Topics for Today:

- Announcements
  - Detailed term project outlines (i.e. Table of Contents + List of references)
  - Software: online students - apply for ATP/ATPDraw license, verify licensing when you receive it by e-mail, and we will mail you the install CD.
  - ASPEN software - updating to V11, remote desktop to MTU server.
  - Office: EERC 614.  Phone: 906.487.2857
  - Recommended problems & all solutions: Ch.7 solns posted.

- Chapter 7 - Network Equations, Admittance Approaches
  - Overview of off-nominal xfmrs
  - Double-circuit lines - mutual coupling
  - Network Reduction (Kron Reduction)
  - Solution of matrix equations (system of linear equations)
  - Lead-in to Short-circuit and other formulations.
  - Upcoming homework - intro to Matlab, matrices, equations.
Term Project

- Literature Search
- Write: the Background section.
  - Intro, Prob Def., Motivation
- Develop
- Develop/implement
- Journal Paper Review
Buses:
- LOADS (Const Z; Const P,Q; Const I_i; ...)
- GENS (Norton Eqniv: I_{inj} || Y_N; Const P,Q)
Goal: Only buses of interest need be observable.

Constraint: Must retain source nodes (nodes at which current is being injected).

Steps:

1) Reorder system, move buses to kept to top, i.e. 1,...,k
   Remaining L,...,Z nodes are absorbed into system.

2) Perform Kron Reduction.
\[
\begin{align*}
\begin{bmatrix} K \mid L \end{bmatrix} \begin{bmatrix} V_A \\ V_B \end{bmatrix} &= \begin{bmatrix} I_A \\ I_x \end{bmatrix} \\
\begin{bmatrix} L_T \mid M \end{bmatrix} Y_{\text{bus}} = Y
\end{align*}
\]

(1) \quad I_A = K V_A + L V_B \\
(2) \quad I_x = L_T V_A + M V_B

Since \( I_x = \begin{bmatrix} 0 \\ \vdots \end{bmatrix} \)
\(3^\circ \quad -L^TVA = MV_B \quad \text{From Egn.} \, 2 \quad \text{for} \, I_x = 0.\)

\(4^\circ \quad -M'LTVA = VB \quad \text{premultiply both sides by} \, M^{-1}.\)

Substituting \(VB\) into Egn. \(1\),

\[
I_A = KVA - LM'LTVA
\]

\[
[I_A] = [K- LM'LT][VA]
\]

The \([Y_{bus}]\) for this reduced system is thus implied to be \([K- LM'LT]\).

Derivation assumes bilateral system (note \(L, L^T\)).
Reduced \([Y_{bus}]\) is

\[
[Y_{bus\ Reduced}] = K - L M L^T
\]

**Important Observation:**
If \(L\) & \(L^T\) are off-diagonals, then this eqn. **only valid for bilateral system**.