DR. ALEX EL-SHAIKH

Data-Intensive Systems • DNA Data Storage • Emerging Storage Technologies

PhD in Computer Science

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RESEARCH AREAS

Database Systems
DNA Data Storage
Storage & Indexing
Random Access & Query Processing
Data-Intensive Systems

METHODS

System Architecture
Algorithms & Optimization
Experimental Evaluation
Interdisciplinary Research

LANGUAGES

German Native

Arabic Native

English Fluent

ACADEMIC PROFILE

Computer scientist specialising in database and data-intensive systems, with a particular focus on designing indexing, random-access and query-processing techniques for emerging storage technologies such as DNA. My research combines database-system concepts, algorithmic methods and experimental systems research to make unconventional storage media accessible through familiar data-management abstractions.

ACADEMIC & PROFESSIONAL EXPERIENCE

Cloud Specialist & Software Developer
08/2026 – Present

Hessische Zentrale für Datenverarbeitung (HZD) • Wiesbaden, Germany

- Architecture and modelling of the database and persistence layer for the modernisation of tax systems used nationwide across Germany, including migration of existing legacy structures.
- Integration of modern cloud solutions and development of secure, high-performance data processing for more efficient tax workflows and to support fraud prevention and detection.

Senior Software Engineer
04/2026 – 07/2026

Accelerated Solutions GmbH • Frankfurt am Main, Germany

- Architectural decisions, performance analysis and cloud integration for production software systems.
- Evaluation and coordination of technical requirements across architecture and implementation.

Postdoctoral Researcher
02/2025 – 02/2026

Imperial College London • London, United Kingdom

- Research on scalable DNA-based storage architectures, random access and economic models for emerging storage technologies.
- Coordinated interdisciplinary work across computer science, biology and chemistry and supervised student research.

Research Fellow
11/2019 – 12/2024

Philipps-Universität Marburg • Marburg, Germany

- Designed and developed database and storage architectures for large scientific datasets, including DNA-based storage, indexing and query processing.
- Coordinated research and software activities, supervised student projects and contributed to NFDI4Biodiversity on interoperable data formats and interfaces.
- Contributed to the preparation of third-party funding proposals, including drafting scientific and technical sections and supporting the development of the research work programme.

AWARDS

- **Best Workshop Paper Award**, NoDMC Workshop at BTW 2023, for *DNAContainer: An object-based storage architecture on DNA*.
- **Editor's Choice**, *NAR Genomics and Bioinformatics* (2022), for *High scale random access on DNA storage systems*.

ACADEMIC SERVICE

Peer reviewer for international journals, including:

- *Trends in Biotechnology*
- *Nature Communications*
- *Nature Computational Science*
- *Archives of Computational Methods in Engineering*
- *Scientific Reports*
- *Briefings in Bioinformatics*
- *Computational and Structural Biotechnology Journal*
- *BMC Bioinformatics*
- *Egyptian Journal of Forensic Sciences*

EDUCATION

2019 – 2024
Philipps-Universität Marburg
Marburg

Dr. rer. nat. in Computer Science

Dissertation: *Implementing random access on DNA data storage systems*
Final grade: 1.0 • *magna cum laude*

2016 – 2019
Philipps-Universität Marburg
Marburg

M.Sc. Computer Science

Thesis: *Lightweight Indexing on Data Streams* • Grade: 1.3
Minor: Economics

08/2016 – 12/2016
Aalto University
Helsinki, Finland

ERASMUS Semester

ERASMUS exchange semester in Helsinki, Finland

2012 – 2015
Philipps-Universität Marburg
Marburg

B.Sc. Computer Science

Thesis: *Developing an Android game with an interactive water simulation* • Grade: 1.3
Minor: Business Administration

PUBLICATIONS

2026 **On supporting ad-hoc filter queries on DNA storage using customized B^+-trees**
Alex El-Shaikh and Bernhard Seeger
Manuscript in preparation.

2026 **Optimising DNA Storage by Utilising DNA-Origami Structures**
Alex El-Shaikh et al.
Manuscript in preparation; joint work with colleagues at Imperial College London.

2026 **An Economic Analysis of DNA-based Data Storage Systems**
Alex El-Shaikh, Bernhard Seeger, and Thomas Heinis
Under review in *Trends in Biotechnology*.
DOI: 10.48550/arXiv.2608.26342

2023 **An Extension of DNAContainer with a Small Memory Footprint**
Alex El-Shaikh and Bernhard Seeger
Datenbank-Spektrum 23.3 (2023), pp. 211–220
DOI: 10.1007/s13222-023-00460-3

2023 **DNAContainer: An object-based storage architecture on DNA**
Alex El-Shaikh and Bernhard Seeger
BTW 2023, pp. 773–795
Best Workshop Paper
DOI: 10.18420/BTW2023-50

2023 **Content-based filter queries on DNA data storage systems**
Alex El-Shaikh and Bernhard Seeger
Scientific Reports 13.1 (2023), 7053
DOI: 10.1038/s41598-023-34160-5

2022 **High-scale random access on DNA storage systems**
Alex El-Shaikh, Marius Welzel, Dominik Heider, and Bernhard Seeger
NAR Genomics and Bioinformatics 4.1 (2022), lqab126
Editor's Choice
DOI: 10.1093/nargab/lqab126

TECHNICAL EXPERTISE

Programming
Java / Python / SQL
C# / C++ / R / Kotlin
Rust / Haskell

Data Systems
PostgreSQL / MongoDB
Neo4j / Elasticsearch
Kafka / Spark

Backend & Cloud
Spring Boot / REST
AWS / Docker / Kubernetes

TALKS & PRESENTATIONS

Invited Speaker 07/2023
Ain Shams University, Cairo, Egypt
Presented DNA as an alternative data-storage medium and discussed current approaches, cost considerations and long-term viability.

Paper Presentation - BTW 2023 03/2023
TU Dresden, Germany
Presented *DNAContainer: An object-based storage architecture on DNA*; received the Best Workshop Paper Award and an invitation for an extended journal version.

Paper Presentation - DSMM 2022 03/2022
Philipps-Universität Marburg, Germany
Presented *High-scale random access on DNA storage systems* and discussed scalable random-access mechanisms for DNA storage.

TEACHING & STUDENT SUPERVISION

My teaching approach combines strong theoretical foundations with the practice-oriented teaching of database and programming concepts. I have experience teaching in both German and English and supervising students across different stages of their studies.

Teaching Experience

- **Databases:** Relational Database Systems • NoSQL Databases • Geospatial Databases • Database System Implementation.
- **Software Development & Programming:** Object-Oriented Programming • Software Engineering • Efficient Algorithms • Programming Lab.
- **Mathematical Foundations:** Linear Algebra • Analysis.
- At Imperial College London, I delivered English-language lectures on NoSQL database systems.

Student Supervision

- Supervision of Bachelor's and Master's theses as well as Bachelor's and Master's projects.
- Supervision of programming projects and practical courses, exercise classes, and tutorials.
- Organisation and coordination of student working groups.