A Comparison of FMS and Sequential File Access Techniques

by

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The purpose of this paper is to report the results of a comparison of access times using a file management system, FMS, and ordinary sequential file techniques.* It is shown that substantial improvements in CP time can be gained over sequential methods by using FMS for certain types of file accesses.

Method of Comparison

In order to compare sequential access methods with FMS tree structure references, CP time was chosen as a quantitative measure for two reasons. First, CP time is easily accessed through the SYSLIB function, CPTIME. Secondly, PP time was fairly constant as a ratio to CP time. The range of the ratio PP/CP time was 25 to 30 with FMS averaging better than sequential methods.

File Initialization

The FMS file was set up to handle a maximum of 250 pages, four of which were reserved for the hash table. Each page consisted of eight 64-word PRU's, which was sufficient to hold one data entity. The system was called without the use of overlays and the entire set-up, access, and comparison program could be loaded with a core memory requirement of only 43200B words. The Extended Core Storage, ECS, facilities of FMS were not used in this comparison. No attempt to optimize slot size and other FMS parameters was made.

* FMS is described in "A General File Management System for the CDC 6600 User's Manual", Version II, UCC Technical Report Number 4, January, 1973, by Douglas A. Kellogg.

The Data Base

The data entities used in this file come from the 1970 U.S. Bureau of the Census First Count statistics for counties and minor civil divisions (MCD's) in the state of Minnesota. A subset of the entities, those for the Seven County Metropolitan Area, was chosen as a suitable data base for the comparison.

The records consist of approximately 400 data items and several geographical descriptors for each area. The entities are input from a sequential binary tape file containing 208 records. It includes the seven county records and the 201 MCD records for the MCD's contained in each county.

The tree structured file set-up using FMS also has a Seven County aggregate record and several dummy file pointer records which are created by the program. The input file was created from the Minnesota Analysis and Planning System (MAPS) data base.

The FMS Tree Structure

Since FMS allows simple and bi-directional (network) tree structure with references through pointers, as well as direct access by name, it was advantageous to represent the geographical relationship of various records in the file structure. The aggregate record points to a county file dummy and an MCD file dummy. The county and MCD file dummies point to the county and MCD records, respectively. The pointer structure of FMS allows one to access all of the records pointed to by a parent. In this case, either file can be accessed as a separate set of entities.

The geographical relationships are portrayed by having each county record point to the MCD records of the MCD's within that county and this allows access of MCD's by location according to county. This bi-directional tree structure is shown in figure 1.

The Accesses

Two types of accesses were made on the FMS and sequential files. The two were designed to represent typical MAPS requests for Census data. The first access involved retrieving one data item from each of two records, the first being a county, and the second an MCD within that county. This simulates a request by a local interest group wanting to compare their area with the county as a whole.

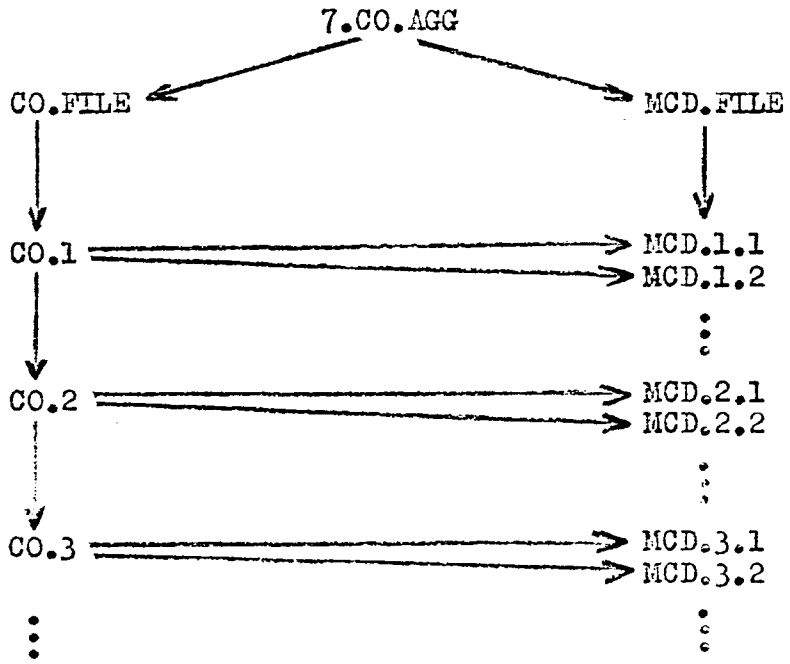

FIGURE 1

Using FMS, it involved calling GETLOC to get the disk address of the entity and GETHSH to return the data from that entity. In order to sequentially access the record, it is necessary to read each record and check for equality of geographical descriptors containing the county code and MCD code.

The second access involved retrieving one data item for every MCD within a given county. This request would be typical of a county planning agency. The sequential access was similar to the first in that every record was checked until all the county's MCD records had been located. FMS structures its pointers so that parent points to first child, first child points to second child, and so on until the last child points back to the first child. To access all MCD's in a county, GTPNTR was called to return the first child of the county and then successive calls to GETHSH for the data retrieval and GTPNTR for the pointer accessing until all the MCD's were found.

CP time was recorded for each type of access using both file accessing methods. The counties and MCD's selected were from the middle of the sequential file to simulate expected access time.

The Results

The results of CP timing on the file set-up and accesses is shown in figure 2. The numerical quantities can vary from one run to the next by a few percent due to system characteristics. The results are only meant to be a guide as to the range of access times for the methods compared.

Discussion

The obvious result is that FMS can access a given record, on the average, in much shorter time than a sequential search. When the number of accesses is on the order of 1% of the file size, FMS accesses a record about 20 times faster than sequential methods allow. Even when 25% of the records are accessed, FMS was about 30% faster.

Another clear result of the comparison is the high cost of set-up involved with FMS. However, this development cost can be made up by storing the file as a permanent file or by using the facility that allows the file to be stored on scratch tape.

FMS Set-up Costs	CP time	# Operations	Average Time
Input and Hash Entities	8.456	210	40 msec.
Set Pointers	12.162	411	30 msec.
Total Set-up	20.618 seconds		

ACCESS # 1 (2 records, about 1% of total file size)

	CP time	Average Time
FMS	.020 seconds	10 msec.
Sequential	.410 seconds	205 msec.

ACCESS # 2 (49 records, about 25% of total file size)

	CP time	Average Time
FMS	.338 seconds	6.9 msec.
Sequential	.444 seconds	9.5 msec.

FIGURE 2

F M S
F I L E A C C E S S

Some printed output has been condensed here to conserve paper.

```
      PROGRAM SCR (INPUT,OUTPUT,TAPE1)
C
C     ICOMSZ=25+64*8+3*(64*8*2+3)=3618
C
000003      COMMON /FMS/ IDUM(3618)
000003      COMMON IBAF(457),IPNTR(9)
000003      DIMENSION JAM(201),JAC(7),JDR(2)
000003      DIMENSION IN(454),IDL(3)
C
C     GET CP TIME FOR TIMING FILE SET-UP
C
000003      START=CPTIME(1,0)
C
C     OPEN FILE (NAME=7LFILE7CO) FOR READ AND WRITING (N=1)
C
000006      CALL OPNFLMG (1,7LFILE7CO)
C
C     4 PAGE HASH TABLE, 2 PARENTS, 8 PRU/PAGE, 250 TOTAL FILE SIZE
C
000010      CALL INIT1 (4,2,8,250,3618)
C
C     3 IN CORE SLOTS, 2 PAGES/SLOT, 457 WORDS/ENTITY (454+3), 9 POINTER WORDS
C
000014      CALL FILSLT (3,2,3618,457,9)
C
C     BLANK OUT IBAF
C
000020      DO 10 I=4,457
000022   10 IBAF(I)=10H
000025      IBAF(1)=457
000026      IBAF(3)=0
C
C     READ 7 COUNTY RECORDS
C
000027      DO 200 I=1,7
000031      READ (1) (IBAF(J),J=4,457)
C
C     AGGREGATE FOR 7 COUNTY RECORD
C
000042      DO 100 J=40,448
000044  100 IN(I)=IN(I)+IBAF(I+3)
C
C     NAMER (I,J,K) COMPOSES ENTITY NAMES K=(I),(J)
C
000050      J=3HCO.
000052      CALL NAMER (IBAF(32),J,IBAF(2))
C
C     GET DISK ADDRESS FOR ENTITY AND ADD TO FILE
C
000054      CALL GETLOC (IBAF,IFLAG,LOC)
000057      IF (IFLAG.NE.1) STOP 1111
000063      CALL ADHASH (IBAF,IPNTR,LOC)
C
C     STORE COUNTY POINTER IN JAC
C
000066  200 JAC(I)=IPNTR(1)
C
```

```
      C     ADD ENTITY NAME TO 7 COUNTY AGGREGATE AND ENTER IN FILE
      C
0072        IN(1)=1H0 $ IN(2)=2H27 $ IN(449)=5HMINN. $ IN(452)=8H7.CO.AGG
0100        IBAF(2)=8H7.CO.AGG
0102        DO 300 I=1,454
0103      300 IBAF(I,3)=IN(I)
0106        CALL GETLOC (IBAF,IFLAG,LOC)
0111        IF (IFLAG.NE.1) STOP 2222
0115        CALL ADHASH (IBAF,IPNTR,LOC)
      C
      C     STORE 7 COUNTY AGGREGATE RECORD POINTER
      C
0120        JJCO=IPNTR(1)
      C
      C     STORE DUMMY ENTITY FOR COUNTY FILE AND MCD FILE POINTERS
      C
0121        IBAF(4)=1H4 $ IBAF(455)=5HDUMMY
0124        IBAF(2)=7HCO.FILE
0126        CALL GETLOC (IBAF,IFLAG,LOC)
0131        IF (IFLAG.NE.1) STOP 3333
0135        CALL ADHASH (IBAF,IPNTR,LOC)
0140        JOR(1)=IPNTR(1)
0141        IBAF(2)=8HMCD.FILE
0143        CALL GETLOC (IBAF,IFLAG,LOC)
0146        IF (IFLAG.NE.1) STOP 4444
0152        CALL ADHASH (IBAF,IPNTR,LOC)
0155        JOR(2)=IPNTR(1)
      C
      C     READ 201 MCD RECORDS
      C
0157        DO 400 I=1,201
0160        READ (1) (IBAF(J),J=4,457)
      C
      C     COMPOSE ENTITY NAME, GET DISK ADDRESS, AND STORE IN FILE
      C
0171        CALL NAMER (IBAF(32),IBAF(10),IBAF(2))
0174        CALL GETLOC (IBAF,IFLAG,LOC)
0177        IF (IFLAG.NE.1) STOP 5555
0203        CALL ADHASH (IBAF,IPNTR,LOC)
      C
      C     STORE MCD POINTER IN JAM
      C
0206      400 JAM(I)=IPNTR(1)
      C
      C     PRINT OUT CURRENT TREE STRUCTURE
      C
 212        PRINT 17
 216        CALL SCOOP (0)
      C
      C     CALCULATE TIME TO HASH AND STORE ENTITIES
      C
 220        T1=CPTIME(1.0)-START
      C
      C     SET POINTER FROM COUNTY AND MCD FILE DUMMIES TO RESPECTIVE ENTITIES
      C
 223        DO 500 I=1,7
 224        CALL STPNTR (JOR(1),JAC(I),1)
 231      500 CONTINUE
```

```
0233          DO 600 I=1,201
0235          CALL STPNTR (JDR(2),JAM(I),2)
0240      600 CONTINUE
          C
          C     PRINT OUT CURRENT TREE STRUCTURE
          C
0242          PRINT 17
0244          CALL SCOOP (0)
          C
          C     SET POINTER FROM 7 COUNTY AGGREGATE TO MCD AND COUNTY FILES
          C
0250          CALL STPNTR (J7CO,JDR(1),0)
0253          CALL STPNTR (J7CO,JDR(2),0)
          C
          C     PRINT OUT CURRENT TREE STRUCTURE
          C
0256          PRINT 17
0262          CALL SCOOP (0)
          C
          C     SET POINTERS FROM COUNTIES TO THEIR MCD GROUPS
          C
0264          M=1
0265          DO 800 I=1,7
0267          READ 27, ICNT
0274          N=M+ICNT-1
0277          DO 700 J=M,N
0300          CALL STPNTR (JAC(I),JAM(J),4)
0303      700 CONTINUE
0306      800 M=N+1
          C
          C     PRINT OUT CURRENT TREE STRUCTURE
          C
0312          PRINT 17
0315          CALL SCOOP (0)
          C
          C     CALCULATE TIME TO SET POINTERS AND TOTAL SET-UP TIME
          C
0317          FINISH=CPTIME(1.0)
0321          T3=FINISH-START
0323          T2=T3-T1
          C
          C     ACCESS ONE COUNTY AND ONE MCD BY NAME (CO=053,MCD=053,110)
          C
0326          PRINT 37
0331          IBAF(2)=7H053,CO,
0333          CALL GETLOC (IBAF,IFLAG,LOC)
0335          IF (IFLAG.NE.0) STOP 6666
0340          CALL GETHSH (IBAF,IPNTR,LOC)
0343          PRINT 47, IBAF(2),IBAF(32),IBAF(10),IBAF(43)
0357          IBAF(2)=7H053,110
0361          CALL GETLOC (IBAF,IFLAG,LOC)
0363          IF (IFLAG.NE.0) STOP 6666
0366          CALL GETHSH (IBAF,IPNTR,LOC)
0371          PRINT 47, IBAF(2),IBAF(32),IBAF(10),IBAF(43)
0405          ACCESS1=CPTIME(1.0)-FINISH
          C
          C     ACCESS ALL MCDS IN ONE COUNTY (CO=053)
          C
```

```
000411          PRINT 37
000415          IBAF(2)=7H053,CO,
000417          CALL GETLOC (IBAF,IFLAG,LOC)
000421          IF (IFLAG.NE.0) STOP 7777
000424          IDL(1)=LOC
000425          IDL(2)=0
000427          CALL GTPNTR (IDL,ITYPE)
000431          ISTOP=IDL(2)
000433      900 CALL GETHSH (IBAF,IPNTR,IDL(2))
000436          PRINT 47, IBAF(2),IBAF(32),IBAF(10),IBAF(43)
000452          CALL GTPNTR (IDL,ITYPE)
000454          IF (IDL(2).NE.ISTOP) GO TO 900
000456          ACCESS2=CPTIME(1.0)-FINISH_ACCESS1
C
C       PRINT OUT TIMING RESULTS
C
000463          PRINT 57, T1,T2,T3,ACCESS1,ACCESS2
C
C       RUN COMPLETE
C
000501          STOP
000503       17 FORMAT (1H1)
000503       27 FORMAT (I10)
000503       37 FORMAT (1H1,4/,1X,*ACCESS RUN ON FILE MANAGEMENT SYSTEM*,4/,
     -              1X,*NAME       COUNTY    MCD        DATA WORD:*,4/)
000503       47 FORMAT (1X,3A10,I10)
000503       57 FORMAT (1H1,4/,1X,*TIMING DATA FOR ACCESS RUNS*,4/,
     -              6X,*TIME TO INPUT ENTITIES*,F10.3,*  SECONDS*,2/,
     -              6X,*TIME TO SET POINTERS*,F12.3,*  SECONDS*,2/,
     -              6X,*     TOTAL SET-UP TIME*,F10.3,*  SECONDS*,4/,
     -              6X,*TIME FOR ACCESS NUMBER ONE*,F7.3,*  SECONDS*,2/,
     -              6X,*TIME FOR ACCESS NUMBER TWO*,F7.3,*  SECONDS*)
000503          END
```

CR

PROGRAM LENGTH INCLUDING I/O BUFFERS
010254

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

0	- 000622	17	- 000606	27	- 000610	37	- 000612
47	- 000627	57	- 000632	100	- 000044	300	- 000103
400	- 000633						

BLOCK NAMES AND LENGTHS

FMS	- 007642	- 000722	

VARIABLE ASSIGNMENTS

ACCESS1	- 002150	ACCESS2	- 002105	FINISH	- 002157	I	- 002146
IMAF	- 000000C02	ICNT	- 002155	IDL	- 002142	IDUM	- 000000C01
IFLAG	- 002150	IN	- 001234	IPNTR	- 000711C02	ISTOP	- 002164
ITYPE	- 002143	J	- 002147	JAC	- 001223	JAM	- 000712
JOB	- 001202	J7CO	- 002152	LOC	- 002151	M	- 002154
T	- 002156	START	- 002145	T1	- 002153	T2	- 002161
T3	- 002160						

START OF CONSTANTS
000505

START OF TEMPORARIES
000732

START OF INDIRECTS
000706

UNUSED COMPILER SPACE
206400

SCOTT
STORAGE ALLOCATION.

ADDRESS	LENGTH
0	10
10	

BINARY CONTROL CARDS.

```
IDENT     SCOTT
END
```

ENTRY POINTS.

NAMER - 2

```
                                    IDENT   SCOTT
                                    ENTRY   NAMER
0  0000000000000555555      BLANK   DATA    3R
1  0000000000000000057      DEC     DATA    578
2  0000000000000000000      NAMER   DATA    0
3  56110                            SA1     B1
       56220                        SA2     B2
            43522                   MX5     18
                 11115              BX1     X1*X5
4  11225                            BX2     X2*X5
       5130000001 *                 SA3     DEC
                 20344              LX3     36
5  12313                            BX3     X1*X3
       20244                        LX2     36
            12323                   BX3     X2*X3
6  5140000000 *                     SA4     BLANK
            12643                   BX6     X4*X3
                 56630              SA6     B3
7  0400000002 *                     EQ      NAMER
10                                  END

                 40755  STORAGE USED          20 STATEMENTS     3 SYMBOLS
                        6600 ASSEMBLY       0.082 SECONDS       7 REFERENCES
```

SCOTT
SYMBOLIC REFERENCE TABLE.

BLANK	0	PROGRAM*	2/03 L	0.	2/16		6			
DEC	1	PROGRAM*	2/04 L	1.	2/11		4			
NAMER	2	PROGRAM*	2/02 E	0.	2/05 L		2.	2/19	7	

LOAD MAP.

LINK - VER 1. 06/07/73 18.41.38. PAGE 1
UNIVERSITY OF MINNESOTA (03/29/73)

CM NECESSARY TO LOAD 43200.
CM NECESSARY TO EXECUTE 33700.
INITIAL TRANSFER TO SCR 7145.

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE
/FMS/	102	7042	
SCR	7144	10254	LGO
SCOTT	17420	10	LGO
IA[illegible]1	17430	260	FMSLIB
FILSLT	17710	103	FMSLIB
SETSZ	20013	35	FMSLIB
PAGE	20050	1057	FMSLIB
PGFIND	21127	156	FMSLIB
FNENTY	21305	306	FMSLIB
GETLOC	21613	165	FMSLIB
DLGNG	22000	46	FMSLIB
ADHASH	22046	362	FMSLIB
GETHSH	22430	217	FMSLIB
SIENTR	22647	435	FMSLIB
FINBAR	23304	71	FMSLIB
SCROP	23375	470	FMSLIB
GTCNTR	24065	64	FMSLIB
FLMSG	24151	137	FMSLIB
FRMES	24310	162	FMSLIB
MOVWLK	24472	5	FMSLIB
FSSP	24477	12	FMSLIB
SHFMAS	24511	31	FMSLIB
MOVPNT	24542	22	FMSLIB
IHASH	24564	24	FMSLIB
LFR	24610	1	FMSLIB
CPC	24611	242	SYSLIB
CPUSYS	25053	36	SYSLIB
GETBA	25111	17	SYSLIB
IBPUTB	25130	246	SYSLIB
IBPUTC	25376	126	SYSLIB
KOOER	25524	1217	SYSLIB
KRAKER	26743	1036	SYSLIB
DUEPTC	30001	73	SYSLIB
SIOS	30074	1320	SYSLIB
/SENVAR./	31414	0	
/SCOPE2/	31414	0	
SYSTEM	31414	1157	SYSLIB
[illegible]RSHFT	32573	6	SYSLIB
TIMDAT	32601	104	SYSLIB
//	32705	722	

FIRST CALL TO SCOOP:

019.CO.
037.CO.
123.CO.
139.CO.
7.CO.AGG
003.005
003.015
003.025
003.035
003.045
003.055
003.065
003.075
003.085
003.095
019.105
019.115
019.125
037.002
037.071
037.105
037.106
037.115
037.125
037.135
037.145
037.155
037.165
037.175
053.010
053.020
053.030
053.040
053.050
053.060
053.070
053.080
053.090
053.151
053.205
053.215
053.225
053.235
053.245
139.082
163.010
163.020
163.030
163.040
163.050
163.060
163.070
163.080
163.090
163.182
163.191
003.CO.
003.081
003.108
019.020
019.030
019.040
019.050
019.060
019.070
019.080
019.090
037.010
037.020
037.030
037.040
037.050
037.060
037.080
037.090
053.100
053.110
053.120
053.130
053.140
053.160
053.170
053.180
053.190
123.010
123.020
123.030
123.040
123.050
123.060
123.070
123.080
139.010
139.020
139.030
139.050
139.060
139.070
139.080
139.090
163.100
163.110
163.120
163.150
163.160
163.170
163.180
CO.FILE
MCD.FILE
003.020
003.030
003.040
003.050
003.060
003.070
003.080
003.090
019.100
019.110
019.120
037.110
037.120
037.130
037.140
037.150
037.160
037.170
037.180
053.005
053.015
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053.139
053.200
053.210
053.220
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053.240
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163.065
163.068
163.075
163.078
163.095
053.CO.
163.CO.
003.110
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019.045
019.055
019.065
019.075
019.085
019.095
037.006
037.015
037.025
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037.045
037.055
037.095
053.105
053.115
053.125
053.135
053.165
053.175
053.185
053.195
123.005
123.015
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123.035
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123.055
123.065
123.073
123.085
123.095
139.005
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163.155
163.165
163.175
163.185

7.CO.AGG
CO.FILE
003.CO.
019.CO.
037.CO.
053.CO.
123.CO.
139.CO.
163.CO.
MCD.FILE
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037.106
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037.120
037.125
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037.165
037.170
037.175
037.180
053.005
053.010
053.015
053.020
053.025
053.026
053.030
053.035
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053.210
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053.230
053.235
053.240
053.245
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123.010
123.015
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123.025
123.030
123.035
123.040
123.045
123.050
123.055
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123.065
123.070
123.075
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123.085
123.095
123.100
139.005
139.010
139.015
139.020
139.025
139.030
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139.045
139.050
139.055
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139.065
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139.075
139.080
139.082
139.085
139.090
163.005
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163.180
163.182
163.185
163.191

SECOND CALL TO SCOOP

THIRD CALL TO SCOOP:

7.CO.AGG

CO.FILE

003.CO.
019.CO.
037.CO.
053.CO.
123.CO.
139.CO.
163.CO.

MCD.FILE

003.005
003.015
003.020
003.025
003.030
003.035
003.040
003.045
003.050
003.051
003.055
003.060
003.065
003.070
003.075
003.080
003.085
003.090
003.095
003.106
003.110
019.005
019.015
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FOURTH CALL TO SCOOP:

CCESS RUN ON FILE MANAGEMENT SYSTEM

NAME	COUNTY	MCD	DATA WORD:
053.CO.	053		960080
053.110	053	110	340

ACCESS RUN O(FILE MANAGEMENT SYSTEM

NAME	COUNTY	MOD	DATA WORD:
053.005	053	005	81970
053.010	053	010	35173
053.015	053	015	26230
053.020	053	020	2429
053.025	053	025	2275
053.026	053	026	40
053.030	053	030	1656
053.035	053	035	30925
053.040	053	040	2162
053.045	053	045	469
053.050	053	050	3853
053.056	053	056	6938
053.060	053	060	44046
053.065	053	065	2563
053.070	053	070	24246
053.075	053	075	977
053.080	053	080	587
053.085	053	085	96
053.090	053	090	917
053.095	053	095	13428
053.100	053	100	1993
053.105	053	105	1506
053.110	053	110	340
053.115	053	115	6275
053.120	053	120	1169
053.125	053	125	930
053.130	053	130	2396
053.135	053	135	434400
053.139	053	139	586
053.140	053	140	35776
053.151	053	151	2878
053.160	053	160	7572
053.165	053	165	23180
053.170	053	170	6787
053.175	053	175	2908
053.180	053	180	17593
053.185	053	185	47231
053.190	053	190	16845
053.195	053	195	162
053.200	053	200	544
053.205	053	205	6886
053.210	053	210	685
053.215	053	215	48883
053.220	053	220	4223
53.225	053	225	1087
53.230	053	230	1397
53.235	053	235	3700
53.240	05	240	544
53.245	05	245	624

TIMING DATA FOR ACCESS RUNS

TIME TO INPUT ENTITIES	8.456	SECONDS
TIME TO SET POINTERS	12.162	SECONDS
TOTAL SET-UP TIME	20.618	SECONDS

TIME FOR ACCESS NUMBER ONE	.020	SECONDS
TIME FOR ACCESS NUMBER TWO	.338	SECONDS

```
 06/07/73  UCC - UNIVERSITY OF MINNESOTA (05JUN73) MOMS 1.0.
R.38.59.JOBLDEN
R.38.59.JOB WAS RERUN
R.38.59.JOB,T=0,CM45000.          ,1     FMS
R.38.59.SCOTT ROBBINS
R.38.59.BIN,L=09007
R.39.00.RUN(S)
R.39.00.REQUEST,TAPE1,HI,DW,SN 1290 MAPS
R.41.33.  (55 ASSIGNED)
R.41.33.P,TAPE1.
R.41.34.P,A,FMSLIB,UCC003,UN=#-----#.
R.41.34.LOAD(LGO,FMSLIB)
R.41.34.EXECUTE.
R.45.58.ROLLOUT COMPLETED.  (FL  33700)
R.48.14.ROLLIN COMPLETED.
S.02.14.ROLLOUT COMPLETED.  (FL  33700)
S.05.13.ROLLIN COMPLETED.
S.11.33.STOP
S.11.34.
S.11.34.   CPU SEC.   PPU SEC.   FCS SEC.
S.11.35.     22.081    537.453      3.281
S.11.35.
S.11.35.   CPU CHG.   PPU CHG.   FCS CHG.
S.11.35.      3.31  +    11.18  +     0.49  =     $ 14.98

 007037 PAGES LP21 JOBLDEN  //// END OF LIST ////
```

SEQUENTIAL
FILE ACCESS

Some printer output has been condensed here to conserve paper.

```
000000          PROGRAM SEQ (INPUT,OUTPUT,TAPE1)
000003          DIMENSION IN(454)
                C
                C     ACCESS ONE COUNTY AND ONE MCD BY NAME (CO=053,MCD=053.110)
                C
000003          START=CPTIME(1.0)
000006          PRINT 17
000011      100 READ (1) IN
000016          IF (EOF,1) 400,200
000021      200 IF (IN(29).EQ.3H053.AND.IN(7).EQ.3H    ) GO TO 300
000031          IF (IN(29).EQ.3H053.AND.IN(7).EQ.3H110) GO TO 300
000040          IF (IN(29).EQ.3H053.AND.IN(7).EQ.115) GO TO 400
000047          GO TO 100
000047      300 PRINT 27, IN(29),IN(7),IN(40)
000061          GO TO 100
000062      400 ACCESS1=CPTIME(1.0)-START
                C
                C      ACCESS ALL MCDS IN ONE COUNTY (CO=053)
                C
000066          REWIND 1
000070          START=CPTIME(1.0)
000073          PRINT 17
000076      600 READ (1) IN
000103          IF (EOF,1) 800,600
000106      700 IF (IN(29).EQ.3H053.AND.IN(7).NE.3H    ) GO TO 700
000116          IF (IN(29).EQ.3H053.AND.IN(7).EQ.005) GO TO 800
000125          GO TO 500
000125      800 PRINT 27, IN(29),IN(7),IN(40)
000137          GO TO 500
000140      900 ACCESS2=CPTIME(1.0)-START
                C
                C      PRINT OUT TIMING RESULTS
                C
000144          PRINT 37, ACCESS1,ACCESS2
                C
                C     RUN COMPLETE
                C
000154          STOP
000156       17 FORMAT (1H1,4/,1X,*ACCESS RUN ON SEQUENTIAL FILE*,4/,
                -         1X,*           COUNTY     MCD        DATA WORD:*,4/)
000156       27 FORMAT (11X,2A10,I10)
000156       37 FORMAT (1H1,4/,1X,*TIMING DATA FOR ACCESS RUNS*,4/,
                -         6X,*TIME FOR ACCESS NUMBER ONE*,F7.3,*  SECONDS*,2/,
                -         6X,*TIME FOR ACCESS NUMBER TWO*,F7.3,*  SECONDS*)
000156          END
```

PROGRAM LENGTH INCLUDING I/O BUFFERS
007267

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

17	-	000214	27	-	000231	37	-	000234	100	-	000011
200	-	000021	300	-	000047	400	-	000062	500	-	000076
600	-	000106	700	-	000125	800	-	000140			

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

ACCESS1	-	001177	ACCESS2	-	001200	IN	-	000270	START	-	001176

START OF CONSTANTS
000160

START OF TEMPORARIES
000260

START OF INDIRECTS
000270

UNUSED COMPILER SPACE
005700

LOAD MAP.

CM NECESSARY TO LOAD 23400.
CM NECESSARY TO EXECUTE 14300.
INITIAL TRANSFER TO SEQ 103.

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE
SEQ	102	7267	LGO
C.OSYS	7371	36	SYSLIB
GETBA	7427	17	SYSLIB
IBERR	7446	60	SYSLIB
INPUTB	7526	246	SYSLIB
[illegible]	7774	1217	SYSLIB
OUTPTC	11213	73	SYSLIB
PRNTNM	11306	62	SYSLIB
SLIB	11370	1320	SYSLIB
/[illegible]VAR./	12710	0	
/SCOPE2/	12710	0	
SYSTEM	12710	1157	SYSLIB
TIMDAT	14067	104	SYSLIB

ACCESS RUN ON SEQUENTIAL FILE

COUNTY	MCD	DATA WORD:
053		960080
053	110	340

ACCESS MODE ON SEQUENTIAL FILE

COUNTY	MCD	DATA WORD:
053	005	81970
053	010	35173
053	015	26230
053	020	2429
053	025	2275
053	026	40
053	030	1656
053	035	30925
053	040	2162
053	045	469
053	050	3853
053	056	6938
053	060	44046
053	065	2563
053	070	24246
053	075	977
053	080	587
053	085	96
053	090	917
053	095	13428
053	100	1993
053	105	1506
053	110	340
053	115	6275
053	120	1169
053	125	930
053	130	2396
053	135	434400
053	139	586
053	140	35776
053	151	2878
053	160	7572
053	165	23180
053	170	6787
053	175	2908
053	180	17593
053	185	47231
053	190	16845
053	195	162
053	200	544
053	205	6886
053	210	685
053	215	48883
053	220	4223
053	225	1087
053	230	1397
053	235	3700
053	240	544
053	245	624

TIMING DATA FOR ACCESS RUNS

TIME FOR ACCESS NUMBER ONE .410 SECONDS

TIME FOR ACCESS NUMBER TWO .444 SECONDS

```
  06/05/73 .UCC - UNIVERSITY OF MINNESOTA (05JUN73) MOMS 1.0.
14.41.34.[illegible]2121
14.41.34.[illegible].T20.          .1     FMS
14.41.34.SCOTT ROBBINS
14.41.34.[illegible].LAD9007
14.41.34.PWR(S)
14.41.41.REQUEST.TAPE1.HI.DW.SN 1290 MAPS
14.43.02.  (52 ASSIGNED)
14.43.02.R.TAPE1.
14.43.02.[illegible].
14.43.44.[illegible]JOB
14.43.49.
14.43.49.   CPU SEC.   PPU SEC.   FCS SEC.
14.43.49.      1.212     36.929      0.591
14.43.49.
14.43.49.   CPU CHG.   PPU CHG.   FCS CHG.
14.43.49.     * 0.18 +     0.76 +     0.08 =      $ 1.02

  PAGES PRINTED   000009
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