AI-Based Medical Diagnosis: System-Level Approaches for Data Generation, Integration, and Clinical Decision Support

BIOGRAPHY

Dr. Yong Oh Lee is an Assistant Professor in Industrial & Data Engineering at Hongik University, South Korea. He received his Ph.D. in Computer Engineering in 2012 from Texas A&M University. Before joining academia, he worked at Samsung Electronics in Korea and at the Korea Institute of Science and Technology Europe (KIST Europe) in Germany. His research focuses on artificial intelligence applications in healthcare, including multimodal medical imaging, clinical data integration, and large language models for medical information and drug safety. He has led projects on rare disease diagnosis, ophthalmology, orthopedics, oral cancer, and AI-enhanced educational systems. Dr. Lee actively collaborates with medical researchers to develop explainable and clinically reliable AI models that bridge engineering and medicine, aiming to advance data-driven healthcare innovation and support translational applications in clinical practice.

ABSTRACT

Human-centered decision making in healthcare increasingly depends on large, complex, and heterogeneous data ranging from medical images and clinical notes to physiological signals and audio recordings. This complexity creates a growing need for system-level AI approaches that can integrate multimodal information, operate under limited data, and provide consistent and reproducible diagnostic support. Unlike traditional clinical research, these challenges closely align with the interests of engineering such as data pipeline design, model efficiency, workflow optimization, and reliable decision-making under uncertainty.

This seminar introduces the engineering examples of medical AI through a series of practical diagnostic case studies. First, I present synthetic medical data generation using generative models as an effective strategy to overcome data scarcity, imbalance, and privacy constraints. Second, we discuss segmentation and multi-view integration frameworks that improve surgical planning for shoulder injuries by combining anatomical information across multiple MRI views through cross-attention mechanisms. Third, we explore voice-based diagnosis of laryngeal diseases, demonstrating how non-invasive acoustic signals and deep learning can support early detection. Finally, we highlight multimodal diagnostic systems, where medical images and electronic medical records (EMR) are jointly processed using large language models to enable structured information extraction and automated report generation.

Through these examples, we illustrate how medical AI is fundamentally a complex systems problem involving data engineering, model architecture design, and workflow integration. The seminar concludes with a discussion on how industrial and systems engineering methodologies can contribute to building scalable, explainable, and clinically reliable AI systems for future healthcare applications.