SYLLABUS – Please read carefully!

FALL Semester 2025
PHY 090-011 & HMS 090-011
Big Question Seminar

How Can AI Enhance Medical Imaging?

3 credits
Big Question Seminar

Artificial Intelligence (AI) could play a crucial role in managing medical data – particularly in reading, interpreting, and even recommending further medical imaging procedures. But what types of AI are most effective in medical imaging? How will AI enhance diagnostic capabilities? What potential drawbacks might arise from its use? And can AI help reduce medical costs, making healthcare more affordable and accessible to all?

To address these questions, we will explore the fundamental physics of medical imaging techniques, investigate how AI can enhance image interpretation, and consider the limitations and challenges that may arise from its use.

This course does not require prior knowledge of physics. We will cover the essential concepts needed to understand medical imaging at a beginner's level, including ultrasound, x-rays and x-ray–based techniques, MRI, SPECT, and PET. In parallel, we will introduce fundamental AI concepts and explore their applications in medical imaging. By the end of the semester, you will present a topic of your choice and critically evaluate the role of AI as a tool for enhancing image interpretation.

In this class, we will also explore how AI can support you as a student, while also considering the challenges it may pose if you do not continue to strengthen your own skills in learning, writing, problem-solving, and research.

Instructor

Prof. Paola M. Cereghetti
pmc5@lehigh.edu
Office: LL 512
Office hours: I will be available after each class, please e-mail me if you need to meet one on one. Thank you!

Class Meetings

Tuesdays and Thursdays: From 10:45am to 12:00pm in room LL512.

Textbook and Class Notes

While there is not a mandatory textbook for this course, I'll be drawing from a diverse range of sources and will provide you with the necessary materials. Here are some interesting books on the subjects we cover. We may draw on material from them, or you might enjoy browsing them on your own.

On physics of medical imaging in general (both available as e-books at library.lehigh.edu):

Introduction to Physics in Modern Medicine (2nd edition, 2009) by Suzanne Amador Kane et al. This text is more basic, but stands out for its clear and concise presentation.

Medical Imaging - Essentials for Physicians by Anthony (1st edition, 2013) B. Wolbarst.

On particular medical imaging techniques (more advanced, all available as e-books at library.lehigh.edu):

The Physics and Technology of Diagnostic Ultrasound: A Practitioner's Guide (2nd edition, 2020) by Robert Gill.

Radiography in the Digital Age: Physics, Exposure, Radiation Biology (4th edition, 2023) by Quinn B. Carroll.

MRI from Picture to Proton (3rd edition, 2017) by D.W. McRobbie et al.

Essentials of Nuclear Medicine Physics, Instrumentation, and Radiation Biology (4th edition, 2022) by Rachel A. Powsner et al.

On Artificial Intelligence:

Co-intelligence. Living and working with AI (1st edition, 2024) by Ethan Mollick

Why Machines Learn. The Elegant Math behind Modern AI (1st edition, 2024) by Anil Ananthaswamy

Attendance & Class Participation

Attendance is mandatory and will count towards your course grade. Should you miss a class for a valid reason or other extenuating circumstances: 1. Let me know, possibly in advance, an e-mail is enough; 2. Make sure that you understand the material you missed and that you catch up with and hand in any missed group activity. You're permitted to miss up to 2 lessons, *whether you have an official excuse or not*. If you miss more than 2 lessons, you will lose 1 point out of 10 points for each additional absence.

We may have guest speakers who cannot attend during our regular class time; attendance will be recorded for those sessions as well. Constructive class participation is encouraged and will be considered in your grade.

Homework

Homework will usually be assigned twice a week, with Tuesday's assignment – due on Thursday – being shorter. Assignments may include readings, problem solving, and/or short writing tasks. They are designed to help clarify the material, so do not use generative AI to complete them unless specifically instructed. All homework must be handwritten on the printed version provided in class.

One point will be deducted for each missed homework assignment, out of a possible 10 points. In extenuating circumstances, please inquire about the possibility of a deadline extension, and I will consider it. Your grade in the homework section will depend on how well you do the HW, as well as on how much you are left of the initial 10 points.

Quizzes

Every week, we will have a short in-class quiz that will require you to apply what you learned or read while completing the homework, and to use the knowledge you gained in the course. If you completed the homework yourself (without AI, unless it was part of the assignment), you should have no trouble doing well on the quiz. The quizzes are necessary to build a good foundation and to understand more advanced topics. Make-up quizzes will not be offered. However, the instructor may consider extenuating circumstances if more than two quizzes are missed.

You may miss up to two quizzes, with or without an official excuse. For each additional quiz missed beyond that, 1 point will be deducted from the 5 points allocated for quizzes. Your quiz grade will be based both on your performance on the quizzes as well as on how many of the initial 5 points remain. Extenuating circumstances may be considered by the instructor.

Semester Project

During the semester, you will develop a special project that will be presented at the end of the term. Specific guidelines and expectations will be provided as the semester progresses. One of the project's key components will be a short presentation, scheduled for the final week of the semester (with the possibility of using the penultimate week, depending on the class's progress).

Use of Generative AI

Generative AI can be for example a useful tool for organizing your thoughts and checking your English. However, unless the instructor explicitly states that it may be used for a specific activity or homework assignment, generative AI of any kind is not permitted. For your own benefit, you should avoid using generative AI unless instructed. The goal of this class is to learn and retain new concepts and fundamental information, and build upon that. Although the material will be kept as accessible as possible for first-year students without a physics background, using generative AI to complete homework will prevent you from gaining the practice needed to truly understand the material.

Grading:

Your grade in the course will be determined based on class participation and attendance, homework, quizzes (no hour or final exams), and the quality of your final presentation project as follows:

Participation & Attendance	25%
Homework	25%
Semester's Quizzes	25%
Final Presentation Project:	25%

Accommodations for Students with Disabilities:

Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online.

The Principles of Our Equitable Community:

Lehigh University endorses The Principles of Our Equitable Community. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Lehigh University Policy on Harassment and Non-Discrimination:

Lehigh University upholds the Principles of Our Equitable Community and is committed to an educational, working, co-curricular, social, and living environment for faculty, staff, and students. The University does not discriminate in its admissions practices, employment practices, or educational programs or activities on the basis of age, color, disability, ethnicity, familial status, gender expression, gender identity, genetic information, marital status, national origin (including shared ancestry), pregnancy or related conditions, race, religion, sex, sexual orientation, and veteran or military status. Harassment or discrimination is unacceptable behavior and will not be tolerated. The University strongly encourages (and, depending upon the circumstances, may require) students, faculty, or staff who experience or witness harassment or discrimination, or have information about harassment or discrimination in University programs or activities, to immediately report such conduct.

If you have questions about Lehigh's Policy on Harassment and Non-Discrimination or need to report harassment or discrimination, contact the Equal Opportunity Compliance Coordinator (Alumni Memorial Building / 610 758 3535 / eocc@lehigh.edu).

Student Senate Statement on Academic Integrity

All members of the Lehigh community have a responsibility to maintain academic integrity. Resources and details of expectations at Lehigh are available on the Provost's website. It is expected that all students will abide by these standards throughout the course (e.g., homework, quizzes, papers, exams, projects, etc.). Academic integrity case studies will be discussed on the first day of class, and students are encouraged to ask questions for further clarity throughout the semester. Violations of academic integrity standards will not be tolerated and will be handled according to the guidelines in the University's Student Conduct System.

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