

# Rakan A. Alseghayer

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## EDUCATION

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- **University of Pittsburgh** Pittsburgh, PA, USA  
*Ph.D. in Computer Science* *Aug. 2014 - present*  
*Thesis: Optimizing Operators for Temporal and Spatiotemporal Data*  
*Advisor: Prof. Panos K. Chrysanthis (panos@cs.pitt.edu)*
- **University of Pittsburgh** Pittsburgh, PA, USA  
*M.Sc. in Information Sciences; GPA: 3.98/4* *May 2011 - Apr. 2013*  
*Specialization: Information Security and Networking*
- **King Saud University** Riyadh, KSA  
*B.Sc. in Computer Science; GPA: 4.68/5* *Aug. 2004 - Jun. 2008*

## RESEARCH INTERESTS

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- Big data Management, data Exploration, spatiotemporal databases, in-memory access methods, timeseries databases, database management systems, data stream management systems, distributed systems, machine learning techniques in databases, high performance computing (HPC), reliability, and computer (and information) security.

## RESEARCH PROJECTS

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- **Spatiotemporal Join processing for Indoors Moving Objects:** Tremendous effort has been put in this context, especially, optimizing index structures for certain crucial operations, such as trajectory join and trajectory similarity, which are used widely in many monitoring and analytic applications. In this project, we are developing techniques that optimizes trajectory joins for contact tracing and avoidance applications.
- **DCS: Detection of Correlated Streams:** There is an increasing demand for real-time analysis of large volumes of data streams that are produced at high velocity. The most recent data needs to be processed within a specified delay target in order for the analysis to lead to actionable result. To this end, in this project, we present an effective solution for detecting the correlation of such data streams within a micro-batch of a fixed time interval. Our solution, coined DCS, for Detection of Correlated Data Streams, combines (1) incremental sliding-window computation of aggregates, to avoid unnecessary re-computations, (2) intelligent scheduling of computation steps and operations, driven by a utility function within a micro-batch, and (3) an exploration policy that tunes the utility function.
- **Environmentally Aware Urban Analytics:** Recently, the use of sensors and IoT has been proposed to address issues related to energy efficiency in connected environments (i.e., smart homes and smart cities). In this project, our goal is to reduce energy consumption and reduce atmospheric pollution. To achieve that, data processing and decision-making need to be carried out at the network edge, specifically as close to the physical system as possible, where data is generated and used. This facilitates processing and generating results in real-time and make sure the data is not exposed to privacy and security risks. Thus, we leverage scheduling principles and statistical techniques in the context of two applications, namely aiming to reduce duty cycle of HVAC systems in smart homes and to mitigate road congestion in a smart cities. The first aim is approached through leveraging intelligent scheduling of the HVAC systems duty cycles in residential buildings. The second aim is achieved by introducing the concept of virtual bus lanes, that combines on demand creation of bus lanes in conjunction with dynamic control of traffic lights.

## PUBLICATIONS

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- Alseghayer R., Petrov D., Chrysanthis P.K., Sharaf M., Labrinidis A. "DCS: A Policy Framework for the Detection of Correlated Data Streams." [**Lecture Notes in Business Information Processing, vol 337. Springer**].
- B. Nixon, R. Alseghayer, C. Costa, B. Graybill, X. Zhang, and P. K. Chrysanthis, "Efficient Detection of COVID-19 Exposure Risk." [**IEEE MDM '22**].
- Rakan Alseghayer. "Racoon: Rapid Contact Tracing of Moving Objects Using Smart Indexes." [**IEEE MDM '21**].
- Daniel Petrov, Rakan Alseghayer, Panos K. Chrysanthis, Daniel Mosse. "Smart Room-by-Room HVAC Scheduling for Residential Savings and Comfort." [**IGSC '19**].
- D. Petrov, R. Alseghayer, P. K. Chrysanthis. "Mitigating Congestion Using Environment Protective Dynamic Traffic Orchestration." [**MDASC '19 - Colocated with MDM '19**].
- Rakan Alseghayer, Panos K. Chrysanthis, Bruce R. Childers. "Reproducibility Score for Computational Artifacts." [**MWS '19**].
- Daniel Petrov, Rakan Alseghayer, Daniel Mosse, Panos K. Chrysanthis. "Data-Driven User-Aware HVAC Scheduling." [**IGSC '18**].

- Rakan Alseghayer, Daniel Petrov, Panos K. Chrysanthis. “Strategies for Detection of Correlated Data Streams.” [ExploreDB ‘18 - Colocated with ACM SIGMOD ‘18].
- R. Alseghayer, D. Petrov, P. K. Chrysanthis, M. Sharaf, A. Labrinidis. “Detection of Highly Correlated Live Data Streams.” [BIRTE ‘17 - Colocated with VLDB ‘17].
- D. Petrov, R. Alseghayer, M. Sharaf, P. K. Chrysanthis, A. Labrinidis. “Interactive Exploration of Correlated Time Series.” [ExploreDB ‘17 - Colocated with ACM SIGMOD ‘17].

## TEACHING EXPERIENCE

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- **University of Pittsburgh** Pittsburgh, PA  
*Lecturing Teaching Assistant* 2015 - Apr. 2022
  - **CS1555/2055 Database Management Systems:** Spring ‘20, Fall ‘20, Spring ‘21, Fall ‘21, Spring ‘22.
  - **CS1501 Algorithm Implementation:** Spring ‘20, Fall ‘20, Spring ‘21, Fall ‘21, Spring ‘22.
  - **CS0011 Introduction to Computing for Scientists:** Summer ‘21.
- **University of Pittsburgh** Pittsburgh, PA  
*Teaching Assistant* 2015 - Apr. 2022
  - **CS2550 Principles of Database Systems:** Spring ‘21, Spring ‘22.
  - **CS1645/2045 Introduction to High Performance Computing:** Fall ‘15, Fall ‘16.
- **King Saud University** Riyadh, KSA  
*Lecturing Teaching Assistant* Aug. 2013 - Jul. 2014
  - **CS311 Design and Analysis of Algorithms:** Spring ‘14.
  - **CS113 programming -2-:** Spring ‘14.
  - **CS215 Procedural Programming using C Language:** Fall ‘13.
  - **CS111 programming -1-:** Fall ‘13.

## WORK EXPERIENCE

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- **University of Pittsburgh** Pittsburgh, PA  
*Graduate Student Researcher (GSR)* May 2022 - present
- **University of Pittsburgh** Pittsburgh, PA  
*Teaching Assistants Mentor* Aug. 2022 - present
- **Advanced Electronics Company Ltd. (AEC)** Riyadh, KSA  
*Associate Software Engineer, Systems Development, R&D Department* Oct. 2008 - Jul. 2009
  - **Industrial Business Unit:** Developed parts of the DCU “Data Collection Unit” as well as the communication part “TCP/IP” under the .Net environment for the project (ADDAD4), which is a smart energy meter system.
  - **Military Business Unit:** Developed parts of a military encrypted communication system.

## SELECTED COURSE WORK PROJECTS

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- **[Distributed Systems] Simple Remote Procedure Call System:** We implemented a client, server, and a port-mapper. We addressed issues related to parameter passing, binding, exception handling, call semantics, performance and data representation. We achieved server high availability and load balancing through replication and name resolution respectively.
- **[Distributed Systems] MiniGoogle: Document Indexing and Querying:** We implemented a basic data-intensive application to index and search large documents. The goal is to design a simple search engine, referred to as tiny-Google, to retrieve documents relevant to simple search queries submitted by users. We did implement a replicated and reliable client/server model that consists of: the client, the server (has the indexing and querying masters), the helpers (for the mapping and reducing), and the name-server (for name resolution).
- **[Distributed Systems and Networks] Simplified File Transfer Protocol System:** The purpose of a file transfer protocol is to enable the transfer of files between machines, typically under the command of a user. We addressed several issues in the design including dealing with differences in file name conventions, text and data representation, and directory structure. Furthermore, the protocol ensured reliable transfer of files from one system to another. We did implement the system in a layered fashion with a replicated and load balanced servers and name-servers. Also, we did implement an error simulation module to introduce unreliability to the medium. We used the Go-Back-N as a sliding window protocol. Consequently, we did conduct a thorough analysis of the performance of the system with multiple experiments. Those involved different packet error rates, different packet drop rates, and different retransmission timeouts.
- **[DBMS] myTRC: my Transactional Row Column store DBMS:** The objective of the project is to develop the Transactional Row Column store (myTRC) that efficiently supports concurrent execution of OLTP (i.e., transactions) and OLAP (i.e., aggregate queries) workloads. myTRC provides limited transactional support. Limited support means that it does not support full durability. In addition to serializable and atomic access, it also provides the standard uncontrolled access to files.
- **[Computer Architecture] Simulator for a modified PowerPc 604 and 620 Architectures:** The goal was to design, implement, and evaluate the performance of a dynamically scheduled processor. Thus, we implemented the simulator using Tomasulo algorithm with renaming registers and reordering buffers. Also, we did implement a dynamic branch prediction using a target buffer.

- **[Computer Architecture] Simulators for cache coherence protocols (MSI, MESI) in CMPs:** The goal was to build a CMP with dynamically configured cores, and each core has its own L1 private cache, and they all share a unified L2 cache. The protocols are writing back with invalidation. We implemented the simulator and evaluated the performance of each protocol.
- **[Artificial Intelligence] Checkers Solver:** Developed a Checkers solver model that competed against my classmates' engines. The engine was developed using minimax algorithm with alpha beta pruning, and some cutoff techniques using some common heuristics, as well as some of my own developed heuristics, I was able to win the tournament of my class.

## TRAINING

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- **University of Washington** Seattle, USA  
*Educational Outreach Program* *Jan. 2010 - Mar. 2011*
  - **Certificate:** Business for International Professionals
  - **Certificate:** Fundamentals of Project Management
  - **Certificate:** ELP Campus Intensive English Program (IEP)
- **Etihad Etisalat "Mobily"** Riyadh, KSA  
*Trainee, Enterprise Resource Planning (ERP) Department* *Oct. 2008 - Jul. 2009*
  - **Developed a knowledge base application under the .Net environment where the ERP team can log their day-to-day problems and challenges with their resolutions.**

## AWARDS, SCHOLARSHIPS & HONORS

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- Student scholarship winner for the cybersecurity event Black Hat 2022.
- Awarded the Diversity and Inclusion Award at the Ph.D. forum of the 22nd IEEE International Conference on Mobile Data Management (MDM '21).
- Awarded the People's Choice of Best Pitch Video at the 22nd IEEE International Conference on Mobile Data Management (MDM '21).
- PITT CS Department Orrin E. and Margaret M. Taulbee Award runner-up ('21).
- Student travel grant winner for the 11th International Workshop on Real-Time Business Intelligence & Analytics (BIRTE '18).
- King Saud University Scholarship for a PhD in Computer Science (2014 - present).
- Saudi Arabian Cultural Mission Scholarship for a MS in Information Science (2010 - 2012).
- Graduated undergrad with Second Class Honors from King Saud University (2008).

## PROFESSIONAL SERVICE & MEMBERSHIPS

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- **Committee Member:** Diversity and Inclusion (D&I) compliance committee in The 16th ACM International Conference on Distributed and Event-based Systems (DEBS '22).
- **Student Volunteer:** The International Workshop on Self-Managing Database Systems (SMDB '21, SMDB '22).
- **External Referee:** The International Conference on Very Large Data Bases (VLDB '17, '21, '22).
- **External Referee:** The International Conference on Database Systems for Advanced Applications (DASFAA '21).
- **External Referee:** The annual IEEE International Conference on Data Engineering (ICDE '17, '19, '20, '21).
- **External Referee:** The ACM Special Interest Group on Management of Data (SIGMOD '17).
- **External Referee:** The IEEE International Conference on Mobile Data Management (MDM '18, '19).
- **External Referee:** The Conference on Information and Knowledge Management (CIKM '19).
- **External Referee:** The ACM/IEEE Conference on Internet of Things Design and Implementation (IoTDI '17).

## SKILLS SUMMARY

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- **Prog. Languages:** C++, JAVA, Python, SQL
- **DBMSs:** PostgreSQL, Oracle, MySQL, SQLite
- **Frameworks:** Scikit-learn, TensorFlow, NumPy, Scipy, Matplotlib
- **Tools:** Git, Docker, Kubernetes
- **Security:** Secured Java, Cryptography
- **Computer Networks:** TCP/IP programming, Traffic and Packet Monitoring (Wireshark, IPTraf), Performance Analysis, Routing Protocols
- **Natural Languages:** Arabic (Native), English (Bilingual Proficiency), Spanish (Beginner)

## VOLUNTEERING

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- Food distribution for the Greater Pittsburgh Community Food Bank.
- Web developer for NephroTalk Conservative Care Curriculum.
- IT support for MusiCare Connections.