SAS® Viya™ 3.1 Component Objects: Reference

SAS® Documentation

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SAS® Viya™ 3.1 Component Objects: Reference

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Chapter 1

About SAS Component Objects

Introduction to DATA Step Component Objects

SAS provides these three predefined component objects for use in a DATA step:

hash and hash iterator objects
: enable you to quickly and efficiently store, search, and retrieve data based on lookup keys. The hash object keys and data are DATA step variables. Key and data values can be directly assigned constant values or values from a SAS data set. For information about the hash and hash iterator object language elements, see Chapter 2, "Dictionary of Hash and Hash Iterator Object Language Elements," on page 39.

Java object
: provides a mechanism that is similar to the Java Native Interface (JNI) for instantiating Java classes and accessing fields and methods on the resultant objects. For more information, see Chapter 3, "Dictionary of Java Object Language Elements," on page 107.

The DATA step Component Interface enables you to create and manipulate these component objects using statements, attributes, operators, and methods. You use the DATA step object dot notation to access the component object's attributes and methods. For detailed information about dot notation and the DATA step objects' statements, attributes, methods, and operators, see the Dictionary of Component Language Elements in *SAS Viya Component Objects: Reference*.

Note: The DATA step component object statement, attributes, methods, and operators are limited to those defined for these objects. You cannot use the SAS Component Language functionality with these predefined DATA step objects.

Dot Notation and DATA Step Component Objects

Definition

Dot notation provides a shortcut for invoking methods and for setting and querying attribute values. Using dot notation makes your SAS programs easier to read.

To use dot notation with a DATA step component object, you must declare and instantiate the component object by using either the DECLARE statement by itself or the DECLARE statement and the _NEW_ operator together.

Syntax

The syntax for dot notation is as follows:

object.attribute

or

object.method (<*argument_tag-1*: *value-1* <,… *argument_tag-n*: *value-n*>>;

The arguments are defined as follows:

object
: specifies the variable name for the DATA step component object.

attribute
specifies an object attribute to assign or query.

When you set an attribute for an object, the code takes this form:

```
object.attribute = value;
```

When you query an object attribute, the code takes this form:

```
value = object.attribute;
```

method
specifies the name of the method to invoke.

argument_tag
identifies the arguments that are passed to the method. Enclose the argument tag in parentheses. The parentheses are required whether the method contains argument tags.

All DATA step component object methods take this form:

```
return_code=object.method(<argument_tag-1:value-1
   <, ...argument_tag-n:value-n>>);
```

The return code indicates method success or failure. A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, an appropriate error message is printed to the log.

value
specifies the argument value.

Using the Hash Object

Why Use the Hash Object?

The hash object provides an efficient, convenient mechanism for quick data storage and retrieval. The hash object stores and retrieves data based on lookup keys.

To use the DATA step Component Object Interface:

1. Declare the hash object.
2. Create an instance of (instantiate) the hash object.
3. Initialize lookup keys and data.

After you declare and instantiate a hash object, you can perform many tasks, including these:

- Store and retrieve data.
- Maintain key summaries.
- Replace and remove data.
- Compare hash objects.
- Generate a data set that contains the data in the hash object.

For example, suppose you have a large data set that contains numeric lab results corresponding to a unique patient number and weight. And suppose you have a small

data set that contains patient numbers (a subset of the lab results in the large data set). You can load the large data set into a hash object using the unique patient number as the key and the weight values as the data. A single pass is made through the small data set using the patient number to look up the current patient in the hash object whose weight is over a certain value. The patient data is then written to a different data set.

Depending on the number of lookup keys and the size of the data set, the hash object lookup can be significantly faster than a standard format lookup. Load the large data set first if you are just looking up keys, have a lot of memory, and want fast performance. If you do not want to use a lot of memory, load the small data set first.

Declaring and Instantiating a Hash Object

You declare a hash object using the DECLARE statement. After you declare the new hash object, use the _NEW_ operator to instantiate the object. For example:

```
declare hash myhash;
myhash = _new_ hash();
```

The DECLARE statement tells the compiler that the object reference MyHash is of type hash. At this point, you have declared only the object reference MyHash, which has the potential to hold a component object of type hash. You should declare the hash object only once. The _NEW_ operator creates an instance of the hash object and assigns the hash object to the object reference MyHash.

There is an alternative to the two-step process of using the DECLARE statement and the _NEW_ operator to declare and instantiate a component object. You can use the DECLARE statement to declare and instantiate the component object in one step:

```
declare hash myhash();
```

The preceding statement is equivalent to this code:

```
declare hash myhash;
myhash = _new_ hash();
```

For more information, see "DECLARE Statement, Hash and Hash Iterator Objects" on page 45 and the "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73.

Initializing Hash Object Data Using a Constructor

When you create a hash object, you might want to provide initialization data. A constructor is a method to instantiate a hash object and initialize the hash object data.

The hash object constructor can have one of these formats:

- `declare hash object_name(argument_tag-1: value-1`
  `<, ...argument_tag-n: value-n>);`
- `object_name = _new_ hash(argument_tag-1: value-1`
  `<, ...argument_tag-n: value-n>);`

For more information, see the "DECLARE Statement, Hash and Hash Iterator Objects" on page 45 and the "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73.

Defining Keys and Data

The hash object uses lookup keys to store and retrieve data. The keys and the data are DATA step variables that you use to initialize the hash object by using dot notation method calls. A key is defined by passing the key variable name to the DEFINEKEY

method. Data is defined by passing the data variable name to the DEFINEDATA method. After you have defined all key and data variables, the DEFINEDONE method is called. Keys and data can consist of any number of character or numeric DATA step variables.

For example, this code initializes a character key and a character data variable:

```
length d $20;
length k $20;

if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k');
   rc = h.defineData('d');
   rc = h.defineDone();
end;
```

You can have multiple key and data variables, but the entire key must be unique, unless you create the hash object with the MULTIDATA:"YES" argument tag. For more information, see "Non-Unique Key and Data Pairs" on page 6.

You can store more than one data item with a particular key. For example, you could modify the previous example to store auxiliary numeric values with the character key and data. In this example, each key and each data item consists of a character value and a numeric value:

```
length d1 8;
length d2 $20;
length k1 $20;
length k2 8;

if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k1', 'k2');
   rc = h.defineData('d1', 'd2');
   rc = h.defineDone();
end;
```

For more information, see the "DEFINEDATA Method" on page 53, "DEFINEDONE Method" on page 55, and the "DEFINEKEY Method" on page 56.

Note: The hash object does not assign values to key variables (for example, **`h.find(key:'abc')`**), and the SAS compiler cannot detect the data variable assignments that are performed by the hash object and the hash iterator. Therefore, if no assignment to a key or data variable appears in the program, SAS issues a note stating that the variable is uninitialized. To avoid receiving these notes, you can perform one of these actions:

- Set the NONOTES system option.
- Provide an initial assignment statement (typically, to a missing value) for each key and data variable.
- Use the CALL MISSING routine with all the key and data variables as parameters. For example:

  ```
  length d $20;
  length k $20;

  if _N_ = 1 then do;
     declare hash h();
  ```

```
    rc = h.defineKey('k');
    rc = h.defineData('d');
    rc = h.defineDone();
    call missing(k, d);
end;
```

Non-Unique Key and Data Pairs

By default, all of the keys in a hash object are unique, which means one set of data variables exists for each key. In some situations, you might want to have duplicate keys in the hash object. That is, you might want to associate more than one set of data variables with a key.

For example, assume that the key is a patient ID and the data is a visit date. If the patient were to visit multiple times, multiple visit dates would be associated with the patient ID. When you create a hash object with the MULTIDATA:“YES” argument tag, multiple sets of the data variables are associated with the key.

If the data set contains duplicate keys, by default, the first instance is stored in the hash object and subsequent instances are ignored. To store the last instance in the hash object, use the DUPLICATE argument tag. The DUPLICATE argument tag also writes an error to the SAS log if there is a duplicate key.

However, the hash object allows storage of multiple values for each key if you use the MULTIDATA argument tag in the DECLARE statement or _NEW_ operator. The hash object keeps the multiple values in a list that is associated with the key. This list can be traversed and manipulated using methods such as HAS_NEXT or FIND_NEXT.

To traverse a multiple data item list, you must know the current list item. Start by calling the FIND method for a given key. The FIND method sets the current list item. Then, to determine whether the key has multiple data values, call the HAS_NEXT method. After you have determined that the key has another data value, you can retrieve that value with the FIND_NEXT method. The FIND_NEXT method sets the current list item to the next item in the list and sets the corresponding data variable or variables for that item.

In addition to moving forward through the list for a given key, you can loop backward through the list by using the HAS_PREV and FIND_PREV methods in a similar manner.

When you have a hash object that has multiple values for a single key, you can use the DO_OVER method in an iterative DO loop to traverse through the duplicate keys. The DO_OVER method reads the key on the first method call and continues to iterate over the duplicate key list until it reaches the end.

Note: The items in a multiple data item list are maintained in the order in which you insert them.

For more information about these and other methods associated with non-unique key and data pairs, see Chapter 2, “Dictionary of Hash and Hash Iterator Object Language Elements,” on page 39.

Storing and Retrieving Data

How to Store and Retrieve Data

After you initialize the hash object's key and data variables, you can store data in the hash object using the ADD method, or you can use the *dataset* argument tag to load a data set into the hash object. If you use the *dataset* argument tag, and if the data set contains more than one observation with the same value of the key, by default, SAS

keeps the first observation in the hash table and ignores subsequent observations. To store the last instance in the hash object or to send an error to the log if there is a duplicate key, use the DUPLICATE argument tag. To allow duplicate values for each key, use the MULTIDATA argument tag.

You can then use the FIND method to search and retrieve data from the hash object if one data value exists for each key. Use the FIND_NEXT and FIND_PREV methods to search and retrieve data if multiple data items exist for each key.

For more information, see "ADD Method" on page 40, "FIND Method" on page 62, "FIND_NEXT Method" on page 64, and the "FIND_PREV Method" on page 66.

You can consolidate a FIND method and an ADD method using the REF method. You can reduce the amount of code in this example:

```
rc = h.find();
  if (rc != 0) then
    rc = h.add();
```

Here, the code is reduced to a single method call:

```
rc = h.ref();
```

For more information, see the "REF Method" on page 87.

Note: You can also use the hash iterator object to retrieve the hash object data, one data item at a time, in forward and reverse order. For more information, see "Using the Hash Iterator Object " on page 15.

Example 1: Using the ADD and FIND Methods to Store and Retrieve Data

The following example uses the ADD method to store the data in the hash object and associate the data with the key. Then, the FIND method is used to retrieve the data that is associated with the key value **`Homer`**.

```
data _null_;
length d $20;
length k $20;

/* Declare the hash object and key and data variables */
if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k');
   rc = h.defineData('d');
   rc = h.defineDone();
end;

/* Define constant value for key and data */
k = 'Homer';
d = 'Odyssey';
/* Use the ADD method to add the key and data to the hash object */
rc =h.add();
if (rc ne 0) then
   put 'Add failed.';

/* Define constant value for key and data */
k = 'Joyce';
d = 'Ulysses';
/* Use the ADD method to add the key and data to the hash object */
rc = h.add();
```

```
if (rc ne 0) then
   put 'Add failed.';

k = 'Homer';
/* Use the FIND method to retrieve the data associated with 'Homer' key */
rc = h.find();
if (rc = 0) then
   put d=;
else
   put 'Key Homer not found.';
run;
```

The FIND method assigns the data value **Odyssey**, which is associated with the key value **Homer**, to the variable D.

Example 2: Loading a Data Set and Using the FIND Method to Retrieve Data

Assume that the data set Small contains two numeric variables K (key) and S (data) and another data set, Large, contains a corresponding key variable K. The following code loads the Small data set into the hash object, and then searches the hash object for key matches on the variable K from the Large data set.

```
data match;
   length k 8;
   length s 8;
   if _N_ = 1 then do;
      /* load SMALL data set into the hash object */
     declare hash h(dataset: "work.small");
      /* define SMALL data set variable K as key and S as value */
      h.defineKey('k');
      h.defineData('s');
      h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(k, s);
   end;

/* use the SET statement to iterate over the LARGE data set using */
/* keys in the LARGE data set to match keys in the hash object */
set large;
rc = h.find();
if (rc = 0) then output;
run;
```

The DATASET argument tag specifies the Small data set whose keys and data are read and loaded by the hash object during the DEFINEDONE method. The FIND method is then used to retrieve the data.

Maintaining Key Summaries

You can maintain a summary count for a hash object key by using the SUMINC argument tag when you declare the hash object. The tag value is a string expression that resolves to the name of a numeric DATA step variable: the SUMINC variable.

This SUMINC argument tag instructs the hash object to allocate internal storage for maintaining a summary value for each key.

The summary value of a hash key is initialized to the value of the SUMINC variable whenever the ADD or REPLACE method is used.

The summary value of a hash key is incremented by the value of the SUMINC variable whenever the FIND, CHECK, or REF method is used.

Note that the SUMINC variable can be negative, positive, or zero valued. The variable does not need to be an integer. The SUMINC value for a key is zero by default.

In the following example, the initial ADD method sets the summary count for K=99 to 1 before the ADD method. Each time a new COUNT value is given, the FIND method adds the value to the key summary. In this example, one data value exists for each key. The SUM method retrieves the current value of the key summary and the value is stored in the DATA step variable TOTAL. If multiple items exist for each key, the SUMDUP method retrieves the current value of the key summary.

```
data _null_;
 length k count 8;
 length total 8;
 dcl hash myhash(suminc: 'count');
 myhash.defineKey('k');
 myhash.defineDone();

 k = 99;
 count = 1;
 myhash.add();


/* COUNT is given the value 2.5 and the */
/* FIND sets the summary to 3.5*/
 count = 2.5;
 myhash.find();

/* The COUNT of 3 is added to the FIND and */
/* sets the summary to 6.5. */
 count = 3;
 myhash.find();


/* The COUNT of -1 sets the summary to 5.5. */
 count = -1;
 myhash.find();

/* The SUM method gives the current value of */
/* the key summary to the variable TOTAL. */
 myhash.sum(sum: total);

/* The PUT statement prints total=5.5 in the log. */
 put total=;
 run;
```

In this example, a summary is maintained for each key value, K=99 and K=100:

```
 k = 99;
 count = 1;
 myhash.add();
 /* key=99 summary is now 1 */

 k = 100;
```

```
 myhash.add();
 /* key=100 summary is now 1 */

 k = 99;
 myhash.find();
 /* key=99 summary is now 2 */

 count = 2;
 myhash.find();
 /* key=99 summary is now 4 */

 k = 100;
 myhash.find();
 /* key=100 summary is now 3 */

 myhash.sum(sum: total);
 put 'total for key 100 = 'total;

 k = 99;

myhash.sum(sum:total);
 put 'total for key 99 = ' total;
```

The first PUT statement prints the summary for K=100:

```
total for key 100 = 3
```

And the second PUT statement prints the summary for K=99:

```
total for key 99 = 4
```

You can use key summaries in conjunction with the DATASET argument tag. As the data set is read into the hash object using the DEFINEDONE method, all key summaries are set to the SUMINC value. And, all subsequent FIND, CHECK, or ADD methods change the corresponding key summaries.

```
declare hash myhash(suminc: "keycount", dataset: "work.mydata");
```

You can use key summaries for counting the number of occurrences of given keys. In the following example, the data set MyData is loaded into a hash object and uses key summaries to count the number of occurrences for each key in the data set Keys. (The SUMINC variable is not set to a value, so the default initial value of zero is used.)

```
data mydata;
 input key;
datalines;
1
2
3
4
5
;
run;


data keys;
 input key;
datalines;
1
2
```

```
1
3
5
2
3
2
4
1
5
1
;
run;

data count;
 length total key 8;
 keep key total;

 declare hash myhash(suminc: "count", dataset:"mydata");
 myhash.defineKey('key');
 myhash.defineDone();
 count = 1;

 do while (not done);
   set keys end=done;
   rc = myhash.find();
 end;

 done = 0;
 do while (not done);
   set mydata end=done;
   rc = myhash.sum(sum: total);
   output;
 end;
 stop;
run;
```

Output 1.1 *Key Summary Output*

The SAS System

Obs	total	key
1	4	1
2	3	2
3	2	3
4	1	4
5	2	5

Note: The KEYSUM constructor in the DECLARE statement or the _NEW_ operator declares a variable that tracks the key summary for all keys. The KEYSUM variable is part of the output data set and works when one or more data items exist for a key.

For more information, see the "SUM Method" on page 102 and the "SUMDUP Method" on page 104.

Replacing and Removing Data in the Hash Object

You can replace or remove data that is stored in the hash object using any of these methods:

- Use the REPLACE method to replace all data items.
- Use the REMOVE method to remove all data items.
- Use the REMOVEDUP method to remove only the current data item.
- Use the REPLACEDUP method to replace only the current data item.

In the following example, the REPLACE method replaces the data **Odyssey** with **Iliad**, and the REMOVE method deletes the entire data entry associated with the **Joyce** key from the hash object:

```
data _null_;
length d $20;
length k $20;

/* Declare the hash object and key and data variables */
if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k');
   rc = h.defineData('d');
   rc = h.defineDone();
end;

/* Define constant value for key and data */
k = 'Joyce';
d = 'Ulysses';
/* Use the ADD method to add the key and data to the hash object */
rc = h.add();
if (rc ne 0) then
   put 'Add failed.';

/* Define constant value for key and data */
k = 'Homer';
d = 'Odyssey';
/* Use the ADD method to add the key and data to the hash object */
rc = h.add();
if (rc ne 0) then
   put 'Add failed.';

/* Use the REPLACE method to replace 'Odyssey' with 'Iliad' */
k = 'Homer';
d = 'Iliad';
rc = h.replace();
if (rc = 0) then
   put d=;
else
   put 'Replace not successful.';

/* Use the REMOVE method to remove the 'Joyce' key and data */
```

```
k = 'Joyce';
rc = h.remove();
if (rc = 0) then
   put k 'removed from hash object';
else
   put 'Deletion not successful.';

run;
```

The following lines are written to the SAS log:

```
d=Iliad
Joyce removed from hash object
```

Note: If an associated hash iterator is pointing to the key, the REMOVE method does not remove the key or data from the hash object. An error message is issued to the log.

For more information, see the "REMOVE Method" on page 89, "REMOVEDUP Method" on page 92, "REPLACE Method" on page 94, and the "REPLACEDUP Method" on page 97.

Saving Hash Object Data in a Data Set

You can create a data set that contains the data in a specified hash object by using the OUTPUT method. In the following example, two keys and data are added to the hash object and then written to the Work.Out data set.

```
options pageno=1 nodate;

data test;
length d1 8;
length d2 $20;
length k1 $20;
length k2 8;

/* Declare the hash object and two key and data variables */
if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k1', 'k2');
   rc = h.defineData('d1', 'd2');
   rc = h.defineDone();
end;

/* Define constant value for key and data */
k1 = 'Joyce';
k2 = 1001;
d1 = 3;
d2 = 'Ulysses';
rc = h.add();

/* Define constant value for key and data */
k1 = 'Homer';
k2 = 1002;
d1 = 5;
d2 = 'Odyssey';
rc = h.add();
```

```
/* Use the OUTPUT method to save the hash object data to the OUT data set */
rc = h.output(dataset: "work.out");
run;

proc print data=work.out;
run;
```

Output 1.2 *Data Set Created from the Hash Object*

The SAS System

Obs	d1	d2
1	5	Odyssey
2	3	Ulysses

The hash object keys are not automatically stored as part of the output data set. The keys can be defined as data items by using the DEFINEDATA method and be included in the output data set. In addition, if no data items are defined using the DEFINEDATA method, the keys are written to the data set specified in the OUTPUT method. In the preceding example, the DEFINEDATA method would be written this way:

```
rc = h.defineData('k1', 'k2', 'd1', 'd2');
```

For more information, see the "OUTPUT Method" on page 80.

Comparing Hash Objects

You can compare one hash object with another by using the EQUALS method. In the following example, two hash objects are being compared. Note that the EQUALS method has two argument tags. The HASH argument tag is the name of the second hash object. The RESULTS argument tag is a numeric variable name that holds the result of the comparison (1 if equal and zero if not equal).

```
length eq k 8;

declare hash myhash1();
myhash1.defineKey('k');
myhash1.defineDone();

declare hash myhash2();
myhash2.defineKey('k');
myhash2.defineDone();

rc = myhash1.equals(hash: 'myhash2', result: eq);
```

For more information, see the "EQUALS Method" on page 60.

Using Hash Object Attributes

You can use the DATA Step Component Interface to retrieve information from a hash object using an attribute. Use the following syntax for an attribute:

```
attribute_value=obj.attribute_name;
```

There are two attributes available to use with hash objects. NUM_ITEMS returns the number of items in a hash object and ITEM_SIZE returns the size (in bytes) of an item. This example retrieves the number of items in a hash object:

```
n = myhash.num_items;
```

This example retrieves the size of an item in a hash object:

```
s = myhash.item_size;
```

You can approximate how much memory the hash object is using with the ITEM_SIZE and NUM_ITEMS attributes. The ITEM_SIZE attribute does not reflect the initial overhead that the hash object requires, nor does it take into account any necessary internal alignments. Although ITEM_SIZE does not provide exact memory usage, it provides a good approximation.

For more information, see the "NUM_ITEMS Attribute " on page 79 and the "ITEM_SIZE Attribute" on page 71.

Using the Hash Iterator Object

About the Hash Iterator Object

Use the hash iterator object to store and search data based on lookup keys. The hash iterator object enables you to retrieve the hash object data in either forward or reverse key order.

Declaring and Instantiating a Hash Iterator Object

You declare a hash iterator object by using the DECLARE statement. After you declare the new hash iterator object, use the _NEW_ operator to instantiate the object. Use the hash object name as an argument tag. For example:

```
declare hiter myiter;
myiter = _new_ hiter('h');
```

The DECLARE statement tells the compiler that the object reference MyIter is of type hash iterator. At this point, you have declared only the object reference MyIter, which has the potential to hold a component object of type hash iterator. You should declare the hash iterator object only once. The _NEW_ operator creates an instance of the hash iterator object and assigns the hash iterator to the object reference MyIter. The hash object, H, is passed as a constructor argument. The hash object, not the hash object variable, is specifically assigned to the hash iterator.

As an alternative to the two-step process of using the DECLARE statement and the _NEW_ operator to declare and instantiate a component object, you can declare and instantiate a hash iterator object in one step by using the DECLARE statement as a constructor method. The syntax is as follows:

```
declare hiter object_name(hash_object_name);
```

In the preceding example, the hash object name must be enclosed in single or double quotation marks.

For example:

```
declare hiter myiter('h');
```

The previous statement is equivalent to these statements:

```
declare hiter myiter;
myiter = _new_ hiter('h');
```

Note: You must declare and instantiate a hash object before you create a hash iterator object. For more information, see "Declaring and Instantiating a Hash Object" on page 4.

For example:

```
if _N_ = 1 then do;
   length key $10;
   declare hash myhash(dataset:"work.x", ordered: 'yes');
   declare hiter myiter('myhash');
   myhash.defineKey('key');
   myhash.defineDone();
end;
```

This code creates an instance of a hash iterator object with the variable name MyIter. The hash object, MyHash, is passed as the constructor argument. Because the hash object was created with the ORDERED argument tag set to **'yes'**, the data is returned in ascending key-value order.

For more information about the DECLARE statement and the _NEW_ operator, see the *SAS Viya Statements: Reference*.

Example: Retrieving Hash Object Data By Using the Hash Iterator

Using the data set ASTRO that contains astronomical data, the following code creates the data set that contains Messier objects (OBJ) whose right-ascension (RA) values are greater than 12. The FIRST and NEXT methods are used to retrieve the data in ascending order. For more information about the FIRST and NEXT methods, see *SAS Viya Component Objects: Reference*.

```
data astro;
   input obj $1-4 ra $6-12 dec $14-19;
   datalines;
 M31 00 42.7 +41 16
 M71 19 53.8 +18 47
 M51 13 29.9 +47 12
 M98 12 13.8 +14 54
 M13 16 41.7 +36 28
 M39 21 32.2 +48 26
 M81 09 55.6 +69 04
M100 12 22.9 +15 49
 M41 06 46.0 -20 44
 M44 08 40.1 +19 59
 M10 16 57.1 -04 06
 M57 18 53.6 +33 02
  M3 13 42.2 +28 23
 M22 18 36.4 -23 54
```

```
 M23 17 56.8 -19 01
 M49 12 29.8 +08 00
 M68 12 39.5 -26 45
 M17 18 20.8 -16 11
 M14 17 37.6 -03 15
 M29 20 23.9 +38 32
 M34 02 42.0 +42 47
 M82 09 55.8 +69 41
 M59 12 42.0 +11 39
 M74 01 36.7 +15 47
 M25 18 31.6 -19 15
;
run;

data out;
   if _N_ = 1 then do;
      length obj $10;
      length ra $10;
      length dec $10;
      /* Read ASTRO data set and store in asc order in hash obj */
      declare hash h(dataset:"work.astro", ordered: 'yes');
      /* Define variables RA and OBJ as key and data for hash object */
      declare hiter iter('h');
      h.defineKey('ra');
      h.defineData('ra', 'obj');
      h.defineDone();
      /* Avoid uninitialized variable notes */
      call missing(obj, ra, dec);
   end;
/* Retrieve RA values in ascending order */
rc = iter.first();
do while (rc = 0);
/* Find hash object keys greater than 12 and output data */
   if ra GE '12' then
      output;
   rc = iter.next();
end;
run;

proc print data=work.out;
   var ra obj;
   title 'Messier Objects Greater than 12 Sorted by Right Ascension Values';
run;
```

Output 1.3 *Messier Objects Greater Than 12, Sorted by Right Ascension Values*

Messier Objects Greater than 12 Sorted by Right Ascension Values

Obs	ra	obj
1	12 13.8	M98
2	12 22.9	M100
3	12 29.8	M49
4	12 39.5	M68
5	12 42.0	M59
6	13 29.9	M51
7	13 42.2	M3
8	16 41.7	M13
9	16 57.1	M10
10	17 37.6	M14
11	17 56.8	M23
12	18 20.8	M17
13	18 31.6	M25
14	18 36.4	M22
15	18 53.6	M57
16	19 53.8	M71
17	20 23.9	M29
18	21 32.2	M39

Using the Java Object

About the Java Object

The Java object provides a mechanism that is similar to the Java Native Interface (JNI) for instantiating Java classes and accessing fields and methods on the resultant objects. You can create hybrid applications that contain both Java and DATA step code.

CLASSPATH and Java Options

In previous versions of SAS, Java classes were found using the JREOPTIONS system option.

In SAS, you must set the CLASSPATH environment variable so that the Java object can find your Java classes. The Java object represents an instance of a Java class that is found in the current Java classpath. Any class that you use must appear in the classpath. If the class is in a JAR file, then the JAR filename must appear in the classpath.

How you set the CLASSPATH environment variable depends on your operating environment. For most operating systems, you can set the CLASSPATH environment variable either globally or locally (for use only in your SAS session). Table 1.1 shows methods and examples for the Linux operating environment.

Table 1.1 *Setting the CLASSPATH Environment Variable in Different Operating Environments*

Linux Operating Environment	Method	Example
Globally	SAS configuration file	`set classpath ~/HelloWorld.jar`
Locally	EXPORT command*	`export classpath=~/HelloWorld.jar;`

* The syntax depends on the shell.

Restrictions and Requirements for Using the Java Object

These restrictions and requirements apply when using the Java object:

- The Java object is designed to call Java methods from SAS. The Java object is not intended to extend the SAS library of functions. Calling PROC FCMP functions is much more efficient for fast in-process extensions to the DATA step, especially when large data sets are involved. Using the Java object to perform this type of processing with large data sets takes significantly more time.
- The only Java Runtime Environments (JREs) that are supported by SAS are those that are explicitly required during the installation of SAS software.
- The only Java options that are supported by SAS are those that are set when SAS is installed.
- Ensure that your Java application runs correctly before using it with the Java object.
- The use of a percent character (%) in the first byte of text written to the SAS log by Java is reserved by SAS. If you need to include a % in the first byte of a Java text line, it must be escaped with another percent immediately next to it (%%).
- When SAS is in a locked-down state, the Java object is not available. For more information about the LOCKDOWN statement, see *SAS Viya Statements: Reference*.

Declaring and Instantiating a Java Object

You declare a Java object by using the DECLARE statement. After you declare the new Java object, use the _NEW_ operator to instantiate the object and the Java object name as an argument tag.

```
declare javaobj j;
j = _new_ javaobj("somejavaclass");
```

In this example, the DECLARE statement tells the compiler that the object reference J is of type Java. That is, the instance of the Java object is stored in the variable J. At this point, you have declared only the object reference J, which has the potential to hold a component object of type Java. You should declare the Java object only once. The _NEW_ operator creates an instance of the Java object and assigns it to the object reference J. The Java class name, SOMEJAVACLASS, is passed as a constructor argument. This is the first and only argument that is required for the Java object constructor. All other arguments are constructor arguments to the Java class itself.

As an alternative to the two-step process of using the DECLARE statement and the _NEW_ operator to declare and instantiate a Java object, you can declare and instantiate a Java object in one step by using the DECLARE statement as a constructor method:

DECLARE JAVAOBJ*object-name*(“*java-class*”, <*argument-1*, … *argument–n*>);

For more information, see the “DECLARE Statement, Java Object” on page 113 and the “_NEW_ Operator, Java Object” on page 126.

Accessing Object Fields

After you instantiate a Java object, you can access and modify its public and class fields in a DATA step through method calls on the Java object. Public fields are non-static and declared as public in the Java class. Class fields are static and accessed from Java classes.

Method calls to access object fields have one of these forms, depending on whether you are accessing non-static or static fields:

GET*type***FIELD**(“*field-name*”, *value*);

GETSTATIC*type***FIELD**(“*field-name*”, *value*);

Method calls to modify object fields have one of these forms, depending on whether you access non-static or static fields:

SET*type***FIELD**(“*field-name*”, *value*);

SETSTATIC*type***FIELD**(“*field-name*”, *value*);

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see “Type Issues” on page 21. The *field-name* argument specifies the type for the Java field, and *value* specifies the value that is returned or set by the method.

For more information and examples, see Chapter 3, “Dictionary of Java Object Language Elements,” on page 107.

Accessing Object Methods

After you instantiate a Java object, you can access its public and class methods in a DATA step through method calls on the Java object. Public methods are non-static and declared as public in the Java class. Class methods are static and accessed from Java classes.

Method calls to access Java methods have one of these forms, depending on whether you are accessing non-static or static methods:

object.**CALL***type***METHOD** (“*method-name*”, <*method-argument-1* …, *method-argument-n*>,
<*return value*>);

object.**CALLSTATIC***type***METHOD** (“*method-name*”,
<*method-argument-1* …, *method-argument-n*>, <*return value*>);

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see "Type Issues" on page 21.

For more information and examples, see Chapter 3, "Dictionary of Java Object Language Elements," on page 107.

Type Issues

The Java type set is a superset of the SAS data types. Java has data types such as BYTE, SHORT, and CHAR in addition to the standard numeric and character values. SAS has only two data types: numeric and character.

The following table describes how Java data types are mapped to SAS data types when using the Java object method calls.

Table 1.2 *How Java Data Types Map to SAS Data Types*

Java Data Type	SAS Data Type
BOOLEAN	numeric
BYTE	numeric
CHAR	numeric
DOUBLE	numeric
FLOAT	numeric
INT	numeric
LONG	numeric
SHORT	numeric
STRING	character*

* Java string data types are mapped to SAS character data types as UTF-8 strings.

Other than STRING, it is not possible to return objects from Java classes to the DATA step. However, it is possible to pass objects to Java methods. For more information, see "Passing Java Object Arguments" on page 24.

Some Java methods that return objects can be handled by creating wrapper classes to convert the object values. In the following example, the Java hash table returns object values. However, you can still use the hash table from the DATA step by creating simple Java wrapper classes to handle the type conversions. Then, you can access the **dhash** and **shash** classes from the DATA step.

```
/* Java code */
import java.util.*;

public class dhash
{
   private Hashtable  table;
```

```
   public dhash()
   {
      table = new Hashtable  ();
   }

   public void put(double key, double value)
   {
      table.put(new Double(key), new Double(value));
   }

   public double get(double key)
   {
      Double ret = table.get(new Double(key));
      return ret.doubleValue();
   }
}

import java.util.*;

public class shash
{
   private Hashtable  table;

   public shash()
  {
      table = new Hashtable  ();
   }

   public void put(double key, String value)
  {
      table.put(new Double(key), value);
  }

   public String get(double key)
   {
      return table.get(new Double(key));
   }
}

/* DATA step code */
data _null_;
   dcl javaobj sh('shash');
   dcl javaobj dh('dhash');
   length d 8;
   length s $20;

   do i = 1 to 10;
      dh.callvoidmethod('vput', i, i * 2);
   end;

   do i = 1 to 10;
      sh.callvoidmethod('put', i, 'abc' || left(trim(i)));  end;

   do i = 1 to 10;
      dh.calldoublemethod('get', i, d);
      sh.callstringmethod('get', i, s);
```

```
      put d= s=;
   end;
run;
```

The following lines are written to the SAS log:

```
d=2 s=abc1
d=4 s=abc2
d=6 s=abc3
d=8 s=abc4
d=10 s=abc5
d=12 s=abc6
d=14 s=abc7
d=16 s=abc8
d=18 s=abc9
d=20 s=abc10
```

Java Objects and Arrays

You can pass DATA step arrays to Java objects.

In this example, the arrays **d** and **s** are passed to the Java object **j**.

```
/* Java code
*/
import java.util.*;
import java.lang.*;
class jtest
{
   public void dbl(double args[])
  {
      for(int i = 0; i < args.length; i++)
         System.out.println(args[i]);
  }

  public void str(String args[])
  {
     for(int i = 0; i < args.length; i++)
        System.out.println(args[i]);
  }
}
```

```
/* DATA Step code */
data _null_;
   dcl javaobj j("jtest");
   array s{3} $20 ("abc", "def", "ghi");
   array d{10} (1:10);
   j.callVoidMethod("dbl", d);
   j.callVoidMethod("str", s);
run;
```

The following lines are written to the SAS log:

```
1.0
2.0
3.0
4.0
5.0
```

```
6.0
7.0
8.0
9.0
10.0
abc
def
ghi
```

Only one-dimensional array parameters are supported. However, it is possible to pass multidimensional array arguments by taking advantage of the fact that the arrays are passed in row-major order. You must handle the dimensional indexing manually in the Java code. That is, you must declare a one-dimensional array parameter and index to the subarrays accordingly.

Passing Java Object Arguments

Although it is not possible to return objects from Java classes to the DATA step, it is possible to pass objects, as well as strings, to Java class methods.

For example, suppose you have the following wrapper classes for **`java/util/Vector`** and its iterator:

```
/* Java code */
import java.util.*;

class mVector extends Vector
{
   public mVector()
  {
     super();
  }

  public mVector(double d)
  {
     super((int)d);
  }

  public void addElement(String s)
  {
     addElement((Object)s);
  }
}

import java.util.*;
public class mIterator
{
   protected mVector m_v;
   protected Iterator iter;

   public mIterator(mVector v)
   {
      m_v = v;
      iter = v.iterator();
   }

  public boolean hasNext()
```

```
  {
      return iter.hasNext();
  }

  public String next()
  {
     String ret = null;
     ret = (String)iter.next();
     return ret;
  }
}
```

These wrapper classes are useful for performing type conversions (for example, the **mVector** constructor takes a DOUBLE argument). Overloading the constructor is necessary because the **java/util/Vector** constructor takes an integer value, but the DATA step has no integer type.

The following DATA step program uses these classes. The program creates and fills a vector, passes the vector to the iterator's constructor, and then lists all the values in the vector. You must create the iterator after the vector is filled. The iterator keeps a copy of the vector's modification count at the time of creation, and this count must stay in synchronization with the vector's current modification count. The code throws an exception if the iterator is created before the vector is filled.

```
/* DATA step code */
data _null_;
   length b 8;
   length val $200;
   dcl javaobj v("mVector");

   v.callVoidMethod("addElement", "abc");
   v.callVoidMethod("addElement", "def");
   v.callVoidMethod("addElement", "ghi");
   dcl javaobj iter("mIterator", v);

   iter.callBooleanMethod("hasNext", b);
   do while(b);
      iter.callStringMethod("next", val);
      put val=;
      iter.callBooleanMethod("hasNext", b);
   end;

   m.delete();
   v.delete();
   iter.delete();
run;
```

The following lines are written to the SAS log:

```
val=abc
val=def
val=ghi
```

One current limitation to passing objects is that the JNI method lookup routine does not perform a full class lookup based on a given signature. This means that you could not change the **mIterator** constructor to take a **Vector** as shown here:

```
/* Java code */
public mIterator(Vector v)
```

```
{
    m_v = v;
    iter = v.iterator();
}
```

Even though **mVector** is a subclass of **Vector**, the method lookup routine cannot find the constructor. Currently, the only solution is to manage the types in Java by adding new methods or by creating wrapper classes.

Java Exceptions

Java exceptions are handled through the EXCEPTIONCHECK, EXCEPTIONCLEAR, and EXCEPTIONDESCRIBE methods.

The EXCEPTIONCHECK method is used to determine whether an exception occurred during a method call. If you call a method that can throw an exception, it is strongly recommended that you check for an exception after the call. If an exception is thrown, take appropriate action, and then clear the exception by using the EXCEPTIONCLEAR method.

The EXCEPTIONDESCRIBE method is used to turn exception debug logging on or off. If exception debug logging is on, exception information is printed to the JVM standard output. By default, JVM standard output is redirected to the SAS log. Exception debugging is turned off by default.

For more information, see the "EXCEPTIONCHECK Method" on page 116, "EXCEPTIONCLEAR Method" on page 117, and the "EXCEPTIONDESCRIBE Method" on page 119.

Java Standard Output

Output from statements in Java that is directed to standard output such as the following is sent to the SAS log by default.

```
System.out.println("hello");
```

The Java output that is directed to the SAS log is flushed when the DATA step ends. This flushing causes the Java output to appear after any output that was generated while the DATA step was running. Use the FLUSHJAVAOUTPUT method to synchronize the output so that it appears in the order of execution.

Java Object Examples

Example 1: Calling a Simple Java Method

This Java class creates a simple method that sums three numbers.

```
/* Java code */
class MyClass
{
   double compute(double x, double y, double z)
      {
         return (x + y + z);
      }
}

/* DATA step code */
data _null_;
```

```
   dcl javaobj j("MyClass");

   rc = j.callDoubleMethod("compute", 1, 2, 3, r);

   put rc= r=;
run;
```

The following line is written to the SAS log:

```
rc=0 rc=6
```

Example 2: Creating a User Interface

In addition to providing a Java component access mechanism, you can use the Java object to create a simple Java user interface.

This Java class creates a simple user interface with several buttons. The user interface also maintains a queue of values that represent the sequence of button choices that are entered by a user.

```
/* Java code */
import java.awt.*;
import java.util.*;
import java.awt.event.*;

class colorsUI extends Frame
{
  private Button red;
  private Button blue;
  private Button green;
  private Button quit;
  private Vector list;
  private boolean d;
  private colorsButtonListener cbl;

  public colorsUI()
  {
    d = false;
    list = new Vector();
    cbl = new colorsButtonListener();

    setBackground(Color.lightGray);
    setSize(320,100);
    setTitle("New Frame");
    setVisible(true);
    setLayout(new FlowLayout(FlowLayout.CENTER, 10, 15));
    addWindowListener(new colorsUIListener());

    red = new Button("Red");
    red.setBackground(Color.red);
    red.addActionListener(cbl);

    blue = new Button("Blue");
    blue.setBackground(Color.blue);
    blue.addActionListener(cbl);

    green = new Button("Green");
    green.setBackground(Color.green);
```

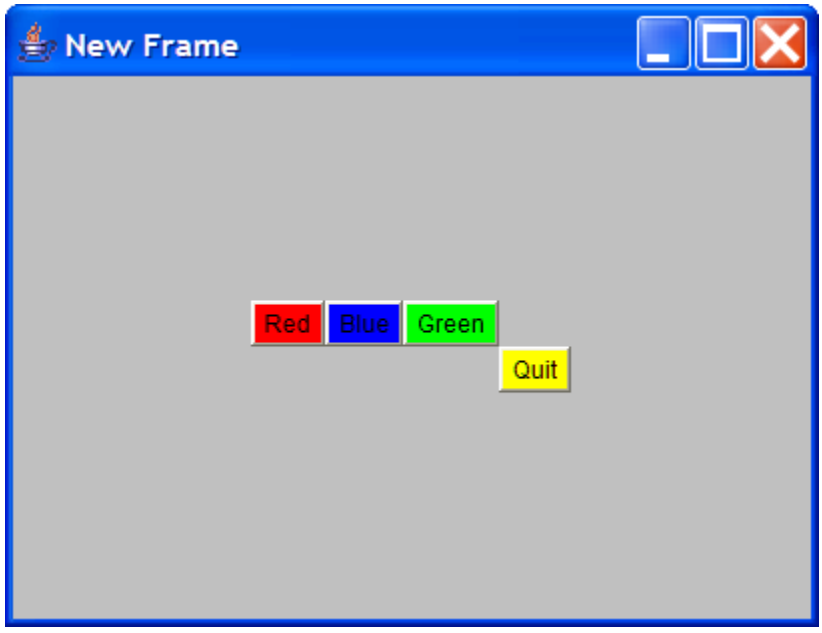
```
  green.addActionListener(cbl);

  quit = new Button("Quit");
  quit.setBackground(Color.yellow);
  quit.addActionListener(cbl);

  this.add(red);
  this.add(blue);
  this.add(green);
  this.add(quit);

  show();
}

public synchronized void enqueue(Object o)
{
  synchronized(list)
    {
      list.addElement(o);
      notify();
    }
}

public synchronized Object dequeue()
{
  try
    {
      while(list.isEmpty())
        wait();

      if (d)
        return null;

      synchronized(list)
        {
          Object ret = list.elementAt(0);
          list.removeElementAt(0);
          return ret;
        }
    }
  catch(Exception e)
    {
      return null;
    }
}

public String getNext()
{
  return (String)dequeue();
}

public boolean done()
{
  return d;
}
```

```
  class colorsButtonListener implements ActionListener
  {
     public void actionPerformed(ActionEvent e)
     {
        Button b;
        String l;
        b = (Button)e.getSource();
        l = b.getLabel();
        if ( l.equals("Quit") )
        {
           d = true;
           hide();
           l = "";
        }
        enqueue(l);
     }
  }

  class colorsUIListener extends WindowAdapter
  {
     public void windowClosing(WindowEvent e)
     {
        Window w;
        w = e.getWindow();
        d = true;
        enqueue("");
        w.hide();
     }
  }

  public static void main(String s[])
  {
      colorsUI cui;
      cui = new colorsUI();
  }
}

/* DATA step code */
data colors;
   length s $10;
   length done 8;
   drop done;

   if (_n_ = 1) then do;
    /* Declare and instantiate colors object (from colorsUI.class) */
      dcl javaobj j("colorsUI");
   end;

   /*
    * colorsUI.class will display a simple UI and maintain a
    * queue to hold color choices.
    */

   /* Loop until user hits quit button */
   do while (1);
      j.callBooleanMethod("done", done);
```

```
      if (done) then
         leave;
      else do;
       /* Get next color back from queue */
         j.callStringMethod("getNext", s);
         if s ne "" then
            output;
         end;
   end;
run;
proc print data=colors;
run;
quit;
```

In the DATA step code, the **colorsUI** class is instantiated and the user interface is displayed. You enter a loop that is terminated when you click **Quit**. This action is communicated to the DATA step through the Done variable. While looping, the DATA step retrieves the values from the Java class's queue and writes the values successively to the output data set.

Figure 1.1 *User Interface Created by the Java Object*



Example 3: Creating a Custom Class Loader

You might not want to put all your Java classes in the classpath. You can write your own class loader to find the classes and load them. The following example illustrates how you can create a custom class loader.

In this example, you create a class, **x**, which resides in a folder or directory, **y**. You call the methods in this class by using the Java object with the classpath that includes the **y** folder.

```
/* Java code */
package com.sas;

public class x
{
```

```
   public void m()
   {
      System.out.println("method m in y folder");
   }

   public void m2()
   {
      System.out.println("method m2 in y folder");
   }
}
```

```
/* DATA step code */
data _null_;
   dcl javaobj j('com/sas/x');
   j.callvoidmethod('m');
   j.callvoidmethod('m2');
run;
```

The following lines are written to the SAS log:

```
method m in y folder
method m2 in y folder
```

Suppose you have another class, **x**, that is stored in a different folder, **z**.

```
/* Java code
*/
package com.sas;

public class z
{
   public void m()
   {
      System.out.println("method m in y folder");
   }

   public void m2()
   {
      System.out.println("method m2 in y folder");
   }
}
```

You can call methods in this class instead of the class in folder **y** by changing the classpath, but you must restart SAS. The following method allows for more dynamic control of how classes are loaded.

To create a custom class loader, you first create an interface that contains all the methods that you will call through the Java object—in this program, **m** and **m2**.

```
/* Java
code */
public interface apiInterface
{
   public void m();
   public void m2();
}
```

Then, you create a class for the actual implementation.

```
/* Java code */
import com.sas.x;
```

```
public class apiImpl implements apiInterface
{
   private x x;

   public apiImpl()
   {
      x = new x();
   }

   public void m()
   {
      x.m();
   }

   public void m2()
   {
      x.m2();
   }
}
```

These methods are called by delegating to the Java object instance class. The code to create the **apiClassLoader** custom class loader is provided later in this section.

```
/* Java code */
public class api
{
  /* Load classes from the z folder */
  static ClassLoader customLoader =  new apiClassLoader("C:\\z");
  static String API_IMPL = "apiImpl";
  apiInterface cp = null;

  public api()
    {
      cp = load();
    }

  public void m()
    {
      cp.m();
    }

  public void m2()
    {
      cp.m2();
    }

  private static apiInterface load()
    {
      try
        {
          Class aClass = customLoader.loadClass(API_IMPL);
          return (apiInterface) aClass.newInstance();
        }
      catch (Exception e)
       {
          e.printStackTrace();
```

```
          return null;
        }
    }
}
```

The following DATA step program calls these methods by delegating through the **api** Java object instance class. The Java object instantiates the **api** class, which creates a custom class loader to load classes from the **z** folder. The **api** class calls the custom loader and returns an instance of the **apiImpl** interface implementation class to the Java object. When methods are called through the Java object, the **api** class delegates them to the implementation class.

```
/* DATA step code */
data _null_;
   dcl javaobj j('api');
   j.callvoidmethod('m');
   j.callvoidmethod('m2');
run;
```

The following lines are written to the SAS log:

```
method m is z folder
method m2 in z folder
```

In the previous Java code, you could also use JAR files to augment the classpath in the **ClassLoader** constructor.

```
static ClassLoader customLoader = new apiClassLoader("C:\\z;C:\\temp\some.jar");
```

In this case, the Java code for the custom class loader is as follows. The code for this class loader can be added to or modified as needed.

```
import java.io.*;
import java.util.*;
import java.util.jar.*;
import java.util.zip.*;

public class apiClassLoader extends ClassLoader
{
  //class repository where findClass performs its search
  private List classRepository;

  public apiClassLoader(String loadPath)
    {
      super(apiClassLoader.class.getClassLoader());
      initLoader(loadPath);
    }

  public apiClassLoader(ClassLoader parent,String loadPath)
    {
      super(parent);
      initLoader(loadPath);
    }

  /**
   * This method will look for the class in the class repository. If
   * the method cannot find the class, the method will delegate to its parent
   * class loader.
   *
   * @param className A String specifying the class to be loaded
```

```
 * @return  A Class object loaded by the apiClassLoader
 * @throws ClassNotFoundException if the method is unable to load the class
 */
public Class loadClass(String name) throws ClassNotFoundException
  {
    // Check if the class is already loaded
    Class loadedClass = findLoadedClass(name);

    // Search for class in local repository before delegating
   if (loadedClass == null)
     {
       loadedClass = myFindClass(name);
     }

    // If class not found, delegate to parent
    if (loadedClass == null)
      {
        loadedClass = this.getClass().getClassLoader().loadClass(name);
      }
    return loadedClass;
  }

private Class myFindClass(String className) throws ClassNotFoundException
  {
    byte[] classBytes = loadFromCustomRepository(className);
    if(classBytes != null)
      {
        return defineClass(className,classBytes,0,classBytes.length);
      }
    return null;
  }

/**
 *  This method loads binary class file data from the classRepository.
 */
private byte[] loadFromCustomRepository(String classFileName)
  throws ClassNotFoundException
  {
    Iterator dirs = classRepository.iterator();
    byte[] classBytes = null;
    while (dirs.hasNext())
      {
        String dir = (String) dirs.next();

        if (dir.endsWith(".jar"))
          {
            // Look for class in jar

            String jclassFileName = classFileName;

            jclassFileName = jclassFileName.replace('.', '/');
            jclassFileName += ".class";

            try
              {
                JarFile j = new JarFile(dir);
```

```
                    for (Enumeration e = j.entries(); e.hasMoreElements() ;)
                      {
                        Object n = e.nextElement();

                        if (jclassFileName.equals(n.toString()))
                          {
                            ZipEntry zipEntry = j.getEntry(jclassFileName);
                            if (zipEntry == null)
                              {
                                return null;
                              }
                            else
                              {
                                // read file
                                InputStream is = j.getInputStream(zipEntry);
                                classBytes = new byte[is.available()];
                                is.read(classBytes);
                                break;
                              }
                          }
                      }
                  }
                catch (Exception e)
                  {
                    System.out.println("jar file exception");
                    return null;
                  }
              }
            else
              {
                // Look for class in directory
                String fclassFileName = classFileName;

                fclassFileName = fclassFileName.replace('.', File.separatorChar);
                fclassFileName += ".class";

                try
                  {
                    File file = new File(dir,fclassFileName);
                    if(file.exists()) {
                      //read file
                      InputStream is = new FileInputStream(file);
                      classBytes = new byte[is.available()];
                      is.read(classBytes);
                      break;
                    }
                  }
                catch(IOException ex)
                  {
                    System.out.println("IOException raised while reading class
file data");
                    ex.printStackTrace();
                    return null;
                  }
              }
          }
```

```
      return classBytes;
    }

  private void initLoader(String loadPath)
    {
      /*
       * loadPath is passed in as a string of directories/jar files
       * separated by the File.pathSeparator
       */
      classRepository = new ArrayList();
      if((loadPath != null) && !(loadPath.equals("")))
        {
          StringTokenizer tokenizer =
            new StringTokenizer(loadPath,File.pathSeparator);
          while(tokenizer.hasMoreTokens())
            {
              classRepository.add(tokenizer.nextToken());
            }
        }
    }
}
```

Tips When Using Component Objects

- You can assign objects in the same manner as you assign DATA step variables. However, the object types must match. The first set of code is valid, but the second generates an error.

```
declare hash h();
declare hash t();
t=h;
```

```
declare hash t();
declare javaobj j();
j=t;
```

- You cannot declare arrays of objects. The following code generates an error:

```
declare hash h1();
declare hash h2();
array h h1-h2;
```

- You can store a component object in a hash object as data but not as keys.

```
data _null_;
   declare hash h1();
   declare hash h2();

   length key1 key2 $20;

   h1.defineKey('key1');
   h1.defineData('key1', 'h2');
   h1.defineDone();

   key1 = 'abc';
   h2 = _new_ hash();
```

```
   h2.defineKey('key2');
   h2.defineDone();

   key2 = 'xyz';
   h2.add();
   h1.add();

   key1 = 'def';
   h2 = _new_ hash();
   h2.defineKey('key2');
   h2.defineDone();

   key1 = 'abc';
   rc = h1.find();
   h2.output(dataset: 'work.h2');
run;

proc print data=work.h2;
run;
```

The data set WORK.H2 is displayed.

Figure 1.2 *Data Set WORK.H2*

Obs	key2
1	xyz

- You cannot use component objects with comparison operators other than the equal sign (=). If H1 and H2 are hash objects, the following code generates an error:

  ```
  if h1>h2 then
  ```

- After you declare and instantiate a component object, you cannot assign a scalar value to it. If J is a Java object, the following code generates an error:

  ```
  j=5;
  ```

- Be careful to not delete object references that might still be in use or that have already been deleted by reference. In the following code, the second DELETE statement generates an error because the original H1 object has already been deleted through the reference to H2. The original H2 can no longer be referenced directly.

  ```
  declare hash h1();
  declare hash h2();
  declare hash t();
  t=h2;
  h2=h1;
  h2.delete();
  t.delete();
  ```

- You cannot use component objects in argument tag syntax. In this example, using the H2 hash object in the ADD methods generates an error:

  ```
  declare hash h2();
  declare hash h();
  h.add(key: h2);
  h.add(key: 99, data: h2);
  ```

- The use of a percent character (%) in the first byte of text output by Java to the SAS log is reserved by SAS. If you need to include a % in the first byte of a Java text line, it must be escaped with another percent immediately next to it (%%).
- You can have a hash table of hash tables.
- A Java object represents an instantiation of a single Java class. A Java object cannot hold anything else. But the Java instance can be arbitrarily complicated just like any Java instance. A Java object can contain references to other Java entities, but the references are not considered Java objects.
- When SAS is in a locked-down state, the Java object is not available. For more information about the LOCKDOWN statement, see *SAS Viya Statements: Reference*.

Chapter 2

Dictionary of Hash and Hash Iterator Object Language Elements

Dictionary

ADD Method

Adds the specified data that is associated with the given key to the hash object.

Applies to: Hash object

Syntax

rc=*object*.**ADD** (<<KEY: *keyvalue-1*>, …<KEY: *keyvalue-n*>, <DATA: *datavalue-1* >, … <DATA: *datavalue-n*>>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

KEY: *keyvalue*
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

DATA: *datavalue*
specifies the data value whose type must match the corresponding data variable that is specified in a DEFINEDATA method call.

The number of "DATA: *datavalue*" pairs depends on the number of data variables that you define by using the DEFINEDATA method.

Details

You can use the ADD method in one of two ways to store data in a hash object.

You can define the key and data item, and then use the ADD method as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   /* Declare hash object and key and data variable names */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
```

```
   end;
   /* Define constant key and data values */
   k = 'Joyce';
   d = 'Ulysses';
   /* Add key and data values to hash object */
   rc = h.add();
run;
```

Alternatively, you can use a shortcut and specify the key and data directly in the ADD method call as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   /* Define hash object and key and data variable names */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Define constant key and data values and add to hash object */
   rc = h.add(key: 'Joyce', data: 'Ulysses');
run;
```

If you add a key that is already in the hash object, then the ADD method will return a nonzero value to indicate that the key is already in the hash object. Use the REPLACE method to replace the data that is associated with the specified key with new data.

If you do not specify the data variables with the DEFINEDATA method, the data variables are automatically assumed to be same as the keys.

If you use the KEY: and DATA: argument tags to specify the key and data directly, you must use both argument tags.

The ADD method does not set the value of the data variable to the value of the data item. It sets only the value in the hash object.

See Also

- "Storing and Retrieving Data" on page 6

Methods:

- "DEFINEDATA Method" on page 53
- "DEFINEKEY Method" on page 56
- "REF Method" on page 87

CHECK Method

Checks whether the specified key is stored in the hash object.

Applies to: Hash object

Syntax

rc=*object*.**CHECK** (<KEY: *keyvalue-1*, … KEY: *keyvalue-n*>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

KEY: ***keyvalue***
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

Details

You can use the CHECK method in one of two ways to find data in a hash object.

You can specify the key, and then use the CHECK method as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   /* Declare hash object and key and data variable names */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();

  /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Define constant key and data values and add to hash object */
   rc = h.add(key: 'Joyce', data: 'Ulysses');
   /* Verify that JOYCE key is in hash object */
   k = 'Joyce';
   rc = h.check();
   if (rc = 0) then
      put 'Key is in the hash object.';
run;
```

Alternatively, you can use a shortcut and specify the key directly in the CHECK method call as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   /* Declare hash object and key and data variable names */
   if _N_ = 1 then do;
```

```
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();

  /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Define constant key and data values and add to hash object */
   rc = h.add(key: 'Joyce', data: 'Ulysses');
   /* Verify that JOYCE key is in hash object */
   rc = h.check(key: 'Joyce');
   if (rc  =0) then
      put 'Key is in the hash object.';
run;
```

Comparisons

The CHECK method returns only a value that indicates whether the key is in the hash object. The data variable that is associated with the key is not updated. The FIND method also returns a value that indicates whether the key is in the hash object. However, if the key is in the hash object, then the FIND method also sets the data variable to the value of the data item so that it is available for use after the method call.

See Also

Methods:

- "DEFINEKEY Method" on page 56
- "FIND Method" on page 62

CLEAR Method

Removes all items from the hash object without deleting the hash object instance.

Applies to: Hash object

Syntax

rc=*object*.**CLEAR** ();

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object

specifies the name of the hash object.

Details

The CLEAR method enables you to remove items from and reuse an existing hash object without having to delete the object and create a new one. If you want to remove the hash object instance completely, use the DELETE method.

Note: The CLEAR method does not change the value of the DATA step variables. It clears only the values in the hash object.

Example: Clearing a Hash Object

The following example declares a hash object, gets the number of items in the hash object, and then clears the hash object without deleting it.

```
data mydata;
  do i = 1 to 10000;
    output;
  end;
run;
data _null_;
  length i 8;

/* Declares the hash object named MYHASH using the data set MyData. */
dcl hash myhash(dataset: 'mydata');
 myhash.definekey('i');
 myhash.definedone();
 call missing (i);
/* Uses the NUM_ITEMS attribute, which returns the */
/* number of items in the hash object.             */
 n = myhash.num_items;
 put n=;
/* Uses the CLEAR method to delete all items within MYHASH. */
 rc = myhash.clear();
/* Writes the number of items in the log. */
 n = myhash.num_items;
 put n=;
 run;
```

The first PUT statement writes the number of items in the hash table MYHASH before it is cleared.

```
n=10000
```

The second PUT statement writes the number of items in the hash table MYHASH after it is cleared.

```
n=0
```

See Also

Methods:

- "DELETE Method, Hash and Hash Iterator Objects" on page 58

DECLARE Statement, Hash and Hash Iterator Objects

Declares a hash or hash iterator object; creates an instance of and initializes data for a hash or hash iterator object.

Alias: DCL

Applies to: Hash object, Hash iterator object

Syntax

Form 1: **DECLARE** *object object-reference*;

Form 2: **DECLARE** *object object-reference* <(*argument_tag-1*: *value-1*, …*argument_tag-n*: *value-n*)>;

Arguments

object

specifies the component object. It can be one of the following values:

hash

specifies a hash object. The hash object provides a mechanism for quick data storage and retrieval. The hash object stores and retrieves data based on lookup keys.

See "Using the Hash Object " on page 3

hiter

specifies a hash iterator object. The hash iterator object enables you to retrieve the hash object's data in forward or reverse key order.

See "Using the Hash Iterator Object " on page 15

object-reference

specifies the object reference name for the hash or hash iterator object.

argument_tag*:*value

specifies the information that is used to create an instance of the hash object.

There are five valid hash object argument and value tags:

dataset: '*dataset_name* <(*datasetoption*)>'

Specifies the name of a SAS data set to load into the hash object.

The name of the SAS data set can be a literal or character variable. The data set name must be enclosed in single or double quotation marks. Macro variables must be enclosed in double quotation marks.

You can use SAS data set options when declaring a hash object in the DATASET argument tag. Data set options specify actions that apply only to the SAS data set with which they appear. They enable you to perform the following operations:

- renaming variables
- selecting a subset of observations based on observation number for processing
- selecting observations using the WHERE option

- dropping or keeping variables from a data set loaded into a hash object, or for an output data set that is specified in an OUTPUT method call
- specifying a password for a data set.

The following syntax is used:

```
dcl hash h (dataset: 'x (where = (i > 10))');
```

For a list of SAS data set options, see *SAS Viya Data Set Options: Reference*.

Restriction Data set options are not valid on the CAS server.

Note If the data set contains duplicate keys, the default is to keep the first instance in the hash object; subsequent instances are ignored. To store the last instance in the hash object or an error message written to the SAS log if there is a duplicate key, use the DUPLICATE argument tag.

duplicate: '*option*'
determines whether to ignore duplicate keys when loading a data set into the hash object. The default is to store the first key and ignore all subsequent duplicates. Option can be one of the following values:

'replace' | 'r'
stores the last duplicate key record.

'error' | 'e'
reports an error to the log if a duplicate key is found.

The following example that uses the REPLACE option stores **brown** for the key 620 and **blue** for the key 531. If you use the default, **green** would be stored for 620 and **yellow** would be stored for 531.

```
data table;
  input key data $;
  datalines;
  531 yellow
  620 green
  531 blue
  908 orange
  620 brown
  143 purple
 run;

data _null_;
length key 8 data $ 8;
if (_n_ = 1) then do;
    declare hash myhash(dataset: "table", duplicate: "r");
    rc = myhash.definekey('key');
    rc = myhash.definedata('data');
    myhash.definedone();
 end;
rc = myhash.output(dataset:"otable");
run;
```

hashexp: *n*
The hash object's internal table size, where the size of the hash table is 2^n.

The value of HASHEXP is used as a power-of-two exponent to create the hash table size. For example, a value of 4 for HASHEXP equates to a hash table size of 2^4, or 16. The maximum value for HASHEXP is 20.

The hash table size is not equal to the number of items that can be stored. Imagine the hash table as an array of 'buckets.' A hash table size of 16 would have 16 'buckets.' Each bucket can hold an infinite number of items. The efficiency of the hash table lies in the ability of the hashing function to map items to and retrieve items from the buckets.

You should specify the hash table size relative to the amount of data in the hash object in order to maximize the efficiency of the hash object lookup routines. Try different HASHEXP values until you get the best result. For example, if the hash object contains one million items, a hash table size of 16 (HASHEXP = 4) would work, but not very efficiently. A hash table size of 512 or 1024 (HASHEXP = 9 or 10) would result in the best performance.

Default 8, which equates to a hash table size of 2^8 or 256

keysum:'*variable-name*'
specifies the name of a variable that tracks the key summary for all keys. A key summary is a count of how many times a key has been referenced on a FIND method call.

Note The key summary is in the output data set.

Example "Example 5: Adding the Key Summary to the Output Data Set" on page 52

ordered: '*option*'
Specifies whether or how the data is returned in key-value order if you use the hash object with a hash iterator object or if you use the hash object OUTPUT method.

option can be one of the following values:

'ascending' | 'a'
Data is returned in ascending key-value order. Specifying '**`ascending`**' is the same as specifying '**`yes`**'.

'descending' | 'd'
Data is returned in descending key-value order.

'YES' | 'Y'
Data is returned in ascending key-value order. Specifying '**`yes`**' is the same as specifying '**`ascending`**'.

'NO' | 'N'
Data is returned in some undefined order.

Default NO

Restriction You can traverse hash items with a hash iterator in sorted order. However, you cannot generate a hash table in sorted order from a CAS server.

Note VARCHAR is not supported when the ORDERED argument tag is set to 'ascending', 'descending', or 'yes'.

Tip The argument can also be enclosed in double quotation marks.

multidata: '*option*'
specifies whether multiple data items are allowed for each key.

option can be one of the following values:

'YES' | 'Y'
Multiple data items are allowed for each key.

'NO' | 'N'
Only one data item is allowed for each key.

Default NO

Tip The argument value can also be enclosed in double quotation marks.

See "Non-Unique Key and Data Pairs" on page 6

suminc: '*variable-name*'
maintains a summary count of hash object keys. The SUMINC argument tag is given a DATA step variable, which holds the sum increment. The sum increment is how much to add to the key summary for each reference to the key.

See "Maintaining Key Summaries" on page 8

Example A key summary changes using the current value of the DATA step variable.

```
dcl hash myhash(suminc: 'count');
```

See "Initializing Hash Object Data Using a Constructor" on page 4 and "Declaring and Instantiating a Hash Iterator Object" on page 15

Details

The Basics

To use a DATA step component object in your SAS program, you must declare and create (instantiate) the object. The DATA step component interface provides a mechanism for accessing predefined component objects from within the DATA step.

For more information about the predefined DATA step component objects, see "Introduction to DATA Step Component Objects" on page 2.

Declaring a Hash or Hash Iterator Object (Form 1)

You use the DECLARE statement to declare a hash or hash iterator object.

```
declare hash h;
```

The DECLARE statement tells SAS that the object reference H is a hash object.

After you declare the new hash or hash iterator object, use the _NEW_ operator to instantiate the object. For example, in the following line of code, the _NEW_ operator creates the hash object and assigns it to the object reference H:

```
h = _new_ hash( );
```

Using the DECLARE Statement to Instantiate a Hash or Hash Iterator Object (Form 2)

As an alternative to the two-step process of using the DECLARE statement and the _NEW_ operator to declare and instantiate a hash or hash iterator object, you can use the

DECLARE statement to declare and instantiate the hash or hash iterator object in one step. For example, in the following line of code, the DECLARE statement declares and instantiates a hash object and assigns it to the object reference H:

```
declare hash h( );
```

The previous line of code is equivalent to using the following code:

```
declare hash h;
h = _new_ hash( );
```

A *constructor* is a method that you can use to instantiate a hash object and initialize the hash object data. For example, in the following line of code, the DECLARE statement declares and instantiates a hash object and assigns it to the object reference H. In addition, the hash table size is initialized to a value of 16 (2^4) using the argument tag, HASHEXP.

```
declare hash h(hashexp: 4);
```

Using SAS Data Set Options When Loading a Hash Object

SAS data set options can be used when declaring a hash object that uses the DATASET argument tag. Data set options specify actions that apply only to the SAS data set with which they appear. They enable you to perform the following operations:

- renaming variables
- selecting a subset of observations based on observation number for processing
- selecting observations using the WHERE option
- dropping or keeping variables from a data set loaded into a hash object, or for an output data set that is specified in an OUTPUT method call
- specifying a password for a data set.

The following syntax is used:

```
dcl hash h(dataset: 'x (where = (i > 10))');
```

For more examples of using data set options, see "Example 4: Using SAS Data Set Options When Loading a Hash Object" on page 51. For a list of data set options, see *SAS Viya Data Set Options: Reference*.

Comparisons

You can use the DECLARE statement and the _NEW_ operator, or the DECLARE statement alone to declare and instantiate an instance of a hash or hash iterator object.

Examples

Example 1: Declaring and Instantiating a Hash Object By Using the DECLARE Statement and _NEW_ Operator

This example uses the DECLARE statement to declare a hash object. The _NEW_ operator is used to instantiate the hash object.

```
data _null_;
   length k $15;
   length d $15;
   if _N_ = 1 then do;
      /* Declare and instantiate hash object "myhash" */
      declare hash myhash;
```

```
      myhash = _new_ hash( );
      /* Define key and data variables */
      rc = myhash.defineKey('k');
      rc = myhash.defineData('d');
      rc = myhash.defineDone( );
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Create constant key and data values */
   rc = myhash.add(key: 'Labrador', data: 'Retriever');
   rc = myhash.add(key: 'Airedale', data: 'Terrier');
   rc = myhash.add(key: 'Standard', data: 'Poodle');
   /* Find data associated with key and write data to log */
   rc = myhash.find(key: 'Airedale');
   if (rc = 0) then
      put d=;
   else
      put 'Key Airedale not found';
run;
```

Example 2: Declaring and Instantiating a Hash Object By Using the DECLARE Statement

This example uses the DECLARE statement to declare and instantiate a hash object in one step.

```
data _null_;
   length k $15;
   length d $15;
   if _N_ = 1 then do;
      /* Declare and instantiate hash object "myhash" */
      declare hash myhash( );
      rc = myhash.defineKey('k');
      rc = myhash.defineData('d');
      rc = myhash.defineDone( );
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Create constant key and data values */
   rc = myhash.add(key: 'Labrador', data: 'Retriever');
   rc = myhash.add(key: 'Airedale', data: 'Terrier');
   rc = myhash.add(key: 'Standard', data: 'Poodle');
   /* Find data associated with key and write data to log*/
   rc = myhash.find(key: 'Airedale');
   if (rc = 0) then
      put d=;
   else
      put 'Key Airedale not found';
run;
```

Example 3: Instantiating and Sizing a Hash Object

This example uses the DECLARE statement to declare and instantiate a hash object. The hash table size is set to 16 (2^4).

```
data _null_;
   length k $15;
   length d $15;
```

```
   if _N_ = 1 then do;
      /* Declare and instantiate hash object "myhash". */
      /* Set hash table size to 16. */
      declare hash myhash(hashexp: 4);
      rc = myhash.defineKey('k');
      rc = myhash.defineData('d');
      rc = myhash.defineDone( );
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Create constant key and data values */
   rc = myhash.add(key: 'Labrador', data: 'Retriever');
   rc = myhash.add(key: 'Airedale', data: 'Terrier');
   rc = myhash.add(key: 'Standard', data: 'Poodle');
   rc = myhash.find(key: 'Airedale');
   /* Find data associated with key and write data to log*/
   if (rc = 0) then
      put d=;
   else
      put 'Key Airedale not found';
run;
```

Example 4: Using SAS Data Set Options When Loading a Hash Object

The following examples use various SAS data set options when declaring a hash object:

```
data x;
retain j 999;
do i = 1 to 20;
   output;
 end;
run;
/* Using the WHERE option. */
data _null_;
  length i 8;
  dcl hash h(dataset: 'x (where =(i > 10))', ordered: 'a');
  h.definekey('i');
  h.definedone();
  h.output(dataset: 'out');
  run;
/* Using the DROP option. */
data _null_;
  length i 8;
  dcl hash h(dataset: 'x (drop = j)', ordered: 'a');
  h.definekey(all: 'y');
  h.definedone();
  h.output(dataset: 'out (where =( i < 8))');
  run;
/* Using the FIRSTOBS option. */
data _null_;
  length i j 8;
  dcl hash h(dataset: 'x (firstobs=5)', ordered: 'a');
  h.definekey(all: 'y');
  h.definedone();
  h.output(dataset: 'out');
  run;
```

```
/* Using the OBS option. */
data _null_;
  length i j 8;
  dcl hash h(dataset: 'x (obs=5)', ordered: 'd');
  h.definekey(all: 'y');
  h.definedone();
  h.output(dataset: 'out (rename =(j=k))');
  run;
```

For a list of SAS data set options, see *SAS Viya Data Set Options: Reference*.

Example 5: Adding the Key Summary to the Output Data Set

The following example declares the variable, *ks*, to hold the key summary and adds the variable to the output data set.

```
data key;
   length key data 8;
   input key data;
   datalines;
      1 10
      2 11
      3 20
      5 5
      4 6
run;

data _null_;
   length key data r i sum 8;
   length ks 8;
   i = 0;
   dcl hash h(dataset:'key', suminc: 'i', keysum: 'ks');
   h.definekey('key');
   h.definedata('key', 'data');
   h.definedone();

   i = 1;
   do key = 1 to 5;
      rc = h.find();
   end;

   do key = 1 to 3;
      rc = h.find();
   end;

   rc = h.output(dataset:'out');
 run;

proc print data=out;
run;
```

Output 2.1 *Output of Key Summary Data*

Obs	key	data	ks
1	2	11	2
2	5	5	1
3	1	10	2
4	3	20	2
5	4	6	1

See Also

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

DEFINEDATA Method

Defines data, associated with the specified data variables, to be stored in the hash object.

Applies to: Hash object

Syntax

rc=*object*.**DEFINEDATA** ('*datavarname-1*' <, …'*datavarname-n*'>);

rc=*object*.**DEFINEDATA** (ALL: 'YES' | "YES");

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

'*datavarname*'
specifies the name of the data variable.

The data variable name can also be enclosed in double quotation marks.

ALL: 'YES' | "YES"
specifies all the data variables as data when the data set is loaded in the object constructor.

If the *dataset* argument tag is used in the DECLARE statement or _NEW_ operator to automatically load a data set, then you can define all the data set variables as data by using the ALL: 'YES' option.

Details

The hash object works by storing and retrieving data based on lookup keys. The keys and data are DATA step variables, which you use to initialize the hash object by using dot notation method calls. You define a key by passing the key variable name to the DEFINEKEY method. You define data by passing the data variable name to the DEFINEDATA method. When you have defined all key and data variables, you must call the DEFINEDONE method to complete initialization of the hash object. Keys and data consist of any number of character or numeric DATA step variables.

Note: If you use the shortcut notation for the ADD or REPLACE method (for example, **`h.add(key:99, data:'apple', data:'orange')`**) and use the ALL:'YES' option on the DEFINEDATA method, then you must specify the data in the same order as it exists in the data set.

Note: The hash object does not assign values to key variables (for example, **`h.find(key:'abc')`**), and the SAS compiler cannot detect the key and data variable assignments that are performed by the hash object and the hash iterator. Therefore, if no assignment to a key or data variable appears in the program, then SAS will issue a note stating that the variable is uninitialized. To avoid receiving these notes, you can perform one of the following actions:

- Set the NONOTES system option.
- Provide an initial assignment statement (typically to a missing value) for each key and data variable.
- Use the CALL MISSING routine with all the key and data variables as parameters. Here is an example:

```
length d $20;
length k $20;
if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k');
   rc = h.defineData('d');
   rc = h.defineDone();
   call missing(k,d);
end;
```

For detailed information about how to use the DEFINEDATA method, see "Defining Keys and Data" on page 4.

Example

The following example creates a hash object and defines the key and data variables:

```
data _null_;
   length d $20;
   length k $20;
   /* Declare the hash object and key and data variables */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
```

```
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
run;
```

See Also

- "Defining Keys and Data" on page 4

Methods:

- "DEFINEDONE Method" on page 55
- "DEFINEKEY Method" on page 56

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

DEFINEDONE Method

Indicates that all key and data definitions are complete.

Applies to: Hash object

Syntax

rc = *object*.**DEFINEDONE**( );

rc = *object*.**DEFINEDONE** (MEMRC: 'y');

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

memrc:'y'
enables recovery from memory failure when loading a data set into a hash object.

If a call fails because of insufficient memory to load a data set, a nonzero return code is returned. The hash object frees the principal memory in the underlying array. The only allowable operation after this type of failure is deletion via the DELETE method.

Details

When the DEFINEDONE method is called and the *dataset* argument tag is used with the constructor, the data set is loaded into the hash object.

The hash object works by storing and retrieving data based on lookup keys. The keys and data are DATA step variables, which you use to initialize the hash object by using dot notation method calls. You define a key by passing the key variable name to the DEFINEKEY method. You define data by passing the data variable name to the DEFINEDATA method. When you have defined all key and data variables, you must call the DEFINEDONE method to complete initialization of the hash object. Keys and data consist of any number of character or numeric DATA step variables.

For detailed information about how to use the DEFINEDONE method, see "Defining Keys and Data" on page 4.

See Also

- "Defining Keys and Data" on page 4

Methods:

- "DEFINEDATA Method" on page 53
- "DEFINEKEY Method" on page 56

DEFINEKEY Method

Defines key variables for the hash object.

Applies to: Hash object

Syntax

rc=*object*.**DEFINEKEY**('*keyvarname-1* '<, … '*keyvarname-n*'>);

rc=*object*.**DEFINEKEY**(ALL: 'YES' | "YES");

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object

specifies the name of the hash object.

'keyvarname'

specifies the name of the key variable.

The key variable name can also be enclosed in double quotation marks.

ALL: 'YES' | "YES"

specifies all the data variables as keys when the data set is loaded in the object constructor.

If you use the *dataset* argument tag in the DECLARE statement or _NEW_ operator to automatically load a data set, then you can define all the key variables by using the ALL: 'YES' option.

Details

The hash object works by storing and retrieving data based on lookup keys. The keys and data are DATA step variables, which you use to initialize the hash object by using dot notation method calls. You define a key by passing the key variable name to the DEFINEKEY method. You define data by passing the data variable name to the DEFINEDATA method. When you have defined all key and data variables, you must call the DEFINEDONE method to complete initialization of the hash object. Keys and data consist of any number of character or numeric DATA step variables.

For more information about how to use the DEFINEKEY method, see "Defining Keys and Data" on page 4.

Note: If you use the shortcut notation for the ADD, CHECK, FIND, REMOVE, or REPLACE methods (for example, **`h.add(key:99, data:'apple', data:'orange')`**) and the ALL:'YES' option on the DEFINEKEY method, then you must specify the keys and data in the same order as they exist in the data set.

Note: The hash object does not assign values to key variables (for example, **`h.find(key:'abc')`**), and the SAS compiler cannot detect the key and data variable assignments done by the hash object and the hash iterator. Therefore, if no assignment to a key or data variable appears in the program, SAS will issue a note stating that the variable is uninitialized. To avoid receiving these notes, you can perform one of the following actions:

- Set the NONOTES system option.
- Provide an initial assignment statement (typically to a missing value) for each key and data variable.
- Use the CALL MISSING routine with all the key and data variables as parameters. Here is an example:

```
length d $20;
length k $20;
if _N_ = 1 then do;
   declare hash h();
   rc = h.defineKey('k');
   rc = h.defineData('d');
   rc = h.defineDone();
   call missing(k, d);
end;
```

See Also

- "Defining Keys and Data" on page 4

Methods:

- "DEFINEDATA Method" on page 53
- "DEFINEDONE Method" on page 55

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

DELETE Method, Hash and Hash Iterator Objects

Deletes the hash or hash iterator object.

Applies to: Hash object, Hash interator object

Syntax

rc=*object*.**DELETE**( );

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is printed to the log.

object
specifies the name of the hash or hash iterator object.

Details

DATA step component objects are deleted automatically at the end of the DATA step. If you want to reuse the object reference variable in another hash or hash iterator object constructor, you should delete the hash or hash iterator object by using the DELETE method.

If you attempt to use a hash or hash iterator object after you delete it, you will receive an error in the log.

If you want to delete all the items from within a hash object and save the hash object to use again, use the "CLEAR Method" on page 43.

DO_OVER Method

Traverses a list of duplicate keys in the hash object.

Applies to: Hash object

Syntax

object.**DO_OVER** (KEY:*keyvalue*);

Arguments

object
specifies the name of the hash object.

KEY:*keyvalue*
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

Details

When a hash object has multiple values for a single key, you can use the DO_OVER method in an iterative DO loop to traverse the duplicate keys. The DO_OVER method reads the key on the first method call and continues to traverse the duplicate key list until the key reaches the end.

Note: If you switch the key in the middle of an iteration, you must use the RESET_DUP method to reset the pointer to the beginning of the list. Otherwise, SAS continues to use the first key.

Example

The following example creates a data set, **dup**, that contains duplicate keys. The DO_OVER and RESET_DUP methods are used to iterate through the duplicate keys.

```
data dup;
 length key data 8;
 input key data;
 datalines;
  1 10
  2 11
  1 15
  3 20
  2 16
  2 9
  3 100
  5 5
  1 5
  4 6
  5 99
;
run;

data _null_;
 length r 8;
 dcl hash h(dataset:'dup', multidata: 'y', ordered: 'y');
 h.definekey('key');
 h.definedata('key', 'data');
 h.definedone();

h.reset_dup();
key = 2;
do while(h.do_over(key:key) eq 0);
  put key= data=;
end;

key = 3;
do while(h.do_over(key:key) eq 0);
  put key= data=;
end;

key = 2;
```

```
do while(h.do_over(key:key) eq 0);
  put key= data=;
end;

run;
```

The following lines are written to the SAS log.

```
key=2 data=11
key=2 data=16
key=2 data=9
key=3 data=20
key=3 data=100
key=2 data=11
key=2 data=16
key=2 data=9
```

See Also

Methods:

- "RESET_DUP Method" on page 99

EQUALS Method

Determines whether two hash objects are equal.

Applies to: Hash object

Syntax

rc=*object*.**EQUALS** (HASH: '*object*', RESULT: *variable name*);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of a hash object.

HASH:'*object*'
specifies the name of the second hash object that is compared to the first hash object.

RESULT: *variable name*
specifies the name of a numeric variable name to hold the result. If the hash objects are equal, the result variable is 1. Otherwise, the result variable is zero.

Details

The following example compares H1 to H2 hash objects:

```
length eq k 8;
```

```
declare hash h1();
h1.defineKey('k');
h1.defineDone();

declare hash h2();
h2.defineKey('k');
h2.defineDone();

rc = h1.equals(hash: 'h2', result: eq);
if eq then
   put 'hash objects equal';
else
   put 'hash objects not equal';
```

The two hash objects are defined as equal when all of the following conditions occur:

- Both hash objects are the same size—that is, the HASHEXP sizes are equal.
- Both hash objects have the same number of items—that is, H1.NUM_ITEMS = H2.NUM_ITEMS.
- Both hash objects have the same key and data structure.
- In an unordered iteration over H1 and H2 hash objects, each successive record from H1 has the same key and data fields as the corresponding record in H2—that is, each record is in the same position in each hash object and each such record is identical to the corresponding record in the other hash object.

Example: Comparing Two Hash Objects

In the following example, the first return call to EQUALS returns a nonzero value and the second return call returns a zero value.

```
data x;
   length k eq 8;
   declare hash h1();
   h1.defineKey('k');
   h1.defineDone();

   declare hash h2();
   h2.defineKey('k');
   h2.defineDone();

   k = 99;
   h1.add();
   h2.add();
   rc = h1.equals(hash: 'h2', result: eq);
   put eq=;

   k = 100;
   h2.replace();

   rc = h1.equals(hash: 'h2', result: eq);
   put eq=;

 run;
```

FIND Method

Determines whether the specified key is stored in the hash object.

Applies to: Hash object

Syntax

rc=*object*.**FIND** (<KEY: *keyvalue-1*, …KEY: *keyvalue-n*>);

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object

specifies the name of the hash object.

KEY: *keyvalue*

specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

Details

You can use the FIND method in one of two ways to find data in a hash object.

You can specify the key, and then use the FIND method as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   /* Declare hash object and key and data variables */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   /* Define constant key and data values */
   rc = h.add(key: 'Joyce', data: 'Ulysses');
   /* Find the key JOYCE */
   k = 'Joyce';
   rc = h.find();
   if (rc = 0) then
      put 'Key is in the hash object.';
run;
```

Alternatively, you can use a shortcut and specify the key directly in the FIND method call as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   /* Declare hash object and key and data variables */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
    /* Define constant key and data values */
   rc = h.add(key: 'Joyce', data: 'Ulysses');
  /* Find the key JOYCE */
   rc = h.find(key: 'Joyce');
   if (rc = 0) then
      put 'Key is in the hash object.';
run;
```

If the hash object has multiple data items for each key, use "FIND_NEXT Method" on page 64 and "FIND_PREV Method" on page 66 in conjunction with the FIND method to traverse a multiple data item list.

Comparisons

The FIND method returns a value that indicates whether the key is in the hash object. If the key is in the hash object, then the FIND method also sets the data variable to the value of the data item so that it is available for use after the method call. The CHECK method returns only a value that indicates whether the key is in the hash object. The data variable is not updated.

Example: Using the FIND Method to Find the Key in a Hash Object

The following example creates a hash object. Two data values are added. The FIND method is used to find a key in the hash object. The data value is returned to the data set variable that is associated with the key.

```
data _null_;
   length k $8;
   length d $12;
   /* Declare hash object and key and data variable names */
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      /* avoid uninitialized variable notes */
      call missing(k, d);
      rc = h.defineDone();
   end;
   /* Define constant key and data values and add to hash object */
   rc = h.add(key: 'Joyce', data: 'Ulysses');
   rc = h.add(key: 'Homer', data: 'Odyssey');
```

```
   /* Verify that key JOYCE is in hash object and */
   /* return its data value to the data set variable D */
   rc = h.find(key: 'Joyce');
   put d=;
run;
```

d=Ulysses is written to the SAS log.

See Also

- "Storing and Retrieving Data" on page 6

Methods:

- "CHECK Method" on page 41
- "DEFINEKEY Method" on page 56
- "FIND_NEXT Method" on page 64
- "FIND_PREV Method" on page 66
- "REF Method" on page 87

FIND_NEXT Method

Sets the current list item to the next item in the current key's multiple item list and sets the data for the corresponding data variables.

Applies to: Hash object

Syntax

rc=*object*.**FIND_NEXT**( );

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, an appropriate error message is printed to the log.

object
specifies the name of the hash object.

Details

The FIND method determines whether the key exists in the hash object. The HAS_NEXT method determines whether the key has multiple data items associated with it. When you have determined that the key has another data item, that data item can be retrieved by using the FIND_NEXT method, which sets the data variable to the value of the data item so that it is available for use after the method call. Once you are in the data item list, you can use the HAS_NEXT and FIND_NEXT methods to traverse the list.

Example

This example uses the FIND_NEXT method to iterate through a data set where several keys have multiple data items. If a key has more than one data item, subsequent items are marked **dup**.

```
data dup;
   length key data 8;
   input key data;
   datalines;
   1 10
   2 11
   1 15
   3 20
   2 16
   2 9
   3 100
   5 5
   1 5
   4 6
   5 99
   ;
data _null_;
   dcl hash h(dataset:'dup', multidata: 'y');
   h.definekey('key');
   h.definedata('key', 'data');
   h.definedone();
   /* avoid uninitialized variable notes */
   call missing (key, data);
   do key = 1 to 5;
      rc = h.find();
      if (rc = 0) then do;
         put key= data=;
         rc = h.find_next();
         do while(rc = 0);
            put 'dup ' key= data;
            rc = h.find_next();
         end;
      end;
   end;
 run;
```

The following lines are written to the SAS log.

```
key=1 data=10
dup key=1 5
dup key=1 15
key=2 data=11
dup key=2 9
dup key=2 16
key=3 data=20
dup key=3 100
key=4 data=6
key=5 data=5
dup key=5 99
```

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "FIND Method" on page 62
- "FIND_PREV Method" on page 66
- "HAS_NEXT Method" on page 68

FIND_PREV Method

Sets the current list item to the previous item in the current key's multiple item list and sets the data for the corresponding data variables.

Applies to: Hash object

Syntax

rc=*object*.**FIND_PREV**( );

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, an appropriate error message is printed to the log.

object

specifies the name of the hash object.

Details

The FIND method determines whether the key exists in the hash object. The HAS_PREV method determines whether the key has multiple data items associated with it. When you have determined that the key has a previous data item, that data item can be retrieved by using the FIND_PREV method, which sets the data variable to the value of the data item so that it is available for use after the method call. Once you are in the data item list, you can use the HAS_PREV and FIND_PREV methods in addition to the HAS_NEXT and FIND_NEXT methods to traverse the list. See "HAS_NEXT Method" on page 68 for an example.

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "FIND Method" on page 62
- "FIND_NEXT Method" on page 64
- "HAS_PREV Method" on page 70

FIRST Method

Returns the first value in the underlying hash object.

Applies to: Hash iterator object

Syntax

rc=*object*.**FIRST**( );

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, an appropriate error message will be printed to the log.

object

specifies the name of the hash iterator object.

Details

The FIRST method returns the first data item in the hash object. If you use the **`ordered: 'yes'`** or **`ordered: 'ascending'`** argument tag in the DECLARE statement or _NEW_ operator when you instantiate the hash object, then the data item that is returned is the one with the 'least' key (smallest numeric value or first alphabetic character), because the data items are sorted in ascending key-value order in the hash object. Repeated calls to the NEXT method will iteratively traverse the hash object and return the data items in ascending key order. Conversely, if you use the **`ordered: 'descending'`** argument tag in the DECLARE statement or _NEW_ operator when you instantiate the hash object, then the data item that is returned is the one with the 'highest' key (largest numeric value or last alphabetic character), because the data items are sorted in descending key-value order in the hash object. Repeated calls to the NEXT method will iteratively traverse the hash object and return the data items in descending key order.

Use the LAST method to return the last data item in the hash object.

Note: The FIRST method sets the data variable to the value of the data item so that it is available for use after the method call.

Example: Retrieving Hash Object Data

The following example creates a data set that contains sales data. You want to list products in order of sales. The data is loaded into a hash object and the FIRST and NEXT methods are used to retrieve the data.

```
data work.sales;
   input prod $1-6 qty $9-14;
   datalines;
banana  398487
apple   384223
orange  329559
```

```
;
data _null_;
   /* Declare hash object and read SALES data set as ordered */
   if _N_ = 1 then do;
      length prod $10;
      length qty $6;
      declare hash h(dataset: 'work.sales', ordered: 'yes');
      declare hiter iter('h');
      /* Define key and data variables */
      h.defineKey('qty');
      h.defineData('prod');
      h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(qty, prod);
   end;
   /* Iterate through the hash object and output data values */
   rc = iter.first();
   do while (rc = 0);
      put prod=;
      rc = iter.next();
   end;
run;
```

The following lines are written to the SAS log:

```
prod=orange
prod=apple
prod=banana
```

See Also

- "Using the Hash Iterator Object " on page 15

Methods:

- "LAST Method" on page 72

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

HAS_NEXT Method

Determines whether there is a next item in the current key's multiple data item list.

Applies to: Hash object

Syntax

rc=*object*.**HAS_NEXT** (RESULT: R);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

RESULT:R
specifies the numeric variable **R**, which receives a zero value if there is not another data item in the data item list or a nonzero value if there is another data item in the data item list.

Details

If a key has multiple data items, you can use the HAS_NEXT method to determine whether there is a next item in the current key's multiple data item list. If there is another item, the method will return a nonzero value in the numeric variable **R**. Otherwise, it will return a zero.

The FIND method determines whether the key exists in the hash object. The HAS_NEXT method determines whether the key has multiple data items associated with it. When you have determined that the key has another data item, that data item can be retrieved by using the FIND_NEXT method, which sets the data variable to the value of the data item so that it is available for use after the method call. Once you are in the data item list, you can use the HAS_PREV and FIND_PREV methods in addition to the HAS_NEXT and FIND_NEXT methods to traverse the list.

Example: Finding Data Items

This example creates a hash object where several keys have multiple data items. It uses the HAS_NEXT method to find all the data items.

```
data testdup;
   length key data 8;
   input key data;
   datalines;
   1 100
   2 11
   1 15
   3 20
   2 16
   2 9
   3 100
   5 5
   1 5
   4 6
   5 99
;
data _null_;
   length r 8;
   dcl hash h(dataset:'testdup', multidata: 'y');
   h.definekey('key');
   h.definedata('key', 'data');
```

```
   h.definedone();
   call missing (key, data);
   do key = 1 to 5;
      rc = h.find();
      if (rc = 0) then do;
         put key= data=;
         h.has_next(result: r);
         do while(r ne 0);
             rc = h.find_next();
             put 'dup ' key= data;
             h.has_next(result: r);
         end;
      end;
   end;
run;
```

The following lines are written to the SAS log.

```
key=1 data=100
dup key=1 5
dup key=1 15
key=2 data=11
dup key=2 9
dup key=2 16
key=3 data=20
dup key=3 100
key=4 data=6
key=5 data=5
dup key=5 99
```

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "FIND Method" on page 62
- "FIND_NEXT Method" on page 64
- "FIND_PREV Method" on page 66
- "HAS_PREV Method" on page 70

HAS_PREV Method

Determines whether there is a previous item in the current key's multiple data item list.

Applies to: Hash object

Syntax

rc=*object*.**HAS_PREV** (RESULT: R);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

RESULT:R
specifies the numeric variable **R**, which receives a zero value if there is not another data item in the data item list or a nonzero value if there is another data item in the data item list.

Details

If a key has multiple data items, you can use the HAS_PREV method to determine whether there is a previous item in the current key's multiple data item list. If there is a previous item, the method will return a nonzero value in the numeric variable **R**. Otherwise, it will return a zero.

The FIND method determines whether the key exists in the hash object. The HAS_NEXT method determines whether the key has multiple data items associated with it. When you have determined that the key has a previous data item, that data item can be retrieved by using the FIND_PREV method, which sets the data variable to the value of the data item so that it is available for use after the method call. Once you are in the data item list, you can use the HAS_PREV and FIND_PREV methods in addition to the HAS_NEXT and FIND_NEXT methods to traverse the list. See "HAS_NEXT Method" on page 68 for an example.

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "FIND Method" on page 62
- "FIND_NEXT Method" on page 64
- "FIND_PREV Method" on page 66
- "HAS_NEXT Method" on page 68

ITEM_SIZE Attribute

Returns the size (in bytes) of an item in a hash object.

Applies to: Hash object

Syntax

variable_name=*object*.**ITEM_SIZE**;

Arguments

variable_name
specifies the name of the variable that contains the size of the item in the hash object.

object
specifies the name of the hash object.

Details

The ITEM_SIZE attribute returns the size (in bytes) of an item, which includes the key and data variables and some additional internal information. You can get an estimate of how much memory the hash object is using with the ITEM_SIZE and NUM_ITEMS attributes. The ITEM_SIZE attribute does not reflect the initial overhead that the hash object requires, nor does it take into account any necessary internal alignments. Therefore, ITEM_SIZE does not provide exact memory usage, but it does return a good approximation.

Example: Returning the Size of a Hash Item

The following example uses ITEM_SIZE to return the size of the item in MYHASH:

```
data work.stock;
   input prod $1-10 qty 12-14;
   datalines;
broccoli 345
corn 389
potato 993
onion 730
;
data _null_;
   if _N_ = 1 then do;
      length prod $10;
   /* Declare hash object and read STOCK data set as ordered */
      declare hash myhash(dataset: "work.stock");
      /* Define key and data variables */
      myhash.defineKey('prod');
      myhash.defineData('qty');
      myhash.defineDone();
   end;
   /* Add a key and data value to the hash object */
   prod = 'celery';
   qty = 183;
   rc = myhash.add();

   /* Use ITEM_SIZE to return the size of the item in hash object */
   itemsize = myhash.item_size;
   put itemsize=;
run;
```

itemsize=40 is written to the SAS log.

LAST Method

Returns the last value in the underlying hash object.

Applies to: Hash iterator object

Syntax

rc=*object*.**LAST**( );

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash iterator object.

Details

The LAST method returns the last data item in the hash object. If you use the **`ordered: 'yes'`** or **`ordered: 'ascending'`** argument tag in the DECLARE statement or _NEW_ operator when you instantiate the hash object, then the data item that is returned is the one with the 'highest' key (largest numeric value or last alphabetic character), because the data items are sorted in ascending key-value order in the hash object. Conversely, if you use the **`ordered: 'descending'`** argument tag in the DECLARE statement or _NEW_ operator when you instantiate the hash object, then the data item that is returned is the one with the 'least' key (smallest numeric value or first alphabetic character), because the data items are sorted in descending key-value order in the hash object.

Use the FIRST method to return the first data item in the hash object.

Note: The LAST method sets the data variable to the value of the data item so that it is available for use after the method call.

See Also

- "Using the Hash Iterator Object " on page 15

Methods:

- "FIRST Method" on page 67

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

NEW Operator, Hash and Hash Iterator Objects

Creates an instance of a hash or hash iterator object.

Applies to: Hash object, Hash iterator object

Syntax

object-reference = **_NEW_***object* (<*argument_tag-1*: *value-1* <, …*argument_tag-n*: *value-n*> >);

Arguments

object-reference
specifies the object reference name for the hash or hash iterator object.

object
specifies the component object. It can be one of the following:

hash
indicates a hash object. The hash object provides a mechanism for quick data storage and retrieval. The hash object stores and retrieves data based on lookup keys.

hiter
indicates a hash iterator object. The hash iterator object enables you to retrieve the hash object's data in forward or reverse key order.

See "Using the Hash Object " on page 3 and "Using the Hash Iterator Object " on page 15

argument_tag*:*value
specifies the information that is used to create an instance of the hash object.

Valid hash object argument tags and values are

dataset: '*dataset_name* <(*datasetoption*)>'
names a SAS data set to load into the hash object.

The name of the SAS data set can be a literal or character variable. The data set name must be enclosed in single or double quotation marks. Macro variables must be enclosed in double quotation marks.

You can use SAS data set options when declaring a hash object in the DATASET argument tag. Data set options specify actions that apply only to the SAS data set with which they appear. They enable you to perform the following operations:

- renaming variables
- selecting a subset of observations based on observation number for processing
- selecting observations using the WHERE option
- dropping or keeping variables from a data set loaded into a hash object, or for an output data set specified in an OUTPUT method call
- specifying a password for a data set.

The following syntax is used:

```
dcl hash h;
h = _new_ hash (dataset: 'x (where = (i > 10))');
```

For a list of SAS data set options, see the *SAS Viya Data Set Options: Reference*.

Restriction Data set options are not valid on the CAS server

Note If the data set contains duplicate keys, the default is to keep the first instance in the hash object; subsequent instances are ignored. To store the last instance in the hash object or to write an error message in the SAS log if there is a duplicate key, use the DUPLICATE argument tag.

duplicate: '*option*'
determines whether to ignore duplicate keys when loading a data set into the hash object. The default is to store the first key and ignore all subsequent duplicates. Option can be one of the following values:

'replace' | 'r'
stores the last duplicate key record.

'error' | 'e'
reports an error to the log if a duplicate key is found.

The following example using the REPLACE option stores **brown** for the key 620 and **blue** for the key 531. If you use the default, **green** would be stored for 620 and **yellow** would be stored for 531.

```
data table;
  input key data $;
  datalines;
  531 yellow
  620 green
  531 blue
  908 orange
  620 brown
  143 purple
 run;
data _null_;
length key 8 data $ 8;
if (_n_ = 1) then do;
    declare hash myhash;
    myhash = _new_ hash (dataset: "table", duplicate: "r");
    rc = myhash.definekey('key');
    rc = myhash.definedata('data');
    myhash.definedone();
 end;
rc = myhash.output(dataset:"otable");
run;
```

hashexp: *n*
is the hash object's internal table size, where the size of the hash table is 2^n.

The value of HASHEXP is used as a power-of-two exponent to create the hash table size. For example, a value of 4 for HASHEXP equates to a hash table size of 2^4, or 16. The maximum value for HASHEXP is 20.

The hash table size is not equal to the number of items that can be stored. Imagine the hash table as an array of 'buckets.' A hash table size of 16 would have 16 'buckets.' Each bucket can hold an infinite number of items. The efficiency of the hash table lies in the ability of the hashing function to map items to and retrieve items from the buckets.

You should set the hash table size relative to the amount of data in the hash object in order to maximize the efficiency of the hash object lookup routines. Try different HASHEXP values until you get the best result. For example, if the hash object contains one million items, a hash table size of 16 (HASHEXP = 4) would

work, but not very efficiently. A hash table size of 512 or 1024 (HASHEXP = 9 or 10) would result in the best performance.

Default 8, which equates to a hash table size of 2^8 or 256

keysum:'*variable-name*'
specifies the name of a variable that tracks the key summary for all keys. A key summary is a count of how many times a key has been referenced on a FIND method call.

Note The key summary is in the output data set.

ordered: '*option*'
specifies whether or how the data is returned in key-value order if you use the hash object with a hash iterator object or if you use the hash object OUTPUT method.

The argument value can also be enclosed in double quotation marks.

option can be one of the following values:

'ascending' | 'a'	Data is returned in ascending key-value order. Specifying '**`ascending`**' is the same as specifying '**`yes`**'.
'descending' | 'd'	Data is returned in descending key-value order.
'YES' | 'Y'	Data is returned in ascending key-value order. Specifying '**`yes`**' is the same as specifying '**`ascending`**'.
'NO' | 'N'	Data is returned in some undefined order.

Default NO

Restriction You can traverse hash items with a hash iterator in sorted order. However, you cannot generate a hash table in sorted order from a CAS server.

Note VARCHAR is not supported when the ORDERED argument tag is set to 'ascending', 'descending', or 'yes'.

Tip The argument can also be enclosed in double quotation marks.

multidata: '*option*'
specifies whether multiple data items are allowed for each key.

The argument value can also be enclosed in double quotation marks.

`option` can be one of the following values:

'YES' | 'Y'	Multiple data items are allowed for each key.
'NO' | 'N'	Only one data item is allowed for each key.

Default NO

See "Non-Unique Key and Data Pairs" on page 6

suminc: '*variable-name*'
maintains a summary count of hash object keys. The SUMINC argument tag is given a DATA step variable, which holds the sum increment. The sum increment is how much to add to the key summary for each reference to the key.

See "Maintaining Key Summaries" on page 8

Example A key summary changes using the current value of the DATA step variable.

```
dcl hash myhash(suminc: 'count');
```

See "Initializing Hash Object Data Using a Constructor" on page 4 and "Declaring and Instantiating a Hash Iterator Object" on page 15

Details

To use a DATA step component object in your SAS program, you must declare and create (instantiate) the object. The DATA step component interface provides a mechanism for accessing the predefined component objects from within the DATA step.

If you use the _NEW_ operator to instantiate the component object, you must first use the DECLARE statement to declare the component object. For example, in the following lines of code, the DECLARE statement tells SAS that the object reference H is a hash object. The _NEW_ operator creates the hash object and assigns it to the object reference H.

```
declare hash h();
h = _new_ hash( );
```

Note: You can use the DECLARE statement to declare and instantiate a hash or hash iterator object in one step.

A constructor is a method that is used to instantiate a component object and to initialize the component object data. For example, in the following lines of code, the _NEW_ operator instantiates a hash object and assigns it to the object reference H. In addition, the data set WORK.KENNEL is loaded into the hash object.

```
declare hash h();
h = _new_ hash(datset: "work.kennel");
```

For more information about the predefined DATA step component objects and constructors, see "Introduction to DATA Step Component Objects" on page 2.

Comparisons

You can use the DECLARE statement and the _NEW_ operator, or the DECLARE statement alone to declare and instantiate an instance of a hash or hash iterator object.

Example: Using the _NEW_ Operator to Instantiate and Initialize Hash Object Data

This example uses the _NEW_ operator to instantiate and initialize data for a hash object and instantiate a hash iterator object.

The hash object is filled with data, and the iterator is used to retrieve the data in key order.

```
data kennel;
   input name $1-10 kenno $14-15;
   datalines;
Charlie      15
Tanner       07
Jake         04
```

```
Murphy       01
Pepe         09
Jacques      11
Princess Z   12
;
run;
data _null_;
   if _N_ = 1 then do;
      length kenno $2;
      length name $10;
      /* Declare the hash object */
      declare hash h();
      /* Instantiate and initialize the hash object */
      h = _new_ hash(dataset:"work.kennel", ordered: 'yes');
      /* Declare the hash iterator object */
      declare hiter iter;
      /* Instantiate the hash iterator object */
      iter = _new_ hiter('h');
      /* Define key and data variables */
      h.defineKey('kenno');
      h.defineData('name', 'kenno');
      h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(kenno, name);
   end;
   /* Find the first key in the ordered hash object and output to the log */
   rc = iter.first();
   do while (rc = 0);
      put kenno '   ' name;
      rc = iter.next();
   end;
run;
```

The following lines are written to the SAS log:

```
NOTE: There were 7 observations read from the data set WORK.KENNEL.
01    Murphy
04    Jake
07    Tanner
09    Pepe
11    Jacques
12    Princess Z
15    Charlie
```

See Also

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

NEXT Method

Returns the next value in the underlying hash object.

Applies to: Hash iterator object

Syntax

rc=*object*.**NEXT**( );

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash iterator object.

Details

Use the NEXT method iteratively to traverse the hash object and return the data items in key order.

The FIRST method returns the first data item in the hash object.

You can use the PREV method to return the previous data item in the hash object.

Note: The NEXT method sets the data variable to the value of the data item so that it is available for use after the method call.

Note: If you call the NEXT method without calling the FIRST method, then the NEXT method will still start at the first item in the hash object.

See Also

- "Using the Hash Iterator Object " on page 15

Methods:

- "FIRST Method" on page 67
- "PREV Method" on page 86

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

NUM_ITEMS Attribute

Returns the number of items in the hash object.

Applies to: Hash object

Syntax

variable_name=*object*.**NUM_ITEMS**;

Arguments

variable_name
specifies the name of the variable that contains the number of items in the hash object.

object
specifies the name of the hash object.

Example: Returning the Number of Items in a Hash Object

This example creates a data set and loads the data set into a hash object. An item is added to the hash object and the total number of items in the resulting hash object is returned by the NUM_ITEMS attribute.

```
data work.stock;
   input item $ qty;
   datalines;
broccoli 345
corn 389
potato 993
onion 730
;
data _null_;
   if _N_ = 1 then do;
      length item $10;
      length qty 8;
      length totalitems 8;
      /* Declare hash object and read STOCK data set as ordered */
      declare hash myhash(dataset: "work.stock");
      /* Define key and data variables */
      myhash.defineKey('item');
      myhash.defineData('qty');
      myhash.defineDone();
   end;
   /* Add a key and data value to the hash object */
   item = 'celery';
   qty = 183;
   rc = myhash.add();
   if (rc ne 0) then
      put 'Add failed';
   /* Use NUM_ITEMS to return updated number of items in hash object */
   totalitems = myhash.num_items;
   put totalitems=;
run;
```

totalitems=5 is written to the SAS log.

OUTPUT Method

Creates one or more data sets each of which contain the data in the hash object.

Applies to: Hash object

Restriction: This method is not supported on the CAS server.

Syntax

rc=*object*.**OUTPUT** (DATASET: '*dataset-1* <(*datasetoption*)> '
<, …<DATASET: '*dataset-n*>'> ('*datasetoption* <(*datasetoption*)> ');

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

DATASET: '*dataset*'
specifies the name of the output data set.

The name of the SAS data set can be a character literal or character variable. The data set name can also be enclosed in double quotation marks. When specifying the name of the output data set, you can use SAS data set options in the DATASET argument tag. Macro variables must be enclosed in double quotation marks.

datasetoption
specifies a data set option.

For complete information about how to specify data set options, see "Syntax" in *SAS Viya Data Set Options: Reference*.

Details

Hash object keys are not automatically stored as part of the output data set. The keys can be defined as data items by using the DEFINEDATA method to be included in the output data set. In addition, if no data items are defined by using the DEFINEDATA method, the keys are written to the data set specified in the OUTPUT method.

If you use the **`ordered: 'yes'`** or **`ordered: 'ascending'`** argument tag in the DECLARE statement or _NEW_ operator when you instantiate the hash object, then the data items are written to the data set in ascending key-value order. If you use the **`ordered: 'descending'`** argument tag in the DECLARE statement or _NEW_ operator when you instantiate the hash object, then the data items are written to the data set in descending key-value order. If you do not use the **`ordered`** argument tag, the order is undefined.

When specifying the name of the output data set, you can use SAS data set options in the DATASET argument tag. Data set options specify actions that apply only to the SAS data set with which they appear. They let you perform the following operations:

- renaming variables
- selecting a subset of observations based on the observation number for processing
- selecting observations using the WHERE option
- dropping or keeping variables from a data set loaded into a hash object, or for an output data set that is specified in an OUTPUT method call

Note: The variables that are dropped or kept must have been included in the hash table by using the DEFINEDATA or DEFINEKEY method. Otherwise, an error occurs.

- specifying a password for a data set.

The following example uses the WHERE data set option to select specific data for the output data set named OUT:

```
data x;
 do i = 1 to 20;
   output;
 end;
run;

/* Using the WHERE option. */
data _null_;
  length i 8;
  dcl hash h(dataset:'x');
  h.definekey(all: 'y');
  h.definedone();
  h.output(dataset: 'out (where =( i < 8))');
run;
```

The following example uses the RENAME data set option to rename the variable J to K for the output data set named OUT:

```
data x;
 do i = 1 to 20;
   output;
 end;
run;
/* Using the RENAME option. */
data _null_;
  length i j 8;
  dcl hash h(dataset:'x');
  h.definekey(all: 'y');
  h.definedone();
  h.output(dataset: 'out (rename =(i=k))');
run;
```

For a list of data set options, see *SAS Viya Data Set Options: Reference*.

Note: When you use the OUTPUT method to create a data set, the hash object is not part of the output data set. In the following example, the H2 hash object is omitted from the output data set and a warning is written to the SAS log.

```
data _null_;
   length k 8;
   length d $10;
   declare hash h2();
   declare hash h(ordered: 'y');
   h.defineKey('k');
   h.defineData('k', 'd', 'h2');
   h.defineDone();
   k = 99;
   d = 'abc';
   h.add();
   k = 199;
   d = 'def';
```

```
      h.add();
      h.output(dataset:'work.x');
   run;
```

Example

Using the data set ASTRO that contains astronomical data, the following code creates a hash object with the Messier (OBJ) objects sorted in ascending order by their right-ascension (RA) values and uses the OUTPUT method to save the data to a data set.

```
data astro;
input obj $1-4 ra $6-12 dec $14-19;
datalines;
 M31 00 42.7 +41 16
 M71 19 53.8 +18 47
 M51 13 29.9 +47 12
 M98 12 13.8 +14 54
 M13 16 41.7 +36 28
 M39 21 32.2 +48 26
 M81 09 55.6 +69 04
M100 12 22.9 +15 49
 M41 06 46.0 -20 44
 M44 08 40.1 +19 59
 M10 16 57.1 -04 06
 M57 18 53.6 +33 02
  M3 13 42.2 +28 23
 M22 18 36.4 -23 54
 M23 17 56.8 -19 01
 M49 12 29.8 +08 00
 M68 12 39.5 -26 45
 M17 18 20.8 -16 11
 M14 17 37.6 -03 15
 M29 20 23.9 +38 32
 M34 02 42.0 +42 47
 M82 09 55.8 +69 41
 M59 12 42.0 +11 39
 M74 01 36.7 +15 47
 M25 18 31.6 -19 15
;
run;
data _null_;
   if _N_ = 1 then do;
      length obj $10;
      length ra $10;
      length dec $10;
      /* Read ASTRO data set as ordered */
   declare hash h(hashexp: 4, dataset:"work.astro", ordered: 'yes');
      /* Define variables RA and OBJ as key and data for hash object */
      h.defineKey('ra');
      h.defineData('ra', 'obj');
      h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(ra, obj);
end;
/* Create output data set from hash object */
rc = h.output(dataset: 'work.out');
```

```
run;

proc print data=work.out;
   var ra obj;
   title 'Messier Objects Sorted by Right-Ascension Values';
run;
```

Output 2.2 *Messier Objects Sorted by Right-Ascension Values*

Messier Objects Sorted by Right-Ascension Values

Obs	ra	obj
1	00 42.7	M31
2	01 36.7	M74
3	02 42.0	M34
4	06 46.0	M41
5	08 40.1	M44
6	09 55.6	M81
7	09 55.8	M82
8	12 13.8	M98
9	12 22.9	M100
10	12 29.8	M49
11	12 39.5	M68
12	12 42.0	M59
13	13 29.9	M51
14	13 42.2	M3
15	16 41.7	M13
16	16 57.1	M10
17	17 37.6	M14
18	17 56.8	M23
19	18 20.8	M17
20	18 31.6	M25
21	18 36.4	M22
22	18 53.6	M57
23	19 53.8	M71
24	20 23.9	M29
25	21 32.2	M39

See Also

- "Saving Hash Object Data in a Data Set" on page 13

Methods:

- "DEFINEDATA Method" on page 53

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

PREV Method

Returns the previous value in the underlying hash object.

Applies to: Hash iterator object

Syntax

rc=*object*.**PREV**( );

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash iterator object.

Details

Use the PREV method iteratively to traverse the hash object and return the data items in reverse key order.

The FIRST method returns the first data item in the hash object. The LAST method returns the last data item in the hash object.

You can use the NEXT method to return the next data item in the hash object.

Note: The PREV method sets the data variable to the value of the data item so that it is available for use after the method call.

See Also

- "Using the Hash Iterator Object " on page 15

Methods:

- "FIRST Method" on page 67
- "LAST Method" on page 72
- "NEXT Method" on page 78

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

REF Method

Consolidates the CHECK and ADD methods into a single method call.

Applies to: Hash object

Syntax

rc=*object*.**REF** (<<KEY: *keyvalue-1*>, … <KEY: *keyvalue-n*>, <DATA: *datavalue-1*> , …<DATA: *datavalue-n*>>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

KEY: *keyvalue*
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

DATA: *datavalue*
specifies the data value whose type must match the corresponding data variable that is specified in a DEFINEDATA method call.

The number of "DATA: *datavalue*" pairs depends on the number of data variables that you define by using the DEFINEDATA method.

Details

You can consolidate CHECK and ADD methods into a single REF method. You can change the following code:

```
rc = h.check();
  if (rc ne 0) then
    rc = h.add();
```

to

```
rc = h.ref();
```

The REF method is useful for counting the number of occurrences of each key in a hash object. The REF method initializes the key summary for each key on the first ADD, and then changes the ADD for each subsequent CHECK.

For more information about key summaries, see "Maintaining Key Summaries" on page 8.

Example: Using the REF Method for Key Summaries

The following example uses the REF method for key summaries:

```
data keys;
 input key;
datalines;
1
2
1
3
5
2
3
2
4
1
5
1
;
data count;
 length count key 8;
 keep key count;
 if _n_ = 1 then do;
   declare hash myhash(suminc: "count", ordered: "y");
   declare hiter iter("myhash");
   myhash.defineKey('key');
   myhash.defineDone();
   count = 1;
  end;
 do while (not done);
   set keys end=done;
   rc = myhash.ref();
 end;
 rc = iter.first();
 do while(rc = 0);
   rc = myhash.sum(sum: count);
   output;
   rc = iter.next();
 end;
 stop;
run;

proc print data=count;
run;
```

Output 2.3 *Output of DATA Using the REF Method*

Obs	count	key
1	4	1
2	3	2
3	2	3
4	1	4
5	2	5

See Also

Methods:

- "ADD Method" on page 40
- "CHECK Method" on page 41

REMOVE Method

Removes the data that is associated with the specified key from the hash object.

Applies to: Hash object

Syntax

rc=*object*.**REMOVE** (<KEY: *keyvalue-1*, …KEY: *keyvalue-n*>);

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object

specifies the name of the hash object.

KEY: ***keyvalue***

specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

Restriction If an associated hash iterator is pointing to the *keyvalue*, then the REMOVE method will not remove the key or data from the hash object. An error message is issued.

Details

The REMOVE method deletes both the key and the data from the hash object.

You can use the REMOVE method in one of two ways to remove the key and data in a hash object.

You can specify the key, and then use the REMOVE method as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   rc = h.add(key: 'Joyce', data: 'Ulysses');
   /* Specify the key */
   k = 'Joyce';
   /* Use the REMOVE method to remove the key and data */
   rc = h.remove();
   if (rc = 0) then
      put 'Key and data removed from the hash object.';
run;
```

Alternatively, you can use a shortcut and specify the key directly in the REMOVE method call as shown in the following code:

```
data _null_;
   length k $8;
   length d $12;
   if _N_ = 1 then do;
      declare hash h();
      rc = h.defineKey('k');
      rc = h.defineData('d');
      rc = h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(k, d);
   end;
   rc = h.add(key: 'Joyce', data: 'Ulysses');
   rc = h.add(key: 'Homer', data: 'Iliad');
   /* Specify the key in the REMOVE method parameter */
   rc = h.remove(key: 'Homer');
   if (rc  =0) then
      put 'Key and data removed from the hash object.';
run;
```

Note: The REMOVE method does not modify the value of data variables. It removes only the value in the hash object.

Note: If you specify **`multidata:'y'`** in the hash object constructor, the REMOVE method will remove all data items for the specified key.

Example: Removing a Key in the Hash Table

This example illustrates how to remove a key in the hash table.

```
/* Generate test data */
data x;
   do k = 65 to 70;
      d = byte (k);
      output;
   end;
run;
data _null_;
   length k 8 d $1;
   /* define the hash table and iterator */
   declare hash H (dataset:'x', ordered:'a');
   H.defineKey  ('k');
   H.defineData ('k', 'd');
   H.defineDone ();
   call missing (k,d);
   declare hiter HI ('H');
/*Use this logic to remove a key in the hash object when an*/
/*iterator is pointing to that key. The NEXT method will*/
/*start at the first item in the hash object if it is called*/
/*without calling the FIRST method. */
    do while (hi.next() = 0);
      if flag then rc=h.remove(key:key);
         if d = 'C' then do;
            key=k;
            flag=1;
         end;
         else flag=0;
      end;
  if flag then rc=h.remove(key:key);
  rc = h.output(dataset: 'work.out');
  stop;
run;
proc print;
run;
```

The following output shows that the key and data for the third object (key=67, data=C) is deleted.

Output 2.4 *Key and Data Removed from Output*

Obs	k	d
1	65	A
2	66	B
3	68	D
4	69	E
5	70	F

See Also

- "Replacing and Removing Data in the Hash Object" on page 12

Methods:

- "ADD Method" on page 40
- "DEFINEKEY Method" on page 56
- "REMOVEDUP Method" on page 92

REMOVEDUP Method

Removes the data that is associated with the specified key's current data item from the hash object.

Applies to: Hash object

Syntax

rc=*object*.**REMOVEDUP** (<KEY: *keyvalue-1*, …KEY: *keyvalue-n*>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

KEY: ***keyvalue***
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

Restriction If an associated hash iterator is pointing to the *keyvalue*, then the REMOVEDUP method does not remove the key or data from the hash object. An error message is issued.

Details

The REMOVEDUP method deletes both the key and the data from the hash object.

You can use the REMOVEDUP method in one of two ways to remove the key and data in a hash object. You can specify the key, and then use the REMOVEDUP method. Alternatively, you can use a shortcut and specify the key directly in the REMOVEDUP method call.

Note: The REMOVEDUP method does not modify the value of data variables. It removes only the value in the hash object.

Note: If only one data item is in the key's data item list, the key and data are removed from the hash object.

Comparisons

The REMOVEDUP method removes the data that is associated with the specified key's current data item from the hash object. The REMOVE method removes the data that is associated with the specified key from the hash object.

Example: Removing Duplicate Items in Keys

This example creates a hash object where several keys have multiple data items. The second data item in the key is removed.

```
data testdup;
   length key data 8;
   input key data;
   datalines;
   1 10
   2 11
   1 15
   3 20
   2 16
   2 9
   3 100
   5 5
   1 5
   4 6
   5 99
;
data _null_;
   length r 8;
   dcl hash h(dataset:'testdup', multidata: 'y', ordered: 'y');
   h.definekey('key');
   h.definedata('key', 'data');
   h.definedone();
   call missing (key, data);
   do key = 1 to 5;
      rc = h.find();
      if (rc = 0) then do;
         h.has_next(result: r);
         if (r ne 0) then do;
            h.find_next();
            h.removedup();
         end;
      end;
   end;
   dcl hiter i('h');
   rc = i.first();
   do while (rc = 0);
      put key= data=;
      rc = i.next();
   end;
run;
```

The following lines are written to the SAS log:

```
key=1 data=10
key=1 data=5
key=2 data=11
key=2 data=9
key=3 data=20
key=4 data=6
key=5 data=5
```

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "REMOVE Method" on page 89

REPLACE Method

Replaces the data that is associated with the specified key with new data.

Applies to: Hash object

Syntax

rc=*object*.**REPLACE** (<<KEY: *keyvalue-1*>, …<KEY: *keyvalue-n*>, <DATA: *datavalue-1*>,
…<DATA: *datavalue-n*>>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

KEY: *keyvalue*
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: **`keyvalue`**" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

Requirement The KEY: *keyvalue* arguments must be in the same order as they were defined in the hash object because the hash object variable names are not specified.

DATA: *datavalue*
specifies the data value whose type must match the corresponding data variable that is specified in a DEFINEDATA method call.

The number of "DATA: **`datavalue`**" pairs depends on the number of data variables that you define by using the DEFINEDATA method.

Requirement The DATA: *datavalue* arguments must be in the same order as they were defined in the hash object because the hash object variable names are not specified.

Details

You can use the REPLACE method in one of two ways to replace data in a hash object.

You can define the key and data item, and then use the REPLACE method as shown in the following code. In this example, the data for the key 'Rottwlr' is changed from '1st' to '2nd'.

```
data work.show;
   length brd $10 plc $8;
   input brd plc;
datalines;
Terrier    2nd
LabRetr    3rd
Rottwlr    1st
Collie     bis
ChinsCrstd 2nd
Newfnlnd   3rd
;

proc print data=work.show;
   title 'SHOW Data Set Before Replace';
run;

data _null_;
   length brd $12;
   length plc $8;
   if _N_ = 1 then do;
      declare hash h(dataset: 'work.show');
      rc = h.defineKey('brd');
      rc = h.defineData('brd', 'plc');
      rc = h.defineDone();
   end;
   /* Specify the key and new data value */
   brd = 'Rottwlr';
   plc = '2nd';
   /* Call the REPLACE method to replace the data value */
   rc = h.replace();
   /* Write the hash table to the data set. */
   rc = h.output(dataset: 'work.show');
run;

proc print data=work.show;
   title 'SHOW Data Set After Replace';
run;
```

Alternatively, you can use a shortcut and specify the key and data directly in the REPLACE method call as shown in the following code:

```
data work.show;
   length brd $10 plc $8;
   input brd plc;
datalines;
Terrier    2nd
LabRetr    3rd
```

```
Rottwlr    1st
Collie     bis
ChinsCrstd 2nd
Newfnlnd   3rd
;
data _null_;
   length brd $12;
   length plc $8;
   if _N_ = 1 then do;
      declare hash h(dataset: 'work.show');
      rc = h.defineKey('brd');
      rc = h.defineData('brd', 'plc');
      rc = h.defineDone();
      /* avoid uninitialized variable notes */
      call missing(brd, plc);
   end;
   /* Specify the key and new data value in the REPLACE method */
   rc = h.replace(key: 'Rottwlr', data: '2nd');
   /* Write the hash table to the data set. */
   rc = h.output(dataset: 'work.show');
run;
```

Note: The hash object's REPLACE method is intended for use with hash tables that have a single item for each key (**MULTIDATA: 'NO'**), whereas the REPLACEDUP method is intended for use with hash tables that have multiple data items for each key (**MULTIDATA: 'YES'**). If you call the REPLACE method and the hash object was declared using the **multidata:'y'** option, then all data items for the current key are replaced with the new data. In previous releases, no items are replaced and the new data is added to the current key.For more information about the MULTIDATA option, see "DECLARE Statement, Hash and Hash Iterator Objects" on page 45.

Note: If you call the REPLACE method and the key is not found, then the key and data are added to the hash object.

Note: The REPLACE method does not replace the value of the data variable with the value of the data item. It replaces only the value in the hash object.

Comparisons

The REPLACE method replaces the data that is associated with the specified key with new data. The REPLACEDUP method replaces the data that is associated with the current key's current data item with new data.

See Also

- "Replacing and Removing Data in the Hash Object" on page 12

Methods:

- "DEFINEDATA Method" on page 53
- "DEFINEKEY Method" on page 56
- "REPLACEDUP Method" on page 97

REPLACEDUP Method

Replaces the data that is associated with the current key's current data item with new data.

Applies to: Hash object

Syntax

rc=*object*.**REPLACEDUP** (<DATA: *datavalue-1*, …DATA: *datavalue-n*>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

DATA: ***datavalue***
specifies the data value whose type must match the corresponding data variable that is specified in a DEFINEDATA method call.

The number of "DATA: *datavalue*" pairs depends on the number of data variables that you define by using the DEFINEDATA method for the current key.

Details

You can use the REPLACEDUP method in one of two ways to replace data in a hash object.

You can define the data item, and then use the REPLACEDUP method. Alternatively, you can use a shortcut and specify the data directly in the REPLACEDUP method call.

Note: If you call the REPLACEDUP method and the key is not found, then the key and data are added to the hash object.

Note: The REPLACEDUP method does not replace the value of the data variable with the value of the data item. It replaces only the value in the hash object.

Comparisons

The REPLACEDUP method replaces the data that is associated with the current key's current data item with new data. The REPLACE method replaces the data that is associated with the specified key with new data.

Example: Replacing Data in the Current Key

This example creates a hash object where several keys have multiple data items. When a duplicate data item is found, 300 is added to the value of the data item.

```
data testdup;
   length key data 8;
   input key data;
```

```
   datalines;
   1 10
   2 11
   1 15
   3 20
   2 16
   2 9
   3 100
   5 5
   1 5
   4 6
   5 99
;
data _null_;
   length r 8;
   dcl hash h(dataset:'testdup', multidata: 'y', ordered: 'y');
   h.definekey('key');
   h.definedata('key', 'data');
   h.definedone();
   call missing (key, data);
   do key = 1 to 5;
      rc = h.find();
      if (rc = 0) then do;
         put key= data=;
         h.has_next(result: r);
         do while(r ne 0);
            rc = h.find_next();
            put 'dup ' key= data;
            data = data + 300;
            rc = h.replacedup();
            h.has_next(result: r);
         end;
      end;
   end;
   put 'iterating...';
   dcl hiter i('h');
   rc = i.first();
   do while (rc = 0);
      put key= data=;
      rc = i.next();
    end;
run;
```

The following lines are written to the SAS log.

```
key=1 data=10
dup key=1 15
dup key=1 5
key=2 data=11
dup key=2 16
dup key=2 9
key=3 data=20
dup key=3 100
key=4 data=6
key=5 data=5
dup key=5 99
iterating...
key=1 data=10
key=1 data=315
key=1 data=305
key=2 data=11
key=2 data=316
key=2 data=309
key=3 data=20
key=3 data=400
key=4 data=6
key=5 data=5
key=5 data=399
```

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "REPLACE Method" on page 94

RESET_DUP Method

Resets the pointer to the beginning of a duplicate list of keys when you use the DO_OVER method.

Applies to: Hash object

Syntax

rc=object.**RESET_DUP**( );

Arguments

rc

specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object

specifies the name of the hash object.

Details

When a hash object has multiple values for a single key, you can use the DO_OVER method in an iterative DO loop to traverse the duplicate keys. The DO_OVER method

reads the key on the first method call and continues to traverse the duplicate key list until the key reaches the end.

If you switch the key in the middle of an iteration, you must use the RESET_DUP method to reset the pointer to the beginning of the list. Otherwise, SAS continues to use the first key.

For an example, see the DO_OVER method example on page 59.

See Also

Methods:

- "DO_OVER Method" on page 58

SETCUR Method

Specifies a starting key item for iteration.

Applies to: Hash iterator object

Syntax

rc=*object*.**SETCUR** (KEY: '*keyvalue-1*' <, …KEY: '*keyvalue-n*'>);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash iterator object.

KEY: '*keyvalue*'
specifies a key value as the starting key for the iteration.

Details

The hash iterator enables you to start iteration on any item in the hash object. The SETCUR method sets the starting key for iteration. You use the KEY option to specify the starting item.

Example: Specifying the Starting Key Item

The following example creates a data set that contains astronomical data. You want to start iteration at RA= 18 31.6 instead of the first or last items. The data is loaded into a hash object and the SETCUR method is used to start the iteration. Because the *ordered* argument tag was set to YES, note that the output is sorted in ascending order.

```
data work.astro;
input obj $1-4 ra $6-12 dec $14-19;
datalines;
```

```
 M31 00 42.7 +41 16
 M71 19 53.8 +18 47
 M51 13 29.9 +47 12
 M98 12 13.8 +14 54
 M13 16 41.7 +36 28
 M39 21 32.2 +48 26
 M81 09 55.6 +69 04
M100 12 22.9 +15 49
 M41 06 46.0 -20 44
 M44 08 40.1 +19 59
 M10 16 57.1 -04 06
 M57 18 53.6 +33 02
  M3 13 42.2 +28 23
 M22 18 36.4 -23 54
 M23 17 56.8 -19 01
 M49 12 29.8 +08 00
 M68 12 39.5 -26 45
 M17 18 20.8 -16 11
 M14 17 37.6 -03 15
 M29 20 23.9 +38 32
 M34 02 42.0 +42 47
 M82 09 55.8 +69 41
 M59 12 42.0 +11 39
 M74 01 36.7 +15 47
 M25 18 31.6 -19 15
;
```

The following code sets the starting key for iteration to **'18 31.6'**:

```
data _null_;
length obj $10;
length ra $10;
length dec $10;
declare hash myhash(hashexp: 4, dataset:"work.astro", ordered:"yes");

declare hiter iter('myhash');
myhash.defineKey('ra');
myhash.defineData('obj', 'ra');
myhash.defineDone();
call missing (ra, obj, dec);
rc = iter.setcur(key: '18 31.6');
  do while (rc = 0);
    put obj= ra=;
    rc = iter.next();
  end;
run;
```

The following lines are written to the SAS log.

```
obj=M25 ra=18 31.6
  obj=M22 ra=18 36.4
  obj=M57 ra=18 53.6
  obj=M71 ra=19 53.8
  obj=M29 ra=20 23.9
  obj=M39 ra=21 32.2
```

You can use the FIRST method or the LAST method to start iteration on the first item or the last item, respectively.

See Also

- "Using the Hash Iterator Object " on page 15

Methods:

- "FIRST Method" on page 67
- "LAST Method" on page 72

Operators:

- "_NEW_ Operator, Hash and Hash Iterator Objects" on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

SUM Method

Retrieves the summary value for a given key from the hash table and stores the value in a DATA step variable.

Applies to: Hash object

Syntax

rc=*object*.**SUM** (<KEY: *keyvalue-1*, …KEY: *keyvalue-n*,> SUM: *variable-name*);

Required Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, then an appropriate error message is written to the log.

object
specifies the name of the hash object.

KEY: *keyvalue*
specifies the key value whose type must match the corresponding key variable that is specified in a DEFINEKEY method call.

The number of "KEY: *keyvalue*" pairs depends on the number of key variables that you define by using the DEFINEKEY method.

SUM: *variable-name*
specifies a DATA step variable that stores the current summary value of a given key.

Details

You use the SUM method to retrieve key summaries from the hash object. For more information, see "Maintaining Key Summaries" on page 8.

Comparisons

The SUM method retrieves the summary value for a given key when only one data item exists per key. The SUMDUP method retrieves the summary value for the current data item of the current key when more than one data item exists for a key.

Example: Retrieving the Key Summary for a Given Key

The following example uses the SUM method to retrieve the key summary for each given key, K=99 and K=100.

```
    k = 99;
    count = 1;
    h.add();
    /* key=99 summary is now 1 */
    k = 100;
    h.add();
    /* key=100 summary is now 1 */
    k = 99;
    h.find();
    /* key=99 summary is now 2 */
    count = 2;
    h.find();
    /* key=99 summary is now 4 */
    k = 100;
    h.find();
    /* key=100 summary is now 3 */
    h.sum(sum: total);
    put 'total for key 100 = ' total;
    k = 99;
    h.sum(sum:total);
    put 'total for key 99 = ' total;
   run;
```

The first PUT statement prints the summary for k=100:

```
total for key 100 = 3
```

The second PUT statement prints the summary for k=99:

```
total for key 99 = 4
```

See Also

Methods:

- “ADD Method” on page 40
- “FIND Method” on page 62
- “CHECK Method” on page 41
- “DEFINEKEY Method” on page 56
- “REF Method” on page 87
- “SUMDUP Method” on page 104

Operators:

- “_NEW_ Operator, Hash and Hash Iterator Objects” on page 73

Statements:

- "DECLARE Statement, Hash and Hash Iterator Objects" on page 45

SUMDUP Method

Retrieves the summary value for the current data item of the current key and stores the value in a DATA step variable.

Applies to: Hash object

Syntax

rc=*object*.**SUMDUP** (SUM: *variable-name*);

Arguments

rc
specifies whether the method succeeded or failed.

A return code of zero indicates success; a nonzero value indicates failure. If you do not supply a return code variable for the method call and the method fails, an appropriate error message is printed to the log.

object
specifies the name of the hash object.

SUM: ***variable-name***
specifies a DATA step variable that stores the summary value for the current data item of the current key.

Details

You use the SUMDUP method to retrieve key summaries from the hash object when a key has multiple data items. For more information, see "Maintaining Key Summaries" on page 8.

Comparisons

The SUMDUP method retrieves the summary value for the current data item of the current key when more than one data item exists for a key. The SUM method retrieves the summary value for a given key when only one data item exists per key.

Example: Retrieving a Summary Value

The following example uses the SUMDUP method to retrieve the summary value for the current data item. It also illustrates that it is possible to loop backward through the list by using the HAS_PREV and FIND_PREV methods. The FIND_PREV method works similarly to the FIND_NEXT method with respect to the current list item except that it moves backward through the multiple item list.

```
data dup;
   length key data 8;
   input key data;
   cards;
   1 10
```

```
   2 11
   1 15
   3 20
   2 16
   2 9
   3 100
   5 5
   1 5
   4 6
   5 99
;
data _null_;
   length r i sum 8;
   i = 0;
   dcl hash h(dataset:'dup', multidata: 'y', suminc: 'i');
   h.definekey('key');
   h.definedata('key', 'data');
   h.definedone();
   call missing (key, data);
   i = 1;
  do key = 1 to 5;
     rc = h.find();
     if (rc = 0) then do;
        h.has_next(result: r);
        do while(r ne 0);
           rc = h.find_next();
           rc = h.find_prev();
           rc = h.find_next();
           h.has_next(result: r);
        end;
     end;
  end;
 i = 0;
 do key = 1 to 5;
   rc = h.find();
   if (rc = 0) then do;
       h.sum(sum: sum);
       put key= data= sum=;
       h.has_next(result: r);
       do while(r ne 0);
          rc = h.find_next();
          h.sumdup(sum: sum);
          put 'dup ' key= data= sum=;
          h.has_next(result: r);
       end;
     end;
 end;
 run;
```

The following lines are written to the SAS log.

```
key=1 data=10 sum=2
dup key=1 data=15 sum=3
dup key=1 data=5 sum=2
key=2 data=11 sum=2
dup key=2 data=16 sum=3
dup key=2 data=9 sum=2
key=3 data=20 sum=2
dup key=3 data=100 sum=2
key=4 data=6 sum=1
key=5 data=5 sum=2
dup key=5 data=99 sum=2
```

To see how this works, consider the key 1, which has three data values: 10, 15, and 5 (which are stored in that order).

```
key=1 data=10 sum=2
dup key=1 data=15 sum=3
dup key=1 data=5 sum=2
```

When traversing the data list in the first **`do key = 1 to 5;`** loop, the key summary for data item 10 is set to 1 on the initial FIND method call. The first FIND_NEXT method call sets the key summary for data item 15 to 1. The next FIND_PREV method call moves back to data item 10 and increments its key summary to 2. Finally, the last call to the FIND_NEXT method increments the key summary for data item 15 to 2. The next iteration through the loop sets the key summary for data item 5 to 1 and the key summary for data item 15 to 3. Finally, the key summary for data item 5 is incremented to 2.

You do not call the HAS_PREV method before calling the FIND_PREV method in this example because you already know that there is a previous entry in the list. Otherwise, you would not be in the loop.

Also shown here is the necessity of using special methods for some duplicate operations. (In this case, the SUMDUP method works similarly to the SUM method by retrieving the key summary for the current data item.)

See Also

- "Non-Unique Key and Data Pairs" on page 6

Methods:

- "SUM Method" on page 102

Chapter 3

Dictionary of Java Object Language Elements

Java Object Methods by Category

There are five categories of Java object methods.

Table 3.1 *Java Object Methods by Category*

Category	Description
Deletion	enables you to delete a Java object.
Exception	enables you to gather information about and clear an exception.
Field reference	enables you to return or set the value of static and non-static instance fields of the Java object.
Method reference	enables you to access static and non-static Java methods.
Output	enables you to send the Java output to its destination immediately.

The following table provides brief descriptions of the Java object methods. For more detailed descriptions, see the dictionary entry for each method.

Category	Language Elements	Description
Deletion	DELETE Method, Java Object (p. 115)	Deletes the Java object.
Exception	EXCEPTIONCHECK Method (p. 116)	Determines whether an exception occurred during a method call.
	EXCEPTIONCLEAR Method (p. 117)	Clears any exception that is currently being thrown.
	EXCEPTIONDESCRIBE Method (p. 119)	Turns the exception debug logging on or off and prints exception information.
Field Reference	GET*type*FIELD Method (p. 122)	Returns the value of a non-static field for a Java object.
	GETSTATIC*type*FIELD Method (p. 124)	Returns the value of a static field for a Java object.
	SET*type*FIELD Method (p. 127)	Modifies the value of a non-static field for a Java object.
	SETSTATIC*type*FIELD Method (p. 130)	Modifies the value of a static field for a Java object.
Method Reference	CALL*type*METHOD Method (p. 108)	Invokes an instance method on a Java object from a non-static Java method.
	CALLSTATIC*type*METHOD Method (p. 111)	Invokes an instance method on a Java object from a static Java method.
Output	FLUSHJAVAOUTPUT Method (p. 120)	Specifies that the Java output is sent to its destination.

Dictionary

CALL*type*METHOD Method

Invokes an instance method on a Java object from a non-static Java method.

Category: Method Reference

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**CALL***type***METHOD** ("*method-name*", <*method-argument-1*, …*method-argument-n*>,
<*return-value*>);

Arguments

object
specifies the name of the Java object.

type
specifies the result type for the non-static Java method. The type can be one of the following values:

BOOLEAN
specifies that the result type is BOOLEAN.

BYTE
specifies that the result type is BYTE.

CHAR
specifies that the result type is CHAR.

DOUBLE
specifies that the result type is DOUBLE.

FLOAT
specifies that the result type is FLOAT.

INT
specifies that the result type is INT.

LONG
specifies that the result type is LONG.

SHORT
specifies that the result type is SHORT.

STRING
specifies that the result type is STRING.

VOID
specifies that the result type is VOID.

See "Type Issues" on page 21

method-name
specifies the name of the non-static Java method.

Requirement The method name must be enclosed in either single or double quotation marks.

method-argument
specifies the parameters to pass to the method.

return-value
specifies the return value if the method returns one.

Details

Once you instantiate a Java object, you can access any non-static Java method through method calls on the Java object by using the CALL*type*METHOD method.

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see "Type Issues" on page 21 .

Comparisons

Use the CALL*type*METHOD method for non-static Java methods. If the Java method is static, use the CALLSTATIC*type*METHOD method.

Example: Setting and Retrieving Field Values

The following example creates a simple class that contains three non-static fields. The Java object **j** is instantiated, and then the field values are set and retrieved using the CALL*type*FIELD method.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class ttest
{
   public int i;
   public double d;
   public string s;
   public int im()
   {
      return i;
   }
   public String sm()
   {
       return s;
   }
   public double dm()
   {
      return d;
   }
}
```

```
/*  DATA step code */
data _null_;
   dcl javaobj j("ttest");
   length val 8;
   length str $20;
    j.setIntField("i", 100);
   j.setDoubleField("d", 3.14159);
   j.setStringField("s", "abc");
   j.callIntMethod("im", val);
   put val=;
   j.callDoubleMethod("dm", val);
   put val=;
   j.callStringMethod("sm", str);
   put str=;
run;
```

The following lines are written to the SAS log:

```
val=100
val=3.14159
str=abc
```

See Also

Methods:

- "CALLSTATICtypeMETHOD Method" on page 111

CALLSTATIC*type*METHOD Method

Invokes an instance method on a Java object from a static Java method.

Category: Method Reference

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**CALLSTATIC***type***METHOD** ("*method-name*", <*method-argument-1*, …*method-argument-n*>, <*return-value*>);

Arguments

object
specifies the name of the Java object.

type
specifies the result type for the static Java method. The type can be one of the following values:

BOOLEAN
specifies that the result type is BOOLEAN.

BYTE
specifies that the result type is BYTE.

CHAR
specifies that the result type is CHAR.

DOUBLE
specifies that the result type is DOUBLE.

FLOAT
specifies that the result type is FLOAT.

INT
specifies that the result type is INT.

LONG
specifies that the result type is LONG.

SHORT
specifies that the result type is SHORT.

STRING
specifies that the result type is STRING.

VOID
specifies that the result type is VOID.

See "Type Issues" on page 21

method-name
specifies the name of the static Java method.

Requirement The method name must be enclosed in either single or double quotation marks.

method-argument
specifies the parameters to pass to the method.

return-value
specifies the return value if the method returns one.

Details

Once you instantiate a Java object, you can access any static Java method through method calls on the Java object by using the CALLSTATIC*type*METHOD method.

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see "Type Issues" on page 21 .

Comparisons

Use the CALLSTATIC*type*METHOD method for static Java methods. If the Java method is not static, use the CALL*type*METHOD method.

Example: Setting and Retrieving Static Fields

The following example creates a simple class that contains three static fields. The Java object `j` is instantiated, and then the field values are set and retrieved using the CALLSTATIC*type*FIELD method.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class ttestc
{
   public static double d;
   public static double dm()
   {
      return d;
   }
```

```
/* DATA step code */
data x;
   declare javaobj j("ttestc");
   length d 8;
   j.SetStaticDoubleField("d", 3.14159);
   j.callStaticDoubleMethod("dm", d);
   put d=;
run;
```

The following line is written to the SAS log:

```
d=3.14159
```

See Also

Methods:

- "CALLtypeMETHOD Method" on page 108

DECLARE Statement, Java Object

Declares a Java object; creates an instance of and initializes data for a Java object.

Alias: DCL

Restriction: This method is not supported on the CAS server.

Syntax

Form 1: **DECLARE JAVAOBJ** *object-reference*;

Form 2: **DECLARE JAVAOBJ** *object-reference* ("*java-class*", <*argument-1*, … *argument-n*>);

Arguments

object-reference
specifies the object reference name for the Java object.

java-class
specifies the name of the Java class to be instantiated.

Requirements The Java class name must be enclosed in either double or single quotation marks.

If you specify a Java package path, you must use forward slashes (/) and not periods (.) in the path. For example, an incorrect class name is *"java.util.Hashtable"*. The correct class name is *"java/util/Hashtable"*.

argument
specifies the information that is used to create an instance of the Java object. Valid values for *argument* depend on the Java object.

See "Using the DECLARE Statement to Instantiate a Java Object (Form 2)" on page 114

Details

The Basics

To use a DATA step component object in your SAS program, you must declare and create (instantiate) the object. The DATA step component interface provides a mechanism for accessing predefined component objects from within the DATA step.

For more information, see "Introduction to DATA Step Component Objects" on page 2.

Declaring a Java Object (Form 1)

You use the DECLARE statement to declare a Java object.

```
   declare javaobj j;
```

The DECLARE statement tells SAS that the object reference J is a Java object.

After you declare the new Java object, use the _NEW_ operator to instantiate the object. For example, in the following line of code, the _NEW_ operator creates the Java object and assigns it to the object reference J:

```
j = _new_ javaobj("somejavaclass");
```

Using the DECLARE Statement to Instantiate a Java Object (Form 2)

Instead of the two-step process of using the DECLARE statement and the _NEW_ operator to declare and instantiate a Java object, you can use the DECLARE statement to declare and instantiate the Java object in one step. For example, in the following line of code, the DECLARE statement declares and instantiates a Java object and assigns the Java object to the object reference J:

```
declare javaobj j("somejavaclass");
```

The preceding line of code is equivalent to using the following code:

```
declare javaobj j;
j = _new_ javaobj("somejavaclass");
```

A *constructor* is a method that you can use to instantiate a component object and initialize the component object data. For example, in the following line of code, the DECLARE statement declares and instantiates a Java object and assigns the Java object to the object reference J. Note that the only required argument for a Java object constructor is the name of the Java class to be instantiated. All other arguments are constructor arguments for the Java class itself. In the following example, the Java class name, **`testjavaclass`**, is the constructor, and the values **`100`** and **`.8`** are constructor arguments.

```
   declare javaobj j("testjavaclass", 100, .8);
```

Comparisons

You can use the DECLARE statement and the _NEW_ operator, or the DECLARE statement alone to declare and instantiate an instance of a Java object.

Examples

Example 1: Declaring and Instantiating a Java Object By Using the DECLARE Statement and the _NEW_ Operator

In the following example, a simple Java class is created. The DECLARE statement and the _NEW_ operator are used to create an instance of this class.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class simpleclass
{
   public int i;
   public double d;
}

/* DATA step code
data _null_;
   declare javaobj myjo;
```

```
   myjo = _new_ javaobj("simpleclass");
run;
```

Example 2: Using the DECLARE Statement to Create and Instantiate a Java Object

In the following example, a Java class is created for a hash table. The DECLARE statement is used to create and instantiate an instance of this class by specifying the capacity and load factor. In this example, a wrapper class, **mhash**, is necessary because the DATA step's only numeric type is equivalent to the Java type DOUBLE.

```
/* Java code */
import java.util.*;
public class mhash extends Hashtable;
{
   mhash (double size, double load)
      {
         super ((int)size, (float)load);
      }
}
```

```
/* DATA step code */
data _null_;
   declare javaobj h("mhash", 100, .8);
run;
```

See Also

Operators:

- "_NEW_ Operator, Java Object" on page 126

DELETE Method, Java Object

Deletes the Java object.

Category: Deletion

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**DELETE**( );

Arguments

object

specifies the name of the Java object.

Details

DATA step component objects are deleted automatically at the end of the DATA step. If you want to reuse the object reference variable in another Java object constructor, you should delete the Java object by using the DELETE method.

If you attempt to use a Java object after you delete it, you will receive an error in the log.

EXCEPTIONCHECK Method

Determines whether an exception occurred during a method call.

Category: Exception

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**EXCEPTIONCHECK** (*status*);

Arguments

object
specifies the name of the Java object.

status
specifies the exception status that is returned.

Tip The status value that is returned by Java is of type DOUBLE, which corresponds to a SAS numeric data value.

Details

Java exceptions are handled through the EXCEPTIONCHECK, EXCEPTIONCLEAR, and EXCEPTIONDESCRIBE methods.

The EXCEPTIONCHECK method is used to determine whether an exception occurred during a method call. Ideally, the EXCEPTIONCHECK method should be called after every call to a Java method that can throw an exception.

Example: Checking an Exception

In the following example, the Java class contains a method that throws an exception. The DATA step calls the method and checks for an exception.

```
/* Java code */
public class a
   {
      public void m() throws NullPointerException
      {
         throw new NullPointerException();
      }
   }

/* DATA step code */
data _null_;
   length e 8;
   dcl javaobj j('a');
   rc = j.callvoidmethod('m');
   /* Check for exception.  Value is returned in variable 'e' */
```

```
rc = j.exceptioncheck(e);
if (e) then
  put 'exception';
else
  put 'no exception';
run;
```

The following line is written to the SAS log:

```
exception
```

See Also

Methods:

- "EXCEPTIONCLEAR Method" on page 117
- "EXCEPTIONDESCRIBE Method" on page 119

EXCEPTIONCLEAR Method

Clears any exception that is currently being thrown.

Category: Exception

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**EXCEPTIONCLEAR**( );

Arguments

object
specifies the name of the Java object.

Details

Java exceptions are handled through the EXCEPTIONCHECK, EXCEPTIONCLEAR, and EXCEPTIONDESCRIBE methods.

If you call a method that throws an exception, it is strongly recommended that you check for an exception after the call. If an exception was thrown, you should take appropriate action and then clear the exception by using the EXCEPTIONCLEAR method.

If no exception is currently being thrown, this method has no effect.

Examples

Example 1: Checking and Clearing an Exception

In the following example, the Java class contains a method that throws an exception. The method is called in the DATA step, and the exception is cleared.

```
/* Java code */
```

```
public class a
   {
      public void m() throws NullPointerException
      {
         throw new NullPointerException();
      }
   }

/* DATA step code */
data _null_;
   length e 8;
   dcl javaobj j('a');
   rc = j.callvoidmethod('m');
   /* Check for exception.  Value is returned in variable 'e' */
   rc = j.exceptioncheck(e);
   if (e) then
     put 'exception';
   else
     put 'no exception';
   /* Clear the exception and check it again */
   rc = j.exceptionclear( );
   rc = j.exceptioncheck(e);
   if (e) then
      put 'exception';
   else
      put 'no exception';
run;
```

The following lines are written to the SAS log:

```
exception
no exception
```

Example 2: Checking for an Exception When Reading an External File

In this example, the Java IO classes are used to read an external file from the DATA step. The Java code creates a wrapper class for **DataInputStream**, which enables you to pass a **FileInputStream** to the constructor. The wrapper is necessary because the constructor actually takes an **InputStream**, which is the parent of **FileInputStream**, and the current method lookup is not robust enough to perform the superclass lookup.

```
/* Java code */
public class myDataInputStream extends java.io.DataInputStream
{
   myDataInputStream(java.io.FileInputStream fi)
   {
      super(fi);
   }
}
```

After you create the wrapper class, you can use it to create a **DataInputStream** for an external file and read the file until the end-of-file is reached. The EXCEPTIONCHECK method is used to determine when the **readInt** method throws an **EOFException**, which enables you to end the input loop.

```
/* DATA step code */
data _null_;
```

```
   length d e 8;
   dcl javaobj f("java/io/File", "c:\temp\binint.txt");
   dcl javaobj fi("java/io/FileInputStream", f);
   dcl javaobj di("myDataInputStream", fi);
   do while(1);
      di.callIntMethod("readInt", d);
      di.ExceptionCheck(e);
      if (e) then
         leave;
      else
         put d=;
   end;
run;
```

See Also

Methods:

- "EXCEPTIONCHECK Method" on page 116
- "EXCEPTIONDESCRIBE Method" on page 119

EXCEPTIONDESCRIBE Method

Turns the exception debug logging on or off and prints exception information.

Category: Exception

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**EXCEPTIONDESCRIBE** (*status*);

Arguments

object
specifies the name of the Java object.

status
specifies whether exception debug logging is on or off. The **status** argument can be one of the following values:

0
specifies that debug logging is off.

1
specifies that debug logging is on.

Default 0 (off)

Tip The status value that is returned by Java is of type DOUBLE, which corresponds to a SAS numeric data value.

Details

The EXCEPTIONDESCRIBE method is used to turn exception debug logging on or off. If exception debug logging is on, exception information is printed to the JVM standard output.

Note: By default, JVM standard output is redirected to the SAS log.

Example: Printing Exception Information to Standard Output

In the following example, exception information is printed to the standard output.

```
/* Java code */
public class a
   {
      public void m() throws NullPointerException
      {
         throw new NullPointerException();
      }
   }

/* DATA step code */
data _null_;
   length e 8;
   dcl javaobj j('a');
   j.exceptiondescribe(1);
   rc = j.callvoidmethod('m');
run;
```

The following lines are written to the SAS log:

```
java.lang.NullPointerException
     at a.m(a.java:5)
```

See Also

Methods:

- "EXCEPTIONCHECK Method" on page 116
- "EXCEPTIONCLEAR Method" on page 117

FLUSHJAVAOUTPUT Method

Specifies that the Java output is sent to its destination.

Category: Output

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**FLUSHJAVAOUTPUT**( );

Arguments

object
specifies the name of the Java object.

Details

Java output that is directed to the SAS log is flushed when the DATA step terminates. If you use the FLUSHJAVAOUTPUT method, the Java output will appear after any output that was issued while the DATA step was running.

Example: Displaying Java Output

In the following example, the "In Java class" lines are written after the DATA step is complete.

```
/* Java code */
 public class p
{
  void p()
     {
        System.out.println("In Java class");
     }
}
```

```
/* DATA step code */
data _null_;
   dcl javaobj j('p');
   do i = 1 to 3;
        j.callVoidMethod('p');
        put 'In DATA Step';
   end;
run;
```

The following lines are written to the SAS log:

```
In DATA Step
In DATA Step
In DATA Step
In Java class
In Java class
In Java class
```

If you use the FLUSHJAVAOUTPUT method, the Java output is written to the SAS log in the order of execution.

```
/* DATA step code */
data _null_;
   dcl javaobj j('p');
   do i = 1 to 3;
        j.callVoidMethod('p');
        j.flushJavaOutput();
        put 'In DATA Step';
   end;
run;
```

The following lines are written to the SAS log:

```
In Java class
In DATA Step
```

```
In Java class
In DATA Step
In Java class
In DATA Step
```

See Also

"Java Standard Output" on page 26

GET*type*FIELD Method

Returns the value of a non-static field for a Java object.

Category: Field Reference

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**GET***type***FIELD** ("*field-name*", *value*);

Arguments

object
specifies the name of a Java object.

type
specifies the type for the Java field. The type can be one of the following values:

BOOLEAN
specifies that the field type is BOOLEAN.

BYTE
specifies that the field type is BYTE.

CHAR
specifies that the field type is CHAR.

DOUBLE
specifies that the field type is DOUBLE.

FLOAT
specifies that the field type is FLOAT.

INT
specifies that the field type is INT.

LONG
specifies that the field type is LONG.

SHORT
specifies that the field type is SHORT.

STRING
specifies that the field type is STRING.

See "Type Issues" on page 21

field-name
specifies the Java field name.

Requirement The field name must be enclosed in either single or double quotation marks.

value
specifies the name of the variable that receives the returned field value.

Details

Once you instantiate a Java object, you can access and modify its public fields through method calls on the Java object. The GET*type*FIELD method enables you to access non-static fields.

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see "Type Issues" on page 21.

Comparisons

The GET*type*FIELD method returns the value of a non-static field for a Java object. To return the value of a static field, use the GETSTATIC*type*FIELD method.

Example: Retrieving the Value of a Non-Static Field

The following example creates a simple class that contains three non-static fields. The Java object **j** is instantiated, and then the field values are modified and retrieved using the GET*type*FIELD method.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class ttest
{
   public int i;
   public double d;
   public string s;
}
}
```

```
/*  DATA step code */
data _null_;
   dcl javaobj j("ttest");
   length val 8;
   length str $20;
   j.setIntField("i", 100);
   j.setDoubleField("d", 3.14159);
   j.setStringField("s", "abc");
   j.getIntField("i", val);
   put val=;
   j.getDoubleField("d", val);
   put val=;
   j.getStringField("s", str);
   put str=;
run;
```

The following lines are written to the SAS log:

```
val=100
```

```
val=3.14159
str=abc
```

See Also

Methods:

- "GETSTATICtypeFIELD Method" on page 124
- "SETtypeFIELD Method" on page 127

GETSTATIC*type*FIELD Method

Returns the value of a static field for a Java object.

Category: Field Reference

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**GETSTATIC***type***FIELD** ("*field-name*", *value*);

Arguments

object
specifies the name of a Java object.

type
specifies the type for the Java field. The type can be one of the following values:

BOOLEAN
specifies that the field type is BOOLEAN.

BYTE
specifies that the field type is BYTE.

CHAR
specifies that the field type is CHAR.

DOUBLE
specifies that the field type is DOUBLE.

FLOAT
specifies that the field type is FLOAT.

INT
specifies that the field type is INT.

LONG
specifies that the field type is LONG.

SHORT
specifies that the field type is SHORT.

STRING
specifies that the field type is STRING.

See "Type Issues" on page 21

field-name
specifies the Java field name.

Requirement The field name must be enclosed in either single or double quotation marks.

value
specifies the name of the variable that receives the returned field value.

Details

Once you instantiate a Java object, you can access and modify its public fields through method calls on the Java object. The GETSTATIC*type*FIELD method enables you to access static fields.

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see"Type Issues" on page 21.

Comparisons

The GETSTATIC*type*FIELD method returns the value of a static field for a Java object. To return the value of a non-static field, use the GET*type*FIELD method.

Example: Retrieving the Value of a Static Field

The following example creates a simple class that contains three static fields. The Java object **j** is instantiated, and then the field values are set and retrieved using the GETSTATIC*type*FIELD method.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class ttest
{
   public int i;
   public double d;
   public string s;
}
}
```

```
/*  DATA step code */
data _null_;
   dcl javaobj j("ttest");
   length val 8;
   length str $20;
   j.setStaticIntField("i", 100);
   j.setStaticDoubleField("d", 3.14159);
   j.setStaticStringField("s", "abc");
   j.getStaticIntField("i", val);
   put val=;
   j.getStaticDoubleField("d", val);
   put val=;
   j.getStaticStringField("s", str);
   put str=;
run;
```

The following lines are written to the SAS log:

```
val=100
val=3.14159
str=abc
```

See Also

Methods:

- "GETtypeFIELD Method" on page 122
- "SETSTATICtypeFIELD Method" on page 130

NEW Operator, Java Object

Creates an instance of a Java object.

Valid in: DATA step

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object-reference = **_NEW_ JAVAOBJ** ("*java-class*", <*argument-1*, …*argument-n*>);

Arguments

object-reference
specifies the object reference name for the Java object.

java-class
specifies the name of the Java class to be instantiated.

Requirement The Java class name must be enclosed in either single or double quotation marks.

argument
specifies the information that is used to create an instance of the Java object. Valid values for *argument* depend on the Java object.

Details

To use a DATA step component object in your SAS program, you must declare and create (instantiate) the object. The DATA step component interface provides a mechanism for accessing the predefined component objects from within the DATA step.

If you use the _NEW_ operator to instantiate the Java object, you must first use the DECLARE statement to declare the Java object. For example, in the following lines of code, the DECLARE statement tells SAS that the object reference J is a Java object. The _NEW_ operator creates the Java object and assigns it to the object reference J.

```
declare javaobj j;
j = _new_ javaobj("somejavaclass" );
```

Note: You can use the DECLARE statement to declare and instantiate a Java object in one step.

A constructor is a method that is used to instantiate a component object and to initialize the component object data. For example, in the following lines of code, the _NEW_ operator instantiates a Java object and assigns it to the object reference J. Note that the only required argument for a Java object constructor is the name of the Java class to be instantiated. All other arguments are constructor arguments for the Java class itself. In the following example, the Java class name, **testjavaclass**, is the constructor, and the values **100** and **.8** are constructor arguments.

```
declare javaobj j;
j = _new_ javaobj("testjavaclass", 100, .8);
```

For more information about the predefined DATA step component objects and constructors, see "Introduction to DATA Step Component Objects" on page 2.

Comparisons

You can use the DECLARE statement and the _NEW_ operator, or the DECLARE statement alone to declare and instantiate an instance of a Java object.

Example: Using the _NEW_ Operator to Instantiate and Initialize a Java Class

In the following example, a Java class is created for a hash table. The _NEW_ operator is used to create and instantiate an instance of this class by specifying the capacity and load factor. In this example, a wrapper class, **mhash**, is necessary because the DATA step's only numeric type is equivalent to the Java type DOUBLE.

```
/* Java code */
import java.util.*;
public class mhash extends Hashtable;
{
   mhash (double size, double load)
      {
         super ((int)size, (float)load);
      }
}

/* DATA step code */
data _null_;
   declare javaobj h;
   h = _new_ javaobj("mhash", 100, .8);
run;
```

See Also

Statements:

- "DECLARE Statement, Java Object" on page 113

SET*type*FIELD Method

Modifies the value of a non-static field for a Java object.

Category: Field Reference

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**SET***type***FIELD** ("*field-name*", *value*);

Arguments

object
specifies the name of a Java object.

type
specifies the type for the Java field. The type can be one of the following values:

BOOLEAN
specifies that the field type is BOOLEAN.

BYTE
specifies that the field type is BYTE.

CHAR
specifies that the field type is CHAR.

DOUBLE
specifies that the field type is DOUBLE.

FLOAT
specifies that the field type is FLOAT.

INT
specifies that the field type is INT.

LONG
specifies that the field type is LONG.

SHORT
specifies that the field type is SHORT.

STRING
specifies that the field type is STRING.

See "Type Issues" on page 21

field-name
specifies the Java field name.

Requirement The field name must be enclosed in either single or double quotation marks.

value
specifies the value for the field.

Details

Once you instantiate a Java object, you can access and modify its public fields through method calls on the Java object. The SET*type*FIELD method enables you to modify non-static fields.

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see "Type Issues" on page 21.

Comparisons

The SET*type*FIELD method modifies the value of a non-static field for a Java object. To modify the value of a static field, use the SETSTATIC*type*FIELD method.

Example: Creating a Java Class with Non-Static Fields

The following example creates a simple class that contains three non-static fields. The Java object **j** is instantiated, the field values are set using the SET*type*FIELD method, and then the field values are retrieved.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class ttest
{
   public int i;
   public double d;
   public string s;
}
}
```

```
/*  DATA step code */
data _null_;
   dcl javaobj j("ttest");
   length val 8;
   length str $20;
   j.setIntField("i", 100);
   j.setDoubleField("d", 3.14159);
   j.setStringField("s", "abc");
   j.getIntField("i", val);
   put val=;
   j.getDoubleField("d", val);
   put val=;
   j.getStringField("s", str);
   put str=;
run;
```

The following lines are written to the SAS log:

```
val=100
val=3.14159
str=abc
```

See Also

Methods:

- "GETtypeFIELD Method" on page 122
- "SETSTATICtypeFIELD Method" on page 130

SETSTATIC*type*FIELD Method

Modifies the value of a static field for a Java object.

Category: Field Reference

Applies to: Java object

Restriction: This method is not supported on the CAS server.

Syntax

object.**SETSTATIC***type***FIELD** ("*field-name*", *value*);

Arguments

object
specifies the name of a Java object.

type
specifies the type for the Java field. The type can be one of the following values:

BOOLEAN
specifies that the field type is BOOLEAN.

BYTE
specifies that the field type is BYTE.

CHAR
specifies that the field type is CHAR.

DOUBLE
specifies that the field type is DOUBLE.

FLOAT
specifies that the field type is FLOAT.

INT
specifies that the field type is INT.

LONG
specifies that the field type is LONG.

SHORT
specifies that the field type is SHORT.

STRING
specifies that the field type is STRING.

See "Type Issues" on page 21

field-name
specifies the Java field name.

Requirement The field name must be enclosed in either single or double quotation marks.

value
specifies the value for the field.

Details

Once you instantiate a Java object, you can access and modify its public fields through method calls on the Java object. The SETSTATIC*type*FIELD method enables you to modify static fields.

Note: The *type* argument represents a Java data type. For more information about how Java data types relate to SAS data types, see "Type Issues" on page 21.

Comparisons

The SETSTATIC*type*FIELD method modifies the value of a static field for a Java object. To modify the value of a non-static field, use the SET*type*FIELD method.

Example: Creating a Java Class with Static Fields

The following example creates a simple class that contains three static fields. The Java object **j** is instantiated, the field values are set using the SETSTATIC*type*FIELD method, and then the field values are retrieved.

```
/* Java code */
import java.util.*;
import java.lang.*;
public class ttestc
{
   public static double d;
   public static double dm()
   {
      return d;
   }
}
```

```
/*  DATA step code */
data _null_;
   dcl javaobj j("ttest");
   length val 8;
   length str $20;
   j.setStaticIntField("i", 100);
   j.setStaticDoubleField("d", 3.14159);
   j.setStaticStringField("s", "abc");
   j.getStaticIntField("i", val);
   put val=;
   j.getStaticDoubleField("d", val);
   put val=;
   j.getStaticStringField("s", str);
   put str=;
run;
```

The following lines are written to the SAS log:

```
val=100
val=3.14159
str=abc
```

See Also

Methods:

- "GETSTATICtypeFIELD Method" on page 124
- "SETtypeFIELD Method" on page 127

Recommended Reading

Here is the recommended reading list for this title:

- *SAS Viya Data Set Options: Reference*
- *SAS Hash Object Programming Made Easy*
- *SAS Viya Statements: Reference*

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