Appendix B
Converting from PC/370 to MVS/ESA

Objectives

Upon completion of this chapter you will be able to:
- Describe the differences between the DOS commands used with PC/370 and the JCL commands used with MVS/ESA,
- Describe the use of ANSI carriage control characters, and
- Convert a PC/370 program to MVS/ESA.

Introduction

Two programs from this text, TEACH2A.MLC and TEACH8A.MLC, will be used to demonstrate the steps necessary to convert source code from PC/370 to assembly language for MVS/ESA compatible machines.

* *

First, we will look at TEACH2A.MLC. Recall that this program lists the teacher records. There are no page headings in this program. The changes needed to assemble this program on MVS/ESA compatible machines are trivial. The new listing is on the next page. All changes have been highlighted. Several of the changes apply to internal documentation and WTOs only, and so will not be discussed. Most changes relate to file processing and include the OPEN macros, DCB macros, and record layouts.

The OPEN Macro

Keep in mind that when working within the MVS/ESA environment, all data is (typically) stored in EBCDIC format. Consequently, the OI (Or Immediate) instruction, with which we have always preceded the OPEN, is no longer used. The two OI instructions used in the PC/370 version of this program have been dropped. The format of the OPEN macro itself is different: you must indicate the DCB name *as well as the file mode*. For example:

```
         OPEN   (TEACHERS,INPUT)
         OPEN   (REPORT,OUTPUT)
```

The DCB Macro

The DCB macro for MVS/ESA is actually simpler than in PC/370. First, we add DSORG=PS (data set organization is physical sequential). Optionally, we remove the RECFM and LRECL parameters as these are typically specified in the JCL (Job Control Language, shown later) or taken from the system catalog entries for the target data sets at run time. (These parameters can be kept in the program provided they do not conflict with the values obtained from the JCL or system catalog. If they conflict, then a run time error is likely.) The MACRF parameter is changed from MACRF=G to

MACRF=GM (get move, for input) or from MACRF=P to MACRF=PM (put move, for output). The DDNAME parameter, rather than giving a DOS file specification, indicates the associated DDNAME on the JCL. The DDNAME is not in apostrophes. For example:

```
         PRINT NOGEN
*****************************************************************
*        FILENAME:  B1973BQ.TRAINING.ASM(TEACH2A)               *
*        AUTHOR  :  Bill Qualls                                 *
*        SYSTEM  :  IBM MVS/ESA Compatible                      *
*        REMARKS :  A quick-and-dirty list of teachers.         *
*****************************************************************
         START 0
         REGS
BEGIN    BEGIN
         WTO   'TEACH2A ... Begin execution'
         OPEN  (TEACHERS,INPUT)
         OPEN  (REPORT,OUTPUT)
LOOP     GET   TEACHERS,IREC      Read a single teacher record
         MVC   OTID,ITID          Move teacher ID Nbr to output
         MVC   OTNAME,ITNAME      Move teacher Name to output
         MVC   OTDEG,ITDEG        Move highest degree to output
         MVC   OTTEN,ITTEN        Move tenure to output
         MVC   OTPHONE,ITPHONE    Move phone nbr to output
         PUT   REPORT,OREC        Write report line
         B     LOOP
*
*        EOJ processing
*
ATEND    CLOSE TEACHERS
         CLOSE REPORT
         WTO   'TEACH2A ... Teacher list on //REPORT'
         WTO   'TEACH2A ... Normal end of program'
         RETURN
*
*        Literals, if any, will go here
*
         LTORG
*
*        File definitions
*
TEACHERS DCB   DSORG=PS,MACRF=GM,EODAD=ATEND,DDNAME=TEACHERS
REPORT   DCB   DSORG=PS,MACRF=PM,DDNAME=REPORT
*
*        Miscellaneous field definitions
*
*
*        Input record definition
*
IREC     DS    0CL80              Teacher record
ITID     DS    CL3                Teacher ID nbr
ITNAME   DS    CL15               Teacher name
ITDEG    DS    CL4                Highest degree
ITTEN    DS    CL1                Tenured?
ITPHONE  DS    CL4                Phone nbr
         DS    CL53
```

(continued)

```
*
*        Output (line) definition
*
OREC     DS    0CL60
OTID     DS    CL3                Teacher ID nbr
         DC    CL3' '
OTNAME   DS    CL15               Teacher name
         DC    CL3' '
OTDEG    DS    CL4                Highest degree
         DC    CL3' '
OTTEN    DS    CL1                Tenured?
         DC    CL3' '
OTPHONE  DS    CL4                Phone nbr
         DC    CL21' '
         END   BEGIN
```

No More CR/LF

The carriage return/line feed which we have had to accommodate in most of our PC/370 programs is *not* used in MVS/ESA. It is a PC consideration only, and so it is dropped from the program. All of our programs have used fixed length records. Input files of the type we have used are typically stored as members of a PDS (Partitioned Data Set), the mainframe equivalent to a PC directory. All members of the same PDS have the same record length, often 80. The input record layout has been changed to reflect its new length:

```
IREC     DS    0CL80              Teacher record
ITID     DS    CL3                Teacher ID nbr
ITNAME   DS    CL15               Teacher name
ITDEG    DS    CL4                Highest degree
ITTEN    DS    CL1                Tenured?
ITPHONE  DS    CL4                Phone nbr
         DS    CL53
```

The output will usually *not* be written to a PDS, but rather to a sequential file on disk or tape, or to a print spool where it will be held (and may be viewed) until it is released for printing or is purged. The output record in this program has been changed to remove the CR/LF and have a total record length at 60:

```
OREC     DS    0CL60
OTID     DS    CL3                Teacher ID nbr
         DC    CL3' '
OTNAME   DS    CL15               Teacher name
         DC    CL3' '
OTDEG    DS    CL4                Highest degree
         DC    CL3' '
OTTEN    DS    CL1                Tenured?
         DC    CL3' '
OTPHONE  DS    CL4                Phone nbr
         DC    CL21' '
```

Be aware that the REGS, BEGIN, and RETURN macros are installation specific. Your company will have equivalent macros already defined, perhaps even with the same name.

Job Control Language

In the MVS/ESA world, JCL (Job Control Language) is used to run batch jobs. (Recall that batch jobs are those jobs which run unattended, as opposed to online programs which respond to a user's commands entered at a terminal.) The assembly and link steps are run in a batch mode, just as they are in PC/370. The following JCL will assemble and link program TEACH2A:

```
//B1973BQX JOB (1973,B1973BQ),'BILL QUALLS',
//           CLASS=A,NOTIFY=B1973BQ,MSGCLASS=X
//*
//ASM    EXEC PGM=ASMA90,PARM='NODECK,OBJECT'
//SYSLIB   DD DSN=B1973BQ.TRAINING.MACLIB,DISP=SHR
//         DD DSN=SYS1.MACLIB,DISP=SHR
//SYSUT1   DD DSN=&SYSUT1,SPACE=(1024,(120,120)),UNIT=VIO
//SYSLIN   DD DSN=&&OBJ,DISP=(,PASS),SPACE=(CYL,(5,1)),UNIT=VIO,
//            DCB=(BLKSIZE=3040,LRECL=80,RECFM=FBS,BUFNO=1)
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DSN=B1973BQ.TRAINING.ASM(TEACH2A),DISP=SHR
//*
//LINK   EXEC PGM=HEWL,COND=(4,LT,ASM)
//SYSLIN   DD DSN=&&OBJ,DISP=(OLD,DELETE)
//SYSLMOD  DD DSN=B1973BQ.TRAINING.LOADLIB(TEACH2A),DISP=SHR
//SYSLIB   DD DSN=SYS1.LINKLIB,DISP=SHR
//SYSUT1   DD DSN=&SYSUT1,SPACE=(1024,(120,120),,,ROUND),UNIT=VIO
//SYSPRINT DD SYSOUT=*
```

The format of the JOB card is installation specific: yours will probably differ slightly. The program name for the assemble and link steps (ASMA90 and HEWL above) will also likely differ. The file (or PDS and member) containing the source code is specified on the SYSIN DD of the assembly step. The file (or PDS and member) to contain the load module is specified on the SYSLMOD DD of the link step. The JCL can be likened to the steps we have used to link and execute our PC/370 programs as follows:

	PC/370	MVS/ESA
Step(s)	m370, a370	//ASM EXEC PGM=ASMA90
Source file (input)	TEACH2A.MLC	B1973BQ.TRAINGING.ASM(TEACH2A)
Assembly listing (output)	TEACH2A.PRN	SYSOUT=*
Object code (output)	TEACH2A.OBJ	&&OBJ (a temporary data set)
Step	l370	//LINK EXEC PGM=HEWL
Object code (input)	TEACH2A.OBJ	&&OBJ
Executable code (output)	TEACH2A.COM	B1973BQ.TRAINING.LOADLIB(TEACH2A)

In order to execute the program, JCL is used to assign each DDNAME (from the DCB macro in the program) to a file or device. This is not unique to assembly language programming: a DD entry would be used for each ASSIGN TO clause in a COBOL program. The following JCL will execute program TEACH2A:

```
//B1973BQA JOB (1073,B1973BQ),'BILL QUALLS',
//           CLASS=A,NOTIFY=B1973BQ,MSGCLASS=X
//TEACH2A EXEC PGM=TEACH2A
//STEPLIB  DD DSN=B1973BQ.TRAINING.LOADLIB,DISP=SHR
//TEACHERS DD DSN=B1973BQ.TRAINING.DATA(TEACHER),DISP=SHR
//REPORT   DD SYSOUT=*,DCB=(RECFM=FB,LRECL=60,BLKSIZE=0)
```

The STEPLIB uses as its DSN the same DSN as the //SYSLMOD of the LINK step. The member name is not included, as it is taken from the PGM name.

The DCB parameters are typically specified for output files only: for input files these values are taken from the system catalog or file header. When the DCB parameters are given, for fixed length records (RECFM=FB) the block size (BLKSIZE) must be a multiple of the record length (LRECL). In some installations, the operating system will determine the optimal BLKSIZE for the specified device if BLKSIZE=0 is used.

To the new user, JCL may seem cumbersome. But it does have some advantages over the methods used in PC/370. In particular, with PC/370, if we want to run the same program with a different file, we must change the filename on the DDNAME parameter of the DCB, reassemble, relink, and execute. With JCL, we change the filename (DSN) on the JCL only: the program is unchanged.

ANSI Carriage Control

The next program we will look at is TEACH8A. Like TEACH2A, this program produces a list of the teachers. However, this program also includes headings and page break logic. When a program produces a report with headings and page break logic, there are additional changes that need to be made to the program, above and beyond those shown in TEACH2A.

These changes have to do with how mainframe printers control form feed and line spacing. Mainframe printers typically make use of ANSI carriage control. According to this standard, the first position of the output record is reserved for the carriage control character as follows:

First position of record	Advance (before printing)
b (blank)	One line (single spacing)
0 (zero)	Two lines (double spaced)
- (hyphen)	Three lines (triple spaced)
+ (plus)	Zero lines (overwrite; suppress spacing)
1 (one)	To top of page

The DCB parameter RECFM=FBA indicates ANSI carriage control is being used.

The new listing is on the next page. All changes have been highlighted. Notice that all references to CR/LF have been removed. The first position of each output record has been reserved for the carriage control character. All references to FORMFEED have been removed, and the carriage

control character for `HD1` is `'1'` indicating advance to top of page before printing. `HD2` was originally used to provide a blank line between `HD1` and `HD3`. It could have been retained, but instead it has been removed and the carriage control character for `HD3` is `'0'` indicating advance two lines before printing.

Note: Mainframe reports are typically 133 characters wide, with the first byte reserved for the carriage control character and the remaining 132 bytes for the data.

```
         PRINT NOGEN
*****************************************************************
*        FILENAME:  B1973BQ.TRAINING.ASM(TEACH8A)               *
*        AUTHOR  :  Bill Qualls                                 *
*        SYSTEM  :  IBM MVS/ESA Compatible                      *
*        REMARKS :  This is a revision of TEACH2C.MLC.          *
*                   Produce list of teachers, with headings.    *
*                   Introduce page break logic.                 *
*****************************************************************
         START 0
         REGS
BEGIN    BEGIN
         WTO   'TEACH8A ... Begin execution'
         BAL   R10,SETUP
MAIN     EQU   *
         CLI   EOFSW,C'Y'
         BE    EOJ
         BAL   R10,PROCESS
         B     MAIN
EOJ      EQU   *
         BAL   R10,WRAPUP
         WTO   'TEACH8A ... Normal end of program'
         RETURN
*****************************************************************
*        SETUP - Those things which happen one time only,       *
*                  before any records are processed.            *
*****************************************************************
SETUP    EQU   *
         ST    R10,SVSETUP
         OPEN  (TEACHERS,INPUT)
         OPEN  (REPORT,OUTPUT)
         BAL   R10,READ
         L     R10,SVSETUP
         BR    R10
*****************************************************************
*        HDGS - Print headings.                                 *
*****************************************************************
HDGS     EQU   *
         ST    R10,SVHDGS
         AP    PGS,=P'1'          Add 1 to page count
         MVC   HDPGS,=X'40202120' Edit pattern for page count
         ED    HDPGS,PGS          Move page count to heading
         PUT   REPORT,HD1          PUT REPORT,FORMFEED dropped
         PUT   REPORT,HD3          PUT REPORT,HD2 dropped
```

(continued)

```
         PUT   REPORT,HD4
         ZAP   LNS,=P'0'          Reset line count to zero
         L     R10,SVHDGS
         BR    R10
*****************************************************************
*        PROCESS - Those things which happen once per record.   *
*****************************************************************
PROCESS  EQU   *
         ST    R10,SVPROC
         BAL   R10,FORMAT
         BAL   R10,CHKLNS
         BAL   R10,WRITE
         BAL   R10,READ
         L     R10,SVPROC
         BR    R10
*****************************************************************
*        READ - Read a record.                                  *
*****************************************************************
READ     EQU   *
         ST    R10,SVREAD
         GET   TEACHERS,IREC      Read a single teacher record
         B     READX
ATEND    EQU   *
         MVI   EOFSW,C'Y'
READX    EQU   *
         L     R10,SVREAD
         BR    R10
*****************************************************************
*        FORMAT - Format a single detail line.                  *
*****************************************************************
FORMAT   EQU   *
         ST    R10,SVFORM
         MVC   OTID,ITID          Move teacher ID Nbr to output
         MVC   OTNAME,ITNAME      Move teacher Name to output
         MVC   OTDEG,ITDEG        Move highest degree to output
         MVC   OTTEN,ITTEN        Move tenure to output
         MVC   OTPHONE,ITPHONE    Move phone nbr to output
         L     R10,SVFORM
         BR    R10
*****************************************************************
*        CHKLNS - Check lines printed. Full page?               *
*****************************************************************
CHKLNS   EQU   *
         ST    R10,SVCHKLNS
         CP    LNS,MAXLNS
         BL    CHKLNSX
         BAL   R10,HDGS
CHKLNSX  EQU   *
         L     R10,SVCHKLNS
         BR    R10
*****************************************************************
*        WRITE - Write a single detail line.                    *
*****************************************************************
WRITE    EQU   *
         ST    R10,SVWRITE
         PUT   REPORT,OREC        Write report line
         AP    LNS,=P'1'
         L     R10,SVWRITE
         BR    R10
```

(continued)

```
*****************************************************************
*        WRAPUP - Those things which happen one time only,      *
*                 after all records have been processed.        *
*****************************************************************
WRAPUP   EQU   *
         ST    R10,SVWRAP
         CLOSE TEACHERS
         CLOSE REPORT
         WTO   'TEACH8A ... Teacher list on //REPORT'
         L     R10,SVWRAP
         BR    R10
*****************************************************************
*        Literals, if any, will go here                         *
*****************************************************************
         LTORG
*****************************************************************
*        File definitions                                       *
*****************************************************************
TEACHERS DCB   DSORG=PS,MACRF=GM,EODAD=ATEND,DDNAME=TEACHERS
REPORT   DCB   DSORG=PS,MACRF=PM,DDNAME=REPORT
*****************************************************************
*        RETURN ADDRESSES                                       *
*****************************************************************
SVSETUP  DC    F'0'               SETUP
SVHDGS   DC    F'0'               HDGS
SVPROC   DC    F'0'               PROCESS
SVREAD   DC    F'0'               READ
SVFORM   DC    F'0'               FORMAT
SVWRITE  DC    F'0'               WRITE
SVWRAP   DC    F'0'               WRAPUP
SVCHKLNS DC    F'0'               CHKLNS
*****************************************************************
*        Miscellaneous field definitions                        *
*****************************************************************
EOFSW    DC    CL1'N'             End of file? (Y/N)
PGS      DC    PL2'0'             Nbr of pages printed.
LNS      DC    PL2'3'             Lines printed on this page.
MAXLNS   DC    PL2'3'             Max nbr lines per page.
*                                 My line counts exclude hdgs.
*****************************************************************
*        Input record definition                                *
*****************************************************************
IREC     DS    0CL80              Teacher record
ITID     DS    CL3                Teacher ID nbr
ITNAME   DS    CL15               Teacher name
ITDEG    DS    CL4                Highest degree
ITTEN    DS    CL1                Tenured?
ITPHONE  DS    CL4                Phone nbr
         DS    CL53
*****************************************************************
*        Output (line) definition                               *
*****************************************************************
OREC     DS    0CL60
OCC      DC    CL1' '             Carriage Control
OTID     DS    CL3                Teacher ID nbr
         DC    CL3' '
OTNAME   DS    CL15               Teacher name
         DC    CL3' '
OTDEG    DS    CL4                Highest degree
         DC    CL3' '
```

(continued)

```
OTTEN    DS    CL1                Tenured?
         DC    CL3' '
OTPHONE  DS    CL4                Phone nbr
         DC    CL20' '
*
*        Headings definitions
*
HD1      DS    0CL60
         DC    CL1'1'
         DC    CL40'            LIST OF TEACHERS        Page'
HDPGS    DC    CL4'BZZ9'
         DC    CL15' '
HD3      DS    0CL60
         DC    CL1'0'
         DC    CL40'ID#        Name          Degr  Ten  Phone'
         DC    CL19' '
HD4      DS    0CL60
         DC    CL1' '
         DC    CL40'---   ---------------   ----  ---  -----'
         DC    CL19' '
         END   BEGIN
```

The JCL to execute program `TEACH8A` is as follows. Note the `RECFM=FBA` parameter indicating that ANSI carriage control is being used.

```
//B1973BQX JOB (1973,B1973BQ),'BILL QUALLS',
//           CLASS=A,NOTIFY=B1973BQ,MSGCLASS=X
//TEACH8A EXEC PGM=TEACH8A
//STEPLIB  DD DSN=B1973BQ.TRAINING.LOADLIB,DISP=SHR
//TEACHERS DD DSN=B1973BQ.TRAINING.DATA(TEACHER),DISP=SHR
//REPORT   DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=60,BLKSIZE=0)
```

The result will appear as follows when printed. The carriage control characters are recognized by the printer but are not shown on the report.

```
             LIST OF TEACHERS        Page   1

ID#        Name          Degr  Ten  Phone
---   ---------------   ----  ---  -----
732   BENSON, E.T.      PHD    N   5156
218   HINCKLEY, G.B.    MBA    N   5509
854   KIMBALL, S.W.     PHD    Y   5594
_____________________________________________
             LIST OF TEACHERS        Page   2

ID#        Name          Degr  Ten  Phone
---   ---------------   ----  ---  -----
626   YOUNG, B.         MBA    Y   5664
574   SMITH, J.         MS     Y   5320
```

This is what we would see if we had used `RECFM=FB`. Note the carriage control characters in column 1.

```
1            LIST OF TEACHERS         Page   1
0ID#        Name          Degr  Ten  Phone
 ---   ---------------   ----  ---  -----
 732   BENSON, E.T.      PHD    N   5156
 218   HINCKLEY, G.B.    MBA    N   5509
 854   KIMBALL, S.W.     PHD    Y   5594
1            LIST OF TEACHERS         Page   2
0ID#        Name          Degr  Ten  Phone
 ---   ---------------   ----  ---  -----
 626   YOUNG, B.         MBA    Y   5664
 574   SMITH, J.         MS     Y   5320
```