# Optimal sampling

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Approximating an unknown function from a limited number of pointwise samples is a fundamental problem in applied mathematics, computer science and machine learning. This talk concerns the following question: given a fixed (linear or nonlinear) approximation space, how should one choose the sample points to obtain as good an approximation from as few samples as possible? In this talk, I will first describe the case of linear approximation spaces. Here a near-complete answer to this question has emerged in recent years. I will survey this recent progress, aiming to highlight connections to approximation theory, information-based complexity and randomized numerical linear algebra. Next, I will explore the significantly more challenging setting of nonlinear approximation spaces. Here I will present several new theoretical results and discuss recent progress towards optimal sampling. I will also discuss an important generalization of the problem to non-pointwise, and potentially non-scalar valued, samples. Finally, and time permitting, I will present a series of novel applications, including learning with sparse models, compressive imaging using generative models, and the numerical solution of PDEs using Physics-Informed Neural Networks (PINNs).

*Joint work with Juan M. Cardenas (Simon Fraser University, Canada) and Nick Dexter (Florida State University, USA).*