file: c:\math\mcad80\mcd_rwn\singval.mcd RWN 10/24/01
example of singular value decomposition A=UDV_transpose, U and V orthogonal, D diagonal>=0

$$A := \begin{bmatrix} 1 & 2 & -1 & -2 \\ -1 & -2 & 1 & 2 \\ 3 & 4 & -3 & -4 \\ -3 & -4 & 3 & 4 \end{bmatrix}$$

Call to get singular value decomposition

$Msvd := svd(A)$ $svalues := svds(A)$ $svalues = \begin{bmatrix} 10.93 \\ 0.732 \\ 0 \\ 0 \end{bmatrix}$

$$Msvd = \begin{bmatrix} -0.286 & -0.647 & 0.707 & 0 \\ 0.286 & 0.647 & 0.707 & 0 \\ -0.647 & 0.286 & 0 & 0.707 \\ 0.647 & -0.286 & 0 & 0.707 \\ -0.407 & 0.578 & -0.707 & 0 \\ -0.578 & -0.407 & 0 & -0.707 \\ 0.407 & -0.578 & -0.707 & 0 \\ 0.578 & 0.407 & 0 & -0.707 \end{bmatrix}$$

first rows of M=U, last =V

submatrix call: submatrix(A,r1,r2,c1,c2) returns for A
where r1=start row, r2=endrow, c1=start column, c2=end column

$U := submatrix(Msvd, 0, 3, 0, 3)$ $U = \begin{bmatrix} -0.286 & -0.647 & 0.707 & 0 \\ 0.286 & 0.647 & 0.707 & 0 \\ -0.647 & 0.286 & 0 & 0.707 \\ 0.647 & -0.286 & 0 & 0.707 \end{bmatrix}$

$V := submatrix(Msvd, 4, 7, 0, 3)$ $V = \begin{bmatrix} -0.407 & 0.578 & -0.707 & 0 \\ -0.578 & -0.407 & 0 & -0.707 \\ 0.407 & -0.578 & -0.707 & 0 \\ 0.578 & 0.407 & 0 & -0.707 \end{bmatrix}$

transpose is ctrl-1

$$U \cdot U^T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad V \cdot V^T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad diag(svalues) = \begin{bmatrix} 10.93 & 0 & 0 & 0 \\ 0 & 0.732 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

As a check:

$$U \cdot diag(svalues) \cdot V^T = \begin{bmatrix} 1 & 2 & -1 & -2 \\ -1 & -2 & 1 & 2 \\ 3 & 4 & -3 & -4 \\ -3 & -4 & 3 & 4 \end{bmatrix}$$