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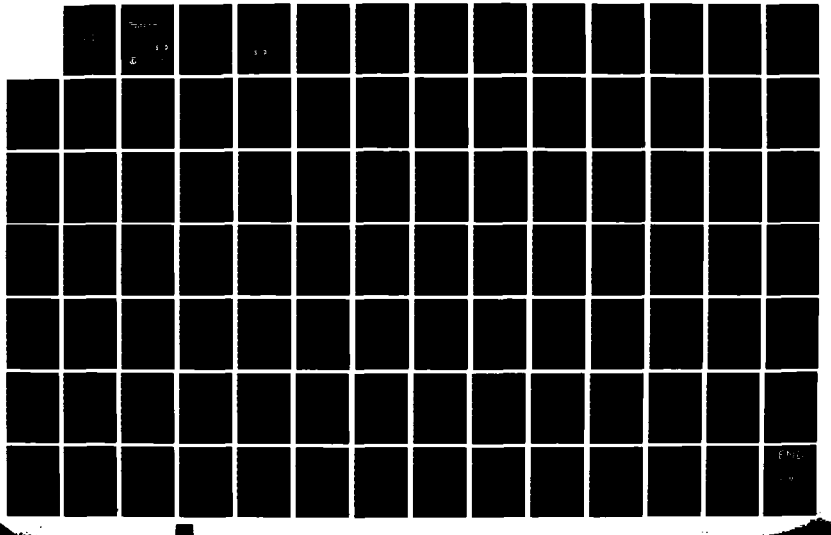

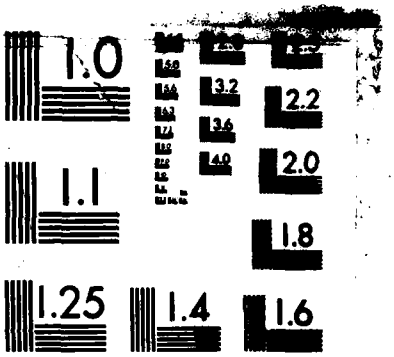

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NSWC TR 85-56

BOSS:
A FORTRAN CODE FOR A RELATIONAL DATABASE MANAGER

BY ELLIOT WINSTON

RESEARCH AND TECHNOLOGY DEPARTMENT

1 MAY 1985

NAVAL SURFACE WEAPONS CENTER

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Relational Database Manager
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Instruction and documentation for an interactive relational database manager is presented, based on a B+ tree data structure for rapidly retrieving record keys.

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FOREWORD

This report contains documentation for a FORTRAN implementation of a relational database manager. Because the code is written in a high-level language, it is basically transportable to any computer with FORTRAN capability (minor modification may be required for compatability with a host computer's operating system and compiler). The work was required by U31 to support computer studies requiring the extensive use of minefield planning codes.

This work has been supported by the Mine Improvement Program at NSWC under Project S0267.

Approved by:

Ira M Blatstein

IRA M. BLATSTEIN, Head
Radiation Division

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TABLES

INTRODUCTION

This report contains instruction and documentation for an interactive relational database manager code called BOSS. BTREE, which is an implementation of a B+ tree and is documented in Winston,[1] provides the fundamental data structure utilized by BOSS for rapidly retrieving data record keys. This work completes the effort begun with BTREE to develop a user-friendly code to manage and maintain medium-sized databases, thereby providing U31 with the capability to efficiently ar easily perform large-scale computer studies which analyze various questions related to minefield planning.

The following sections constitute a manual for using BOSS, along with an illustrative example; Appendix A contains documentation of the subprograms and Appendix B contains a complete listing of the code itself. The code is written in a DEC version of FORTRAN 77 for a VAX/VMS system, and is therefore essentially transportable to any computer with FORTRAN capability. (Minor modification may be required for compatability with a host computer's operating system and compiler.) The format for file names is assumed to be (name).(ext), where (name) consists of at most 9 characters, and (ext) is an extender, or modifier, of at most 3 characters.

DATA CATEGORIES

BOSS can manage several logically independent collections of data, henceforth called categories. A data record in a category consists of a number of fields, each of which is described by a set of parameters: field name, data type, field length, and resource category.

1) The field name is usually chosen to be a generic descriptor of the data stored in the field.

2) A discussion of each data type follows:

   (a) "Character data" is data which generally consists of names and descriptive words, but can also be a string of numbers, usually interspersed by separators for parsing and conversion into actual numerical value by an application program. (This is a convenient way to store a row or column in a numerical table.) BOSS, itself, never ascribes any numerical significance to such data.

   (b) "Numerical data" differs from character data in that the user may request BOSS to compare it with respect to its numerical, and not lexacographical, value.

   (c) The function ENDATE converts a date between January 1, 1900 and December 31, 2075 into the number of days since December 31, 1899. The function SYM then uses ASCII symbols to convert this integer into a 2-byte symbol. (The inverse process is accomplished by calling VAL and DEDATE.) Hence, only 2 bytes of memory are required

to store such a date, a much smaller memory requirement than interpreting the date as character data. Moreover, a comparison between different dates is easily accomplished by comparing their associated integer values. Character data provides an adequate way of storing dates outside the allowable range.

(d) The category TABLE is a special category created by BOSS to save mass storage memory and also aid in reducing keystroke errors. When a field has a limited number of possible values, e.g., color, job title, etc., it is more efficient to enter each of the possible values once as data in TABLE, and instead store the associated TABLE record number, or pointer, in the corresponding field of the actual data record. As previously discussed above in part (c), a pointer requires only 2 bytes of memory. Thus, records in TABLE consist of two fields: the field name, and the field value, both designated to have a field length of 10 characters. Also, when data records are added to the current category, all of the possible values of any field with "table data" are displayed in a numbered list from which the user makes a selection, thereby eliminating the burden of entering the complete data value.

(e) "Duplicate data" is somewhat similar to table data in that pointers are stored rather than actual data values. If the data records of different categories contain a common field, that is, a field with the same name and same set of data values, it may be possible to avoid a complete duplication of the field in each of the categories. If the field in question is the key for some category, then pointers can be stored as the field data in the other categories containing the field. (See the next section for an explanation of keys.) It is important to stress that duplicate fields in different categories must have exactly the same field name!

3) The field length is the maximum number of characters required by any of the possible field data values.

4) The resource category is the name of the category containing the actual field data values rather than any associated pointers.

CATEGORY CREATION

In order to create a category, a category name, a category password (optional), the number of fields in a typical category data record, and the number of the key field all must be supplied by the user. The data in the key field is called the key and must uniquely identify the data record. These four category parameters are stored in the file CAT.DAR, a record of which uses the category name as its key; CAT.KEY is the associated B+ tree. In addition, the user must supply the field parameters, discussed in the previous section, which describe a typical category data record. The parameters for the n th field are contained in the n th record of (name).LAR.

When appropriate, parameters have default values assigned to them by BOSS. For example, the field length is automatically set equal to 2 when the data type of a field is neither character nor numerical. All information which must be supplied by the user is entered in response to a series of prompts by BOSS.

The entire collection of data record keys is stored in the B+ tree (name).KEY, and (name).DAR contains the associated category data records.

The specifications of the implementation of BOSS given in Appendix B are:

maximum number of records per category	65,535
maximum number of fields per record	20
maximum number of characters per field	100
maximum number of characters per record	256
maximum number of categories associated with a current category via duplicate data	7

CATEGORY REQUESTS

Most category requests are self-explanatory, such as adding, getting, deleting, or modifying a category data record. In addition, the user can change the category password, review the record field parameters, inquire about the number of records currently in a category, or write all the records in a category to an output file. A special type of search, called a "range query", retrieves all the records in a category which satisfy a particular set of conditions. The user selects a subset of all the record fields, and for each such field, specifies a range of values within which data in that field must lie. Since BOSS examines every record in a category to execute this request, it is possible for this procedure to consume a relatively larger amount of time.

EXAMPLE

The example discussed in this section is purely hypothetical, but is useful in demonstrating how to specify the parameters needed to define categories. The more fundamental problem of identifying which collections of data are appropriate as categories is not addressed in this report, and therefore the reader is urged to consult Kent[2] or Neely and Steward[3] for very readable introductions to the important concepts of logically independent data and normal forms. A more theoretical discussion can be found in Stout and Woodworth.[4]

Table 1 is a list of all the courses offered by a small mathematics department. This table of data constitutes the category "COURSES".

TABLE 1. COURSES

Title	Number	Credits
Calculus I	120	4
Calculus II	121	4
Linear Algebra	235	3
Probability	250	3
Statistics	251	3
Analysis	310	3

The second field serves as the key field, and is admissable as the key because the course number uniquely identifies all the data in the row (record) containing it. The first field, "Title", also qualifies as a key, but is not as convenient for defining the category "ASSIGN", below. "Title" is assumed to contain character data with a field length of 15 characters, "Number" has numerical data with a field length of 3, and "Credits" also has numerical data, but with a field length of 1. The data type of "Number" is chosen to be numerical to give the user the ability to make certain types of requests, such as asking for a list of all 200-level courses. This can be accomplished by a range query on field 2 with an inclusive upper bound of 299 and an inclusive lower bound of 200.

Table 2 is a faculty list. The key field, "Name", has character data

TABLE 2. FACULTY

Name	Rank
Jones	lecturer
Smith	instructor
Brown	instructor
Thomas	professor
Johnson	instructor

with a field length of 10. (Although 7 characters are sufficient for all current faculty names, the field is defined to be a bit larger to allow for possible future changes in faculty.) Since there are only three faculty ranks, the second field, "Rank", is assumed to contain table data. The three associated records in "Table" are (rank,lecturer), (rank,instructor), and (rank,professor).

Finally, the course assignments listed in Table 3 provide the data for the category "ASSIGN". Fields 1 and 3 are copies of key fields in other

TABLE 3. ASSIGN

Number	Section	Name
120	1	Jones
120	2	Johnson
121	1	Jones
121	2	Johnson
235	1	Smith
250	1	Brown
251	1	Brown
312	1	Thomas

categories. Consequently, they are assumed to have duplicate type data which is related to the resource categories "Courses" and "Faculty"; the data type of "Section" is numerical with a field length of 1. However, no single field can serve as the key field because, in general, no row is uniquely identified by the data in any one field. The data in field 1 together with the data in field 2 do identify rows, and thus, an additional field containing "compound" data is added to the category, as is shown in Table 4.

TABLE 4. ASSIGN

Key	Number	Section	Name
1201	120	1	Jones
1202	120	2	Johnson
1211	121	1	Jones
1212	121	2	Johnson
2351	235	1	Smith
2501	250	1	Brown
2511	251	1	Brown
3101	310	1	Thomas

The new field, "Key", is an artifice which provides "ASSIGN" with a key. This device is not uncommon in practice.

RECONFIGURATION

The following specifications can be altered easily to satisfy special requirements of the user:

(a) To change the maximum number of fields per record to f, declare the arrays LONG(f), IO(f), TYPE(f), FLD(f), TITLE(f), WHERE(f), INA(f), INB(f), EXA(f), and EXB(f) in COMMON/XXXBOSS/, and LINK(f) and WIDTH(f) in SUBROUTINE OUTPUT;

(b) To change the maximum number of characters per field to c, declare the array FLD(f) as CHARACTER*c (the maximum key length in BTREE should also be checked to make sure it is at least as big as c);

(c) To change the maximum number of characters per record to r, declare the variable RECDATA as CHARACTER*r.

APPLICATION PROGRAMS

In order for an application program to retrieve data from one or more categories, the user need only check the source code of BOSS to find out how to access a category and its data. Usually, this requires little more than adding SUBROUTINE OPENCAT and SUBROUTINE RECOUT to the application program, and writing a short subroutine to get the appropriate data. Of course, the application program must also be linked with BTREE when forming the executable image.

REFERENCES

1. Winston, E., BTREE: A FORTRAN Code for a B+ Tree, NSWC TR 85-54, Apr 1985.

2. Kent, W., "A Simple Guide to Five Normal Forms in Relational Database Theory," Communications ACM, Vol 26, No. 2, 1983, pp. 120-126.

3. Neely, J., and Steward, S., "Fundamentals of Relational Data Organization," BYTE, Nov 1981, pp. 51-60.

4. Stout, Q., and Woodworth, P., "Relational Databases," MAA Monthly, Vol. 90, 1983, pp. 101-118.

APPENDIX A

SUBROUTINE DOCUMENTATION

SUBROUTINE MODWORD

PURPOSE: To modify the current category password.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
NINE	BYTE	parameter set equal to 9
HOW( )	CHARACTER*6	array of record formats

OUTPUTS:

none

EXTERNALS:

BTREE

SUBROUTINE MODREC

PURPOSE: To control the logic for modifying a data record.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
KEYFLD	INTEGER*4	number of the key field
INA( )	BYTE	array of pointers for start of each field in current category record
INB( )	BYTE	array of pointers for end of each field in current category record
ONE,NINE	BYTE	parameter set equal to 1,9
HOW( )	CHARACTER*6	array of record formats

OUTPUTS:

none

EXTERNALS:

FETCH,RECOUT,VERIFY,BTREE,RECIN,INSERT

SUBROUTINE DELREC

PURPOSE: To control the logic for deleting a data record.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
NFIELD	INTEGER*4	number of current fields
KEYFLD	INTEGER*4	number of the key field
TITLE( )	CHARACTER*10	array of field names
ONE,NINE	BYTE	parameter set equal to 1,9
HOW( )	CHARACTER*6	array of record formats

OUTPUTS:

none

EXTERNALS:

BTREE,OPENCAT,VAL,RECOUT,SHOWREC,RECIN

SUBROUTINE FETCH

PURPOSE: To retrieve a data record in the current category.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
KEYFLD	INTEGER*4	number of the key field
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
WHERE( )	CHARACTER*9	array of resource categories
IO( )	BYTE	array of unit number links between fields and resource categories
HOW( )	CHARACTER*6	array of record formats
ONE	BYTE	parameter set equal to 1

OUTPUTS:

RECDATA	CHARACTER*256	data record in current category

EXTERNALS:

SYM,ENDATE,TABLIST,BTREE

SUBROUTINE GETREC

PURPOSE: To control the logic for getting a data record.

INPUTS:

CATNAME	CHARACTER*9	name of current category
ONE	BYTE	parameter set equal to 1
HOW( )	CHARACTER*6	array of record formats

OUTPUTS:

none

EXTERNALS:

FETCH,RECOUT,SHOWREC

SUBROUTINE INSERT

PURPOSE: To insert a data record into the current category.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
NFIELD	INTEGER*4	number of current fields
KEYFLD	INTEGER*4	number of the key field
FLD( )	CHARACTER*100	array of field data in internal format
INA( )	BYTE	array of pointers for start of each field in current category record
INB( )	BYTE	array of pointers for end of each field in current category record
ONE	BYTE	parameter set equal to 1
HOW( )	CHARACTER*6	array of record formats

OUTPUTS:

none

EXTERNALS:

BTREE

SUBROUTINE VERIFY

PURPOSE: To verify a data record.

INPUTS:

NFIELD	INTEGER*4	number of current fields
FLD( )	CHARACTER*100	array of field data in external format
TITLE( )	CHARACTER*10	array of field names

OUTPUTS:

FLD( )	CHARACTER*100	updated array of field data in external format

EXTERNALS:

SHOWREC,CHECK,TABLIST

SUBROUTINE ADDREC

PURPOSE: To control the logic for adding a record.

INPUTS:

NFIELD	INTEGER*4	number of current fields
KEYFLD	INTEGER*4	number of the key field
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
EXA( )	BYTE	array of pointers for start of duplicate fields in resource category records
EXB( )	BYTE	array of pointers for end of duplicate fields in resource category records

OUTPUTS:

none

EXTERNALS:

TABLIST,VERIFY,RECIN,INSERT

SUBROUTINE DELCAT

PURPOSE: To control the logic for deleting a category.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
HOW(9)	CHARACTER*6	record format for CAT.DAR
HOW(10)	CHARACTER*6	record format for (CATNAME).LAR

OUTPUTS:

none

EXTERNALS:

BTREE

SUBROUTINE OPENCAT

PURPOSE: To initialize the parameters of the current category.

INPUTS:

HOW(10)	CHARACTER*6	record format for (CATNAME).LAR
CATNAME	CHARACTER*9	name of the current category
NFIELD	INTEGER*4	number of current fields

OUTPUTS:

IO( )	BYTE	array of unit number links between fields and resource categories
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
LONG( )	INTEGER*4	array of field lengths
WHERE( )	CHARACTER*9	array of resource categories
INA( )	BYTE	array of pointers for start of each field in current category record
INB( )	BYTE	array of pointers for end of each field in current category record
EXA( )	BYTE	array of pointers for start of duplicate fields in resource category records
EXB( )	BYTE	array of pointers for end of duplicate fields in resource category records
NREF	BYTE	number of related categories with respect to current category
HOW( )	CHARACTER*6	array of record formats

EXTERNALS:

BTREE

SUBROUTINE PICKCAT

PURPOSE: To either delete a category selected by the user, or open a category and execute category requests.

INPUTS:

HOW(9)	CHARACTER*6	record format for CAT.DAR

OUTPUTS:

CATNAME	CHARACTER*9	name of the current category
KEYFLD	INTEGER*4	number of the key field
NFIELD	INTEGER*4	number of current fields

EXTERNALS:

BTREE,CHECK,TABMENU,DELCAT,OPENCAT,ADDREC,GETREC,DELREC,MODREC, QUERY,CATLIST,MODWORD,REVIEW

SUBROUTINE VIEWSPEC

PURPOSE: To review the field parameters of the current category; editing permitted during category creation only.

INPUTS:

HOW(10)	CHARACTER*6	record format for (CATNAME).LAR
CATNAME	CHARACTER*9	name of the current category
KEYFLD	INTEGER*4	number of the key field
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
LONG( )	INTEGER*4	array of field lengths
WHERE( )	CHARACTER*9	array of resource categories
NEW	LOGICAL*1	.TRUE. upon category creation, .FALSE. otherwise

OUTPUTS:

TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
LONG( )	INTEGER*4	array of field lengths
WHERE( )	CHARACTER*9	array of resource categories

EXTERNALS:

CHECK,SYM

SUBROUTINE NEWCAT

PURPOSE: To create a new category.

INPUTS:

HOW(9)	CHARACTER*6	record format for CAT.DAR
HOW(10)	CHARACTER*6	record format for (CATNAME).LAR

OUTPUTS:

CATNAME	CHARACTER*9	name of the current category
NFIELD	INTEGER*4	number of current fields
KEYFLD	INTEGER*4	number of the key field
MAXLEN	INTEGER*4	length of the key field
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
WHERE( )	CHARACTER*9	array of resource categories
LONG( )	INTEGER*4	array of field lengths
NEW	LOGICAL*1	.TRUE. upon category creation, .FALSE. otherwise

EXTERNALS:

CHECK,SYM

PROGRAM BOSS

PURPOSE: To open the database and control the logic needed to execute user requests.

INPUTS:

none

OUTPUTS:

HOW(9)	CHARACTER*6	record format for CAT.DAR
HOW(10)	CHARACTER*6	record format for (CATNAME).LAR

EXTERNALS:

BTREE,CHECK,PICKCAT,NEWCAT

SUBROUTINE REVIEW

PURPOSE: To select a field and review its parameters.

INPUTS:

none

OUTPUTS:

none

EXTERNALS:

FLDLIST,VIEWSPEC

SUBROUTINE FLDLIST

PURPOSE: To list the field names of the current category and select one of them.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
NFIELD	INTEGER*4	number of current fields
TITLE( )	CHARACTER*10	array of field names

OUTPUTS:

N	INTEGER*4	number of selected field

EXTERNALS:

CHECK

SUBROUTINE RECIN

PURPOSE: To transform a record from external format into internal format.

INPUTS:

NFIELD	INTEGER*4	number of current fields
FLD( )	CHARACTER*100	array of field data in external format
TYPE( )	INTEGER*4	array of field data types
TITLE( )	CHARACTER*10	array of field names
WHERE( )	CHARACTER*9	array of resource categories
IO( )	BYTE	array of unit number links between fields and resource categories
TEN	BYTE	parameter set equal to 10

OUTPUTS:

FLD( )	CHARACTER*10	array of field data in internal format

EXTERNALS:

SYM,ENDATE,BTREE

SUBROUTINE RECOUT

PURPOSE: To transform a record from internal format into external format.

INPUTS:

NFIELD	INTEGER*4	number of current fields
INA( )	BYTE	array of pointers for start of each field in current category record
INB( )	BYTE	array of pointers for end of each field in current category record
RECDATA	CHARACTER*256	data record in current category
TEN	BYTE	parameter set equal to 10
IO( )	BYTE	array of unit number links between fields and resource categories
HOW( )	CHARACTER*6	array of record formats
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
EXA( )	BYTE	array of pointers for start of duplicate fields in resource category records
EXB( )	BYTE	array of pointers for end of duplicate fields in resource category records

OUTPUTS:

FLD( )	CHARACTER*10	array of field data in external format

EXTERNALS:

VAL,BTREE

SUBROUTINE SHOWREC

PURPOSE: To display a record on the screen.

INPUTS:

NFIELD	INTEGER*4	number of current fields
TITLE( )	CHARACTER*10	array of field names
FLD( )	CHARACTER*10	array of field data in external format

OUTPUTS:

none

EXTERNALS:

none

SUBROUTINE QUERY

PURPOSE: To control the logic for a range query.

INPUTS:

HOW( )	CHARACTER*6	array of record formats
TYPE( )	INTEGER*4	array of field data types
ONE,SIX	BYTE	parameter set equal to 1,6

OUTPUTS:

none

EXTERNALS:

FLDLIST,CHECK,SYM,ENDATE,BTREE,RECOUT,VAL,CONVERT,OUTPUT

SUBROUTINE CATLIST

PURPOSE: To write the number of every record of the current category on a scratch file.

INPUTS:

none

OUTPUTS:

none

EXTERNALS:

BTREE,OUTPUT

SUBROUTINE OUTPUT

PURPOSE: To write a set of records on an output file.

INPUTS:

CATNAME	CHARACTER*9	name of the current category
NFIELD	INTEGER*4	number of current fields
TITLE( )	CHARACTER*10	array of field names
TYPE( )	INTEGER*4	array of field data types
EXA( )	BYTE	array of pointers for start of duplicate fields in resource category records
EXB( )	BYTE	array of pointers for end of duplicate fields in resource category records

OUTPUTS:

none

EXTERNALS:

FLDLIST,RECOUT

SUBROUTINE TABMENU

PURPOSE: To control the logic for a "TABLE" request.

INPUTS:

HOW( )	CHARACTER*6	array of record formats
FIVE,NINE	BYTE	parameter set equal to 5,9

OUTPUTS:

none

EXTERNALS:

BTREE,CHECK,TABLIST,TABDEL,TABADD

SUBROUTINE TABADD

PURPOSE: To add a record to "TABLE".

INPUTS:

FLDNAME	CHARACTER*10	name of table field
TEN	BYTE	parameter set equal to 10

OUTPUTS:

none

EXTERNALS:

BTREE

SUBROUTINE TABDEL

PURPOSE: To delete a record from "TABLE".

INPUTS:

FLDVAL	CHARACTER*10	value of table field
FLDNAME	CHARACTER*10	name of table field
ONE,NINE,TEN	BYTE	parameter set equal to 1,9,10
HOW( )	CHARACTER*6	array of record formats
NREF	BYTE	number of related categories with respect to current category

OUTPUTS:

none

EXTERNALS:

BTREE,VAL,OPENCAT,RECOUT,SHOWREC

SUBROUTINE TABLIST

PURPOSE: To list all the current values of a field with table type data.

INPUTS:

FLDNAME	CHARACTER*10	name of table field
TEN	BYTE	parameter set equal to 10
IND	INTEGER*4	indicator which selects appropriate screen message

OUTPUTS:

FLDVAL	CHARACTER*10	value of table field

EXTERNALS:

BTREE,CHECK

SUBROUTINE CHECK

PURPOSE: To trap a particular class of typographical error.

INPUTS:

ANS	CHARACTER*3	numerical user input in string format
NMAX	INTEGER*4	largest admissible value for user input

OUTPUTS:

N	INTEGER*4	integer value of user input

EXTERNALS:

none

FUNCTION ENDATE

PURPOSE: To convert the date passed by WHEN into the number of days since December 31,1899.

INPUTS:

WHEN	CHARACTER*10	date in string format

OUTPUTS:

ENDATE	INTEGER*4	number of days since December 31,1899 associated with WHEN

EXTERNALS:

none

```
      HOW(1) = '(A'//HOW(1)(1:K)//')'
      NREF = 1
      DO 4040 I=1,NFIELD
      IF (TYPE(I).LE.2) THEN
         EXA(I) = INA(I)
         EXB(I) = INB(I)
      ELSE IF (TYPE(I).EQ.4) THEN
         IO(I) = 10
      ELSE IF (TYPE(I).EQ.5) THEN
         NREF = NREF + 1
         IO(I) = NREF
         LTR = 'O'
         A = WHERE(I)
         CALL BTREE(LTR,NREF,A,MAXLEN,IREC,IERR)
         LDU = NREF + 10
         CLOSE(UNIT=LDU)
         OPEN(UNIT=LDU,FILE=WHERE(I)//'.DAR',STATUS='OLD',
     *        FORM='FORMATTED',ACCESS='DIRECT')
         LTR = 'G'
         CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
         READ(19,HOW(9),REC=IREC) RECDATA
         MEND = VAL(RECDATA(20:21))
         CLOSE(UNIT=20)
         OPEN(UNIT=20,FILE=WHERE(I)//'.LAR',STATUS='OLD',
     *        FORM='FORMATTED',ACCESS='DIRECT')
         DO 4020 M=1,MEND
            READ(20,HOW(10),REC=M) RECDATA
            IF (M.EQ.1) THEN
               MA = 1
               MB = VAL(RECDATA(11:12))
            ELSE
               MA = MB + 1
               MB = MB + VAL(RECDATA(11:12))
            END IF
            IF (TITLE(I).EQ.RECDATA(1:10)) THEN
               EXA(I) = MA
               EXB(I) = MB
            END IF
4020     CONTINUE
         K = 1
         DO WHILE (MB/10**K.GT.0)
            K = K + 1
         END DO
         ENCODE(K,402,HOW(NREF)) MB
         HOW(NREF) = '(A'//HOW(NREF)(1:K)//')'
      END IF
4040  CONTINUE
      RETURN
      END
```

```
      SUBROUTINE OPENCAT
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
  402 FORMAT(I<K>)
C
C-------------------------------------------------------------
C         INITIALIZE CATEGORY PARAMETERS
C-------------------------------------------------------------
C
      LTR = 'O'
      A = CATNAME
      CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
      CLOSE(UNIT=11)
      OPEN(UNIT=11,FILE=CATNAME//'.DAR',STATUS='OLD',FORM='FORMATTED',
     *     ACCESS='DIRECT')
      CLOSE(UNIT=20)
      OPEN(UNIT=20,FILE=CATNAME//'.LAR',STATUS='OLD',FORM='FORMATTED',
     *     ACCESS='DIRECT')
      LENREC = 0
      DO 4005 I=1,NFIELD
         IO(I) = 1
         READ(20,HOW(10),REC=I) RECDATA
         TITLE(I) = RECDATA(1:10)
         LONG(I) = VAL(RECDATA(11:12))
         LENREC = LENREC + LONG(I)
         IF (I.EQ.1) THEN
            INA(I) = 1
            INB(I) = LONG(I)
         ELSE
            INA(I) = INB(I-1) + 1
            INB(I) = INB(I-1) + LONG(I)
         END IF
         TYPE(I) = VAL(RECDATA(13:14))
         WHERE(I) = RECDATA(15:23)
 4005 CONTINUE
      K = 1
      DO WHILE (INB(NFIELD)/10**K.GT.0)
         K = K + 1
      END DO
      ENCODE(K,402,HOW(1)) LENREC
```

```
C
          CALL DELCAT
C
       ELSE
C
C         SELECT AND EXECUTE A CATEGORY REQUEST
C
          CALL OPENCAT
 3045     WRITE(22,317) CATNAME
          WRITE(22,318)
          READ(21,302) ANS
          CALL CHECK(ANS,ACT,TEN,TYPO)
          IF (TYPO) GO TO 3045
C
          IF (ACT.EQ.1) THEN
             CALL ADDREC
          ELSE IF (ACT.EQ.2) THEN
             CALL GETREC
          ELSE IF (ACT.EQ.3) THEN
             CALL DELREC
          ELSE IF (ACT.EQ.4) THEN
             CALL MODREC
          ELSE IF (ACT.EQ.5) THEN
             CALL QUERY
          ELSE IF (ACT.EQ.6) THEN
             CALL CATLIST
          ELSE IF (ACT.EQ.7) THEN
             CALL MODWORD
          ELSE IF (ACT.EQ.8) THEN
             CALL REVIEW
          ELSE IF (ACT.EQ.9) THEN
             READ(1,303,REC=1) I,J
             K = J - I
             WRITE(6,321) CATNAME,K
          ELSE IF (ACT.EQ.10) THEN
             DO 3060 I=1,NFIELD
                LDU = IO(I) + 10
                CLOSE(UNIT=LDU)
 3060        CONTINUE
             RETURN
          END IF
          GO TO 3045
C
       END IF
       END
```

```
      KOUNT = 1
      FLD(1) = 'TABLE'
      WRITE(22,301) KOUNT,FLD(1)
      LTR = 'F'
 3010 CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 3020
      LTR = 'S'
      KOUNT = KOUNT + 1
      FLD(KOUNT) = A
      LINK(KOUNT) = IREC
      WRITE(22,301) KOUNT,A
      IF (MOD(KOUNT,20).EQ.0) THEN
 3015    WRITE(22,311)
         READ(21,302) ANS
         CALL CHECK(ANS,N,KOUNT,TYPO)
         IF (TYPO) GO TO 3015
         IF (N.NE.0) GO TO 3030
         KOUNT = 0
      END IF
      GO TO 3010
 3020 WRITE(22,312)
      WRITE(22,313)
      READ(21,302) ANS
      CALL CHECK(ANS,N,KOUNT,TYPO)
      IF (TYPO) GO TO 3020
      IF (N.EQ.0) RETURN
C
 3030 IF (FLD(N)(1:5).EQ.'TABLE') THEN
         IF (NUM.EQ.1) THEN
            CALL TABMENU
         ELSE IF (NUM.EQ.2) THEN
            WRITE(22,314)
         END IF
         RETURN
      END IF
      READ(19,HOW(9),REC=LINK(N)) RECDATA
      CATNAME = RECDATA(1:9)
      CATWORD = RECDATA(10:19)
      NFIELD = VAL(RECDATA(20:21))
      KEYFLD = VAL(RECDATA(22:23))
      IF (CATWORD.EQ.' ') GO TO 3035
      WRITE(22,315)
      READ(21,302) TRY
      IF (TRY.EQ.CATWORD) THEN
         GO TO 3035
      ELSE
         WRITE(22,316)
         RETURN
      END IF
 3035 IF (NUM.EQ.2) THEN
C
C        DELETE A CATEGORY
```

```
      SUBROUTINE PICKCAT(NUM)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      INTEGER LINK(20)
      CHARACTER TRY*10,CATWORD*10
      LOGICAL*1 THERE,TYPO
C
  301 FORMAT(11X,I3,15X,A10)
  302 FORMAT(A10)
  303 FORMAT(2I5)
  310 FORMAT(/10X,'NUMBER',10X,'CATEGORY NAME'/)
  311 FORMAT(/3X,'ENTER THE APPROPRIATE NUMBER OR ENTER'/
     *7X,'ZERO TO SEE MORE LIST')
  312 FORMAT(/3X,'ENTER THE APPROPRIATE NUMBER')
  313 FORMAT(3X,'OR ENTER ZERO TO RETURN TO PREVIOUS MENU')
  314 FORMAT(/3X,'REQUEST DENIED - "TABLE" CANNOT BE DELETED'/)
  315 FORMAT(/3X,'ENTER CATEGORY PASSWORD')
  316 FORMAT(/3X,'INCORRECT CATEGORY PASSWORD')
  317 FORMAT(/15X,'THE CURRENT CATEGORY IS  ',A8,//)
  318 FORMAT(10X,'NUMBER',10X,'ACTION'//
     *12X,'1',13X,'ADD DATA'/
     *12X,'2',13X,'GET DATA'/
     *12X,'3',13X,'DELETE DATA'/
     *12X,'4',13X,'MODIFY DATA'/
     *12X,'5',13X,'RANGE QUERY'/
     *12X,'6',13X,'LIST ENTIRE CATEGORY'/
     *12X,'7',13X,'CHANGE CATEGORY PASSWORD'/
     *12X,'8',13X,'DISPLAY RECORD FORMAT'/
     *12X,'9',13X,'CURRENT NUMBER OF RECORDS'/
     *12X,'10',12X,'RETURN TO PREVIOUS MENU'/
     */3X,'ENTER APPROPRIATE NUMBER')
  321 FORMAT(/3X,'CURRENT NUMBER OF RECORDS IN CATEGORY  ',A9,' =',I6)
C
C-------------------------------------------------------------
C         DRIVER FOR CATEGORY REQUEST
C-------------------------------------------------------------
C
C         SELECT A CATEGORY
C
 3005 WRITE(22,310)
```

```
      WRITE(22,612) K,B(J)
      IF (J.LE.2) THEN
         K = 3
         WRITE(22,613) K,LONG(I)
      ELSE
         LONG(I) = 2
         IF (J.EQ.5) THEN
            K = 4
            WRITE(22,614) K,WHERE(I)
         END IF
      END IF
      IF (I.EQ.KEYFLD) WRITE(22,615)
      IF (.NOT.NEW) RETURN
 6015 WRITE(22,616)
      READ(21,601) ANS
      CALL CHECK(ANS,NUM,FOUR,TYPO)
      IF (TYPO) GO TO 6015
      IF (NUM.EQ.0) GO TO 6020
      WRITE(22,617)
      IF (NUM.EQ.1) THEN
         READ(21,601) TITLE(I)
      ELSE IF (NUM.EQ.2) THEN
         WRITE(22,618)
         READ(21,*) TYPE(I)
      ELSE IF (NUM.EQ.3) THEN
         READ(21,*) LONG(I)
      ELSE IF (NUM.EQ.4) THEN
         READ(21,601) WHERE(I)
      END IF
      GO TO 6010
 6020 RECDATA(1:10) = TITLE(I)
      RECDATA(11:12) = SYM(LONG(I))
      RECDATA(13:14) = SYM(TYPE(I))
      RECDATA(15:23) = WHERE(I)
      WRITE(20,HOW(10),REC=I) RECDATA
      RETURN
      END
```

```
      SUBROUTINE VIEWSPEC(I,NEW)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER SYM*2,B(5)*10
      LOGICAL*1 NEW,TYPO
C
      DATA B/'CHARACTER','NUMERICAL','DATE','TABLE','DUPLICATE'/
C
  601 FORMAT(A10)
  610 FORMAT(/15X,'FIELD',I3,'  PARAMETERS')
  611 FORMAT(/5X,I3,5X,'TITLE',T50,A10)
  612 FORMAT(5X,I3,5X,'DATA TYPE',T50,A10)
  613 FORMAT(5X,I3,5X,'MAXIMUM NUMBER OF CHARACTERS',T50,I3)
  614 FORMAT(5X,I3,5X,'RESOURCE CATEGORY',T50,A9)
  615 FORMAT(/5X,'***  -  KEY FIELD')
  616 FORMAT(/3X,'ENTER ZERO IF SATISFACTORY OR ENTER THE NUMBER'/
     *8X,'OF THE PARAMETER TO BE MODIFIED')
  617 FORMAT(/3X,'ENTER NEW PARAMETER')
  618 FORMAT(/10X'DATA TYPE'//
     *15X,'1   -   CHARACTER'/
     *15X,'2   -   NUMERICAL'/
     *15X,'3   -   DATE (FROM 1 JAN 1900 TO 1 JAN 2076)'/
     *15X,'4   -   TABLE'/
     *15X,'5   -   DUPLICATE'/)
C
C-------------------------------------------------------------
C         REVIEW THE FIELD PARAMETERS FOR A CATEGORY
C           (EDITING PERMITTED UPON CATEGORY CREATION)
C-------------------------------------------------------------
C
      WRITE(22,610) I
 6010 J = TYPE(I)
      IF (J.LE.3) THEN
         WHERE(I) = CATNAME
      ELSE IF (J.EQ.4) THEN
         WHERE(I) = 'TABLE'
      END IF
      K = 1
      WRITE(22,611) K,TITLE(I)
      K = 2
```

```
      WRITE(22,212)
      READ(21,201) CATWORD
      WRITE(22,213)
      READ(21,*) NFIELD
      LENREC = 0
      DO 2010 I=1,NFIELD
         WRITE(22,214) I
         READ(21,201) TITLE(I)
         WRITE(22,215)
         READ(21,*) TYPE(I)
         LONG(I) = 2
         IF (TYPE(I).LE.2) THEN
            WRITE(22,216)
            IF (TYPE(I).EQ.2) WRITE(22,217)
            READ(21,*) LONG(I)
         ELSE IF (TYPE(I).EQ.5) THEN
            WRITE(22,218)
            READ(21,201) WHERE(I)
         END IF
         LENREC = LENREC + LONG(I)
2010  CONTINUE
      WRITE(22,219)
      READ(21,*) KEYFLD
      NEW = .TRUE.
      DO 2020 I=1,NFIELD
      CALL VIEWSPEC(I,NEW)
2020  CONTINUE
      LTR = 'A'
      A = CATNAME
      CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      RECDATA = CATNAME
      RECDATA(10:19) = CATWORD
      RECDATA(20:21) = SYM(NFIELD)
      RECDATA(22:23) = SYM(KEYFLD)
      WRITE(19,HOW(9),REC=IREC) RECDATA
      LTR = 'C'
      A = CATNAME
      MAXLEN = LONG(KEYFLD)
      CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
      CLOSE(UNIT=11)
      OPEN(UNIT=11,FILE=CATNAME//'.DAR',STATUS='NEW',FORM='FORMATTED',
     *     ACCESS='DIRECT',RECL=LENREC)
      RETURN
      END
```

```
      SUBROUTINE NEWCAT
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER SYM*2,CATWORD*10
      LOGICAL*1 THERE,NEW
C
  201 FORMAT(A10)
  210 FORMAT(/3X,'ENTER NAME OF NEW CATEGORY (AT MOST 9 CHARACTERS)')
  211 FORMAT(/10X,'CATEGORY NAME ALREADY IN USE - CHOOSE ANOTHER')
  212 FORMAT(/3X,'ENTER CATEGORY PASSWORD (AT MOST 10 LETTERS) -'/
     *5X,'IF NONE SIMPLY PRESS THE "RETURN" KEY')
  213 FORMAT(/3X,' ENTER NUMBER OF FIELDS PER DATA RECORD')
  214 FORMAT(/15X,'PARAMETERS OF FIELD',I3//
     *3X,'ENTER FIELD NAME (AT MOST 10 CHARACTERS)')
  215 FORMAT(/10X'DATA TYPE'//
     *15X,'1    -   CHARACTER'/
     *15X,'2    -   NUMERICAL'/
     *15X,'3    -   DATE (FROM 1 JAN 1900 TO 1 JAN 2076)'/
     *15X,'4    -   TABLE'/
     *15X,'5    -   DUPLICATE'/
     */3X,'ENTER NUMBER CORRESPONDING TO DATA TYPE')
  216 FORMAT(/3X,'ENTER MAXIMUM NUMBER OF CHARACTERS')
  217 FORMAT(3X,'COUNTING SIGNS AND DECIMAL POINTS')
  218 FORMAT(/3X,'ENTER RESOURCE CATEGORY')
  219 FORMAT(/3X,'ENTER NUMBER OF KEY FIELD')
C
C-------------------------------------------------------------
C         CREATE A NEW CATEGORY
C-------------------------------------------------------------
C
      WRITE(22,210)
      READ(21,201) CATNAME
      INQUIRE(FILE=CATNAME//'.DAR',EXIST=THERE)
      IF (THERE) THEN
         WRITE(22,211)
         RETURN
      END IF
      CLOSE(UNIT=20)
      OPEN(UNIT=20,FILE=CATNAME//'.LAR',STATUS='NEW',FORM='FORMATTED',
     *     ACCESS='DIRECT',RECL=23)
```

```
     *10X,'3',10X,'CREATE A NEW CATEGORY'/
     *10X,'4',10X,'EXIT'/
     */3X,'ENTER APPROPRIATE NUMBER')
C
C-------------------------------------------------------------
C         OPEN THE DATA BASE
C-------------------------------------------------------------
C
      OPEN(UNIT=21,FILE='SYS$INPUT',STATUS='UNKNOWN')
      OPEN(UNIT=22,FILE='SYS$OUTPUT',STATUS='UNKNOWN')
C
      HOW(9) = '(A23)'
      HOW(10) = '(A23)'
      INQUIRE(FILE='CAT.KEY',EXIST=THERE)
      IF (THERE) THEN
         LTR = 'O'
      ELSE
         LTR = 'C'
      END IF
      A = 'CAT'
      MAXLEN = 9
      CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      CLOSE(UNIT=19)
      OPEN(UNIT=19,FILE='CAT.DAR',STATUS='UNKNOWN',FORM='FORMATTED',
     *     ACCESS='DIRECT',RECL=23)
      A = 'TABLE'
      MAXLEN = 20
      CALL BTREE(LTR,TEN,A,MAXLEN,IREC,IERR)
 1010 WRITE(22,110)
      READ(21,101) ANS
      CALL CHECK(ANS,NUM,FOUR,TYPO)
      IF (TYPO) GO TO 1010
      IF (NUM.EQ.1.OR.NUM.EQ.2) THEN
         CALL PICKCAT(NUM)
      ELSE IF (NUM.EQ.3) THEN
         CALL NEWCAT
      ELSE IF (NUM.EQ.4) THEN
         STOP
      END IF
      GO TO 1010
      END
```

```
      PROGRAM BOSS
C
C*****************************************************************
C        BOSS is an interactive relational database manager
C     which uses a B+ tree for storing and retrieving record
C     keys.  This implementation can accomodate up to 65,535
C     data records in any one category.
C        Complete documentation for BOSS is contained in
C     "BOSS : A FORTRAN Code for a Relational Database
C     Manager" by Elliot Winston, NSWC TR 85-56.  Associated
C     documentation can be found in "BTREE : A FORTRAN
C     Code for a B+ Tree" by Elliot Winston, NSWC TR 85-54.
C*****************************************************************
C
C       LDU          FILE              LDU          FILE
C
C         1       (NREF=1).KEY         11       (NREF=1).DAR
C         2       (NREF=2).KEY         12       (NREF=2).DAR
C         :               :             :               :
C         :               :             :               :
C         8       (NREF=8).KEY         18       (NREF=8).DAR
C         9            CAT.KEY         19            CAT.DAR
C        10          TABLE.KEY         20          (***).LAR
C        21       INPUT (KEYBOARD)     22       OUTPUT (SCREEN)
C        23          SCRATCH           24          SCRATCH
C
C         MAXIMUM NUMBER OF FIELDS PER RECORD = 20
C         MAXIMUM FIELD LENGTH = 100 BYTES
C         MAXIMUM NUMBER OF BYTES PER RECORD = 256
C         MAXIMUM NUMBER OF RELATED CATEGORIES = 8
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      LOGICAL*1 THERE,TYPO
C
      DATA ONE,TWO,THREE,FOUR,FIVE/1,2,3,4,5/
      DATA SIX,SEVEN,EIGHT,NINE,TEN/6,7,8,9,10/
C
  101 FORMAT(A3)
  110 FORMAT('0',9X,'1',10X,'ACCESS AN ACTIVE CATEGORY'/
     *10X,'2',10X,'DELETE AN ACTIVE CATEGORY'/
```

APPENDIX B

FORTRAN CODE LISTING

FUNCTION CONVERT

PURPOSE: To convert a number in string format into its real numerical value.

INPUTS:

A	CHARACTER*15	number in string format

OUTPUTS:

CONVERT	REAL*4	real value associated with A

EXTERNALS:

none

FUNCTION DEDATE

PURPOSE: To convert the number of days since December 31,1899 into the format MONTH/DAY/YEAR .

INPUTS:

MANY	INTEGER*4	number of days since December 31,1899

OUTPUTS:

DEDATE	CHARACTER*10	date associated with MANY

EXTERNALS:

none

```
      SUBROUTINE DELCAT
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER NAME*9
C
  301 FORMAT(A3)
  310 FORMAT(/' REQUEST DENIED -  ',A10,'  IS REFERENCED BY  ',A10)
  311 FORMAT(/3X,'DO YOU WISH TO DELETE CATEGORY ',A9'?  (Y/N)')
  312 FORMAT(/3X' REQUEST TO DELETE CATEGORY ',A9,' IS CANCELLED')
C
C-------------------------------------------------------------
C         DRIVER TO DELETE A CATEGORY
C-------------------------------------------------------------
C
C         CHECK FOR RELATED CATEGORIES
C
      CLOSE(UNIT=20)
      LTR = 'F'
 3010 CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 3030
      LTR = 'S'
      READ(19,HOW(9),REC=IREC) RECDATA
      NAME   RECDATA(1:9)
      END = VAL(RECDATA(20:21))
      IF (NAME.EQ.CATNAME) GO TO 3010
      OPEN(UNIT=20,FILE=NAME//'.LAR',STATUS='OLD',FORM='FORMATTED',
     *     ACCESS='DIRECT')
      DO 3020 I=1,END
         READ(20,HOW(10),REC=I) RECDATA
         WHERE(I) = RECDATA(15:23)
         IF (WHERE(I).EQ.CATNAME) THEN
            WRITE(22,310) CATNAME,NAME
            RETURN
         END IF
 3020 CONTINUE
      CLOSE(UNIT=20)
      GO TO 3010
C
C         DELETION OF CATEGORY
C
```

```
3030 CLOSE(UNIT=20)
     WRITE(22,311) CATNAME
     READ(21,301) ANS
     IF (ANS(1:1).EQ.'Y') THEN
        LTR = 'D'
        A = CATNAME
        CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
        CLOSE(UNIT=1)
        OPEN(UNIT=1,FILE=A//'.KEY',STATUS='OLD',FORM='FORMATTED',
    *        ACCESS='DIRECT')
        CLOSE(UNIT=1,STATUS='DELETE')
        CLOSE(UNIT=11)
        OPEN(UNIT=11,FILE=A//'.DAR',STATUS='OLD',FORM='FORMATTED',
    *        ACCESS='DIRECT')
        CLOSE(UNIT=11,STATUS='DELETE')
        CLOSE(UNIT=20)
        OPEN(UNIT=20,FILE=A//'.LAR',STATUS='OLD',FORM='FORMATTED',
    *        ACCESS='DIRECT')
        CLOSE(UNIT=20,STATUS='DELETE')
        OPEN(UNIT=1,FILE=A//'.NOD',STATUS='UNKNOWN')
        CLOSE(UNIT=1,STATUS='DELETE')
        OPEN(UNIT=1,FILE=A//'.REC',STATUS='UNKNOWN')
        CLOSE(UNIT=1,STATUS='DELETE')
     ELSE IF (ANS(1:1).EQ.'N') THEN
        WRITE(22,312) CATNAME
     ELSE
        GO TO 3030
     END IF
     RETURN
     END
```

```
      SUBROUTINE ADDREC
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
  601 FORMAT(A100)
  610 FORMAT(/10X,'ENTER THE DATA FOR FIELD',I3,' (',A10,')')
  611 FORMAT(/5X,'THE FORMAT FOR A DATE IS   MM/DD/YYYY'//
     *15X,'MM     =   INTEGER FROM 1 TO 12  (MONTH)'/
     *15X,'DD     =   INTEGER FROM 1 TO 31  (DAY)'/
     *15X,'YYYY   =   4 DIGITS WHICH SPECIFY THE YEAR'/
     */3X,'ENTER THE DATE')
  612 FORMAT(13X,'(AT MOST ',I3,' CHARACTERS)')
  613 FORMAT(//3X,'ERROR - DATA IS REQUIRED FOR FIELD',I3)
  614 FORMAT(/3X,'REQUEST TO ADD DATA IS DENIED')
C
C-------------------------------------------------------------
C         DRIVER FOR ADDING A DATA RECORD
C-------------------------------------------------------------
C
      DO 6020 I=1,NFIELD
 6010    WRITE(22,610) I,TITLE(I)
         IF (TYPE(I).EQ.3) THEN
            WRITE(22,611)
            READ(21,601) FLD(I)
         ELSE IF (TYPE(I).EQ.4) THEN
            IND = 3
            CALL TABLIST(TITLE(I),FLD(I),IND)
            IF (FLD(I).EQ.' ') THEN
               WRITE(22,614)
               RETURN
            END IF
         ELSE
            K = EXB(I) - EXA(I) + 1
            WRITE(22,612) K
            READ(21,601) FLD(I)
         END IF
         IF ((I.EQ.KEYFLD.OR.TYPE(I).GE.3).AND.FLD(I).EQ.' ') THEN
            WRITE(6,613) I
            GO TO 6010
         END IF
 6020 CONTINUE
```

```
CALL VERIFY
CALL RECIN
IF (IERR.EQ.4) THEN
   WRITE(22,614)
   RETURN
END IF
CALL INSERT
RETURN
END
```

```
      SUBROUTINE VERIFY
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      LOGICAL*1 TYPO
C
  701 FORMAT(A100)
  710 FORMAT(/3X,'ENTER ZERO IF THE DATA IS CORRECT, OR ENTER THE'
     */3X,'NUMBER OF THE FIELD WITH THE INCORRECT DATA')
  711 FORMAT(/3X,'ENTER THE CORRECT DATA')
C
C-------------------------------------------------------------
C         VERIFY A DATA RECORD
C-------------------------------------------------------------
C
 7010 CALL SHOWREC
      WRITE(22,710)
      READ(21,701) ANS
      CALL CHECK(ANS,N,NFIELD,TYPO)
      IF (TYPO) GO TO 7010
      IF (N.EQ.0) RETURN
      IF (TYPE(N).EQ.4) THEN
         IND = 3
         CALL TABLIST(TITLE(N),FLD(N),IND)
      ELSE
         WRITE(22,711)
         READ(21,701) FLD(N)
      END IF
      GO TO 7010
      END
```

```
      SUBROUTINE INSERT
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
  401 FORMAT(2I5)
  410 FORMAT(/3X,'RECORD NOT INSERTED INTO THE DATABASE -'
     */3X,'THE KEY IS ALREADY IN USE')
  411 FORMAT(/3X,'CATEGORY ',A9,' CONTAINS THE MAXIMUM NUMBER OF'
     */3X,'RECORDS ALLOWED - NO ADDITIONAL RECORDS WILL BE ADDED')
  412 FORMAT(/3X,'WARNING -  ',A9,'  NOW CONTAINS',I6,' RECORDS;'
     */3X,'THE MAXIMUM NUMBER IS 65530')
C
C-------------------------------------------------------------
C         INSERT A DATA RECORD INTO CURRENT CATEGORY
C-------------------------------------------------------------
C
C         CHECK ON NUMBER OF CURRENT RECORDS
C
      READ(1,401,REC=1) I,J
      K = J - I
      IF (K.GT.65530) THEN
         WRITE(22,411) CATNAME
         RETURN
      END IF
C
      LTR = 'A'
      A = FLD(KEYFLD)
      CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
      IF (IREC.GE.65475) WRITE(22,412) CATNAME,IREC
      IF (IERR.EQ.6) THEN
         WRITE(22,410)
         RETURN
      END IF
      DO 4010 I=1,NFIELD
         RECDATA(INA(I):INB(I)) = FLD(I)
 4010 CONTINUE
      WRITE(11,HOW(1),REC=IREC) RECDATA
      RETURN
      END
```

```
      SUBROUTINE GETREC
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
  601 FORMAT(A3)
  610 FORMAT(/3X,'SEE NEXT RECORD OF KEY SEQUENCE?  (Y/N)')
  611 FORMAT(/3X,'THERE ARE NO MORE RECORDS IN ',A9)
C
C-------------------------------------------------------------
C        DRIVER FOR GETTING A DATA RECORD
C-------------------------------------------------------------
C
      CALL FETCH
      IF (IERR.EQ.4) RETURN
 6010 CALL RECOUT
      CALL SHOWREC
 6020 WRITE(22,610)
      READ(21,601) ANS
      IF (ANS(1:1).EQ.'Y') THEN
         LTR = 'S'
         CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
         IF (IERR.EQ.5) THEN
           WRITE(22,611) CATNAME
           RETURN
         END IF
         READ(11,HOW(1),REC=IREC) RECDATA
         GO TO 6010
      ELSE IF (ANS(1:1).EQ.'N') THEN
         RETURN
      ELSE
         GO TO 6020
      END IF
      RETURN
      END
```

```
      SUBROUTINE FETCH
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER SYM*2,WHEN*10
C
  701 FORMAT(A10)
  710 FORMAT(/5X,'THE FORMAT FOR A DATE IS   MM/DD/YYYY'//
     *15X,'MM     =   INTEGER FROM 1 TO 12  (MONTH)'/
     *15X,'DD     =   INTEGER FROM 1 TO 31  (DAY)'/
     *15X,'YYYY   =   4 DIGITS WHICH SPECIFY THE YEAR'/
     */3X,'ENTER THE DATE')
  711 FORMAT(/3X,'ENTER THE VALUE OF ',A10)
  712 FORMAT(/3X,'NO RECORD IN ',A9,' HAS THE REQUESTED KEY')
C
C-------------------------------------------------------------
C        RETRIEVE A DATA RECORD FROM CURRENT CATEGORY
C-------------------------------------------------------------
C
      K = TYPE(KEYFLD)
      IF (K.EQ.3) THEN
         WRITE(22,710)
         READ(21,701) WHEN
         A = SYM(ENDATE(WHEN))
      ELSE IF (K.EQ.4) THEN
         IND = 3
         CALL TABLIST(TITLE(KEYFLD),A,IND)
      ELSE
         WRITE(22,711) TITLE(KEYFLD)
         READ(21,701) A
         IF (K.EQ.5) THEN
            LTR = 'G'
            CALL BTREE(LTR,IO(KEYFLD),A,MAXLEN,IREC,IERR)
            IF (IERR.EQ.4) THEN
               WRITE(22,712) WHERE(KEYFLD)
               RETURN
            END IF
            A = SYM(IREC)
         END IF
      END IF
      LTR = 'G'
```

```
CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
IF (IERR.EQ.4) THEN
   WRITE(22,712) CATNAME
ELSE
   READ(11,HOW(1),REC=IREC) RECDATA
END IF
RETURN
END
```

```
      SUBROUTINE DELREC
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER NAME*9,COPYCAT*9,UNIQUE*20
C
  302 FORMAT(A10)
  310 FORMAT(/3X,'ENTER FULL KEY VALUE OF ',A10)
  311 FORMAT(/3X,'NO RECORD IN ',A9,' HAS THE REQUESTED KEY')
  312 FORMAT(/3X,'RECORD DELETION REQUEST CANCELLED')
  313 FORMAT(/3X,' REQUEST DENIED - REFERENCED IN A DATA RECORD'/
     *3X,'CONTAINED IN CATEGORY ',A9)
  314 FORMAT(/3X,'DO YOU WISH TO DELETE THIS RECORD?  (Y/N)')
  315 FORMAT(/3X,'PRESS THE "RETURN" KEY TO CONTINUE')
  316 FORMAT(/3X,'KEYSTROKE ERROR - TRY AGAIN')
C
C-------------------------------------------------------------
C         DRIVER FOR DELETING A DATA RECORD
C-------------------------------------------------------------
C
      COPYCAT = CATNAME
      NF = NFIELD
      WRITE(22,310) TITLE(KEYFLD)
      READ(21,302) UNIQUE
      LTR = 'G'
      A = UNIQUE
      CALL BTREE(LTR,ONE,A,MAXLEN,KEYREC,IERR)
      IF (IERR.EQ.4) THEN
         WRITE(22,311) CATNAME
         WRITE(22,312)
         RETURN
      END IF
C
C         CHECK FOR RELATED RECORDS
C
      LTR = 'F'
 3010 CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.5) GO TO 3040
      LTR = 'S'
      READ(19,HOW(9),REC=IREC) RECDATA
      CATNAME = RECDATA(1:9)
```

```
      NFIELD = VAL(RECDATA(20:21))
      IF (CATNAME.EQ.COPYCAT) GO TO 3010
      CLOSE(UNIT=20)
      OPEN(UNIT=20,FILE=CATNAME//'.LAR',STATUS='OLD',
     *     FORM='FORMATTED',ACCESS='DIRECT')
      DO 3030 I=1,NFIELD
         READ(20,HOW(10),REC=I) RECDATA
         IF (RECDATA(15:23).EQ.COPYCAT) THEN
            CALL OPENCAT
            LTR = 'F'
 3020       CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
            IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 3030
            LTR = 'S'
            READ(11,HOW(1),REC=IREC) RECDATA
            K = VAL(RECDATA(INA(I):INB(I)))
            IF (K.EQ.KEYREC) THEN
               WRITE(22,313) CATNAME
               CALL RECOUT
               CALL SHOWREC
               WRITE(22,315)
               READ(21,302) ANS
               CATNAME = COPYCAT
               NFIELD = NF
               CALL OPENCAT
               RETURN
            END IF
            GO TO 3020
         END IF
 3030 CONTINUE
      LTR = 'S'
      GO TO 3010
C
C        DELETION OF RECORD
C
 3040 CATNAME = COPYCAT
      NFIELD = NF
      CALL OPENCAT
      READ(11,HOW(1),REC=KEYREC) RECDATA
      CALL RECOUT
      CALL SHOWREC
 3050 WRITE(22,314)
      READ(21,302) ANS
      IF (ANS(1:1).EQ.'Y') THEN
         CALL RECIN
         LTR = 'D'
         A = FLD(KEYFLD)
         CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
      ELSE IF (ANS(1:1).EQ.'N') THEN
         WRITE(22,312)
      ELSE
         WRITE(22,316)
         GO TO 3050
```

```
END IF
RETURN
END
```

```
      SUBROUTINE MODREC
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER NAME*9,OLDKEY*20
      LOGICAL*1 NOTE
C
  401 FORMAT(A3)
  410 FORMAT(/3X,'APPROPRIATE CHANGES IN ',A9,' WILL BE MADE')
  411 FORMAT(/3X,'DO YOU WISH TO MAKE THE MODIFICATION?  (Y/N)')
  412 FORMAT(/3X,'REQUEST TO MODIFY DATA DENIED')
  413 FORMAT(/3X,'REQUEST TO MODIFY DATA CANCELLED')
C
C-------------------------------------------------------------
C         DRIVER FOR MODIFYING A DATA RECORD
C-------------------------------------------------------------
C
      NOTE = .FALSE.
      CALL FETCH
      IF (IERR.EQ.4) RETURN
      OLDKEY = RECDATA(INA(KEYFLD):INB(KEYFLD))
      CALL RECOUT
      CALL VERIFY
C
C         CHECK FOR CATEGORIES AFFECTED BY THE MODIFICATION
C
      LTR = 'F'
 4010 CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.5) GO TO 4030
      LTR = 'S'
      READ(19,HOW(9),REC=IREC) RECDATA
      NAME = RECDATA(1:9)
      END = VAL(RECDATA(20:21))
      IF (NAME.EQ.CATNAME) GO TO 4010
      CLOSE(UNIT=20)
      OPEN(UNIT=20,FILE=NAME//'.LAR',STATUS='OLD',FORM='FORMATTED',
     *     ACCESS='DIRECT')
      DO 4020 I=1,END
         READ(20,HOW(10),REC=I) RECDATA
         WHERE(I) = RECDATA(15:23)
         IF (WHERE(I).EQ.CATNAME) THEN
```

```
            WRITE(22,410) NAME
            NOTE = .TRUE.
            GO TO 4010
         END IF
 4020 CONTINUE
      GO TO 4010
C
C        MODIFICATION OF RECORD
C
 4030 CLOSE(UNIT=20)
      IF (NOTE) THEN
         WRITE(22,411)
         READ(21,401) ANS
      ELSE
         ANS = 'Y'
      END IF
      IF (ANS(1:1).EQ.'Y') THEN
         CALL RECIN
         IF (IERR.EQ.4) THEN
            WRITE(22,412)
            RETURN
         END IF
         LTR = 'D'
         CALL BTREE(LTR,ONE,OLDKEY,MAXLEN,IREC,IERR)
         CALL INSERT
      ELSE IF (ANS(1:1).EQ.'N') THEN
         WRITE(22,413)
      ELSE
         GO TO 4030
      END IF
      RETURN
      END
```

```
      SUBROUTINE TABMENU

      IMPLICIT INTEGER*4 (A-Z)

      COMMON /XXXBOSS/
     1    NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2    IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3    ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4    IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256

      CHARACTER FLDNAME*10,FLDVAL*10
      LOGICAL*1 TYPO

901   FORMAT(A3)
910   FORMAT(/15X,'FIELD NAMES IN "TABLE"'/
     *  /10X,'NUMBER',10X,'NAME'/)
911   FORMAT(11X,I3,12X,A10)
912   FORMAT(/3X,'ENTER THE APPROPRIATE NUMBER')
913   FORMAT(3X,'OR ENTER ZERO TO SEE MORE LIST')
914   FORMAT(3X,'OR ENTER ZERO TO RETURN TO PREVIOUS MENU')
915   FORMAT(/10X,'NUMBER',10X,'ACTION'//
     *  12X,'1',13X,'MODIFY DATA'/
     *  12X,'2',13X,'DELETE DATA'/
     *  12X,'3',13X,'LIST CURRENT FIELD VALUES'/
     *  12X,'4',13X,'ADD DATA'/
     *  12X,'5',13X,'RETURN TO PREVIOUS MENU')

C-------------------------------------------------------------
C       DRIVER FOR "TABLE" REQUEST
C-------------------------------------------------------------

C       LIST ALL "TABLE" FIELDS OF ALL CATEGORIES

000   WRITE(22,910)
      KOUNT = 0
      LTR = 'F'
005   CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 9020
      LTR = 'S'
      READ(19,HOW(9),REC=IREC) RECDATA
      CATNAME = RECDATA(1:9)
      NFIELD = VAL(RECDATA(20:21))
      CLOSE(UNIT=20)
      OPEN(UNIT=20,FILE=CATNAME//'.LAR',STATUS='OLD',
     *     FORM='FORMATTED',ACCESS='DIRECT')
      DO 9010 I=1,NFIELD
         READ(20,HOW(10),REC=I) RECDATA
```

```
         M = N + 1
         N = N + WIDTH(J)
         KM = 16
         KN = KM + WIDTH(J)
         DO 5065 K=1,NCOL
            LINE(KM:KN) = COL(K)(M:N)
            KM = KM + TAB
            KN = KM + WIDTH(J)
5065     CONTINUE
         WRITE(24,514) LINE
5070  CONTINUE
      LINE = ' '
      WRITE(24,514) LINE
      IF (IND.EQ.0) GO TO 5040
      CLOSE(UNIT=23)
      CLOSE(UNIT=24)
      RETURN
      END
```

```
      ELSE
         MUCH = 0
5020     MUCH = MUCH + 1
         WRITE(22,512)
         CALL FLDLIST(LINK(MUCH))
         WRITE(22,513)
         READ(21,502) ANS
         IF (ANS(1:1).EQ.'Y') GO TO 5020
      END IF

         COMPUTE FORMAT PARAMETERS OF OUTPUT FILE

      DO 5030 I=1,MUCH
         J = LINK(I)
         IF (TYPE(J).EQ.3.OR.TYPE(J).EQ.4) THEN
            WIDTH(J) = 10
         ELSE
            WIDTH(J) = EXB(J) - EXA(J) + 1
         END IF
5030  CONTINUE
      TAB = 0
      DO 5035 I=1,MUCH
         TAB = MAXO(TAB,WIDTH(LINK(I)))
5035  CONTINUE
      TAB = TAB + 5
      NCOL = MINO(115/TAB,8)

         WRITE SELECTED RECORD FIELDS

      REWIND(UNIT=23)
      OPEN(UNIT=24,FILE=CATNAME//'.OUT',STATUS='NEW')
5040  DO 5045 K=1,NCOL
         COL(K) = ' '
5045  CONTINUE
      DO 5055 K=1,NCOL
         READ(23,501,END=5060,IOSTAT=IND) IREC
         READ(11,HOW(1),REC=IREC) RECDATA
         CALL RECOUT
         M = 0
         N = 0
         DO 5050 I=1,MUCH
            J = LINK(I)
            M = N + 1
            N = N + WIDTH(J)
            COL(K)(M:N) = FLD(J)
5050     CONTINUE
5055  CONTINUE
5060  M = 0
      N = 0
      DO 5070 I=1,MUCH
         J = LINK(I)
         LINE = TITLE(J)
```

```
      SUBROUTINE OUTPUT
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      INTEGER WIDTH(20)
      BYTE LINK(20)
      CHARACTER LINE*132,COL(8)*256
C
  501 FORMAT(I5)
  502 FORMAT(A3)
  510 FORMAT(//3X,'DO YOU WISH TO CREATE THE OUTPUT FILE  ',A12
     */3X,' CONTAINING ALL THE RECORDS FOUND?  (Y/N)')
  511 FORMAT(/3X,'DO YOU WISH TO WRITE ALL FIELDS?  (Y/N)')
  512 FORMAT(/3X,'SELECT A FIELD TO BE WRITTEN'/)
  513 FORMAT(/3X,'DO YOU WISH TO WRITE AN ADDITIONAL FIELD? (Y/N)')
  514 FORMAT(' ',A132)
C
C-------------------------------------------------------------
C         WRITE A SET OF RECORDS ON AN OUTPUT FILE
C-------------------------------------------------------------
C
C         SELECT RECORD FIELDS TO BE WRITTEN
C
      J = 9
      DO WHILE (CATNAME(J:J).EQ.' ')
         J = J - 1
      END DO
      A = CATNAME(1:J)//'.OUT'
      WRITE(22,510) A
      READ(21,502) ANS
      IF (ANS(1:1).EQ.'N') THEN
         CLOSE(UNIT=23)
         RETURN
      END IF
      WRITE(22,511)
      READ(21,502) ANS
      IF (ANS(1:1).EQ.'Y') THEN
         MUCH = NFIELD
         DO 5015 I=1,MUCH
            LINK(I) = I
 5015    CONTINUE
```

```
      SUBROUTINE CATLIST

      IMPLICIT INTEGER*4 (A-Z)

      COMMON /XXXBOSS/
     1    NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2    IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3    ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4    IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256

  701 FORMAT(I5)
  710 FORMAT(/3X,I5,'  RECORDS WERE FOUND')

C-------------------------------------------------------------
C         WRITE NUMBER OF EVERY RECORD OF CURRENT
C              CATEGORY ON A SCRATCH FILE
C-------------------------------------------------------------

      OPEN(UNIT=23,FILE='RECNOS',STATUS='SCRATCH')
      KOUNT = 0
      LTR = 'F'
 7010 CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 7020
      KOUNT = KOUNT + 1
      LTR = 'S'
      WRITE(23,701) IREC
      GO TO 7010
 7020 WRITE(22,710) KOUNT
      CALL OUTPUT
      RETURN
      END
```

```
                SO = A.GE.BD(K)
             END IF
          ELSE
             IF (TYPE(J).EQ.3) THEN
                X = ENDATE(A)
                Y = VAL(BD(K))
             ELSE IF (TYPE(J).EQ.2) THEN
                X = CONVERT(A)
                Y = CONVERT(BD(K))
             END IF
             IF (L.EQ.1) THEN
                SO = X.EQ.Y
             ELSE IF (L.EQ.2) THEN
                SO = X.NE.Y
             ELSE IF (L.EQ.3) THEN
                SO = X.LT.Y
             ELSE IF (L.EQ.4) THEN
                SO = X.GT.Y
             ELSE IF (L.EQ.5) THEN
                SO = X.LE.Y
             ELSE IF (L.EQ.6) THEN
                SO = X.GE.Y
             END IF
          END IF
          IF (.NOT.SO) GO TO 8030
 8045 CONTINUE
      MANY = MANY + 1
      WRITE(23,802) IREC
      GO TO 8030
C
C        OPTION TO WRITE ADMISSIBLE RECORDS TO A FILE
C
 8050 WRITE(22,815) MANY
      CALL OUTPUT
      RETURN
      END
```

```
      CALL FLDLIST(I)
      LIST(KOUNT) = I
 8015 WRITE(22,811)
      READ(21,801) ANS
      CALL CHECK(ANS,LINK(KOUNT),SIX,TYPO)
      IF (TYPO) GO TO 8015
      J = TYPE(I)
      IF (J.EQ.3) THEN
         WRITE(22,812)
         READ(21,801) WHEN
         BD(KOUNT) = SYM(ENDATE(WHEN))
      ELSE
         WRITE(22,813)
         READ(21,801) BD(KOUNT)
      END IF
 8020 WRITE(22,814)
      READ(21,801) ANS
      IF (ANS(1:1).EQ.'Y') THEN
         GO TO 8010
      ELSE IF (ANS(1:1).EQ.'N') THEN
         GO TO 8025
      ELSE
         WRITE(22,816)
         GO TO 8020
      END IF
C
C        EXAMINE EVERY RECORD IN CATEGORY
C
 8025 OPEN(UNIT=23,FILE='RECNOS',STATUS='SCRATCH')
      MANY = 0
      LTR = 'F'
 8030 CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 8050
      LTR = 'S'
      READ(11,HOW(1),REC=IREC) RECDATA
      CALL RECOUT
      DO 8045 K=1,KOUNT
         L = LINK(K)
         J = LIST(K)
         A = FLD(J)
         IF (TYPE(J).EQ.1.OR.TYPE(J).GE.4) THEN
            IF (L.EQ.1) THEN
               SO = A.EQ.BD(K)
            ELSE IF (L.EQ.2) THEN
               SO = A.NE.BD(K)
            ELSE IF (L.EQ.3) THEN
               SO = A.LT.BD(K)
            ELSE IF (L.EQ.4) THEN
               SO = A.GT.BD(K)
            ELSE IF (L.EQ.5) THEN
               SO = A.LE.BD(K)
            ELSE IF (L.EQ.6) THEN
```

```
      SUBROUTINE QUERY
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      BYTE LINK(20),LIST(20)
      REAL X,Y
      CHARACTER SYM*2,WHEN*10,BD(20)*10
      LOGICAL*1 SO,TYPO
C
  801 FORMAT(A20)
  802 FORMAT(I5)
  810 FORMAT(//10X,'SELECT QUERY FIELD')
  811 FORMAT(/10X,'NUMBER',10X,'RELATION'//
     *13X,'1',27X,'EQUAL'/
     *13X,'2',27X,'NOT EQUAL'/
     *13X,'3',27X,'STRICTLY LESS THAN'/
     *13X,'4',27X,'STRICTLY GREATER THAN'/
     *13X,'5',27X,'LESS THAN OR EQUAL'/
     *13X,'6',27X,'GREATER THAN OR EQUAL'/
     */3X,'ENTER APPROPRIATE NUMBER')
  812 FORMAT(/5X,'THE FORMAT FOR A DATE IS   MM/DD/YYYY'//
     *15X,'MM    =   INTEGER FROM 1 TO 12  (MONTH)'/
     *15X,'DD    =   INTEGER FROM 1 TO 31  (DAY)'/
     *15X,'YYYY  =   4 DIGITS WHICH SPECIFY THE YEAR'/
     */3X,'ENTER THE DATE')
  813 FORMAT(/3X,'ENTER THE BOUND  (NO MORE THAN 10 CHARACTERS)')
  814 FORMAT(/3X,'DO YOU WISH TO SPECIFY MORE RELATIONS?  (Y/N)')
  815 FORMAT(/3X,I6,' RECORDS WERE FOUND')
  816 FORMAT(/3X,'KEYSTROKE ERROR - TRY AGAIN')
C
C-------------------------------------------------------------
C        WRITE NUMBERS OF ALL DATA RECORDS SATISFYING A
C        SET OF SPECIFIED CONDITIONS ON A SCRATCH FILE
C-------------------------------------------------------------
C
C        SELECT QUERY FIELDS AND SPECIFY CONDITIONS
C
      KOUNT = 0
 8010 KOUNT = KOUNT + 1
      IF (KOUNT.EQ.20) GO TO 8025
      WRITE(22,810)
```

```
      SUBROUTINE SHOWREC
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
  801 FORMAT(A3)
  810 FORMAT(/)
  811 FORMAT(3X,'FIELD',I3,3X,A10,5X,A100)
  812 FORMAT(/3X,'DO YOU WISH TO SEE MORE LIST?  (Y/N)')
C
C-------------------------------------------------------------
C        DISPLAY A RECORD ON THE SCREEN
C-------------------------------------------------------------
C
      WRITE(22,810)
      DO 8010 I=1,NFIELD
         WRITE(22,811) I,TITLE(I),FLD(I)
         IF (MOD(I,20).EQ.0) THEN
            WRITE(22,812)
            READ(21,801) ANS
            IF (ANS(1:1).EQ.'N') RETURN
         END IF
 8010 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE RECOUT
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER DEDATE*10
C-------------------------------------------------------------
C         TRANSFORM A RECORD FROM INTERNAL TO EXTERNAL FORMAT
C-------------------------------------------------------------
C
      DO 4010 I=1,NFIELD
         FLD(I) = RECDATA(INA(I):INB(I))
 4010 CONTINUE
      DO 4030 I=1,NFIELD
         IF (TYPE(I).LE.2) GO TO 4030
         K = VAL(FLD(I))
         IF (TYPE(I).EQ.3) THEN
            FLD(I) = DEDATE(K)
         ELSE IF (TYPE(I).EQ.4) THEN
            LTR = 'F'
            A = TITLE(I)
 4020       CALL BTREE(LTR,TEN,A,MAXLEN,IREC,IERR)
            LTR = 'S'
            IF (IREC.NE.K) GO TO 4020
            FLD(I) = A(11:20)
         ELSE IF (TYPE(I).EQ.5) THEN
            LDU = IO(I) + 10
            READ(LDU,HOW(IO(I)),REC=K) RECDATA
            FLD(I) = RECDATA(EXA(I):EXB(I))
         END IF
 4030 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE RECIN
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER SYM*2
C
  310 FORMAT(/3X,'KEY CANNOT BE FOUND IN ',A9)
C
C-------------------------------------------------------------
C         TRANSFORM A RECORD FROM EXTERNAL TO INTERNAL FORMAT
C-------------------------------------------------------------
C
      IERR = 0
      DO 3010 I=1,NFIELD
         IF (TYPE(I).EQ.3) THEN
            FLD(I) = SYM(ENDATE(FLD(I)))
         ELSE IF (TYPE(I).EQ.4) THEN
            LTR = 'G'
            A = TITLE(I)//FLD(I)
            CALL BTREE(LTR,TEN,A,MAXLEN,IREC,IERR)
            FLD(I) = SYM(IREC)
         ELSE IF (TYPE(I).EQ.5) THEN
            LTR = 'G'
            A = FLD(I)
            CALL BTREE(LTR,IO(I),A,MAXLEN,IREC,IERR)
            FLD(I) = SYM(IREC)
         END IF
         IF (IERR.EQ.4) THEN
            WRITE(22,310) WHERE(I)
            RETURN
         END IF
 3010 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FLDLIST(N)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      LOGICAL*1 TYPO
C
  501 FORMAT(A3)
  510 FORMAT(/8X,'LIST OF FIELDS OF ',A9/)
  511 FORMAT(5X,'FIELD',I3,10X,A10)
  512 FORMAT(/3X,'ENTER THE APPROPRIATE FIELD NUMBER')
C
C-------------------------------------------------------------
C         LIST FIELD NAMES OF CURRENT CATEGORY
C                 AND SELECT A FIELD
C-------------------------------------------------------------
C
 5010 WRITE(22,510) CATNAME
      DO 5020 I=1,NFIELD
      WRITE(22,511) I,TITLE(I)
 5020 CONTINUE
      WRITE(22,512)
      READ(21,501) ANS
      CALL CHECK(ANS,N,NFIELD,TYPO)
      IF (TYPO) GO TO 5010
      RETURN
      END
```

```
      SUBROUTINE REVIEW
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      LOGICAL*1 NEW
C
  501 FORMAT(A3)
  510 FORMAT(/3X,'SEE PARAMETERS OF ANOTHER FIELD?  (Y/N)')
C
C-------------------------------------------------------------
C         SELECT A FIELD AND REVIEW ITS PARAMETERS
C-------------------------------------------------------------
C
      NEW = .FALSE.
 5010 CALL FLDLIST(N)
      CALL VIEWSPEC(N,NEW)
      WRITE(22,510)
      READ(21,501) ANS
      IF (ANS(1:1).EQ.'Y') GO TO 5010
      RETURN
      END
```

```
      SUBROUTINE MODWORD
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
  601 FORMAT(A10)
  610 FORMAT(/3X,'ENTER NEW CATEGORY PASSWORD')
C
C-------------------------------------------------------------
C        MODIFY PASSWORD OF CURRENT CATEGORY
C-------------------------------------------------------------
C
      LTR = 'G'
      A = CATNAME
      CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      READ(19,HOW(9),REC=IREC) RECDATA
      WRITE(22,610)
      READ(21,601) RECDATA(10:19)
      WRITE(19,HOW(9),REC=IREC) RECDATA
      RETURN
      END
```

```
            TYPE(I) = VAL(RECDATA(13:14))
            IF (TYPE(I).EQ.4) THEN
               KOUNT = KOUNT + 1
               FLD(KOUNT) = RECDATA(1:10)
               WRITE(22,911) KOUNT,FLD(KOUNT)
               IF (MOD(KOUNT,20).EQ.0) THEN
 9008             WRITE(22,912)
                  WRITE(22,913)
                  READ(21,901) ANS
                  CALL CHECK(ANS,N,KOUNT,TYPO)
                  IF (TYPO) GO TO 9008
                  IF (N.EQ.0) THEN
                     KOUNT = 0
                     WRITE(22,910)
                  ELSE
                     GO TO 9025
                  END IF
               END IF
            END IF
 9010    CONTINUE
         GO TO 9005
C
C           SELECT AND EXECTUE "TABLE" REQUEST
C
 9020    WRITE(22,912)
         WRITE(22,914)
         READ(21,901) ANS
         CALL CHECK(ANS,N,KOUNT,TYPO)
         IF (TYPO) GO TO 9020
         IF (N.EQ.0) RETURN
 9025    FLDNAME = FLD(N)
 9030    WRITE(22,915)
         WRITE(22,912)
         READ(21,901) ANS
         CALL CHECK(ANS,NUM,FIVE,TYPO)
         IF (TYPO) GO TO 9030
         IF (NUM.LE.3) THEN
 9040       CALL TABLIST(FLDNAME,FLDVAL,NUM)
            IF (NUM.LE.2) THEN
               IF (FLDVAL.EQ.' ') GO TO 9030
               CALL TABDEL(FLDNAME,FLDVAL,NUM)
               IF (NUM.EQ.1) THEN
                  CALL TABADD(FLDNAME)
                  GO TO 9040
               END IF
            END IF
         ELSE IF (NUM.EQ.4) THEN
            CALL TABADD(FLDNAME)
         ELSE IF (NUM.EQ.5) THEN
            GO TO 9000
         END IF
         GO TO 9030
```

END

```
      SUBROUTINE TABADD(FLDNAME)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER FLDNAME*10,FLDVAL*10
C
  801 FORMAT(A10)
  810 FORMAT(/3X,'ENTER FIELD VALUE'/
     *3X,'(AT MOST 10 CHARACTERS)')
C
C-------------------------------------------------------------
C        ADD A RECORD TO CATEGORY "TABLE"
C-------------------------------------------------------------
C
      WRITE(22,810)
      READ(21,801) FLDVAL
      A(1:10) = FLDNAME
      A(11:20) = FLDVAL
      LTR = 'A'
      CALL BTREE(LTR,TEN,A,MAXLEN,IREC,IERR)
      RETURN
      END
```

```
      SUBROUTINE TABDEL(FLDNAME,FLDVAL,NUM)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
         BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
         BYTE INA,INB,EXA,EXB,IO,IERR,NREF
         CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
         CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER FLDNAME*10,FLDVAL*10
C
  401 FORMAT(A3)
  410 FORMAT(/' REQUEST DENIED - REFERENCED BY CATEGORY ',A9)
  411 FORMAT(/3X,'PRESS THE "RETURN" KEY TO CONTINUE')
  412 FORMAT(/3X,'DO YOU WISH TO DELETE THE FIELD VALUE ',A10/
     *3X,'FROM THE FIELD NAMED ',A10,'?  (Y/N)')
  413 FORMAT(/3X,'DELETION REQUEST CANCELLED')
C
C-------------------------------------------------------------
C         DRIVER FOR DELETING A "TABLE" FIELD VALUE
C-------------------------------------------------------------
C
      A(1:10) = FLDNAME
      A(11:20) = FLDVAL
      LTR = 'G'
      CALL BTREE(LTR,TEN,A,MAXLEN,KEYREC,IERR)
C
C         CHECK FOR RELATED RECORDS
C
      LTR = 'F'
 4005 CALL BTREE(LTR,NINE,A,MAXLEN,IREC,IERR)
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 4035
      LTR = 'S'
      READ(19,HOW(9),REC=IREC) RECDATA
      CATNAME = RECDATA(1:9)
      NFIELD = VAL(RECDATA(20:21))
      CLOSE(UNIT=20)
      OPEN(UNIT=20,FILE=CATNAME//'.LAR',STATUS='OLD',
     *     FORM='FORMATTED',ACCESS='DIRECT')
      DO 4025 I=1,NFIELD
         READ(20,HOW(10),REC=I) RECDATA
         TITLE(I) = RECDATA(1:10)
         TYPE(I) = VAL(RECDATA(13:14))
         IF (TITLE(I).EQ.FLDNAME.AND.TYPE(I).EQ.4) THEN
            CALL OPENCAT
            LTR = 'F'
```

```
 4010        CALL BTREE(LTR,ONE,A,MAXLEN,IREC,IERR)
             IF (IERR.EQ.4.OR.IERR.EQ.5) THEN
                DO 4020 N=1,NREF
                   K = N + 10
                   CLOSE(UNIT=K)
 4020           CONTINUE
                GO TO 4025
             END IF
             READ(11,HOW(1),REC=IREC) RECDATA
             K = VAL(RECDATA(INA(I):INB(I)))
             IF (K.EQ.KEYREC) THEN
                WRITE(22,410) CATNAME
                CALL RECOUT
                CALL SHOWREC
                WRITE(22,411)
                READ(21,401) ANS
                RETURN
             END IF
             LTR = 'S'
             GO TO 4010
          END IF
 4025 CONTINUE
      LTR = 'S'
      GO TO 4005
C
C        DELETE A "TABLE" FIELD VALUE
C
 4035 IF (NUM.EQ.2) THEN
          WRITE(22,412) FLDVAL,FLDNAME
          READ(21,401) ANS
          IF (ANS(1:1).EQ.'Y') THEN
             GO TO 4040
          ELSE IF (ANS(1:1).EQ.'N') THEN
             WRITE(22,413)
             RETURN
          ELSE
             GO TO 4035
          END IF
      END IF
C
 4040 LTR = 'D'
      A(1:10) = FLDNAME
      A(11:20) = FLDVAL
      CALL BTREE(LTR,TEN,A,MAXLEN,IREC,IERR)
      RETURN
      END
```

```
      SUBROUTINE TABLIST(FLDNAME,FLDVAL,IND)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      COMMON /XXXBOSS/
     1   NFIELD,KEYFLD,CATNAME,RECDATA,A,NREF,LONG(20),
     2   IO(20),ANS,TYPE(20),FLD(20),TITLE(20),WHERE(20),
     3   ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,
     4   IERR,INA(20),INB(20),EXA(20),EXB(20),HOW(10),LTR
          BYTE ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN
          BYTE INA,INB,EXA,EXB,IO,IERR,NREF
          CHARACTER LTR*1,HOW*6,CATNAME*9,WHERE*9,TITLE*10
          CHARACTER ANS*3,A*20,FLD*100,RECDATA*256
C
      CHARACTER FLDNAME*10,FLDVAL*10,TEMP(20)*10
      LOGICAL*1 TYPO
C
  201 FORMAT(A3)
  210 FORMAT(/15X,'FIELD VALUES FOR ',A10//
     *10X,'NUMBER',10X,'FIELD VALUE'/)
  211 FORMAT(11X,I3,2X,A20)
  212 FORMAT(/)
  213 FORMAT(3X,'ENTER THE APPROPRIATE NUMBER OR')
  214 FORMAT(3X,'ENTER ZERO TO SEE MORE LIST')
  215 FORMAT(3X,'ENTER THE APPROPRIATE NUMBER')
  216 FORMAT(3X,'ENTER ZERO IF SATISFACTORY')
  217 FORMAT(3X,'ENTER ZERO TO CONTINUE')
C
C-------------------------------------------------------------
C         LIST ALL "TABLE" VALUES FOR A GIVEN FIELD
C-------------------------------------------------------------
C
      WRITE(22,210) FLDNAME
      KOUNT = 0
      LTR = 'G'
      A = FLDNAME
 2010 CALL BTREE(LTR,TEN,A,MAXLEN,IREC,IERR)
      LTR = 'S'
      IF (IERR.EQ.4.OR.IERR.EQ.5) GO TO 2020
      IF (A(1:10).EQ.FLDNAME) THEN
         KOUNT = KOUNT + 1
         TEMP(KOUNT) = A(11:20)
         WRITE(22,211) KOUNT,TEMP(KOUNT)
         IF (MOD(KOUNT,20).NE.0) GO TO 2010
 2015    WRITE(22,212)
         IF (IND.LE.2) WRITE(22,213)
         WRITE(22,214)
         READ(21,201) ANS
         CALL CHECK(ANS,N,KOUNT,TYPO)
         IF (TYPO) GO TO 2015
         IF (N.EQ.0) THEN
```

```
               KOUNT = 0
               GO TO 2010
            ELSE
               GO TO 2030
            END IF
         END IF
         GO TO 2010
C
 2020 WRITE(22,212)
         IF (IND.EQ.1) THEN
            WRITE(22,213)
            WRITE(22,216)
         ELSE IF (IND.EQ.2) THEN
            WRITE(22,215)
         ELSE IF (IND.EQ.3) THEN
            WRITE(22,217)
         END IF
         READ(21,201) ANS
         CALL CHECK(ANS,N,KOUNT,TYPO)
         IF (TYPO) GO TO 2020
         IF (N.EQ.0) THEN
            FLDVAL = ' '
            RETURN
         END IF
C
 2030 FLDVAL = TEMP(N)
         RETURN
         END
```

```
      SUBROUTINE CHECK(ANS,N,NMAX,TYPO)
C
      CHARACTER ANS*3,B*1
      LOGICAL*1 TYPO
C
  401 FORMAT(I<L>)
  410 FORMAT(/3X,'KEYSTROKE ERROR - TRY AGAIN')
C
C-------------------------------------------------------------
C         TRAP FOR A PARTICULAR CLASS OF TYPOGRAPHICAL ERRORS
C-------------------------------------------------------------
C
      TYPO = .FALSE.
      DO 4010 L=3,1,-1
         IF (ANS(L:L).NE.' ') GO TO 4020
 4010 CONTINUE
      TYPO = .TRUE.
      GO TO 4040
 4020 DO 4030 K=1,L
         B = ANS(K:K)
         IF (ICHAR(B).LT.48.OR.ICHAR(B).GT.57) TYPO = .TRUE.
 4030 CONTINUE
      IF (TYPO) GO TO 4040
      DECODE(L,401,ANS) N
      IF (N.GT.NMAX) TYPO = .TRUE.
 4040 IF (TYPO) WRITE(22,410)
      RETURN
      END
```

```
      FUNCTION ENDATE(WHEN)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      INTEGER*2 MCDF(12)
      CHARACTER MM*2,DD*2,YYYY*4,WHEN*10
C
      DATA MCDF/0,31,59,90,120,151,181,212,243,273,304,334/
C
  701 FORMAT(I<L>)
C
C-------------------------------------------------------------
C         CONVERT THE DATE GIVEN BY 'WHEN' INTO THE
C           NUMBER OF DAYS SINCE DECEMBER 31,1899
C-------------------------------------------------------------
C
      I = INDEX(WHEN,'/')
      L = 2
      IF (I.EQ.2) L = 1
      DECODE(L,701,WHEN(1:I-1)) MONTH
      J = INDEX(WHEN(I+1:10),'/') + I
      K = J - I
      L = 2
      IF (K.EQ.2) L = 1
      DECODE(L,701,WHEN(I+1:J-1)) DOM
      L = 4
      DECODE(L,701,WHEN(J+1:J+4)) YEAR
C
      DIFF = YEAR - 1900
      MANY = DIFF*365
      MANY = MANY + DIFF/4 - DIFF/100 + (DIFF+300)/400
      IF (MONTH.GT.2) THEN
         UNLEAP = 0
      ELSE IF (MOD(YEAR,400).EQ.0) THEN
         UNLEAP = 1
      ELSE IF (MOD(YEAR,100).EQ.0) THEN
         UNLEAP = 0
      ELSE IF (MOD(YEAR,4).EQ.0) THEN
         UNLEAP = 1
      ELSE
         UNLEAP = 0
      END IF
      ENDATE = MANY + MCDF(MONTH) + DOM - UNLEAP
      RETURN
      END
```

```
      FUNCTION DEDATE(MANY)
C
      IMPLICIT INTEGER*4 (A-Z)
C
      INTEGER*2 MCDF(12)
      CHARACTER MM*2,DD*2,YYYY*4,DEDATE*10
C
      DATA MCDF/0,31,59,90,120,151,181,212,243,273,304,334/
C
  801 FORMAT(I<L>)
C
C-------------------------------------------------------------
C         CONVERT NUMBER OF DAYS SINCE DECEMBER 31,1899
C                     INTO MONTH/DAY/YEAR
C-------------------------------------------------------------
C
      YEAR = 1900
 8010 IF (MOD(YEAR,400).EQ.0) THEN
         LEAP = 1
      ELSE IF (MOD(YEAR,100).EQ.0) THEN
         LEAP = 0
      ELSE IF (MOD(YEAR,4).EQ.0) THEN
         LEAP = 1
      ELSE
         LEAP = 0
      END IF
      DO WHILE (MANY.GT.365+LEAP)
         MANY = MANY - (365 + LEAP)
         YEAR = YEAR + 1
         GO TO 8010
      END DO
      J = 12
      DO WHILE (MANY.LE.MCDF(J))
         J = J - 1
      END DO
      MONTH = J
      DOM = MANY - MCDF(J)
      IF (DOM.EQ.0) THEN
         J = J - 1
         MONTH = J
         DOM = MCDF(J+1) - MCDF(J)
      END IF
      IF (MONTH.GT.2.AND.LEAP.EQ.1) THEN
         DOM = DOM - 1
         IF (DOM.EQ.0) THEN
            J = J - 1
            MONTH = J
            IF (MONTH.EQ.2) THEN
               DOM = 29
            ELSE
               DOM = MCDF(J+1) - MCDF(J)
```

```
            END IF
         END IF
      END IF
C
      L = 2
      IF (MONTH/10.EQ.0) L = 1
      ENCODE(L,801,MM) MONTH
      MML = L
      L = 2
      IF (DOM/10.EQ.0) L = 1
      ENCODE(L,801,DD) DOM
      DDL = L
      L = 4
      ENCODE(L,801,YYYY) YEAR
      DEDATE = MM(1:MML)//'/'//DD(1:DDL)//'/'//YYYY
      RETURN
      END
```

```
      FUNCTION CONVERT(A)

      CHARACTER A*15

501   FORMAT(I<L>)

-----------------------------------------------------------
         CONVERT A NUMBER IN STRING FORMAT INTO ITS REAL VALUE
-----------------------------------------------------------

      FRAC = 0.
      N = INDEX(A,' ')
      IF (N.EQ.0) THEN
         N = LEN(A)
      ELSE
         N = N - 1
      END IF

         INTEGER PORTION

      K = INDEX(A(1:N),'.')
      IF (K.EQ.0) THEN
         L = N
         DECODE(L,501,A) M
         X = M
      ELSE IF (K.EQ.1) THEN
         X = 0.
      ELSE
         L = K - 1
         DECODE(L,501,A(1:L)) M
         X = M
      END IF
      IF (K.EQ.0.OR.K.EQ.N) GO TO 5020

         FRACTIONAL PORTION

      KP1 = K + 1
      DO 5010 J=KP1,N
         Y = ICHAR(A(J:J)) - 48
         FRAC = FRAC + Y/10**(J-K)
010   CONTINUE

020   IF (A(1:1).EQ.'-') THEN
         X = M - FRAC
      ELSE
         X = M + FRAC
      END IF
      CONVERT = X
      RETURN
      END
```

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END

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