Syllabus for CDS 212 - Fall 2007*

Instructor: Danielle C. Tarraf

• **TOPIC 1 (Review): Linear algebra** *(1 lecture)*
  - Brief review of linear algebra: Vector spaces, subspaces, bases; normed vector spaces.
  - Representation of linear maps; matrix rank, range, null space.
  - Spectral decomposition; singular value decomposition.
  - Vector and matrix norms.

• **TOPIC 2 (Review): Introduction to systems** *(1 lecture)*
  - State space models: Concept of state, closed form solutions.
  - LTI systems: Transfer function models.
  - Signal spaces; signal and system norms.

• **TOPIC 3: System stability** *(3.5 lectures)*
  - Internal stability: Lyapunov stability, asymptotic stability and exponential stability.
  - Input/output stability.
  - Incremental stability.
  - Stability of LTI systems: Verifying LTI stability, Lyapunov equations, introduction to the KYP Lemma; equivalence of internal, input/output and incremental stability.

• **TOPIC 4: Use of optimization in system analysis** *(2.5 lectures)*
  - SOS Tools.
  - LMIs in system analysis.

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• **TOPIC 5: Complexity implies fragility** *(1 lecture)*
  – Demonstration of concept for LTI systems.

• **TOPIC 6: Feedback control** *(4 lectures)*
  – Feedback interconnections; well-posedness.
  – Parametrization of stabilizing controllers.
  – Fundamental limitations.

• **TOPIC 7: Uncertainty and Robustness** *(4 lectures)*
  – Introduction via matrix perturbation problems.
  – System approximation, description of modeling errors.
  – Small Gain Theorem; scaling.
  – Structured uncertainty.

• **TOPIC 8: Control under communication constraints** *(1 lecture)*
  – Introduction to communication, channels.
  – Fundamental limitations.