About this course: The course is of interest to students working in the intersections of control theory, decision making, and machine learning. The main thrust of the course is built on recent interests in verifiable autonomy in the presence of uncertainties and unknown characteristics of the underlying systems. The course begins with a selected number of classical topics in control and learning theory dealing with uncertainties and unknown parameters. We then visit some contemporary topics which possibly include data-driven control, online learning, and emerging probabilistic methods.

The Syllabus of the course is posted. More details will be added in due time.

Outline of Lectures:

- Lecture 1.1: **Parametric dynamics in control vs. linear regression in ML**
- Lecture 1.2: **Classics on adaptive control: Lyapunov-based design and lack of identification guarantees**
- Lecture 2.1: **The need for exploration: Nussbaum's impossibility result in adaptive control**
- Lecture 2.2: **Universal regularizers, and Nussbaum functions for adaptive control**
- Lecture 3.1: **Gradient descent with uncertain gradient information: SGD**
- Lecture 3.2: **Online learning with information at hindsight: regret minimization, and rate implications for SGD**
- Lecture 4.1: **Adaptive control and persistency of excitations via online learning**
- Lecture 4.2: **Extremum seeking for adaption, and connections to averaging theory**
- Lecture 5.1: **A premier on realization theory for LTV control systems: Weiss-Kalman-Youla weighting patterns**
- Lecture 5.2: **Realization theory for LTI control systems: minimal realization**
- Lecture 6.1: **Ho-Kalman's method for identification of LTI systems ala impulse response**
- Lecture 6.2: **Subspace identification method, and persistency of excitations**
- Lecture 7.1: **Willem's fundamental lemma, and the boom of "data-driven control"**
- Lecture 7.2: **A Probabilistic view of identification theory: laws of large numbers**
- Lecture 8.1: **A Probabilistic view of identification theory: the role of ergodic theorems, and fading memory**
- Lecture 8.2: **Almost sure convergence results for parametric identification**
- Lecture 9.1: **Non-asymptotic identification of linear systems ala McDiarmid inequality**
- Lecture 9.2: **Recurrent neural networks for identification of dynamical systems: universality results**
- Lecture 10.1: **Recurrent neural networks for identification of dynamical systems: empirical loss minimization using k-jets**