Technical University of Denmark

DTU Compute
Department of Applied Mathematics and Computer Science

02170 Database Systems Course

Course Introduction, Spring 2025

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Course Introduction

- Teachers and Students
- Database Systems: What and Why
- Course and Learning Objectives
- Course Prerequisites
- Course Material
- Course Activities and Assessment
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- Study Advice
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Teachers

- Main lecturer
  - Julian Neuberger, DTU Compute
  - Background
    - MSc in Computer Science University of Bayreuth, Germany 2018
    - PhD in Computer Science University of Bayreuth, Germany 2025
    - Postdoctoral Researcher DTU since 2025

Course Responsibles

- Main Course responsible
  - Associate Professor Giovanni Meroni, DTU Compute
  - Background
    - MSc in Information Engineering Politecnico di Milano, Italy 2013
    - PhD in Information Engineering Politecnico di Milano, Italy 2018
    - Postdoctoral Researcher Politecnico di Milano, Italy 2018 – 2022
    - Researcher & Teacher DTU since 2022

- Course responsible
  - Associate Professor Anne Haxthausen, DTU Compute
  - Background
    - MSc in Applied Mathematics DTU 1985
    - PhD in Computer Science DTU 1989
    - Software Engineer Dansk Datamatik Center and Computer Resources International 1988 – 1994
    - Researcher & teacher DTU since 1995

Students

- approx. 180 students from
  - 19 different DTU study lines
  - other universities (in DK + abroad)
  - continuing education

Teaching Assistants

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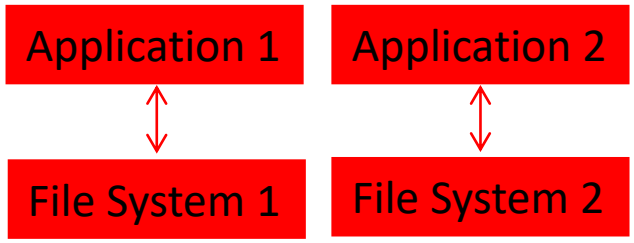
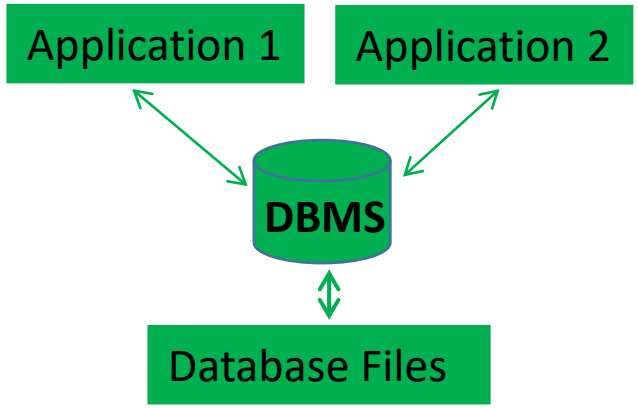
Database Systems: What

- A Database System contains data and programs:
  - A Database is a collection of structured, interrelated data.
  - A Database Management System (DBMS) is a collection of programs used to access and manipulate data in a database.
  - DBMS examples: MariaDB, MySQL, Oracle, IBM DB2, Microsoft Access, …

- Database Systems are widely used:
  - Banking: Transactions
  - Airlines: Reservations, schedules
  - Universities: Registration, grades
  - Sales: Customers, products, purchases
  - Online retailers: Order tracking, customized recommendations
  - Manufacturing: Production, inventory, orders, supply chain
  - Human resources: Employee records, salaries, tax deductions
  - Internet: Google, Facebook, …

Why Using Databases instead of File Systems?



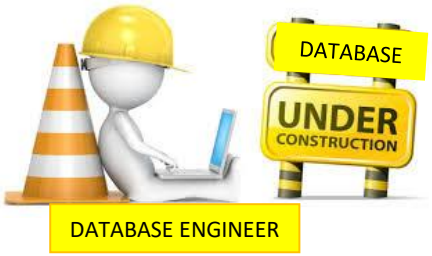


- Conventional file system approach:
  - Applications store and access data **directly** in files.
  - Typically decentralized.
- Advantages of using a database instead:
  - Applications and data are separated. Data is centralized.
  - Easier data access and manipulation using a high-level DB language.
  - Less risk of data duplication and data inconsistency.
  - Integrated handling of concurrent access from multiple users.
  - Integrated security and performance management.

Course and Learning Objectives

- Course objectives and scope
  - Give an introduction to *theory and usage* of databases.
  - Focus is on so-called *relational* databases.

- Learning objectives
  - Be able *to design and implement relational databases* from *data models*.
  - Be able *to use a widely used database language* (**SQL**) and *database management system* (**MariaDB**) to perform create, query and update operations on databases.
  - Be able *to understand tasks* normally performed by database designers, programmers and administrators.

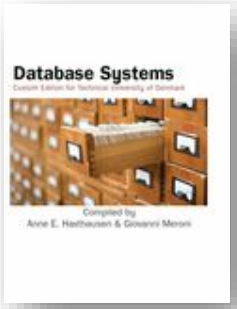


- Course category: BSc

Course Pre-requisites

- Discrete mathematics (01017/01019/01904):
  - set theory and predicate logic.
- Imperative programming:
  - Variable and data types.
  - Methods/procedures/functions and parameter passing.
  - Statements (assignment, loops, branching statements, etc).
- Algorithms and data structures:
  - as taught in 02105
  - balanced trees as taught in 02110

Course Material



- Mandatory Text Book:
  - Database Systems - CUSTOM DTU, By Silberschatz, Korth, and Sudarshan. Published by McGraw-Hill Education.
    - Can be bought in the DTU book store **Polyteknisk Boghandel**.
      Buy here: https://polyteknisk.dk/home/Detaljer/9798219061042
    - **Price:** 299,70 kr.
  - Students who own the 6th or 7th edition of the book (used in previous editions of the course) **can still use it.**
    - However, **chapter numbers are different**.
    - When not explicitly mentioned, **all references to chapters use the custom DTU book numbers.**
  - **Typo lists** (for both editions) can be found on DTU Learn -> Content->OtherMaterial.
- Tools guides can be found on DTU Learn -> Content.
- Slides (incl. exercises), videos and solutions to exercises:
  - can be found on DTU Learn -> Content where they are organized according to the week in which they should be used;
  - slides will be made available not later than the evening before use;
  - solutions will be made available at the end (11:45) of their exercise session.

Course Activities and Assessment

- Activities:
  - ***Lectures*** (most) Thursdays 8:00-9:50.
    - Format (*physical* or *none*): see on DTU Learn Content about details.
    - Literature and slides can be found on DTU Learn Content under the course week number.
    - Recordings of lecture will be uploaded after the lecture, but:
      The blackboard will be used and not recorded, so attend in person!
  - ***Exercises*** 10:00-11:45, where the TAs will advice you.
    - Exercises can be found in the slides on DTU Learn Content under the week number.
    - Work together in groups.
    - Solutions are provided at 11:45 on DTU Learn under the week number.
  - ***Mandatory group project*** where you and your teammates will develop a database.
  - ***Written exam.*** Note that the exam is in schema group F7.

- Assessment:
  - An *approved group project* is mandatory for participation in the written examination!
  - The *final mark* is the mark from the *written examination*.

Tentative Lecture Plan

Date		Comments	DTU Learn Content	Slideset
Thu, Feb 5	0. Course Introduction		Content → Week 1: Introduction	0. Database Systems Course.pdf
Thu, Feb 5	1. The Relational Model		Content → Week 1: Introduction	1. The Relational Model.pdf
Thu, Feb 5	1.5 Database Tools		Content → Week 1: Introduction	1.5 Database Tools
Thu, Feb 12	2. Introductory SQL		Content → Week 2: SQL	2. Introductory SQL.pdf
Thu, Feb 19	3. Introductory SQL		Content → Week 3: SQL	3. Introductory SQL 2.pdf
Fri, Feb 20	**Deadline for Group Registration**			
Thu, Feb 26	4. Intermediary SQL		Content → Week 4: SQL	4. Intermediary SQL.pdf
Thu, Mar 5	5. Advanced SQL		Content → Week 5: SQL	5. Advanced SQL.pdf
Thu, Mar 12	6. Entity-Relationship Diagrams		Content → Week 6: Design	6. Entity-Relationship Diagrams.pdf
Thu, Mar 19	7. Mandatory Group Project	No Lecture	Content → Weeks 7/8: Project	
Thu, Mar 26	8. Mandatory Group Project	No Lecture	Content → Weeks 7/8: Project	
Wed, Apr 1	**Deadline for Project Report**			
Thu, Apr 2	Easter Holidays	No Lecture		
Thu, Apr 9	9. Relational Algebra & Calculus		Content → Week 9: Formal Query Language	10. Formal Query Languages.pdf
Thu, Apr 9	9.5 Query Optimization		Content → Week 9: Formal Query Language	10.5 Query optimization
Thu, Apr 16	10. Normalization		Content → Week 10: Normal Forms	7. Normalization.pdf
Thu, Apr 23	11. Indexing and Hashing		Content → Week 11: Indexing and Hashing	11. Indexing and Hashing.pdf
Thu, Apr 30	12. Guest Lecture			
Thu, May 7	13. Exam Preparation			
Thu, May 14	14. Exam Preparation			
Tue, Jun 2	**Written Examination**			

Key
Formal Foundation
Database Usage
Database Design
Database Scaling
Exam & Passing

- *A detailed plan* for each week can be found on DTU Learn Content.
- Will be updated during the course. Check it out each week!

Plans for 8:00-9:50 Today

- Lecture 8:00 - …:
  1. This Course Introduction (this slide set 0)
  2. The Relational Model (slide set 1)
  3. Database Tools (slide set 1.5)

  Slides are on DTU Learn Content under Week 1.

  Videos will be provided (later).

Exercises 10:00 – 11:45 Today

- Exercise description can be found on DTU Learn Content under Week 1:
  1. Install and try the database tools to be used in this course.
  2. Demo Exercises and Exercises in the Relational Model. Solutions at 11:00.
- Take place in building 303A: in **rooms 46+47+East Hall**
- Today (not needed next weeks), organize your-self at
  - "Windows tables" in East Hall (+ IT-46 if not enough seats)
  - "Linux tables" in IT-46
  - "Mac tables" in IT-47

  so you can also help each other with installations.

TA	IT-46 (40 seats)	IT-47 (64 seats)	East Hall (96 seats)
Adolfo			Windows
Bastian		Mac (+Linux, Windows)	
Chris		Mac (+Linux, Windows)	
Laurits			Windows
Sigurd	Linux (+ Windows)		

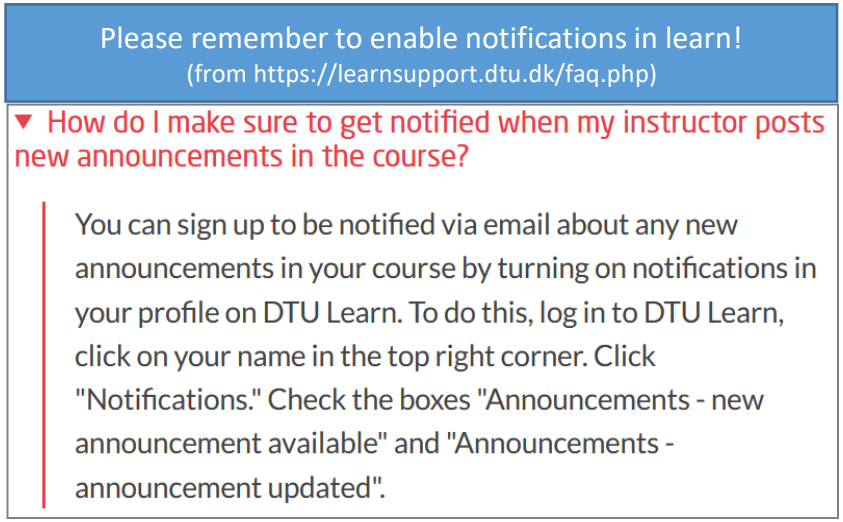
About Group Registration

- We have 5 TAs for approx. 180 students, so you must work together and help each other in groups which can get then help from the TAs.
- You should form groups of **5 persons** for the mandatory group project.
- Look for group partners:
  - contact people you know, or
  - talk with people you meet at DTU in the exercise sessions, or
  - use the Discussion Forum "Look for Group Partners“ on DTU Learn, or
- When you have found a group, you should **register** it on DTU Learn. Must be done by end of **20th of February**.

Your Duty to Read Messages

- It is your **mandatory** duty
  - to follow and read announcements on DTU Learn and mails.
    I may send important messages, e.g.
    - about changes in the time schedule and teaching format
    - info about the mandatory group project and the exam

- Please remember to enable notifications in DTU Learn.



Study Advice

- How to optimize your work
  1) Attending *Lectures* will save you a great deal of time!
  2) Solving *Demo Exercises and Exercises* will enhance learning!
  3) Optimizing your *Group Project* will prepare you for your examination. Project **must be passed** in order to attend the written exam!
  4) Reading *Textbook Chapters* is needed and highly recommended!

If You Have Questions

- Questions to lectures are most welcome during the lecture question time.
- Otherwise, as this is a BIG class, please first contact one of the teaching assistants. If they can't answer, they will contact me.