Muhammad Ridzuan

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LinkedIn | Google Scholar | https://mfarnas.github.io/portfolio-cv/

Personal Profile

PhD graduate in Machine Learning with extensive expertise in data science, deep learning, computer vision, and predictive modeling (forecasting/survival analysis), with a strong foundation in geology (BSc & MSc). Over 5 years of applied experience delivering impactful AI-driven solutions in healthcare and geology, including direct experience in the oil and gas sector. I have a demonstrated track record of successful projects in healthcare, supported by peer-reviewed publications and top rankings in AI competitions, showcasing my ability to deliver impactful, data-driven solutions. My skills are highly transferable to the energy sector, where I aim to leverage AI to optimize production, improve operational workflows, and reduce costs.

Work Experience

AI Research Assistant, *MBZUAI, Abu Dhabi, UAE* Jan 2021 – Dec 2024

- Conducted computer vision research in BioMedIA Lab
- Led and coded smart solutions in biotechnology by integrating diverse, multi-dimensional measurements including tabular data (EHR), thin sections, X-rays, MRIs, and CT/PET scans
- Designed deep learning models for image classification, segmentation, and predictive modeling across large-scale medical imaging datasets, with techniques adaptable to oil and gas exploration (e.g. petrophysical analysis of thin sections, CT scans, cores and potentially seismic)
- Developed dockerized AI solutions for deployment, handled complex data pipelines (multimodal data collection, cleaning, wrangling/preprocessing, analysis), improved algorithm efficiency and accuracy; won top 5 and top 10 placements in multiple international competitions

Graduate Teaching Assistant, *MBZUAI, Abu Dhabi, UAE* Jan 2023 - Jun 2023

- Course lab assistant for HC701 Medical Imaging Physics & Analysis | *Github*
- Mentored 3 graduate students in translating medical imaging problems into practical AI applications, resulting in 3 successful Master theses

Visiting Scholar, *University of Nebraska-Lincoln, Lincoln, NE, USA* May 2023 - July 2023

- Researched causal inference and discovery methods using Python

Geological Data Science Advisor, *Curtis & Associates, Houston, TX, USA* Aug 2018 - Nov 2020

- SME in Product Management for Innovation and Data Science divisions; co-led the digital transformation team in collaboration with geologists, data scientists, and operations teams to improve operational decision-making in the oil-and-gas sector using analytics, automation, and AI
- Enhanced data visualization techniques for contour mapping, well-log correlation and cross-sectional views, resulting in clearer insights and more efficient workflows across monitored wells

Geosteering Operations Center Intern, *Saudi Aramco, Dhahran, KSA* May 2015 - Jul 2015

- Hands-on experience in handling multiple wells for real-time geosteering; applied various well log correlation techniques for vertical wells, horizontal dipping beds, and lateral facies variations using sequence stratigraphy and sedimentation

Geology Lab Instructor & Coordinator, *Iowa State University, Ames, IA* Aug 2014 - Dec 2015

- Led 4 teaching assistants & coordinated 8 labs of 15-20 students each
- Taught *Introductory Geology* and *Geology for Engineers and Environmental Scientists*
- One of two recipients of *Outstanding Teaching Assistant Award*, Dept. of Geological and Atmospheric Sciences

Computer Vision/AI Projects

I aim to integrate advanced AI biotechnologies from the healthcare industry into O&G, as has been historically shown with successful cross-domain tool adoptions such as CT scans for digital rock analysis and NMR for petrophysical properties evaluation.

1. AI for Thin Section Analysis (Whole-Slide Imaging)

Objective: Build AI models for classifying and segmenting whole-slide medical images (e.g. tissues and cells; with data size up to 2TB), which can be applied to thin section analysis for petrographic studies in O&G reservoirs
Tech: CNN, ViT, multiple instance learning, foundation models, docker

Impact: Reduced manual interpretation time by >60%, demonstrating the scalability of image classification algorithms in geological imaging. Implemented docker solutions to deploy foundation model and multiple-instance learning for thin section analysis.
Publications:

- MAC-MIL: Multi-head Attention-Challenging Multiple Instance Learning for Survival Analysis. *Learning Biochemical Prostate Cancer Recurrence from Histopathology Slides (LEOPARD) Challenge*, 2024.
- Color Space-based HoVer-Net for Nuclei Instance Segmentation and Classification. *Colon Nuclei Identification and Counting Challenge (CoNIC).* IEEE International Symposium on Biomedical Imaging Challenges (ISBIC), 2022. | *Paper*

2. **Predictive Maintenance (Survival Analysis)**

Objective: Develop predictive models for survival analysis in healthcare to predict future survival probabilities, a method that can be adapted to predict survival trajectories and failure rates of O&G tools and equipments
Tech: CoxPH, DeepMTLR, DeepHit, partial logistic regression (Nnet Survival), multimodal fusion techniques, custom human-in-the-loop model & survival algorithms
Impact: Improved prediction accuracy by 10% using a human-in-the-loop intervention framework, combining human expertise with AI predictive power. This solution has potential applications in predictive maintenance across different sectors. 2 papers were early accepted at top medical imaging conference (MICCAI) with 11% early acceptance rate.
Publications:

- SurvRNC: Learning Ordered Representations for Survival Prediction using Rank-N-Contrast*, MICCAI,* 2024*,* Springer Nature Switzerland. | *Paper* | *Github*
- HuLP: Human-in-the-Loop for Prognosis, *Medical Image Computing and Computer-Assisted Interventions (MICCAI),* 2024, Springer Nature Switzerland. | *Paper* | *Github*

3. **Magnetic Resonance Imaging (MRI) for Cancer Prediction**

Objective: Assess the predictive ability of MRI to chemotherapy response
Tech: CNN, ViT, feature map visualization, Grad-CAM, t-SNE, PCA, loss landscape
Impact: Critically evaluated a scenario where deep learning prediction models should not be used as a cost-efficient alternative to traditional biopsies, contrary to common findings in literature. Highlighted the limitations of deep learning algorithms through extensive visualizations and explainable AI techniques. Work was accepted at a leading high-impact medical journal
Publication: MGMT Promoter Methylation Status Prediction Using MRI Scans: An Extensive Experimental Evaluation of Deep Learning Models. *Medical Image Analysis (MEDIA),* 2022. | *Paper*

4. **Cost-cutting Deep Learning for the Detection of COVID-19 from Chest X-rays**

Objective: Develop a method to detect COVID-19 from partially annotated X-ray images, employing self-supervised techniques that can be adapted to effectively utilize the massive (partially and unlabeled) data obtained by years of exploration and development in the O&G sector.
Tech: ResNet, DenseNet, YOLO, MOCO, inpainting, self-supervised learning
Impact: Saved cost by reducing reliance on expensive & time-consuming human annotations while maintaining competitive predictive performance. Work selected as an oral presentation at the University of Cambridge (*link*).
Publication: Self-Supervision and Multi-Task Learning: Challenges in Fine-Grained COVID-19 Multi-Class Classification from Chest X-rays, *Medical Image Understanding and Analysis (MIUA),* Spring Lecture Notes in Computer Science, 2022. | *Paper*

5. **Other Projects**

- Self-supervised learning for fine-grained image classification using Jigsaw solving as a pretext task, adversarial learning (super-resolution GAN) and contrastive learning. | *Paper* | *Github*
- Built multimodal search and RAG to retrieve relevant context using different data types
- Explored counterfactual synthetic image generation (generative AI) for 3D images conditioned on tabular attributes using a diffusion model
- App development: Built an easy-to-use software for radiologists to annotate medical images using Streamlit

AI Competition Achievements

- 1st place at *GITEX YouthX High Flyer Individual Track Competition 2021, Dubai* | *Demo*
- 1st place at CHAIMELEON lung cancer validation challenge using a custom-developed multimodal architecture (1D tabular EHR + 3D medical images) that allows human expert intervention

- Top 10 at LEarning biOchemical Prostate cAncer Recurrence from histopathology sliDes (LEOPARD) 2024 Challenge for survival prediction using multiple instance learning, MICCAI
- Top 10 at Colon Nuclei Identification and Counting (CoNIC) Challenge 2022 for nuclei (grain) segmentation and classification from thin section images, MICCAI | *Paper*
- Top 10 at MICCAI HECKTOR 2022 for lymph & tumor segmentation from CT/PET using 3D transformers

Technical Skills

Programming and Tools: Python, PyTorch, Streamlit, Jupyter, MONAI, VSCode, Docker
AI & ML: CNN, Transformers, UNet, Diffusion, GAN, classification, regression, segmentation, survival analysis, multimodal RAG, causality
Geoscience Tools: Well-log Correlation, Thin-section Analysis, Rock Image Processing
Data Science and Visualization: pandas, scikit-learn, scikit-image, numpy, pycox, seaborn, matplotlib, OpenCV, Slicer, Grad-CAM, simple-itk

O&G Research and Field Experience

Petrophysics (Computation of Shape Statistics from Rock Images) Oct 2016 - Jan 2017
- Developed cost-saving in-house algorithm for pore-scale analysis of 2D images and 3D tomographic volumes of Fontainebleau sandstone; results obtained were comparable to a commercial package for pore-scale feature calculations (porosity and permeability)

Refining the Centrifuge Method, US Department of Transportation Feb 2015 - May 2015
- Assessed the centrifuge method as a potential non-destructive, cost-efficient, and environmentally friendly alternative to mercury intrusion porosimetry to evaluate the frost durability of crushed rocks

AAPG Imperial Barrel Competition Feb 2015 - Apr 2015
- Received *Honorable Mention* (first team sent by Iowa State University); interpreted faults, correlated well-log and seismic data, developed petroleum play analysis and prospectivity of Cooper-Eromanga Basin, Australia from three seismic blocks and three wells

Understanding the Geological Basis of the Iowa Pore Index Aug 2013 - Dec 2013
- Analyzed MICP, XRD, XRF, and thin-section microscopic images of carbonate rocks to characterize the porosity and textural relationship between mineral grains

Bighorn Basin Summer Field Camp, Shell, WY, USA May 2013 - Jul 2013
- Ranked first by industry panelists on hydrocarbon prospect generation and risk analysis of Greybull sandstone
- Interpreted sedimentary rock, fossil records, and created geologic maps from field measurements and observations

Latest Computer Vision/AI Conference Presentation

John Hopkins Aramco Healthcare Annual Research Symposium, Aramco Plaza, Dhahran, KSA 24 Sep 2024
- *Interactive Prognostic Systems: Leveraging Clinician Expertise and Advanced Imputation Method Using Deep Learning to Improve Survival Prediction*

Cancer Prevention, detection and intervenTion (CaPTion) Workshop, Marrakesh, MOROCCO 6 Oct 2024
- *Survival Analysis with Conditional Ordinal Ranking Neural Network*

LEarning biOchemical Prostate cAncer Recurrence from histopathology slides (LEOPARD) Challenge, Marrakesh, MOROCCO 6 Oct 2024
- *Multi-head Attention-Challenging Multiple Instance Learning for Survival Analysis*

Medical Image Computing and Computer-Assisted Interventions (MICCAI) Conference, Marrakesh, MOROCCO 8-9 Oct 2024
- *SurvRNC: Learning Ordered Representations for Survival Prediction using Rank-N-Contrast*
- *HuLP: Human-in-the-Loop for Prognosis*

Geology Conference Presentation

Geological Society of America (GSA) 2016, Denver, CO, USA | *Abstract* Sep 2016

- *Understanding how carbonate micropores affect the Iowa Pore Index method for evaluating highway aggregates*

AAPG Annual Convention & Exhibition, Calgary, Alberta, CANADA | *Abstract* Jun 2016
- *Understanding the geological basis of the Iowa Pore Index*

3rd Graduate and Professional Students' Research Conference (GPSRC), Ames, IA, USA Apr 2016
- Best Poster Presentation Award (university-wide award): *Understanding the geol. basis of the Iowa Pore Index*

Leadership Experience

- *C-Suite Facilitator*, MBZUAI Leadership Training for Industry 2024, Abu Dhabi, UAE
- *Executive Mentor*, MBZUAI Executive Program (MEP) 2022-2023, Abu Dhabi, UAE
- *Session Chair, Computer and Info. Sciences,* UAE Graduate Students Research Conf. 2022, Dubai, UAE
- *Research Mentor*, MBZUAI Undergraduate Research Internship Program (UGRIP) 2023, Abu Dhabi, UAE
- *Treasurer,* Iowa State Student Chapter of American Association of Petroleum Geologists (AAPG), 2013-2015, ISU, IA, USA
- *Student Advisor,* International Student Council 2014-2016, ISU, IA, USA
- *Vice President,* International Student Council 2014, ISU, IA, USA
  - Awarded *Outstanding Service as Vice President of International Student Council*
  - Awarded *Outstanding Commitment to Diversity* (university-wide award)
  - Voted as *Outstanding Student Council Leader*
- *Events Coordinator & Volunteer Coordinator,* International Student Council 2013, ISU, IA, USA

Other Awards/Achievements

- *1st Place,* GITEX YouthX High Flyer Individual Track Competition 2021, Dubai, UAE
- *2nd Place,* John Hopkins Aramco Research Symposium 2024, Dhahran, KSA
- *Critical Thinking Mentor,* MBZUAI Executive Program 2022-2023, Abu Dhabi, UAE
- *Finalist,* Wyakom Community Pitch 2022, Dept. of Community Development, Abu Dhabi, UAE
- *Champion of Student Success*, MAP-Works, recognized for promoting student success, ISU, IA, USA
- *Beck Family Field Camp Scholarship*, ISU Dept. of Geological and Atmospheric Sciences, IA, USA
- *Best Poster Presentation Award*, 3rd Graduate and Professional Students' Research Conference (university-wide award), ISU, IA, USA
- *Outstanding Teaching Assistant Award*, ISU Dept. of Geological and Atmospheric Sciences, IA, USA
- *National Scholarship*, American Institute of Professional Geologists (AIPG), USA
- *President's Award for Competitive Excellence*, ISU, IA, USA

Education Background

Mohamed bin Zayed University of Artificial Intelligence (MBZUAI), Abu Dhabi, UAE Jan 2021 - Dec 2024
- *Doctor of Philosophy, Machine Learning* (CGPA: 3.90/4.00)
- Thesis: *Survival Analysis Using Interpretable Deep Learning for Cancer Patients*
- First batch intake (full scholarship); world's 1st AI research university
- Advisor: Dr. Mohammad Yaqub

ML x Health, Oxford Machine Learning Summer School (OxML), University of Oxford, UK Aug 2022
- Courses: Computer Vision in Medical Imaging; Advanced Topics in Representation Learning (i.e., learning with little or no supervision, self-supervised learning, multi-modal representation learning); Causality

Iowa State University of Science and Technology (ISU), Ames, IA, USA
- *Master of Science, Geology* (CGPA: 4.00/4.00) Aug 2014 - Dec 2016
  - Thesis: *Understanding the geological basis of the Iowa Pore Index*
  - Advisor: Dr. Franek Hasiuk, ex-ExxonMobil
- *Bachelor of Science, Geology* (CGPA: 3.98/4.00) Jan 2012 - May 2014
  - *Summa Cum Laude (Highest Distinction),* completed degree in the top 2% in 2.5 years