Oracle

Sales Cloud

Groovy Scripting Reference

Release 12

Sales Cloud Groovy Scripting Reference for Oracle Sales Cloud

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Contents

Preface

This document explains how to use the Groovy scripting language to enhance your CRM Application Composer applications.

Audience

This document is intended for application developers that are new to Groovy scripting.

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Conventions

The following text conventions are used in this document:

Table 1: Conventions Used in this Document

This table summarizes conventions used in this document.

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

1 Introduction

Terminology

Throughout the document the term *script* is used to describe one or more lines of Groovy code that the Oracle ADF framework executes at runtime. Often a very-short script is all that is required. For example, to validate that a `CommissionPercentage` field's value does not exceed 40%, you might use a one-line script like:

```
return CommissionPercentage < 0.40
```

In fact, this one-liner can be conveniently shortened by dropping the `return` keyword since the `return` keyword is always implied on the last line of a script:

```
CommissionPercentage < 0.40
```

For slightly more complicated logic, your script might require some conditional handling. For example, suppose the maximum commission percentage is 40% if the salesperson's job grade is less than or equal to 3, but 60% if the job grade is higher. Your script would grow a little to look like this:

```
if (JobGrade <= 3) {
  return CommissionPercentage < 0.40
}
else {
  return CommissionPercentage < 0.60
}
```

Scripts that you'll write for other purposes like complex validation rules or reusable functions may span multiple pages, depending on your needs.

When a context requiring a Groovy script will typically use a short (often, one-line) script, we emphasize that fact by calling it an *expression*, however technically the terms *script* and *expression* are interchangeable. Anywhere you can provide a one-line expression is also a valid context for providing a multi-line script if the need arises. Whether you provide a short expression or a multi-line script, the syntax and features at your disposal are the same. You need only pay attention that your code returns a value of the appropriate type for the context in which you use it. Each section below highlights the expected return type for the script in question.

Where You'll Use Groovy in Your Application

There are a number of different contexts where you will use Groovy scripts as you customize existing objects or create new custom ones. You will write shorter scripts to provide an expression to:

- calculate a custom formula field's value
- calculate a custom field's default value

- make a custom field conditionally updateable, or
- make a custom field conditionally required
- define the condition for executing an object workflow

You will generally write somewhat longer scripts to define:

- a field-level validation rule
- an object-level validation rule
- a trigger to complement default processing
- utility code in a global function, or
- reusable behavior in an object function

If you anticipate calling the same code from multiple different contexts, any of your scripts can call the reusable code you write in either global functions or object functions. As their name implies, global functions can be called from scripts in any object or from other global functions. Object functions can be called by any scripts in the same object, or even triggered by a button in the user interface.

After exploring the Groovy basic techniques needed to understand the examples, see Examples of Each Context Where You Can Use Groovy for a concrete example of each of these usages, and Groovy Tips and Techniques for additional tips and techniques on getting the most out of Groovy in your application.

2 Groovy Basics

Commenting Your Scripts

It is important that you document your scripts so that you and your colleagues who might view the code months from now will remember what the logic is doing. You can use either a double-slash combination `//` which makes the rest of the current line a comment, or you can use the open-comment and close-comment combination of `/*` followed later by `*/`. The latter style can span multiple lines.

Here is an example of both styles in action:

```
// Loop over the names in the list
for (name in listOfNames) {
  /*
   * Update the location for the current name.
   * If the name passed in does not exist, will result in a no-op
   */
  adf.util.updateLocationFor(name,      // name of contact
                             'Default', /* location style */
                             )
}
```

When using multi-line comments, it is illegal for a nested /* ... */ comment to appear inside of another one. So, for example, the following is not allowed:

```
// Nested, multi-line comment below is not legal
def interest = 0
/*
  18-MAY-2001 (smuench) Temporarily commented out calculation!

  /*
   * Interest Accrual Calculation Here
   */
   interest = complexInterestCalculation()
*/
```

Instead, you can comment out an existing multi-line block like this:

```
// Nested, multi-line comment below is legal
def interest = 0
//
// 18-MAY-2001 (smuench) Temporarily commented out calculation!
//
//  /*
//   * Interest Accrual Calculation Here
//   */
//   interest = complexInterestCalculation()
//
```

Or, alternatively had your initial code used the `//` style of comments, the following is also legal:

```
// Nested, multi-line comment below is not legal
def interest = 0
/*
  18-MAY-2001 (smuench) Temporarily commented out calculation!

  //
  // Interest Accrual Calculation Here
  //
  interest = complexInterestCalculation()
*/
```

The most common style-guide for comments would suggest to use multi-line comments at the beginning of the script, and single-line comments on subsequent lines. This allows you to most easily comment out code for debugging purposes. Thus, you typical script would look like this:

```
/*
 * Object validation rule for BankAccount
 *
 * Ensures that account is not overdrawn
 */
def balance = CurrentBalance_c
// Use an object function to calculate uncleared charges
def unclearedCharges = unclearedChargesAmountForAccount()
// Perform some other complicated processing
performComplicatedProcessing()
// return true if the account is not overdrawn
return balance > unclearedCharges
```

Defining Variables

Groovy is a dynamic language, so variables in your scripts can be typed dynamically using the `def` keyword as follows:

```
// Assign the number 10 to a variable named "counter"
def counter = 10

// Assign the string "Hello" to a variable named "salutation"
def salutation = 'Hello'

// Assign the current date and time to a variable named "currentTime"
def currentTime = now()
```

Using the `def` keyword you can define a local variable of the right type to store *any* kind of value, not only the three examples above. Alternatively you can declare a specific type for variables to make your intention more explicit in the code. For example, the above could be written like this instead:

```
// Assign the number 10 to a variable of type Integer named "counter"
Integer counter = 10

// Assign the string "Hello" to a variable named "salutation"
String salutation = 'Hello'

// Assign the current date and time to a variable named "currentTime"
```

```
Date currentTime = now()
```

Note:

You can generally choose to use the `def` keyword or to use a specific type for your variables according to your own preference, however when working with ADF objects you must to use the `def` keyword to define a variable to hold them. See the tip in Using Substitution Expressions in Strings below for more information.

Referencing the Value of a Field in the Current Object

When writing scripts that execute in the context of the current business object, you can reference the value of any field in the current object by simply using its API name. This includes all of the following contexts:

- object validation rules
- field-level validation rules
- formula field expressions
- custom field conditionally updateable expressions
- custom field conditionally required expressions
- object triggers
- field triggers
- object functions, and
- conditions for executing an object workflow

The API name of custom fields that you have added to a standard object will be suffixed with `_c` to distinguish them from standard field names. So, for example to write a script that references the value of a standard field named `ContactPhoneNumber` and a custom field named `ContactTwitterName`, you would use the following code:

```
// Assign value of standard field "ContactPhoneNumber" to "phone" var
def phone = ContactPhoneNumber

// Assign value of custom field "ContactTwitterName" to "twitterName" var
def twitterName = ContactTwitterName_c

// Assemble text fragment by concatenating static text and variables
def textFragment = 'We will try to call you at ' + phone +
                   ' or send you a tweet at ' + twitterName
```

Defining a local variable to hold the value of a field is a good practice if you will be referencing its value more than once in your code. If you only need to use it once, you can directly reference a field's name without defining a local variable for it, like this:

```
def textFragment = 'We will try to call you at ' + ContactPhoneNumber +
                   ' or send you a tweet at ' + ContactTwitterName_c
```

Note:

When referencing a field value multiple times, you can generally choose to use or not to use a local variable according to your own preference, however when working with an ADF `RowIterator` object, you must to use the `def` keyword to define a variable to hold it. See the tip in the Using Substitution Expressions in Strings for more information.

Working with Numbers, Dates, and Strings

Groovy makes it easy to work with numbers, dates and strings. You can use the normal `+` and `-` operators to do date, number, and string arithmetic like this:

```
// Assign a date three days after the CreatedDate
def targetDate = CreatedDate + 3

// Assign a date one week (seven days) before the value
// of the custom SubmittedDate field
def earliestAcceptedDate = SubmittedDate_c - 7

// Increase an employee's custom Salary field value by 100 dollars
setAttribute('Salary_c', Salary_c + 100)

// Decrement an salesman's commission field value by 100 dollars
setAttribute('Commission_c', Commission_c - 100)

// Subtract (i.e. remove) any "@"-sign that might be present
// in the contact's twitter name
def twitNameWithoutAtSign = ContactTwitterName_c - '@'

// Add the value of the twitter name to the message
def message = 'Follow this user on Twitter at @' + twitNameWithoutAtSign
```

Using Substitution Expressions in Strings

Groovy supports using two kinds of string literals, normal strings and strings with substitution expressions. To define a normal string literal, use single quotes to surround the contents like this:

```
// These are normal strings
def name = 'Steve'
def confirmation = '2 message(s) sent to ' + name
```

To define a string with substitution expressions, use double-quotes to surround the contents. The string value can contain any number of embedded expressions using the `${expression}` syntax. For example, you could write:

```
// The confirmation variable is a string with substitution expressions
def name = 'Steve'
def numMessages = 2
def confirmation = "${numMessages} message(s) sent to ${name}"
```

Executing the code above will end up assigning the value **2 messages(s) sent to Steve** to the variable named confirmation. It does no harm to use double-quotes all the time, however if your string literal contains no substitution expressions it is slightly more efficient to use the normal string with single-quotes.

Tip:

As a rule of thumb, use normal (single-quoted) strings as your default kind of string, unless you require the substitution expressions in the string.

Using Conditional Expressions

When you need to perform the conditional logic, you use the familiar `if`/`else` construct. For example, in the text fragment example in the previous section, if the current object's `ContactTwitterName_c` returns `null`, then you won't want to include the static text related to a twitter name. You can accomplish this conditional text inclusion using `if`/`else` like this:

```
def textFragment = 'We will try to call you at ' + ContactPhoneNumber
if (ContactTwitterName_c != null) {
  textFragment += ', or send you a tweet at '+ContactTwitterName_c
}
else {
  textFragment += '. Give us your twitter name to get a tweet'
}
textFragment += '.'
```

While sometimes the traditional `if`/`else` block is more easy to read, in other cases it can be quite verbose. Consider an example where you want to define an `emailToUse` variable whose value depends on whether the `EmailAddress` custom field ends with a `.gov` suffix. If the primary email ends with `.gov`, then you want to use the `AlternateEmailAddress` instead. Using the traditional `if`/`else` block your script would look like this:

```
// Define emailToUse variable whose value is conditionally
// assigned. If the primary email address contains a '.gov'
// domain, then use the alternate email, otherwise use the
// primary email.
def emailToUse
if (endsWith(EmailAddress_c,'.gov') {
  emailToUse = AlternateEmailAddress_c
}
else {
  emailToUse = EmailAddress_c
}
```

Using Groovy's handy inline `if`/`then`/`else` operator, you can write the same code in a lot fewer lines:

```
def emailToUse = endsWith(EmailAddress_c,'.gov') ? AlternateEmailAddress_c : EmailAddress_c
```

The inline `if`/`then`/`else` operator has the following general syntax:

`BooleanExpression ?If_True_Use_This_Expression :If_False_Use_This_Expression`

Using the Switch Statement

If the expression on which your conditional logic depends may take on many different values, and for each different value you'd like a different block of code to execute, use the `switch` statement to simplify the task. As shown in the example below, the expression passed as the single argument to the `switch` statement is compared with the value in each `case` block. The code inside the first matching `case` block will execute. Notice the use of the `break` statement inside of each `case` block. Failure to include this `break` statement results in the execution of code from subsequent `case` blocks, which will typically lead to bugs in your application.

Notice, further, that in addition to using a specific value like `'A'` or `'B'` you can also use a range of values like `'C'..'P'` or a list of values like `['Q','X','Z']`. The `switch` expression is not restricted to being a string as is used in this example; it can be any object type.

```
def logMsg
def maxDiscount = 0
// warehouse code is first letter of product SKU
// uppercase the letter before using it in switch
def warehouseCode = upperCase(left(SKU_c,1))
// Switch on warehouseCode to invoke appropriate
// object function to calculate max discount
switch (warehouseCode) {
  case 'A':
    maxDiscount = Warehouse_A_Discount()
    logMsg = "Used warehouse A calculation"
    break
  case 'B':
    maxDiscount = Warehouse_B_Discount()
    logMsg = "Used warehouse B calculation"
  case 'C'..'P':
    maxDiscount = Warehouse_C_through__P_Discount()
    logMsg = "Used warehouse C-through-P calculation"
    break
  case ['Q','X','Z']:
    maxDiscount = Warehouse_Q_X_Z_Discount()
    logMsg = "Used warehouse Q-X-Z calculation"
    break
  default:
    maxDiscount = Default_Discount()
    logMsg = "Used default max discount"
}
adf.util.log(logMsg+' ['+maxDiscount+']')
// return expression that will be true when rule is valid
return Discount_c == null || Discount_c <= maxDiscount
```

Returning a Boolean Result

Several different contexts in ADF runtime expect your groovy script to return a boolean true or false result. These include:

- custom field's conditionally updateable expressions
- custom field's conditionally required expressions
- object-level validation rules
- field-level validation rules
- conditions for executing an object workflow

Groovy makes this easy. One approach is to use the groovy `true` and `false` keywords to indicate your return as in the following example:

```
// Return true if value of the Commission custom field is greater than 1000
if (Commission_c > 1000) {
  return true
}
else {
  return false
}
```

However, since the expression `Commission_c > 1000` being tested above in the `if` statement is *itself* a boolean-valued expression, you can write the above logic in a more concise way by simply returning the expression itself like this:

```
return Commission_c > 1000
```

Furthermore, since Groovy will implicitly change the last statement in your code to be a `return`, you could even remove the `return` keyword and just say:

```
Commission_c > 1000
```

This is especially convenient for simple comparisons that are the only statement in a validation rule, conditionally updateable expression, conditionally required expression, formula expression, or the condition to execute an object workflow.

Assigning a Value to a Field in the Current Object

The most logical way to assign the value of a field would be to using the groovy assignment operator like this:

```
// Logical, but incorrect, way to assign the value "steve"
// to a custom field named ContactTwitterName in the current object
ContactTwitterName_c = 'steve'
```

However, since it is easy for you to inadvertently substitute the assignment operator `=` with the equals operator `==` ADF requires that your Groovy scripts explicitly use the `setAttribute()` function to avoid any accidental assignments from being silently performed without your knowledge. It has the following syntax:

```
// Correct way to assign the value "steve" to a custom field
// named ContactTwitterName in the current object
setAttribute('ContactTwitterName_c', 'steve')
```

Notice above that the second argument `'steve'` passed to `setAttribute()` is a literal string, so it requires the single quotes around it. However, if the value to be assigned to the field is a literal number, or a groovy expression, or a value that is already stored in a variable `myNewVal` then the second argument to `setAttribute()` does not require any quotes like this:

```
// Correct way to assign the value 3 to a custom field
// named ContactNumberOfChildren in the current object
setAttribute('ContactNumberOfChildren_c', 3)
```

```
// Correct way to assign the value "one year from today's date"
// to a custom field ContactCallbackDate in the current object
setAttribute('ContactCallbackDate_c', today() + 365)

// Correct way to assign the value in the variable myNewVal
// to a custom field ContactNumberOfChildren in the current object
def myNewVal = /* compute new number of children value here */
setAttribute('ContactNumberOfChildren_c', myNewVal)
```

Notice that the *name* of the field whose value you want to assign is passed as a literal string (enclosed in quotes). Failure to enclose the value in quotes will result in either an error or unexpected functionality. For example, if you did the following:

```
// Incorrect way to assign the value "steve" to a custom field
// named ContactTwitterName in the current object.
// The name of the field is not being passed as a literal string
setAttribute( ContactTwitterName_c, 'steve')
```

Using this incorrect syntax, at runtime, ADF will evaluate the value of the `ContactTwitterName` custom field and use its *value* as the name of the field to assign. So, as a silly example, if the `ContactTwitterName` field currently had the value "*NoComment*", then ADF would attempt to assign the value "*steve*" to the field in the current object named `NoComment`. If there were such a field, its value will be assigned without error. If no such field exists, then a runtime exception will be thrown.

Tip:

See Avoiding Validation Threshold Errors By Conditionally Assigning Values for a tip about how to avoid your field assignments from causing an object to hit its validation threshold.

Writing Null-Aware Expressions

When writing your scripts, be aware that field values can be `null`. You can use the `nvl()` null value function to easily define a value to use instead of `null` as part of any script expressions you use. Consider the following examples:

```
// Assign a date three days after the PostedDate
// Use the current date instead of the PostedDate if the
// PostedDate is null
def targetDate = nvl(PostedDate_c,now()) + 3

// Increase an employee's custom Salary field value by 10 percent
// Use zero if current Salary is null
setAttribute('Salary_c', nvl(Salary_c,0) * 1.1)
```

Understanding Null Versus the Empty String

In Groovy, there is a subtle difference between a variable whose value is `null` and a variable whose value is the empty string. The value `null` represents the absence of any object, while the empty string is an object of type `String` with zero characters. If you try to compare the two, they are not the same. For example, any code inside the following conditional block will not execute because the value of `varA` (null) does not equals the value of `varB` (the empty string).

```
def varA = null
def varB = "" /* The empty string */
if (varA == varB) {
  // Do something here when varA equals varB
}
```

Another common gotcha related to this subtle difference is that trying to compare a variable to the empty string does *not* test whether it is `null`. For example, the code inside the following conditional block will execute (and cause a `NullPointerException` at runtime) because the `null` value of `varA` is not equal to the empty string:

```
def varA = null
if (varA != "") {
  // set varB to the first character in varA
  def varB = varA.charAt(0)
}
```

To test whether a string variable is neither `null` nor empty, you *could* explicitly write out both conditions like this:

```
if (varA != null && varA != "") {
  // Do something when varA is neither null nor empty
}
```

However, Groovy provides an even simpler way. Since both `null` and the empty string evaluate to `false` when interpreted as a boolean, you can use the following instead:

```
if (varA) {
  // Do something when varA has a non-null and non-empty value
}
```

If `varA` is `null`, the condition block is skipped. The same will occur if `varA` is equal to the empty string because either condition will evaluate to boolean `false`. This more compact syntax is the recommended approach.

Understanding Secondary Fields Related to a Lookup

A lookup field represents a many-to-1 foreign key reference between one object and a another object of the same or different type. For example, a `TroubleTicket` object might have a lookup field named `Contact` that represents a foreign key reference to the specific `Contact` object that reported the trouble ticket. When defining a lookup field, you specify a primary display field name from the reference object. For example, while defining the `Contact` lookup field referencing the `Contact` object, you might specify the *Contact Name* field.

When you define a lookup field like `Contact`, you get one primary field and two secondary fields:

- **The Lookup Field**

  This primary field is named `Contact_c` and it holds the value of the primary display field related to the referenced object, for example the name of the related contact.

- **The Foreign Key Field**

  This secondary field is named `Contact_Id_c` and it holds the value of the primary key of the reference contact.

- **The Related Object Accessor Field**

  This secondary field is named `Contact_Obj_c` and it allows you to programmatically access the related contact object in script code

To access other fields on the related object, you can use the related object accessor field like this:

```
// Assume script runs in context of TroubleTicket object
def contactEmail = Contact_Obj_c?.EmailAddress_c
```

To change which contact the `TroubleTicket` is related to, you can set a new contact by using one of the following techniques. If you know the primary key value of the new contact, then use this approach:

```
// Assume script runs in context of TroubleTicket object
def newId = /* ... Get the Id of the New Contact Here */
setAttribute('Contact_Id_c', newId)
```

If you know the value of the contact's primary display field, then use this approach instead:

```
// Assume script runs in context of TroubleTicket object
setAttribute('Contact_c', 'James Smith')
```

Using Groovy's Safe Navigation Operator

If you are using "dot" notation to navigate to reference the value of a related object, you should use Groovy's safe-navigation operator `?.` instead of just using the `.` operator. This will avoid a `NullPointerException` at runtime if the left-hand-side of the operator happens to evaluate to null. For example, consider a `TroubleTicket` object with a lookup field named `AssignedTo` representing the staff member assigned to work on the trouble ticket. Since the `AssignedTo` field may be `null` before the ticket gets assigned, any code referencing fields from the related object should use the safe-navigation operator as shown here:

```
// access related lookup object and access its record name
// Using the ?. operator, if related object is null,
// the expression evaluates to null instead of throwing
// NullPointerException
def assignedToName = AssignedTo_Obj_c?.RecordName
```

Tip:

For more information on why the code here accesses `AssignedTo_Obj_c` instead of a field named `AssignedTo_c`, see Understanding Secondary Fields Related to a Lookup

Assigning a Value to a Field in a Related Object

When using the `setAttribute()` method — see Assigning a Value to a Field in the Current Object — the first argument must be a string that represents the name of a single field in object on which you invoke it. For example, the following is *not* a correct way to use the `setAttribute()` function to set the `Status` field of the parent `TroubleTicket` object for an activity because `TroubleTicket_c?.Status_c` is not the name of a field on the current activity object:

```
// Assume script runs in context of Activity object
// which is a child object of parent TroubleTicket

// INCORRECT way to set a parent field's value
setAttribute('TroubleTicket_c?.Status_c', 'Open')
```

Instead, you must first assign the parent object to a variable, then invoke the `setAttribute()` method on this parent object as shown here:

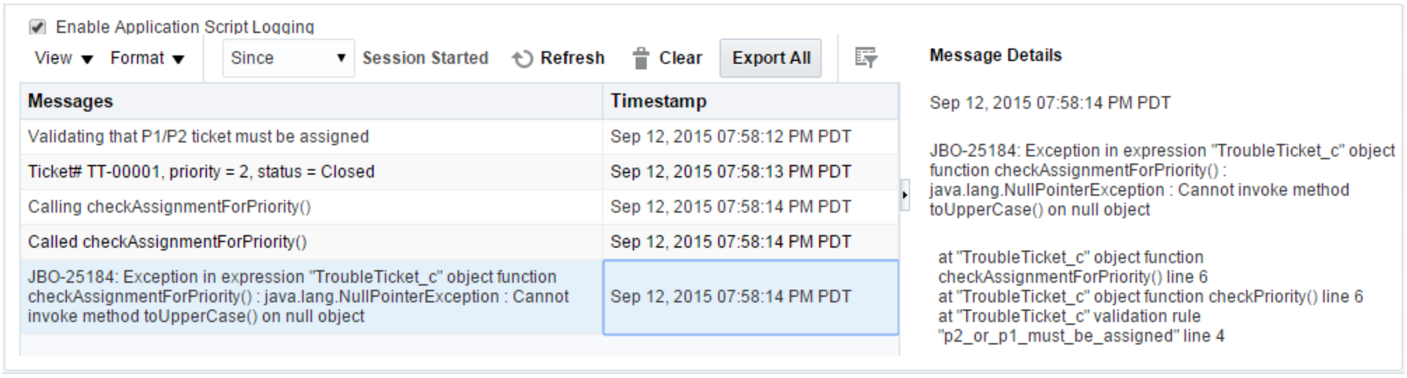
```
// Assume script runs in context of Activity object
// which is a child object of parent TroubleTicket

// First access the parent object
def parentTicket = TroubleTicket_c
// Then call the setAttribute on that parent object
parentTicket?.setAttribute('Status_c', 'Open')
```

Tip:

For more information on accessing related objects see Using the Related Object Accessor Field to Work with a Parent Object and Using the Related Object Accessor Field to Work with a Referenced Object..

Printing and Viewing Diagnostic Messages

To assist with debugging, use the diagnostic log to view the runtime diagnostic messages your scripts have written to the log, as well as any exception stack traces that coding errors have produced at runtime. On entering the diagnostic log viewer, if the *Enable Application Script Logging* check box is checked, then all of the messages from your current session are shown. The diagnostic console toolbar reflects this by showing that you are viewing all messages *Since Session Started*. As shown in the figure below, the messages are shown by default in chronological order and the display is scrolled to view the most recent messages. When an exception has occurred, additional details on the call stack where the error occurred are visible in the *Message Details* panel at the right.


☑ Enable Application Script Logging
View ▾ Format ▾ Since ▾ Session Started Refresh Clear Export All

Messages	Timestamp
Validating that P1/P2 ticket must be assigned	Sep 12, 2015 07:58:12 PM PDT
Ticket# TT-00001, priority = 2, status = Closed	Sep 12, 2015 07:58:13 PM PDT
Calling checkAssignmentForPriority()	Sep 12, 2015 07:58:14 PM PDT
Called checkAssignmentForPriority()	Sep 12, 2015 07:58:14 PM PDT
JBO-25184: Exception in expression "TroubleTicket_c" object function checkAssignmentForPriority() : java.lang.NullPointerException : Cannot invoke method toUpperCase() on null object	Sep 12, 2015 07:58:14 PM PDT

Message Details

Sep 12, 2015 07:58:14 PM PDT

```
JBO-25184: Exception in expression "TroubleTicket_c" object
function checkAssignmentForPriority() :
java.lang.NullPointerException : Cannot invoke method
toUpperCase() on null object

 at "TroubleTicket_c" object function
 checkAssignmentForPriority() line 6
 at "TroubleTicket_c" object function checkPriority() line 6
 at "TroubleTicket_c" validation rule
 "p2_or_p1_must_be_assigned" line 4
```

Writing Diagnostic Log Messages from Your Scripts

To write messages to the diagnostic log, use the `print` or `println` function. The former writes its value without any newline character, while the latter writes it value along with a newline. For example:

```
// Write a diagnostic message to the log. Notice how
// convenient string substitution expressions are
println("Status = ${Status_c}")
```

In this release, the diagnostic messages in the log are not identified by context, so it can be helpful to include information in the printed diagnostic messages to identify what code was executing when the diagnostic message was written. For example:

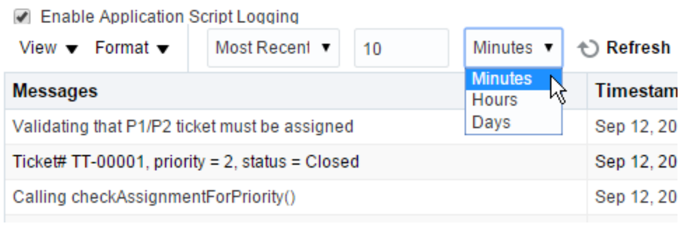
```
// Write a diagnostic message to the log, including info about the context
println("[In: BeforeInsert] Status = ${Status_c}")
```

Clearing the Diagnostic Log Message Viewer

While you are debugging your code, it can be handy to clear the log message display before repeating a test so that only the most recent log messages appear in the console. To do this, click the *Clear* button in the toolbar. The diagnostic console toolbar reflects your action by showing that you are viewing all messages *Since Log Cleared*.

Viewing the Most Recent Messages by Minute, Hour, or Day

To view the messages that have occurred in the last several minutes, hours, or days, change the diagnostic console toolbar selector from the value *Since* to the value *Most Recent* as shown in the figure below. Choose a time unit from the list among *Minutes*, *Hours* or *Days*. Type in a number of time units into the field between the two selection lists. For example, if you want to see the messages for the last 10 minutes, type in the number `10` with the time unit selector set to *Minutes*. Finally, click the *Refresh* button to view the most recent messages in the new time span.



Messages	Timestam
Validating that P1/P2 ticket must be assigned	Sep 12, 20
Ticket# TT-00001, priority = 2, status = Closed	Sep 12, 20
Calling checkAssignmentForPriority()	Sep 12, 20

Working with Lists

A list is an ordered collection of objects. You can create list of objects using Groovy's square-bracket notation and a comma separating each list element like this:

```
// Define a list of numbers
def list = [101, 334, 1208, 20]
```

Of course, the list can be of strings as well:

```
// Define a list of strings
def names = ['Steve','Paul','Jane','Josie']
```

If needed, the list can contain objects of any type, including a heterogeneous set of object types, for example a mix of strings and numbers.

To refer to a specific element in the list, use the square brackets with an integer argument like this.

```
// Store the third name in the list in a variable
def thirdName = names[2] // zero based index!
```

Remember that the list is zero-based so `list[0]` is the first element of the list and `list[5]` is the six element. Of course you can also pass a variable as the value of the operand like this:

```
for (j in 2..3) {
  def curName = names[j]
  // do something with curName value here
}
```

To update a specific list item's value, you can use the combination of the subscript and the assignment operator:

```
names[2] = 'John'
```

To add an entry to the end of the list, use the `add()` method:

```
names.add('Ringo')
```

A list can contain duplicates, so if you write code like the following, then the string `Ringo` will be added twice to the list:

```
// This will add 'Ringo' twice to the list!
names.add('Ringo')
names.add('Ringo')
```

To test if an entry already exists in the list, use the `contains()` function. This way, you can ensure that you don't add the same item twice if duplicates are not desirable for your purposes:

```
// The exclamation point is the "not" operator, so this
// first checks if the 'names' list does NOT contain 'Ringo' before
// adding it to the list
```

```
if (!names.contains('Ringo')) {
  names.add('Ringo')
}
```

To remove an entry from the list, use the `remove()` method.

```
names.remove('Ringo')
```

Note that this only removes the first occurrence of the item in the list, returning a boolean result indicating true if the desired item was found and removed. Therefore, if your list allows duplicates and you need to remove them all, you'll need to write a loop to call `remove()` until it returns false.

You can iterate over the entries in a list using the `for...in` loop like this:

```
// Process each name in the list, returning
// false if any restricted name is encountered
for (name in names) {
  // call a custom global function for each name processed
  if (adf.util.isNameRestricted(name)) {
    return false
  }
}
return true
```

You can define an empty list using the square-bracket notation with nothing inside like this:

```
def foundElements = [] // empty list!
```

Working with Maps

A map is an unordered collection of name/value pairs. The name in each name/value pair is called the map's *key* for that entry since it is the key to looking up the value in the map later. You can create a map using Groovy's square-bracket notation, using a colon to separate each key and value, and a comma between each key/value pair like this:

```
// Define a map of name/value pairs that associate
// a status value (e.g. "Open", "Closed", "Pending") with a
// maximum number of days
def maxDaysByStatus = [Open:30, Closed:90, Pending:45]
```

Notice that by default, the map key is assumed to be a string so you don't need to include the key values in quotes. However, if any key value contains spaces you will need to use quotes around it like this:

```
def maxDaysByStatus = [Open:30, Closed:90, Pending:45, 'On Backorder':10]
```

If you want to use another type as the map key, you need to surround the key with parentheses. Consider the following example without the parentheses:

```
def x = 1
def y = 2
def xvalue = 'One'
def yvalue = 'Two'
// this creates a map with entries ('x'->'One') and ('y'->'Two')
def m = [x:xvalue,y:yvalue]
```

The above example creates a map with key values of the strings `x` and `y`, rather than using the value of the variable *x* and the value of the variable *y* as map keys. To obtain this effect, surround the key expressions with parentheses like this:

```
def x = 1
def y = 2
def xvalue = 'One'
def yvalue = 'Two'
// this creates a map with entries (1->'One') and (2->'Two')
def m = [(x):xvalue,(y):yvalue]
```

This creates a map with key values of the numbers `1` and `2`.

To reference the value of a map entry, use dot notation like this, using the may key value as if it were a field name on the map object:

```
def closedDayLimit = maxDaysByStatus.Closed
```

If the key value contains a literal dot character or contains spaces or special characters, you can also use the square-bracket notation, passing the key value as the operand:

```
def onBackorderDayLimit = maxDaysByStatus['On Backorder']
```

This square bracket notation is also handy if the key value is coming from the value of a variable instead of a literal string, for example:

```
// Loop over a list of statuses to process
for (curStatus in ['Open','On Backorder']) {
  def limitForCurStatus = maxDaysByStatus[curStatus]
  // do something here with the current status' limit
}
```

To add an new key/value pair to the map, use the `put()` method:

```
// Add an additional status to the map
maxDaysByStatus.put('Ringo')
```

A map cannot contain duplicate key entries, so if you use `put()` to put the value of an existing element, the existing value for that key is overwritten. You can use the `containsKey()` function to test whether or not a particular map entry already exists with a given key value, or you can use the `containsValue()` function to test if any map entry exists that has a given value — there might be zero, one, or multiple entries!

```
// Test whether a map key matching the value of the
// curKey variable exists or not
if (maxDaysByStatus.containsKey(curKey)) {
  def dayLimit = maxDaysByStatus[curKey]
  // do something with dayLimit here
}
else {
  println("Unexpected error: key ${curKey} not found in maxDaysByStatusMap!")
}
```

To remove an entry from the map, use the `remove()` method. It returns the value that was previously associated with the key passed in, otherwise it returns null if it did not find the given key value in the map to remove.

```
maxDaysByStatus.remove('On Backorder')
```

You can define an empty map using the square-bracket notation with only a colon inside like this:

```
def foundItemCounts = [:] // empty map!
```

Working with Ranges

Using ranges, you can conveniently creates lists of sequential values. If you need to work with a list of integers from 1 to 100, rather than creating a list with 100 literal numbers in it, you can use the `..` operator to create a range like this:

```
def indexes = 1..100
```

The range is particularly useful in performing iterations over a list of items in combination with a `for` loop like this:

```
def indexes = 1..100
for (j in indexes) {
  // do something with j here
}
```

Of course, you need not assign the range to a variable to use it in a loop, you can use it inline like this:

```
for (j in 1..100) {
  // do something with j here
}
```

3 Examples of Each Context Where You Can Use Groovy

Providing an Expression to Calculate a Custom Formula Field's Value

When you need a calculated field or a transient value-holder field with an optional initial, calculated value, use a formula field.

Read-Only Calculated Fields

A formula field defaults to being a read-only, calculated value. It displays the value resulting from the runtime evaluation of the calculation expression you supply. By using the *Depends On* multi-select list in the field create or edit page, you can configure the names of fields on which your expression depends. By doing this, its calculated value will update dynamically when any of those *Depends On* fields' value changes. The expected return type of the formula field's expression must be compatible with the formula field type you specified (Number, Date, or Text).

For example, consider a custom `TroubleTicket` object. If you add a formula field named `DaysOpen`, you can provide its calculated value with the expression:

```
(today() - CreationDate) as Integer /* truncate to whole number of days */
```

Transient Value Holder Fields with Optional Calculated Initial Value

If you want to allow the end user to override the calculated value, then mark your formula to be updateable. An updateable formula field is a "transient value holder" whose expression provides the value of the field until the user overrides it. If the user overrides the value, the object remembers this user-entered value for the duration of the current transaction so that your validation rules and triggers can reference it. If you have configured one or more *Depends On* fields for your updateable formula field, then note that the value of the formula will revert back to the calculated value should any of the dependent fields' value change. If you want a transient field whose initial value is `null` until the user fills it in, simply provide no formula expression for your updateable formula field to achieve this.

Providing an Expression to Calculate a Custom Field's Default Value

When a new row is created for an object, the value of a custom field defaults to `null` unless you configure a default value for it. You can supply a literal default value of appropriate type or supply an expression to calculate the default value for new rows. The default value expression is evaluated at the time the new row is created. The expected return type of your field's default value expression must be compatible with the field's type (Number, Date, Text, etc.)

For example, consider a custom `CallbackDate` field in a `TroubleTicket` object. If you want the callback back for a new trouble ticket to default to 3 days after it was created, then you can provide a default expression of:

```
CreationDate + 3
```

Providing an Expression to Make a Custom Field Conditionally Updateable

A custom field can be updateable or read-only. By default, any non-formula field is updateable. Alternatively, you can configure a *conditionally updateable expression*. If you do this, it is evaluated each time a page displaying the field is rendered or refreshed. The expected return type the expression is `boolean`. If you define one for a field, you must also configure the *Depends On* list to indicate the names of any fields on which your conditionally updateable expression depends. By doing this, your conditionally updateable field will interactively enable or disable as appropriate when the user changes the values of fields on which the conditionally updateable expression depends.

For example, consider a custom `TroubleTicket` object with `Status` and `Justification` fields. Assume you want to prevent a user from editing the justification of a closed trouble ticket. To achieve this, configure the conditionally updateable expression for the `Justification` field as follows:

```
Status_c != 'Closed'
```

After configuring this expression, you must then indicate that the `Justification` field depends on the `Status` field as described in Understanding Automatic Dependency Information for Cascading Fixed-Choice Lists.. This ensures that if a trouble ticket is closed during the current transaction, or if a closed trouble ticket is reopened, that the `Justification` field becomes enable or disabled as appropriate.

Tip:

A field configured with a conditionally updateable expression only enforces the conditional updateability through the web user interface in this release. See Enforcing Conditional Updateability of Custom Fields for Web Service Access for more information on how to ensure it gets enforced for web service access as well.

Caution:

It is not recommended to assign a new value to any field as part of the code of a conditionally updateable expression. The script can consult the value of one or more fields, but should not assign a new value to any field in the row. Doing so will cause unexpected behavior in the user interface, may impact runtime performance, and can cause deadlocks.

Providing an Expression to Make a Custom Field Conditionally Required

A custom field can be optional or required. By default it is optional. Alternatively, you can configure a *conditionally required expression*. If you do this, it is evaluated each time a page displaying the field is rendered or refreshed, as well as when the object is validated. The expected return type of the expression `boolean`. If you define one for a field, you must also configure the *Depends On* list to indicate the names of any fields on which your conditionally required expression depends. By doing this, your conditionally required field will interactively show or hide the visual indicator of the field's being required as appropriate when the user changes the values of fields on which the conditionally required expression depends.

For example, consider a custom `TroubleTicket` object with `Priority` and `Justification` fields. Assume that priority is an integer from 1 to 5 with priority 1 being the most critical kind of problem to resolve. To enforce that a justification is required for trouble tickets whose priority is 1 or 2, configure the conditionally required expression for the `Justification` field as follows:

```
Priority_c <= 2
```

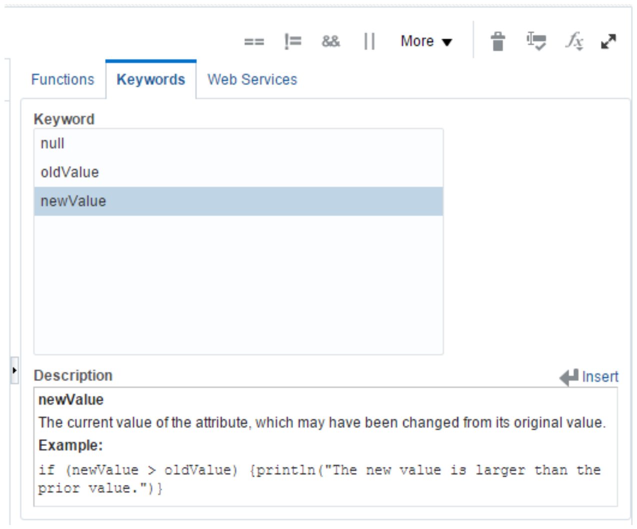
After configuring this expression, you must then indicate that the `Justification` field depends on the `Priority` field as described in Understanding When to Configure Field Dependencies. This ensures that if a trouble ticket is created with priority 2, or an existing trouble ticket is updated to increase the priority from 3 to 2, that the `Justification` field becomes mandatory.

Caution:

It is not recommended to assign a new value to any field as part of the code of a conditionally required expression. The script can consult the value of one or more fields, but should not assign a new value to any field in the row. Doing so will cause unexpected behavior in the user interface, may impact runtime performance, and can cause deadlocks.

Defining a Field-Level Validation Rule

A field-level validation rule is a constraint you can define on any standard or custom field. It is evaluated whenever the corresponding field's value is set. When the rule executes, the field's value has not been assigned yet and your rule acts as a gatekeeper to its successful assignment. The expression (or longer script) you write must return a `boolean` value that indicates whether the value is valid. If the rule returns `true`, then the field assignment will succeed so long as all other field-level rules on the same field also return `true`. If the rule returns `false`, then this prevents the field assignment from occurring, the invalid field is visually highlighted in the UI, and the configured error message is displayed to the end user. Since the assignment fails in this situation, the field retains its current value (possibly `null`, if the value was `null` before), however the UI component in the web page allows the user to see and correct their invalid entry to try again. Your script can use the `newValue` keyword to reference the new value that will be assigned if validation passes. To reference the existing field value, use the `oldValue` keyword. A field-level rule is appropriate when the rule to enforce only depends on the new value being set. As shown in the figure below, you can use the *Keywords* tab of the Expression Palette to insert the `newValue` and `oldValue` keywords.



newValue
The current value of the attribute, which may have been changed from its original value.
Example:

```
if (newValue > oldValue) {println("The new value is larger than the
prior value.")}
```

For example, consider a custom `TroubleTicket` object with a `Priority` field. To validate that the number entered is between 1 and 5, your field-level validation rule would look like this:

- **Field Name**: *Priority*
- **Rule Name**: `Validate_Priority_Range`
- **Error Message**: `The priority must be in the range from 1 to 5`

Rule Body

```
newValue == null || (1..5).contains(newValue as Integer)
```

Tip:

If a validation rule for field *A* depends on the values of one or more other fields (e.g. *Y* and *Z*), then create an object-level rule and programmatically signal which field or fields should be highlighted as invalid to the user as explained in Setting Invalid Fields for the UI in an Object-Level Validation Rule.

Defining an Object-Level Validation Rule

An object-level validation rule is a constraint you can define on any standard or custom object. It is evaluated whenever the framework attempts to validate the object. This can occur upon submitting changes in a web form, when navigating from one row to another, as well as when changes to an object are saved. Use object-level rules to enforce conditions that depend on two or more fields in the object. This ensures that regardless of the order in which the user assigns the values, the rule will be consistently enforced. The expression (or longer script) you write must return a `boolean` value that indicates whether the object is valid. If the rule returns `true`, then the object validation will succeed so long as all other object-level rules on the same object return `true`. If the rule returns `false`, then this prevents the object from being saved, and the configured error message is displayed to the end user.

For example, consider a TroubleTicket object with `Priority` and `AssignedTo` fields, where the latter is a dynamic choice list field referencing `Contact` objects whose `Type` field is a 'Staff Member'. To validate that a trouble ticket of priority 1 or 2 cannot be saved without being assigned to a staff member, your object-level rule would look like this:

- **Rule Name**: `Validate_High_Priority_Ticket_Has_Owner`
- **Error Message**: `A trouble ticket of priority 1 or 2 must have a staff member assigned to it`

Rule Body

```
// Rule depends on two fields, so must be written as object-level rule
if (Priority_c <= 2 && AssignedTo_Id_c == null) {
  // Signal to highlight the AssignedTo field on the UI as being in error
  adf.error.addAttribute('AssignedTo_c')
  return false
}
return true
```

Defining Utility Code in a Global Function

Global functions are useful for code that multiple objects want to share. To call a global function, preface the function name with the `adf.util.` prefix. When defining a function, you specify a return value and can optionally specify one or more typed parameters that the caller will be required to pass in when invoked. The most common types for function return values and parameters are the following:

- `String`: a text value
- `Boolean`: a logical `true` or `false` value
- `Long`: an integer value in the range of ±2^{63}-1
- `BigInteger`: a integer of arbitrary precision
- `Double`: a floating-point decimal value in the range of ±1.79769313486231570 x 10^{308}
- `BigDecimal`: a decimal number of arbitrary precision
- `Date`: a date value with optional time component
- `List`: an ordered collection of objects
- `Map`: an unordered collection of name/value pairs
- `Object`: any object

In addition, a function can define a `void` return type which indicates that it returns no value.

Tip:

A global function has no current object context. To write global functions that work on a particular object, refer to Passing the Current Object to a Global Function.

For example, you could create the following two global functions to define standard helper routines to log the start of a block of groovy script and to log a diagnostic message. Examples later in this document will make use of them.

- **Function Name**: `logStart`
- **Return Type**: `void`
- **Parameters**: `scriptName String`

Function Definition

```
// Log the name of the script
println("[In: ${scriptName}]")
```

- **Function Name**: `log`
- **Return Type**: `void`
- **Parameters**: `message String`

Function Definition

```
// Log the message, could add other info
println(message)
```

Context Information Available in a Global Function

In global functions, your Groovy script can reference only the following elements in the `adf` namespace:

- `adf.context`, as described in Referencing Information About the Current User..
- `adf.util`, to invoke other global functions as described in the section above.
- `adf.webServices`, to invoke registered web services as described in Calling Web Service Methods in Groovy .

In particular, other `adf`-prefixed elements like `adf.source` to reference the current object cannot be directly referenced in a global function's script. You need to reference them in the calling script and pass them in as a parameter to the global function. See Passing the Current Object to a Global Function for an example.

Defining Reusable Behavior with an Object Function

Object functions are useful for code that encapsulates business logic specific to a given object. You can call object functions by name from any other script code related to the same object. In addition, you can invoke them using a button or link in the user interface. The supported return types and optional parameter types are the same as for global functions (described above).

For example, you might define the following `updateOpenTroubleTicketCount()` object function on a `Contact` custom object. It begins by calling the `logStart()` global function above to log a diagnostic message in a standard format to signal the beginning of a block of custom Groovy script. It calls the `newView()` built-in function (described in Accessing the View Object for Programmatic Access to Business Objects) to access the view object for programmatic access of trouble tickets, then appends a view criteria find trouble tickets related to the current contact's id and having either 'Working' or 'Waiting' as their current status. Finally, it calls `getEstimatedRowCount()` to retrieve the count of trouble tickets that qualify for the filter criteria.

- **Function Name**: `updateOpenTroubleTicketCount`
- **Return Type**: `void`
- **Parameters**: *None*

Function Definition

```
adf.util.logStart('updateOpenTroubleTicketCount')
// Access the view object for TroubleTicket programmatic access
def tickets = newView('TroubleTicket_c')
tickets.appendViewCriteria("""
Contact_Id_c = ${Id} and Status_c in ('Working','Waiting')
"""
// Update OpenTroubleTickets field value
setAttribute('OpenTroubleTickets_c',tickets.getEstimatedRowCount())
```

Controlling the Visibility of an Object Function

When you create an object function named `doSomething()` on an object named `Example`, the following is true by default:

- other scripts on the same object can call it,
- any script written on *another* object that obtains a row of type `Example` can call it
- external systems working with an `Example` object via Web Services, *cannot* call it
- it displays in the *Row* category of the *Functions* tab on the *Expression Palette*.

You can alter some of this default behavior by changing your `doSomething()` object function's *Visibility* setting. If you change its *Visibility* to the value *Callable by External Systems*, then an external system working with an `Example` object will be able to invoke your `doSomething()` via Web Services. Do this when the business logic it contains should be accessible to external systems.

If instead you change the *Visibility* to the value *Hidden in Expression Builder*, then `doSomething()` will not display in the *Row* category of the *Functions* tab of the *Expression Palette*, and it remains inaccessible to external systems. Do this when you want to discourage colleagues from inadvertently invoking the `doSomething()` function directly because you know that its correct use is limited to being called by some other script on the `Example` object.

Defining an Object-Level Trigger to Complement Default Processing

Triggers are scripts that you can write to complement the default processing logic for a standard or custom object. You can define triggers both at the object-level and the field-level. The object-level triggers that are available are described below. See Defining a Field-Level Trigger to React to Value Changes for the available field-level triggers.

- ***After Create***:

  Fires when a new instance of an object is created. Use to assign programmatic default values to one or more fields in the object.

- ***Before Modify***

  Fires when the first persistent field is changed in an unmodified row.

- ***Before Invalidate***

  Fires on a valid parent object when a child row is created, removed, or modified, or also like “Before Modify” when the first persistent field is changed in an unmodified row.

- ***Before Remove***

  Fires when an attempt is made to delete an object. Returning false stops the row from being deleted and displays the optional trigger error message.

- ***Before Insert in Database***

  Fires before a new object is inserted into the database.

- ***After Insert in Database***

  Fires after a new object is inserted into the database. Best to use *Before Insert* for field derivations.

- ***Before Update in Database***

  Fires before an existing object is modified in the database

- ***After Update in Database***

  Fires after an existing object is modified in the database. Best to use *Before Update* for field derivations.

- ***Before Delete in Database***

  Fires before an existing object is deleted from the database

- ***After Delete in Database***

  Fires after an existing object is deleted from the database

- ***After Changes Posted to Database***

  Fires after all changes have been posted to the database, but before they are permanently committed. Can be used to make additional changes that will be saved as part of the current transaction.

- ***Before Commit in Database***

  Fires before the change pending for the current object (insert, update, delete) is made permanent in the current transaction. Any changes made in this trigger will **not** be part of the current transaction. Use "After Changed Posted to Database" trigger if your trigger needs to make changes.

- ***After Commit in Database***

  Fires after the change pending for the current object (insert, update, delete) is made permanent in the current transaction.

- ***Before Rollback in Database***

  Fires before the change pending for the current object (insert, update, delete) is rolled back

- ***After Rollback in Database***

  Fires after the change pending for the current object (insert, update, delete) is rolled back

For example, consider a `Contact` object with a `OpenTroubleTickets` field that needs to be updated any time a trouble ticket is created or modified. You can create the following two triggers on the `TroubleTicket` object which both invoke the `updateOpenTroubleTicketCount()` object function described above.

- **Trigger Object**: `TroubleTicket`
- **Trigger**: *After Insert In Database*
- **Trigger Name**: `After_Insert_Set_Open_Trouble_Tickets`

Trigger Definition

```
adf.util.logStart('After_Insert_Set_Open_Trouble_Tickets')
// Get the related contact for this trouble ticket
def relatedContact = Contact_Obj_c
// Update its OpenTroubleTickets field value
relatedContact?.updateOpenTroubleTicketCount()
```

- **Trigger Object**: `TroubleTicket`
- **Trigger**: *After Update In Database*
- **Trigger Name**: `After_Update_Set_Open_Trouble_Tickets`

Trigger Definition

```
// Get the related contact for this trouble ticket
def relatedContact = Contact_Obj_c
// Update its OpenTroubleTickets field value
relatedContact?.updateOpenTroubleTicketCount()
```

Defining a Field-Level Trigger to React to Value Changes

Field-level triggers are scripts that you can write to complement the default processing logic for a standard or custom field. The following field-level trigger is available:

- ***After Field Changed***

  Fires when the value of the related field has changed (implying that it has passed any field-level validation rules that might be present).

Use the *After Field Changed* trigger to calculate other derived field values when another field changes value. Do not use a field-level *validation rule* to achieve this purpose because while your field-level validation rule may succeed, *other* field-level validation rules may fail and stop the field's value from actually being changed. Since generally you only want your field-change derivation logic to run when the field's value actually changes, the *After Field Changed* trigger guarantees that you get this desired behavior.

See Deriving Values of a Field When Other Fields Change Value for tips on using this trigger.

4 Groovy Tips and Techniques

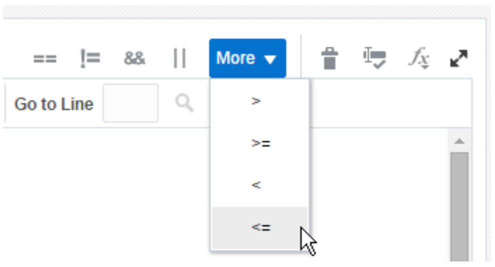
Simplifying Code Authoring with the Expression Palette

Before diving into the specifics of each example, keep in mind that the CRM Application Composer always makes an *Expression Palette* available to assist you. It helps you insert the names of built-in functions, object fields, or function names.

The Expression Editor Toolbar

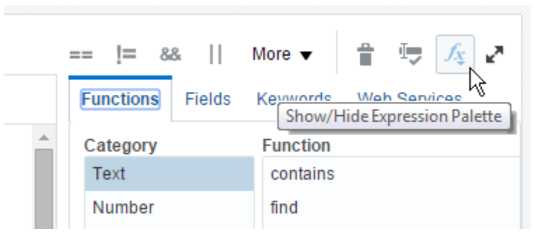
Typically the expression editor opens with the expression palette collapsed to give you more space to your script. In this minimized, hidden state, as shown in the figure below, you have a number of useful toolbar buttons that can assist you to :

- insert one of the common comparison operators like equals (`==`), not equals (`!=`), less than (`<`), greater than (`>`), etc.
- erase the code editor to start over with a clean slate
- validate the correct syntax of your script, or
- show the expression palette for help with functions, field names, keywords, and web services, or
- maximize the code editor to give you the largest possible area in which to see and edit your script.



Showing and Hiding the Expression Palette

To expand the amount of assistance available to you, you can show the expression palette. As shown in the figure below, click the *Show/Hide Expression Palette* button to expand the palette, revealing its four tab display. You can adjust how much horizontal space the palette occupies by using the slider between the code editor and the palette. To hide the palette again, just click again on the *Show/Hide Expression Palette* button.



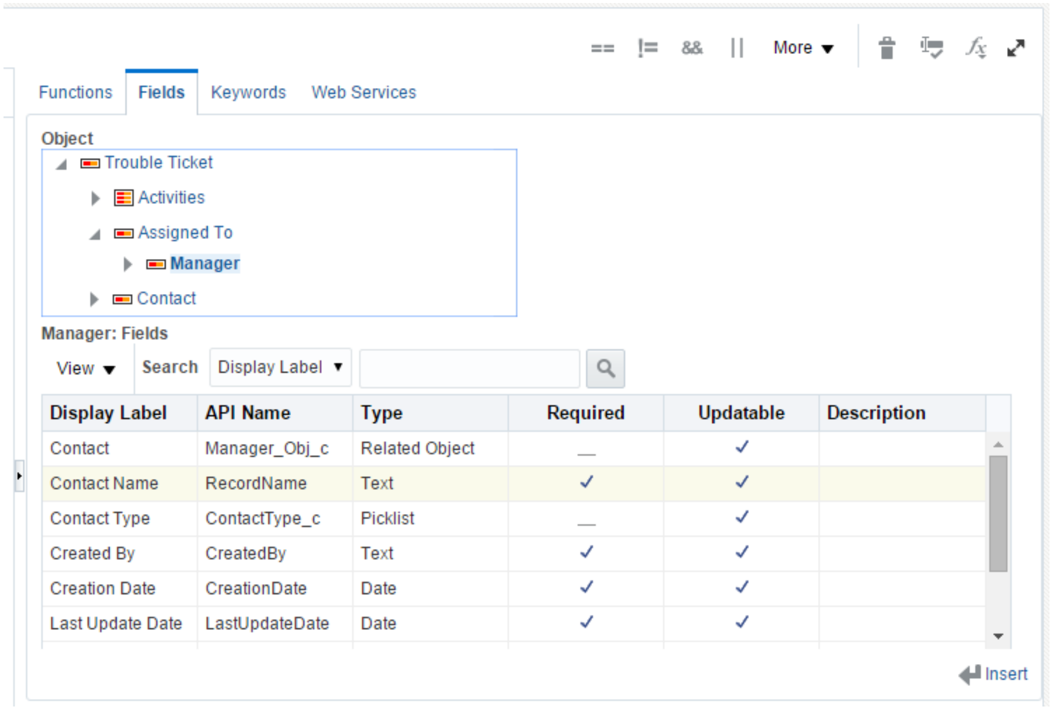
Inserting an Expression for Fields of Related Objects

As shown in the figure below, the *Fields* tab of the palette shows you the current object at the root of the tree, and allows you to explore the related objects and collections of related objects by expanding the tree nodes. If the selected node has the single-row icon ▬ then it represents a single, related object. If the selected node has the multiple-row icon ☰ then it represents a collection of related objects. For example, in the figure the tree shows *Activities* with the multiple-row icon, so this represents the collection of `Activity` objects related to the current trouble ticket. The *Contact* node has a single-row icon so it represents a single `Contact` object that is the customer who reported the trouble ticket. The *Assigned To* node represents the staff member to whom the trouble ticket has been assigned, and lastly, the *Manager* node represents the manager of that staff member.

As shown in the numbered steps in the figure, to insert the name of a field, do the following:

1. Select the object you want to work with, for example the *Manager* of the staff member *Assigned To* this *Trouble Ticket*
2. In the fields table, select the field you want to insert, for example *Contact Name*

3. Click the (*Insert*) button to insert the field's name.



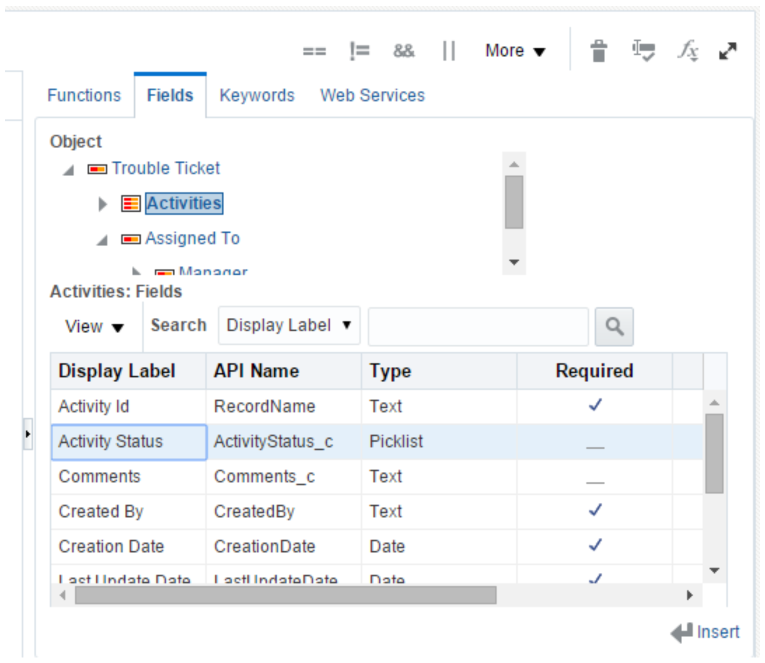
Display Label	API Name	Type	Required	Updatable	Description
Contact	Manager_Obj_c	Related Object	—	✓	
Contact Name	RecordName	Text	✓	✓	
Contact Type	ContactType_c	Picklist	—	✓	
Created By	CreatedBy	Text	✓	✓	
Creation Date	CreationDate	Date	✓	✓	
Last Update Date	LastUpdateDate	Date	✓	✓	

If the field on the selected object is directly accessible from the current object through "dot" navigation, then the expression palette will insert the expression for you. For example, if you click (*Insert*) after selecting the *Contact Name* field of the *Manager* object related to the *Assigned To* staff member assigned to the current *Trouble Ticket*, then the expression inserted will be:

```
AssignedTo_c?.Manager_c?.RecordName
```

Inserting Field Name of Object in Related Collection

In contrast, as shown in the figure below, if you were to select the *Activities* collection and then select the *Activity Status* field from the object in that collection, when you click (*Insert*) only the API name `ActivityStatus_c` of the selected field will be inserted. The reason a complete expression cannot be inserted in this case is due to the fact that you cannot use "dot" notation to work with a specific row in a collection in order to access its field value. You need to use Groovy code to access the collection of rows and then work with one row at a time.



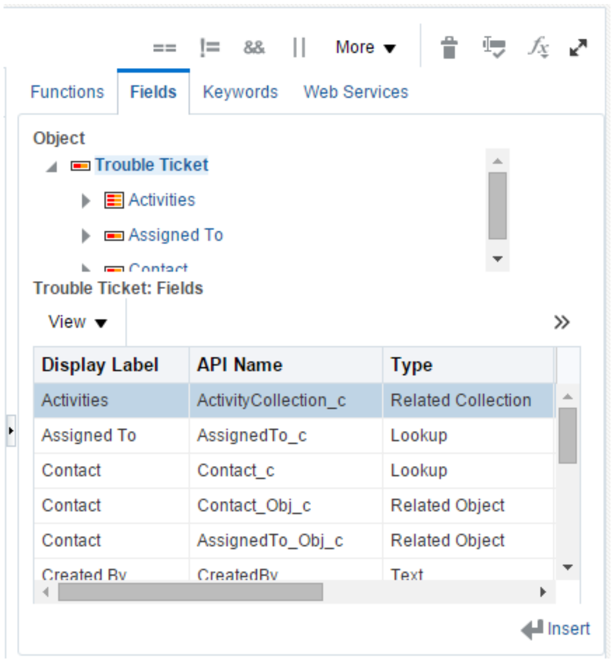
Display Label	API Name	Type	Required
Activity Id	RecordName	Text	✓
Activity Status	ActivityStatus_c	Picklist	—
Comments	Comments_c	Text	—
Created By	CreatedBy	Text	✓
Creation Date	CreationDate	Date	✓
Last Update Date	LastUpdateDate	Date	✓

Inserting a Related Object Accessor or Related Collection Accessor Field Name

As shown in the figure below, to insert the name of an Related Object or Related Collection field, select the object and field in the express ion palette, and click (*Insert*) as you do with any other type of field. For example, to insert the API name of the collection of `Activity` objects related to a `TroubleTicket`, do the following:

1. Select the *Trouble Ticket* node in the tree (representing the current object in this example)
2. Select the desired *Related Collection* or *Related Object* field in the table at the right, for example, the *ActivityCollection_c* field.

3. Click the (*Insert*) button.



Display Label	API Name	Type
Activities	ActivityCollection_c	Related Collection
Assigned To	AssignedTo_c	Lookup
Contact	Contact_c	Lookup
Contact	Contact_Obj_c	Related Object
Contact	AssignedTo_Obj_c	Related Object
Created By	CreatedBy	Text

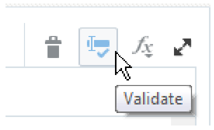
Once you have inserted the name of the related collection field, you can write a loop to process each row in the collection like this:

```
def activities = ActivityCollection_c
while (activities.hasNext()) {
  def activity = activities.next()
  // if the activity status is 'Open'...
  if (activity.Status_c == 'Open') {
    // do something here to the current child activity
  }
}
```

When writing the code in the loop that processes `Activity` rows, you can use the Expression Palette again to insert field names of the object in that collection by selecting the *Activities* collection in the tree, choosing the desired field, then clicking (*Insert*).

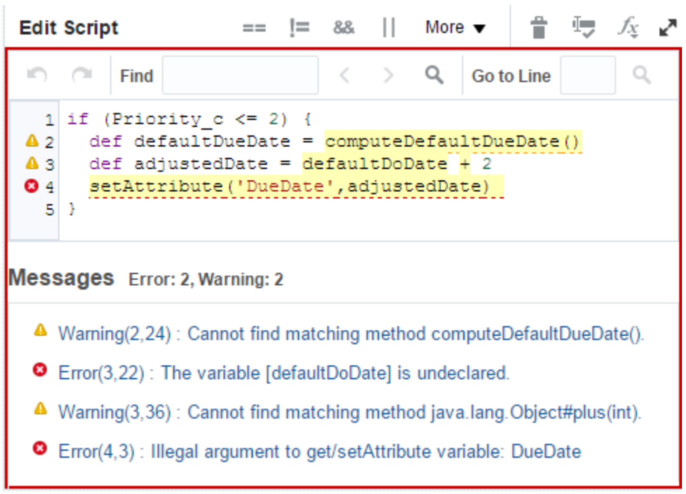
Validating the Syntax and Correctness of Your Script

To validate the syntax and correctness of any script you write, click on the *Validate* script button in the expression editor toolbar as shown in the figure below.



The validator highlights places in your script where you've violated the rules of Groovy scripting language syntax, making them easier to find and correct. For example, this helps you catch mismatched parenthesis or curly braces. The process also checks for the most common kinds of typographical errors like when you misspel the name of a built-in, global, or object function, or when you mistype the name of a field. Wherever your script calls a function, the system ensures that you have passed the correct number and types of arguments and that the security policy allows using that function.

The figure below shows the result of validating a script that contains three typographical errors. In line 2, the `computeDefaultDueDate()` function name is incorrect because the actual function name is `calculateDefaultDueDate()`. In line 3, the local variable `defaultDueDate` is misspelled as `defaultDoDate`. In line 4, the name of the field passed as the first argument to the `setAttribute()` function is incorrect, because the actual field name is `DueDate_c`. A fourth warning message appears related to the plus sign (`+`) operator. Since the `defaultDoDate` is not recognized, the validator assumes it must have the default type `Object` which does not have a function named `plus()`. To quickly navigate to the line containing an error or warning, just click on the relevant line in the *Messages* panel. The cursor moves automatically to the line and column containing the problem in the expression editor.



```
1 if (Priority_c <= 2) {
2   def defaultDueDate = computeDefaultDueDate()
3   def adjustedDate = defaultDoDate + 2
4   setAttribute('DueDate',adjustedDate)
5 }
```

Messages Error: 2, Warning: 2

Warning(2,24) : Cannot find matching method computeDefaultDueDate().
Error(3,22) : The variable [defaultDoDate] is undeclared.
Warning(3,36) : Cannot find matching method java.lang.Object#plus(int).
Error(4,3) : Illegal argument to get/setAttribute variable: DueDate

Using the Related Object Accessor Field to Work with a Parent Object

When writing business logic in a child object like `Activity`, you can access its owning parent `TroubleTicket` object using the related object accessor field. If the parent object is named `TroubleTicket`, the related object accessor field in `Activity` will be named `TroubleTicket_c`. The example below shows how to reference the parent `TroubleTicket` object and access one of its fields.

```
// Assume code in context of Activity
if (TroubleTicket_c.Status_c == 'Open') {
  // Do something here because the owning parent
  // trouble ticket's status is open
}
```

Notice that since the child object cannot exist without an owning parent object, the reference to the parent object will never be `null`, so here instead of the Groovy safe navigation operator (`?.`) we can just use the normal dot operator in the expression `TroubleTicket_c.Status_c`.

If you will be referencing multiple fields from the parent, or calling any of its object functions, then it is best practice to store the parent object in a local variable as shown in the example below.

```
// Store the parent object in a local variable
def ticket = TroubleTicket_c
// Now reference one or more fields from the parent
if (ticket.Status_c == 'Working' && ticket.Priority_c >= 2) {
  // Do something here because the owning parent
  // trouble ticket is high priority and being worked on.
}
```

Using the Related Object Accessor Field to Work with a Referenced Object

When writing business logic for an object like `TroubleTicket` that has a lookup field like `Contact` or `AssignedTo`, you can access the object referenced by the lookup field using the respective lookup field's secondary related object accessor field. See Understanding Secondary Fields Related to a Lookup for more information on this. For the `Contact` and `AssignedTo` lookup fields, the secondary related object accessor fields are named `Contact_Obj_c` and `AssignedTo_Obj_c`, respectively. The example below shows how to reference the two lookup objects from script written in the context of `TroubleTicket`, and access one of each's fields.

```
// Assume code in context of TroubleTicket
if (endsWith(Contact_Obj_c?.EmailAddress_c,'.gov') &&
    startsWith(AssignedTo_Obj_c?.PhoneNumber_c,'202')) {
  // Do something here because contact's email address
  // is a government mail address and assigned-to staff member's
  // phone number is in the 202 area code for Washington DC.
}
```

If you will be referencing multiple fields from the referenced lookup object, or calling any of its object functions, then it is best practice to store the referenced lookup object in a local variable as shown in the example below.

```
// Store the contact object and assignedTo object in a local variable
def customer = Contact_Obj_c
def supportRep = AssignedTo_Obj_c
// Now reference one or more fields from the parent
if ((endsWith(customer?.EmailAddress_c,'.gov') ||
     endsWith(customer?.EmailAddress_c,'.com')
    )
    &&
    (startsWith(supportRep?.PhoneNumber_c,'(202)')||
     startsWith(supportRep?.PhoneNumber_c,'(206)')
    )
   )
{
  // Do something here because contact's email address
  // is a government or business email and assigned-to
  // support rep is in 202 or 206 Washington DC area code
}
```

Using the Related Collection Accessor Field to Work with Child Rows

When an parent object like `TroubleTicket` has a child object `Activity`, the parent object will have a related collection accessor field whose name you decided when you created the child object. For example, if when creating the child `Activity` object for the `TroubleTicket` parent, you decided to name the related collection accessor field `ActivityCollection`, then you can write business logic in the context of the parent `TroubleTicket` object that works with the one or more `Activity` child rows. To do this, your code accesses the related collection accessor field by name like this:

```
// Assume code in context of TroubleTicket
// define a variable to hold activities collection
def activities = ActivityCollection_c
// work with activities here...
```

Tip:

Always store a child collection you want to work with in a local variable. Failure to do this will result in your code that does not behave as you expect.

The related collection accessor field returns a row iterator object, so you can use methods like those listed in the table below to work with the rows. The row iterator tracks the current row in the collection that your code is working with.

Table 2: Most Commonly Used RowIterator Methods

Most Commonly Used RowIterator Methods

Method Name	Description
`hasNext()`	*Returns:* - `true` if the row iterator has more rows to iterate over, `false` if there are no rows in the iterator's row set or if the iterator is already on or beyond the last row.
`next()`	*Returns:* - the next row in the row iterator
`reset()`	*Returns:* - `void`. Resets the row iterator to the "slot" before the first row.
`first()`	*Returns:* - the first row in the row iterator, or `null` if the iterator's row set is empty

Putting the commonly used row iterator methods from the following table into practice, the example below shows the typical code you will use to work with the child row iterator. This example accesses the child row iterator using the related collection field's API name, and saves it in a local variable. Then, it resets the iterator so that it sits on the "slot" before the first row in the row iterator. Next, it uses a `while` loop in combination with the `hasNext()` method to iterate over each row in the row iterator.

```
// store the child row iterator in a local variable
def activities = ActivityCollection_c
```

```
// ensure iterator is on slot before first row
activities.reset()
// loop while there are more rows to process
while (activities.hasNext()) {
  // access the next row in the row iterator
  def curActivity = activities.next()
  // reference fields or object functions from the current row
  if (curActivity.Status_c == 'Open') {
    // do something here to the current child activity
  }
}
// to process the same row iterator again in this block of code,
// call activities.reset() method again to reset the
// iterator to the slot before the first row
```

To detect whether the child row iterator is empty or not, you can use the `first()` method. If it returns `null` then the row iterator's row set is empty. As shown in the example below, if you call the `first()` method and there *are* rows in the row iterator's row set, this method sets the iterator to point at the first row. So, if your script uses the `first()` method, then plans to iterate over all the rows in the iterator again using the typical `while(`*`rowiterator`*`.hasNext())` idiom, you need to call the `reset()` method on the row iterator to move the current row pointer back to the slot before the first row. Failure to do this could result in inadvertently not processing the first row in the row set.

```
def activities = ActivityCollection_c
// If there are no child activities...
if (activities.first() == null) {
   // Do something here because there are no child activities
}
else {
  // There are some child activities, call reset() to set
  // iterator back to slot before first row
  activities.reset()
  while (activities.hasNext()) {
    def curActivity = activities.next();
    // Do something here with the current activity
  }
}
```

Accessing Current Date and Time from the Application Server

To reference the application server's current date in any groovy expression, use:

```
adf.currentDate
```

To reference the application server's current date including the current time, use the expression:

```
adf.currentDateTime
```

Note:

This function cannot currently be referenced inside code for a Global Function. An object function can reference it and pass the value, if necessary, into the global function.

Accessing Current Date and Time from the Database

To reference the database's current date in any groovy expression, use:

```
adf.currentDBDate
```

To reference the application server's current date including the current time, use the expression:

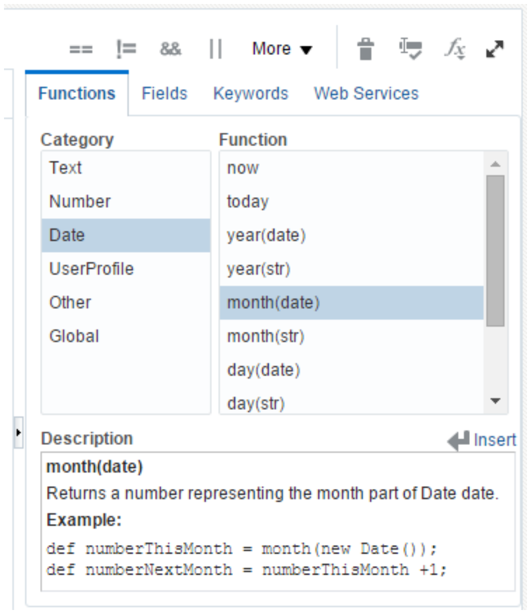
```
adf.currentDBDateTime
```

Note:

This function cannot currently be referenced inside code for a Global Function. An object function can reference it and pass the value, if necessary, into the global function.

Understanding ADF's Additional Built-in Groovy Functions

Oracle ADF adds a number of additional helper functions that you can use in your Groovy scripts. This section defines each one and provides a simple example of its use. As shown in the figure below, you can use the *Functions* tab of the Expression Palette to insert any of the built-in functions and get a quick example of their use.



month(date)

Returns a number representing the month part of Date date.

Example:

```
def numberThisMonth = month(new Date());
def numberNextMonth = numberThisMonth +1;
```

Table 3: Built-in Date Functions

Built-in Date Functions

Function	Description
`today()`	**Returns:** the current date, with no time **Return Type:** `Date`
`now()`	The current date and time **Return Type:** `Timestamp`
`date(`*`year`*`,`*`month`*`,`*`day`*`)`	**Returns:** a date, given the year, month, and day **Return Type:** `Date` **Parameters:** • `year` - a positive integer • `month` - a positive integer between 1 and 12 • `day` - a positive integer between 1 and 31 **Example:** to return a date for February 8th, 1998, use `date(1998,2,8)`
`dateTime(`*`y`*`,`*`m`*`,`*`d`*`,`*`hr`*`,`*`min`*`,`*`sec`*`)`	**Returns:** a timestamp, given the year, month, day, hour, minute, and second **Return Type:** `Timestamp` **Parameters:** • `year` - a positive integer • `month` - a positive integer between 1 and 12 • `day` - a positive integer between 1 and 31 • `hour` - a positive integer between 0 and 23 • `minute` - a positive integer between 0 and 59 • `second` - a positive integer between 0 and 59 **Example:** to return a timestamp for February 8th, 1998, at 23:42:01, use `dateTime(1998,2,8,23,42,1)`
`year(`*`date`*`)`	**Returns:** the year of a given date **Return Type:** `Integer` **Parameters:** • `date` - date **Example:** if `curDate` represents April 19th, 1996, then `year(curDate)` returns *1996.*

Function	Description
`month(`*`date`*`)`	**Returns:** the month of a given date **Return Type:** `Integer` **Parameters:** • `date` - a date **Example:** if `curDate` represents April 12th, 1962, then `month(curDate)` returns *4*.
`day(`*`date`*`)`	**Returns:** the day for a given date **Return Type:** `Integer` **Parameters:** • `date` - a date **Example:** if `curDate` represents July 15th, 1968, then `day(curDate)` returns *15*.

Table 4: Built-in String Functions

Built-in String Functions

Function	Description
`contains(`*`s1`*`,`*`s2`*`)`	**Returns:** `true`, if string `s1` contains string `s2`, `false` otherwise **Return Type:** `boolean` **Parameters:** • `s1` - a string to search in • `s2` - a string to search for **Example:** if `twitterName` holds the value *@steve*, then `contains(twitterName,'@')` returns `true`.
`endsWith(`*`s1`*`,`*`s2`*`)`	**Returns:** `true`, if string `s1` ends with string `s2`, `false` otherwise **Return Type:** `boolean` **Parameters:** • `s1` - a string to search in • `s2` - a string to search for For example, if `twitterName` holds the value *@steve*, then `endsWith(twitterName,'@')` returns `false`.

Function	Description
`find(s1,s2)`	**Returns:** the integer position of the first character in string `s1` where string `s2` is found, or zero (0) if the string is not found **Return Type:** `Integer` **Parameters:** • `s1` - a string to search in • `s2` - a string to search for **Example:** if `twitterName` holds the value *@steve*, then `find(twitterName,'@')` returns *1* and `find(twitterName,'ev')` returns *4*.
`left(s,len)`	**Returns:** the first `len` characters of the string `s` **Return Type:** `String` **Parameters:** • `s` - a string • `len` - an integer number of characters to return **Example:** if `postcode` holds the value *94549-5114*, then `left(postcode,5)` returns *94549*.
`length(s)`	**Returns:** the length of string `s` **Return Type:** `Integer` **Parameters:** • `s` - a string **Example:** if `name` holds the value *Julian Croissant*, then `len(name)` returns *16*.
`lowerCase(s)`	**Returns:** the string `s` with any uppercase letters converted to lowercase **Return Type:** `String` **Parameters:** • `s` - a string **Example:** if `sku` holds the value *12345-10-WHT-XS*, then `lowerCase(sku)` returns *12345-10-wht-xs*.

Function	Description
`right(s,len)`	**Returns:** the last `len` characters of the string `s` **Return Type:** `String` **Parameters:** • `s` - a string • `len` - an integer number of characters to return **Example:** if `sku` holds the value *12345-10-WHT-XS*, then `right(sku,2)` returns *XS*.
`startsWith(s1,s2)`	**Returns:** `true`, if string `s1` starts with `s2`, `false` otherwise **Return Type:** `boolean` **Parameters:** • `s1` - a string to search in • `s2` - a string to search for **Example:** if `twitterName` holds the value *@steve*, then `startsWith(twitterName,'@')` returns `true`.
`substringBefore(s1,s2)`	**Returns:** the substring of `s1` that precedes the *first* occurrence of `s2`, otherwise an empty string **Return Type:** `String` **Parameters:** • `s1` - a string to search in • `s2` - a string to search for Examples: if `sku` holds the value *12345-10-WHT-XS*, then `substringBefore(sku,'-')` returns the value *12345*, `substringBefore(sku,'12345')` returns an empty string, and `substringBefore(sku,'16-BLK')` also returns an empty string.

Function	Description
`substringAfter(s1,s2)`	**Returns:** the substring of `s1` that follows the *first* occurrence of `s2`. otherwise an empty string **Return Type:** `String` **Parameters:** • `s1` - a string to search in • `s2` - a string to search for **Example:** if `sku` holds the value *12345-10-WHT-XS*, then `substringAfter(sku,'-')` returns the value 10-WHT-XS, `substringAfter(sku,'WHT-')` returns the value *XS*, `substringAfter(sku,'XS')` returns an empty string, and `substringAfter(sku,'BLK')` also returns an empty string.
`upperCase(s)`	**Returns:** the string `s` with any lowercase letters converted to uppercase **Return Type:** `String` **Parameters:** • `s` - a string **Example:** if `sku` holds the value *12345-10-Wht-xs*, then `upperCase(sku)` returns *12345-10-WHT-XS*.

Table 5: Other Built-in Functions

Other Built-in Functions

Function	Description
`newView(objectAPIName)`	**Returns:** a `ViewObject` reserved for programmatic use, or `null` if not available. **Return Type:** `ViewObject` **Parameters:** • `objectAPIName` - the object API name whose rows you want to find, create, update, or remove **Example:** if `TroubleTicket` is a custom object, then `newView('TroubleTicket_c')` returns a new view object instance you can use to find, create, update, or delete `TroubleTicket` rows.

Function	Description
`key(`*`list`*`)`	**Returns:** a multi-valued key object for use in the `ViewObject`'s `findByKey()` method. **Return Type:** `Key` **Parameters:** • `list` - a list of values for a multi-field key **Example:** if a standard object has a two-field key, use `key([101,'SAMBA'])`
`key(`*`val`*`)`	**Returns:** a key object for use in the `ViewObject`'s `findByKey()` method. **Return Type:** `Key` **Parameters:** • `val` - a value to use as the key field **Example:** if a standard object has a single-field key, as all custom objects do, use `key(123456789)`
`nvl(`*`o1`*`,`*`o2`*`)`	**Returns:** the object `o1` if it is not null, otherwise the object `o2`. **Return Type:** `Object` **Parameters:** • `o1` - a value to use if not null • `o2` - a value to use instead if `o1` is null **Example:** to calculate the sum of `Salary` and `Commission` custom fields that might be null, use `nvl(Salary_c,0) + nvl(Commission_c,0)`

Understanding Groovy's Null-Safe Comparison Operators

It's important to know that Groovy's comparison operators `==` and `!=` handle nulls gracefully so you don't have to worry about protecting `null` values in equality or inequality comparisons. Furthermore, the `>`, `>=`, `<`, and `<=` operators are *also* designed to avoid null-related exceptions, however you need to be conscious of how Groovy treats `null` in these order-dependent comparisons. Effectively, a `null` value is "less than" any other non-null value in the natural ordering, so for example observe the following comparison results.

Table 6: Examples of How null Is Less Than Everything

Examples of How null Is Less Than Everything

Left-Side Expression	Operator	Right-Side Expression	Comparison Result
`'a'`	`>`	`null`	`true`
`'a'`	`<`	`null`	`false`
`100`	`>`	`null`	`true`
`100`	`<`	`null`	`false`
`-100`	`>`	`null`	`true`
`-100`	`<`	`null`	`false`
`now()`	`>`	`null`	`true`
`now()`	`<`	`null`	`false`
`now() - 7`	`>`	`null`	`true`
`now() - 7`	`<`	`null`	`false`

If you want a comparison to treat a null-valued field with different semantics — for example, treating a null `MaximumOverdraftAmount` field as if it were zero (0) like a spreadsheet user might expect — then use the `nvl()` function as part of your comparison logic as shown in the following example:

```
// Change default comparison semantics for the MaximumOverdraftAmount custom field in
// case its value is null by using nvl() to treat null like zero (0)
if (nvl(MaximumOverdraftAmount_c,0) < -2000) {
  // do something for suspiciously large overdraft amount
}
```

As illustrated by the table above, without the `nvl()` function in the comparison any `MaximumOverdraftAmount_c` value of `null` would always be less than `-2000` — since by default `null` is less than everything.

Testing Whether a Field's Value Is Changed

You can test whether an field's value has changed in the current transaction by using the built-in `isAttributeChanged()` function. As shown in this example, it takes a single string argument that provides the name of the field whose changed status you want to evaluate:

```
if (isAttributeChanged('Status_c')) {
  // perform some logic here in light of the fact
  // that status has changed in this transaction
}
```

Avoiding Validation Threshold Errors By Conditionally Assigning Values

When you write scripts for validation rules that modify the values of fields in the current object, you must be aware of how this affects the object's so-called "validation cycle". Before allowing an object to be saved to the database, the Oracle ADF framework ensures that its data passes all validation rules. The act of successfully running all defined validation rules results in the object's being marked as valid and allows the object to be saved along with all other valid objects that have been modified in the current transaction. If as part of executing a validation rule your script modifies the value of a field, this marks the object "dirty" again. This results in ADF's subjecting the object again to all of the defined validation rules to ensure that your new changes do not result in an invalid object. If the act of re-validating the object runs your scripts that modify the field values again, this process could result in a cycle that would appear to be an infinite loop. ADF avoids this possibility by imposing a limit of 10 validation cycles on any given object. If after 10 attempts at running all the rules the object still has not been able to be successfully validated due to the object's being continually modified by its validation logic, ADF will throw an exception complaining that you have exceeded the validation threshold:

Validation threshold limit reached. Invalid Entities still in cache

A simple way to avoid this from happening is to test the value of the field your script is about to assign and ensure that you perform the `setAttribute()` call to modify its value only if the value you intend to assign is *different* from its current value. An example script employing this approach would look like this:

```
// Object-level validation rule on a PurchaseOrder object
// to derive the default purchasing rep based on a custom
// algorithm defined in an object function named
// determinePurchasingRep() if both the Discount and NetDaysToPay
// fields have changed in the current transaction.
if (isAttributeChanged("Discount") &&
    isAttributeChanged("NetDaysToPay")) {
  def defaultRep = determinePurchasingRep()
  // If new defaultRep is not the current rep, assign it
  if (PurchasingRep_c != defaultRep) {
    setAttribute('PurchasingRep_c',defaultRep)
  }
}
return true
```

Note:

This example illustrates how to avoid a typical problem that can occur when using a validation rule to perform field derivations. The recommended trigger to use for such purposes would be the field-level "After Value Changed" trigger, or alternatively the "Before Insert" and/or "Before Update" trigger. It is still a good practice to perform conditional field assignment in those cases, too. See Deriving Values of a Field When Other Fields Change Value for more information on deriving field values.

Prefer “Before” Save-time Triggers to “After” Ones for Best Performance

When you write a trigger to derive field values programmatically, wherever possible use the *Before Insert* or *Before Update* triggers instead of *After Insert*, *After Update*, or *After Changed Posted to Database*. When the After-save triggers fire, the changes in the row have already been sent to the database, and performing further field assignments therein requires doing a second database DML operation per row modified to communicate your field updates to the database for permanent storage. Using the Before-save triggers sets the field values before the changes are sent the first time to the database, resulting in better performance.

Avoiding Posting Threshold Errors By Conditionally Assigning Values

Despite the recommendation in Prefer “Before” Save-time Triggers to “After” Ones for Best Performance, if for some reason you still must use an *After Insert*, *After Update*, or *After Changed Posted to Database* trigger to perform field value assignments — for example, your custom logic must perform a query that filters on the data being updated in the current transaction — then you must be aware of how this affects the object's so-called "posting cycle". If your trigger modifies the value of a field, this marks the object "dirty" again. This results in ADF's subjecting the object again to all of the defined validation rules to ensure that your new changes do not result in an invalid object. If the object passes validation, then your trigger's most recent field value changes must be posted again to the database. In the act of re-posting the object's changes, your trigger may fire again. If your trigger again unconditionally modifies one or more field values again, this process could result in a cycle that would appear to be an infinite loop. ADF avoids this possibility by imposing a limit of 10 posting cycles on any given object. If after 10 attempts to post the (re)validated object to the database it remains "dirty," due to the object's being continually modified by your trigger logic, then ADF will throw an exception complaining that you have exceeded the posting threshold:

Post threshold limit reached. Some entities yet to be posted

A simple way to avoid this from happening is to test the value of the field your script is about to assign and ensure that you perform the `setAttribute()` call to modify its value only if the value you intend to assign is *different* from its current value. An example script employing this approach would look like this:

```
// After Changes Posted in Database Trigger
// If total score is 100 or more, set status to WON.
def totalScore = calculateTotalScoreUsingQuery()
if (totalScore >= 100) {
  // Only set the status to WON if it's not already that value
  if (Status != 'WON') {
    setAttribute('Status','WON')
  }
}
```

Functional Restrictions in Trigger Scripts

This section documents functional restrictions of which you should be aware when writing custom Groovy script in triggers.

- *After Delete in Database* Trigger

  Your trigger cannot set the value of fields in the deleted object. An attempt to do so will raise the `InvalidOperException` exception.

- *Before Commit in Database* Trigger

Your trigger should not set the value of any fields in this trigger. The changes are too late to be included in the current transaction.

- *After Commit in Database* Trigger

  Your trigger should not set the value of any fields in this trigger. The changes are too late to be included in the current transaction.

- *Before Rollback in Database* Trigger

  Your trigger should not set the value of any fields in this trigger. The changes are too late to be included in the current transaction.

- *After Rollback in Database* Trigger

  Your trigger should not set the value of any fields in this trigger. The changes are too late to be included in the current transaction.

Passing the Current Object to a Global Function

As you begin to recognize that you are writing repetive code in more than one object's functions, triggers, or validation rules, you can refactor that common code into a global function that accepts a parameter of type `Object` and then have your various usages call the global function. Since a global function does not have a "current object" context, you need to pass the current object as an argument to your global function to provide it the context you want it to work with. When you define the global function, the `Object` type is not shown in the dropdown list of most commonly used argument types, but you can type it in yourself. Note that the value is case-sensitive, so `Object` must have an initial capital letter "O".

When writing code in an object trigger, object function, or other object script, you can use the expression `adf.source` to pass the current object to a global function that you invoke. Referencing Original Values of Changed Fields shows an example of putting these two techniques into practice.

Referencing Original Values of Changed Fields

When the value of a field gets changed during the current transaction, the ADF framework remembers the so-called "original value" of the field. This is the value it had when the existing object was retrieved from the database. Sometimes it can be useful to reference this original value as part of your business logic. To do so, use the `getOriginalAttributeValue()` function as shown below (substituting your field's name for the example's `Priority_c`):

```
// Assume we're in context of a TroubleTicket
if (isAttributeChanged('Priority_c')) {
  def curPri = Priority_c
  def origPri = getOriginalAttributeValue("Priority_c")
  adf.util.log("Priority changed: ${origPri} -> ${curPri}")
  // do something with the curPri and origPri values here
}
```

Raising a Warning From a Validation Rule Instead of an Error

When your validation rule returns `false`, it causes a validation error that stops normal processing. If instead you want to show the user a warning that does *not* prevent the data from being saved successfully, then your rule can signal a warning and then return `true`. For example, your validation rule would look like this:

```
// if the discount is over 50%, give a warning
if (Discount > 0.50) {
  // raise a warning using the default declarative error message
  adf.error.warn(null)
}
return true
```

Throwing a Custom Validation Exception

When defining object level validation rules or triggers, normally the declaratively-configured error message will be sufficient for your needs. When your validation rule returns `false` to signal that the validation has failed, the error message you've configured is automatically shown to the user. The same occurs for a trigger when it calls the `adf.error.raise(null)` function. If you have a number of different conditions you want to enforce, rather than writing one big, long block of code that enforces several distinct conditions, instead define a separate validation rule or trigger (as appropriate) for each one so that each separate check can have its own appropriate error message.

That said, on occasion you may require writing business logic that does not make sense to separate into individual rules, and which needs to conditionally determine *which* among several possible error messages to show to the user. In this case, you can throw a custom validation exception with an error string that you compose on the fly using the following technique:

```
// Throw a custom object-level validation rule exception
// The message can be any string value
throw new oracle.jbo.ValidationException('Your custom message goes here')
```

Note that choose this approach, your error message is not translatable in the standard way, so it becomes your responsibility to provide translated versions of the custom-thrown error messages. You could use a solution like the one presented in Returning Locale-Sensitive Custom Strings for accomplishing the job.

Returning Locale-Sensitive Custom Strings

When you throw custom validation error messages, if your end users are multi-lingual, you may need to worry about providing a locale-specific error message string. To accomplish this, you can reference the end user's current locale as part of global function that encapsulates all of your error strings. Consider a `getMessage` function like the one below. Once it is defined, your validation rule or trigger can throw a locale-sensitive error message by passing in the appropriate message key:

```
// context is trigger or object-level validation rule
```

```
throw new oracle.jbo.ValidationException(adf.util.getMessage('BIG_ERROR'))
```

The global function is defined as follows.

- **Function Name**: `getMessage`
- **Return Type**: `String`
- **Parameters**: `stringKey String`

Function Definition

```
// Let "en" be the default lang
// Get the language part of the locale
// e.g. for locale "en_US" lang part is "en"
def defaultLang = 'en';
def userLocale = adf.context.getLocale() as String
def userLang = left(userLocale,2)
def supportedLangs=['en','it']
def lookupLang = supportedLangs.contains(userLang)
                 ? userLang : defaultLang
def messages =
   [BIG_ERROR:  [en:'A big error occurred',
                 it:'È successo un grande errore'],
    SMALL_ERROR:[en:'A small error occurred',
                 it:'È successo un piccolo errore']
]
return messages[stringKey][lookupLang]
```

Raising a Trigger's Optional Error Message

In contrast with a validation rule where the declarative error message is mandatory, when you write a trigger it is optional. Since any return value from a trigger's script is ignored, the way to cause the optional error message to be shown to the user is by calling the `adf.error.raise()` method, passing `null` as the single argument to the function. This causes the default declarative error message to be shown to the user and stops the current transaction from being saved successfully. For example, you trigger would look like this:

```
// Assume this is in a Before Insert trigger
if (someComplexCalculation() == -1) {
  // raise an exception using the default declarative error message
  adf.error.raise(null)
}
```

Accessing the View Object for Programmatic Access to Business Objects

A "view object" is an Oracle ADF component that simplifies querying and working with business object rows. The `newView()` function allows you to access a view object dedicated to programmatic access for a given business object. By default, any custom object you create is enabled to have such a view object, and selected standard objects will be so-enabled by the developers of the original application you are customizing. Each time the `newView(`*`objectAPIName`*`)` function is invoked for a given value of object API name, a new view object instance is created for its programmatic access. This new view object instance is in a predictable initial state. Typically, the first thing you will then do with this new view object instance is:

- Call the `findByKey()` function on the view object to find a row by key, or
- Append a view criteria to restrict the view object to only return some desired *subset* of business objects rows that meet your needs, as described in Finding Objects Using a View Criteria.

A view object will typically be configured to return its results in sorted order. If the default sort order does not meet your needs, you can use the `setSortBy()` method on the view object to provide a comma-separated list of field names on which to sort the results. The new sort order will take effect the next time you call the `executeQuery()` method on the view object. See Defining the Sort Order for Query Results for further details on sorting options available.

A view object instance for programmatic access to a business object is guaranteed not to be used by any application user interface pages. This means that any iteration you perform on the view object in your script will not inadvertently affect the current row seen in the user interface. That said, the end user will see the results of any field values that you change, any new rows that you add, and any existing rows that you modify, presuming that they are presently on a page where said objects and fields are visible.

For example, suppose the user interface is displaying an employee along with the number and associated name of the department in which she works. If a script that you write...

- uses `newView()` to obtain the view object for programmatic access for the `Department` object, then
- uses `findByKey()` to find the department whose id matches the current employee's department, and finally
- changes the name of the current employee's department

then this change should be reflected in the screen the next time it is updated. Once you've accessed the view object, the most common methods that you will use on the view object are shown in the following table.

Table 7: Most Commonly Used View Object Methods

Most Commonly Used View Object Methods

Method Name	Description
`findByKey()`	Allows you to find a row by unique id. **Returns:** an array of rows having the given key, typically containing either zero or one row. **Parameters:** • `key` - a key object representing the unique identifier for the desired row • `maxRows` - an integer representing the maximum number of rows to find (typically `1` is used) **Example:** See Finding an Object by Id

Method Name	Description
`findRowsMatchingCriteria()`	Allows you to find a set of matching rows based on a filter criteria. **Returns:** an iterator you can use to process the matching rows using methods `iter.hasNext()` and `iter.next()` ofr one row. **Parameters:** • `viewCriteria` - a view criteria representing the filter. The easiest way to create a new view criteria is to use the `newViewCriteria()` function. • `maxRows` - an integer representing the maximum number of rows to find (`-1` means return all matching rows up to a limit of `500`) **Example:** See Finding Rows in a Child Rowset Using findRowsMatchingCriteria
`appendViewCriteria()`	Appends an additional view criteria query filter. **Parameters:** • `filterExpr` - a String representing a filter expression. *Returns:* - `void`. Alternatively, if you already have created a view criteria using `newViewCriteria()` you can pass that view criteria as the single argument to this function.
`executeQuery()`	Executes the view object's query with any currently appended view criteria filters. *Returns:* - `void`.
`hasNext()`	*Returns:* - `true` if the row iterator has more rows to iterate over, `false` if there are no further rows in the iterator or it is already on or beyond the last row.
`next()`	*Returns:* - the next row in the iterator
`reset()`	Resets the view object's iterator to the "slot" before the first row. *Returns:* - `void`.
`first()`	*Returns:* - the first row in the row iterator, or `null` if the iterator's row set is empty

Method Name	Description
`createRow()`	Creates a new row, automatically populating its system-generated `Id` primary key field. *Returns:* - the new row
`insertRow()`	Inserts a new row into the view object's set of rows. *Returns:* - `void`
`setSortBy()`	Set the sort order for query results. *Returns:* - `void`

Defining the Sort Order for Query Results

To define the sort order for view object query results, call the `setSortBy()` method on the view object instance you are working with *before* calling its `executeQuery()` method to retrieve the results. The `setSortBy()` function takes a single string argument whose value can be a comma-separated list of one or more field names in the object. The following example shows how to use this method to sort by a single field.

```
def vo = newView('TroubleTicket_c')
// Use object function to simplify filtering by agent
applyViewCriteriaForSupportAnalyst(vo, analystId)
vo.setSortBy('Priority_c')
vo.executeQuery()
while (vo.hasNext()) {
  def curRow = vo.next()
  // Work with current row curRow here
}
```

By default the sort order will be *ascending*, but you can make your intention explicit by using the `asc` or `desc` keyword after the field's name in the list, separated by a space. The example below shows how to sort descending by the number of callbacks.

```
def vo = newView('TroubleTicket_c')
// Use object function to simplify filtering by customer
applyViewCriteriaForCustomerCode(vo, custCode)
vo.setSortBy('NumberOfCallbacks_c desc')
vo.executeQuery()
while (vo.hasNext()) {
  def curRow = vo.next()
  // Work with current row curRow here
}
```

As mentioned before, the string can be a comma-separated list of two or more fields as well. This example shows how to sort by multiple fields, including explicitly specifying the sort order.

```
def vo = newView('TroubleTicket_c')
// Use object function to simplify filtering by customer
```

```
applyViewCriteriaForCustomerCode(vo, custCode)
// Sort ascending by Priority, then descending by date created
vo.setSortBy('Priority_c asc, CreationDate desc')
vo.executeQuery()
while (vo.hasNext()) {
  def curRow = vo.next()
  // Work with current row curRow here
}
```

By default, when sorting on a text field, its value is sorted case-senstively. A value like 'Blackberry' that starts with a capital 'B' would sort before a value like 'apple' with a lower-case 'a'. To indicate that you'd like a field's value to be sorted case-insensitively, surround the field name in the list by the `UPPER()` function as shown in the following example.

```
def vo = newView('TroubleTicket_c')
// Use object function to simplify filtering by customer
applyViewCriteriaForCustomerCode(vo, custCode)
// Sort case-insensitively by contact last name, then by priority
vo.setSortBy('UPPER(ContactLastName_c),Priority_c')
vo.executeQuery()
while (vo.hasNext()) {
  def curRow = vo.next()
  // Work with current row curRow here
}
```

Tip:

While it is possible to sort on a *formula field* or *dynamic choice field* by specifying its name, don't do so unless you can guarantee that only a small handful of rows will be returned by the query. Sorting on a formula field or dynamic choice list must be done in memory, therefore doing so on a large set of rows will be inefficient.

Finding an Object by Id

To find an object by id, follow these steps:

1. Use the `newView()` function to obtain the view object for programmatic access for the business object in question
2. Call `findByKey()`, passing in a key object that you construct using the `key()` function

The new object will be saved the next time you save your work as part of the current transaction. The following example shows how the steps fit together in practice.

```
// Access the view object for the custom TroubleTicket object
def vo = newView('TroubleTicket_c')
def foundRows = vo.findByKey(key(100000000272002),1)
def found = foundRows.size() == 1 ? foundRows[0] : null;
if (found != null) {
  // Do something here with the found row
}
```

To simplify the code involved in this common operation, you could consider defining the following `findRowByKey()` global helper function:

- **Function Name**: `findRowByKey`

- **Return Type**: `oracle.jbo.Row`
- **Parameters**: `vo oracle.jbo.ViewObject, idValue Object`

Function Definition

```
adf.util.logStart('findRowByKey')
def found = vo.findByKey(key(idValue),1)
return found.size() == 1 ? found[0] : null;
```

After defining this helper function, the example below shows the simplified code for finding a row by key.

```
// Access the view object for the custom TroubleTicket object
def vo = newView('TroubleTicket_c')
def found = adf.util.findRowByKey(vo,100000000272002)
if (found != null) {
  // Do something here with the found row
}
```

Finding Objects Using a View Criteria

A "view criteria" is a declarative data filter for the custom or standard objects you work with in your scripts. After creating a view object using the `newView()` function, but before calling `executeQuery()` on it, use the `appendCriteria()` method to add a filter so the query will return only the rows you want to work with. This section explains the declarative syntax of view criteria filter expressions, and provides examples of how to use them. At runtime, the Oracle ADF framework translates the view criteria into an appropriate SQL `WHERE` clause for efficient database execution.

Using a Simple View Criteria

To find custom or standard objects using a view criteria, perform the following steps:

1. Create a view object with the `newView()` function
2. Append a view criteria with the `appendViewCriteria()` function, using an appropriate filter expression
3. Execute the query by calling `executeQuery()`
4. Process the results

The example below queries the `TroubleTicket` custom object to find the trouble tickets assigned to a particular staff member with id `100000000089003` and which have a status of `Working`.

```
/*
 * Query all 'Working'-status trouble tickets assigned to a staff member with id 100000000089003
 */
// 1. Use the newView() function to get a view object
def vo = newView('TroubleTicket_c')
// 2. Append a view criteria using a filter expression
vo.appendViewCriteria("AssignedTo_Id_c = 100000000089003 and Status_c = 'Working'")
// 3. Execute the query
vo.executeQuery()
// 4. Process the results
if (vo.hasNext()) {
  def row = vo.next()
  // Do something here with the current result row
}
```

Syntax of View Criteria Filter Expressions

You use a view criteria filter expression to identify the specific rows you want to retrieve from a view object. Each expression includes the case-sensitive name of a queriable field, followed by an operator and one or more operand values (depending on the operator used). Each operand value can be either a literal value or a bind variable value. An attempt to filter on a field that is not queriable or a field name that does not exist in the current object will raise an error. The following are simple examples of filter expressions.

To test whether a value is `null` you must use the `is null` or the `is not null` keywords:

- `AssignedTo_Id_c is null`
- `AssignedTo_Id_c is not null`

For equality use the `=` sign, and for inequality use either the `!=` or the `<>` operators. Literal datetime values must adhere exclusively to the format shown here.

- `NextCallSchedule_c = '2015-07-15 16:26:30'`
- `AssignedTo_Id_c = 100000000089003`
- `Priority_c != 1`
- `Priority_c <> 1`
- `ActivityType_c != 'RS'`
- `ActivityType_c <> 'RS'`

For relational comparisons, use the familiar `<`, `<=`, `>`, or `>` operators, along with `between` or `not between`. Literal date values must adhere exclusively the format shown here.

- `CreationDate >= '2015-07-15'`
- `Priority_c <= 2`
- `Priority_c < 3`
- `Priority_c <> 1`
- `Priority_c > 1`
- `Priority_c >= 1`
- `TotalLoggedHours_c >= 12.75`
- `Priority_c between 2 and 4`
- `Priority_c not between 2 and 4`

For string matching, you can use the `like` operator, employing the percent sign `%` as the wildcard character to obtain "starts with", "contains", or "ends with" style filtering, depending on where you place your wildcard(s):

- `RecordName like 'TT-%'`
- `RecordName like '%-TT'`
- `RecordName like '%-TT-%'`

To test whether a field's value is in a list of possibilities, you can use the `in` operator:

- `ActivityType_c in ('OC','IC','RS')`

You can combine expressions using the conjunctions `and` and `or` along with matching sets of parentheses for grouping to create more complex filters like:

- `(AssignedTo_Id_c is null) or ( (Priority_c <= 2) and (RecordName like 'TT-99%'))`
- `(AssignedTo_Id_c is not null) and ( (Priority_c <= 2) or (RecordName like 'TT-99%'))`

When using the `between` or `in` clauses, you must surround them by parentheses when you join them with other clauses using `and` or `or` conjunctions.

You use a filter expression in one of two ways:

1. Append the view criteria filter expression using `appendViewCriteria()` to a view object created using `newView()`
2. Create the view criteria by passing a filter expression to `newViewCriteria()`, then filter a related collection with `findRowsMatchingCriteria()`

Filter expressions are not validated at compile time, so if your expression contains typographical errors like misspelled field names, incorrect operators, mismatched parentheses, or other errors, you will learn of the problem at runtime when you test your business logic.

Tips for Formatting Longer Criteria Across Multiple Lines

Groovy does not allow carriage returns or newlines to appear inside of a quoted string, so for example, the following lines of script would raise an error:

```
def vo = newView("StaffMember")
// ERROR: Single-line quotes cannot contain carriage returns or new lines
vo.appendViewCriteria("
  (Salary between 10000 and 24000)
  and JobId <> 'AD_VP'
  and JobId <> 'PR_REP'
  and CommissionPct is null
  and Salary != 11000
  and Salary != 12000
  and (DepartmentId < 100
       or DepartmentId > 200)
")
vo.executeQuery()
```

Luckily, Groovy supports the triple-quote-delimited, multi-line string literal, so you can achieve a more readable long view criteria filter expression using this as shown:

```
def vo = newView("StaffMember")
vo.appendViewCriteria("""
  (Salary between 10000 and 24000)
  and JobId <> 'AD_VP'
  and JobId <> 'PR_REP'
  and CommissionPct is null
  and Salary != 11000
  and Salary != 12000
  and (DepartmentId < 100
       or DepartmentId > 200)
""")
vo.executeQuery()
```

Using String Substitution for Literal Values into a View Criteria Expression Used Only Once

If you will only be using a view object a single time after calling `newView()`, you can use Groovy's built-in string substitution feature to replace variable or expression values directly into the view criteria expression text as shown in the following example:

```
def vo = newView("StaffMember")
def loSal = 13500
def anon = 'Anonymous'
vo.appendViewCriteria("(Salary between ${loSal} and ${loSal + 1}) and LastName != '${anon}'")
vo.executeQuery()
```

Notice that you must still include single quotes around the literal string values. The string subsitution occurs at the moment the string is passed to the `appendViewCriteria()` function, so if the values of the `loSal` or `anon` variables change, their new values are not reflected retroactively in the substituted string filter criteria expression. In this example below, Groovy substitutes the values of the `loSal` and `anon` into the view criteria expression string before passing it to the `appendViewCriteria()` function. Even though their values have changed later in the script, when the `vo.executeQuery()` is performed a second time, the view object re-executes using the exact same filter expression as it did before, unaffected by the changed variable values.

```
def vo = newView("StaffMember")
def loSal = 13500
def anon = 'Anonymous'
vo.appendViewCriteria("(Salary between ${loSal} and ${loSal + 1}) and LastName != '${anon}'")
vo.executeQuery()
// ... etc ...
loSal = 24000
anon = 'Julian'
// The changed values of 'loSal' and 'anon' are not used by the
// view criteria expression because the one-time string substitutions
// were done as part of the call to appendViewCriteria() above.
vo.executeQuery()
```

If you need to use a view object with appended view criteria filter expression multiple times within the same script, use named bind variables as described in the following section instead of string substitution. Using named bind variables, the updated values of the variables are automatically used by the re-executed query.

Using Custom Bind Variables for View Criteria Used Multiple Times

Often you may need to execute the same view object multiple times within the same script. If your operand values change from query execution to query execution, then named bind variables allow you to append a view criteria once, and use it many times with different values for the criteria expression operands. Just add one or more named bind variables to your view object, and then set the values of these bind variables as appropriate before each execution. The bind variables act as "live" placeholders in the appended filter expression, and their current values are used each time the view object's query is executed.

To add a named bind variable, use the `addBindVariable()` function. Pass a view object or rowset as the first argument and a string value to define the name of the bind variable as the second argument as shown in the example below. You can name your bind variable using any combination of letters, numbers, and underscores, as long as the name starts with a letter. When using a view criteria with a standard object like the `StaffMember` in this example, it is best practice to name your bind variables with the same suffix (`_c`) as custom objects and custom fields use.

```
def vo = newView("StaffMember")
addBindVariable(vo,"VarLastName_c")
setBindVariable(vo,"VarLastName_c","King")
vo.appendViewCriteria("LastName = :VarLastName_c")
vo.executeQuery()
while (vo.hasNext()) {
  def r = vo.next();
  // Will return "Steven King" and "Janette King"
}
setBindVariable(vo,"VarLastName_c","Higgins")
vo.executeQuery()
while (vo.hasNext()) {
  def r = vo.next();
  // Will return "Shelley Higgins"
}
```

You can reference a named bind variable in the view criteria expression anywhere a literal value can be used, prefacing its name by a colon (e.g. `:VarLastName_c`). After adding the bind variable, you use the `setBindVariable()` function one or more times in your script to assign values to the variable. Until you explicitly set its value for the current view object or rowset, your bind variable defaults to having a value of `null`. Accidentally leaving the value `null` will result in retrieving no rows for most filter expressions involving a bind variable operand due to how the SQL language treats the `null` value in comparisons. The current value of the bind variable is used each time your script executes the view object. In the example below, this causes the rows for employees "Steven King" and "Janette King" to be returned during the first view object execution, and the row for "Shelly Higgins" to be returned on the second view object execution.

By default, the data type of the named bind variable is of type `Text`. If you need to use a bind variable in filter expressions involving number, date, or datetime fields, then you need to explicitly define a bind variable with the appropriate type for best performance. To add a bind variable of a specific datatype, pass one of the values `Text`, `Number`, `Date`, or `Datetime` as a string value to the optional third argument of the `addBindVariable()` function. For example, the following script uses two bind variables of type `Number` and another of type `Date`. Notice that the data type name is not case-sensitive (e.g. `Number`, `number`, or `NUMBER` are all allowed).

```
def vo = newView('TroubleTicket_c')
addBindVariable(vo,"VarLowPri_c","number")
addBindVariable(vo,"VarHighPri_c","Number")
addBindVariable(vo,"VarDueDate_c","DATE")
setBindVariable(vo, "VarLowPri_c", 1)
setBindVariable(vo, "VarDueDate_c", 2)
setBindVariable(vo, "VarDueDate_c", today() + 3)
vo.appendViewCriteria("(Priority__c between :VarLowPri_c and :VarHighPri_c) and DueDue < :VarDueDate_c
 ")
vo.executeQuery()
```

```
while (vo.hasNext()) {
  def row = vo.next()
  // Returns trouble tickets with priorities 1 and 2 that are
  // due within three days from today
}
setBindVariable(vo, "VarLowPri_c", 3)
setBindVariable(vo, "VarDueDate_c", 4)
setBindVariable(vo, "VarDueDate_c", today() + 5)
vo.executeQuery()
while (vo.hasNext()) {
  def row = vo.next()
  // Returns trouble tickets with priorities 3 and 4 that are
  // due within five days from today
}
```

Using View Criteria to Query Case-Insensitively

If you want to filter in a case-insensitive way, you can use the `upper()` function around the field name in the filter. If you are not sure whether the operand value is uppercase, you can also use the `upper()` function around the operand like this:

- `upper(JustificationCode_c) = 'BRK'`
- `upper(JustificationCode_c) = upper(:VarJustCode_c)`
- `upper(JustificationCode_c) like upper(:VarJustCode_c)||'%'`

Limitations of View Criteria Filter Expressions

While view criteria filter expressions are extremely convenient, they do not support every possible type of filtering that you might want to do. This section describes several constructs that are not possible to express directly, and where possible, suggests an alternative way to achieve the filtering.

- *Only a case-sensitive field name is allowed before the operator*

  On the left hand side of the operator, only a case-sensitive field name is allowed. So, for example, even a simple expression like `1 = 1` is considered illegal because the left-hand side is not a field name.

- *Cannot reference a calculated expression directly as an operand value*

  You might be interested in querying all rows where one field is equal to a calculated quantity. For example, when querying trouble tickets you might want to find all open tickets whose Due Date is less than three days away. Unfortunately, an expression like `ResolutionPromisedDate_c <= today() + 3` is not allowed because is used a calculated expression on the right hand side of the operator. As an alternative, you can compute the value of the desired expression prior to appending the view criteria and use the already-computed value as a literal operand value string substitution variable in the string or as the value of a bind variable.

- *Cannot reference a field name as an operand value*

  You might be interested in querying all rows where one field is equal to another field value. For example, when querying contacts you might want to find all contacts whose Home Phone Number is equal to their Work Phone Number. Unfortunately, an expression like `HomePhoneNumber_c = WorkPhoneNumber_c` is not allowed because it uses a field name on the right hand side of the operator. A clause such as this will be ignored at runtime, resulting in no effective filtering.

- *Cannot reference fields of related objects in the filter expression*

  It is not possible to reference fields of related objects directly in the filter query expression. As an alternative, you can reference the value of a related expression prior to appending the view criteria and use the already-computed value as a literal operand value string substitution variable in the string or as the value of a bind variable.

- *Cannot use bind variable values of types other than Text, Number, Date, or Datetime*

  It is not possible to use bind variable values of types other than the four supported types: Text, Number, Date, and Datetime. An attempt to use other data types as the value of a bind variable may result in errors or in the criteria's being ignored.

Finding Rows in a Child Rowset Using findRowsMatchingCriteria

In addition to using view criteria to filter a view object that you create using `newView()`, you can also use one to retrieve a subset of the rows in a related collection. For example, if a TroubleTicket custom object contains a child object collection of related activities, you can process selected activities in the related collection using code as shown below:

```
def vo = newView('TroubleTicket__c')
vo.appendViewCriteria("Priority_c = 1 and Status_c = 'Open')
vo.executeQuery()
def vc = null
// Process all open P1 trouble tickets
while (vo.hasNext()) {
  def curTicket = vo.next()
  def activities = curTicket.ActivityCollection_c
  if (vc == null) {
    addBindVariable(activities,"TodaysDate","date")
    vc = newViewCriteria(activities,"ActivityType_c in ('OC','IC') and CreationDate > :TodaysDate")
  }
  // Process the activities created today for inbound/outbound calls
  setBindVariable(activities,"TodaysDate",today())
  def iter = activities.findRowsMatchingCriteria(vc,-1)
  while (iter.hasNext()) {
    def activity = iter.next()
    // process the activity here
  }
}
```

Using a Predefined View Criteria on a Standard Object

Standard objects may predefine named view criteria you can use in your scripts to simplify common searches. See a particular standard object's documentation to learn whether it defines any named view criteria. After learning the name of the view criteria you want to employ, use the `copyNamedViewCriteria()` function to use it in your script. The example below shows the code you need to work with a fictitious `ServiceTicket` standard object that predefines an `AllSeverityOneOpenTickets` named view criteria.

```
/*
 * Query all open severity 1 service tickets
 * using a predefined view criteria
 */
// 1. Use newView() to get a view object
def vo = newView('ServiceTicket')
// 2. Copy predefined named view criteria
def vc = copyNamedViewCriteria(vo,'AllSeverityOneOpenTickets')
```

```
// 3. Append view criteria to the view object
vo.appendViewCriteria(vc)
// 4. Execute the query
vo.executeQuery()
```

Named view criteria may reference named bind variables in their filter criteria. Your code *can* (or sometimes must!) assign a value to one or more these bind variables for the view criteria to work correctly. After consulting the documentation for the standard object you are working with, if it mentions that named bind variables must be set, then use the `setBindVariable()` function to assign a value to these in your script before executing the query. The example below shows the code you need to work with a fictitious `ServiceTicket` standard object that predefines an `AllOpenTicketsByAssigneeAndPriority` named view criteria. The `Bind_MaxPriority` bind variable might default to the value `4`, so it may be optional to set it in your script. In contrast, the `Bind_Assignee` bind variable would likely *not* have a default value and your script must provide a value. Failure to do this would result in the query's returning no rows.

```
/*
 * Query all open tickets less than a given priority
 * assigned to a given support engineer
 */
// 1. Use newView() to get a view object
def vo = newView('ServiceTicket')
// 2. Copy predefined, named view criteria
def vc = copyNamedViewCriteria(vo,'AllOpenTicketsByAssigneeAndPriority')
// 3. Append view criteria to the view object
vo.appendViewCriteria(vc)
// 4. Set optional Bind_Priority bind variable
setBindVariable(vo,'Bind_MaxPriority',2)
// 5. Set mandatory Bind_Assignee bind variable
setBindVariable(vo,'Bind_Assignee','psmith')
// 6. Execute the query
vo.executeQuery()
```

Creating a New Object

To create a new object, follow these steps:

1. Use the `newView()` function to obtain the view object for programmatic access for the business object in question
2. Call the `createRow()` function on the view object to create a new row
3. Call `setAttribute()` as needed to set the desired field values in the new row
4. Call `insertRow()` on the view object to insert the row.

The new object will be saved the next time you save your work as part of the current transaction. The example below shows how the steps fit together in practice.

```
// Access the view object for the custom TroubleTicket object
def vo = newView('TroubleTicket_c')
// Create the new row
def newTicket = vo.createRow()
// Set the problem summary
newTicket.setAttribute('ProblemSummary_c','Cannot insert floppy disk')
// Assign the ticket a priority
newTicket.setAttribute('Priority_c',2)
// Relate the ticket to a customer by name
newTicket.setAttribute('Contact_c','Tim Tubbington')
```

```
// Relate the ticket to a staff member by name
newTicket.setAttribute('AssignedTo_c','Jane Jedeye')
// Insert the new row into the view object
vo.insertRow(newTicket)
// The new data will be saved to the database as part of the current
// transaction when it is committed.
```

Updating an Existing Object

If the object you want to update is the current row in which your script is executing, then you need only use the `setAttribute()` function to assign new values to the fields as needed.

However, if you need to update an object that is different from the current row, perform these steps:

1. Use `newView()` to access the appropriate view object for programmatic access
2. Find the object by id or find one or more objects using a view criteria, depending on your use requirements
3. Call the `setAttribute()` method on the row or rows to assign new values as needed

The changes will be saved as part of the current transaction when the user commits it.

Tip:

See Avoiding Validation Threshold Errors By Conditionally Assigning Values for a tip about how to avoid your field assignments from causing an object to hit its validation threshold.

Permanently Removing an Existing Object

To permanently remove an existing object, perform these steps:

1. Use `newView()` to access the appropriate view object for programmatic access
2. Find the object by id or find one or more objects using a view criteria, depending on your use requirements
3. Call the `remove()` method on the row or rows as needed

The changes will be saved as part of the current transaction when the user commits it.

Reverting Changes in a Single Row

To revert pending changes to an existing object, perform these steps:

1. Use `newView()` to access the appropriate view object for programmatic access
2. Find the object by id
3. Call the `revertRowAndContainees()` method as follows on the row

```
yourRow.revertRowAndContainees()
```

Understanding Why Using Commit or Rollback In Scripts Is Disallowed

By design you cannot commit or rollback the transaction from within your scripts. Any changes made by your scripts get committed or rolled-back along with the rest of the current transaction. If your script code were allowed to call `commit()` or `rollback()`, this would affect all changes pending in the current transaction, not only those performed by your script and could lead to data inconsistencies.

Using the User Data Map

The Oracle ADF framework provides a map of name/value pairs that is associated with the current user's session. You can use this map to temporarily save name/value pairs for use by your business logic. Be aware that the information that you put in the user data map is never written out to a permanent store, and is not replicated under failover conditions. If the code that reads the value in the user data map executes as part of different web request from the code that put the value in the map, then that code reading the map should be written to expect that the value that has been put their may not be there as expected (due to server failover).

To access the server map from a validation rule or trigger, use the expression `adf.userSession.userData` as shown in the following example:

```
// Put a name/value pair in the user data map
adf.userSession.userData.put('SomeKey', someValue)

// Get a value by key from the user data map
def val = adf.userSession.userData.SomeKey
```

Tip:

See Using Groovy Maps and Lists with Web Services for more information on using maps in your scripts.

Referencing Information About the Current User

The `adf.context.getSecurityContext()` expression provides access to the security context, from which you can access information about the current user like her user name or whether she belongs to a particular role. The following code illustrates how to reference these two pieces of information:

```
// Get the security context
def secCtx = adf.context.getSecurityContext()
// Check if user has a given role
if (secCtx.isUserInRole('MyAppRole')) {
  // get the current user's name
  def user = secCtx.getUserName()
  // Do something if user belongs to MyAppRole
}
```

Using Aggregate Functions

Oracle ADF's built-in support for row iterator aggregate functions can simplify a number of common calculations you will perform in your scripts, especially in the context of scripts written in a parent object which has one or more collections of child objects.

Understanding the Supported Aggregate Functions

Oracle ADF supports five built-in aggregate functions over all the rows in a row set. The most common use case is to calculate an aggregate value of a child collection in the context of a parent object. The table below provides a description and example of the supported functions.

Table 8: Supported Aggregate Functions

Supported Aggregate Functions

Aggregate Function	Description	Example (in Context of`TroubleTicket` Parent Object
`avg`	Average value of an expression	`ActivityCollection_c.avg('Duration_c')`
`min`	Minimum value of an expression	`ActivityCollection_c.min('Duration_c')`
`max`	Maximum value of an expression	`ActivityCollection_c.max('Duration_c')`
`sum`	Sum of the value of an expression	`ActivityCollection_c.sum('Duration_c')`
`count`	Count of rows having a non-null expression value	`ActivityCollection_c.count('Duration_c')`

Understanding Why Aggregate Functions Are Appropriate Only to Small Numbers of Child Rows

The aggregate functions described in this section compute their result by retrieving the rows of a child collection from the database and iterating through all of these rows in memory. This fact has two important consequences. The first is that these aggregate functions should only be used when you know the number of rows in the child collection will be reasonably small. The second is that your calculation may encounter a runtime error related to exceeding a fetch limit if the child collection's query retrieves more than 500 rows.

Understanding How Null Values Behave in Aggregate Calculation

When an ADF aggregate function executes, it iterates over each row in the row set. For each row, it evaluates the Groovy expression provided as an argument to the function in the context of the current row. If you want a null value to be considered as zero for the purposes of the aggregate calculation, then use the `nvl()` function like this:

```
// Use nvl() Function in aggregate expression
def avgDuration = ActivityCollection_c.min('nvl(Duration_c,0)')
```

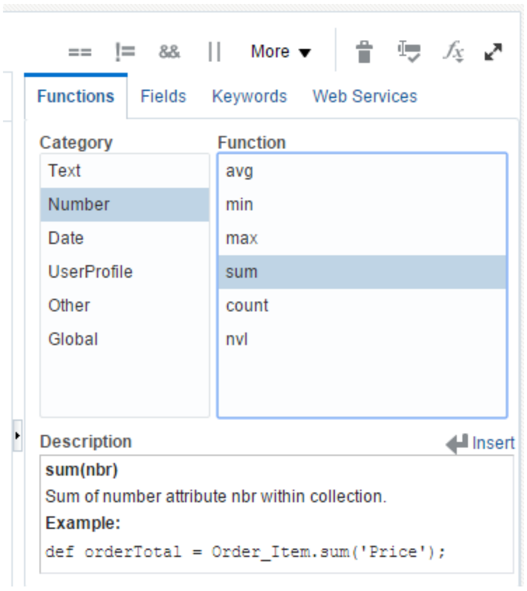
Performing Conditional Counting

In the case of the `count()` function, if the expression evaluates to null then the row is not counted. You can supply a conditional expression to the `count()` function which will count only the rows where the expression returns a non-null value. For example, to count the number of child activities for the current trouble-ticket where the Duration was over half an hour, you can use the following expression:

```
// Conditional expression returns non-null for rows to count
// Use the inline if/then/else operator to return 1 if the
// duration is over 0.5 hours, otherwise return null to avoid
// counting that the non-qualifying row.
def overHalfHourCount = ActivityCollection_c.count('nvl(Duration_c,0) > 0.5 ? 1 : null')
```

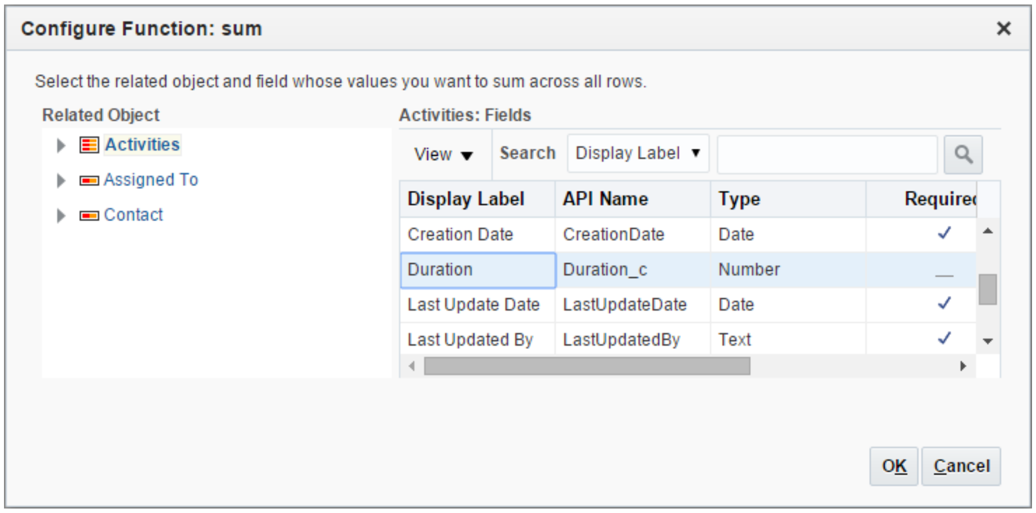
Inserting an Aggregate Expression Using the Expression Palette

As shown in the figure below, the Expression Palette's *Functions* tab allows you to insert any of the aggregate functions. They appear in the *Number* category.



sum(nbr)
Sum of number attribute nbr within collection.
Example:
```
def orderTotal = Order_Item.sum('Price');
```

After selecting the desired function and clicking the (*Insert*) button, as shown in the following figure, and additional *Configure Function* dialog appears to allow you to select the field name over which the aggregate function will be performed. Note that in this dialog, the *Fields* table only shows field names when you select an object representing a multi-row collection in the tree at the left.



Display Label	API Name	Type	Require
Creation Date	CreationDate	Date	✓
Duration	Duration_c	Number	—
Last Update Date	LastUpdateDate	Date	✓
Last Updated By	LastUpdatedBy	Text	✓

Understanding When to Configure Field Dependencies

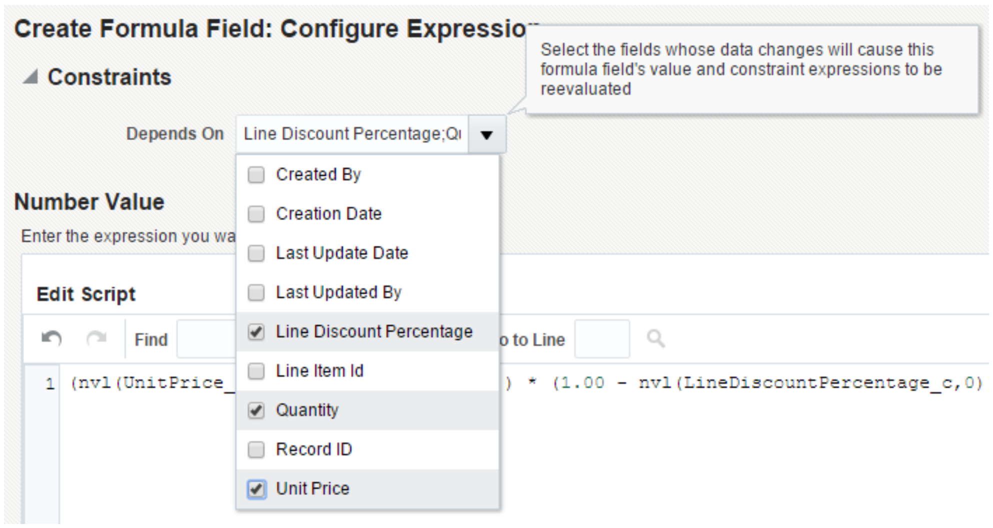
You need to correctly configure dependent field information when you define a formula field or when you configure conditionally updateable and/or conditionally required expressions. If you fail to correctly configure this information, your application will not behave correctly at runtime.

Configuring Depends On Fields for a Formula

The ADF framework — unlike, say, a spreadsheet program — does not automatically infer what field(s) your Groovy scripts depend on. For example, suppose that in a `OrderLineItem` object, you added a formula field named `LineTotal` object having the following Groovy formula:

```
(nvl(UnitPrice_c,0) * nvl(Quantity_c,0)) * (1.00 - nvl(LineDiscountPercentage_c,0))
```

On its own, the ADF framework would not be able to automatically recalculate the line total when the user changed the `UnitPrice`, `Quantity`, or `LineDiscountPercentage` Instead, you manually configure the *Depends On* information for any field formulas need it. For example, the figure below shows the *Depends On* multi-select list configured to reflect the fields on which the `LineTotal` formula depends. With this information correctly configured, the `LineTotal` will automatically update to reflect the new value whenever any of the values of the field on which it depends is changed.


Create Formula Field: Configure Expressio
Constraints
Select the fields whose data changes will cause this formula field's value and constraint expressions to be reevaluated
Depends On
Line Discount Percentage;Qu
Number Value
Enter the expression you wa
Edit Script
Find
o to Line
Created By
Creation Date
Last Update Date
Last Updated By
Line Discount Percentage ✓
Line Item Id
Quantity ✓
Record ID
Unit Price ✓

```
(nvl(UnitPrice_ ) * (1.00 - nvl(LineDiscountPercentage_c,0)
```

Configuring Depends On Fields for Conditional Updateability or Conditional Mandatory

When you define a formula field, the *Depends On* multi-select list is always visible. However, for other field types it is only visible when you have configured either a conditionally updateable expression or a conditionally required expression. In this latter case, it appears to remind you that you must configure the information that tells the Oracle ADF framework on which other fields your conditionally updateable and/or conditionally required expression depends. If you fail to configure this information, your application will not behave correctly.

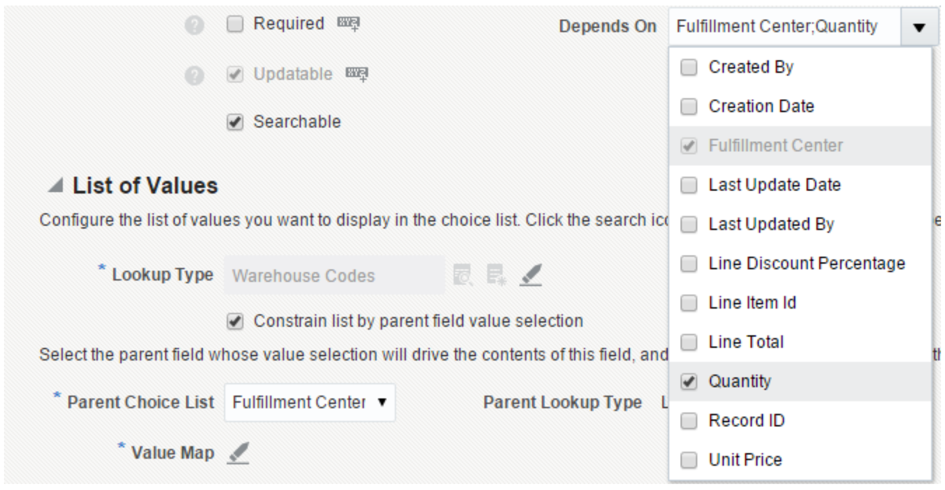
Understanding Automatic Dependency Information for Cascading Fixed-Choice Lists

Assume that you have defined two fixed-choice fields on the `OrderLineItem` objects named `FulfillmentCenter` and `FulfillmentWarehouse`. When defining the `FulfillmentWarehouse` field, further assume that you configured it to be constrained based on the value of the `FulfillmentCenter` field. This combination allows the end-user to first pick a fulfillment center, then to pick an appropriate fulfillment warehouse related to that choice of fulfillment center. If the user changes the value of the fulfillment center, then the current value of the fulfillment warehouse is set to `null` to force the end-user to select an appropriate fulfillment warehouse based on the new value of the constraining `FulfillmentCenter` field. This type of cascading fixed-choice list dependency is automatically configured when you setup the "constrained by" field as part of defining the second fixed-choice field. In this example, the `FulfilmentWarehouse` field depends on the `FulfillmentCenter` field.

Next, assume that your application has the requirement to allow configuring the fulfillment warehouse only for line items with a quantity greater than five. To support this functionality, you would configure the following conditionally updateable expression on the `FulfillmentWarehouse` field:

```
Quantity_c > 5
```

After doing this, the *Depends On* multi-select list will appear in the *Constraints* section so you can configure the fact that your `FulfillmentWarehouse` now also depends on the `Quantity` field. After doing this, when the user changes the value of the quantity at runtime, this will dynamically affect whether the fulfillment warehouse field is updateable or not. The figure below shows the process of configuring the *Quantity* field as one on which the `FulfillmentWarehouse` field now depends. Notice that the *Fulfillment Center* field appears selected in the *Depends On* list, yet is disabled. This is because that dependency is required for the correct runtime functionality of the constrained fixed-choice fields and so you are not allowed to remove it.



Enforcing Conditional Updateability of Custom Fields for Web Service Access

In this release any conditional updateability expression you provide for a field is enforced only within the web application's user interface. Depending on the condition you've provided — assuming you have correctly configured the *Depends On* information as described in Configuring Depends On Fields for Conditional Updateability or Conditional Mandatory — the field in the user interface will enable or disable as appropriate. However, the same cannot be said for updates to that field performed through the web service interface. Using the example from Understanding Automatic Dependency Information for Cascading Fixed-Choice Lists, if the line item's quantity field is less than or equal to five (5), then the fulfillment warehouse field will be disabled in the user interface. In contrast, if a system attempts to update the same line item using the web service interface, an attempt to update `FulfillmentWarehouse` will succeed *regardless of the value of the Quantity field!*

To enforce this conditional updateability through the web service as well, you need to add an object-level validation rule that enforces the same condition. For example, you would configure the following rule to prevent web service updates to the fulfillment warehouse value if the quantity is not greater than five:

- **Rule Name**: `Warehouse_Updateable_Only_With_Quantity_Over_Five`

- **Error Message**: `A warehouse can be specified only for quantities over five`

Rule Body

```
// If the fulfillment warehouse is changed, ensure the
// quantity is greater than five (5)
if (isAttributeChanged('FulfillmentWarehouse_c')) {
  if (Quantity_c <= 5) {
    return false
}
return true
```

Implementing Non-Formula Field Changeable Only From Script

Assume you want to add a `LineEditedCount` field to the `OrderLineItem` object to track how many times it has been edited. The field value needs to be stored in the database, so a formula field is not appropriate. Start by adding a custom field of type Number to the object, configuring its default value to be the literal value `0` (zero). Next, configure a conditionally updateable expression for the new `LineEditedCount` with the expression:

```
false
```

This will cause the user interface to always see that the field is not updateable, and the value will only be updateable from script. Note that configuring the conditionally updateable expression to always return `false` is semantically different from unchecking the *Updateable* checkbox. Doing the latter, your field would never be updateable (neither from the user interface nor from script). Using the conditionally updateable expression, the updateability enforcement is done only at the user interface level.

Finally, to derive the value of the `LineEditedCount` you would add the following trigger:

- **Trigger Object**: `OrderLineItem`
- **Trigger**: *Before Update In Database*
- **Trigger Name**: `Before_Update_Adjust_Edited_Count`

Trigger Definition

```
adf.util.logStart('Before_Update_Adjust_Edited_Count')
// Get the original value of the LineEditedCount field
def origCount = getOriginalAttributeValue('LineEditedCount_c')
def newCount = origCount + 1
// Only assign the value if it's not already what we want it to be
if (LineEditedCount_c != newCount) {
  setAttribute('LineEditedCount_c',newCount)
}
```

Understanding When Field Default Value Expressions Are Evaluated

A default value expression provides you the ability to dynamically calculate the initial value of a field in a newly-created row. If you configure a default value expression for a field, it is evaluated only when a new row is created. The expression is not evaluated at any other time. If your use case requires the value of a field to change automatically when the value of one or more other fields is changed, see Deriving Values of a Field When Other Fields Change Value.

Understanding the Difference Between Default Expression and Create Trigger

There are two ways you can assign default values to fields in a newly-created row and it is important to understand the difference between them.

The first way is to provide a *default value expression* for one or more fields in your object. Your default value expression should **not** depend on other fields in the same object since you cannot be certain of the order in which the fields are assigned their default values. The default value expression should evaluate to a legal value for the field in question and it should not contain any `setAttribute()` calls as part of the expression. The framework evaluates your default expression and assigns it to the field to which it is associated automatically at row creation time.

On the other hand, If you need to assign default values to one or more fields after first allowing the framework to assign each field's literal default values or default value expression, then the second way is more appropriate. Define a `Create` trigger on the object and inside that trigger you can reference any field in the object as well as perform any `setAttribute()` calls to assign default values to one or more fields.

Deriving Values of a Field When Other Fields Change Value

There are three different use cases where you might want to derive the value of a field. This section assists you in determining which one is appropriate for your needs.

Deriving the Value of a Formula Field When Other Fields Change Value

If the value of your derived field is calculated based on other fields and its calculated value does not need to be permanently stored, then use a formula field. To derive the value of the formula field, perform these two steps:

1. Configure the formula expression
2. Configure the *Depends On* information to indicate the fields on which your formula expressions depends

Deriving the Value of Non-Formula Field When Other Fields Change Value

If the value of your derived field must be stored, then use one of strategies in this section to derive its value.

Deriving a Non-Formula Field Using a Before Trigger

The simplest way to derive a stored field's value is to create an appropriate "before" trigger (*Before Insert in Database* and/or *Before Update in Database*) which sets the field's value to your calculated value by calling the `setAttribute()`. See Testing Whether a Field's Value Is Changed for more information on this function and Avoiding Validation Threshold Errors By Conditionally Assigning Values for a tip about how to avoid your field assignments from causing an object to hit its validation threshold.

Deriving a Non-Formula Field Using an After Field Changed Trigger

If you want the end-user to see the derived field's value update on the user interface immediately, then you need to perform the assignment of the derived field's value inside an *After Field Changed* trigger. When this trigger fires, the value of the field in question has already changed. Therefore, you can simply reference the new value of the field by name instead of using the special `newValue` expression (as would be required in a field-level *validation rule* to reference the field's candidate new value that is attempting to be set).

Setting Invalid Fields for the UI in an Object-Level Validation Rule

When a field-level validation rule that you've written returns `false`, ADF signals the failed validation with an error and the field is highlighted in red in the user interface to call the problem to the user's attention. However, since object-level validation rules involve multiple fields, the framework does not know which field to highlight in the user interface as having the problematic value. If you want your object-level validation rule to highlight one or more fields as being in need of user review to resolve the validation error, you need to assist the framework in this process. You do this by adding a call to the `adf.error.addAttribute()` function in your validation rule script before returning `false` to signal the failure. For example, consider the following rule to enforce: A contact cannot be his/her own manager. Since the `Id` field of the `Contact` object cannot be changed, it will make sense to flag the `Manager_Id` field — a secondary field related to the `Manager` lookup field — as the field in error to highlight in the user interface. Here is the example validation rule.

- **Rule Name**: `Contact_Cannot_Be_Own_Manager`
- **Error Message**: `A contact cannot be his/her own manager`

Rule Body

```
// Rule depends on two fields, so must be
// written as object-level rule
if (Manager_Id_c == Id) {
  // Signal to highlight the Manager field on the UI
  // as being in error. Note that Manager_Id field
  // is not shown in the user interface!
  adf.error.addAttribute('Manager_c')
  return false
}
return true
```

Determining the State of a Row

A row of data can be in any one of the following states:

- **New**

  A new row that will be inserted into the database during the next save operation.

- **Unmodified**

  An existing row that has not been modified

- **Modified**

  An existing row where one or more values has been changed and will be updated in the database during the next save operation

- **Deleted**

  An existing row that will be deleted from the database during the next save operation

- **Dead**

  A row that was new and got removed before being saved, or a deleted row after it has been saved

To determine the state of a row in your Groovy scripts, use the function `getPrimaryRowState()` and its related helper methods as shown in the following example.

```
// Only perform this business logic if the row is new
if (getPrimaryRowState().isNew())
{
  // conditional logic here
}
```

The complete list of helper methods that you can use on the return value of `getPrimaryRowState()` is shown below:

- **isNew()**

  Returns boolean `true` if the row state is new, `false` otherwise.

- **isUnmodified()**

  Returns boolean `true` if the row state is unmodified, `false` otherwise.

- **isModified()**

  Returns boolean `true` if the row state is modified, `false` otherwise.

- **isDeleted()**

  Returns boolean `true` if the row state is deleted, `false` otherwise.

- **isDead()**

  Returns boolean `true` if the row state is dead, `false` otherwise.

Understanding How Local Variables Hide Object Fields

If you define a local variable whose name is the same as the name of a field in your object, then be aware that this local variable will take precedence over the current object's field name when evaluated in your script. For example, assuming your object has a custom field named `Status_c`, then consider the following object validation script:

```
// Assuming current object has a Status_c field
def Status_c = 'Closed'
/*
 *    :
 * imagine pages full of complex code here
 *    :
 */
// If the object's current status is Open, then change it to 'Pending'
// ------------------
// POTENTIAL BUG HERE: The Status_c local variable takes precedence
// ------------------  so the Status_c field value is not used!
//
if (Status_c == 'Open') {
  setAttribute('Status_c','Pending')
}
```

At the top of the example, a variable named `Status_c` is defined. After pages full of complex code, later in the script the author references the custom field named `Status_c` without remembering that there is also a local variable named `Status_c` defined above. Since the local variable named `Status_c` will always take precedence, the script will never enter into the conditional block here, regardless of the current value of the `Status_c` field in the current object. As a rule of thumb, use a naming scheme for your local variables to ensure their names never clash with object field names.

Invoking Web Services from Your Scripts

Calling web service methods from your scripts involves two high-level steps:

1. Registering a variable name for the web service you want to invoke
2. Writing Groovy code that prepares the inbound arguments, calls the web service function, and then processes the return value

Using Groovy Maps and Lists with Web Services

When passing and receiving structured data from a web service, a Groovy `Map` represents an object and its properties. For example, an `Employee` object with properties named `Empno` , `Ename`, `Sal`, and `Hiredate` would be represented by a `Map` object having four key/value pairs, where the names of the properties are the keys.

You can create an empty `Map` using the syntax:

```
def newEmp = [:]
```

Then, you can add properties to the map using the explicit `put()` method like this:

```
newEmp.put("Empno",1234)
newEmp.put("Ename","Sean")
newEmp.put("Sal",9876)
newEmp.put("Hiredate",date(2013,8,11))
```

Alternatively, and more conveniently, you can assign and/or update map key/value pairs using a simpler direct assignment notation like this:

```
newEmp.Empno = 1234
newEmp.Ename = "Sean"
newEmp.Sal = 9876
newEmp.Hiredate = date(2013,8,11)
```

Finally, you can also create a new map and assign some or all of its properties at once using the constructor syntax:

```
def newEmp = [Empno    : 1234,
              Ename    : "Sean",
              Sal      : 9876,
              Hiredate : date(2013,8,11)]
```

To create a collection of objects you use the Groovy `List` object. You can create one object at a time and then create an empty list, and call the list's `add()` method to add both objects to the list:

```
def dependent1 = [Name      : "Dave",
                  BirthYear : 1996]
def dependent2 = [Name      : "Jenna",
                  BirthYear : 1999]
def listOfDependents = []
listOfDependents.add(dependent1)
listOfDependents.add(dependent2)
```

To save a few steps, the last three lines above can be done in a single line by constructing a new list with the two desired elements in one line like this:

```
def listOfDependents = [dependent1, dependent2]
```

You can also create the list of maps in a single go using a combination of list constructor syntax and map constructor syntax:

```
def listOfDependents = [[Name      : "Dave",
                         BirthYear : 1996],
                        [Name      : "Jenna",
                         BirthYear : 1999]]
```

If the employee object above had a property named `Dependents` that was a list of objects representing dependent children, you can assign the property using the same syntax as shown above (using a list of maps as the value assigned):

```
newEmp.Dependents = [[Name      : "Dave",
                      BirthYear : 1996],
                     [Name      : "Jenna",
                       BirthYear : 1999]]
```

Lastly, note that you can also construct a new employee with nested dependents all in one statement by further nesting the constructor syntax:

```
def newEmp = [Empno      : 1234,
              Ename      : "Sean",
              Sal        : 9876,
              Hiredate   : date(2013,8,11),
              Dependents : [
                   [Name      : "Dave",
                    BirthYear : 1996],
                   [Name      : "Jenna",
                    BirthYear : 1999]]
             ]
```

For more information on Maps and Lists, see Using Groovy Maps and Lists with Web Services.

Registering a Web Service Variable

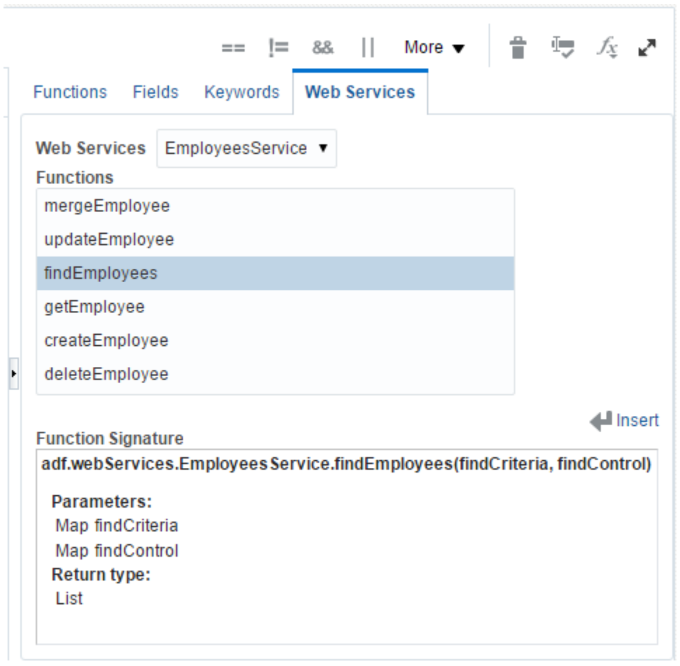
The composer allows you to register a web service for use in your scripts. This capability lets you associate a web service *variable name* with a URL that provides the location of the Web Service Description Language (WSDL) resource that represents the service you want to invoke. For example, you might register a web service variable name of `EmployeeService` for a web service that your application needs to invoke for working with employee data from another system. This service's WSDL resource URL might look something like:

```
http://example.com:8099/Services/EmployeeService?WSDL
```

Of course, the server name, the port number, and path name for your actual service will be different. If the port number is omitted, then it will assume the service is listening on the default HTTP port number 80.

Browsing Available Web Service Methods

When writing your scripts, the ***Web Services*** tab in the expression builder shown in figure below displays the available web service methods for a given web service. The ***Web Services*** drop down list displays the set of registered web service variable names. After you select a particular web service, the ***Functions*** list displays the function names that are available to invoke for that service. As shown in the figure, after selecting a particular method, the *Function Signature* panel lists name of the expected arguments as well as their data types and that of the function's return value. In addition, a code example appears for each parameter that requires a `Map` value. It illustrates the structure the argument must have, include the map key names and expected data type of the map values for each key. You can copy and paste the variable definition statements into your code to replace the tokens like `integerValue`, `booleanValue`, and `stringValue` with appropriate literal values or expressions as necessary. Finally, click on the (*Insert*) button to insert the syntax to invoke the web service method.



adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)

Parameters:
Map findCriteria
Map findControl
Return type:
List

Calling Web Service Methods in Groovy

To invoke a web service method named `someMethodName()` on a web service that you registered with the variable name `YourServiceVariableName`, use the syntax:

```
adf.webServices.YourServiceVariableName.someMethodName(args)
```

For instance, the example below shows how to invoke a `getEmployee()` method on a web service registered with the web service variable name `EmployeeService`, passing the integer `7839` as the single argument to the function.

```
// retrieve Employee object by id from remote system
def emp = adf.webServices.EmployeeService.getEmployee(7839)
// log a message, referencing employee fields with "dot" notation
println('Got employee '+emp.Ename+' with id '+emp.Empno)
// access the nested list of Dependent objects for this employee
def deps = emp.Dependents
if (deps != null) {
  println("Found "+deps.size()+" dependents")
  for (dep in deps) {
    println("Dependent:"+dep.Name)
  }
}
```

The code in the following example illustrates how to use Groovy's convenient Map and List construction notation to create a new employee with two nested dependents. The `newEmp` object is then passed as the argument to the `createEmployee()` method on the service.

```
// Create a new employee object using a Groovy map. The
// nested collection of dependents is a Groovy list of maps
def newEmp = [ Ename:"Steve",
              Deptno:10,
                 Job:"CLERK",
                 Sal:1234,
              Dependents:[[Name:"Timmy",BirthYear:1996],
                          [Name:"Sally",BirthYear:1998]]]
// Create the new employee by passing this object to a web service
newEmp = adf.webServices.EmployeeService.createEmployee(newEmp)
// The service returns a new employee object which may have
// other attributes defaulted/assigned by the service, like the Empno
println("New employee created was assigned Empno = "+ newEmp.Empno)
```

The script in this example shows how to use the `mergeEmployee()` method to update fields in an employee object that is retrieved at the outset via another call to the `getEmployee()` method. The script updates the `Ename` field on the `emp` object retrieved, updates the names of the existing depedents, and then adds a new dependent before calling the `mergeEmployee()` method on the same service to save the changes.

```
// Merge updates and inserts on Employee and nested Dependents
def emp = adf.webServices.EmployeeService.getEmployee(7839)
// update employee's name to add an exclamation point!
emp.Ename = emp.Ename + '!'
def deps = emp.Dependents
// Update dependent names to add an exclamation point!
for (dep in deps) {
   dep.Name = dep.Name + '!'
}
// Add a new dependent
def newChild = [Name:"Jane", BirthYear:1997]
deps.add(newChild)
emp = adf.webServices.EmployeeService.mergeEmployee(emp)
```

Calling the Find Method on an Oracle Service Interface

When your Groovy script needs to invoke a `find` method on the service interface for an Oracle Fusion Applications object, you need to pass a structured `Map` value for its `findCriteria` parameter. This section provides some simple examples you can use to jumpstart your usage of the `find` method. Assume that you've already registered a web service variable named `EmployeesService` for an Oracle Applications web service that provides information about staff members. Furthermore, assume that its standard `find` method is named `findEmployees`.

The script in the following example shows the simplest possible example of creating a correctly-structured `findCriteria` parameter to pass as the first argument to this `findEmployees()` method. This example retrieves all employees whose `Deptno` field is equal to the value `30`. The results are returned using the default sorting order. All fields of the employee object are returned to your calling script by default. Note that the carriage returns and other whitespace used in these examples are purely to improve readability and assist with visually matching the square brackets.

```
// Example findCriteria parameter definition
def findCriteria =
[
  filter:
  [
    group:
    [
      [
        item:
        [
          [
            attribute         :'Deptno',
            operator          :'=',
            value             :[[item:30]]
          ]
        ]
      ]
    ]
  ]
]
// findControl needs to be an empty list rather than null
def findControl = [ ]
def emps = adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)
for (emp in emps) {
  // Do something with each 'emp' row
  println(emp)
}
```

The script in the example below expands on the previous one by adding two additional view criteria items to further constrain the search. To accomplish this, we added two additional maps to the comma-separated list-of-maps value provided for the `item` map entry in the `group` list-of-maps entry of the `filter` map entry. The default conjunction between multiple view criteria items in the same view criteria row is `AND`, so this example finds all employees whose `Deptno` field is equal to `30`, and whose commission field named `Comm` is greater than `300`, and whose `Job` field starts with the value `sales` (using a case-insensitive comparison).

```
  // Example findCriteria parameter definition
  def findCriteria =
  [
    filter:
    [
      group:
      [
        [
          item:
          [
            [
              attribute :'Deptno',
              operator  :'=',
              value     :[[item:30]]
            ],
            [
              attribute :'Comm',
              operator  :'>',
              value     :[[item:300]]
            ],
            [
              upperCaseCompare :true,
              attribute        :'Job',
              operator         :'STARTSWITH',
              value            :[[item:'sales']]
            ]
          ]
        ]
      ]
    ]
  ]
  // findControl needs to be an empty list rather than null
  def findControl = [ ]
```

```
def emps = adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)
for (emp in emps) {
  println(emp)
}
```

The script in this example extends the one above to add a *second* view criteria row to the filter. To accomplish this, we added an additional map to the comma-separated list-of-maps value provided for the `group` list-of-maps entry of the `filter` map entry. The default conjunction between separate view criteria rows in a view criteria filter is `OR`, so the filter in this example finds all employees matching the criteria from the previous example, or any employee whose `Ename` field equals `allen`. The `upperCaseCompare : true` entry ensures that a case-insensitive comparison is performed. For more information on the valid values you can pass for the `operator` entry for the view criteria item, see Understanding View Criteria Item Operators.

```
// Example findCriteria parameter definition
def findCriteria =
[
  filter:
  [
    group:
    [
      [
        item:
        [
          [
            attribute :'Deptno',
            operator  :'=',
            value     :[[item:30]]
          ],
          [
            attribute :'Comm',
            operator  :'>',
            value     :[[item:300]]
          ],
          [
            upperCaseCompare :true,
            attribute        :'Job',
            operator         :'STARTSWITH',
            value            :[[item:'sales']]
          ]
        ]
      ],
      [
        item:
        [
          [
            upperCaseCompare :true,
            attribute        :'Ename',
            operator         :'=',
            value            :[[item:'allen']]
          ]
        ]
      ]
    ]
  ]
]
// findControl needs to be an empty list rather than null
def findControl = [ ]
def emps = adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)
for (emp in emps) {
  println(emp)
}
```

The script in the example below enhances the original one above to explicitly specify a single field sort order. The results will be sorted ascending by the value of their `Ename` field. Since the value of the `sortAttribute` entry is a list of maps, you could add additional maps separated a commas to perform a sort on multiple fields.

```
// Example findCriteria parameter definition
def findCriteria =
[
  filter:
  [
    group:
    [
      [
        item:
        [
          [
            attribute :'Deptno',
            operator  :'=',
            value     :[[item:30]]
          ]
        ]
      ]
    ]
  ],
  sortOrder:
  [
    sortAttribute:
    [
      [
        name       :'Ename',
        descending : false
      ]
    ]
  ]
]
// findControl needs to be an empty list rather than null
def findControl = [ ]
def emps = adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)
for (emp in emps) {
  println(emp)
}
```

The script below extends the previous one to add a specific find attribute criteria in order to request that only a subset of employee object fields should be returned in the result. In this example, for each employee object in department `30`, only its `Empno` and `Ename` field values will be returned to the calling groovy script.

```
// Example findCriteria parameter definition
def findCriteria =
[
  filter:
  [
    group:
    [
      [
        item:
        [
          [
            attribute         :'Deptno',
            operator          :'=',
            value             :[[item:30]]
          ]
        ]
      ]
    ]
  ],
  sortOrder:
  [
    sortAttribute:
    [
      [
        name        :'Ename',
        descending : false
      ]
    ]
  ],
  findAttribute:
  [
    [item :'Empno'],
    [item :'Ename']
  ]
]
// findControl needs to be an empty list rather than null
def findControl = [ ]
def emps = adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)
for (emp in emps) {
  println(emp)
}
```

The script shown here shows how to use the `fetchSize` map entry to limit the number of rows returned to only the first 3 rows that match the supplied criteria in the requested sort order, including only the requested field values in the result. This example returns the `EmpNo`, `Ename`, and `Sal` fields of the top 3 employees whose `Job` fields equals `CLERK` (performed case-sensitively this time), ordered descending by `Sal`.

```
// Example findCriteria parameter definition
def findCriteria =
[
  fetchSize : 3,
  filter:
  [
    group:
    [
      [
        item:
        [
          [
            attribute         :'Job',
            operator          :'=',
            value             :[[item:'CLERK']]
          ]
        ]
      ]
    ]
  ],
  sortOrder:
  [
    sortAttribute:
    [
      [
        name        :'Sal',
        descending : true
      ]
    ]
  ],
  findAttribute:
  [
    [item :'Empno'],
    [item :'Ename'],
    [item :'Sal']
  ]
]
// findControl needs to be an empty list rather than null
def findControl = [ ]
def emps = adf.webServices.EmployeesService.findEmployees(findCriteria, findControl)
for (emp in emps) {
  println(emp)
}
```

Understanding View Criteria Item Operators

When building view criteria filters for use in a web service call, the following table provides the list of valid values that you can provide as an `operator` in a view criteria item. Notice that some operators are valid only for fields of certain data types. For example, for a field `{Priority` of type number, you can use the `>=` operator, but in contrast, for a view criteria item related to a `ResolutionDate` field of type Date, you would use the `ONORAFTER` operator.

Table 9: View Criteria Item Operators (Case-Sensitive!)

View Criteria Item Operators (Case-Sensitive!)

Operator	Description	Valid for Field Types
`=`	Equals	Number, Text, Date
`<>`	Not equals	Number, Text, Date
`ISBLANK`	Is null (no view criteria item value required)	Number, Text, Date
`ISNOTBLANK`	Is not null (no view criteria item value required)	Number, Text, Date
`LIKE`	Like	Text
`STARTSWITH`	Starts with	Text
`>`	Greater than	Number, Text
`AFTER`	Date comes after	Date
`>=`	Greater than or equal to	Number, Text
`ONORAFTER`	Date is on or comes after	Date
`<`	Less than	Number, Text
`BEFORE`	Date comes before	Date

Operator	Description	Valid for Field Types
`<=`	Less than or equal to	Number, Text
`ONORBEFORE`	Date is on or comes before	Date
`BETWEEN`	Is between (two view criteria item values required)	Number, Text, Date
`NOTBETWEEN`	Is not between (two view criteria item values required)	Number, Text, Date

Accessing the Display Value of the Selected Item(s) in a List Field

When your object contains a single-selection fixed-choice list field named *`SomeListField`*, you can use the `getSelectedListDisplayValue()` function to access the description that corresponds to the current field's code value. The function takes a single argument that is the name of the list field for whose selected value you want the description. For example, consider a single-selection fixed-choice field called `RequestStatus`. You could write conditional logic based on the selected status' description string using code like this:

```
def meaning = getSelectedListDisplayValue('RequestStatus')
if (meaning.contains("Emergency")) {
   // do something here when description contains the string "Emergency"
}
```

If your object contains a multiple-selection fixed-choice field named *`MultiChoiceField`*, you can use the `getSelectedListDisplayValues()` function to access a list of the descriptions that correspond to the current field's one or more selected code values. As above, the function takes a single argument that is the name of the multiple-selection fixed-choice list for whose selected values you want the descriptions. For example, consider a custom multiple-selection fixed-choice list named `Category_c`. You could write conditional logic based on the selected status' description string using code like this:

```
// return true if any of the selected meanings contains the
// string "wood" case-insensitively (using Groovy regular expressions)
def meaningsList = getSelectedListDisplayValues('Category_c')
for (meaning in meaningsList) {
  // if current meaning contains "wood" case-insensitively
  if (meaning =~ /(?i)wood/) {
     return true
  }
}
return false
```

If you call the multi-selection list function `getSelectedListDisplayValues()` on a single-selection list field, it returns a list containing a single value. If you call the single-selection list function `getSelectedListDisplayValue()` on a multi-selection list field, it returns the String value of the first of the multiple choices selected. If you call either of these functions on a list field whose value is `null` or whose value is not a valid choice for the list, then the function returns `null`.

Formatting Numbers and Dates Using a Formatter

Groovy provides the `Formatter` object that you can use in a text formula expression or anywhere in your scripts that you need for format numbers or dates. The general pattern for using a `Formatter` is to first construct a new instance like this, passing the the expression for the current user's locale as an argument:

```
def fmt = new Formatter(adf.context.locale)
```

This `Formatter` object you've instantiated will generally be used to format a *single*, non-null value by calling its `format()` method like this:

```
def ret = fmt.format( formatString, arg1 [, arg2, ..., argN] )
```

Note that if you call the `format()` method of the same `Formatter` object multiple times, then the results are concatenated together. To format several distinct values without having their results be concatentated, instantiate a new `Formatter` for each call to a `format()` method.

The format string can include a set of special characters that indicate how to format each of the supplied arguments. Some simple examples are provided below, however the complete syntax is covered in the documentation for the Formatter class.

Example of Formatting a Number Using a Formatter

To format a number `numberVal` as a floating point value with two (2) decimal places and thousands separator you can do:

```
Double dv = numberVal as Double
def fmt = new Formatter(adf.context.locale)
def ret = (dv != null) ? fmt.format('%,.2f', dv) : null
```

If the value of `numberVal` were `12345.6789`, and the current user's locale is US English, then this would produce a formatted string like:

12,345.68

If instead the current user's locale is Italian, it would produce a formatted string like:

12.345,68

To format a number `numberVal` as a floating point value with three (3) decimal places and no thousands separator you can do:

```
Double dv = numberVal as Double
def fmt = new Formatter(adf.context.locale)
def ret = (dv != null) ? fmt.format('%.3f', dv) : null
```

If the value of `numberVal` were `12345.6789`, and the current user's locale is US English, then this would produce a formatted string like:

12345.679

To format a number value with no decimal places to have a zero-padded width of 8, you can do:

```
Long lv = numberVal as Long
def fmt = new Formatter(adf.context.locale)
def ret = (lv != null) ? fmt.format('%08d', lv) : null
```

If the value of `numberVal` were `5543`, then this would produce a formatted string like:

00005543

Formatting a Date Using a Formatter

To format a datetime value `datetimeVal` to display only the hours and minutes in 24-hour format, you can do:

```
Date dv = datetimeVal as Date
def fmt = new Formatter(adf.context.locale)
def ret = (dv != null) ? fmt.format('%tH:%tM', dv, dv) : null
```

If the value of `datetimeVal` were `2014-03-19 17:07:45`, then this would produce a formatted string like:

17:07

To format a date value `dateVal` to display the day of the week, month name, the day, and the year, you can do:

```
Date dv = dateVal as Date
def fmt = new Formatter(adf.context.locale)
def ret = (dv != null) ? fmt.format('%tA, %tB %te, %tY',dv,dv,dv,dv) : null
```

If the value of `dateVal` were `2014-03-19`, and the current user's locale is US English, then this would produce a formatted string like:

Wednesday, March 19, 2014

5 Understanding Common JBO Exceptions in Groovy Scripts

JBO-25030: Detail entity X with row key Y cannot find or invalidate its owning entity

- **Problem Description**

  You tried to create a new child object row of type `X` row without providing the necessary context information to identify its owning parent object. At the moment of child row creation the correct owning parent context must be provided, otherwise the new child row created would be an "orphan".

  For example, consider a custom object named `TroubleTicket` that has a child object named `Activity`. The following script that tries to create a new activity would generate this error:

```
def activityVO = newView('Activity_c')
// PROBLEM: Attempting to create a new child activity row
// -------  without providing context about which owning
//          TroubleTicket row this activity belongs to.
def newActivity = activityVO.createRow()
```

  This generates a *JBO-25030: Detail entity Activity_c with row key null cannot find or invalidate its owning entity* exception because the script is trying to create a new Activity row without providing the context that allows that new row to know which TroubleTicket it should belong to.

- **Resolution**

  There are two ways to provide the appropriate parent object context when creating a new child object row. The first approach is to get the owning parent row to which you want to add a new child row and use the parent row's child collection attribute to perform the `createRow()` and `insertRow()` combination. For example, to create a new `Activity` row in the context of `TroubleTicket` with an `Id` of 100000000272002 you can do the following, using the helper function mentioned in Finding an Object by Id. When you use this approach, the parent object context is implicit since you're performing the action on the parent row's child collection.

```
def idParent = 100000000272002
def ttVO = newView('TroubleTicket_c')
def parent = adf.util.findRowByKey(ttVO,idParent)
if (parent != null) {
  // Access the collection of Activity child rows for
  // this TroubleTicket parent object
  def activities = parent.ActivityCollection_c
  // Use this child collection to create/insert the new row
  def newActivity = activities.createRow()
  activities.insertRow(newActivity);
  // Set other field values of the new activity here...
}
```

  The second approach you can use is to pass the context that identifies the id of the parent `TroubleTicket` row when you create the child row. You do that using an alternative function named `createAndInitRow()` as shown below. In this case, you don't need to have the parent row in hand or even use the parent TroubleTicket view object. Providing the id to the owning parent row at the moment of child activity row creation is good enough.

```
def idParent = 100000000272002
// Create an name/value pairs object to pass the parent id
def parentAttrs = new NameValuePairs()
parentAttrs.setAttribute("Id",idParent)
// Use this name/value pairs object to pass the parent
// context information while creating the new child row
def activityVO = newView('Activity_c')
def newActivity = activityVO.createAndInitRow(parentAttrs)
activityVO.insertRow(newActivity);
// Set other field values of the new activity here...
```

JBO-26020: Attempting to insert row with no matching EO base

- **Problem Description**

  You inadvertently added a row that was created or queried from one view object to another view object of a different type. For example, the following script would generate this error:

  ```
  def empVO = newView("Employees")
  def newEmp = empVO.createRow()
  def deptVO = newView("Department")
  // PROBLEM: Incorrectly adding a row of type "Employees"
  // -------  to the view of type "Department"
  deptVO.insertRow(newEmp)
  ```

  This generates a *JBO-26020: Attempting to insert row with no matching EO base* exception because the script is trying to insert a row from "Employees" view into a view that is expecting rows of type "Department". This leads to a type mismatch that is not supported.

- **Resolution**

  Ensure that when you call `insertRow()` on a view object that the row you are trying to insert into the collection is of the correct view type.

6 Supported Classes and Methods for Use in Groovy

Supported Classes and Methods for Use in Groovy Scripts

When writing Groovy scripts, you may only use the classes and methods that are documented in the table below. Using any other class or method may work initially, but will throw a runtime exception when you migrate your code to later versions. Therefore, we strongly suggest that you ensure the Groovy code you write adheres to the classes and methods shown here. For each class, in addition to the method names listed in the table, the following method names are also allowed:

- `equals()`
- `hashCode()`
- `toString()`

In contrast, the following methods are never allowed on any object:

- `finalize()`
- `getClass()`
- `getMetaClass()`
- `notify()`
- `notifyAll()`
- `wait()`

Table 10: Groovy Allowed Classes, Methods, and Packages

Classes/Methods Allowed for Groovy Scripts

Class Name	Allowed Methods	Package
`ADFContext`	• `getLocale()` • `getSecurityContext()`	`oracle.adf.share`
`Array`	• *Any constructor* • *Any method*	`java.sql`
`Array`	• `getArray()` • `getElemType()` • `getList()`	`oracle.jbo.domain`

Class Name	Allowed Methods	Package
`ArrayList`	• *Any constructor* • *Any method*	`java.util`
`Arrays`	• *Any constructor* • *Any method*	`java.util`
`AttributeDef`	• `getAttributeKind()` • `getIndex()` • `getName()` • `getPrecision()` • `getProperty()` • `getScale()` • `getUIHelper()` • `getUpdateableFlag()` • `isMandatory()` • `isQueriable()`	`oracle.jbo`
`AttributeHints`	• `getControlType()` • `getDisplayHeight()` • `getDisplayHint()` • `getDisplayWidth()` • `getFormat()` • `getFormattedAttribute()` • `getFormatter()` • `getFormatterClassName()` • `getHint()` • `getLocaleName()` • `parseFormattedAttribute()`	`oracle.jbo`
`AttributeList`	• `getAttribute()` • `getAttributeIndexOf()` • `getAttributeNames()` • `setAttribute()`	`oracle.jbo`
`BaseLobDomain`	• `closeCharacterStream()` • `closeInputStream()` • `closeOutputStream()` • `getInputStream()` • `getLength()` • `getOutputStream()` • `getcharacterStream()`	`oracle.jbo.domain`
`BigDecimal`	• *Any constructor* • *Any method*	`java.math`
`BigInteger`	• *Any constructor* • *Any method*	`java.math`
`BitSet`	• *Any constructor* • *Any method*	`java.util`

Class Name	Allowed Methods	Package
`Blob`	• *Any constructor* • *Any method*	`java.sql`
`BlobDomain`	• *Any constructor* • `getBinaryOutputStream()` • `getBinaryStream()` • `getBufferSize()`	`oracle.jbo.domain`
`Boolean`	• *Any constructor* • *Any method*	`java.lang`
`Byte`	• *Any constructor* • *Any method*	`java.lang`
`Calendar`	• *Any constructor* • *Any method*	`java.util`
`Char`	• *Any constructor* • `bigDecimalValue()` • `bigIntegerValue()` • `booleanValue()` • `doubleValue()` • `floatValue()` • `getValue()` • `intValue()` • `longValue()`	`oracle.jbo.domain`
`Clob`	• *Any constructor* • *Any method*	`java.sql`
`ClobDomain`	• *Any constructor* • `toCharArray()`	`oracle.jbo.domain`
`Collection`	• *Any constructor* • *Any method*	`java.util`
`Collections`	• *Any constructor* • *Any method*	`java.util`
`Comparator`	• *Any constructor* • *Any method*	`java.util`
`Currency`	• *Any constructor* • *Any method*	`java.util`
`DBSequence`	• *Any constructor* • `getValue()`	`oracle.jbo.domain`

Class Name	Allowed Methods	Package
`Date`	• *Any constructor* • *Any method*	`java.util`
`Date`	• *Any constructor* • *Any method*	`java.sql`
`Date`	• *Any constructor* • `compareTo()` • `dateValue()` • `getValue()` • `stringValue()` • `timeValue()` • `timestampValue()`	`oracle.jbo.domain`
`Dictionary`	• *Any constructor* • *Any method*	`java.util`
`Double`	• *Any constructor* • *Any method*	`java.lang`
`Enum`	• *Any constructor* • *Any method*	`java.lang`
`EnumMap`	• *Any constructor* • *Any method*	`java.util`
`EnumSet`	• *Any constructor* • *Any method*	`java.util`
`Enumeration`	• *Any constructor* • *Any method*	`java.util`
`EventListener`	• *Any constructor* • *Any method*	`java.util`
`EventListenerProxy`	• *Any constructor* • *Any method*	`java.util`
`EventObject`	• *Any constructor* • *Any method*	`java.util`
`Exception`	• *Any constructor* • *Any method*	`java.lang`

Class Name	Allowed Methods	Package
`ExprValueErrorHandler`	• `addAttribute()` • `clearAttributes()` • `raise()` • `raiseLater()` • `warn()`	`oracle.jbo`
`Float`	• *Any constructor* • *Any method*	`java.lang`
`Formattable`	• *Any constructor* • *Any method*	`java.util`
`FormattableFlags`	• *Any constructor* • *Any method*	`java.util`
`Formatter`	• *Any constructor* • *Any method*	`java.util`
`GregorianCalendar`	• *Any constructor* • *Any method*	`java.util`
`HashMap`	• *Any constructor* • *Any method*	`java.util`
`HashSet`	• *Any constructor* • *Any method*	`java.util`
`Hashtable`	• *Any constructor* • *Any method*	`java.util`
`IdentityHashMap`	• *Any constructor* • *Any method*	`java.util`
`Integer`	• *Any constructor* • *Any method*	`java.lang`
`Iterator`	• *Any constructor* • *Any method*	`java.util`
`JboException`	• `getDetails()` • `getErrorCode()` • `getErrorParameters()` • `getLocalizedMessage()` • `getMessage()` • `getProductCode()` • `getProperty()`	`oracle.jbo`

Class Name	Allowed Methods	Package
`JboWarning`	• *Any constructor* • `getDetails()` • `getErrorCode()` • `getErrorParameters()` • `getLocalizedMessage()` • `getMessage()` • `getProductCode()` • `getProperty()`	`oracle.jbo`
`Key`	• `toStringFormat()`	`oracle.jbo`
`LinkedHashMap`	• *Any constructor* • *Any method*	`java.util`
`LinkedHashSet`	• *Any constructor* • *Any method*	`java.util`
`LinkedList`	• *Any constructor* • *Any method*	`java.util`
`List`	• *Any constructor* • *Any method*	`java.util`
`ListIterator`	• *Any constructor* • *Any method*	`java.util`
`ListResourceBundle`	• *Any constructor* • *Any method*	`java.util`
`Locale`	• *Any constructor* • *Any method*	`java.util`
`Long`	• *Any constructor* • *Any method*	`java.lang`
`Map`	• *Any constructor* • *Any method*	`java.util`
`Math`	• *Any constructor* • *Any method*	`java.lang`
`MathContext`	• *Any constructor* • *Any method*	`java.math`
`NClob`	• *Any constructor* • *Any method*	`java.sql`

Class Name	Allowed Methods	Package
`NameValuePairs`	• *Any constructor* • `getAttribute()` • `getAttributeIndexOf()` • `getAttributeNames()` • `setAttribute()`	`oracle.jbo`
`NativeTypeDomainInterface`	• `getNativeObject()`	`oracle.jbo.domain`
`Number`	• *Any constructor* • `bigDecimalValue()` • `bigIntegerValue()` • `booleanValue()` • `byteValue()` • `doubleValue()` • `floatValue()` • `getValue()` • `intValue()` • `longValue()` • `shortValue()`	`oracle.jbo.domain`
`Number`	• `abs()` • `and()` • `compareTo()` • `div()` • `downto()` • `intdiv()` • `leftShift()` • `minus()` • `mod()` • `multiply()` • `next()` • `or()` • `plus()` • `power()` • `previous()` • `rightShift()` • `rightShiftUnsigned()` • `step()` • `times()` • `toBigDecimal()` • `toBigInteger()` • `toDouble()` • `toInteger()` • `toLong()` • `unaryMinus()` • `upto()` • `xor()`	`java.lang`

Class Name	Allowed Methods	Package
`Object`	• `any()` • `asBoolean()` • `asType()` • `collect()` • `each()` • `eachWithIndex()` • `every()` • `find()` • `findAll()` • `findIndexOf()` • `findIndexValues()` • `findLastIndexOf()` • `findResult()` • `getAt()` • `grep()` • `identity()` • `inject()` • `inspect()` • `is()` • `isCase()` • `iterator()` • `print()` • `printf()` • `println()` • `putAt()` • `split()` • `sprintf()` • `toString()` • `with()`	`java.lang`
`Observable`	• *Any constructor* • *Any method*	`java.util`
`Observer`	• *Any constructor* • *Any method*	`java.util`
`PriorityQueue`	• *Any constructor* • *Any method*	`java.util`
`Properties`	• *Any constructor* • *Any method*	`java.util`
`PropertyPermission`	• *Any constructor* • *Any method*	`java.util`
`PropertyResourceBundle`	• *Any constructor* • *Any method*	`java.util`
`Queue`	• *Any constructor* • *Any method*	`java.util`

Class Name	Allowed Methods	Package
`Random`	• *Any constructor* • *Any method*	`java.util`
`RandomAccess`	• *Any constructor* • *Any method*	`java.util`
`Ref`	• *Any constructor* • *Any method*	`java.sql`
`ResourceBundle`	• *Any constructor* • *Any method*	`java.util`
`Row`	• `getAttribute()` • `getAttributeHints()` • `getKey()` • `getLookupDescription()` • `getOriginalAttributeValue()` • `getPrimaryRowState()` • `getSelectedListDisplayValue()` • `getSelectedListDisplayValues()` • `getStructureDef()` • `isAttributeChanged()` • `isAttributeUpdateable()` • `remove()` • `revertRow()` • `revertRowAndContainees()` • `setAttribute()` • `setAttributeValues()` • `validate()`	`oracle.jbo`
`RowId`	• *Any constructor* • *Any method*	`java.sql`
`RowIterator`	• `createAndInitRow()` • `createRow()` • `findByKey()` • `findRowsMatchingCriteria()` • `first()` • `getAllRowsInRange()` • `getCurrentRow()` • `getEstimatedRowCount()` • `hasNext()` • `hasPrevious()` • `insertRow()` • `last()` • `next()` • `previous()` • `reset()`	`oracle.jbo`

Class Name	Allowed Methods	Package
`RowSet`	• `avg()` • `count()` • `createAndInitRow()` • `createRow()` • `executeQuery()` • `findByKey()` • `findRowsMatchingCriteria()` • `first()` • `getAllRowsInRange()` • `getCurrentRow()` • `getEstimatedRowCount()` • `hasNext()` • `hasPrevious()` • `insertRow()` • `last()` • `max()` • `min()` • `next()` • `previous()` • `reset()` • `sum()`	`oracle.jbo`
`Scanner`	• *Any constructor* • *Any method*	`java.util`
`SecurityContext`	• `getUserName()` • `getUserProfile()` • `isUserInRole()`	`oracle.adf.share.security`
`Session`	• `getLocale()` • `getLocaleContext()` • `getUserData()`	`oracle.jbo`
`Set`	• *Any constructor* • *Any method*	`java.util`
`Short`	• *Any constructor* • *Any method*	`java.lang`
`Short`	• *Any constructor* • *Any method*	`java.lang`
`SimpleTimeZone`	• *Any constructor* • *Any method*	`java.util`
`SortedMap`	• *Any constructor* • *Any method*	`java.util`
`SortedSet`	• *Any constructor* • *Any method*	`java.util`

Class Name	Allowed Methods	Package
`Stack`	• *Any constructor* • *Any method*	`java.util`
`StackTraceElement`	• *Any constructor* • *Any method*	`java.lang`
`StrictMath`	• *Any constructor* • *Any method*	`java.lang`
`String`	• *Any constructor* • *Any method*	`java.lang`
`StringBuffer`	• *Any constructor* • *Any method*	`java.lang`
`StringBuilder`	• *Any constructor* • *Any method*	`java.lang`
`StringTokenizer`	• *Any constructor* • *Any method*	`java.util`
`Struct`	• *Any constructor* • *Any method*	`java.sql`
`Struct`	• `getAttribute()` • `setAttribute()`	`oracle.jbo.domain`
`StructureDef`	• `findAttributeDef()` • `getAttributeIndexOf()`	`oracle.jbo`
`Time`	• *Any constructor* • *Any method*	`java.sql`
`TimeZone`	• *Any constructor* • *Any method*	`java.util`
`Timer`	• *Any constructor* • *Any method*	`java.util`
`TimerTask`	• *Any constructor* • *Any method*	`java.util`
`Timestamp`	• *Any constructor* • *Any method*	`java.sql`

Class Name	Allowed Methods	Package
`Timestamp`	• *Any constructor* • `compareTo()` • `dateValue()` • `getValue()` • `stringValue()` • `timeValue()` • `timestampValue()`	`oracle.jbo.domain`
`TreeMap`	• *Any constructor* • *Any method*	`java.util`
`TreeSet`	• *Any constructor* • *Any method*	`java.util`
`UUID`	• *Any constructor* • *Any method*	`java.util`

Class Name	Allowed Methods	Package
UserProfile	• getBusinessCity() • getBusinessCountry() • getBusinessEmail() • getBusinessFax() • getBusinessMobile() • getBusinessPOBox() • getBusinessPager() • getBusinessPhone() • getBusinessPostalAddr() • getBusinessPostalCode() • getBusinessState() • getBusinessStreet() • getDateofBirth() • getDateofHire() • getDefaultGroup() • getDepartment() • getDepartmentNumber() • getDescription() • getDisplayName() • getEmployeeNumber() • getEmployeeType() • getFirstName() • getGUID() • getGivenName() • getHomeAddress() • getHomePhone() • getInitials() • getJpegPhoto() • getLastName() • getMaidenName() • getManager() • getMiddleName() • getName() • getNameSuffix() • getOrganization() • getOrganizationalUnit() • getPreferredLanguage() • getPrincipal() • getProperties() • getProperty() • getTimeZone() • getTitle() • getUIAccessMode() • getUniqueName() • getUserID() • getUserName() • getWirelessAccountNumber()	oracle.adf.share.security.identitymanagment

Class Name	Allowed Methods	Package
`ValidationException`	• `getDetails()` • `getErrorCode()` • `getErrorParameters()` • `getLocalizedMessage()` • `getMessage()` • `getProductCode()` • `getProperty()`	`oracle.jbo`
`Vector`	• *Any constructor* • *Any method*	`java.util`
`ViewCriteria`	• `createAndInitRow()` • `createRow()` • `createViewCriteriaRow()` • `findByKey()` • `findRowsMatchingCriteria()` • `first()` • `getAllRowsInRange()` • `getCurrentRow()` • `getEstimatedRowCount()` • `hasNext()` • `hasPrevious()` • `insertRow()` • `last()` • `next()` • `previous()` • `reset()`	`oracle.jbo`
`ViewCriteriaItem`	• `getValue()` • `makeCompound()` • `setOperator()` • `setUpperColumns()` • `setValue()`	`oracle.jbo`
`ViewCriteriaItemCompound`	• `ensureItem()` • `getValue()` • `makeCompound()` • `setOperator()` • `setUpperColumns()` • `setValue()`	`oracle.jbo`
`ViewCriteriaRow`	• `ensureCriteriaItem()` • `getConjunction()` • `isUpperColumns()` • `setConjunction()` • `setUpperColumns()`	`oracle.jbo`

Class Name	Allowed Methods	Package
`ViewObject`	• `appendViewCriteria()` • `avg()` • `count()` • `createAndInitRow()` • `createRow()` • `createViewCriteria()` • `executeQuery()` • `findByKey()` • `findRowsMatchingCriteria()` • `first()` • `getAllRowsInRange()` • `getCurrentRow()` • `getEstimatedRowCount()` • `getMaxFetchSize()` • `hasNext()` • `hasPrevious()` • `insertRow()` • `last()` • `max()` • `min()` • `next()` • `previous()` • `reset()` • `setMaxFetchSize()` • `setSortBy()` • `sum()`	`oracle.jbo`
`WeakHashMap`	• *Any constructor* • *Any method*	`java.util`