
CS




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Hi, I am Boris Glavic,
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I am a **database** guy!




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Hi, I am Boris Glavic,
Assistant Professor in
CS



I am a **database** guy!



I will teach you:
database stuff

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Why are Databases Important?

- What do Databases do?
 1. Provide persistent storage
 2. Efficient declarative access to data -> Querying
 3. Protection from hardware/software failures
 4. Safe concurrent access to data

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What happens if you do not pay attention?



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Who uses Databases?









- Most big software systems involve DBs!
 - Business Intelligence ⇒ e.g., IBM Cognos
 - Web based systems
 - ...
- You! (desktop software)
 - Your music player ⇒ e.g., Amarok
 - Your Web Content Management System
 - Your email client
 - Half of the apps on your phone
 - ...
- Every big company
 - Banks
 - Insurance
 - Government
 - Google, ...

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Who Produces Databases?

- Traditional relational database systems is big business
 - IBM ⇒ DB2
 - Oracle ⇒ Oracle
 - Microsoft ⇒ SQLServer
 - Open Source ⇒ MySQL, Postgres, SQLite, ...
- Emerging distributed systems with DB characteristics and Big Data
 - Cloud storage and Key-value stores ⇒ Amazon S3, Google Big Table, ...
 - Big Data Analytics ⇒ Hadoop, Google Map & Reduce, ...
 - SQL on Distributed Platforms ⇒ Hive, Tenzing, ...

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Why are Database Interesting (for Students)?

- The pragmatic perspective
 - Background in databases makes you competitive in the job market :-)
- Systems and theoretical research
 - Database research has a strong systems aspect
 - ▶ Hacking complex and large systems
 - ▶ Low-level optimization
 - cache-conscious algorithms
 - Exploit modern hardware
 - Databases have a strong theoretical foundation
 - ▶ Complexity of query answering
 - ▶ Expressiveness of query languages
 - ▶ Concurrency theory
 - ▶ ...

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Why are Database Interesting (for Students)?

- Connection to many CS fields
 - Distributed systems
 - ▶ Getting more and more important
 - Compilers
 - Modeling
 - AI and machine learning
 - ▶ Data mining
 - Operating and file systems
 - Hardware
 - ▶ Hardware-software co-design

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Webpage and Faculty


- Course Info
 - Course Webpage: <http://cs.iit.edu/~cs425>
 - Google Group: <https://groups.google.com/d/forum/cs425-2017-fall-group>
 - ▶ Used for announcements
 - ▶ Use it to discuss with me, TA, and fellow students
 - Syllabus: <http://cs.iit.edu/~cs425/files/syllabus.pdf>
 - Git Repos: <https://github.com/IITDBGGroup/cs425>
- Faculty
 - Boris Glavic (<http://cs.iit.edu/~glavic>)
 - Email: bglavic@iit.edu
 - Phone: 312.567.5205
 - Office: Stuart Building, room 226C
 - Office Hours: Mondays, 12pm-1pm (and by appointment)

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TAs

- TAs
 - TBA


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Workload and Grading

- **Exams**
 - Midterm (25%)
 - Final (35%)
- **Homework Assignments** (preparation for exams!) – 20%
 - HW1 (Relational algebra)
 - HW2 (SQL)
 - HW3 (Database modeling)
- **Course Project** (20%)
 - In groups of 3 students
 - Given an example application (e.g., ticketing system)
 - Develop a database model
 - Derive a database schema from the model
 - Implement the application accessing the database


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Course Objectives

- Understand the underlying ideas of database systems
- Understand the **relational data model**
- Be able to write and understand **SQL** queries and data definition statements
- Understand **relational algebra** and its connection to SQL
- Understand how to **write programs that access a database server**
- Understand the **ER model** used in database design
- Understand **normalization** of database schemata
- Be able to **create a database design** from a requirement analysis for a specific domain
- Know basic **index structures** and understand their importance
- Have a basic understanding of relational database concepts such as **concurrency control, recovery, query processing, and access control**


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PostgreSQL

- In this course we will use PostgreSQL, a powerful open source database management system
 - <https://www.postgresql.org/>


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Course Project

- Forming groups
 - Your responsibility!
 - Inform me + TA
 - Deadline: TBA
- Git repositories
 - Create an account on Bitbucket.org (<https://bitbucket.org/>) using your IIT email
 - We will create a repository for each student
 - Use it to exchange code with your fellow group members
 - The project has to be submitted via the group repository
- Timeline:
 - Brainstorming on application (by Sep 11th)
 - Design database model (by Nov 12th)
 - Derive relational model (by Nov 25th)
 - Implement application (by end of the semester)


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Fraud and Late Assignments

- All work has to be original!
 - Cheating = 0 points for assignment/exam
 - Possibly E in course and further administrative sanctions
 - Every dishonesty will be reported to office of academic honesty
- Late policy:
 - -20% per day
 - No exceptions!
- Course projects:
 - Every student has to contribute in **every** phase of the project!
 - **Don't let others freeload on you hard work!**
 - Inform me or TA immediately


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Reading and Prerequisites

- **Textbook:** Silberschatz, Korth and Sudarshan
 - **Database System Concepts, 6th edition**
 - McGraw Hill
 - publication date:2006,
 - ISBN 0-13-0-13-142938-8.
- Prerequisites:
 - CS 331 or CS401 or CS403


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Self-study

- **I expect you to learn by yourself how to effectively use the following technologies**
 - **Git** – a version control system
 - ▶ You have to submit your project through git and should also use git to collaborate with your project group members
 - ▶ We provide some useful examples/scripts through git
 - **Docker** – a virtualization platform (think VMs, but more lightweight)
 - ▶ The easiest way to get postgres running is by using the docker image we provide
 - **PostgreSQL**
 - ▶ I expect you to learn how to start/stop/configure a postgres server and how to connect to a running postgres server
- **Help is on the way!**
 - <https://github.com/IITDBGGroup/cs425>


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PostgreSQL Overview

- **Client/Server Architecture**
 - Postgres Cluster
 - ▶ A directory on the machine running the server that stores data and configuration files
 - Postgres Server
 - ▶ A postgres server handles the data of single cluster
 - ▶ Clients connect to the server via network (TCP/IP)
 - Send commands and receive results
 - Clients
 - ▶ GUI clients: e.g., PGAdmin (<https://www.pgadmin.org/>)
 - ▶ CLI clients: e.g., the built-in **psql** tool
 - ▶ Programming Language Libraries
 - Java: JDBC (<https://jdbc.postgresql.org/>)
 - Python: pycopg (<http://initd.org/pycopg/>)
 - ...


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Get Your Hands Dirty

- **Get a working version of the PostgreSQL server**
 - Your options
 - ▶ **Install locally**
 - Installer packages for windows exists
 - Most Linux distributions have a postgres package
 - Installation from source is not that hard
 - ▶ **Get our docker image (docker pull iitdbgroup/cs425)**
 - It's an extension of the official postgres image which loads our running example university database
 - **Validate your installation**
 - Create a database cluster (the directory PostgreSQL uses to store data)
 - Check that you can start/stop the server
 - Check that you can connect to the running server using **psql** or any other client
- <https://github.com/IITDBGGroup/cs425>


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Jupyter notebook

- **Jupyter notebooks**
 - Notebooks mix documentation and code
 - Over the course of the class I will put SQL examples we discuss in class into a notebook that is shared through the class repository:
 - ▶ [classnotebook-2017-Fall/CS425-2017-Notebook.ipynb](#)
- **Find the classnotebook**
 - <https://github.com/IITDBGGroup/cs425>

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Outline

- Introduction
- Relational Data Model
- Formal Relational Languages (relational algebra)
- SQL
- Database Design
- Transaction Processing, Recovery, and Concurrency Control
- Storage and File Structures
- Indexing and Hashing
- Query Processing and Optimization

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