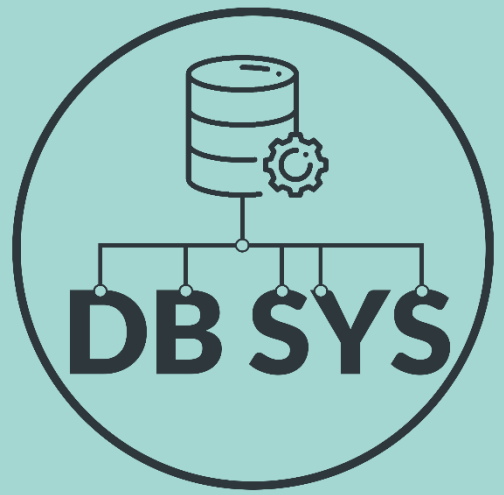
University of Basel

cs246 Database Systems

Fall Semester 2025

Prof. Dr. Heiko Schuldt

Dr. Ilir Fetai



Dates

Lecture (10909-01), takes place in presence:

Start:	– Thursday, September 18, 2025	
Dates:	– Thursday, 14:15 – 16:00	Kollegienhaus, Hörsaal 118
	– Friday, 14:15 – 16:00	Alte Universität, Hörsaal -101

Exercises (10909-02), takes place in presence:

Start: – week #2, i.e., Thursday, September 25, 2025

Dates: – Thursday, 12:15 – 14:00 Kollegienhaus, Hörsaal 118

The exercise slot on Wednesday 10:15–12:00 at Kollegienhaus, Hörsaal 118 will only be used occasionally (for the embedded project; dates will be specified in the course schedule, see slides 0–12 and 0–13). Moreover, this slot might also used to catch up on individual lectures, if necessary.

If changes occur, they will be announced during the semester.

Team

Lecturers:

Prof. Dr. Heiko Schuldt
Office: Spiegelgasse 1, 06.005
Consultation: upon appointment
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Dr. Ilir Fetai
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Assistants:

David Lengweiler, MSc david.lengweiler@unibas.ch (contact)
Martin Vahlensieck, MSc martin.vahlensieck@unibas.ch

Tutors:

Luc Bryan Heitz luc.heitz@unibas.ch
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Course Organization

- Throughout the semester, the topics of the course will be complemented by theoretical and practical exercises. After the launch of each exercise, it will be introduced in the exercise slot; after the hand-in date, there will be a detailed discussion of the solution, also in the exercise slot.
- In addition, we will organize a practical Data Analysis project (more details on the project will be given later). The project will be graded.
- The successful completion of the exercises is prerequisite for the admission to the written examination on the Database Systems course.

Note on cs246

- Target audience of the course cs246 Database Systems (10909-01) are Bachelor students in Computer Science in their 5th semester (and all other disciplines are of course welcome as well)
- cs246 builds upon the 2 credits cs245 Introduction to Databases (70356-01) course

Please note: cs245 Introduction to Databases (70356-01) and cs246 Database Systems (10909-01) (this course) cannot be taken together.
Exception: if you need to take both as requirement for the MSc admission.
In this case, please contact any member of the cs246 team.

Contents of cs246 ...

- The Database Systems course provides an in-depth introduction to the use of databases and their inner workings :

- Relational Algebra and Relational Calculus (Chapter 2):
  A mathematical model to specify the operations on data in a relational schema.

- Information Integration (Chapter 3):
  Heterogeneity of data models and database schemas requires the integration of different data sources, i.e., to make these data available in a common format, before they can be queried and analyzed. An important post-integration aspect is to guarantee a high degree of data quality (e.g., eliminate inconsistencies, identify and resolve duplicates, etc).

- Data Integrity (Chapter 4):
  Aims at preventing inconsistencies and provides mechanisms that allow databases to check (and automatically enforce) data consistency.

How to set-up and use a database

… Contents of cs246 …

- Normalization (Chapter 5):
  Data that is not properly structured usually comes with redundancy which leads to problems when managing these data. Normalization addresses the elimination of such redundancies and leads to easier-to-maintain data.

- Application Development (Chapter 6):
  This chapter presents how to access databases from within an application program, especially Java.

- Storage and Access Management (Chapter 7):
  This chapter addresses and analyzes the internal structure of a database system. This includes the mapping of relations to physical storage and different index structures that aim at providing search support for data and thus fast access to data in a database.

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- Query Optimization (Chapter 8):
  How are queries that are submitted to a database processed internally, which optimizations are applied (and in which order), how can index structures be used effectively?

- Transaction Management (Chapter 9):
  How can failures (e.g., in application programs) be handled in databases without leading to inconsistencies (i.e., how can failures in one application be shielded from other applications and their data)? How can a database system guarantee data consistency even when several users or applications concurrently access the same data?

Exam and Grading

- At the end of the semester, a written exam (duration: 120 min) is scheduled on Monday, January 12, 2026 at 13:00 – 15:00 (room: *Maurice E. Müller Hörsaal Biozentrum U1.101*).
- Prerequisite for the admission to the exam is the successful completion of the exercises:
  In total, at least 50% of the total number of points for the exercises (6 different exercises, 30 points each) have to be earned, and at least 30% from each individual exercise.
- The Data Analysis project will be graded. The project grade will contribute 1/3 to the overall grade, the written exam 2/3 to the overall grade.
- The Data Analysis project as well as the exercises should be done in groups of at most two students (but individual work is possible as well).
- The final presentations of the Data Analysis projects will take place on Friday, February 6, 2026, starting 9:00 h (location: *tba*). More details will be communicated during the semester.

Course Material

- Up-to-date information on the course are available on the course website:

  https://dmi.unibas.ch/de/studium/computer-science-informatik/lehrangebot-hs25/lecture-database-systems/

- Course material, background information, additional material, exercises, and announcements will be available on the course website and the ADAM platform of the University of Basel. Access to ADAM will be provided automatically after enrollment to the course (with a 24 hrs delay):

  https://adam.unibas.ch/go/crs/1995841

- All exercises (submissions, grading, feedback) will be handled via the LMS (learning management system) features of ADAM.

- For the recap of the material we discuss during the lectures, we will set up Kahoot! quizzes.

Organization

Thu. 14 – 16 h Fr. 14 – 16 h	Lecture
Thu. 12 – 14 h	Exercise
Throughout the semester, final presentation 06.02.26	Project
January 12, 2026	Written examination
	6 ETCS

Course Schedule –1–

- The following table depicts the planned course schedule (as of September 2025). The schedule might still be subject to changes in the course of the semester.

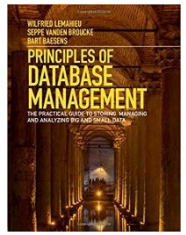
Week	Date	Topic	Who	Exercise: Hand-out	Exercise: Hand-in	Remarks
1	Thu,18.09.2025	0: Organisation 1: Introduction & Recap cs245 to Databases	IF			
1	Fr, 19.09.2025	2: Relational Model (I)	IF			
2	Thu, 25.09.2025	2: Relational Model (II)	IF	E0: Recap CS245		
2	Fr, 26.09.2025	2: Relational Model (III)	IF			
3	Thu, 02.10.2025	3: Data Integration (I)	IF		E0: Recap CS245	
3	Fr, 03.10.2025	3: Data Integration (II)	IF			
4	Thu, 09.10.2025	3: Data Integration (III)	IF	E1: Relational Algebra and Calculus		
4	Fr, 10.10.2025	4: Data Integrity (I)	HS			
5	Thu, 16.10.2025	4: Data Integrity (II)	IF		E1: Relational Algebra and Calculus	
5	Fr, 17.10.2025	4: Data Integrity (III)	HS			

Course Schedule –2–

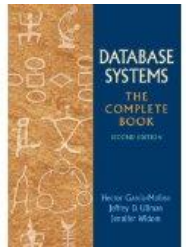
Week	Date	Topic	Who	Exercise: Hand-out	Exercise:Hand-in	Remarks
6	Thu, 23.10.2025	5: Normalization (I)	HS	E2: Data Integrity		
6	Fr, 24.10.2025	5: Normalization (II)	HS			
7	Thu, 30.10.2025	6: Application Development (I)	DL		E2: Data Integrity	
7	Fr, 31.10.2025	6: Application Development (II)	DL			
8	Thu, 06.11.2025	5: Normalization (III)	IF	E3: Normalization		
8	Fr, 07.10.2025	7: Storage and Access Management (I)	IF			
9	Thu, 13.11.2025	7: Storage and Access Management (II)	IF		E3: Normalization	
9	Fr, 14.11.2025	7: Storage and Access Management (III)	IF			
10	Thu, 20.11.2025	8: Query Optimization (I)	IF	E4: Storage and Access Management		
10	Fr, 21.11.2025	8: Query Optimization (II)	IF			
11	Thu, 27.11.2025	8: Query Optimization (III)	IF	E5: Query Optimization	E4: Storage and Access Management	
11	Fr, 28.11.2025	*Dies Academicus – No Lecture*				
12	Thu, 04.12.2025	9: Transaction Management (I)	IF		E5: Query Optimization	
12	Fr, 05.12.2025	9: Transaction Management (II)	IF			
13	Thu, 11.12.2025	9: Transaction Management (III)	IF	E6: Transaction Management		
13	Fr, 12.12.2025	9: Transaction Management (IV)	IF			
14	Thu, 18.12.2025	9: Transcation Management (V)	IF		E6: Transaction Management	
14	Fr, 19.12.2025	Q&A, Discussion	all			
	Mo, 12.01.2026	**Written Exam**, *Maurice E. Müller Hörsaal Biozentrum U1.101*				
	Fr, 06.02.2026	**Project Presentations**, **Room**: TBD	all			

Literature

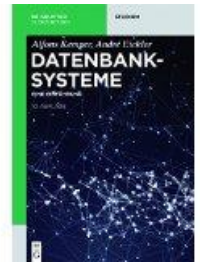
[LvBB 18] W. Lemahieu, S. vanden Broucke, B. Baesens: *Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data.* Cambridge University Press, 2018. ISBN: 978-1107186125



[GUW 08] H. Garcia-Molina, J. Ullman, J. Widom: *Database Systems: The Complete Book.* Pearson; 2nd edition, 2008. ISBN: 978-0131873254



[KE 15] A. Kemper, A. Eickler: *Datenbanksysteme: Eine Einführung.* De Gruyter, 10. Auflage, 2015. ISBN 978-3110443752.



In some chapters, further references are given to cover selected topics in greater detail.

cs246 in Context

The course *cs246 Database Systems* is largely aligned to [LvBB 18]. If a German reference is preferred, [KE 15] can be recommended.

The lecture slides are intentionally more detailed than usual presentation slides. The objective is to come close to a script-like level of detail. However, these slides should not be considered as an alternative to a complete script. They shall rather stimulate active participation and further reading.

At Master's level, the topic will be deepened in the MSc specialization Distributed Systems, especially in *Foundations of Distributed Systems*, and by means of advanced courses from Databases and Information Systems, in particular in *Distributed Information Systems* and *Multimedia Retrieval*.

Basel, September 2025

Ilir Fetai and Heiko Schuldt