The 2nd Summer School on AI-Powered Medical Imaging Informatics; Object Detection and Localization in Medical Images

2024 AI Summer School for High School Students
University of Pittsburgh

The 2nd Summer School on AI-Powered Medical Imaging Informatics aims to provide a stimulating and unique opportunity for students in grades 11 and 12 to dive into the fascinating world of artificial intelligence (AI) and its application in medical imaging informatics. This summer school will be held between June 24 and June 28, 2024, at the University of Pittsburgh, organized by the Computational Pathology & AI Center of Excellence (CPACE) within the School of Medicine, plus the School of Health and Rehabilitation Sciences, and IEEE Computer Society in Pittsburgh.

Overview:

Computer vision as a subfield of AI has been around for several years dealing with how computers can learn to understand from digital images and video sequences. Advanced computer vision algorithms have already demonstrated successful applications in a variety of domains, including medical image interpretation, remote surgery, surveillance systems, security and biometrics, autonomous vehicles, and scene reconstruction, purposing to name a few. There is a list of fascinating problems in applied computer vision in medical imaging, with object detection and localization being one of the most interesting ones. Object detection and localization is now also widely associated with self-driving cars where automatic systems combine computer vision, LIDAR, and GPUs to generate a multidimensional representation of the road with all its participants. This summer school will teach AI-powered computer vision techniques for object detection and localization in medical images. Through hands-on practices and Python programming, participants will learn, from scratch, how to implement these technologies, gaining practical skills to address this task. The program includes lectures and collaborative project assignments.

Objectives:

The main objectives of this summer school are threefold including: (1) delivering a solid curriculum on AI-powered medical imaging informatics research, (2) enhancing the competitiveness of high school students for undergraduate and then graduate level programs (e.g., computer science, data science, artificial intelligence, medical imaging informatics), and (3) equipping them with the essential skills for pursuing professional careers in AI-powered medical imaging informatics.

Program:

- **Date:** Monday, June 24 to Friday, June 28, 2024.
- **Time:** 9:00am EDT to 2:30pm EDT.
- **Location:** Forbes Tower, Room # 6048 [6th floor] (Atwood Ave, Pittsburgh, PA 15213)
- **Format:** Our summer school will feature a blend of lectures, hands-on projects, team projects, and guest speaker sessions, ensuring an engaging and dynamic learning experience for all participants.
- **Certification:** Upon successful completion of the summer school, students will receive a certificate of participation, recognizing their dedication and achievement in AI-powered medical imaging informatics.

Prerequisite:

Basic Python programming (If not familiar with this prerequisite, follow the link here: https://www.tutorialspoint.com/python/index.htm)

Topics included but not limited to:

- Introduction to AI and Computer Vision
- Introduction to Deep Learning Computer Vision and Deep Convolutional Neural Networks (CNNs)
- Introduction to Object Detection and Localization in Computer Vision
- Introduction to PyTorch
- Manual Annotation of Medical Images using the LabelImg Toolset
- Sliding Windows and Bounding Boxes in Object Detection
- Non-max Suppression
- YOLO (You Only Look Once) and SSD (Single Shot Detector)
- Liner.ai; Liner is an end-to-end tool for training machine learning models without code

Schedule:

Day	Time	Agenda	Speaker/Instructor
Monday, June 24th	9:00 – 9:15	• Opening Remark; University of Pittsburgh	Dr. Liron Pantanowitz
	9:15 – 9:30	• Welcome Keynote; IEEE	Dr. Kalyan Sen
	9:30 – 10:00	• Introduction to AI	Dr. Hooman Rashidi
	10:00 – 10:15	• Break	
	10:15 – 11:00	• Introduction to Computer Vision	Dr. Ahmad P. Tafti
	11:00 – 12:00	• Digital Image and Digital Image Operation	Dr. Ahmad P. Tafti
	12:00 – 12:45	• Lunch (will be provided)	
	12:45 – 14:30	Hands-on-Practice: ○ Google Colab; What and Why? ○ Basic Python Programming	Dr. Ahmad P. Tafti
Tuesday, June 25th	9:00 – 9:45	• Medical Imaging	Jamie Gramz
	9:45 – 10:30	• Medical Image Filtering • Image Morphology • Shape Analysis	Dr. Ahmad P. Tafti
	10:30 – 10:45	• Break	
	11:00 – 12:00	• Introduction to Deep Learning Computer Vision	Dr. Ahmad P. Tafti
	12:00 – 12:45	• Lunch (will be provided)	
	12:45 – 13:45	Hands-on-Practice: ○ Image Operation ○ Image Filtering ○ Shape Analysis	Dr. Ahmad P. Tafti
	14:00 – 14:30	Guest Lecture/Guest Speaker Speaker: Dr. Soheyla Amirian; University of Georgia Topic: AI Fairness in Medical Image Segmentation	
Wednesday, June 26th	9:00 – 10:00	• Introduction to Deep Convolutional Neural Networks (CNNs) in Computer Vision	Dr. Ahmad P. Tafti
	10:00 – 10:15	• Break	
	10:15 – 11:00	• Introduction to PyTorch	Nickolas Littlefield
	11:00 – 12:00	• Introduction to Image Annotation	Nickolas Littlefield

		• Intersection over Union (IoU)	
	12:00 – 12:45	• Lunch (will be provided)	
	12:45 – 13:45	Hands-on-Practice: ○ Medical image annotation (manual annotation) ○ LabelImg ○ ITK-SNAP	Nickolas Littlefield
	14:00 – 14:30	Guest Lecture/Guest Speaker Speaker: Saba Dadsetan, University of Pittsburgh Topic: AI for Harmonizing MRI Scanner Variabilities	
Thursday, June 27th	9:00 – 10:00	• Sliding Windows • Convolutional Implementation of Sliding Windows • Bounding Box Prediction	Dr. Ahmad P. Tafti
	10:00 – 10:15	• Break	
	10:15 – 11:15	• Non-Max Suppression • YOLO (You Only Look Once) • SSD (Single Shot Detector)	Nickolas Littlefield
	11:15 – 12:00	• Liner.ai	Dias Mashikov
	12:00 – 12:45	• Lunch (will be provided)	
	12:45 – 13:45	Hands-on-Practice: ○ Object Detection and Localization in Medical Images and Model Analysis (IoU measurement) ○ Working with Liner.ai	Nickolas Littlefield Dias Mashikov
	14:00 – 14:30	Guest Lecture/Guest Speaker Speaker: Dr. Illah Nourbakhsh; Carnegie Mellon University Topic: AI & Humanity	
Friday, June 28th	9:00 – 9:30	• Description of the Team Project • Team Arrangement	Nickolas Littlefield Dias Mashikov Dr. Ahmad P. Tafti
	9:30 – 11:15	• Teams will be working on their projects	
	11:15 – 12:30	• Online quiz and Team Presentations	
	12:30 – 13:15	• Lunch (will be provided)	
	13:15 – 13:30	• Closing Remark	Dr. Bambang Parmanto
	13:30 – 14:00	• Certificate Award Ceremony	Dr. Yanshan Wang Dr. Hooman Rashidi

Organizers:

- Hooman Rashidi, MD, MS, FCAP
- Liron Pantanowitz, MD, PhD
- Ahmad P. Tafti, PhD, FAMIA

Steering Committee:

- Hooman Rashidi, MD, MS, FCAP

- Liron Pantanowitz, MD, PhD
- Bambang Parmanto, PhD
- Soheyla Amirian, PhD
- Nicole Myers, BSN, RN
- Kalyan Sen, PhD
- Ann Vinski, PhD
- Ahmad P. Tafti, PhD, FAMIA