Guussiun Elim with (row) pivoting 16 Oct 123
what if, at some stage of the elim, the <u>pivot element</u> (i.e., the diagonal element used as the denominator of the multiplier) is zero?
$A = \begin{bmatrix} 1 & 2 & 1 \\ 1 & 2 & 4 \\ 1 & 3 & 2 \end{bmatrix},  L_1 = \begin{bmatrix} 1 & 0 & 0 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$
$L_{1}A = \begin{cases} 1 & 2 & 1 \\ 0 & 0 & 3 \\ 0 & 1 & 2 \end{cases}.$
Carnot use row ô to elim â <sub>37</sub> from row ô.  Solution: Swap rows ô and ô.
$P_{2}(L_{3}A) = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 3 \end{bmatrix}.  (Now \Delta^{r})$ Permutation Materix
A similar problem occurs if $\hat{a}_{22}$ is <u>very small</u> in magnitude (which is more common).  e.g., (not same as above)
$L_{1}A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 10^{-16} & 3 \\ 0 & 1 & 2 \end{bmatrix} \qquad L_{2} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -10^{+26} & 1 \end{bmatrix}$
$L_{2}(L_{1}A) = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 10^{-16} & 3 \\ 0 & 0 & * \end{bmatrix},  * = 2 - 10^{+16} \cdot 3,$ $very \text{ large relative to the other elements in the matrix.}$
This could even be an entire submatrix that gets amplified.  Problem: This amplifies roundoff of the obscenely.
Roundoff error cour be shown to be directly proportional
to the largert element that occur during the factorization.  Solution: row (partial) pivoting
When eliminating the $k^{th}$ column, first look for row; $j > k$ , with the largest-magnitude element in column $k$ , then swap rows; and $k$ .
e.g., (continuing from previous)
$P_{2}(L_{2}A) = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ 0 & 10^{-16} & 3 \end{bmatrix} \qquad L_{2} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -10^{-16} & 1 \end{bmatrix}$
$L_{3}(P_{2}L_{1}A) = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & * \end{bmatrix}$ , where $* = 3 - 10^{-16} \cdot 2$ $\approx 3$ . $\bigcirc$
e.g., [2 6 6][*1] [10]
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
Step 1 pivot (i.e., swap rows)
exchange nows 12 & 3 (6 is largest in 1st col)  [0 0 1]
$P_{1}Ax = P_{1}b, \qquad P_{2} = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$
$\begin{bmatrix} 6 & 6 & 12 \\ 3 & 5 & 12 \\ 2 & 6 & 6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 30 \\ 25 \\ 10 \end{bmatrix}$
Now subtract ½ Rs from R2, and ½ R1 from R3.  Note that all multipliers are at most 1 in magnitude. (Good for roundoff error propagation)
L <sub>4</sub> (P <sub>3</sub> A <sub>70</sub> = l <sub>4</sub> (P <sub>3</sub> b)
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 2 & 6 \\ 6 & 4 & 2 \end{bmatrix} \approx \begin{bmatrix} 30 \\ 10 \\ 10 \end{bmatrix}$
$P_3(L_3P_3A_{\pi}) = P_3(L_3P_4b)$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 3 & 6 \end{bmatrix} \times = \begin{bmatrix} 30 \\ 10 \\ 10 \end{bmatrix},  P_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$
[0 2 6] [20]
1 (0.1 0 4 2 m / (0 1 c 0 12)
$L_{2}(P_{2}L_{3}P_{3}A_{2}) = L_{2}(P_{2}L_{3}P_{3}b)$ $\begin{bmatrix} 6 & 6 & 12 \end{bmatrix} \begin{bmatrix} 30 \end{bmatrix}$
$L_{2}(P_{2}L_{3}P_{3}A_{2}) = L_{2}(P_{2}L_{3}P_{3}b)$ $\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_2 P_2 L_1 P_2 A_{\pi} = L_2 P_2 L_2 P_3 b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_2 P_2 L_3 P_3 A = U$ $\Leftrightarrow L_3 P_3 L_4 P_3 P_3 P_4 A = U$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_2 P_2 L_1 P_2 A_{\pi} = L_2 P_2 L_2 P_3 b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_2 P_2 L_3 P_3 A = U$ $\Leftrightarrow L_3 P_3 L_4 P_3 P_3 P_4 A = U$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_{1}P_{2}L_{3}P_{3}A = L_{1}P_{2}L_{1}P_{3}b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_{2}P_{3}L_{3}P_{3}A = U$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_1 P_2 L_1 P_4 A \pi = L_1 P_2 L_2 P_3 b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_2 P_3 L_3 P_4 A = U$ $\Leftrightarrow L_3 P_2 L_3 P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_1 P_3) P_3 P_4 A = U$ $\Leftrightarrow L_3 (P_3 L_1 P_3) P_3 P_4 A = U$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_1 P_2 L_3 P_5 A \pi = L_1 P_3 L_2 P_3 b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_2 P_3 L_3 P_3 A = U$ $\Leftrightarrow L_3 P_3 L_3 P_3 A = U$ $\Leftrightarrow L_3 P_3 L_3 P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_2 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 P_3 A = U$ $\Leftrightarrow L_3 (P_3 L_3 P_3) P_3 P_3 P_3 P_3 P_3 P_3 P_3 P_3 P_3 P_3$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_{2}P_{3}L_{1}P_{3}A = L_{2}P_{2}L_{2}P_{3}b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_{2}P_{3}L_{3}P_{3}A = U$ $\Leftrightarrow L_{2}P_{3}L_{3}P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{3}L_{3}P_{3})P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{3}L_{3}P_{3})P_{3}P_{3}A = U$ $Cloim: L_{3} is a modified Gauer transform.$ e.g., $P_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ $L_{2} = \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 1 & 0 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $((P_{3}L_{3})P_{3}) = \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ R_{3}S & 0 & 1 \\ R_{3}S & 0 & 1 \end{bmatrix}$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_{1}P_{1}L_{2}P_{3}A\pi = \underbrace{L_{1}P_{2}L_{2}P_{3}b}.$ How to extract a factorization when row pivoting is used to control roundoff error propagation?  From the above example, $L_{2}P_{1}L_{3}P_{3}A = U$ $\Leftrightarrow L_{3}P_{2}L_{3}P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{2}L_{3}P_{3})P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{2}L_{3}P_{3})P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{3}L_{3}P_{3})P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{3}L_{3}P_{3})P_{3}P_{3}A = U$ $([P_{3}L_{3}P_{3}]P_{3}P_{3}A = U$ $([P_{3}L_{3}P_{3}]P_{3}P_{3}A = U$ $([P_{3}L_{3}P_{3}]P_{3}P_{3}P_{3}A = U$ $([P_{3}L_{3}P_{3}]P_{3}P_{3}P_{3}A = U$ $([P_{3}L_{3}P_{3}]P_{3}P_{3}P_{3}A = U$ $([P_{3}L_{3}P_{3}]P_{3}P_{3}P_{3}A = U$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \propto = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_{1}P_{1}L_{2}P_{2}A\pi = L_{1}P_{3}L_{2}P_{3}b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation? From the above example, $L_{2}P_{3}L_{3}P_{3}A = U$ $\Leftrightarrow L_{3}P_{3}L_{3}P_{3}A = U$ $\Leftrightarrow L_{3}P_{3}L_{3}P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}P_{3}L_{3}P_{3}P_{3}A = U$ $\Leftrightarrow L_{3}(P_{3}L_{3}P_{3})P_{3}P_{3}A = U$ $Claim: L_{3} \text{ is a modified Gause transform.}$ $e.g.,$ $P_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ $L_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 233 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ $((P_{3}L_{3})P_{3}) = \begin{bmatrix} 1 & 0 & 0 \\ 233 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{31} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{31} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 0 & 1 \end{bmatrix}$ $E_{1} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{1} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{2} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{1} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{2} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{4} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{1} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{2} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{3} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{4} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 1 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 1 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 0 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 0 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 0 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 0 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 0 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 231 & 0 & 0 \\ 231 & 0 & 0 \end{bmatrix}$ $E_{5} = \begin{bmatrix} 1 & 0 & 0 \\ 2$
$\begin{bmatrix} 6 & 6 & 12 \\ 0 & 4 & 2 \\ 0 & 0 & 5 \end{bmatrix} \chi = \begin{bmatrix} 30 \\ 10 \\ 5 \end{bmatrix}$ $L_1 P_1 L_2 P_2 A \pi = L_1 P_3 L_2 P_3 b.$ How to extract a factorization when row pivoting is used to control roundoff error propagation? From the above example, $L_2 P_3 L_3 P_2 A = U$ $\Leftrightarrow L_3 P_3 L_3 P_3 P_3 A = U$ $\Leftrightarrow L_3 P_3 L_4 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_4 P_3 L_4 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_5 P_3 L_4 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_5 P_4 L_4 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_5 P_4 L_4 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_5 P_4 L_5 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_5 P_4 L_5 P_3 P_3 P_3 A = U$ $\Leftrightarrow L_5 P_4 L_5 P_3 P_3 P_3 P_3 P_3 P_3 P_4 P_5 P_5 P_5 P_5 P_5 P_5 P_5 P_5 P_5 P_5$
Claim: L_s is a modified Gave transform.    Claim: L_s is a modified Gave transform.
Continuing   Continuing
\[ \begin{align*} & \be
[6 6 12] [0 7 2] [0 7 2] [1 2]  L1 P1 L2 PLAR = L2 P1 L2 P2 b.  How to extract a factorization when row proting is used to control roundoff error propagation?  From the above example,  L2 P2 L2 P2 A = U  L2 P2 L3 P3 P3 P4 P4 = U  Claim: Si is a modified Gover transform.  e.g.,  P3 = [0 0 1] [2 0 0] [2
\[ \begin{align*} & \be
[6 6 12] [0 9 2] [0 9 2] [0 9 5]  L1P3LsPAR = L1P3LsP3b.  How to extract a factorization when now pivoting is used to control roundoff area propagation?  From the above example,  L2P3LsP4R = U  L2P4LsP4R = U  L2P4LsP
[6 6 12] [0 7 7 2] [0 7 7 2] [1 5]  LiphisPiAn = LiphisPib.  How to extract a fuctorization when now proving it used to control rounder? arror propagation? From the above example,  LiphisPiAn A = U  Ching LiphisPiAn A = U  (IPLISPIAN A = U  (IPLISPIAN A = U  (IPLISPIAN A = U  (IPLISPIAN A = U  LiphisPiAn A = U  LiphisPiAn A = U  Con prove this in general — see Az! Similar proof technique at fir Lemma 1 and Lemma 2.  (In the book)  Continuing,  LiphisPiAn A = U  Chiliphian An A = D  An A = LiphisPiAn A = U  Ching LiphisPiAn An = U  Chi
[6 6 52] [0 4 2] [0 4 2] [0 7 2] [1 2] [1 2] [1 2] [1 2] [1 3] [1 3] [1 3] [1 3] [1 3] [1 4] [1 5] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6] [1 6 0] [1 6]
[6 6 52] [0 7 9 2] [1 0 0 5]  Ly Pola Para = Ly Pola Para.  How to extrect a factorization when now pivoling is used to control roundoff arms propagation?  From the above example,  Ly Pola Para = U  Ly Pola Para = U  Ly Pola Para Para = U  Claim; Li is a modified Gover transform.  Cog;  Pa = [0 0 1] [1 0 0] [2 0 0 1] [2 0 0
Continuing:
Continuing:
Solution
Continuing:
Liphis pink = Liphis pink.  Liphis pink = Liphis pink.  Liphis pink = Liphis pink.  How to extract a fractivation what now piveling is used to combol rewarder? error papagation?  From the above enoughs,  Liphis pink pink = U  Liphis pink pink pink = U  Liphis pink pink = U  Liphis pink pink pink pink pink pink pink pink
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Combining   Combined the state of the elanguage of the state of the
Light Spirit   Light Spirit