Minji Lee, Ph.D.

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EDUCATION

- **Ph.D,** in Technology Candidate, Purdue University, West Lafayette, IN. May 2021 – December 2024 (Expected). Dissertation: *UAV-Based Eastern Red Cedar Semantic Segmentation with Custom SAM Model in MLOps*
- **Master of Science** in Computer and Information Technology, Purdue University, West Lafayette, IN. August 2019 – May 2021. Thesis: *Intelligent Self Adapting Robot Apparel To Adapt Comfort*
- **Bachelor of Fine Arts and Bachelor of Software Convergence**, Sejong University, Seoul, South Korea. March 2012 – February 2017.

EDUCATIONAL EXPERIENCES

- **Visiting Scholarship Student**, Purdue University, West Lafayette, IN, USA, June - August, 2016

  Selected by the Institute for Information & Communication Technology Planning & Evaluation (IITP) as part of an international scholarship program for undergraduate students.

  Conducted a project focused on image processing and drone malicious tracking, utilizing advanced algorithms such as Extended Kalman Filter (EKF) and Multiple Model Adaptive Estimation (MMAE) to enhance detection and prevention capabilities.

  Collaborated with peers and faculty on research initiatives, gaining hands-on experience in applying theoretical knowledge to real-world problems in computer vision and drone technology.

INTERNSHIP

I interned every summer from 2021 to 2023, gaining valuable experience in different technical roles. In 2023, I worked at LG Innotek, where I focused on designing MLOps solutions. In 2022, I interned at Argonne National Laboratory, where I developed Ansible scripts to facilitate communication with Argonne's environment. In 2021, also at Argonne National Laboratory, where I integrated multiple data types into the Argonne data storage to enhance user accessibility and functionality. The details are as follows:

- **MLOps Researcher**, AI/BigData Solution Team, LG Innotek

  Date and Location: July to August, 2023, Seoul, South Korea

  Designed and revised the MLOps platform (InnoMLOps) for manufacturing model utilization, enhancing the production of core components for mobile devices, automotive displays, semiconductors, and smart products.

Developed an autonomous machine learning pipeline system as well as an AI model re-learning algorithm, resulting in a 2.1% improvement in model deployment efficiency.

Generated +1,200 synthetic datasets using a diffusion model noise, enhancing data quality and quantity for training.

Conducted research to compare and evaluate MLOps platforms such as AWS SageMaker, MLFlow, TFX, and Kubeflow, considering both business processes and performance metrics.

- **Research Aide**, Mathematics and Computer Science Lab, Argonne National Laboratory

  Date and Location: May to August, 2022, Lemont, IL

  Created an Ansible script for the NVidia Nano node platform, enabling students and scientists to develop edge-to-cloud software pipelines. This facilitated collaboration and innovation in geographical data analysis and research.

  Utilized the script to explore the capabilities of machine learning and deep learning for intelligent sensor designs, thereby facilitating experimentation and advancing the Sage Project.

- **Research Aide**, Mathematics and Computer Science Lab, Argonne National Laboratory

  Date and Location: May to August, 2021, Lemont, IL (Virtual)

  Implemented integration of Node-RED into the IBM cloud computing platform and web portal inside of Docker managed by Kubernetes.

  Analyzed geographical and meteorological data from local conditions and events, facilitating real-time data collection in diverse environments wildfires, heat waves, and storms.

POSITIONS

- **Research Assistant**, M2M Lab and K-SW Software Program, Purdue University, West Lafayette, IN. August 2019 - Current.

  Worked as a research assistant at Purdue University since the fall semester of 2019. Primarily assisted undergraduate visiting students with various aspects of their research, including establishing the research setup, defining the problem statement, and identifying gaps in current research. The details are as follows:

  Assisted in structuring and writing research papers, offering insights on best practices for academic writing and publication standards.

  Guided students in conducting research by helping them formulate problem statements and address them through comprehensive literature reviews. Provided feedback on drafts to help students refine their arguments and improve the clarity and coherence of their papers.

  – **Political Compass Evaluation of ChatGPT: Assessing Consistency Bias in Generated Responses**, M2M Lab, Purdue University, West Lafayette, IN. June 2024 - Current.

    Collected datasets to analyze the consistency of ChatGPT's responses to political bias prompts, focusing on progressive and libertarian views, using the ChatGPT 4.0 Political Compass plugin.

    Conducted natural language processing research to compare the biases inherent in different architectures, focusing on models such as BERT and the GPT family, highlighting how architectural differences influence the expression of bias in generated responses.

    Revealed that ChatGPT's bias, as measured by the standard deviation, is higher for the economic left-right dimension (≈ 0.78) compared to the social libertarian-authoritarian dimension (≈ 0.29).

Published in the proceedings of an IEEE conference at the 2024 IEEE First International Conference on Artificial Intelligence for Medicine, Health and Care (AIMHC).

– **Resolution Free Human Image Generation and control**, K-SW Software Program, Purdue University, West Lafayette, IN. January - June 2024.

  Utilized publicly available COCO datasets to perform generative facial generation, enhancing image quality and diversity through advanced algorithms such as Variational Autoencoders (VAEs).

  Developed a Diffusion Transformer (DiT) model combined with Patch n' Pack to create high-resolution images of people, trained on a vast dataset comprising real-world images containing individuals.

  Designed and conducted experiments and simulations to test hypotheses and validate model predictions.

  Explained foundational deep learning models, including the Gaussian model, to visiting students, ensuring they understand the applications and implications of these models.

  Managed weekly meetings with the professor to discuss research progress and plan future steps.

– **Deploying a Sustainable Deep Learning Pipeline for Poison Ivy Image Classification**, K-SW Software Program, Purdue University, West Lafayette, IN. March 2023 – June 2023.

  Worked as a manager on a project to classify poison ivy plants, which poses risks to allergic skin reaction to human skin.

  Collected data throughout the seasons—early, mid, and late summer—as poison ivy's appearance varies significantly by season due to the lack of publicly available datasets.

  Utilized Segmeny Anything Model (SAM) for segmentation and analysis, followed by data preprocessing and augmentation.

  Developed a classification model and constructed a pipeline using Kubeflow to streamline the process.

  Published in the proceedings of an IEEE conference at the 9th International Conference on Mathematics and Computers in Sciences and Industry (MCSI).

– **Safe Route Recommendation based on Crime Risk Prediction with Urban and Crime Data**, K-SW Software Program, Purdue University, West Lafayette, IN. August 2022 – January 2023.

  Conducted innovative research on safe route recommendations, integrating urban and crime data to predict road risks in Chicago.

  Developed an advanced machine learning model that uses Gaussian Kernel Density Estimation (KDE) to estimate crime densities and assess crime severity.

  Implemented a novel approach to assign risk scores to roads, optimizing route safety through the Dijkstra shortest path algorithm.

  Demonstrated enhanced safety measures by achieving a potential 50% reduction in route risk with only a minimal increase in travel distance.

  Published in the proceedings of an IEEE conference at the IEEE 9th International Conference on Big Data Computing Service and Applications

– **Program Coordinator with IITP**, K-SW Software Program, Purdue University, West Lafayette, IN. March to August 2020

  Collaborated with IITP Korean Government mentors to manage, tutor, and instruct Korean and Purdue undergraduate students in research classes and lab sessions virtually due to the pandemic.

  Developed and delivered curriculum content tailored to the needs of international students, fostering an inclusive and supportive learning environment.

- **Research Advisor**, K-SW Software Program, Purdue University, West Lafayette, IN. December 2019 to February 2020

  Advised international students on navigating their research projects and career paths, offering guidance on academic planning, research methodologies, and professional development.

  Provided hands-on instruction in data analysis techniques, equipping students with the skills needed to effectively analyze and interpret complex datasets.

  Taught programming skills and concepts such as C during lab sessions, facilitating students' understanding of key topics and enhancing their practical coding abilities.

- **Interviewer**, IITP Institute for Information & Communication Technology Planning & Evaluation, Seoul, South Korea. December 2019.

  Participated in the selection process for the visiting scholarship program, conducting interviews in both Korean and English to identify undergraduate students from multiple countries such as Korean, Chinese and Mongolia.

  Evaluated candidates based on academic performance, research potential, and alignment with the program's objectives aimed at fostering international collaboration in ICT research.

  Played a key role in enhancing cultural and academic exchanges between Purdue University and South Korean institutions by selecting high-potential students for the scholarship program.

SKILLS

- **Mathematics:** Proficient in algebra, calculus, and statistics, with the ability to analyze and interpret complex mathematical models and familiarity with mathematical optimization techniques and probability theory.
- **Python3:** Certified and proficient in Python programming language, with experience in developing applications, scripts, and data analysis tools using libraries such as NumPy, Pandas, and Matplotlib.
- **PyTorch:** Proficient in deep learning, adept at debugging dependency issues to ensure seamless implementation across diverse OS, with experience in building and training neural networks for computer vision.
- **Docker:** Highly proficient in Docker containerization, with extensive experience in packaging applications and their dependencies into lightweight, portable containers. Skilled in optimizing the deployment process to ensure seamless, efficient management across diverse environments.
- **Kubernetes:** Competent in collaborating with Kubernetes to orchestrate containerized applications, enhancing scalability and reliability. Experienced in setting up and managing Kubernetes clusters to facilitate robust, fault-tolerant systems across multiple hosts.

PUBLICATIONS

1. **Title:** *Political Compass Evaluation of ChatGPT: Assessing Consistency Bias in Generated Responses* presented at IEEE 9th International Conference on Mathematics and Computers in Sciences and Industry (MCSI)

   Date and Location: August 22-24, 2024, Rhodes Island, Greece

   Coauthors: Eric T. Matson

Details: Presented research on assessing the political bias of ChatGPT using the Political Compass framework to analyze bias in AI responses, which revealed progressive and libertarian tendencies. Administered 62 questions 40 times to collect a dataset for evaluating response patterns and consistency. The findings indicate a bias towards progressive and libertarian views, with greater variability in ChatGPT's economic positions compared to its social positions, as evidenced by a higher standard deviation on the economic left-right axis.

2. **Title:** *Deploying a Sustainable Deep Learning Pipeline for Poison Ivy Image Classification* presented at the 2024 IEEE First International Conference on Artificial Intelligence for Medicine, Health and Care (AIMHC)

   Date and Location: February 5-7, 2024, Laguna Hills, CA

   Coauthors: Wonjun Park, Sumin Cho, Subin Kim, Jiyeon Lee, Jack Mahedy, and Nebey Gebresalssie

   Details: Discussed the development of a deep learning pipeline for classifying poison ivy images, utilizing MLOps to enhance public health outcomes. The system dynamically adapts to seasonal changes, potentially reducing health incidents related to poison ivy. Advanced AI segmentation tools like SAM are utilized in environmental health through the implementation of innovative MLOps workflows.

3. **Title:** *Prediction based Auto-Pilot Interface for Drone to Object Chasing using Historical TSPI Data* presented at the 2023 23rd International Conference on Control, Automation and Systems (ICCAS)

   Date and Location: October 17-20, 2023, Yeosu, South Korea.

   Coauthors: Shinhyoung Jang, Byeonghwi Park, Juheon Jeong, Jack Mahedy, Nebey Gebreslassie, and Eric T. Matson

   Details: The system comprises drone detection, movement prediction, and tracking. Devices such as radar are used to detect drones and provide Time-Space Position Information (TSPI) using suitable data formats. Machine learning techniques make it feasible to predict an object's future location, represented with equations. Utilizing trained machine learning models, the Auto-pilot API of the drone is employed to track it based on the predicted results. Experiments have confirmed the feasibility of predicting an object's future location using various ML techniques. Furthermore, verification has been conducted to establish the feasibility of implementing the Auto-pilot API through the utilization of DJI's API.

4. **Title:** *Safe Route Recommendation based on Crime Risk Prediction with Urban and Crime Data* presented at the IEEE 9th International Conference on Big Data Computing Service and Applications

   Date and Location: July 17-20, 2023, Athens, Greece

   Coauthors: Daye Kim, Juwon Baek, Jihu Yang, Hyun Roh, Heewon Jeong, Bryanna Ruiz, and Eric T. Matson

   Details: Led a project to recommend safe routes in Chicago by integrating crime and urban data. Employed machine learning to predict and map crime risks, thereby enhancing public safety through advanced data analytics. Calculated crime and urban data densities at each coordinate in Chicago, considering the severity of crimes. A machine learning model used these densities to forecast future crime rates, which were mapped onto Chicago's road network as risk indicators. The Dijkstra algorithm was applied using four types of weighted graphs, which varied by road risk and length, to propose safer routes. This approach aims to reduce crime and enhance community safety, providing valuable insights for safety initiatives.

5. **Title:** *Ehdnet: Enhanced human detection network for search and rescue* presented at the 2022 IEEE 46th Annual Computers, Software, and Applications Conference (COMPSAC)

   Date and Location: June 27-July 1, 2022, Torino, Italy

Coauthors: Seungoh Han, Ah-Young Nho, Wei Teng Kwan, Benjamin Paglia, Jacob Visniski, Eric T. Matson, and Minsun Lee

Details: Focused on detecting small objects that are often overlapped or obscured in various environments, and designed an Enhanced Human Detection Network (EHDNet) specifically targeting small object detection. The research improved detection performance by utilizing an Attentive Feature Pyramid Network (AFPN), which emphasizes the importance of multiscale feature integration to enhance the visibility of small objects in complex scenes. The EHDNet architecture incorporates several innovative components to address the challenges posed by small object detection, such as refined feature extraction techniques that prioritize high-resolution details and contextual information.

6. **Title:** *Feasibility of Measuring Shot Group Using LoRa Technology and YOLO V5* presented at the 2022 IEEE Sensors Applications Symposium (SAS)

   Date and Location: August 1-3, 2022, Sundsvall, Sweden

   Coauthors: Sanghyun Park, Dongheon Lee, Jisoo Choi, Dohyeon Ko, Zack Murphy, Nowf Binhowidy, and Anthony Smith

   Details: Aimed to create a reasonable automated shot grouping size measuring module that is available from several kilometers away. LoRa technology is adopted for covering long distances, and YOLO V5 is implemented to detect bullet impacts. Mathematical methods for calculating accurate distance and engineering techniques to fill the needs are described with experiments on various parameters and conditions. The proposed module showed that indoor tests measured the shot group with a mean accuracy of 91.8%.

7. **Title:** *Cost-Effective Solution for Fallen Tree Recognition Using YOLOX Object Detection* presented at the 2022 Sixth IEEE International Conference on Robotic Computing (IRC)

   Date and Location: December 5-7, 2022, Naples, Italy

   Coauthors: Hearim Moon, Eunsik Park, Junghyun Moon, Juyeong Lee, Doyoon Kim, Minsun Lee, and Eric T. Matson

   Details: Managed and addressed the significant impact of tropical cyclones on forest ecosystems by developing a cost-effective method for recognizing fallen trees. Utilized a high-resolution secondary camera-equipped UAV to collect data and trained a YOLOX model for rapid and accurate object detection. The project aimed to offer a low-cost and reliable solution for detecting fallen trees, providing crucial data to minimize further damage in disaster-stricken areas.

INVITED KEYNOTES, TALKS, AND PRESENTATIONS

- **PMRI Workshop**

  Date and Location: June 25-26, 2024 in West Lafayette, IN, 47907

  Presented research at the Purdue Military Research Institute (PMRI) Symposium to US and Korean military personnel. The presentation focused on the crucial role of segmentation in computer vision, demonstrating the application of the Segment Anything Model (SAM) for semantic segmentation. This session was part of a larger symposium aimed at advancing collaborative military research.

  Included a demonstration of using SAM for semantic segmentation, underlining its efficacy in military applications of computer vision and geographical data analysis.

- **IITP Career Talk Workshop**

  Date and Location: Dec 15-16, 2023 in Seoul, South Korea, 04535

Invited by the IITP to deliver a talk aimed at motivating undergraduate students to pursue advanced academic and professional opportunities.

Shared insights on the journey to becoming a master's and Ph.D. student, emphasizing the importance of setting clear academic goals, building a strong research portfolio, and selecting the right graduate programs that align with their career aspirations.

Provided practical advice on how to secure internships in the United States, which included tips on networking, crafting effective resumes and cover letters, and leveraging university resources and career services.

Highlighted the benefits of gaining international experience and how it can enhance their academic and professional growth.

- **PMRI Workshop**

  Date and Location: October 5-6, 2023 in West Lafayette, IN, 47907

  Mentored military service on the practical applications of the confusion matrix, emphasizing its role in evaluating the performance of machine learning models.

  Covered its use in various industries, such as healthcare and finance, to improve decision-making processes.

  Focused on its critical importance in computer vision tasks, such as image classification and object detection, where precision and recall metrics derived from the confusion matrix are crucial for optimizing model performance.

  Conducted seminars on various topics, including machine learning, deep learning, confusion matrices, computer vision, and statistics, providing students with a comprehensive understanding of these subjects. Facilitated lectures that covered advanced topics such as UAV (Unmanned Aerial Vehicles), UAS (Unmanned Aircraft Systems), antenna networking, and Explainable AI, enabling participants to grasp the latest technological advancements.

  Served as an interpreter for a specialized AI program tailored for military officers, while also acting as an assistant, effectively leading and managing a group of 17 officers to ensure successful program delivery.

INVITED ACTIVITIES

- **Panelist**, Samsung SDI Tech & Career Forum

  Date and Location: August 3, 2024 in Cambridge, MA 02139

  Participated as a panelist in the Tech Sessions, focusing on the role of computer vision in battery manufacturing. Discussed the application of imaging and analysis technologies to enhance precision and efficiency in production processes. Highlighted innovative approaches to integrating computer vision for quality control and operational improvements in the battery technology sector. The audience comprised exclusively of PhD and postdoc students, fostering a focused and advanced level of discussion.

- **Mentor and Speaker**, LG Innotek Global Campus Discussion

  Date and Location: July 24, 2024 in West Lafayette, IN, 47907

  Discussed experiences and insights related to working at LG Innotek, a leading electronic component manufacturer in Seoul, South Korea.

  Explored the application of computer vision in the production of core components for mobile devices, automotive displays, semiconductors, and smart products.

Focused on the potential enhancements and future directions in computer vision technologies within LG Group's manufacturing processes.

- **Symposium Participant**, Samsung Display Tech Forum

  Date and Location: May 17, 2024 in San Jose, CA, 95134

  Attended insightful tech seminars on modeling scene-dependent imaging in cameras using deep neural networks and leveraging generative AI for defect detection in OLED manufacturing.

  Engaged in discussions with diverse experts from fields such as mathematics, physics, biotechnology, and computer science.

  Highlighted the application of advanced technologies in real-world industry settings and had meaningful conversations with global peers and leaders like Changhee Lee, EVP & Head of Research Center.

Certifications

- **The Recreational UAS Safety Test (TRUST)**
  Completed the FAA's official safety test for recreational drone pilots, demonstrating knowledge of key safety practices, regulations, and airspace rules for operating unmanned aerial systems (UAS).
- **Neural Networks and Deep Learning (Coursera)**
  Earned certification from the online course taught by Andrew Ng, covering foundational concepts of neural networks, backpropagation, and techniques to train deep learning models effectively.
- **EBEC Programming in Python (Purdue)**
  Completed a specialized course at Purdue University focused on programming in Python, gaining proficiency in writing efficient code, data manipulation, and problem-solving using Python.

LANGUAGE PROFICIENCY

- **Korean:** Native proficiency. Extensive academic and professional use.
- **English:** Fluent. Professional working proficiency with academic publications and conference presentations.
- **Japanese:** Intermediate proficiency. Practical conversational and business communication.