EECS 16B
Designing Information Devices and Systems II
Department of Electrical Engineering and Computer Sciences

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A little bit about myself ...

• Live in Orinda with my wife and two children.
• Grew up in India and received PhD from EECS, UC Berkeley.
• Primary research area is networks.
• Divide my time between academia and industries.
• Currently focusing on performance issues in 5G networks.
• Fond of hiking/trekking, photography, cricket, tennis, ...
• Like to understand things starting from the basics.
Important Quiz ...
System-Level Issues

• System-Level Model
• Stability
• Impact of Feedback
• Controllability & Reachability
• Minimum Energy Control
• Linearization of a Non-Linear Model
• ...
\[
\ddot{x}_d[i + 1] = A_d \ddot{x}_d[i] + B_d \ddot{u}_d[i] + \ddot{w}_d[i]
\]

(Going forward, we’ll drop the subscript \(d\) for simplicity.)
Scalar Discrete-Time System Model

\[ x[i+1] = ax[i] + bu[i] + w[i] \]

System Identification Problem: Find the model parameters \( a \) & \( b \).
Vector Discrete-Time System Model

\[ \dot{x}[i+1] = Ax[i] + Bu[i] + w[i] \]

System Identification Problem: Find the model parameters A & B.
Validation

• How good is $\hat{P}$?
  – Gold Standard: Use it in the discrete-time model with to see if specific $\tilde{u}[i]'s$ result in the desired $\tilde{x}[i]'s$.
  – Silver Standard: Test $\hat{P}$ against some test data.
Is $D^T D$ invertible?

• $\text{Null}(D^T D) = \text{Null}(D)$.
  – Hence, if $D$ has linearly independent columns, $D^T D$ will also have linearly independent columns.
  – Hence, if $D$ has linearly independent columns, $D^T D$ is invertible.

• Highly likely that $D$ has linearly independent columns.
  – Also, we have some control over $D$.

• We’ll deal with the case of non-invertible $D^T D$ when we discuss SVD (and Moore-Penrose Pseudoinverse).