Tayyaba Arooj

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Research Interests

My research focuses on Computer Vision and Natural Language Processing, specifically AI for healthcare, medical image analysis, trustworthy NLP and LLM reasoning.

EDUCATION

Bachelor of Science in Computer Science   *Sep 2020 - June 2024*

Hamdard University, Islamabad Campus

3.5/4.0 | Ranked 2nd in my Batch | Awarded with Merit Certificate and Scholarship

Thesis: AI based Skin Cancer Detection Algorithms: Opportunities, Challenges, and Way Forward

Thesis secured First Position in the FEST open house held at Hamdard University.   *October 2025*

Relevant Coursework: Artificial Intelligence, Natural Language Processing, Cryptography & Network Security, Data Science, Information Security, Human Computer Interaction, Calculus I & II, Linear Algebra, Differential Equations, Probability & Statistics

RESEARCH EXPERIENCE

AI for Healthcare

- Finetuned and evaluated ten CNN variants including VGG-16, DenseNet, MobileNet for systematic comparison of widely used CNN architectures for skin cancer detection.
- VGG-16 achieved the highest accuracy of 97% on the International Skin Imaging Collaboration (ISIC) dataset.
- MobileNet-V2 and EfficientNet demonstrate low computational complexity requiring 0.3 and 0.39 GFLOPs while VGG-19 requires approximately 19.6 GFLOPs.
- Synthesized these findings into a qualitative and quantitative analysis for a research paper published in Asian Journal of Science, Engineering and Technology (AJEST).
- This project secured first position in the FEST Open House held at Hamdard University.

MelanoDetect AI

- Developed a handheld device with app integration leveraging VGG-16, DenseNet-201 and ResNet-50 for melanoma classification.
- Evaluated the model's performance using the HAM10000 dataset.
- Conducted data analysis of the survey responses to refine usability and clinical relevance.
- Secured 100,000 HKD in funding from the Hong Kong Science and Technology Park incubation program

Privacy Preserving Contextual Aware Well-being Meter   .

- Implemented Logistic Regression, SVM and LSTM models to compare their performance on a corpus of 336,029 text records curated from public and clinical sources.
- LSTM achieved the highest performance of 99.41% accuracy in sentiment classification and 99.75% in capital classification.
- Developed FedBiLSTM-Net by implementing LSTM model into federated learning settings using the FedAvg algorithm in Flower for a privacy-preserving well-being meter.
- Trained the model across 20 non-IID clients in 9 rounds and achieved a centralized evaluation accuracy of 80.17%.
- First authored the research paper for this project.

LLM Reasoning

- Developed a two stage pipeline using the Indiana University- Chest X-Rays dataset for automated radiology report generation.

- Implemented Qwen-VL to extract structured clinical reasoning in the form of chain-of-thought outputs from chest X-ray images.
- Employed MedGemma-27B to convert findings from chest X-ray images into radiologist style reports.
- Designed custom prompt constraints to ensure factual accuracy and prevent hallucination in reports.
- The project was part of an 8 weeks internship at Medical Imaging and Diagnostics Lab, National Center of Artificial Intelligence (NCAI).

PROFESSIONAL EXPERIENCE

Utech Innovative Solutions and Consultancy   Remote, Hong Kong
Research & Development Engineer   **April 2024 – Present**
Engaged in AI-based R&D projects. Led a team of 3 researchers for MelanoDetect AI, a handheld melanoma detection device with app integration supported by 100,000 HKD funding from Hong Kong Science and Technology Park.

Medical Imaging & Diagnostic Lab, National Center of AI   Onsite, Islamabad
AI Research & Development Engineer   **July 2025 – September 225**
Worked on clinical reasoning using LLMs, contributing to methodology design and evaluation of Chain-of-Thought and RAG-based models on MIMIC medical data under the supervision of Dr. Tehseen Zia.

WebRange Solutions   Onsite, Islamabad
AI Engineer- Internship   **April 2025 – May 2025**
Completed a 6-week paid internship focused on chatbot development using RAG techniques, MCP implementation and integration of large language models (LLMs).

Skillhat   Remote, Canada
Software Developer (Bubble Developer)   **September 2024 – November 2024**
Developed an MVP web app on Bubble.io for SkillHat's CoFundEstate product, enabling property co-investment for up to 10 investors by integrating AI-driven features for an enhanced user experience and streamlined processes

Alberuni Tech   Islamabad, Pakistan
Front-End Developer - Intern   **July 2023 – September 2023**
Developed a YouTube clone and other interfaces using HTML, CSS, JavaScript, and React. Collaborated with team members to ensure responsive, user-friendly designs across various front-end projects.

PROJECTS

AI-based Skin Cancer Detection Algorithms | FINAL YEAR PROJECT (THESIS)
Conducted in-depth research on AI algorithms for skin cancer detection, implementing state-of-the-art CNN variants. VGG-16 achieved top accuracy at 97%.

SMS Spam Classification | Python (Semester Project)
Implemented Naive Bayes algorithm to classify SMS messages as spam or not spam on SMS spam collection dataset by UCI Machine Learning, along with exploratory data analysis (EDA) to analyze class distribution and text characteristics.

Traffic Sign Classification Using CNN | Python (Coursera Project)
Built a CNN model for traffic sign classification in computer vision, applying data augmentation and optimized training with EarlyStopping and ModelCheckpoint.

CERTIFICATIONS
- IELTS (English Proficiency, Overall Bands: 8.0)   September – 2024

- Exploratory Data Analysis for Machine Learning – Coursera – IBM   March – 2024
- Introduction to Computer Vision and Image Processing – Coursera – IBM   March – 2024
- HTML, CSS, and Javascript for Web Developers – Coursera – IBM   August – 2022

LEADERSHIP & EXTRACURRICULAR ACTIVITIES

MIMIC-Based Clinical Reasoning with Chain-of-Thought LLM   MIDL, NCAI
- Led a team of 4 researchers

MelanoDetect AI   UTech Innovative Solutions & Consultancy
- Led a team of 3 researchers

Volunteer Usher   Hamdard University, Islamabad
Seniors' Convocation 2023
- Assisted in event coordination.

Seminars Compere   Hamdard University, Islamabad
- Seminar Title: "Can Digital Transformation Succeed Without Analytics"
- Seminar Title: "Research Rainbow in Data Science: Open Issues and Challenges"

CodeWar
Participant, Coding Competition (Python)   HiTech University, Taxila
- Demonstrated coding proficiency and problem-solving skills under competitive conditions

VisioSpark
Participant, Quiz Competition   Comsats University, Wah Cantt
- Competed in a computer science-focused quiz, showcasing knowledge in core topics and quick problem-solving skills.

The Youth Trust   Islamabad, Pakistan
Volunteer - Social Media Team Member   September 2023 – July 2024
- Created social media posts and banners for campaigns.
- Fundraising for "Bait-ul-Barkat" vocational center.

Alkhidmat Foundation Pakistan   Remote
Volunteer - Digital Volunteer   June 2023 – July 2024
- Content writing for social media posts

TECHNICAL SKILLS

Languages:	Python, SQL, HTML/CSS
Frameworks:	FastAPI, Flower
Libraries:	Pandas, NumPy, Matplotlib, TensorFlow, PyTorch, Keras, transformers, NLTK, Streamlit
Databases:	MySQL, PostgresSQL, MangoDB, Pinecone, ChromaDB

PUBLICATIONS

[1] Shaheer Muhammad, **Tayyaba Arooj,** Hannan Adeel, Tahir Saleem, and Inamur Rehman Rao. "AI-based skin cancer detection algorithms: opportunities, challenges and a way forward." Asian Journal of Science, Engineering and Technology (AJSET) 4, no. 1 (2025): 87-109.

[2] **Tayyaba Arooj,** Muhammad Hassan Farid, Shaheer Muhammad, Sania Ishaq, Syed Asad Abbas. "Well-being meter based on federated learning powered sentiment analysis".