

MATHEMATICS OF GENERATIVE AI

MATH 496T – Special Topics

Spring 2027

Mathematics + computation + research, with AI tools fully allowed

A **math-first, research-oriented introduction to modern generative AI**. We will connect classical applied mathematics directly to the mechanisms behind contemporary AI: representations, optimization, uncertainty, sampling, diffusion, transport, learning, and decision-making.

What will we study?

- Linear algebra, automatic differentiation, optimization, and neural networks – a compact review.
- Probability, information theory, stochastic processes, Brownian motion, sampling, and MCMC.
- Energy-based / graphical models, variational methods, and latent-variable generative models.
- Diffusion and score-based models, normalizing flows, VAEs, transformers, reinforcement learning, and agentic/decision-based viewpoints.
- Connections to statistical mechanics, optimal transport, dynamical systems, and stochastic control.

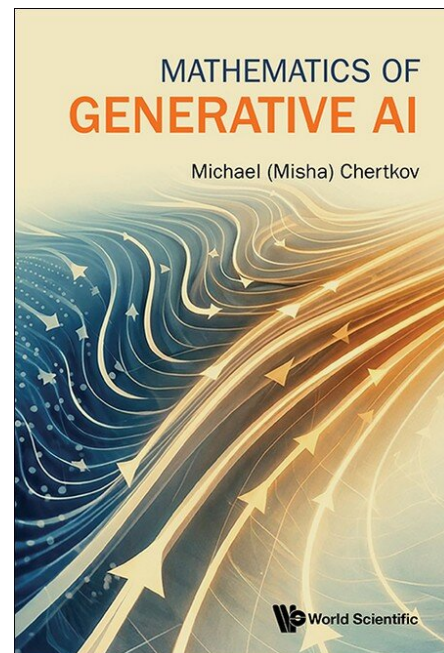
How will the course work?

- **No midterm. No final exam. No point-counting.**
- A portfolio of theory + Python/Jupyter experiments, with revision option.
- A compact research/reproduction project:
formulate → **reproduce** → **stress-test** → **extend**.
- Student challenges, corrections, new examples, and notebook extensions are encouraged (earn points).
- **AI tools may be used without restriction.** You remain responsible for understanding, checking, and reproducing what you submit.

Who should take it?

Motivated juniors and seniors – interested in research carriers – from Mathematics, Computer Science, Statistics/Data Science, Physics, Astronomy, Engineering, quantitative programs in Eller, and other STEM areas are welcome. **MATH 412 is helpful but not required.**

Recommended preparation: Calculus II (MATH 129 or equivalent), Linear Algebra (MATH 313 or equivalent), and basic Python (CSC 110 / ISTA 130 or equivalent). Students with equivalent quantitative preparation are encouraged to contact the instructor.



Course text

Michael (Misha) Chertkov,
Mathematics of Generative AI,
World Scientific (2026).

doi.org/10.1142/14943



Book / github



Book / DOI

Instructor

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Spring 2027

Jan. 13 – May 5

Meeting time / room:

see UAccess / Math website