Cobol Tutorial

Searching Tables

Introduction

Aims

The task of searching a table to determine whether it contains a particular value is a common operation. The method used to search a table depends heavily on how the values in the table are organized.

For instance, if the values are not ordered, the table may only be searched sequentially, but if the values are ordered, then either a sequential or a binary search may be used.

In COBOL, the SEARCH verb is used for sequential searches and the SEARCH ALL for binary searches.

This tutorial introduces the syntax and rules of operation of the SEARCH and SEARCH ALL verbs. It introduces the extensions to the OCCURS clause that are required when the SEARCH or SEARCH ALL is used. It shows how the SET verb may be used to alter the value of an index and it demonstrates how the SEARCH and SEARCH ALL may be used to search a table.

Objectives

By the end of this unit you should -

1. Know the new OCCURS clause entries that are required when the SEARCH is used to search a table.
2. Be able to use the SEARCH to search a table.
3. Understand the restrictions that apply to manipulating a table index.
4. Be able to use the SET verb to change the value of a table index.

5. Understand how the SEARCH can be used to search a multi-dimension table.
6. Know the new OCCURS clause entries that are required when the SEARCH ALL is used to search a table.
7. Understand how a binary search works.

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

Sorting and Merging files

Using Tables

Creating Tables - syntax and semantics

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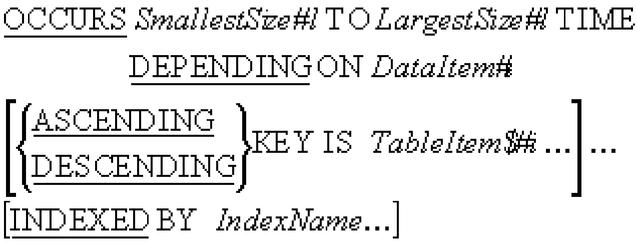
Occurs clause extensions

Introduction

When the SEARCH and SEARCH ALL are used the normal table declarations are no longer sufficient and the OCCURS clause must be extended with the INDEXED BY phrase and, in the case of the SEARCH ALL, by the KEY IS phrase.

The full syntax of the OCCURS clause, including the INDEXED BY and KEY IS phrases is shown below.

Full OCCURS clause syntax



```
OCCURS SmallestSize#l TO LargestSize#l TIMES
            DEPENDING ON DataItem#
[{ASCENDING }KEY IS TableItem$#i ...]...
 {DESCENDING}
[INDEXED BY IndexName...]
```

INDEXED BY phrase - notes

Before the SEARCH or SEARCH ALL can be used to search a table, the table must be defined as having an index item associated with it.

The index is specified by the *IndexName* given in the INDEXED BY phrase.

The index defined in a table declaration is associated with that table and is the subscript which the SEARCH or SEARCH ALL uses to access the table.

Using an index makes the searching more efficient. Since the index is linked to a particular table, the compiler, taking into account the size of the table, can choose the most efficient representation possible for the index and this speeds up the search.

The only entry that needs to be made for an *IndexName* is to use it in an INDEXED BY phrase. There is no need to define a picture clause for it, because the compiler handles its declaration automatically.

Because an index has a special internal representation it cannot be displayed and can only be assigned a value, or have its value assigned, by the SET verb. The MOVE cannot be used with a table index.

Normal arithmetic cannot be performed on a table index. The SET verb must be used to increment or decrement the value of an index item.

KEY IS phrase - notes

While the SEARCH performs a sequential search on a table, the SEARCH ALL performs a binary search. But a binary search requires that the table is ordered on some key field. The key field may be the element itself or, where the element is a group item, a field within the element.

Before a table can be searched with the SEARCH ALL, the key field must be identified by using the KEY IS phrase in the table declaration. As well as identifying the key field, the KEY IS phrase specifies whether the table is in ascending or descending order.

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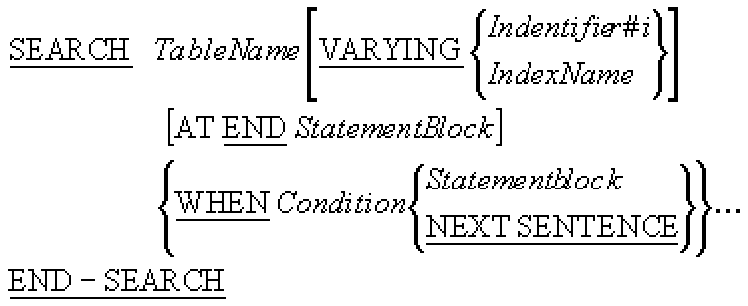
The SEARCH verb

Introduction

When the values in a table are not ordered, the only way to find the item we seek is to search through the table sequentially, element by element. In COBOL, the SEARCH verb is used to search a table sequentially.

SEARCH syntax



```
SEARCH  TableName [VARYING {Indentifier#i}]
                           {IndexName    }
        [AT END StatementBlock]
        {WHEN Condition {StatementBlock}}...
                        {NEXT SENTENCE }
END-SEARCH
```

SEARCH rules

1. *TableName* must identify a data-item in the table hierarchy with both OCCURS and INDEXED BY clauses. The index specified in the INDEXED BY clause of *TableName* is the controlling index of the SEARCH.
2. The SEARCH can only be used if the table to be searched has an index item associated with it. An index item is associated with a table by using the INDEXED BY phrase in the table declaration. The index item is known as

the table index. The table index is the subscript which the SEARCH uses to access the table.

SEARCH notes

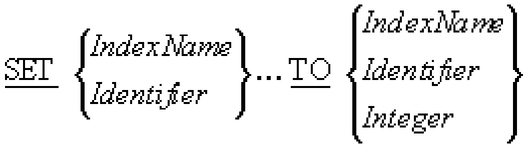
- The SEARCH searches a table sequentially starting at the element pointed to by the table index.
- The starting value of the table index is under the control of the programmer. The programmer must ensure that, when the SEARCH executes, the table index points to some element in the table (for instance, it cannot have a value of 0 or be greater than the size of the table).
- The VARYING phrase is only required when we require data-item to mirror the values of the table index. When the VARYING phrase is used, and the associated data-item is not the table index, then the data-item is varied along with the index.
- The AT END phrase allows the programmer to specify an action to be taken if the searched for item is not found in the table.
- When the AT END is specified, and the index is incremented beyond the highest legal occurrence for the table (i.e. the item has not been found), then the statements following the AT END will be executed and the SEARCH will terminate.
- The conditions attached to the SEARCH are evaluated in turn and as soon as one is true the statements following the WHEN phrase are executed and the SEARCH ends.

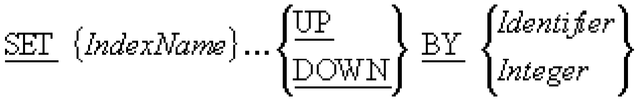
The SET verb syntax

The SET verb is used for a number of unrelated purposes. We have already seen how the SET verb may be used to set a condition name to true. This section introduces the versions of the SET verb used to manipulate table indexes.

Because an index item has a special internal representation designed to optimize searching, it cannot be used in any type of normal arithmetic operation (ADD, SUBTRACT etc.) or even in a MOVE or DISPLAY statement. For index items, all these operations must be handled by the SET verb.

The versions of the SET verb shown below are used to assign a value to an index item, to assign the value of an index item to a variable, and to increment or decrement the value of an index item.





SEARCH example 1

The example program below accepts an upper case letter from the user and then uses the SEARCH verb to searche a pre-filled table of letters to find and display the position of the letter in the alphabet.

Because a table index can be tricky to manipulate (can't display it, can't move it) the program uses the VARYING phrase to vary an ordinary numeric value along with the index. When the letter is found in the table, this item will contain the same value as the index and we can display it without the complications we might encounter with the index item. For instance, to display the value of the index item we would require following code -

```
SET LetterPos TO LetterIdx
MOVE LetterPos TO PrnPos
DISPLAY LetterIn, " is in position ", PrnPos
```

The example below is not meant to be a practical example of how to find the position of a letter in the alphabet. Nowadays, this task would be accomplished in much the same way as it would in C or Modula-2 except that, in COBOL, we would use the Intrinsic Function - ORD - as shown below.

```
COMPUTE PrnIdx = FUNCTION ORD(LetterIn) - FUNCTION ORD("A") + 1
```

Program

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. LetterSearch.
AUTHOR. Michael Coughlan.
* This program accepts an upper case letter from the
* user and then displays which letter of the alphabet
* it is.

DATA DIVISION.
WORKING-STORAGE SECTION.
01  LetterTable.
    02 LetterValues.
       03 FILLER PIC X(13)
          VALUE "ABCDEFGHIJKLM".
       03 FILLER PIC X(13)
          VALUE "NOPQRSTUVWXYZ".
    02 FILLER REDEFINES LetterValues.
       03 Letter PIC X OCCURS 26 TIMES
                       INDEXED BY LetterIdx.


01 LetterIn      PIC X.
01 LetterPos     PIC 99.
01 PrnPos        PIC Z9.

PROCEDURE DIVISION.
Begin.
    DISPLAY "Enter the letter please - "
          WITH NO ADVANCING
    ACCEPT LetterIn
    SET LetterIdx LetterPos TO 1
    SEARCH Letter VARYING LetterPos
       AT END DISPLAY "Letter " LetterIn " not found!"
       WHEN Letter(LetterIdx) = LetterIn
            MOVE LetterPos TO PrnPos
            DISPLAY LetterIn, " is in position ", PrnPos
    END-SEARCH
    STOP RUN.
```

Example program 2

In this example below, we return to the County Tax Report problem. In the last question we posed in the *Using Tables* tutorial we asked how the County Tax report problem could be solved if the tax record contained a county name instead of a county code. We noted that the county name had to be converted into a numeric value that we could use as a subscript. In the *Using Tables* tutorial we used a PERFORM to search through the table to find the numeric equivalent of the county name. In this example we use the SEARCH.

The VARYING phrase is used in this SEARCH example so that we don't have to set the *Idx* to the *CountyIdx*. We can not use *CountyIdx* as a subscript for the *CountyTaxTable* because it is bound to the *CountyNameTable*.

Program

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. CountyTaxTable.
AUTHOR. Michael Coughlan.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT TaxFile ASSIGN TO "CountyTaxes.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD TaxFile.
01 TaxRec.
   88 EndOfTaxFile   VALUE HIGH-VALUES.
   02 PAYENum        PIC 9(8).
   02 County         PIC X(9).
   02 TaxPaid        PIC 9(7)V99.

WORKING-STORAGE SECTION.
01 CountyTaxTable.
   02 CountyTaxDetails OCCURS 26 TIMES.
      03 CountyTax   PIC 9(8)V99.
      03 PayerCount  PIC 9(7).
         88 NoOnePaidTax VALUE ZEROS.

01 Idx               PIC 99.

01 CountyTaxLine.
   02 PrnCounty      PIC X(9).
   02 FILLER         PIC X(7) VALUE " Tax = ".
   02 PrnTax         PIC $$$,$$$,$$9.99.
   02 FILLER         PIC X(12) VALUE "   Payers = ".
   02 PrnPayers      PIC Z,ZZZ,ZZ9.


01 CountyNameTable.
   02 TableValues.
      03 FILLER  PIC X(9)  VALUE "Carlow".
      03 FILLER  PIC X(9)  VALUE "Cavan".
      03 FILLER  PIC X(9)  VALUE "Clare".
      03 FILLER  PIC X(9)  VALUE "Cork".
      03 FILLER  PIC X(9)  VALUE "Donegal".
      03 FILLER  PIC X(9)  VALUE "Dublin".
      03 FILLER  PIC X(9)  VALUE "Galway".
      03 FILLER  PIC X(9)  VALUE "Kerry".
      03 FILLER  PIC X(9)  VALUE "Kildare".
      03 FILLER  PIC X(9)  VALUE "Kilkenny".
      03 FILLER  PIC X(9)  VALUE "Laois".
      03 FILLER  PIC X(9)  VALUE "Leitrim".
      03 FILLER  PIC X(9)  VALUE "Limerick".
      03 FILLER  PIC X(9)  VALUE "Longford".
      03 FILLER  PIC X(9)  VALUE "Louth".
      03 FILLER  PIC X(9)  VALUE "Mayo".
      03 FILLER  PIC X(9)  VALUE "Meath".
      03 FILLER  PIC X(9)  VALUE "Monaghan".
      03 FILLER  PIC X(9)  VALUE "Offaly".
      03 FILLER  PIC X(9)  VALUE "Roscommon".
      03 FILLER  PIC X(9)  VALUE "Sligo".
      03 FILLER  PIC X(9)  VALUE "Tipperary".
      03 FILLER  PIC X(9)  VALUE "Waterford".
      03 FILLER  PIC X(9)  VALUE "Westmeath".
      03 FILLER  PIC X(9)  VALUE "Wexford".
      03 FILLER  PIC X(9)  VALUE "Wicklow".
   02 FILLER REDEFINES TableValues.
      03   CountyName  PIC X(9)
                       OCCURS 26 TIMES
                       INDEXED BY CountyIdx.

PROCEDURE DIVISION.
Begin.
   OPEN INPUT TaxFile
   MOVE ZEROS TO CountyTaxTable
   READ TaxFile
      AT END SET EndOfTaxFile TO TRUE
   END-READ
   PERFORM UNTIL EndOfTaxFile
      SET CountyIdx Idx TO 1
      SEARCH CountyName VARYING Idx
         AT END DISPLAY "County " County " was not found"
         WHEN CountyName(CountyIdx) = County
              ADD TaxPaid TO CountyTax(Idx)
              ADD 1 TO PayerCount(Idx)
      END-SEARCH
      READ TaxFile
         AT END SET EndOfTaxFile TO TRUE
      END-READ
   END-PERFORM
   PERFORM DisplayCountyTaxes VARYING Idx FROM 1 BY 1
           UNTIL Idx GREATER THAN 26
   CLOSE TaxFile
   STOP RUN.

DisplayCountyTaxes.
   IF NOT NoOnePaidTax(Idx)
      MOVE CountyName(Idx) TO PrnCounty
      MOVE CountyTax(Idx)  TO PrnTax
      MOVE PayerCount(Idx) TO PrnPayers
      DISPLAY CountyTaxLine
   END-IF.
```

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Searching multi-dimension tables

Introduction

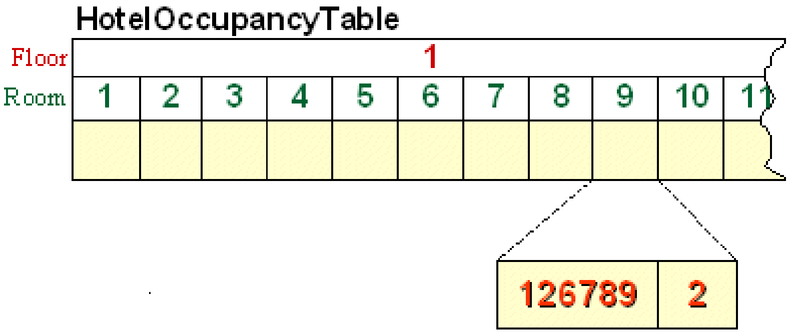
When the SEARCH verb is used, the target of the SEARCH must be an item in the table with both an OCCURS clause and an INDEXED BY phrase. The index item specified in the INDEXED BY phrase is the controlling index of the search. The controlling index governs the submission of the elements, or element items, for examination by the WHEN phrase of the SEARCH. A SEARCH can only have one controlling index.

Because a SEARCH can only have one controlling index it can only be used to search a single dimension of a table at a time. If the table to be searched is a multi-dimension table then the programmer must control the indexes of the other dimensions.

For instance, suppose a hotel keeps an Occupancy Table showing which rooms in the hotel are currently occupied. The table might be described as -

```
01 HotelOccupanyTable.
   02 Floor OCCURS 5 TIMES INDEXED BY Fidx.
      03 Room OCCURS 25 TIMES INDEXED BY Ridx.
         04 CustomerId  PIC 9(6).
         04 NumOfOccupants PIC 9.
```

and we can represent this diagrammatically as follows -



Suppose we want to search the table to discover which room is occupied by customer 126789. We can't use the SEARCH to search the whole two-dimension table directly but we can use the SEARCH to search the table floor by floor. In other words, we can treat the table as if it were a collection of floor tables and we use the SEARCH to search all the rooms in a particular floor table.

The example program below demonstrates how the SEARCH verb may be used to search the two-dimension *HotelOccupancyTable*.

Program

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. HotelSearch.
AUTHOR. Michael Coughlan.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT OccupancyFile ASSIGN TO "Occupancy.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD OccupancyFile.
01 FloorRec      PIC X(175).
   88  EndOfFile VALUE HIGH-VALUES.
*Each record represents one row of the table

WORKING-STORAGE SECTION.
01 HotelOccupanyTable.
   02 Floor OCCURS 5 TIMES INDEXED BY Fidx.
      03 Room OCCURS 25 TIMES INDEXED BY Ridx.
         04 CustomerId     PIC 9(6).
         04 NumOfOccupants PIC 9.

01 CustId                  PIC 9(6).
01 RoomNum                 PIC 99.
01 FloorNum                PIC 9.
01 FILLER                  PIC 9 VALUE 0.
   88 CustomerFound        VALUE 1.


PROCEDURE DIVISION.
Begin.
   PERFORM LoadTable
   DISPLAY "Enter Customer Id  - " WITH NO ADVANCING
   ACCEPT CustId
   PERFORM VARYING Fidx FROM 1 BY 1 UNTIL Fidx > 5
                   OR CustomerFound
      SET Ridx TO 1
      SEARCH Room
         WHEN CustomerId(Fidx,Ridx) = CustId
              SET CustomerFound TO TRUE
              SET FloorNum TO Fidx
              SET RoomNum TO Ridx
              DISPLAY "Customer " CustId
                      " is in room " FloorNum "-" RoomNum
      END-SEARCH
   END-PERFORM
   IF NOT CustomerFound
      DISPLAY "That customer is not in the hotel"
   END-IF
   STOP RUN.

LoadTable.
   OPEN INPUT OccupancyFile
   READ OccupancyFile
      AT END SET EndOfFile TO TRUE
   END-READ
   PERFORM VARYING Fidx FROM 1 BY 1 UNTIL EndOfFile
      MOVE FloorRec TO Floor(Fidx)
      READ OccupancyFile
        AT END SET EndOfFile TO TRUE
      END-READ
   END-PERFORM
   CLOSE OccupancyFile.
```

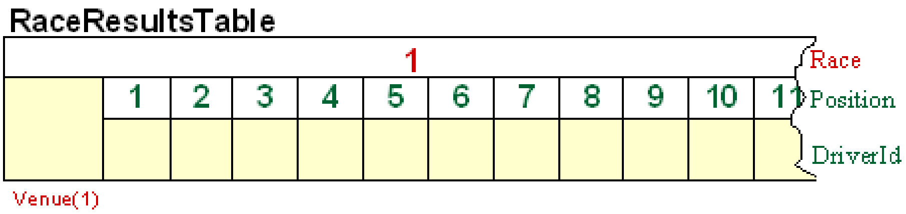
The Race Results Example program

This example demonstrates how the SEARCH may be used to search either of the dimensions of a two-dimension table.

Suppose that we want to use a two-dimension table to hold the finishing positions of drivers in fifteen races. The table to hold these details may be described as -

```
01 RaceResultsTable.
   02 Race OCCURS 15 TIMES INDEXED BY Ridx.
      03 Venue  PIC X(20).
      03 RacePos OCCURS 50 TIMES INDEXED BY Pidx.
         04 DriverId    PIC 9(4).
```

We can represent this diagramatically as follows -



In the example program below, the first dimension of the table is searched to find the results for a particular venue and then the second dimension, representing the results fo the race at that venue, are searched to find the finishing position of a particular driver.

Program

```
       $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. RaceSearch.
AUTHOR. Michael Coughlan.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT RaceResultsFile ASSIGN TO "RaceResults.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD RaceResultsFile.
01 VenueRec.
   88 EndOfFile VALUE HIGH-VALUES.
   02 RaceVenue         PIC X(20).
   02 Results           PIC X(200).
*Each record represents one row of the table

WORKING-STORAGE SECTION.
01 RaceResultsTable.
   02 Race OCCURS 15 TIMES INDEXED BY Ridx.
      03 Venue  PIC X(20).
      03 RacePos OCCURS 50 TIMES INDEXED BY Pidx.
         04 DriverId    PIC 9(4).

01 VenueName            PIC X(20).
01 DriverIdNum          PIC 9(4).
01 Pos                  PIC 99.


PROCEDURE DIVISION.
Begin.
   PERFORM LoadTable
   DISPLAY "Enter Venue name - " WITH NO ADVANCING
   ACCEPT VenueName
   DISPLAY "Enter the drivers id  - "WITH NO ADVANCING
   ACCEPT DriverIdNum
   SET Ridx TO 1
   SEARCH Race
      AT END DISPLAY "Venue not found."
      WHEN Venue(Ridx) = VenueName
           PERFORM SearchForDriver
   END-SEARCH
   STOP RUN.

SearchForDriver.
   SET Pidx TO 1
   SEARCH RacePos
       AT END DISPLAY "Driver not in top 50 finishers"
       WHEN DriverId(Ridx, Pidx) = DriverIdNum
            SET Pos TO Pidx
            DISPLAY "In the race at " VenueName
            DISPLAY "Driver " DriverIdNum
                    "finished in position " Pos
   END-SEARCH.

LoadTable.
   OPEN INPUT RaceResultsFile
   READ RaceResultsFile
      AT END SET EndOfFile TO TRUE
   END-READ
   PERFORM VARYING Ridx FROM 1 BY 1 UNTIL EndOfFile
      MOVE VenueRec TO Race(Ridx)
      READ RaceResultsFile
        AT END SET EndOfFile TO TRUE
      END-READ
   END-PERFORM
   CLOSE RaceResultsFile.
```

In the example above an out-of-line perform was used for the second SEARCH. This was not strictly necessary. The same result could have been achieved with nested SEARCH statements. For instance -

```
SET Ridx TO 1
SEARCH Race
   AT END DISPLAY "Venue not found."
   WHEN Venue(Ridx) = VenueName
     SET Pidx TO 1
     SEARCH RacePos
        AT END DISPLAY "Driver not in top 50 finishers"
        WHEN DriverId(Ridx, Pidx) = DriverIdNum
             SET Pos TO Pidx
             DISPLAY "In the race at " VenueName
             DISPLAY "Driver " DriverIdNum
                     " finished in position " Pos
     END-SEARCH
END-SEARCH
```

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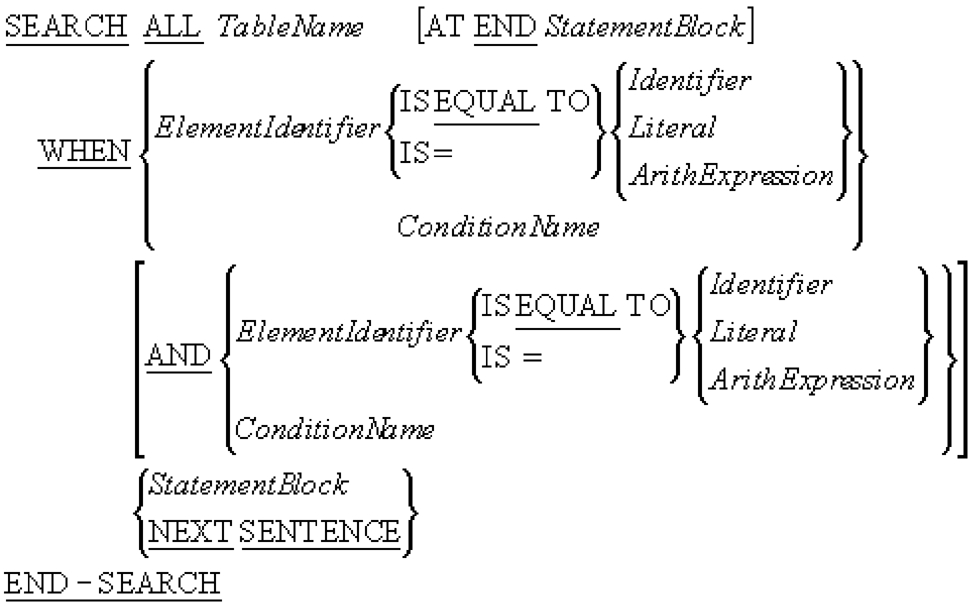
The SEARCH ALL verb

Introduction

The SEARCH ALL is used when a binary search is required. For this reason, the SEARCH ALL will only work on an ordered table. The table must be ordered on some some key field. The key field may be the element itself or, where the element is a group item, a field within the element. The key field must be identified by using the KEY IS phrase in the table declaration.

SEARCH ALL syntax



SEARCH ALL rules

1. The OCCURS clause of the table to be searched must have a KEY IS clause in addition to an INDEXED BY clause.

2. The *ElementIdentifier* must be the item referenced by the KEY IS phrase of the table's OCCURS clause.
3. The *ConditionName* must have only one value and it must be associated with a data-item referenced by the KEY IS phrase of the table's OCCURS clause.

SEARCH ALL notes
The KEY IS phrase identifies the data-item upon which the table is ordered.

When the SEARCH ALL is used, the programmer does not need to set the table index to a starting value because the SEARCH ALL controls it automatically.

Some problems using the SEARCH ALL
If the table to be searched is only partially populated, the SEARCH ALL may not work correctly. If the table is ordered in ascending sequence then, to get the SEARCH ALL to function correctly, the unpopulated elements must be filled with HIGH-VALUES. If the table is in descending sequence, the unpopulated elements should be filled with LOW-VALUES.

How a binary search works

A binary search requires that the table to be searched is ordered on some key field. A binary search works by repeatedly dividing the search area into a top and bottom half, deciding which half contains the required item, and then making that half the new search area. It continues halving the search area like this until the required item is found or it discovers that the item is not in the table.

The algorithm for the binary search is -

```
PERFORM UNTIL ItemFound OR ItemNotInTable
  COMPUTE Middle = (Lower + Upper) / 2
  EVALUATE TRUE
    WHEN Key(Middle) < SearchItem COMPUTE Lower = Middle + 1
    WHEN Key(Middle) > SearchItem COMPUTE Upper = Middle -1
    WHEN Key(Middle) = SearchItem SET ItemFound TO TRUE
    WHEN Lower > Upper THEN SET ItemNotInTable TO TRUE
  END-EVALUATE
END-PERFORM
```

The animation below demonstrates how the binary search works. It uses a search of the letter table described in one of the examples above, as an example. To allow the table to be searched with the SEARCH ALL the description of the table has to be amended to include a KEY IS phrase as shown below.

```
01  LetterTable.
    02 LetterValues.
       03 FILLER PIC X(13)
          VALUE "ABCDEFGHIJKLM".
       03 FILLER PIC X(13)
          VALUE "NOPQRSTUVWXYZ".
    02 FILLER REDEFINES LetterValues.
       03 Letter PIC X OCCURS 26 TIMES
                   ASCENDING KEY IS Letter
                   INDEXED BY LetterIdx.
```

When the table description contains a KEY IS phrase we can search it using the following statement -

```
SEARCH ALL Letter
  AT END DISPLAY "Letter " SearchLetter " was not found!"
  WHEN Letter(LetterIdx) = SearchLetter
```

```
           SET LetterPos TO LetterIdx
           DISPLAY SearchLetter " is in position " LetterPos
    END-SEARCH.
```

Animation

The full program for searching the letter table is given below.

Program

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. LetterSearchAll.
AUTHOR. Michael Coughlan.
* This program accepts an upper case letter from the
* user and then displays which letter of the alphabet
* it is.

DATA DIVISION.
WORKING-STORAGE SECTION.
01  LetterTable.
    02 LetterValues.
       03 FILLER PIC X(13)
          VALUE "ABCDEFGHIJKLM".
       03 FILLER PIC X(13)
          VALUE "NOPQRSTUVWXYZ".
    02 FILLER REDEFINES LetterValues.
       03 Letter PIC X OCCURS 26 TIMES
                       ASCENDING KEY IS Letter
                       INDEXED BY LetterIdx.


01 SearchLetter   PIC X.
01 LetterPos      PIC 99.

PROCEDURE DIVISION.
Begin.
    DISPLAY "Enter the letter please - "
          WITH NO ADVANCING
    ACCEPT SearchLetter
    SET LetterIdx LetterPos TO 1
    SEARCH ALL Letter
       AT END DISPLAY "Letter " SearchLetter " was not found!"
       WHEN Letter(LetterIdx) = SearchLetter
       SET LetterPos TO LetterIdx
       DISPLAY SearchLetter " is in position " LetterPos
    END-SEARCH
    STOP RUN.
```

Example program

In this example, we revisit the County Tax Report program once more. This time we use the SEARCH ALL to search the pre-filled table of county names.

The new parts of the program are coloured red.

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID. CountyTaxTable4.
AUTHOR. Michael Coughlan.
```

Program

```
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT TaxFile ASSIGN TO "CountyTaxes.DAT"
           ORGANIZATION IS LINE SEQUENTIAL.

DATA DIVISION.
FILE SECTION.
FD TaxFile.
01 TaxRec.
   88 EndOfTaxFile   VALUE HIGH-VALUES.
   02 PAYENum        PIC 9(8).
   02 County         PIC X(9).
   02 TaxPaid        PIC 9(7)V99.

WORKING-STORAGE SECTION.
01 CountyTaxTable.
   02 CountyTaxDetails OCCURS 26 TIMES.
      03 CountyTax   PIC 9(8)V99.
      03 PayerCount  PIC 9(7).
         88 NoOnePaidTax VALUE ZEROS.

01 Idx               PIC 99.

01 CountyTaxLine.
   02 PrnCounty      PIC X(9).
   02 FILLER         PIC X(7) VALUE " Tax = ".
   02 PrnTax         PIC $$$,$$$,$$9.99.
   02 FILLER         PIC X(12) VALUE "   Payers = ".
   02 PrnPayers      PIC Z,ZZZ,ZZ9.


01 CountyNameTable.
   02 TableValues.
      03 FILLER  PIC X(9)  VALUE "Carlow".
      03 FILLER  PIC X(9)  VALUE "Cavan".
      03 FILLER  PIC X(9)  VALUE "Clare".
      03 FILLER  PIC X(9)  VALUE "Cork".
      03 FILLER  PIC X(9)  VALUE "Donegal".
      03 FILLER  PIC X(9)  VALUE "Dublin".
      03 FILLER  PIC X(9)  VALUE "Galway".
      03 FILLER  PIC X(9)  VALUE "Kerry".
      03 FILLER  PIC X(9)  VALUE "Kildare".
      03 FILLER  PIC X(9)  VALUE "Kilkenny".
      03 FILLER  PIC X(9)  VALUE "Laois".
      03 FILLER  PIC X(9)  VALUE "Leitrim".
      03 FILLER  PIC X(9)  VALUE "Limerick".
      03 FILLER  PIC X(9)  VALUE "Longford".
      03 FILLER  PIC X(9)  VALUE "Louth".
      03 FILLER  PIC X(9)  VALUE "Mayo".
      03 FILLER  PIC X(9)  VALUE "Meath".
      03 FILLER  PIC X(9)  VALUE "Monaghan".
      03 FILLER  PIC X(9)  VALUE "Offaly".
      03 FILLER  PIC X(9)  VALUE "Roscommon".
      03 FILLER  PIC X(9)  VALUE "Sligo".
      03 FILLER  PIC X(9)  VALUE "Tipperary".
      03 FILLER  PIC X(9)  VALUE "Westmeath".
      03 FILLER  PIC X(9)  VALUE "Waterford".
      03 FILLER  PIC X(9)  VALUE "Wexford".
      03 FILLER  PIC X(9)  VALUE "Wicklow".
   02 FILLER REDEFINES TableValues.
      03   CountyName  PIC X(9)
                       OCCURS 26 TIMES
                       ASCENDING KEY IS CountyName
                       INDEXED BY CountyIdx.

PROCEDURE DIVISION.
Begin.
   OPEN INPUT TaxFile
   MOVE ZEROS TO CountyTaxTable
   READ TaxFile
      AT END SET EndOfTaxFile TO TRUE
   END-READ
   PERFORM UNTIL EndOfTaxFile
      SEARCH ALL CountyName
         AT END DISPLAY "County " County " was not found"
         WHEN CountyName(CountyIdx) = County
              SET Idx TO CountyIdx
              ADD TaxPaid TO CountyTax(Idx)
              ADD 1 TO PayerCount(Idx)
      END-SEARCH
      READ TaxFile
         AT END SET EndOfTaxFile TO TRUE
      END-READ
   END-PERFORM
   PERFORM DisplayCountyTaxes VARYING Idx FROM 1 BY 1
           UNTIL Idx GREATER THAN 26
   CLOSE TaxFile
   STOP RUN.

DisplayCountyTaxes.
   IF NOT NoOnePaidTax(Idx)
      MOVE CountyName(Idx) TO PrnCounty
      MOVE CountyTax(Idx)  TO PrnTax
      MOVE PayerCount(Idx) TO PrnPayers
      DISPLAY CountyTaxLine
   END-IF.
```

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