

# The 2<sup>nd</sup> Summer School on AI-Powered Medical Imaging Informatics; Object Detection and Localization in Medical Images

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## 2024 Summer School for High School Students

The 2<sup>nd</sup> 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 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, gaining practical skills to address this task. The program includes lectures and collaborative project assignments.

### Objectives:

The main objectives of this summer school are in 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 2:00 pm EDT.
- **Location:** Forbes Tower, Room # 6048 (219 Meyran Avenue, Pittsburgh, PA 15213)
- **Capacity:** We have limited capacity for up to 30 students (in-person), with priority given to under-represented students and groups in AI and machine learning.
- **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.
- **Cost:** \$0.00 (HIM/SHRS is taking care of the classroom and PCs)
- **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.

**Who may apply:**

- High school students currently in grades 11 and 12 with a keen interest in advanced technology, healthcare, and artificial intelligence (AI).
- Students from all backgrounds and levels of experience are encouraged to apply, with priority given to under-represented groups in AI and machine learning.

**Prerequisite:**

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

**Registration (Free):**

[Register online using this Google form](#). Registration required by Monday, May 25, 2024. 30 in-person seats are available on a first-come-first-serve basis. For any questions, please write to Nicole Myers at [ntm23@pitt.edu](mailto:ntm23@pitt.edu) or Kalyan Sen at [senkk@ieee.org](mailto:senkk@ieee.org)

**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	
<b>Monday, June 24<sup>th</sup></b>	9:00 – 9:15	<ul style="list-style-type: none"> <li>Opening Remark; University of Pittsburgh</li> </ul>	Dr. Liron Pantanowitz	
	9:15 – 9:30	<ul style="list-style-type: none"> <li>Welcome Keynote; IEEE</li> </ul>	Dr. Kalyan Sen	
	9:30 – 10:00	<ul style="list-style-type: none"> <li>Introduction to AI</li> </ul>	Dr. Hooman Rashidi	
	10:00 – 10:15	<ul style="list-style-type: none"> <li>Break (Coffee &amp; Snack)</li> </ul>		
	10:15 – 11:00	<ul style="list-style-type: none"> <li>Introduction to Computer Vision</li> </ul>	Dr. Ahmad P. Tafti	
	11:00 – 12:00	<ul style="list-style-type: none"> <li>Digital Image and Digital Image Operation</li> </ul>	Dr. Ahmad P. Tafti	
	12:00 – 12:45	<ul style="list-style-type: none"> <li>Lunch (will be provided)</li> </ul>		
	12:45 – 13:45	Hands-on-Practice: <ul style="list-style-type: none"> <li>Google Colab; What and Why?</li> <li>Basic Python Programming</li> </ul>	Dr. Ahmad P. Tafti	
	14:00 – 14:30	Guest Lecture/Guest Speaker (Research Oriented) [TBD]		
<b>Tuesday, June 25<sup>th</sup></b>	9:00 – 9:45	<ul style="list-style-type: none"> <li>Medical Imaging</li> </ul>	Jamie Gramz	
	9:45 – 10:30	<ul style="list-style-type: none"> <li>Medical Image Filtering</li> <li>Image Morphology</li> <li>Shape Analysis</li> </ul>	Dr. Ahmad P. Tafti	
	10:30 – 10:45	<ul style="list-style-type: none"> <li>Break (Coffee &amp; Snack)</li> </ul>		
	11:00 – 12:00	<ul style="list-style-type: none"> <li>Introduction to Deep Learning Computer Vision</li> </ul>	Dr. Soheyla Amirian	
	12:00 – 12:45	<ul style="list-style-type: none"> <li>Lunch (will be provided)</li> </ul>		
	12:45 – 13:45	Hands-on-Practice: <ul style="list-style-type: none"> <li>Image Operation</li> <li>Image Filtering</li> <li>Shape Analysis</li> </ul>	Dr. Ahmad P. Tafti	
	14:00 – 14:30	Guest Lecture/Guest Speaker (Research Oriented) [TBD]		
	<b>Wednesday, June 26<sup>th</sup></b>	9:00 – 10:00	<ul style="list-style-type: none"> <li>Introduction to Deep Convolutional Neural Networks (CNNs) in Computer Vision</li> </ul>	Dr. Soheyla Amirian
10:00 – 10:15		<ul style="list-style-type: none"> <li>Break (Coffee &amp; Snack)</li> </ul>		
10:15 – 11:00		<ul style="list-style-type: none"> <li>Introduction to PyTorch</li> </ul>	Nickolas Littlefield	
11:00 – 12:00		<ul style="list-style-type: none"> <li>Introduction to Image Annotation</li> <li>Intersection over Union (IoU)</li> </ul>	Nickolas Littlefield	
12:00 – 12:45		<ul style="list-style-type: none"> <li>Lunch (will be provided)</li> </ul>		
12:45 – 13:45		Hands-on-Practice: <ul style="list-style-type: none"> <li>Medical image annotation (manual annotation)</li> <li>LabelImg</li> <li>ITK-SNAP</li> </ul>	Zoe Menesez & Maimouna Sanogo	

	14:00 – 14:30	Guest Lecture/Guest Speaker (Research Oriented) [TBD]	
<b>Thursday, June 27<sup>th</sup></b>	9:00 – 10:00	<ul style="list-style-type: none"> <li>• Sliding Windows</li> <li>• Convolutional Implementation of Sliding Windows</li> <li>• Bounding Box Prediction</li> </ul>	Dr. Ahmad P. Tafti
	10:00 – 10:15	• Break (Coffee & Snack)	
	10:15 – 11:15	<ul style="list-style-type: none"> <li>• Non-Max Suppression</li> <li>• YOLO (You Only Look Once)</li> <li>• SSD (Single Shot Detector)</li> </ul>	Nickolas Littlefield
	11:15 – 12:00	• Liner.ai	Jason Ran
	12:00 – 12:45	• Lunch (will be provided)	
	12:45 – 13:45	Hands-on-Practice: <ul style="list-style-type: none"> <li>○ Object Detection and Localization in Medical Images and Model Analysis (IoU measurement)</li> <li>○ Working with Liner.ai</li> </ul>	Nickolas Littlefield & Jason Ran
	14:00 – 14:30	Guest Lecture/Guest Speaker (Research Oriented) [TBD]	
<b>Friday, June 28<sup>st</sup></b>	9:00 – 9:30	<ul style="list-style-type: none"> <li>• Description of the Team Project</li> <li>• Team Arrangement</li> </ul>	Dr. Ahmad P. Tafti
	9:30 – 11:15	• Teams will be working on their projects	
	11:15 – 12:30	• Online quiz and Team Presentations	Jason Ran & Nickolas Littlefield
	12:30 – 13:15	• Lunch (will be provided)	
	13:15 – 14:00	<ul style="list-style-type: none"> <li>• Certificate of Participation</li> <li>• Closing Remark</li> </ul>	Dr. Hooman Rashidi Dr. Bambang Parmanto

### 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
- Ahmad P. Tafti, PhD, FAMIA