Vatsa S. Patel

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SUMMARY

Education: Ph.D. in Computer Science specializing in artificial intelligence, machine learning, and computational technologies.
Experience: Research, Teaching and Professional experience in computer vision, and real-world machine learning applications.
Skills: Proficient in Python, PyTorch, TensorFlow, OpenCV, and ML techniques for designing and deploying robust models.
Soft Skills: Creative thinker, adaptable to independent or team-based work, with strong time management skills.

EDUCATIONS

Doctor of Philosophy, Computer Science August 2021 – December 2024, GPA: 3.8/4
University of Dayton, Dayton, OH, USA

Master of Science, Computer Science August 2019 – May 2021, GPA: 3.9/4
University of Dayton, Dayton, OH, USA

INDUSTRY EXPERIENCES AND RESEARCH

Machine Learning Associate
University of Dayton Research Institute (UDRI), Dayton, OH January 2025 – Present

- Developing ML algorithms for UAVs and dynamic systems with real-time control. Additionally, exploring applications in biomedical science, specifically modeling amino acids and proteins using PySCF and quantum chemistry techniques.
- Designing modular signal processing pipelines in Python for efficient data preprocessing, inference, and visualization across domains.
- Building interactive UI/UX frameworks to streamline dataset selection, model execution, and result visualization.

Research Intern
University of Dayton Research Institute (UDRI), Dayton, OH May 2024 – August 2024

- Led development of signal processing models, achieving a 10% improvement in accuracy and reduced noise interference.
- Designed and optimized probabilistic models (Bayesian neural networks) for signal extraction, integrated with quantum machine learning (QML) frameworks, enhancing denoising performance.
- Delivered 100% on time, within-budget project completion using Python, MATLAB, and Qiskit, ensuring efficient development and meeting all project requirements.

Computer Vision Engineer
NSF I-Corp Funded Research, University of Dayton May 2023 – August 2023

- Implemented YOLOv5 for real-time vehicle detection on 26,000+ video frames, improving accuracy and reducing latency across 244,000+ vehicles.
- Optimized object detection models for real-time traffic monitoring using a hyperplane-based approach to count vehicles, enhancing detection speed and accuracy for data-driven urban planning.
- Developed a data pipeline integrating video feeds with traffic simulators to support infrastructure and planning decisions.

Research Assistant
University of Dayton February 2022 – August 2022

- Researched and tested the robustness of computer vision object detection frameworks on real-world traffic scenarios by simulating adverse weather conditions (fog, rain, snow) by generating a dataset of 9,700 images with 8 weather effects using image processing libraries such as Imgaug, Albumentations, and Gaussian blur.
- Supervised an extensive evaluation of YOLO-based object detection models, with particular emphasis on models like Yolov5x, showcasing resilience and accuracy across diverse weather scenarios.
- Enhanced object detection in traffic monitoring systems for improved resilience under extreme weather conditions.

Machine Learning Researcher
Silfex, Inc. – Division of Lam Research, in collaboration with University of Dayton October 2020 – July 2021

- Constructed motion frame detection algorithms using CNNs and OpenCV, achieving 80% accuracy in detecting machine failures from 7 stages of Czochralski silicon growth.
- Trained TCN, CNN and SVM using OpenCV, Matplotlib, and Keras in Python. Attained results through comparison.
- Automated real-time CCTV failure detection, saving 168+ hours of manual monitoring and improving efficiency.

PhD, Research Assistant
Vision & Mixed Reality Lab, University of Dayton August 2021 – December 2024

Large Language Model – Based Text Generation and Analysis
- Configured a custom Generative Pre-trained Transformer – 2 model for Generative AI and Natural Language Processing (NLP) tasks such as text generation and analysis, leveraging Hugging Face Transformers and PyTorch to improve output diversity and coherence through advanced sampling techniques.
- Formed a user-friendly interface using Gradio, enabling real-time interaction for dynamic, context-aware text generation based on user inputs.
- Evaluated the model's performance using BLEU and ROUGE metrics, ensuring more relevant and coherent outputs compared to the default model configuration.

Image De-Photobombing Benchmarking
- Compiled and annotated 300 photobombed images, De-Photobombing dataset (DPD 300), using MATLAB to create logical masks and ground truth data.
- Applied and investigated various inpainting methods, including Exemplar-Based, Coherence Transport, Fast Marching, Fluid Dynamics, Gated Convolution, and Fourier Convolution-based techniques.
- Validated inpainting methods using FID, SSIM, and PSNR metrics for effectiveness analysis.

GAIA: Generative Artificial Image Assessment for Text-to-Image Model Evaluation
- Developed GAIA, a novel dataset comprising 800 images from 8 generative AI models, evaluated using user rankings for criteria like realism, aesthetics, visual quality, and prompt similarity.
- Integrated visual and textual features for analysis using deep learning models (VGG16, Word2Vec) and regression techniques, providing a benchmark for evaluating text-to-image synthesis performance.
- Conducted prompt complexity analysis, categorizing 100 prompts into simple and complex sets, offering insights into generative AI's ability to handle diverse scenarios and advancing multimodal learning approaches.

Auto Grader – Code Evaluating Code
- Crafted an Express-React app for real-time auto-grading of diverse, language-agnostic assignments.
- Empowered Teaching Assistants (TAs) to create assignments with flexible configurations, encompassing submission limits, dynamic scoring, and hint systems based on test cases and future releases.
- Achieved an optional plagiarism detection feature, facilitating code originality checks. Utilized Docker and deployed on Google Cloud Platform instances managed by Network Load Balancing.

Real Estate Pricing Prediction Via Textual and Visual Features
- Adopted multimodal methodologies focusing on integrating visual cues and estate attributes for real estate price prediction.
- Managed a dataset of 3,000 houses across 74 U.S. cities, annotating 14 estate attributes and five images per house.
- Utilized CNNs to extract image features, combined with estate attributes, achieving a Mean Absolute Error (MAE) of 16.60 using a multi-kernel deep learning regression model.

TEACHING EXPERIENCES

Graduate Teaching Assistant
University of Dayton, Department of Computer Science August 2021 – December 2024

CPS 501: Advanced Programming and Data Structures – (Graduate Level)
- Led bi-weekly lab sessions for two sections, covering Object-Oriented Programming (OOP) in Python, including classes, inheritance, polymorphism, encapsulation, and design patterns.
- Developed hands-on coding exercises and project-based assignments, reinforcing real-world applications of OOP.
- Conducted help sessions, mentoring students in debugging techniques, best coding practices, and advanced Python concepts.
- Evaluated and graded lab assignments, programming projects, and exams, ensuring timely and constructive feedback.
- Proctored and assessed midterms and final exams, upholding academic integrity.

CPS 150: Algorithms & Programming I – (Undergraduate Level)
- Led lab sessions for two sections, teaching Java fundamentals like loops, conditionals, functions, and OOP.
- Assisted students in IDE setup and debugging (e.g., Eclipse, VS Code), enhancing their proficiency in Java programming.
- Designed structured coding exercises to strengthen problem-solving skills and reinforce course concepts.
- Conducted Led help sessions, mentoring individuals and groups on Java syntax, logic building, and debugging.

PUBLICATIONS

1. Ba-Thinh Tran-Le, **Vatsa S. Patel**, Viet-Tham Huynh, Mai-Khiem Tran, Kunal Agrawal, Minh-Triet Tran, Tam V. Nguyen. "Towards Safer Roads: Benchmarking Object Detection Models in Complex Weather Scenarios." Machine Vision Application, 2025. [Under review].
2. Ba-Thinh, Reyansh Mishra, **Vatsa S. Patel,** Kunal Agrawal. "Road Surface Material Recognition, 2025 [Under Review].
3. **Vatsa S. Patel**, Kunal Agrawal, Samah S. Baraheem, Amira Yousif, Tam V. Nguyen. "Image de-photobombing benchmark." Multimedia Tools and Applications (2024): 1-16.
4. **Vatsa S. Patel**, Kunal Agrawal, Tam V. Nguyen. "A Comprehensive Analysis of Object Detectors in Adverse Weather Conditions." In 2020 58th Annual Conference on Information Sciences and Systems (CISS), IEEE, 2024.
5. **Vatsa S. Patel**, and Zhenhua Jiang. "An Initial Survey on Quantum Enhanced RF Signal Extraction in Cluttered Environments." In NAECON 2024-IEEE National Aerospace and Electronics Conference, pp. 136-141. IEEE, 2024.
6. Tam V. Nguyen, Ngoc-Dat Thanh, Viet-Tham Huynh, **Vatsa S. Patel**, Umang Jain, Mai-Khiem Tran, Trung-Nghia Le, Minh-Triet Tran. "Urban Traffic Planning Simulation with Time and Weather Dynamics". In 2024 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct). IEEE, 2024.
7. Reyansh Mishra, **Vatsa S. Patel**, Hongjo Kim, Tam V. Nguyen. "Road Surface Material Recognition from Dashboard Cameras." International Symposium on Visual Computing, 2024.
8. Kriti Sharma, Thomas Shrek, **Vatsa S. Patel**, Minh-Triet Tran, Tam V. Nguyen "GAIA: A Benchmark of Analyzing User Rankings for Synthesized Images." International Symposium on Visual Computing, 2024.
9. Kunal Agrawal, **Vatsa S. Patel**, Ian Cannon, Minh-Triet Tran and Tam Nguyen"Motorcycle Helmet Detection Benchmarking." Special issue on "3th International Symposium on Information and Communication Tech, SOICT, 2024.
10. Kunal Agrawal, **Vatsa S. Patel**, Reema Tharra, Trung-Nghia Le, Minh-Triet Tran and Tam Nguyen "Motion Analysis in Static Images." Special issue on "3th International Symposium on Information and Communication Tech, SOICT, 2024.
11. Amira Yousif, Samah Baraheem, Sai Surya Vaddi, **Vatsa S. Patel**, Ju Shen, Tam V. Nguyen. "Real Estate Pricing Prediction Via Textual and Visual Features." Machine Vision Application, 2023.
12. Prakya, Sai Pavan Kumar, Madamanchi Manju Venkata Sainath, **Vatsa S. Patel**, Samah Saeed Baraheem, and Tam V. Nguyen. "Photobombing Removal Benchmarking." In International Symposium on Visual Computing, pp. 55-66. Cham: Springer Nature Switzerland, 2022.
13. Nguyen, Tam V., Thanh Ngoc-Dat Tran, Viet-Tham Huynh, Bao Truong, Minh-Quan Le, Mohit Kumavat, **Vatsa S. Patel**, Mai-Khiem Tran, and Minh-Triet Tran. "Data-Driven City Traffic Planning Simulation." In 2022 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), pp. 859-864. IEEE, 2022.
14. **Vatsa S. Patel**, Zhongliang Nie, Trung-Nghia Le, and Tam V. Nguyen. "Masked face analysis via multi-task deep learning." Journal of Imaging 7, no. 10 (2021): 204.

TECHINICAL PROFICIENCIES

Programming languages: Python, Java, C++, MATLAB, R, JavaScript, HTML5, CSS3.
Machine Learning & Deep Learning: TensorFlow, PyTorch, Keras, Scikit-learn, Autoencoders, Transformers (BERT, GPT), Bayesian Neural Networks (BNNs), Multi-modal Modeling, Hugging Face, Qiskit.
Data Analytics & Visualization: Tableau, Power BI, Excel, TensorBoard, Matplotlib, Pandas, NumPy.
Image & Signal Processing: OpenCV, SciPy, Pillow, Image Augmentation, Object Detection, Convolutional Neural Networks (CNNs), Feature Engineering, Image Segmentation, Signal Denoising, Librosa.
Software Development Tools & DevOps: Docker, GCP, OpenAPI, Gradio, PyQt, Streamlit, Tkinter, Simulink, Visual Studio.
Database & Web Development: MySQL, MongoDB, Flask, Express, React.

DEMONSTRATIONS (DEMOS) AND CERTIFICATES

1. Reviewer Certificate. "Springer Nature." Issued Mar 2025.
2. Certificate of Peer Review. "Springer Nature." Issued (Nov 2024, Oct 2024).
3. Certified as Entrepreneurial Lead by NSF I-Corps™ Northeast Regional I-Corps Hub Program. "I-Corps Hub Northeast Region." Aug 2023 and awarded $50,000.
4. Responsible Conduct of Research. "CITI Program." Issued Apr 2023.
5. Presented a Demo on "House Price Prediction via Visual Cues and Estate Attributes" at ISVC 2022: 17th ISVC.
6. Presented a Demo on "Photobombing Removal Benchmarking" at ISVC 2022: 17th ISVC.
7. Presented a Demo on" Masked Face Analysis" 2022. Stander Symposium Projects. 2476.
8. Poster on" BetterU: A daily activity monitoring pervasive mobile application" 2022. Stander Symposium Projects.
9. I-Corps NSF Innovation Corps as Entrepreneurial Lead. "The University of Akron." 2021.