NBS TECHNICAL NOTE 738

Subroutine for the Calculation of CODEN Check Characters

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Calculation of CODEN Check Characters

David Garvin

A FORTRAN subroutine is described that computes the check character for an ASTM CODEN for Journal Titles. This routine, written for input in Hollerith characters, is adaptable to other coding schemes. A listing of the routine is provided.

Keywords: Check character; CODEN; computer program; journal abbreviations.

1. Introduction

CODEN for journal titles are abbreviations, such as JCPSA, that provide a completely defined, short, frequently mnemonic identifier for a serial publication. This system is maintained by the American Society for Testing and Materials and is used both by information systems and some scientific journals.

When other identifiers are added to the CODEN a compact specific reference to an article can be obtained. E.g.

Schofield IJCKBO-1972-4-255

identifies an article by K. Schofield, Int. J. Chem. Kinetics, (1972) vol. 4 pg. 255. In a similar manner the designation

IJCKBO 4(3) 255-336 (1972)

is used as a "bibliographic strip" to identify the page contents of issue no. 3 of volume 4. This is useful in accession procedures in libraries.

The sixth character, "O" above, is a "check character" formed from the first five by a unique algorithm. It is used to spot transcription errors when the CODEN is keyboarded.

In this note a FORTRAN subroutine is provided that calculates and verifies check characters for CODEN. The technical description starts in section 2 and the program listing is in section 4. The application of the routine is discussed below. The algorithm given in the ASTM CODEN publication and used here is stated at the end of this section.

Application There are three types of potential uses for this subroutine.

(1) It may be used to generate check characters for CODEN for use in an information system. At present these characters are not given in the ASTM publication.

(2) It may be used to check the validity of CODEN keyboarded in constructing an information system. This is the most likely use in a small system.

(3) It may serve as a benchmark routine against which the performance of more efficient routines can be tested. This is the most likely use in a large system.

The ASTM algorithm for check characters [1] is quoted below:

"CHECK CHARACTERS

"The following information is included about check characters for those users of the CODEN system who may wish to use the character. Its purpose is to provide a letter or digit which, when properly calculated, will eliminate errors in CODEN notation in the keyboarding stage.

"The initial suggestion for the use of a machine-generated check-letter for controlling errors in CODEN came from A. D. Pratt at the School of Library Science, University of Indiana, Bloomington. F. E. Hajjar is responsible for reducing the idea to practice for Chemical Abstracts Service. The check-character becomes a sixth letter or digit whose value depends upon value and order of the five elements of the CODEN. Any error in a single letter or an inversion of letters, plus most other types of errors, will produce a check character that is inconsistent with the correct one and expose the error. Following is a brief description of the system as used at Chemical Abstracts Service.

"1. CODEN may be entered as a 5- or 6-character field.

(a) If the CODEN is entered as a 5-character field, then a check-character is generated and added as a sixth character.

(b) If the CODEN is entered as a 6-character field, then a check-character is generated from the first five and matched with the sixth. If the check-characters match, the CODEN is verified as being valid. If the check-characters do not match, then the generated character replaces the original check-character and a switch is turned on to be interrogated by the operating program.

"2. The check-character is generated as follows:

(a) Each alpha-numeric character of the CODEN is replaced with an equivalent value. The equivalents are:

CODEN:	A, B,..... Y, Z, 1, 2,..... 9,0
Equivalent:	1, 2,..... 25, 26, 27, 28,..... 35, 36

(b) The equation used to generate the check-character is:

$$\frac{(11xN_1) + (7xN_2) + (5xN_3) + (3xN_4) + (1xN_5)}{34} = X + \frac{\text{remainder}}{34}$$

Where N_1, N_2, etc. are the equivalents of the CODEN characters in order of their appearance in the CODEN and X is a whole number that is discarded.

(c) The remainder is converted to a check-character by the following set of equivalents:

remainder:	1, 2,....25, 26, 27, 28, 29,....33, 34 [34 = 0]
Check-character:	A, B,.... Y, Z, 2, 3, 4,.... 8, 9 [or zero, [sic])

The numeric check-characters one (1) and zero (0) have been eliminated to avoid confusion with the alphabetic characters I and O.

(d) Sample calculation of a check character for the CODEN JACS-A:

$$N_1 = J = 10$$
$$N_2 = A = 1$$
$$N_3 = C = 3$$
$$N_4 = S = 19$$
$$N_5 = A = 1$$

Substituting these equivalents for the characters in the CODEN into the equation yields an "X" of 5 and a remainder of 20. The check-character equivalent of 20 is T. Thus the complete CODEN with check-character is JACS-AT."

* * *

The rule as applied in this program calculates X then uses the formula

$$(X-1) \text{ Mod } 34 + 1 = C$$

where C is the check character. This rule is implied in paragraph 2 c in the quotation, where a remainder of zero must be assigned to the check character nine (9).

2. GENERAL DESCRIPTION OF PROGRAM

Name: Subroutine CODCHK (LINE, MINE, IS, IL, IERR)
Language: Fortran IV with "implied do loop" DATA statements
Purpose: Calculation of (or verification of) the check character of a CODEN for Periodical Titles. Uses the algorithm stated in ASTM DS 23B, vol. 1 pg. ix.. [1].
Formal Arguments: LINE: Integer array
MINE: Integer array, 6 words minimum
IS, IL, IERR: Integers

Input Required: The CODEN is to be processed is suppled to the routine in the array LINE, one character per word. It is located in the zone LINE (IS) to LINE (IL) where IS and IL are the left and right limits, IS≤IL. It is the only item in this zone. In this version the characters are assumed to be Hollerith, in A1 (left adjusted) format.

The first six non-blank characters are processed. Embedded blanks and minus signs are ignored. The sixth character may be missing. Examples of acceptable CODEN are

JACSA, JACS-A, JACS A, JACSAT,
J A C S A T

Signals returned: Input errors are signalled by a non-zero value of IERR returned by the routine

IERR = 0	Successful calculation
= 1	Check character provided at input did not match the calculated one
= 2	There were more than six characters in the input (first six used)
= 4	There were fewer than five legal characters in the input (no calculation made)
= 8	Illegal character in the input (ignored)

These signals are additive.

Text returned: The routine returns a six character CODEN in MINE, one character per word, A1 format. The sixth character is the check character (except when IERR=4, in which case MINE (6) is left blank).

3. REMARKS:

Subroutine operation: The input characters are converted to integers using a table search of a dictionary, INDICT. The word INDICT (K) contains the character that corresponds to the integer K in the algorithm. A similar dictionary, JØDICT, is used to convert the integer value of the check character to the character itself. Both dictionaries in this version contain left adjusted Hollerith characters. Other character codes may be substituted. The two constants used in the program, blank and minus, are defined in data.

This table search procedure is much slower than a table look-up based on right adjusted integers. Any production program should use the latter technique. The search procedure is used here because ANSI FORTRAN does not provide for shifting Hollerith characters, this being the language feature needed if the procedure is to be changed.

Relation to other routines: This subroutine must be called into action by another program. The essential function of the calling program is to isolate the CODEN, that is, to set pointers (IS and IL) showing where in the array LINE the CODEN (and only it) is located. The calling program must also dispose of the result returned: print error messages, replace the old with the new, etc. The nature of this calling routine cannot be specified here since it must be constructed to match the file of material that is to be examined. (However, a sample is included in the program listing).

4. PROGRAM LISTING:

Listings of two routines are attached. These are Subroutine CODCHK, which does the work, and Main program CODEN, which is an example showing how CODCHK can be used with simple card input. An example of the output follows the listings.

[1] Blumenthal, J. G., Karaman, M. and Peters, A. "CODEN for Periodical Titles" ASTM Data Series DS 23B (American Society for Testing and Materials, Philadelphia, 1970), Volume 1 pgs ix-x.

```
      SUBROUTINE CODCHK(LINE,MINE,IS,IL,IERR)                          CDK   1
      DIMENSION LINE(1),MINE(1)                                        CDK   2
C  SIZES OF LINE AND MINE ARE SET IN CALLING PROGRAM                    CDK  2A
C  MINIMUM IS 6 WORDS EACH                                              CDK  2B
       DIMENSION INDICT(36),JODICT(34),LIN2(6)                         CDK   3
C  ROUTINE COMPUTES A CHECK CHARACTER FOR A CODEN  WRITTEN IN ONE OF     CDK   4
C    THESE FORMS                                                       CDK   5
C      JACSA    JACS-A    JACS A   JACSAT                             CDK   6
C        (EMBEDDED BLANKS AND DASH IGNORED)                            CDK   7
C  ROUTINE  RECEIVES SIX CHAR (A1 FORMAT) IN -LINE-   AND  RETURNS     CDK   8
C   SIX CHAR (A1 FORMAT) IN MINE.  THE SIXTH CHAR IN MINE IS THE       CDK   9
C     CHECK CHARACTER CALC PER  PG IX-X OF ASTM DATA SER. DS 23 B      CDK  10
C   THE ARRAY LINE IS NOT CHANGED.                                     CDK  11
C   IF THE INCOMING CODEN HAD A CHECK CHAR.,THAT IS COMPARED WITH      CDK  12
C      THE CALC MADE HERE.                                             CDK  13
C   THE  FORMAL ARGUMENT  -IERR- IS RETURNED WITH THESE  VALUES        CDK  14
C      AND MEANINGS                                                    CDK  15
C      IERR=0   OK                                                     CDK  16
C      IERR=1   CHECK CHAR DID NOT MATCH                               CDK  17
C      IERR = 2 CODEN HAD MORE THAN 6 CHARACTERS (FIRST 6 USED)        CDK  18
C     IERR = 4    CODEN HAD LESS THAN 4 CHARACTERS (NO CALC. MADE)     CDK  19
C     IERR = 8  ILLEGAL CHARACTER IN CODEN                            CDK  20
C      CONSTANTS                                                       CDK  21
       DATA IBLNK,IMIN/ 1H ,1H-/                                       CDK  22
C   DICTIONARIES                                                       CDK  23
C INPUT      ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890          (36)        CDK  24
C  OUTPUT    ABCDEFGHIJKLMNOPQRSTUVWXYZ23456789          (34)         CDK  25
C INPUT CHAR DICTIONARY                                                CDK  26
      DATA (INDICT(I),I=1,36)/                                         CDK  27
     1 1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO,1HP,CDK  28
     2 1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ,                        CDK  29
     3 1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0/                        CDK  30
C OUTPUT DICTIONARY FOR CHECK CHARACTER                                CDK  31
      DATA(JODICT(I),I=1,34) /                                         CDK  32
     1 1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO,1HP,CDK  33
     2 1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ,                        CDK  34
     3 1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9 /                               CDK  35
      DO 10 I=1,6                                                      CDK  36
      MINE(I)=1H                                                       CDK  37
10    LIN2(I)=0                                                        CDK  38
      IERR=0                                                           CDK  39
      MODE=0                                                           CDK  40
      K=0                                                              CDK  41
      IF (IL-IS-4) 140,20,20                                           CDK  42
C   SEARCH INDICT FOR THE CHARACTERS    IGNORE BLANKS AND MINUS        CDK  43
20    DO 80 I=IS,IL                                                    CDK  44
      IF (LINE(I)-IBLNK) 30,80,30                                      CDK  45
30    IF (LINE(I)-IMIN) 40,80,40                                       CDK  46
40    DO 50 J=1,36                                                     CDK  47
      IF (LINE(I)-INDICT(J)) 50,60,50                                  CDK  48
50    CONTINUE                                                         CDK  49
C   ILLEGAL CHARACTER                                                  CDK  50
      IF (IERR.LT.8) IERR=IERR +8                                      CDK  51
      GO TO 80                                                         CDK  52
C CONVERT VALUE TO AN INTEGER                                          CDK  53
60    K=K+1                                                            CDK  54
      IF (K.LE.6) GO TO 70                                             CDK  55
C   MORE THAN 6 CHAR IN FIELD                                          CDK  56
      IF (MOD(IERR,4).LE.1) IERR=IERR+2                                CDK  57
      GO TO 90                                                         CDK  58
70    LIN2(K)=J                                                        CDK  59
```

```
      MINE(K)=LINE(I)                                                   CDK  60
80    CONTINUE                                                          CDK  61
      IF (K-5) 140,100,90                                               CDK  62
90    MODE=1                                                            CDK  63
100   MSUM=11*LIN2(1)                                                   CDK  64
      MSUM=MSUM+7*LIN2(2)                                               CDK  65
      MSUM=MSUM+5*LIN2(3)                                               CDK  66
      MSUM=MSUM+3*LIN2(4)                                               CDK  67
      MSUM=MSUM+LIN2(5)                                                 CDK  68
C  COMPUTE  NUMERICAL EQUIVALENT OF CHECK CHARACTER                     CDK  69
      ICK=MOD(MSUM-1,34)+1                                              CDK  70
      ICHECK=JODICT(ICK)                                                CDK  71
      IF (MODE-1) 130,110,130                                           CDK  72
C COMPARE WITH EXISTING CHECK CHARACTER                                 CDK  73
110   JCK=LIN2(6)                                                       CDK  74
      JCHECK=INDICT(JCK)                                                CDK  75
      IF (ICHECK-JCHECK) 120,130,120                                    CDK  76
C     INCONSISTENT CHECK CHARACTER                                      CDK  77
120   IF (MOD(IERR,2).LT.1) IERR=IERR+1                                 CDK  78
130   MINE(6)=ICHECK                                                    CDK  79
      GO TO 150                                                         CDK  80
C    FEWER THAN 5 CHARACTERS                                            CDK  81
140   IF (MOD(IERR,8).LT.4) IERR=IERR+4                                 CDK  82
150   RETURN                                                            CDK  83
      END                                                               CDK  84-
```

```
C     SAMPLE MAIN PROGRAM FOR CODEN INPUT FROM CARDS                    CDN   1
        DIMENSION  LINE(80),MINE(80)                                    CDN   2
C    CARD READER AND PRINTER UNITS                                      CDN   3
      KR=5                                                              CDN   4
      KP=6                                                              CDN   5
C     ZONE ON THE INPUT WHERE CODEN IS LOCATED                          CDN   6
      I1=1                                                              CDN   7
      I2=10                                                             CDN   8
      PRINT 10                                                          CDN   9
10    FORMAT ('1 OUTPUT       INPUT FOR CODEN CHECK PROGRAM')           CDN  10
C  READ THE INPUT.  THIS IS UNIVAC FORTRAN V                            CDN  11
20    READ (KR,40,END=70) (LINE(I),I=1,80)                              CDN  12
      CALL CODCHK (LINE,MINE,I1,I2,IERR)                                CDN  13
      IF (IERR.EQ.0) GO TO 30                                           CDN  14
      WRITE (KP,50) IERR                                                CDN  15
30    WRITE (KP,60) (MINE(I),I=1,6),(LINE(I),I=I1,I2)                   CDN  16
      GO TO 20                                                          CDN  17
40    FORMAT (80A1)                                                     CDN  18
50    FORMAT (' *****  ERROR TYPE'I3,' ON NEXT CARD')                   CDN  19
C    FORMAT FOR ARRAY LINE SHOULD ALLOW FOR I2-I1+1 CHARACTERS          CDN  20
60    FORMAT (1H 6A1,6X,30A1)                                           CDN  21
70    STOP                                                              CDN  22
      END                                                               CDN  23-
```

TEST OF SUBROUTINE CODCHK (TYPED COPY OF OUTPUT)

```
 OUTPUT      INPUT FOR CODEN CHECK PROGRAM
*****  ERROR TYPE  4 ON NEXT CARD
ABCD         ABCD
*****  ERROR TYPE  3 ON NEXT CARD
ABCDEW       ABCDEFG
ANYAA9       ANYAA
APOPAI       APOPA
*****  ERROR TYPE  1 ON NEXT CARD
CHREAY       CHREAB
*****  ERROR TYPE  8 ON NEXT CARD
GCAXZ6       *GCAXZ
*****  ERROR TYPE  8 ON NEXT CARD
GCAXZ6       GC*AXZ
*****  ERROR TYPE 12 ON NEXT CARD
GCAZ         GC*A*Z
IJCKBO       IJCKB
JACSAT       JACSA
JACSAT       JACS-A
JACSAT       J A C SAT
*****  ERROR TYPE  1 ON NEXT CARD
JASCAR       JASCAT
JATPA3       JATPA
JGREA2       JGREA
NBCIAG       NBCIA
NBCIAG       NBCIA-G
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