Subroutine Crout for Solution of Simultaneous Linear Equations

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1620 USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter or pencil, do not use ink)

Program No. _____ Date _____

Program Name: _____

1. Does the abstract adequately describe what the program is and what it does? Yes___ No___
   Comment _____

2. Does the program do what the abstract says? Yes___ No___
   Comment _____

3. Is the Description clear, understandable, and adequate? Yes___ No___
   Comment _____

4. Are the Operating Instructions understandable and in sufficient detail? Yes___ No___
   Comment _____
   Are the Sense Switch options adequately described (if applicable)? Yes___ No___
   Are the mnemonic labels identified or sufficiently understandable? Yes___ No___
   Comment _____

5. Does the source program compile satisfactorily (if applicable)? Yes___ No___
   Comment _____

6. Does the object program run satisfactorily? Yes___ No___
   Comment _____

7. Number of test cases run_____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes___ No___
   Comment _____

8. Does the Program Meet the minimal standards of the 1620 Users Group? Yes___ No___
   Comment _____

9. Were all necessary parts of the program received? Yes___ No___
   Comment _____

10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

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Your Name _____

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11/09/64

Subroutine Crout

for the solution of simultaneous linear equations

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User: 3155
Date: 12-22-64
Program:

COMPUTER TECHNOLOGY

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Program Abstract

Title: Subroutine Crout for solution of simultaneous linear equations

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Description/Purpose

This subroutine will solve a system of simultaneous linear equations using the Crout method. The number of equations is limited only by the size of the main program and the core available.

Specifications

1. IBM 1620 able to use FORTRAN II

Programming type FORTRAN II subroutine

Language used in writeup English

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Deck Labelling Sheet

Deck No.	Name	Card numbers
1	Subroutine Crout	1--60

Subroutine Crout for solution of simultaneous linear equations

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Program Developed On:

1. IBM 1620 MODEL II - 60 K
2. Indirect addressing
3. 1 disk drive
4. TNS, TNF, and MF special instructions
5. Floating point hardware

Machine Configuration Required:

1. IBM 1620 capable of using FORTRAN II

System used:

FORTRAN II

Program Description

Given the set of equations [A] [X] = [B] the subroutine will solve them using a modified Crout* method. In reducing the coefficient determinate the subroutine searches out the largest coefficient on or below the major diagonal in the column being reduced. It then interchanges the rows, placing this coefficient on the diagonal before continuing. This reduces the round-off error in the calculation. The main program must read in or calculate the coefficients of the equations.

When writing the main program the size of the dimensioned arrays of the coefficient matrix (A in the subroutine), the constant terms (B), and the solution (X) must agree between the main program and the subroutine. The three items above must also be put in common in that order.

To call the subroutine a statement

CALL CROUT (N1, V1)

should be used where N1 is a fixed point variable or constant equal to the number of simultaneous linear equations and V1 is a floating point variable name.

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* F. B. Hildebrand, Introduction to Numerical Analysis, McGraw-Hill, New York, 1956, pp. 429-434.

When returning from the subroutine V1 should be checked. If V1 = 0. a solution has been reached. If V1 = 1. , the subroutine has found that the set of equations is probably dependent and a solution has not been reached. This indicates that the largest term in any column on or below the major diagonal is less than $1.X10^{-30}$. Unless the coefficients of the matrix are very small this condition would indicate that the equations are dependent. Therefore, if the coefficients of the matrix are very small to begin with, the constant in statement 0021+01 lines should be made smaller.

The operating instructions are the same as for any FORTRAN II subroutine. There are no sense switches used.

```
      SUBROUTINE CROUT(N,V)
      DIMENSION A(9,9),B(9),X(9)
      COMMON A,B,X
      NM1=N-1
      DO 2 J=1,N
      JP1=J+1
      JM1=J-1
      DO 6 I=J,N
      ASUM=0.
      IF (JM1)6,6,7
    7 DO 9 K=1,JM1
    9 ASUM=ASUM+A(I,K)*A(K,J)
    6 A(I,J)=A(I,J)-ASUM
      AMAX=A(J,J)
      IMAX=J
      IF (JP1-N)20,20,21
   20 CONTINUE
      DO 1 I=JP1,N
      IF(ABSF(AMAX)-ABSF(A(I,J)))3,1,1
    3 AMAX=A(I,J)
      IMAX=I
    1 CONTINUE
   21 CONTINUE
      IF (ABSF(AMAX)-1.E-30)10,10,4
   10 V=1.
      RETURN
    4 DO 5 K=1,N
      ASAVE=A(IMAX,K)
      A(IMAX,K)=A(J,K)
    5 A(J,K)=ASAVE
      ASAVE=B(IMAX)
      B(IMAX)=B(J)
      B(J)=ASAVE
       I1=J
      J1=JP1
      IF (JP1-N)22,22,23
   22 CONTINUE
      DO 8 J2=JP1,N
      ASUM=0.
      IF (JM1)8,8,11
   11 DO 12 K=1,JM1
   12 ASUM=ASUM+A(I1,K)*A(K,J2)
    8 A(I1,J2)=(A(I1,J2)-ASUM)/A(I1,I1)
   23 CONTINUE
      ASUM=0.
      IF (JM1)2,2,13
   13 DO 14 K=1,JM1
   14 ASUM=ASUM+A(I1,K)*B(K)
    2 B(I1)=(B(I1)-ASUM)/A(I1,I1)
      DO 15 J=1,N
      I1=N-J+1
      I=I1+1
      ASUM=0.
      IF (I1-N)17,15,15
   17 DO 16 K=I,N
   16 ASUM=ASUM+A(I1,K)*X(K)
   15 X(I1)=B(I1)-ASUM
      V=0.
      RETURN
      END
```



```
      DIMENSION A(9,9),B(9),X(9),Z(9,9)
      COMMON A,B,X
   18  READ100,N
      IF (N)106,106,107
  106 PUNCH200
      STOP
  200 FORMAT (/2X27HTHIS IS THE END OF THE DATA)
  100 FORMAT (I2)
  107 CONTINUE
      READ 101,((A(I,J),J=1,N),I=1,N)
  101 FORMAT (5E15.0)
      READ 102,(B(I),I=1,N)
  102 FORMAT (5E15.0)
      DO 108 I=1,N
      DO 108 J=1,N
  108  Z(I,J)=A(I,J)
      CALL CROUT (N,V)
      IF (V)120,120,10
  120 CONTINUE
      DO 103 I=1,N
      PUNCH 104,I,X(I)
  104 FORMAT (12H           X(I2,5H)=   E15.5)
  103 CONTINUE
      DO 109 I=1,N
      SUM=0.
      DO 110 J=1,N
  110 SUM=SUM+Z(I,J)*X(J)
  109 PUNCH 111,I,SUM
  111 FORMAT (3X9HCONSTANT(I2,5H)=   E15.5)
      GO TO 18
   10 PUNCH 105
  105 FORMAT (/2X22HTHE MATRIX IS SINGULAR/)
      GO TO 18
      END
```

```
****************** EQUATIONS ***********************

-.48X1        -.67X2          .6X3          =0.
 .64X1         .67X2          .8X3          =4000.
 .6 X1        -.33X2          0.X3          =0.


********************* INPUT ************************

3
-.48           -.67           .6            .64           .67
.8             .6             -.33
0.             4000.


******************** RESULTS ***********************

        X( 1)=      970.30300E+00
        X( 2)=      176.41870E+01
        X( 3)=      274.62511E+01
  CONSTANT( 1)=     000.00000E-99
  CONSTANT( 2)=     399.99999E+01
  CONSTANT( 3)=     900.00000E-07
```