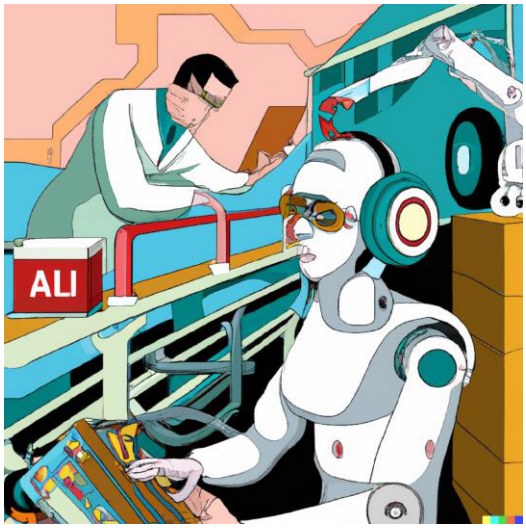
## Course Announcement for Spring 2024

# *Mathematical and Numerical Problem Solving*

# MSE 510

### Instructor: Sergei V. Kalinin

Times and locations: TR 9:45-11:00, location TBD




In the mid-20th century, Eugene Wigner illuminated the deep relationship between mathematics and the natural sciences, emphasizing their interconnectedness in understanding the world. *Building on this foundational perspective, our course introduces participants to the game-changing capabilities and methodologies of mathematical methods, machine learning (ML), and Bayesian techniques.* As we advance into an age dominated by technological innovation, the importance of intertwining mathematical and ML strategies with experimental practices becomes abundantly clear. Our curriculum offers an immersive dive into the realm of scientific Python, providing students a chance to grasp both its fundamental and advanced mathematical applications. Beyond just theory, you'll get hands-on exposure, solving intricate equations and harnessing powerful data analysis tools. The course also emphasizes the importance and application of Bayesian methods, demonstrating how to effectively merge raw data with domain-specific insights and knowledge.

But our journey doesn't stop there. We'll lead you into the captivating domain of causal analysis within machine learning, allowing for deeper understanding and interpretation of data-driven phenomena. As experimental disciplines become increasingly complex, the ability to make informed decisions in uncertain environments becomes paramount. Hence, our focus also shifts towards probabilistic decision-making techniques, ensuring you're well-equipped to handle challenges in modern science from data analysis to automated and autonomous experiments. The instructor worked on ML in materials science for 15 years at ORNL and spent a year at Amazon (special projects). Attend if you aim to:

1. Achieve proficiency in scientific Python, tapping into its diverse mathematical applications.
2. Gain the ability to solve both foundational and advanced equations with confidence.
3. Deep dive into data analysis, mastering tools that empower data-driven decisions.
4. Grasp the nuances of Bayesian methods, learning how to weave together data with prior knowledge.
5. Explore the intricate landscape of causal analysis within the ML spectrum.
6. Develop a solid understanding of probabilistic techniques for decision-making in uncertain scenarios.

If you are an undergraduate student, this course can give you an early edge for adopting Python in the industrial role or graduate school at UTK or elsewhere. If you are a graduate student - welcome to the journey spanning mathematics, machine learning, and human intuition in the materials world!

**Contact: Sergei V. Kalinin – sergei2@utk.edu**

**Course website: https://github.com/SergeiVKalinin/MSE_Spring2024**