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SUBROUTINE INVR(A,N,NI)
CCC THIS SUBROUTINE CALLS DECOMP ONCE AND SOLVE SEVERAL TIMES
CCC TO CONSTRUCT THE INVERSE. IT SOLVES AX=I WHERE EACH MATRIX
CCC IS N BY N.
CCC INPUT
CCC A(N,N) - AN N BY N ARRAY, STORED IN MATRIX WITH DIMENSIONS
CCC NI BY NI
CCC N - THE SIZE OF THE MATRIX TO BE INVERTED, <=20
CCC NI - THE SIZE OF THE DIMENSION OF A
CCC OUTPUT
CCC A(N,N) - ON OUTPUT THIS IS THE INVERSE OF THE ORIGINAL A
CCC THE ORIGINAL A IS DESTROYED
DIMENSION A(NI,NI), B(20), C(400)
CCC PACK A DENSELY INTO C
DO 5 J=1,N
    IND = N*(J-1)
    DO 5 I=1,N
        C(IND+I) = A(I,J)
5 CONTINUE
CCC PERFORM AN LU DECOMPOSITION ON C
CALL INVERT (N,1,C,B,1)
CCC SOLVE AX=I
DO 20 J=1,N
    DO 10 I=1,N
10 B(I) = 0.
    B(J) = 1.
    CALL INVSU (N,1,C,B,1)
CCC PUT B INTO INVERSE A
DO 15 I=1,N
    A(I,J) = B(I)
15 CONTINUE
20 CONTINUE
RETURN
END
SUBROUTINE DECOMP(N,A)
DIMENSION A(N,N)
COMMON /DENSE/ IPS(201),SC(201)
CCC PAGE 68, FORSYTH AND MOLER
CCC INITIALIZE IPS, A AND SCALES
IF (N.EQ.1) RETURN
DO 25 I=1,N
    IPS(I) = I
    ROWNRM = 0.0
    DO 10 J=1,N
        IF (ROWNRM-ABS(A(I,J))) 5,10,10
5 ROWNRM = ABS(A(I,J))
10 CONTINUE
IF (ROWNRM) 15,20,15
15 SC(I) = 1./ROWNRM
GO TO 25
C
20 CALL SING (1)
SC(I) = 0.
25 CONTINUE
CCC GAUSSIAN ELIMINATION WITH PARTIAL PIVOTING
NM1 = N-1
DO 65 K=1,NM1
    BIG = 0.

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        DO 35 I=K,N
            IP = IPS(I)
            SIZE = ABS(A(IP,K)*SC(IP))
            IF (SIZE-BIG) 35,35,30
30         BIG = SIZE
            IDXPIV = I
35        CONTINUE
            IF (BIG) 45,40,45

40        CALL SING (2)
            GO TO 65
C
45        IF (IDXPIV-K) 50,55,50
50        J = IPS(K)
            IPS(K) = IPS(IDXPIV)
            IPS(IDXPIV) = J
55        KP = IPS(K)
            PIVOT = A(KP,K)
            KP1 = K+1
            DO 60 I=KP1,N
                IP = IPS(I)
                EM = -A(IP,K)/PIVOT
                A(IP,K) = -EM
                DO 60 J=KP1,N
                    A(IP,J) = A(IP,J)+EM*A(KP,J)
CCC INNER LOOP
60        CONTINUE
65        CONTINUE
            KP = IPS(N)
            IF (A(KP,N)) 75,70,75
70        CALL SING (2)
75        CONTINUE
            RETURN
            END
            SUBROUTINE SOLVE(N,A,B)
            DIMENSION A(N,N), B(N)
            COMMON /DENSE/ IPS(201),SC(201)
CCC PAGE 69, FORSYTH AND MOLER
CCC FORWARD SWEEP DENSE MATRIX
            IF (N.GT.1) GO TO 5
            B(1) = B(1)/A(1,1)
            RETURN
5         CONTINUE
            NP1 = N+1
            IP = IPS(1)
            SC(1) = B(IP)
            DO 15 I=2,N
                IP = IPS(I)
                IM1 = I-1
                SUM = 0.
                DO 10 J=1,IM1
                    SUM = SUM+A(IP,J)*SC(J)
10         CONTINUE
                SC(I) = B(IP)-SUM
15        CONTINUE
CCC BACK SUBSTITUTION
            IP = IPS(N)
            SC(N) = SC(N)/A(IP,N)

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DO 25 IBACK=2,N
  I = NP1-IBACK
  IP = IPS(I)
  IP1 = I+1
  SUM = 0.
  DO 20 J=IP1,N
    SUM = SUM+A(IP,J)*SC(J)
20  CONTINUE
    SC(I) = (SC(I)-SUM)/A(IP,I)
25 CONTINUE
  DO 30 I=1,N
30 B(I) = SC(I)
  RETURN
  END
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