Cobol Tutorial

# Sorting and Merging files

## Introduction

### Aims

As we noted in the tutorial - Processing Sequential Files - it is possible to apply processing to an ordered sequential file that is difficult, or impossible, when the file is unordered.

When this kind of processing is required, and the data file we have to work with is an unordered Sequential file, then part of the solution to the problem must be to sort the file. COBOL provides the SORT verb for this purpose.

Sometimes, when two or more files are ordered on the same key field or fields, we may want to combine them into one single ordered file. COBOL provides the MERGE verb for this purpose.

This tutorial explores the syntax, semantics, and use of the SORT and MERGE verbs.

### Objectives

By the end of this unit you should -

1. Understand why you might want to sort a file as part of your solution to a programming problem.
2. Understand the role of the temporary work file and the USING and GIVING files.

3. Be able to apply the SORT to sort a file on ascending or descending or multiple keys..
4. Understand why you might want to use an INPUT PROCEDURE or an OUTPUT PROCEDURE to filter or alter records.
5. Know the difference between an INPUT PROCEDURE and an OUTPUT PROCEDURE and know when to use one, and when the other.
6. Be able to use the MERGE verb to merge two or more files.
7. Understand the significance of the merge keys.

### Prerequisites

Introduction to COBOL

Declaring data in COBOL

Basic Procedure Division Commands

Selection Constructs

Iteration Constructs

Introduction to Sequential files

Processing Sequential files

Print files and variable length records

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## Simple Sorting

### Introduction

In COBOL programs, the SORT verb is usually used to sort Sequential files.

Some programmers claim that SORT verb is unnecessary, preferring to use a vendor-provided or "bought in" sort. But one major advantage of using the SORT verb, is that it enhances the portability of COBOL programs.

Because the SORT verb is available in every COBOL compiler, when a program that uses the SORT verb has to be moved to a different computer system, it can make the transition without requiring any changes to the SORT. This is rarely the case when programs rely on a vendor-supplied or "bought in" sort.

### Why sort the file?

Sometimes, processing that is is difficult or impossible to do if the file is unordered, is easy if the file is ordered. In these situations, an obvious part of the solution is to sort the file. This is an approach to problem solving sometimes called, "beneficial wishful thinking". We start by thinking *if only this file were ordered, then it would be easy to write the code to process it*, and then take the next logical step which is - "Well then, let's sort the file first".

Consider the following specification;

A program is required to print out a monthly report detailing the value of calls made by each telephone subscriber (i.e. anyone who has a telephone and who used it in the month in question).

The program will use as input, the file CALLS.DAT. This file contains a record of all the calls made that month. The cost per unit is �0.10.

The calls file in an unordered Sequential file. The record description is as follows;

```
FIELD           TYPE   LENGTH        VALUE
SubscriberNum    9       8     00000001 - 99999999
UnitsUsed        9       5        00001 - 99999
```

The report must be printed on ascending subscriber number and has the following format;

```
Telephone Analysis Monthly Report

SubscriberNum      ValueOfCalls

  99999999         �999,999.99
  99999999         �999,999.99
  99999999         �999,999.99
-------------------------------
Total value =  �999,999,999.99
```

## Solving the problem without sorting the file?

There are millions of telephone subscribers and, in the course of a month, they will make tens, if not hundreds, of calls. So the calls file will contain tens of millions, or hundreds of millions, of records. Is there any viable way for a program to produce the report, without first sorting the calls file?

An array or table based solution does not seem viable. For one thing, the array would have to contain millions of elements. For another, new subscribers are constantly joining, so the array would have to be re-dimensioned every time the program ran.

If we had pointers available to us, we might try a linked list or tree based solution. But the problem with these solutions is that, with millions of subscribers in the list or tree, the search to find a particular subscriber would involve a serious performance hit, as well as being complicated to implement.

Since a Relative file may be thought of as a table on disk, a Relative file solution might beckon. But while Relative file based solution would be easy to implement (though still not as easy as the control break solution) there would be serious performance implications. For each of the millions of records in the file we would have to;

```
Read the Sequential File
IF the record already exists THEN
   Read the Relative Record
   Add the units to the total units
   Write the Relative Record to the file
ELSE
   Write a new Relative Record to the file
END-IF
```

And when the calls file ended we would have to read through the entire Relative file again to create the report.

We can arrive at the most viable solution by using "beneficial wishful thinking". We might think - *If only the calls file were ordered on ascending subscriber number, then this would be a very simple control break problem. For each* *subscriber, we'd sum all the units until there was a change of subscriber number, and then we'd multiply the total units by the cost per unit.* This thinking would lead us to the obvious conclusion - we must sort the calls file.

---

## Syntax of a simplified SORT

The syntax for a simplified version of the SORT is shown below. The SORT takes the records in the *InFileName* file, sorts them on the *SortKeyIdentifier* key or keys and writes the sorted records to the *OutFileName* file.

```
SORT SDWorkFileName
          { ON { ASCENDING  } KEY {SortKeyIdentifier}... }...
               { DESCENDING }
          [WITH DUPLICATES IN ORDER]
          [COLLATING SEQUENCE IS AlphabetName]
          USING  {InFileName} ...
          GIVING {OutFileName} ...
```

e.g.

```
     SORT WorkFile ON ASCENDING KEY CourseCode
          USING  StudentFile
          GIVING SortedStudentsFile.


     SORT WorkFile ON ASCENDING ProvinceCode
                      DESCENDING VendorNumber
                      USING SalesFile
                      GIVING SortedSalesFile.
```

**SORT notes**

The *SDWorkFileName* identifies a temporary work file that the SORT process uses for the sort. It is defined in the FILE SECTION using an SD (Stream/Sort Description) entry. Even though the work file is a temporary file, it must still have an associated SELECT and ASSIGN clause in the ENVIRONMENT DIVISION.

The *SDWorkFileName* file is a Sequential file with an organization of RECORD SEQUENTIAL. Since this is the default organization is it usually omitted; as it is in the example below.

Detail

Records in LINE SEQUENTIAL files are followed by the carriage return and line feed characters, but RECORD SEQUENTIAL files are organized as a simple stream of bytes.

Each *SortKeyIdentifier* identifies a field in the record of the work file. The sorted file will be in sequence on this key field(s).

When more than one *SortKeyIdentifier* is specified, the keys decrease in significance from left to right (leftmost key is most significant, rightmost is least significant).

*InFileName* and *OutFileName*, are the names of the input and output files respectively.

If the DUPLICATES clause is used then, when the file has been sorted, the final order of records with the duplicate keys is the same as that in the unsorted file. If no DUPLICATES clause is used, the order of records with duplicate keys is undefined.

*AlphabetName* is an alphabet-name defined in the SPECIAL-NAMES paragraph of the ENVIRONMENT DIVISION. This clause is used to select the character set the

SORT verb uses for collating the records in the file. The character set may be ASCII (8 or 7 bit ), EBCDIC,or user-defined.

**SORT rules**

1. The SORT can be used anywhere in the PROCEDURE DIVISION except in an INPUT or OUTPUT PROCEDURE, or another SORT, or a MERGE, or in the DECLARATIVES SECTION.
2. The records described for the input file (USING) must be able to fit into the records described for the *SDWorkFileName*.
3. The records described for the *SDWorkFileName* must be able to fit into the records described for the output file (GIVING).
4. The *SortKeyIdentifer* description cannot contain an OCCURS clause (i.e., it can't be a table/array) nor can it be subordinate to an entry that does contain one.
5. *InFileName* and *OutFileName* files are automatically opened by the SORT. When the SORT executes they must **not** be open already.

**SORT example**

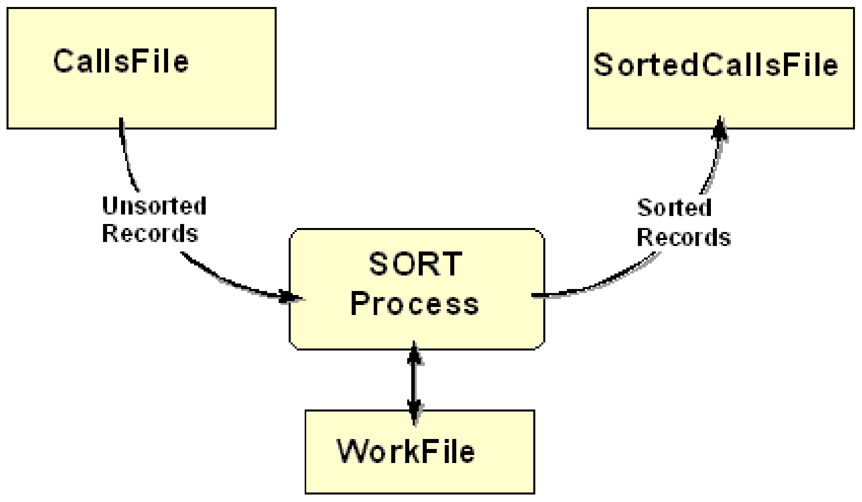
Program Fragment

```
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
   SELECT CallsFile
          ASSIGN TO �CALLS.DAT�
          ORGANIZATION IS LINE SEQUENTIAL.

   SELECT SortedCallsFile
          ASSIGN TO �SORTEDCALLS.DAT�
          ORGANIZATION IS LINE SEQUENTIAL.

   SELECT WorkFile
          ASSIGN TO �WORK.TMP�.

DATA DIVISION.
FILE SECTION.
FD CallsFile.
01 CallRec.
   02 SubscriberNumCF   PIC 9(8).
   02 UnitsUsedCF       PIC 9(5).

FD SortedCallsFile.
01 SortedCallRec.
   02 SubscriberNumSF   PIC 9(8).
   02 UnitsUsedSF       PIC 9(5).

SD WorkFile.
01 WorkRec.
   02 SubscriberNumWF   PIC 9(8).
   02 UnitsUsedWF       PIC 9(5).

        etc.


PROCEDURE DIVISION.
Begin.
   SORT WorkFile ON ASCENDING SubscriberNumWF
        USING  CallsFile
        GIVING SortedCallsFile.

        etc.
```

### How a simple SORT works

As illustrated by the diagram below, the sort process takes records from the input file (CallsFile) and sorts them using the temporary file (WorkFile) on the field(s), and in the sequence, specified in the KEY phrase. When all the records have been sorted, the sort process writes them to the output file (SortedCallsFile).

Remember - the SORT automatically opens the CallsFile and the SortedCallsFile. These files must not be open when the SORT executes or it will fail.



```
SORT WorkFile ON ASCENDING SubscriberNumWF
               USING  CallsFile
              GIVING SortedCallsFile.
```

## Using multiple keys.

If you examine the SORT syntax diagram above, carefully, you will realize that, not only can a file be sorted on a number of keys, but that one key can be ascending while another can be descending. This is illustrated in the table below. The table contains a sales file that has been sorted into descending VendorNumber, within ascending ProvinceCode, by the following SORT statement;

```
SORT WorkFile ON ASCENDING ProvinceCode
                 DESCENDING VendorNumber
                 USING SalesFile
                 GIVING SortedSalesFile
```

Notice that ProvinceCode is the major key, and that VendorNumber is only in descending sequence, *within* ProvinceCode. The first key named in a SORT statement is the major key and keys get less significant with each successive declaration.

**SortedSalesFile**

| Ascending Province Code | Descending Vendor Number | Remaining Record |
|---|---|---|
| 1 | 91234 | etc. |
| 1 | 91234 | etc. |
| 1 | 81234 | etc. |
| 1 | 71234 | etc. |
| 1 | 71234 | etc. |
| 1 | 71234 | etc. |
| 1 | 22222 | etc. |
| 2 | 91234 | etc. |
| 2 | 90345 | etc. |
| 2 | 90345 | etc. |
| 2 | 81234 | etc. |
| 2 | 81234 | etc. |
| 2 | 81111 | etc. |

| | | |
|---|---|---|
| 3 | 99999 | etc. |
| 3 | 99999 | etc. |
| 3 | 91234 | etc. |
| 3 | 91234 | etc. |
| 3 | 89765 | etc. |
| 3 | 11111 | etc. |
| 3 | 11111 | etc. |
| 4 | 56789 | etc. |
| 4 | 56789 | etc. |
| 4 | 44444 | etc. |

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## SORTing with an INPUT PROCEDURE

### Introduction

Some times, not all the records in an unsorted file are required in the sorted file. Other times, it may be that the sorted file records require additional, altered, or fewer fields, than the unsorted records. In these cases, an INPUT PROCEDURE can be used to eliminate unwanted records, or to alter the format of the records, before they are submitted to the sort process.

Since sorting is a disk-based process, and thus comparatively slow, every effort should be made to reduce the amount of data that has to be sorted.

### SORT syntax with INPUT PROCEDURE

```
SORT SDWorkFileName
     { ON {ASCENDING } KEY {SortKeyIdentifier}... }...
          {DESCENDING}
     [WITH DUPLICATES IN ORDER]
     [COLLATING SEQUENCE IS AlphabetName]
     { INPUT PROCEDURE IS ProcName [{THRU   } ProcName] }
     {                             {THROUGH}           }
     { USING {InFileName} ...                           }

     GIVING {OutFileName} ...
```

e.g.

```
SORT WorkFile ON ASCENDING CountyNumWF, VendorNumWF
              INPUT PROCEDURE RejectNorthernRecs
              GIVING SortedSalesFile.


SORT WorkFile ON ASCENDING CountryNameWF
              INPUT PROCEDURE IS SelectForeignGuests
              GIVING SortedGuestsFile.


SORT WorkFile ON ASCENDING CountryNameWF, CustomerNameWF
              INPUT PROCEDURE IS RestructureRecords
              GIVING SortedSubscriptionsFile.
```

**INPUT PROCEDURE notes**
When an INPUT PROCEDURE is used, it replaces the USING phrase. The *ProcName*

in the INPUT PROCEDURE phrase, identifies a block of code, that uses the RELEASE verb to supply records to the sort process.

The INPUT PROCEDURE must finish before the sort process sorts the records supplied to it by the procedure. That's why the records are RELEASEd to the work file. They are stored there until the INPUT PROCEDURE finishes and then they are sorted.

An INPUT PROCEDURE allows us to select which records, and what type of records, will be submitted to the sort process. Because an INPUT PROCEDURE executes before the sort process sorts the records, only the data that is actually required in the sorted file will be sorted.

**INPUT PROCEDURE rules**

1. The INPUT PROCEDURE must contain at least one RELEASE statement to transfer the records to the *SDWorkFileName*.
2. The old COBOL rules for the SORT verb stated that the INPUT and OUTPUT procedures had to be self-contained sections of code, and could not be entered from elsewhere in the program.
3. In COBOL '85, INPUT and OUTPUT procedures can be any contiguous group of paragraphs or sections. The only restriction is that the range of paragraphs or sections used, must not overlap.

---

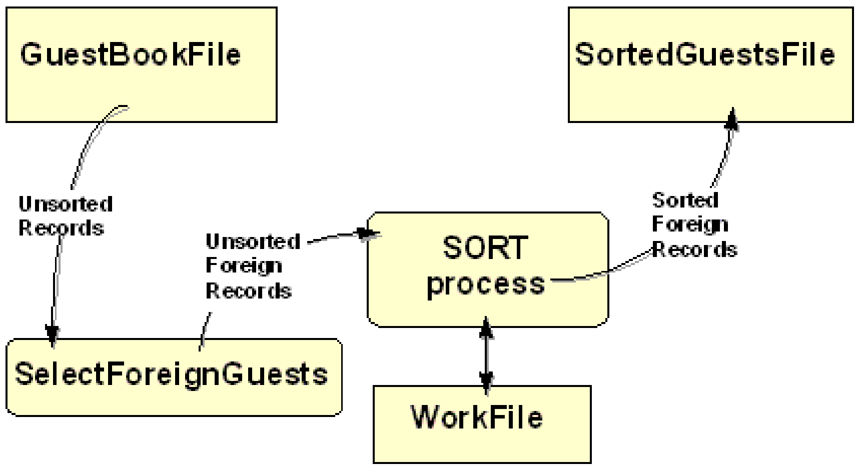
## How a SORT with and INPUT PROCEDURE works.

A simple SORT works by taking records from the USING file, sorting them, and then writing them to the GIVING file. When an INPUT PROCEDURE is used, there is no USING file, so the SORT process has to get its records from the INPUT PROCEDURE . The INPUT PROCEDURE uses the RELEASE verb to supply the records to the SORT, one at a time.

Although an INPUT PROCEDURE usually gets the records it supplies to the sort process from an input file, the records can actually originate from anywhere. For instance, if we wanted to sort the elements of a table, we could use an INPUT PROCEDURE to send the elements, one at a time, to the sort process. Or if we wanted to sort the records as they were entered by the user, we could use an INPUT PROCEDURE to get the records from the user and supply them to the sort process.

When an INPUT PROCEDURE gets its records from an input file it can select which records to send to the sort process and can even alter the structure of the records before they are sent.

In the example below, an INPUT PROCEDURE is used to select only the records of foreign guests, for sorting. The diagram shows how an INPUT PROCEDURE, is used to sit between the input file and the sort process, to filter the records.



```
SORT WorkFile ON ASCENDING CountryNameWF
              INPUT PROCEDURE IS SelectForeignGuests
              GIVING SortedGuestsFile.
```

## Creating an INPUT PROCEDURE

An INPUT PROCEDURE supplies records to the sort process by writing them to the work file declared in the SORT's SD entry. But to write the records to the work file a special verb - the RELEASE verb is used. The syntax of the RELEASE verb is;

RELEASE *SDRecordName* [FROM *Identifier*]

where SDRecordName is the name of the record declared in the work file's SD entry.

An operational template for an INPUT PROCEDURE, which gets records from and input file and RELEASEs them to the work file, is shown in the table below.

```
OPEN INPUT InFileName
READ InFileName
PERFORM UNTIL TerminatingCondition
   Process input record
   RELEASE SDWorkRec
   READ InFileName
END-PERFORM
CLOSE InFileName
```

## The Foreign Guests Report - example program

Visitors to the CSIS web site are asked to fill in a "guestbook" form. The form requests the name of the visitor, his/her country of origin and a comment. These fields are stored, as a fixed length record, in the GuestBook file.

The example program below prints a report showing the number of visitors from each foreign country. The records in the GuestBook file are not in any particular order, so before the report can be printed, the file must be sorted by CountryName.

Detail

In this instance, since the number of countries in the world is fairly static, a table-based solution might also be viable.

Since we are only interested in foreign visitors, there is no point in sorting the whole file. The program uses an INPUT PROCEDURE to select only the records of visitors from foreign countries.

When we examine the fields of a GuestBook record, we notice that, for the purposes of this report, the GuestName and GuestComment are irrelevant. The only field we actually need for the report, is the CountryName field. So as well as selecting only foreign guests, the INPUT PROCEDURE alters the structure of the

GuestBook records supplied to the sort process. Since the new records are only 20 characters in size, rather than 80 characters, the amount of data that has to be sorted is substantially reduced.

Program

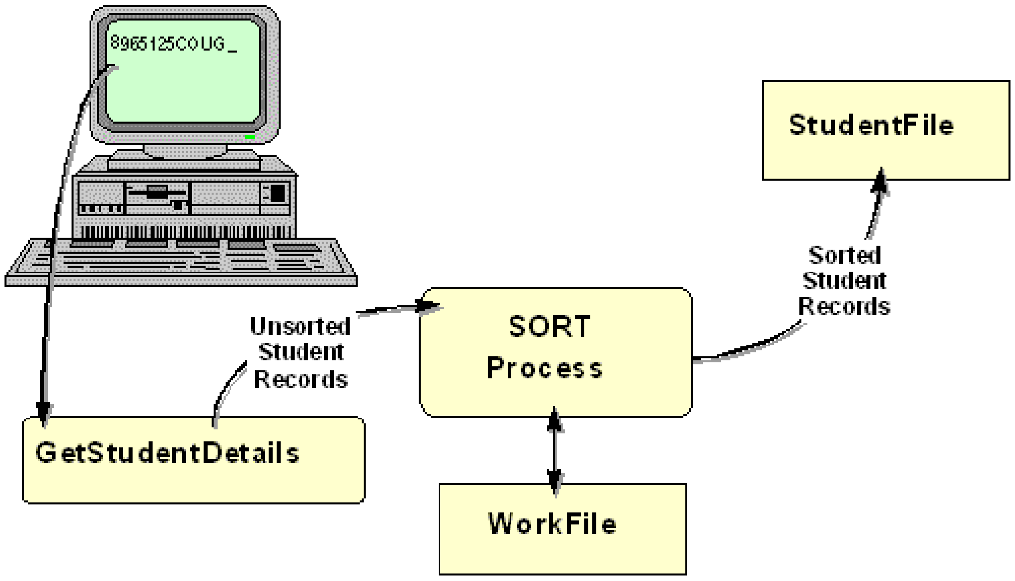
```
         $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID.  ForeignGuestsRpt.
AUTHOR.  Michael Coughlan.
* This program analyses the CSIS web site GuestBook file
* and prints a report showing the number of visitors
* to the web site from each foreign country.

ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
   SELECT GuestBookFile
          ASSIGN TO "GuestBook.Dat"
          ORGANIZATION IS LINE SEQUENTIAL.

   SELECT WorkFile
          ASSIGN TO "Work.Tmp".

   SELECT SortedGuestsFile
          ASSIGN TO "SortedGuests.Dat"
          ORGANIZATION IS LINE SEQUENTIAL.

   SELECT ForeignGuestReport
          ASSIGN TO "ForeignGuest.Rpt"
          ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD GuestBookFile.
01 GuestRec.
   88  EndOfFile  VALUE HIGH-VALUES.
   02  GuestNameGF         PIC X(20).
   02  CountryNameGF       PIC X(20).
       88 CountryIsIreland VALUE "IRELAND".
   02  GuestCommentGF      PIC X(40).

SD WorkFile.
01 WorkRec.
   02 CountryNameWF        PIC X(20).

FD SortedGuestsFile.
01 SortedRec.
   88 EndOfSortedFile VALUE HIGH-VALUES.
   02 CountryNameSF        PIC X(20).

FD ForeignGuestReport.
01 PrintLine               PIC X(38).


WORKING-STORAGE SECTION.
01 Heading1                PIC X(37)
         VALUE "CSIS Web site - Foreign Guests Report".

01 Heading2.
   02 FILLER               PIC X(25) VALUE "   Country".
   02 FILLER               PIC X(8)  VALUE "Visitors".

01 CountryLine.
   02 FILLER               PIC X(3) VALUE SPACES.
   02 PrnCountryName       PIC X(20).
   02 PrnVisitorCount      PIC BBBZZ,ZZ9.

01 ReportFooting           PIC X(36)
         VALUE "*** End of Foreign Guests report ***".
```

```
01 VisitorCount            PIC 9(5).

PROCEDURE DIVISION.
PrintGuestReport.
   SORT WorkFile ON ASCENDING CountryNameWF
        INPUT PROCEDURE IS SelectForeignGuests
        GIVING SortedGuestsFile.

   OPEN INPUT  SortedGuestsFile
   OPEN OUTPUT ForeignGuestReport
   WRITE PrintLine FROM Heading1
         AFTER ADVANCING PAGE
   WRITE PrintLine FROM Heading2
         AFTER ADVANCING 2 LINES

   READ SortedGuestsFile
        AT END SET EndOfSortedFile TO TRUE
   END-READ
   PERFORM PrintReportBody UNTIL EndOfSortedFile
   WRITE PrintLine FROM ReportFooting
         AFTER ADVANCING 3 LINES
   CLOSE SortedGuestsFile, ForeignGuestReport
   STOP RUN.

SelectForeignGuests.
   OPEN INPUT GuestBookFile.
   READ GuestBookFile
      AT END SET EndOfFile TO TRUE
   END-READ
   PERFORM UNTIL EndOfFile
      IF NOT CountryIsIreland
         MOVE CountryNameGF TO CountryNameWF
         RELEASE WorkRec
      END-IF
      READ GuestBookFile
        AT END SET EndOfFile TO TRUE
      END-READ
   END-PERFORM
   CLOSE GuestBookFile.


PrintReportBody.
   MOVE CountryNameSF TO PrnCountryName
   MOVE ZEROS TO VisitorCount
   PERFORM UNTIL CountryNameSF NOT EQUAL TO PrnCountryName
                 OR EndOfSortedFile
      ADD 1 TO VisitorCount
      READ SortedGuestsFile
         AT END SET EndOfSortedFile TO TRUE
      END-READ
   END-PERFORM
   MOVE VisitorCount TO PrnVisitorCount
   WRITE PrintLine FROM CountryLine
         AFTER ADVANCING 1 LINE.
```

## Feeding the SORT from the keyboard - example program

As we noted earlier, because the INPUT PROCEDURE is responsible for supplying records to the sort process, the records could be coming from anywhere. We could obtain them from a table, or, as in this example, directly from the user.

As the illustration below shows, this example program gets records from the user, sorts them on ascending StudentId, and then outputs them to the StudentFile. Notice that the sort process only sorts the file, when the INPUT PROCEDURE has finished.



Program

```
     $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID.  SortInput.
AUTHOR.  Michael Coughlan.
* An example program using the SORT and an INPUT PROCEDURE.
* The program accepts records from the user RELEASEs them
* to the work file where they are sorted and then written
* to the StudentFile.
* This program allows student records to be entered in any
* order but creates a file sorted on ascending StudentId.

ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT StudentFile ASSIGN TO "SORTSTUD.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

    SELECT WorkFile ASSIGN TO "WORK.TMP".


DATA DIVISION.
FILE SECTION.
FD StudentFile.
01 StudentDetails      PIC X(30).

* The StudentDetails record has the description shown below.
* But in this program we don't actually need to refer to any
* of the items in the record so we have described it as
* PIC X(30)
* 01 StudentDetails
*    02  StudentId       PIC 9(7).
*    02  StudentName.
*        03 Surname      PIC X(8).
*        03 Initials     PIC XX.
*    02  DateOfBirth.
*        03 YOBirth      PIC 9(4).
*        03 MOBirth      PIC 9(2).
*        03 DOBirth      PIC 9(2).
*    02  CourseCode      PIC X(4).
*    02  Gender          PIC X.
```

```
SD WorkFile.
01 WorkRec.
   02 StudentIdWF        PIC 9(7).
   02 FILLER             PIC X(23).


PROCEDURE DIVISION.
Begin.
   SORT WorkFile ON ASCENDING KEY StudentIdWF
        INPUT PROCEDURE IS GetStudentDetails
        GIVING StudentFile.
   STOP RUN.


GetStudentDetails.
    DISPLAY "Enter student details using template below."
    DISPLAY "Enter no data to end.".
    DISPLAY "NNNNNNNSSSSSSSSIIYYYYMMDDCCCCG".
    ACCEPT  WorkRec.
    PERFORM UNTIL WorkRec = SPACES
       RELEASE WorkRec
       ACCEPT WorkRec
    END-PERFORM.
```

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## Sorting with an OUTPUT PROCEDURE

### Introduction

The advantage of an INPUT PROCEDURE is that it allows us to filter, or alter, records before they are supplied to the sort process and this can substantially reduce the amount of data that has to be sorted.

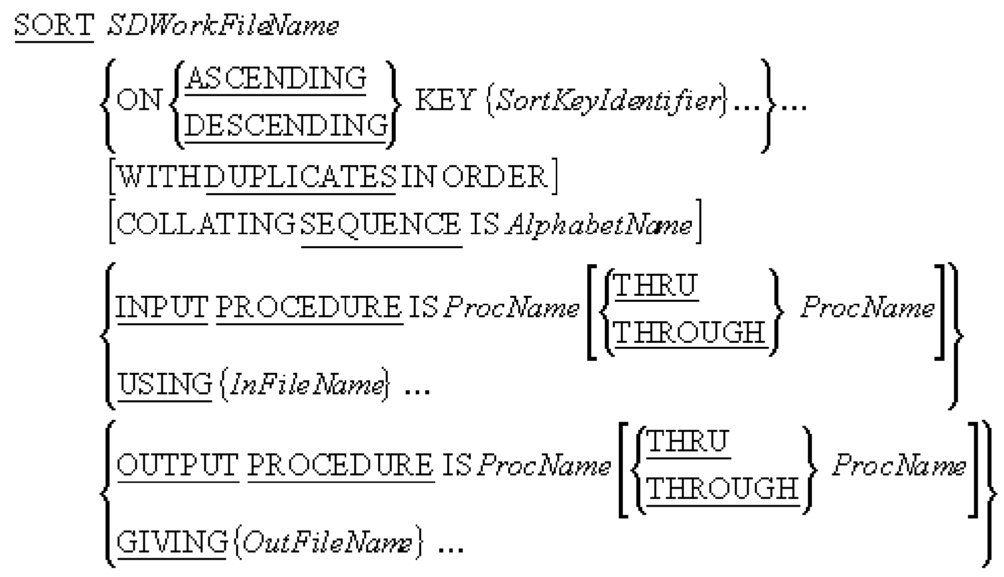
An OUTPUT PROCEDURE has no such advantage. An OUTPUT PROCEDURE only executes when the sort process has already sorted the file.

Nevertheless, an OUTPUT PROCEDURE is useful when we don't need to preserve the sorted file. For instance, if we are sorting records to produce a once-off report, we can use an OUTPUT PROCEDURE to create the report directly, without first having to create a file containing the sorted records. This is what we do in the revised ForeignGuestsRpt program below. Instead of creating a sorted guest file and then reading it to create the report; we use an OUTPUT PROCEDURE to create the report directly.

An OUTPUT PROCEDURE is also useful when we want to alter the structure of the records written to the sorted file. For instance, in the first example program below, we use an OUTPUT PROCEDURE to summarize the sorted records. The resulting sorted file contains summary records, rather than the detail records, contained in the unsorted file.

### SORT syntax with OUTPUT PROCEDURE

The syntax diagram below is the complete syntax for the SORT verb.


SORT SDWorkFileName
ON ASCENDING DESCENDING KEY {SortKeyIdentifier}...}...
[WITH DUPLICATES IN ORDER]
[COLLATING SEQUENCE IS AlphabetName]
INPUT PROCEDURE IS ProcName [THRU THROUGH ProcName]
USING {InFileName} ...
OUTPUT PROCEDURE IS ProcName [THRU THROUGH ProcName]
GIVING {OutFileName} ...

e.g.

```
SORT WorkFile ON ASCENDING CustNameWF
     INPUT PROCEDURE IS SelectEssentialOils
     OUTPUT PROCEDURE IS PrintOilSalesReport.


SORT WorkFile ON ASCENDING KEY SalespersonNumWF
     USING SalesFile
     OUTPUT PROCEDURE IS SummariseSales.
```

**OUTPUT PROCEDURE notes**
An OUTPUT PROCEDURE is used to retrieve sorted records from the work file using the RETURN verb.

An OUTPUT PROCEDURE only executes after the file has been sorted.

**OUTPUT PROCEDURE rules**

1. An OUTPUT PROCEDURE must contain at least one RETURN statement to get the records from the SortFile.
2. The SORT ..GIVING phrase cannot be used if an OUTPUT PROCEDURE is used.

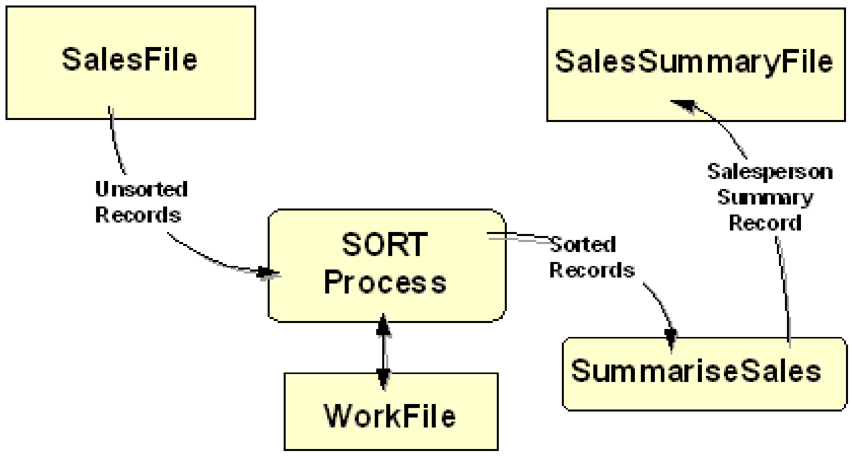
## How the OUTPUT PROCEDURE works

An OUTPUT PROCEDURE uses the RETURN verb to retrieve sorted records from the work file. An OUTPUT PROCEDURE can do what it likes with the records it gets from work file. It could put them into an array, display them on the screen, or send them to an output file.

When the OUTPUT PROCEDURE sends records to an output file, it can control which records, and what type of records, appear in the file. For instance, the SORT statement in the illustration below produces a sorted SalesSummaryFile from an unsorted SalesFile.

The SalesSummaryFile is a sequential file sorted on ascending salesperson number but each record in the summary file is the *sum* of all the items sold by a particular salesperson.

An OUTPUT PROCEDURE is used because, until the records have been sorted into salesperson number order, the quantities sold cannot be summed.



```
SORT WorkFile ON ASCENDING KEY SalespersonNumWF
              USING SalesFile
        OUTPUT PROCEDURE IS SummariseSales.
```

## Creating an OUTPUT PROCEDURE

An OUTPUT PROCEDURE uses the RETURN verb to read sorted records from the work file declared in the Sort's SD entry. The syntax of the RETURN verb is;

<u>RETURN</u> *SDFileName* RECORD [<u>INTO</u> *Identifier*]
    AT END *StatementBlock*
END-RETURN

where SDFileName is the name of the file declared in the SD entry.

An operational template for an OUTPUT PROCEDURE, which gets records from the work file and writes them to an output file, is shown in the table below. Notice that the work file is not opened by the code in the OUTPUT PROCEDURE. The work file is automatically opened by the SORT.

```
OPEN OUTPUT OutFile
RETURN SDWorkFile RECORD
PERFORM UNTIL TerminatingCondition
   Setup OutRec
   WRITE OutRec
   RETURN SDWorkFile RECORD
END-PERFORM
CLOSE OutFile
```

## Sales summary file - example program

The example below creates a sorted SalesSummaryFile from an unsorted SalesFile. The SalesSummaryFile is a sequential file, sorted on ascending salesperson-number. Each record in the summary file is the sum of all the items sold by a particular salesperson. An OUTPUT PROCEDURE is used, because until the records have been sorted into salesperson number order, the salesperson records cannot be summarized.

Program

```
     $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. MakeSummaryFile.
AUTHOR. Michael Coughlan.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT WorkFile ASSIGN TO "WORK.TMP".
    SELECT SalesFile ASSIGN TO "SALES.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

    SELECT SalesSummaryFile ASSIGN TO "SUMMARY.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.

FD  SalesFile.
01  SalesRec             PIC X(10).

SD  WorkFile.
01  WorkRec.
    88 EndOfWorkFile     VALUE HIGH-VALUES.
    02 SalespsnNumWF     PIC X(5).
    02 QtySoldWF         PIC 9(4).

FD  SalesSummaryFile.
01  SummaryRec.
    02 SalespsnNum       PIC 9(5).
    02 TotalQtySold      PIC 9(6).

PROCEDURE DIVISION.
Begin.
    SORT WorkFile ON ASCENDING KEY SalespsnNumWF
           USING SalesFile
           OUTPUT PROCEDURE IS SummariseSales
    STOP RUN.

SummariseSales.
    OPEN OUTPUT SalesSummaryFile
    RETURN WorkFile
       AT END SET EndOfWorkFile TO TRUE
    END-RETURN
    PERFORM UNTIL EndOfWorkFile
      MOVE SalespsnNumWF TO SalespsnNum
      MOVE ZEROS TO TotalQtySold
      PERFORM UNTIL SalespsnNumWF NOT = SalespsnNum
                    OR EndOfWorkFile
         ADD QtySoldWF TO TotalQtySold
         RETURN WorkFile
            AT END SET EndOfWorkFile TO TRUE
         END-RETURN
      END-PERFORM
      WRITE SummaryRec
    END-PERFORM
    CLOSE SalesSummaryFile.
```

## Revised Foreign Guests Report - example program

This example program is a revised version of the Foreign Guest Report program. In this example, instead of creating a sorted file which is read to create the report; the report is created directly from the OUTPUT PROCEDURE. This has the effect of making the program simpler and shorter, since we no longer need all the sorted file declarations.

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID.  ForeignGuestsRpt2.
AUTHOR.  Michael Coughlan.
* This program analyses the CSIS web site GuestBook file
```

Program

```
* and uses an OUTPUT PROCEDURE to print a report showing
* the number of visitors to the web site from each
* foreign country.

ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
   SELECT GuestBookFile
          ASSIGN TO "GuestBook.Dat"
          ORGANIZATION IS LINE SEQUENTIAL.

   SELECT WorkFile
          ASSIGN TO "Work.Tmp".

   SELECT ForeignGuestReport
          ASSIGN TO "ForeignGuest.Rpt"
          ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD GuestBookFile.
01 GuestRec.
   88  EndOfFile  VALUE HIGH-VALUES.
   02  GuestNameGF         PIC X(20).
   02  CountryNameGF       PIC X(20).
       88 CountryIsIreland VALUE "IRELAND".
   02  GuestCommentGF      PIC X(40).

SD WorkFile.
01 WorkRec.
   88 EndOfWorkFile VALUE HIGH-VALUES.
   02 CountryNameWF        PIC X(20).

FD ForeignGuestReport.
01 PrintLine               PIC X(38).


WORKING-STORAGE SECTION.
01 Heading1                PIC X(37)
         VALUE "CSIS Web site - Foreign Guests Report".

01 Heading2.
   02 FILLER               PIC X(25) VALUE "   Country".
   02 FILLER               PIC X(8)  VALUE "Visitors".

01 CountryLine.
   02 FILLER               PIC X(3) VALUE SPACES.
   02 PrnCountryName       PIC X(20).
   02 PrnVisitorCount      PIC BBBZZ,ZZ9.

01 ReportFooting           PIC X(36)
         VALUE "*** End of Foreign Guests report ***".

01 VisitorCount            PIC 9(5).

PROCEDURE DIVISION.
PrintForeignGuestReport.
   SORT WorkFile ON ASCENDING CountryNameWF
        INPUT PROCEDURE IS SelectForeignGuests
        OUTPUT PROCEDURE IS PrintGuestReport.
   STOP RUN.

SelectForeignGuests.
   OPEN INPUT GuestBookFile.
   READ GuestBookFile
      AT END SET EndOfFile TO TRUE
   END-READ
   PERFORM UNTIL EndOfFile
      IF NOT CountryIsIreland
         MOVE CountryNameGF TO CountryNameWF
         RELEASE WorkRec
      END-IF
      READ GuestBookFile
        AT END SET EndOfFile TO TRUE
      END-READ
   END-PERFORM
   CLOSE GuestBookFile.


PrintGuestReport.
   OPEN OUTPUT ForeignGuestReport
   WRITE PrintLine FROM Heading1
         AFTER ADVANCING PAGE
   WRITE PrintLine FROM Heading2
         AFTER ADVANCING 2 LINES
   RETURN WorkFile
      AT END SET EndOfWorkFile TO TRUE
   END-RETURN
   PERFORM PrintReportBody UNTIL EndOfWorkFile
   WRITE PrintLine FROM ReportFooting
         AFTER ADVANCING 3 LINES
   CLOSE ForeignGuestReport.

PrintReportBody.
   MOVE CountryNameWF TO PrnCountryName
   MOVE ZEROS TO VisitorCount
   PERFORM UNTIL CountryNameWF NOT EQUAL TO PrnCountryName
                 OR EndOfWorkFile
      ADD 1 TO VisitorCount
      RETURN WorkFile
        AT END SET EndofWorkFile TO TRUE
      END-RETURN
   END-PERFORM
   MOVE VisitorCount TO PrnVisitorCount
   WRITE PrintLine FROM CountryLine
         AFTER ADVANCING 1 LINE.
```

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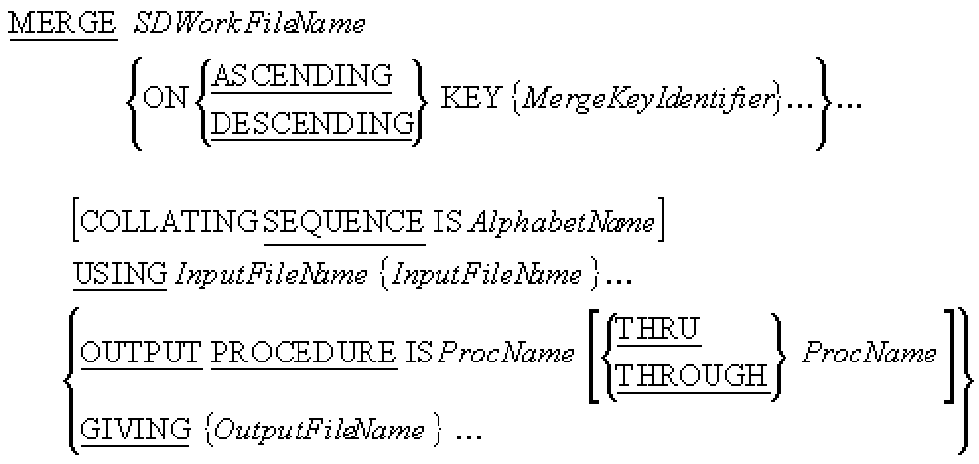
## MERGEing files

### Introduction

It is often useful to combine two or more files into a single large file. If the files are unordered, this is easy to accomplish because we can simply append the records in one file to the end of the other. But if the files are unordered, the task is somewhat more complicated, especially if there are more than two files, because we must preserve the ordering in the combined file.

In COBOL, instead of having to write special code every time we want to merge files, we can use the MERGE verb. The MERGE verb takes two or more identically sequenced files and combines them, according to the key values specified. The combined file is then sent to an output file or an OUTPUT PROCEDURE.

### MERGE syntax


MERGE SDWorkFileName
{ON {ASCENDING / DESCENDING} KEY {MergeKeyIdentifier}...}...
[COLLATING SEQUENCE IS AlphabetName]
USING InputFileName {InputFileName}...
{OUTPUT PROCEDURE IS ProcName [{THRU / THROUGH} ProcName] / GIVING {OutputFileName} ...}

e.g.

```
MERGE MergeWorkFile
   ON ASCENDING KEY TransDateWF, TransCodeWF, StudentIdWF
   USING InsertTransFile, DeleteTransFile, UpdateTransFile
   GIVING CombinedTransFile.
```

**MERGE notes**
The results of the MERGE verb are predictable only when the records in the input files are ordered as described in the KEY clause associated with the MERGE statement. For instance, if the MERGE statement has an ON DESCENDING KEY StudentId clause, then all the USING files must be ordered on descending StudentId.

As with the SORT, the *SDWorkFileName* is the name of a temporary file, with an SD entry in the FILE SECTION, a SELECT and ASSIGN entry in the INPUT-OUTPUT SECTION, and an organization of RECORD SEQUENTIAL.

Each *MergeKeyIdentifier* identifies a field in the record of the work file. The sorted file will be in sequence on this key field(s).

When more than one *MergeKeyIdentifier* is specified, the keys decrease in significance from left to right (leftmost key is most significant, rightmost is least significant).

*InFileName* and *OutFileName*, are the names of the input and output files respectively. These files are automatically opened by the MERGE. When the MERGE executes they must **not** be already open.

*AlphabetName* is an alphabet-name defined in the SPECIAL-NAMES paragraph of the ENVIRONMENT DIVISION. This clause is used to select the character set the SORT verb uses for collating the records in the file. The character set may be ASCII (8 or 7 bit ), EBCDIC,or user-defined.

The MERGE can use an OUTPUT PROCEDURE and the RETURN verb to get merged records from the *SDWorkFileName.*

The OUTPUT PROCEDURE only executes after the files have been merged and must contain at least one RETURN statement to get the records from the SortFile.□

## MERGE example

In this example program, instead of writing code to insert records from a transaction file into an ordered master file, we have used the MERGE verb to merge the files.

```
      $ SET SOURCEFORMAT "FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. MergeFiles.
AUTHOR. MICHAEL COUGHLAN.
* Example program demonstrating the use of the MERGE.
* The program merges the file Students.Dat and
* Transins.Dat to create a new file Students.New

ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT StudentFile ASSIGN TO "STUDENTS.DAT"
             ORGANIZATION IS LINE SEQUENTIAL.

    SELECT InsertionsFile ASSIGN TO "TRANSINS.DAT"
             ORGANIZATION IS LINE SEQUENTIAL.

    SELECT NewStudentFile    ASSIGN TO "STUDENTS.NEW"
             ORGANIZATION IS LINE SEQUENTIAL.

    SELECT WorkFile ASSIGN TO "WORK.TMP".

DATA DIVISION.
FILE SECTION.
FD  StudentFile.
01  StudentRec             PIC X(30).

FD  InsertionsFile.
01  InsertionRec           PIC X(30).

FD  NewStudentFile.
01  NewStudentRec          PIC X(30).

SD  WorkFile.
01  WorkRec.
    02 StudentIdWF         PIC 9(7).
    02 FILLER              PIC X(23).

PROCEDURE DIVISION.
Begin.
    MERGE WorkFile
       ON ASCENDING KEY StudentIdWF
       USING InsertionsFile,  StudentFile
       GIVING NewStudentFile.
    STOP RUN.
```

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