48 [9.20].—SOL WEINTRAUB, *Computer Program for Compact Prime List*, Microfiche supplement, this issue.

This FORTRAN program computes primes beginning at N and lists them in compact form as shown in [1].

The user enters the number N, where N ranges from zero to a limit set by the user's computer. For 32-bit machines the maximum N is $\sim 2^{30}$, or approximately 1.1 billion. N should be a multiple of 50000.

The program calculates primes for 20 intervals of 50000, i.e., an interval of 10^6, and lists the primes in compact form at the rate of an interval of 50000 per page.

The primes are generated by a modified sieve. The number N is divided by odd numbers j and the remainders r_j are noted. The *composite* numbers are then the numbers of the form $N - r_j + k_j$, where $k = 1, 2, 3, \ldots$. The entire run takes a few seconds of computer time.

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1. S. WEINTRAUB, "A compact prime listing," *Math. Comp.*, v. 28, 1974, pp. 855–857.

49 [4.00].—RALPH A. WILLOUGHBY, Editor, *Stiff Differential Systems*, Plenum Press, New York, 1974, x + 323 pp., 25 cm. Price $25.00.

This proceedings of an International Symposium on Stiff Differential Systems held in October, 1973, consists of nineteen papers on theoretical and practical aspects of stiff methods and their applications. In addition to a unified bibliography with dates from 1885 to 1973, there is an extremely valuable subject index which refers not only to the symposium papers but also to the bibliography.

Stability is the principal subject of four of the papers. Tests for A-stability and for stiff stability of composite multistep methods are given by Bickart and Rubin. Van Veldhuisen uses new concepts of consistency and stability to analyse global errors when the step size is large. Gear, Tu and Watanabe give sufficient conditions for changing both order and step size without affecting the stability of Adams methods. Also, Brayton shows that an A-stable multistep formula together with "passive" interpolation yields stable difference equations for certain difference-differential systems.

Five papers deal with new methods. Enright presents his stiffly stable second derivative methods and two modifications directed at large systems. Liniger and Gagnebin give an explicit construction for a $(2k - 2)$-parameter family of second order A-stable methods. The implicit midpoint method with smoothing and extrapolation is the basis for Lindberg's stiff system solver, and Dahlquist's paper provides the theoretical foundation for this approach. Two unconventional classes of methods are introduced by Lambert: a linear multistep method with variable matrix coefficients and an explicit nonlinear method based on local rational extrapolation.

Other program packages besides those of Enright and Lindberg are described. The special package by Edsberg for simulating chemical reaction kinetics automatically constructs an o.d.e. system from given reaction equations, generates subroutines for both the derivative and the Jacobian and uses Lindberg's solver. Gourlay and Watson indicate some of the practical difficulties they encountered while adding a version of Gear's stiff solver to the IBM "Continuous System Modeling Program", and Hull discusses validation and comparison of stiff program packages.

Stiff systems obtained by semidiscretization of parabolic partial differential equations are treated in two papers. Chang, Hindmarsh and Madsen study the simulation of

COMPUTER PROGRAM FOR COMPACT PRIME LIST

by

SOL WEINTRAUB

```
C                          CALLING ROUTINE
C
      INTEGER CSUM
      DIMENSION L(26000),LP(5600)
      DIMENSION MS(47)
C
C     THE DATA IN THE ARRAY MS ARE THE CUML. COUNTS
C     OF PRIMES IN STEPS OF 1 MILLION TO 46 MILN.
C
      DATA MS/0,78498,148933,216816,283146,348513,412849,47
     1  539777,602489,664579,726517,788060,849252,910077,97
     1   1031130,1091314,1151367,1211050,1270607.1329943,13
     1  1448221,1507122,1565927,1624527,1683065,1741430,179
     1  1915979,1973815,2031667,2089379,2146775,
     1  2204262, 2261623,2318966,2376402,2433654,2490756,25
     1  2604535,2661384,2718160,2775053/
      PRINT 98
      MLN =1000000
C
C     NEXT LINE SETS INITIAL N (STARTING VALUE)
*->   N=0
      M =50000
C
C     NEXT 3 LINES INITIALIZE CORRECT CUMULATIVE
C     SUM IF N IS AN EVEN MILLION N.LE.46 MILLION
      JS = N/MLN    +1
      IF ( JS .GT. 46) CSUM = 0
      IF(JS.LE.46) CSUM = MS(JS)
C
      DO 40 JN = 1,20
      CALL SIEVE (L,LP,N,M,K)
C          IF A LIST OF THE PRIMES IS DESIRED (BESIDES
C          THE COMPACT LIST) TAKE C OUT OF NEXT LINE
C     PRINT 96,     (LP(K3), K3= 1,K)
      K1 =K + 1
      DO 45  J = K1,5600
 45   LP(J) =LP(J-1) + 220
      CALL Q(LP,N,M,CSUM)
 40   N = N + 50000
C
 96   FORMAT (1X,12I11)
 98   FORMAT (1H1)
      CALL EXIT
      END
```

```
C                         SIEVE SUBROUTINE
C
      SUBROUTINE SIEVE (L,LP,N,M,K)
C
C          THIS SUBROUTINE USES A MODIFIED ERATOSTHENES
C          SIEVE TO FIND THE PRIMES FROM N TO N+M.
C          L IS WORKING STORAGE AND SHOULD SLIGHTLY
C          EXCEED M/2.   THE OUTPUT VARIABLE K IS THE
C          NUMBER OF PRIMES IN THE INTERVAL. THE PRIMES
C           ARE STORED IN THE ARRAY LP.
C
      INTEGER Q,R,RR,S
      DIMENSION L(1),LP(1)
      LM=(M+1)/2
      IF (N.EQ.O) GO TO 500
       X=N+M
      NF = SQRT(X)
C
      DO 5    I = 1, LM
 5    L(I) = I + I - 1          +N
C
C                              3 ONLY
      Q = N/3
      R = N - 3*Q
      Q = R/2
      RR = R- 2*Q
      K = (4-R+3*RR)/2
 6    IF  (K .GT.  LM) GO TO 10
      L(K) = 0
      K = K + 3.
      GO TO 6
 10    J = 5
C
C                                      5 AND UP
      S = 1
 11   Q = N/J
      R = N-J*Q
      Q = R/2
      RR = R-2*Q
      K = (J + 1-R + J*RR)/2
 16   IF ( K   .GT.  LM) GO TO 18
      L(K) = 0
      K = K + J
      GO TO 16
 18   J = J + 3 -S
      S = -S
      IF(   J .LE. NF)     GO TO 11
C
      K = 0
      DO 22 I = 1, LM
      IF(L(I) .EQ. 0) GO TO 22
      K = K + 1
      LP(K) = L(I)
 22   CONTINUE
```

```
C
      K = 0
      DO 22 I = 1, LM
      IF(L(I) .EQ. 0) GO TO 22
      K = K + 1
      LP(K) = L(I)
 22   CONTINUE
C
C
      RETURN
 500  CONTINUE

      X=M
      NF = SQRT(X )
C
      I = 1
 100   L(I) = I + I - 1
      I = I +1
      IF ( I .LE. LM) GO TO 100
C
      J = 1
 150   J = J + 2
      IF(J .GT. NF)  GO TO 350
      K = (J*J + 1 )/2
 200   IF (K  .GT. LM) GO TO 150
      L(K) = 0
      K = K + J
      GO TO 200
C
 350   K = 1
      LP(1) = 2
      I = 2
 410    CONTINUE
      IF(L(I) .EQ. 0) GO TO 400
      K = K + 1
      LP(K) = L(I)
 400   I = I + 1
      IF ( I .LE. LM) GO TO 410
      RETURN
      END
```

```
C                              SUBROUTINE FOR COMPACT LISTING
C
      SUBROUTINE Q(L,L1,LU, CSUM)
C
C              THIS SUBROUTINE TAKES AN ARRAY L OF PRIMES
C              AND LISTS THEM IN COMPACT FORM. THE LOWER
C              LIMIT,L1,IS THE NEAREST THOUSAND BELOW THE
C              FIRST PRIME. LU IS THE LENGTH OF THE INTERVAL
C              I.E. THE LISTING IS FROM L1 TO L1 + LU.
C              CSUM IS AN INPUT VARIABLE AND EQUALS THE
C              NUMBER OF PRIMES LESS THAN L1.
C
      DIMENSION L(1), N(100),NH(100),M(16),N4(9),MN(16)  ,SUMC(10),MZ(27)
      INTEGER P,SUMC,PSUM,CSUM,H
      DIMENSION LKC(26),H(100)
      DATA MN/0000,1000,0300,0070,0009,1300, 1070,1009,0370,0309,0079,
     1  1370,1309,1079,0379,1379/
      DATA LP/'P'/
      DATA LQ/'Q'/
      DATA NSP/' '/
      DATA
     1    MZ/ 0,1,1,1,1,2,2,2,2,2,2,3,3,3,3,4/
       DATA M/'O','A','B','C','D','E','F','G',
     1    'H','I','J','K','L','M','N','P'/
      DATA LKC/'0','1','2','3','4','5','6','7','8'
     1 ,'9','A','B','C','D','E','F','G','H','I',
     1  'J','K','L','M','N','O','P'/
C
      IX=0
      DO 873 JCC=1,100
      NH(JCC)=0
      H(JCC)=0
 873  CONTINUE
C
      K23 = 1
      IF(L(1) .NE. 2) GO TO 200
      L(1) = 1
      L(3) = 7
      L(4) = 9
      K23 = 2
 200  CONTINUE
      KM10=0
C
      DO 111 I = 1,9
 111  N4(I) = 0
C
      DO 3 I = 1,10
      JH=10*(I-1)
      DO 3 J =1,10
 3    NH(JH+J)=LKC(J)
C
C
      DO 2  I = 1,100
 2    N(I) =NSP
C
```

```
C
C
      DO 2  I = 1,100
 2    N(I) =NSP
C
      NPL = 100
      J = 0
      L2=L1+LU
      L3 = L1 + 10
      L3M = L3 - 10
      NK = 1
      LINE  = 1
 10   PRINT 90, (LC,LC= 100,900,100)
      PSUM = 0
      IF(IX .NE. 0) GO TO 11
      PRINT 910,NH
      GO TO 20
 11   PRINT 91   ,IX,NH
 20   J = J + 1
 21   P = L(J)
      IF( P .GT. L3) GO TO 30
      I = P - L3+ 10
      PSUM = PSUM + 1
      N4(I) = I
      GO TO 20
C
 30   L3 = L3 + 10
      LW = 1000*N4(1) + 100*N4(3) + 10*N4(7) + N4(9)
      DO 1  I= 1,9
 1    N4(I) = 0
      DO 35  KW = 1,16
      IF ( MN(KW) .EQ. LW) GO TO 40
 35   CONTINUE
 40   N(NK) = M(KW)
      H(NK) = MZ(KW)
      NK = NK + 1
      IF( NK .LE. NPL) GO TO 21
      L3M = L3- 10*NPL      -10
      NK = 1
C
      NTH = 0
      KC = 0
      DO 60  IL = 1, 100,10
      KC = KC + 1
      JT = IL + 9
      SUMC(KC) = 0
      DO 50  JL = IL, JT
 50   SUMC(KC) = SUMC(KC) + H(JL)
      NTH = NTH + SUMC(KC)
      NKC=SUMC(KC)
      SUMC(KC)=LKC(NKC +1)
 60   CONTINUE
C
      N1 = N(1)
      IF( N1 .EQ. LP .AND. N(2) .EQ. LP) N(1) = LO
      L3P = L3M/1000
```

```
C
      N1 = N(1)
      IF( N1 .EQ. LP .AND. N(2) .EQ. LP) N(1) = LO
      L3P = L3M/1000
      IF(L3P.GE.1000000) L3P=L3P-1000000
      PRINT 92, L3P,N,SUMC ,NTH
      N(1) = N1
      KM10 = KM10 + 1
      IF(KM10 .LE. 9) GO TO 65
      KM10 = 0
      PRINT 92
 65   CONTINUE
C
C
      IF(L3 .GE. L2) GO TO 100
      LINE = LINE + 1
      IF(LINE .LE. 50) GO TO 21
      J = J - 1
      LINE = 1
      CSUM = CSUM + PSUM
      IF (K23.EQ.1) PRINT 93,PSUM,CSUM
      IF (K23.EQ.2) PRINT 930,PSUM,CSUM
      PRINT 94
      GO TO 10
 100   CONTINUE
      CSUM = CSUM + PSUM
      PRINT 92
      PRINT 93, PSUM,CSUM
      PRINT 94
C
      IF( K23 .EQ. 1) RETURN
      L(1) = 2
      L(3) = 5
      L(4) =7
      RETURN
C
 90   FORMAT ( 1H1,14X,9I11,7X,'COUNTS BY')
 91   FORMAT(1X,'(10**',I2,')',
     1              1X, 10(1X,10A1),2X,'HUNDREDS    M'/)
 910  FORMAT(5X,    2X, 10(1X,10A1),2X,'HUNDREDS    M'/)
 92   FORMAT(    I7, 10(1X,10A1),1X, 10A1,I4)
 93   FORMAT(  8X, '0=0 A=1 B=3 C=7 D=9 E=13 F=17 G=19 H=37 I=39 J=79
     1K=137 L=139 M=179 N=379 P=1379',16X,'COUNT',I6,3X,'CUML.',I7)
 930  FORMAT(  8X, '0=0 A=1 B=3 C=7 D=9 E=13 F=17 G=19 H=37 I=39 J=79

     1K=137 L=139 M=179 N=379 P=1379 Q=2357'
     1                                            ,9X,'COUNT',I6,3X,'CUML.',I7)
 94   FORMAT( 21X, 'KEY FOR HUNDREDS... A=10 B=11 C=12 D=13 E=14 F=15 G=
     116 H=17 I=18 J=19 K=20 L=21 P=25')
      END
```