Topics for Today:
- Questions?
- Questions/Comments on Homework #4?
- Loadflow Formulation: “NR Details” handout (Week 4)
- NR Algorithm implementation.
- LU Factorization (needed for each iteration)
- Reordering

Coming up:
- More MatLab - build Jacobian, solve for $\Delta \delta$ and $\Delta V$, iterate.
- Data structures, more on reordering to avoid zero divides and/or speed up solution.
Matlab - Compiler vs. Matlab interpreter?

- Binary .exe
  - C++
  - Fortran
    - F90, F95, F2000

Hybrid Environment:
- C++, Fortran, Pascal/Delphi,
- Java, C, etc.

Make .obj & link

Slow!
Warning...
Iterations, nested loops, etc. can be very slow!

Key: Data structure passing

Use Vector Operations!
### Flat Start:
All $V$ at PQ (LOAD) buses are set to 1.0 pu.
All $S$ at PQ buses set to 0°.

### Hot Start:
Use $\bar{V}$ values from a similar case that converged.

<table>
<thead>
<tr>
<th></th>
<th>Flat</th>
<th>Hot</th>
</tr>
</thead>
<tbody>
<tr>
<td>PQ (LOAD)</td>
<td>$V_1 = 1.0$ pu. $\delta = 0°$</td>
<td>Copy converged similar case</td>
</tr>
<tr>
<td>PV (GEN)</td>
<td>$V_1$ = Fixed $\delta = 0°$</td>
<td>$V_1$ = Fixed $\delta$: Copy similar case</td>
</tr>
</tbody>
</table>
Filling Jacobian:

For \( N \) buses:
- \( N-1 \): S's to solve for
- \( N-1-\text{NGen} \): V's to solve for

\[
\begin{bmatrix}
\frac{\partial P_i}{\partial V_i} & \frac{\partial Q_i}{\partial V_i} \\
\frac{\partial P_i}{\partial V_j} & \frac{\partial Q_i}{\partial V_j}
\end{bmatrix}
\]
\[
\begin{cases}
\text{If } BNUM > NSLACK \\
\quad \text{Row } = \text{BNUM} - 1 \\
\text{ELSE} \\
\quad \text{Row } = \text{BNUM} \\
\end{cases}
\]

Row = INT value of row in \([J]\) that \(\frac{\partial P_4}{\partial -}\) go into.

Row = NDDst

Row 14

\[
\begin{bmatrix}
2 & 3 \\
\vdots & \vdots \\
14 & 4578 \\
\vdots & \vdots \\
14 & \vdots \\
\end{bmatrix}
\]
For a given bus:

Bus 4: PQ

What row in [J] do \( \frac{\partial P_4}{\partial \theta} \) go in?

Answer: row \( \bar{J} = [\begin{array}{c} \bar{J} \\ \bar{J} \end{array}] \)

IF \( \bar{J} \) is slack

bus is 1.
Good place to start: \( \Delta S \) at vector

\[
J \Delta S \Rightarrow \begin{bmatrix} \Delta S \\ \Delta \phi \end{bmatrix} = \begin{bmatrix} A^T \\ \Delta \phi \end{bmatrix}
\]

\( \Rightarrow \Delta \phi = \Delta V \) at all PV buses

\[= \Delta \phi, \Delta V \) at slack bus. \]
Gen Buses: 2, 3, 6, 8, 4

Total Buses: 14

Swing/Slack: 1 (only one)

Size of \([AS AV]\) vector:

\[
\text{NDb} = (\text{NBus}-1)
\]

\[
\text{NDvs} = (\text{NBus}-1) - \text{NPV}
\]

\[
\text{initialize } \text{Db} \text{ vs. } \text{Du}
\]