MAT 400: Monte Carlo Methods

University of Maine
Department of Mathematics and Statistics

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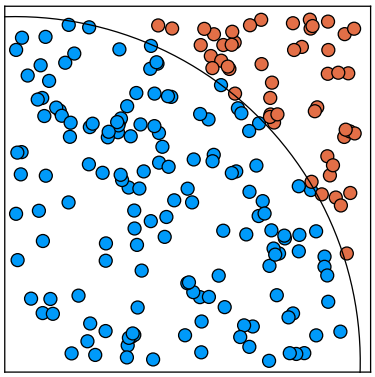
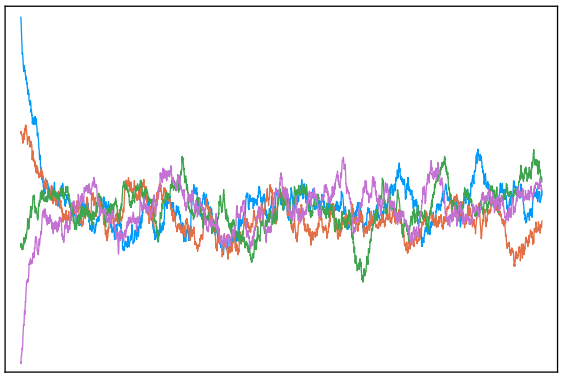
Course Description: Modern science regularly poses problems that cannot be solved exactly without vast amounts of computation. Surprisingly, we can often make much more efficient progress by carefully introducing randomness into our calculations. This course will provide an introduction to randomized techniques for solving not-necessarily-random problems. Such tools underly the most significant recent advances in statistics and machine learning, from superhuman game-playing perfomance to training the neural networks that process images for a self-driving car.

Topics covered will include Monte Carlo tree search, Monte Carlo integration, Bayesian inference with Markov Chain Monte Carlo, and randomized optimization via simulated annealing or stochastic gradient descent.





Class Time: MWF 2-2:50pm in Neville 206

Text: No single text is required. Each of the books below covers some of the course topics.

Pattern Recognition and Machine Learning, Bishop (2006).
Available free online.

Bayesian Data Analyis, Gelman, Carlin, Stern, Dunson, Vehtari, and Rubin (2020).
Available free online.

Prerequisites: Grade of C or better in MAT 228 (Calculus III) and in one of MAT 258, MAT 262, or MAT 362 (Linear Algebra).

Experience with probability theory (for example from STS 232, STS 332, or STS 434), proofs (for example from MAT 261 or MAT 425), and programming (for example from COS 125) will be helpful.