SOI-178

Challenge: Can We Trust AI in Medical Imaging?
Turning AI Promises into Clinically Reliable Solutions

Designing Validation Strategies for Healthcare

Challenge Provider: ASUIT (Azienda Sanitaria Universitaria Integrata del Trentino)

Hosting Institution
University of Trento, School of Innovation (SOI)

Study Format: Blended. International students can ask their home International Office for Short Term Mobility scholarships to participate in the in-presence week in Trento.

Who can apply: Bachelor Students in Physics, Engineering (Data Science), Computer Science, Medicine, Bioengineering, Medical Radiology.

Study period: 15 October 2026 - 29 January 2027
In presence: 25-29 January in Trento

Calendar of activities

Thu	*15/10*	*Presentation of the Challenge: program overview and objectives (ONLINE)*
Thu	*22/10*	*Introduction to medical physics and medical imaging (ONLINE)*
Thu	*12/11*	*Fundamentals and applications of AI in medical imaging (ONLINE)*
Thu	*3/12*	*Can we trust AI in medical imaging in real-world clinical practice? (ONLINE)*

Mon 25 Jan to Fri 29 Jan: In-presence week in Trento (detailed program will follow)

Learning Outcomes
The learning objectives of this Challenge reflect a challenge-based and interdisciplinary approach, combining medical physics, artificial intelligence, and

real-world healthcare applications. This course will offer a stimulating learning environment to develop both interdisciplinary knowledge and transversal skills, with a strong emphasis on critical thinking, teamwork, and scientific communication. Students are expected to understand, apply and evaluate key concepts learned from the lectures to the validation and reliability of AI systems in healthcare.

At the end of the challenge, students will be able to:

- explain the physical principles underlying medical imaging modalities;
- describe the main machine learning and deep learning approaches used in medical imaging, including segmentation, detection, classification, and prediction tasks;
- analyze the challenges associated with the deployment of AI systems in real-world clinical settings,
- evaluate existing validation protocols for AI-based medical technologies, identifying their limitations and potential sources of bias;
- design and suggest proof-of-concept workflows for the validation of AI systems;
- apply quantitative metrics to assess the performance, robustness, and reliability of AI models in specific healthcare contexts;
- work in synergy with interdisciplinary teams, progressively integrating knowledge from physics, engineering, and data science;
- communicate scientific results through written reports and oral presentations.

The Challenge - Description

How can we objectively evaluate the performance of AI systems in modern healthcare? Within this challenge, students will work in interdisciplinary teams to suggest a strategy for evaluating AI solutions through rigorous and feasible procedures ahead of clinical practice.

Medical physicists have a central role in modern healthcare systems, ensuring the reliability and quality of technologies, as well as the proper use of radiation to guarantee patient safety. Quality assurance of imaging devices, radiation safety, optimization of clinical protocols, and validation of medical technologies are traditionally their major responsibilities. Recently, the rapid development of artificial intelligence (AI) and its progressive integration in healthcare has gained considerable attention due to its seemingly remarkable performance in supporting radiological workflows and medical diagnosis. Applications of interest in medical imaging include automated organ segmentation, disease classification, clinical outcome prediction, and synthetic image generation. Commercial AI solutions have been developed to improve efficiency, reproducibility, and diagnostic support.

Despite the growing interest, several studies have highlighted suboptimal performance in real-world healthcare and performance degradation over time. This critical aspect emerges from a persistent mismatch between development and deployment conditions: commercial AI systems are often trained on polished datasets, whereas real-world clinical data are highly fragmented and heterogeneous. As a result, the current lack of standardized procedures prevents quantitative validation of the performance, robustness, and clinical reliability of these systems before deployment

Information

Within this new learning strategy, the course aims at developing the ability of students to address complex, real-world challenges in healthcare, integrating concepts of medical physics and artificial intelligence. In particular, it seeks to bridge theoretical knowledge and practice by engaging interdisciplinary teams in the design of validation strategies for AI systems in medical imaging. The course promotes critical thinking, problem-solving, teamwork, and the ability to assess the reliability and clinical applicability of emerging technologies.

The innovative aspect lies in the combination of challenge based learning with highly specialized and rapidly evolving research fields, where the educational offering is still limited. Conversely to traditional AI courses which focus on model development, this intervention emphasizes the validation and critical evaluation of AI systems, a crucial but underrepresented competence in healthcare.

Assessment

The effectiveness of the intervention will be assessed through measurable indicators related to learning outcomes, engagement, and skill development. Project performance will be evaluated using standardized rubrics, focusing on the quality, rigor, and feasibility of the proposed validation workflows. Participation and completion rates, including attendance and engagement in course activities, will provide quantitative indicators of student involvement. The degree of interdisciplinarity within teams and peer feedback will be used to assess collaborative skills, while the quality of final reports and presentations will measure the ability of students to apply critical thinking and produce scientifically sound outputs. Self-assessment surveys administered during the course will be used as formative tools to monitor students' perceived learning and to support the teaching process, rather than as elements of formal evaluation. Overall, these indicators will enable a structured assessment of the impact of the challenge-based learning approach on both disciplinary knowledge and transversal competencies.

Contacts

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