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Publications
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Aous A. Abdo, Ph.D.

DoD Clearance: TS/SCI with CI Poly

Seasoned Data Scientist with 18 years of dedicated experience in transforming complex data into actionable insights. Proven expertise as an R programming specialist, complemented by proficient use of Matlab, Python, and other analytical tools. Demonstrated excellence in devising, architecting, and executing sophisticated machine learning algorithms and AI solutions to drive significant advancements in different sectors. Known for a deep-rooted passion for data science, coupled with a strong track record in delivering innovative solutions and tangible results.

Key Skills

- **Software and Programming Proficiency:** Advanced expertise in R, Python, Matlab, Mathematica, and JMP, with a focus on developing innovative solutions and optimizing data-driven processes.
- **Big Data Analytics and Modeling:** Specialized in Machine Learning, Neural Networks, Text Mining, Natural Language Processing, and Recommender Systems. Skilled in applying advanced analytics techniques such as Fraud Analytics, GIS Mapping, Regression Analysis, Logistic Regression, Decision Tree Models, Multivariate Analysis, Time Series Analysis and Forecasting, and Monte Carlo Simulations for comprehensive data interpretation and forecasting.
- **Database Management and Big Data Tools:** Proficient in utilizing cutting-edge tools including Spark, Microsoft R Server, and various relational databases like PostgreSQL and Vertica, demonstrating adeptness in managing and analyzing large data sets.
- **Business Intelligence Technologies:** Skilled in deploying BI technologies such as Tableau, AWS QuickSight, Power BI, and TIBCO Spotfire to transform complex data into intelligible and actionable business insights.
- **Collaborative Expertise**: Over 20 years of experience in effectively collaborating with teams varying in age, size, and cultural backgrounds, highlighting strong interpersonal and leadership skills.
- **Educational Contributions:** Played a pivotal role in educating the next generation of data scientists by teaching data science fundamentals at several NASA-sponsored international workshops and conferences.
- **Scholarly Contributions**: Co-author of 24 peer-reviewed publications in high-impact journals, demonstrating a significant contribution to the field of data science and its application in astrophysics. (Publications)

- **Authorship**:
  - **Published Work:** "Development of New Mining Techniques in Astrophysics" – An exploration of innovative methodologies in astrophysics, demonstrating advanced applications in data mining and analysis. (Amazon link)
  - **Upcoming Publications:**
    - "Future-Ready Parenting: Navigating Childhood in the AI Era" (Expected Fall 2024) – A forward-looking guide addressing the intersection of parenting and AI technology, offering insights and strategies for raising children in the digital age.
    - "Securing Tomorrow: The Role of AI in National Security" (Expected Fall 2025) – An in-depth analysis of AI's evolving role in national security, discussing its implications, challenges, and potential strategies for responsible and effective utilization.

Professional Experience

2018–Present. **Senior Data Scientist**, *National Risk Management Center, Department of Homeland Security, Washington DC*

Helping improve the functionality and preparedness of NRMC through advanced data analytics.

- Architected and developed **DocuMint**, an AI-powered document generation system leveraging large language models (Claude, GPT-4o, Llama-3) for document creation, resulting in streamlined procurement processes for DHS
- Helped architect and develop **SmartProcure**, an intelligent procurement assistant to automate and optimize the selection of appropriate document types for procurement request (PR) packages at the Department of Homeland Security (DHS), significantly reducing decision-making time and improving accuracy in procurement processes
- **Operational Enhancement**: Played a pivotal role in augmenting the functionality and preparedness of NRMC, leveraging advanced data analytics to drive strategic improvements.
- **Big Data Initiative Leadership**: Spearheaded the conceptualization and leadership of a project to establish robust Big Data Processing and Analytics capabilities, employing Artificial Intelligence (AI) and Machine Learning. This initiative significantly enhanced the Modeling Capability Transition Environment (MCTE).
- **US Economic Clusters Analysis**: Directed efforts to identify local and national economic clusters using unsupervised machine learning algorithms. Developed a comprehensive platform employing GIS tools in R to measure and visualize the impacts of natural disasters on these economic clusters.
- **Pioneering Critical Infrastructure Analysis:** In a landmark project, I orchestrated the extensive collection and analysis of data from a multitude of sources to accurately identify and map critical infrastructures at a national level. This endeavor was pivotal in shaping strategies and policies for infrastructure security and resilience.
  - **Revolutionary Algorithm Development**: Spearheaded the development of groundbreaking algorithms for entity matching, setting new industry benchmarks in efficiency and speed. These algorithms, incorporating advanced techniques like fuzzy matching, spatial-matching, and precise entity matching, significantly outperformed existing methods in literature and market solutions.
  - **Comprehensive Data Ingestion Platform**: Architected and built a sophisticated platform capable of ingesting vast arrays of structured and unstructured data. This platform was integral to the success of the critical infrastructure analysis, enabling rapid processing and accurate matching of entities across diverse data sets.
  - **Strategic Impact and Recognition**: The success of this project was not just in its technical execution but in its strategic importance. It provided unparalleled insights into

infrastructure vulnerabilities and needs, influencing decision-making at the highest levels of government and contributing substantially to national security.

- **Interactive Dashboard Development**: Designed and developed an interactive Shiny dashboard(s) to effectively visualize the interdependencies among National Critical Functions.
- **Data Management System Development**: Led the development of a sophisticated data management system to ingest, process, and analyze both structured and unstructured data from various sources, enhancing the data-handling capabilities of MCTE.

2017–2018 **Senior Data Scientist**, *Southern California Edison (SCE), Energy Sector, Westminster, California*

Senior data scientist at Saker Systems working with a major utility company in Southern California.
Leading advanced-analytics teams to build analytics solutions to gain actionable business insights from data.

- **Innovative Storm-Damage Prediction Model**: Pioneered the design and development of the Storm Impact Prediction Model (SIPM). This predictive model revolutionized SCE's grid operations by forecasting storm-induced damage to the electric grid, enabling proactive and efficient storm preparedness.
    - Developed a fully interactive dashboard that provided instant damage reports, marking a substantial improvement over the previous hours-long manual process.
    - Integrated interactive maps on the dashboard to display predicted damage and correlate it with weather forecasts.
    - Achieved full automation of damage report production, enhancing operational efficiency.
    - Ensured web accessibility within SCE's network, allowing personnel to easily generate and access damage reports.
    - Enabled the generation of daily and 5-day damage reports for all districts, with options to download in multiple formats (CSV, Excel, PDF).
    - Incorporated functionality for accessing historical data to verify the model's accuracy.
- **Database and Automation Expertise**: Constructed a PostgreSQL database to host all necessary SIPM data, and developed R scripts to fully automate the ETL process, streamlining data management and analytics.
- **Severe-Weather Alert System**: Designed automated R-scripts to generate and disseminate severe-weather email alerts, providing critical, timely information on impending high-damage risks.
- **Strategic Big Data and AI Advisory**: Acted as a key advisor for SCE's Big Data and AI initiatives, contributing to the development of proof-of-concepts (POCs) and prototypes for advanced analytics and AI applications.
- **AI and BI Technology Research**: Led extensive research and analysis of advanced commercial and open-source AI and BI technologies, identifying optimal solutions to enhance SCE's data analytics and AI capabilities.
- **Situational Awareness in Energy Grids**: Assisted SCE in planning and developing an advanced analytical platform. This platform was instrumental in elevating situational awareness around Distributed Energy Resources (DERs) in the grid, thereby facilitating grid modernization with integrated advanced analytics.

2015–2017 **Senior Data Scientist**, *Jones Lang LaSalle (Commercial Real Estate & Investment Management)*

Senior Data Scientist with the Global Innovation Group.

- **Innovative Recommender Systems**: Architected and implemented a state-of-the-art recommender system platform. Utilized a mix of Collaborative Filtering, Content-based, and Hybrid algorithms to adeptly match investors with appropriate properties, significantly enhancing client investment strategies.
- **Data Lake Development Leadership**: Helped in the development of JLL's corporate technical roadmap, addressing key client needs in Big Data, Data Analytics, AI/Machine Learning, and Cloud Computing. Collaborated with cross-disciplinary teams to construct a robust Azure data lake to support advanced analytics, integrating custom AI and ML algorithms..

- **Advanced Text and Social Media Mining**: Developed a comprehensive text mining platform to empower JLL's prestigious clients, including Capital One Bank, Apple, Cisco, P&G, and Nike, in understanding their employees' needs and feedback. This platform provided deep insights into employee sentiments and requirements.
- **Strategic Market Analytics**: Conducted extensive data mining on a vast array of commercial real estate transactions, uncovering intricate networks and interactions among brokers, landlords, and tenants. This analysis provided JLL and its clients with a unique competitive advantage in the market.
- **Preventive Maintenance Analysis**: Performed in-depth data mining for key clients like HSBC Bank, focusing on property maintenance. My analysis identified correlations between common maintenance issues and various external factors, enabling predictive and preventive maintenance strategies.
- **Fraud Detection in Real Estate**: Analyzed decades' worth of real estate transaction data, applying advanced analytics to detect and prevent potential fraudulent activities, thereby safeguarding client interests.
- **Insightful Market Trends Analysis**: Delved into historical commercial real estate transactions across the U.S. market, identifying patterns and trends that informed future market strategies and investment decisions.
- **Expenditure Optimization**: Conducted a thorough analysis of JLL's Travel and Entertainment (T&E) spending data, uncovering potential areas for cost-saving and financial optimization.

2014–2015 **Senior Data Scientist**, *Hewlett Packard*, Herndon, Virginia.

Senior Data Scientist with the Analytics & Data Management Group.

- **Infectious Disease Modeling and Simulation Leadership**: Led the work in creating a comprehensive and predictive model for the spread of infectious diseases within populations. This model was a significant contribution to the field, with the results being showcased at the prestigious HIMSS annual conference in Chicago. Additionally, developed sophisticated Monte Carlo simulations to further refine the disease spread model.
- **Predictive Text Analytics and Text Mining**: Developed an advanced statistical language model using a large, unstructured database of the English language. This model served as a cornerstone for predictive text analytics, enhancing language processing capabilities.
- **Innovative Big Data Mining Projects:**
    - **Cape-to-Cape Race Analysis:** Analyzed sensor data from Volkswagen race cars to model driver behavior and predict driver identity, showcasing the application of data science in automotive performance and safety.
    - **Peace Corps Volunteer Attrition Analysis:** Investigated publicly available data to identify potential causes of high attrition rates among Peace Corps volunteers, providing insights for organizational improvement and volunteer retention strategies.
    - **Environmental Impact Study on Oil Drilling:** Conducted a thorough analysis of publicly available data to assess the environmental and societal impacts of tar-sand oil mining in Alberta, Canada. Made a significant discovery regarding the cause of a major failure event dated March 31st, 1997, highlighting the critical role of data science in environmental research and policy formulation.

2012–2014 **Senior Scientist**, *Institute for Defense Analyses*, Alexandria, Virginia.

Lead Scientist for multiple US Navy programs including the RAM Block II and ESSM missile programs, the T-AO(X) next generation ship, and the Joint High-Speed Vessel program.

- **Lead Scientist in Key US Navy Programs**: Directed scientific efforts for critical US Navy programs including RAM Block II and ESSM missile programs, the T-AO(X) next-generation ship, and the Joint High-Speed Vessel program, playing a pivotal role in advancing national defense capabilities.
- **Advanced Text Mining and Analytics:**
    - Developed a sophisticated text mining platform to assist the Pentagon in analyzing extensive documents, enhancing strategic decision-making processes.
    - Created the IDA Text Semantics Analytics (ITSA), an R software package, to streamline and improve text mining tasks for scientists and analysts.
- **Data Mining in Defense Systems:**
    - Conducted in-depth analysis of large datasets of missile tracks, providing crucial insights into the performance of aerial defense systems on US Navy Ships.

- Analyzed radar data from US Navy ships to evaluate system performance, contributing to enhancements in radar accuracy and reliability.

- **Interactive Statistical Web Applications Development:** Led the design, development, and implementation of a suite of interactive statistical web applications using R and Shiny. These applications became essential tools for data scientists, statisticians, and analysts in both defense and academic sectors, featuring:
  - Tools for calculating statistical power and confidence for various distributions.
  - Simulations for missile flight profiles to predict ship radar system performance.
  - Applications to explore properties of common statistical distributions.
  - Mean-time-between-failure calculator with confidence intervals.
- **Systems Design and Performance Evaluation:**
  - Formulated experimental design (DOE) plans for testing and evaluating next-generation Navy systems, enhancing the precision and effectiveness of these trials.
  - Performed extensive statistical analyses to refine experimental designs and evaluate the efficiency of systems under study.
  - Analyzed the design, execution, and outcomes of operational tests for Surface-to-Air missile defense technologies and ship radar systems, contributing to significant advancements in these critical defense technologies.

2010–2012 **Research Professor**, *George Mason University*, Fairfax, Virginia.

Head of several research programs to study variable and complex systems in the gamma-ray sky using several NASA, ESA (European Space Agency), and JAXA (Japan Aerospace Exploration Agency) space telescopes.

- **Astrophysical Research Leadership**: Directed several high-profile research programs focusing on variable and complex systems in the gamma-ray sky, utilizing a suite of space telescopes from NASA, ESA, and JAXA.
- **Pioneering Binary-Star Collision Project**:
  - Led a renowned international team of scientists in a groundbreaking study of a binary-star collision in December 2010, gaining significant insights into stellar behaviors and interactions.
  - Developed and deployed an innovative automated analysis pipeline for the continuous retrieval and analysis of satellite data, facilitating real-time monitoring of celestial events.
  - Successfully secured funding from NASA, demonstrating exceptional proposal writing and project justification skills.
  - Obtained valuable telescope time on several space and ground-based telescopes, a testament to the project's importance and potential impact.
- **Advancements in Big Data Analytics and Mining in Astrophysics**
  - Spearheaded a major initiative to design, develop, and implement a sophisticated analysis pipeline for automated analysis of data from various NASA telescopes.
  - Oversaw the implementation and application of this pipeline on Linux servers at key research institutions, including NASA Goddard Flight Center, the Naval Research Laboratory, and Stanford University.
  - Innovated in the development and implementation of algorithms to optimize the detection of periodic signals from celestial sources, enhancing the accuracy and depth of astrophysical data analysis.
  - Formulated and executed algorithms for detecting gravitationally-lensed signals from distant galaxies through meticulous time-series analysis, contributing to the understanding of cosmic phenomena.

2007–2010 **National Academy of Sciences Fellow**, *Naval Research Laboratory*, Washington, DC.

Lead scientist for several research programs:

- **Lead Scientist in Advanced Data Analytics Projects:**
  - Co-led a significant 3-year NASA-funded project, focusing on the time-series analysis of astronomical data. This pivotal project aimed at modeling the behavior of various stellar systems, contributing to our understanding of cosmic phenomena.
  - Orchestrated the planning, development, implementation, and ongoing maintenance of an automated system designed for precise timing analysis of celestial sources. This system played a crucial role in enhancing the accuracy of celestial observations.

- **Significant Contributions to Astrophysics**
  - Successfully delivered comprehensive time-series profiles of gamma-ray pulsars to the astrophysical community, utilizing databases hosted at Stanford University and NASA. This effort significantly enriched the field's data repository and research capabilities.
  - Pioneered the development and implementation of algorithms for optimizing signal-to-noise ratios in faint signals within Poisson data. This involved intricate scanning over spatial and spectral parameter spaces, elevating the precision of data analysis in astrophysics.
- **Data Synthesis and Management Expertise:**
  - Expertly synthesized observational data from multiple sources, creating a cohesive and detailed picture of various stellar systems and their environments.
  - Led the comprehensive data management efforts, including the acquisition, storage, and retrieval of data from the Fermi NASA mission. This encompassed the full spectrum of data handling, from planning and development to implementation and administration.
- **Instrument Calibration and Monitoring:**
  - Developed sophisticated calibration software to monitor and analyze the temperature trends of NASA's Fermi Gamma-Ray Space Telescopes calorimeter while in orbit. This software ensured the high accuracy and reliability of the telescope's measurements, vital for astrophysical research.

2003–2007 **Research Scientist**, *Los Alamos National Laboratory,* Los Alamos, NM.

Doctoral research work conducted as part of the Milagro international collaboration to search for rare celestial gamma-ray sources.

- **Doctoral Research in Astrophysics:** Engaged in groundbreaking doctoral research as part of the Milagro international collaboration, focused on the detection of rare celestial gamma-ray sources.
- **Innovative Big Data Mining in Astrophysics:**
  - Developed and implemented advanced algorithms for mining extensive datasets, handling tens of billions of data points. These efforts were crucial for detecting extremely faint gamma-ray signals within the overwhelming background noise of charged cosmic rays.
  - My development of the A4 algorithm was a cornerstone achievement, surpassing the effectiveness of existing machine learning techniques like the Multi-Adaptive Regression Spline (MARS) and various neural networks. This innovation was fundamental to the success of the Milagro collaboration.
- **Critical Impact on Milagro Collaboration:**
  - My work was instrumental in preventing the potential shutdown of the Milagro experiment. The success brought about by the A4 algorithm led to the flourishing of the project, culminating in the discovery of new TeV gamma-ray sources in the sky.
  - The achievements in Milagro directly influenced the securing of tens of millions of dollars in funding for the HAWC international collaboration, further advancing the field of gamma-ray telescopic research.
- **Advanced Monte Carlo Simulations:**
  - Employed Monte Carlo simulations extensively to model detector responses and the propagation of radiation through the atmosphere. This rigorous approach significantly improved the accuracy and reliability of astrophysical data analysis, contributing to key discoveries in the field.

Education

2007 **Ph.D. Physics**, *Michigan State University*, East Lansing, MI, USA, ***Graduated Summa Cum Laude***.

2003 **M.S. Physics**, National *Superconducting Cyclotron Laboratory/Michigan State University*, East Lansing, MI, USA, *Theoretical Nuclear Physics.* ***Graduated Cum Laude***.

2000 **B.S. Physics & Mathematics**, *University of Jordan*, Amman, Jordan, ***Graduated Summa Cum Laude***

Honors & Awards

- NASA Group Achievement Award – NASA & George Mason University
- Continuous Research Proposal Award - Institute for Defense Analyses
- National Research Council Postdoctoral Research Publication Award – NASA & Naval Research Laboratory
- Sherwood K. Haynes Graduate Physics Award for the Outstanding Ph.D. Student in Physics and Astronomy - Michigan State University
- The Outstanding Scientific Achievement in Physics Award - University of Jordan.
- The Outstanding Scientific Achievement in Natural Sciences Award - University of Jordan.