



Developing Business Rules

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For Support questions about any InterSystems products, contact:

InterSystems Worldwide Response Center (WRC)

Tel: +1-617-621-0700

Tel: +44 (0) 844 854 2917

Email: support@InterSystems.com

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About This Book

This book explains how to define business rules that direct business process logic. It contains the following chapters:

- [About Business Rules](#)
- [Introduction to the Rule Editor](#)
- [Creating and Editing Rule Sets](#)
- [Example Rule Classes](#)
- [Debugging Routing Rules](#)
- [Ensemble Utility Functions](#)

For a detailed outline, see the [table of contents](#).

The following books provide related information:

- [Ensemble Best Practices](#) describes best practices for organizing and developing Ensemble productions.
- [Developing Ensemble Productions](#) explains how to perform the development tasks related to creating an Ensemble production.
- [Configuring Ensemble Productions](#) explains how to perform the configuration tasks related to creating an Ensemble production.
- [Monitoring Ensemble](#) describes how to monitor Ensemble. In particular, see the chapter “[Viewing the Business Rule Log](#).”

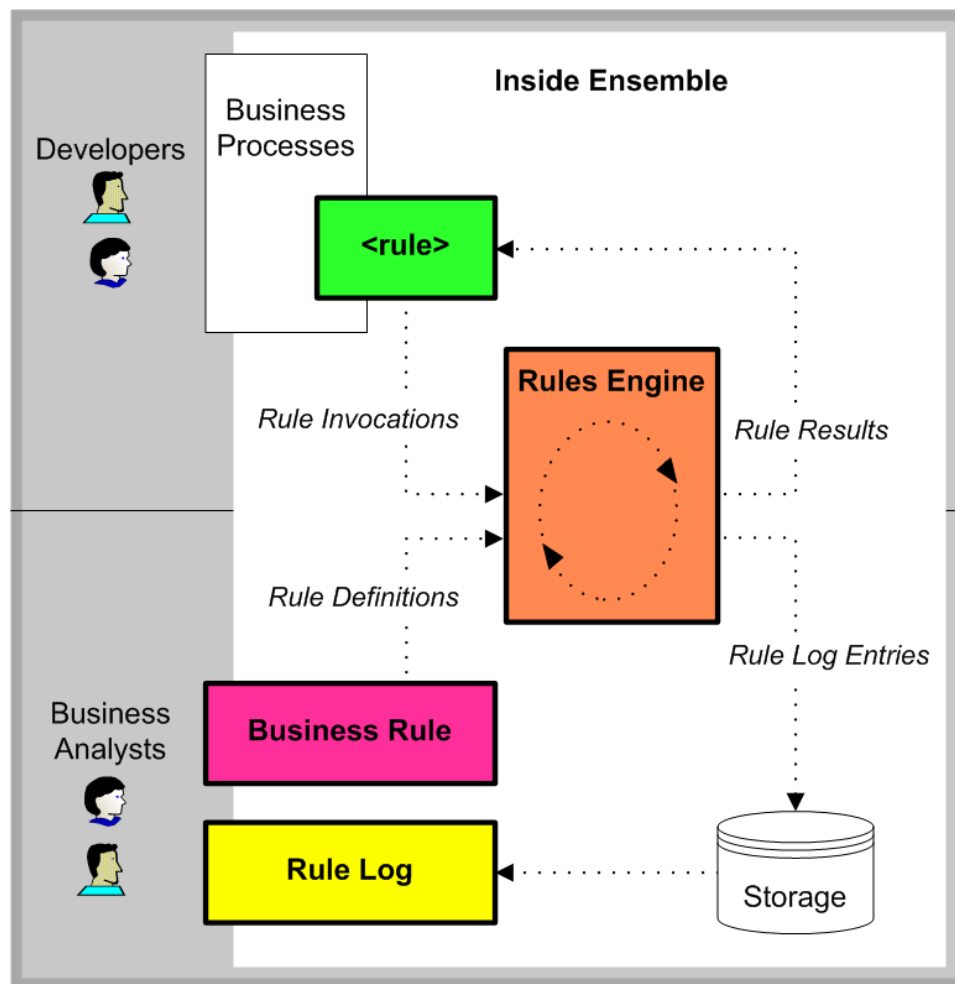
If you are using an Ensemble production to route and transform messages in an Electronic Data Interchange (EDI) format such as HL7 or X12, see the books in the Ensemble Interoperability set.

For general information, see the *InterSystems Documentation Guide*.

1

About Business Rules

Business rules allow nontechnical users to change the behavior of Ensemble business processes at specific decision points. You can change the logic of the rule instantly, using the Ensemble Rule Editor in the Management Portal. There is no need for programming or diagramming skills to change the rule, and there is no need to modify or compile production code for changes to take effect. The following figure shows how business rules work.



Suppose an enterprise runs an Ensemble production that processes loan applications consistently across an international enterprise. The decision process is consistent worldwide, but banks must adjust the local acceptance criteria from country to country. Business rules support this division of responsibility as follows:

1. The developer of the business process identifies a decision point, by naming the business rule that will make the decision on behalf of the business process. The developer leaves a placeholder for that business rule in the Business Process Language (BPL) code by invoking the Business Process Language (BPL) element `<rule>`. The `<rule>` element specifies the business rule name, plus parameters to hold the result of the decision and (optionally) the reason for that result. Suppose we call this rule `LoanDecision`.
2. Wherever the `<rule>` element appears in a BPL business process, a corresponding rule definition must exist within the production. A user at the enterprise, typically a business analyst, may define the rule using a browser-based online form called the Ensemble Rule Editor. This form prompts the user for the simple information required to define the business rule called `LoanDecision`. Ensemble saves this information in its configuration database.

Any enterprise user who is familiar with the Ensemble Rule Editor and who has access to it in the Management Portal can modify the rule definition. Modifications are simply updates to the database and can be instantly applied to a production while it is running. Therefore, it is possible for business analysts at various regional locations to run the Ensemble Rule Editor to modify their copies of the rule to provide different specific criteria appropriate to their locales.

3. At runtime, upon reaching the BPL `<rule>` statement the business process invokes the rule named `LoanDecision`. The rule retrieves its decision criteria from the configuration database, which may be different at different locales. Based on these criteria, the rule returns an answer to the business process. The business process redirects its execution path based on this answer.
4. For ongoing maintenance purposes, the business process developer need not be involved if a rule needs to change. Any rule definition is entirely separate from business process code. Rule definitions are stored in the Ensemble configuration database as classes and are evaluated at runtime. Additionally, rule definitions can be exported and imported from one Ensemble installation to another.

In this way, enterprise users such as business analysts can change the operation of the business process at the decision point, without needing the programming expertise that would be required to revise the BPL or class code for the business process.

Ensemble provides four types of business rule definition:

- *General Business Rule*
- *HL7 Message Routing Rule*
- *General Message Routing Rule*
- *Virtual Document Message Routing Rule*

Each type has an associated rule assist class that controls how the editor works and provides a **Rules Assistant** in the right pane while you are editing.

You create rules for a definition that are grouped into rule sets. Each rule definition has one or more rule sets. Each rule set is associated with a beginning and ending effective date and time. Each time a process invokes a rule, one and only one rule set is executed.

Note that there is overlap among the options available in business processes, data transformations, and business rules. For a comparison, see “[Comparison of Business Logic Tools](#)” in *Developing Ensemble Productions*.

The remaining chapters in this book describe how to define business rules including how to create and use rule sets using the Ensemble Rule Editor as well as how to invoke rules using BPL and using business process routing engines.

1.1 Rules as Classes

The Ensemble Rule Editor provides a structured way for enterprise business analysts to shape the logical decisions made by a business process, without needing any programming skills.

However, a business process developer can instead work with business rule definitions as classes, using Studio. The following figure shows this format.

Class Definition

```
/// Business rule responsible for mapping an input location
/// to "F" for Fahrenheit or "C" for Celsius temperature scale.
Class Demo.ZenService.Bproc.WeatherReport.TempScale Extends Ens.Rule.Definition
{

Parameter RuleAssistClass = "Ens.Rule.GeneralBusinessRuleAssist";

XData RuleDefinition [ XMLNamespace = "http://www.intersystems.com/rule" ]
{
<ruleDefinition alias="" context="Demo.ZenService.Bproc.WeatherReport.Context">
<ruleSet name="" effectiveBegin="" effectiveEnd="">
<rule name="" disabled="false">
<when condition="(Location=&quot;US&quot;)|| (Location=&quot;USA&quot;)">
<return>"F"</return>
</when>
<otherwise>
<return>"C"</return>
</otherwise>
</rule>
</ruleSet>
</ruleDefinition>
}
}
```

You can open a business rule as a class in Studio, edit the document, and save the changes. Changes saved in Studio are immediately visible in the Ensemble Rule Editor. If you do not see your changes, simply refresh the page.

Package Mapping Rule Classes

Since they are classes, you can map rules to other namespaces. If you do map rule classes, you must recompile all the mapped rule classes in each namespace where you use them to insure the local metadata is available in each namespace. If you are using rules that have been upgraded from legacy rules, you may encounter compile errors due to rule aliases not being unique. You must fix these compiler errors manually.

For details, see “Package Mapping” in the chapter “Packages” in *Using Caché Objects*.

2

Introduction to the Rule Editor

This chapter introduces the Rule Editor in the Management Portal. It is divided into the following sections:

- [Business Rule List](#)
- [Business Rule Editor](#)

2.1 Business Rule List

The Business Rule List page displays a list of the business rule classes defined in the active Ensemble namespace. Navigate to this page from the **Business Rules** item of the Ensemble **List** menu.

Select a rule class to be the target of one of the following commands in the ribbon bar:

- **Edit** — Click to change or view the rule definition using the [Business Rule Editor](#).
- **Delete** — Click to permanently delete the rule definition class.
- **Export** — Click to export the selected rule class as an XML file.
- **Import** — Click to import an XML file into a rule class.

You can also export and import rule classes as you do any other class in Ensemble. You can use the Globals page of the Management Portal (**System Explorer** > **Globals**) or use the **Export** and **Import** commands on the **Tools** menu in Studio.

2.2 Business Rule Editor

The Ensemble Rule Editor page is where you create and edit business rule class definitions for all types of business rule. The page opens with the last rule you had open in the namespace. The tab at the left of the title bar contains the name of the business rule definition class. If this is the first time on the page for this namespace, the working pane is empty and you must either create a new rule or open an existing one.

The “[Creating and Editing Rule Sets](#)” chapter describes the details of how to use the editor to define business and routing rules; the rest of this chapter describes how the user interface works with the Ensemble rule structure.

The ribbon bar of the Ensemble Rule Editor page contains the following elements:

- **New** button — Click to launch the [Business Rule Wizard](#) to create a new business rule definition.

- **Open** button — Click to launch the **Finder Dialog** to choose an existing business rule definition to edit.
- **Save** button — Click to save and compile any changes you have made to the rule definition.
- **Save As** button — Click if you have been editing a rule definition and wish to save your changes as a new business rule class.
- **Contract** — Click to contracts the display of all of the rules in the rule set. You can then individually expand the rule you want to view or edit.
- **Expand** — Click to expand the display of all of the rules in the rule set.
- Open new windows checkbox — If checked, the **New** and **Open** commands open the rule editor in a new window or browser tab.
- Zoom drop-down—Specifies the zoom percentage to view the rule.

General Tab

Once you have a rule definition in the working pane you see tabs of information. The general tab contains the summary information for the rule definition:

Description

Class description of the rule definition and its purpose.

Rule Type / Rule Assist Class

Each rule type has an associated rule assist class which controls the constraints of the rule and provides information in the right pane of the page to guide you when editing rules.

The table shows the four rule types and their associated `Ens.Rule.Assist` class:

Rule Type	Rule Assist Class
General Business Rule	<code>Ens.Rule.GeneralBusinessRuleAssist</code>
HL7 Message Routing Rule	<code>EnsLib.HL7.MsgRouter.RuleAssist</code>
General Message Routing Rule	<code>EnsLib.MsgRouter.RuleAssist</code>
Virtual Document Message Routing Rule	<code>EnsLib.MsgRouter.VDocRuleAssist</code>

Context Class

The class that contains the information to tell the Ensemble Rule Editor which object properties to provide as choices in the Value editor while you are editing a rule. For general rules, it is generated from the business process BPL class and ends in `.Context`. For routing rules without a BPL process, it is usually the routing engine business process class.

Rule Alias

This field may have a value if a rule was created in older releases before Ensemble stored rule definitions as classes. When the rule is upgraded, if the old name does not conform to class naming conventions, it becomes the alias. You can use this field for continuing such naming conventions, but if you are creating a new rule you do not need to use this field.

Temporary Variables

You can specify temporary variables in this field. You can use these temporary variables in the business rule. Each variable specification is separated by commas. For example:

```
FreeShippingValue,ShipMethod,PremierMember
```

Temporary variables are used in a rule by preceding the variable name with an @ (at sign). For example, @FreeShippingValue. Temporary variables are available only within the rule. If you want to pass information to the transformation using the rule, use the RuleUserData property. See “[Selecting the Transformation and Target of a Send Action](#)” for details.

Production Name

(Only for routing rules) This optional, informational setting makes it easier for you to define rules because the rule editor uses this setting to select configuration items to display when you are defining rules. The production configuration actually specifies that a rule is used for a production.

Rule Set List

List of **Rule Sets** with the following information:

- **Rule Set Name** —Name to identify the particular set.
- **Beginning Date and Time** — The time from which the rule becomes active. The exact time is included in the active interval. The format is *YYYY-MM-DDTHH:MM:SS*. The time portion is optional and defaults to 00:00:00.
- **Ending Date and Time** — The time when the rule stops being active. The exact time is excluded from the active interval. The format is *YYYY-MM-DDTHH:MM:SS*. The time portion is optional and defaults to 24:00:00

Rule Set Tabs

Each rule set has its own tab for editing its list of rules. For details, see the “[Creating and Editing Rule Sets](#)” chapter.




Editor Icons

Both tabs contain following set of icons. The following icons are available to edit the rule definition, rule sets, rules, and clauses within a rule set:



The specific action may differ depending on the entity you are editing; the following table describes the action of each icon in general.

Icon	Action
↑	Click the <i>Up</i> icon to move the selected item up in the list.
↓	Click the <i>Down</i> icon to move the selected item down in the list.
+	Click the <i>Add</i> icon to add the type of item you choose from the list or beneath the icon in the Rule Assistant.
×	Click the <i>Delete</i> icon to delete the item next to it.

Icon	Action
	Click the <i>Undo</i> icon to undo the last change.
	Click the <i>Redo</i> icon to redo the last change that was undone.
	Click the <i>Function</i> icon to open the associated editor for the selected action.

If an action is not available, its icon appears dimmed.

Rule Assistant

You can hide or show the Rule Assistant using the double-arrow in the right pane of the Ensemble Rule Editor. When you are editing a rule set, the expanded **Rule Assistant** pane provides you with help throughout the editing process. It describes the item you have selected and provides a list of options based on your assist class.

2.2.1 Business Rule Wizard

This wizard helps you create a new business rule definition based on the `Ens.Rule.Definition` class with an XData block named `RuleDefinition`. Enter values for the following fields:

Package

Enter a package name or use the arrow to select an existing package name.

Name

Enter the name of the business rule class.

Alias

(*Optional*) Enter the alias name for this rule. Do not use any of the following characters:

`; , : | ! * - $ ` " < > &`

Generally, this exists for some rules created in older releases before Ensemble stored rule definitions as classes and for continuing such naming conventions. If you are creating a new rule you do not need to use this field.

Description

(*Optional*) Enter a description for this rule definition. This becomes the class description.

Type

Enter one of four rule types:

- General Business Rule
- HL7 Message Routing Rule
- General Message Routing Rule
- Virtual Document Message Routing Rule

Each rule type has an associated rule assist class which provides information in the right pane of the page to guide you in entering rules and controls which options the editor presents.

Context Class

(Optional)

This field tells the Ensemble Rule Editor which object properties to provide as choices in the Value field when you are editing a rule. For general rules, this class is generated from the BPL business process class that invokes the [rule](#). The naming convention of the class is the business process class name plus the .Context extension, as in Demo.ZenService.Bproc.WeatherReport.Context.

3

Creating and Editing Rule Sets

This chapter describes how to use the Ensemble Rule Editor to develop rule sets.

There are two types of rule set:

- *General business rule set* — A list of rules that are evaluated sequentially until one of them is found to be true. The “true” case determines the next action of the business process that invoked the rule. If none of the rules is true, the rule set returns a default value. This is the type of rule that you invoke using the BPL `<rule>` element.
- *Routing rule set* — A rule set for use in message routing productions. Based on the type and contents of incoming messages (constraint), the routing rule set determines the correct destination for each message and how to transform the message contents prior to transmission. You use a routing engine business process to invoke this rule set.

Rule Set Properties

When you add a rule set, you see three property fields that you can use to distinguish rule sets in a rule definition: *Name*, *Effective begin date and time*, and *Effective end date and time*. These are the values the rule set list shows on the general tab.

Most business rule definitions have only one rule set that is always in effect. You can, however, have more than one version of a rule defined and become active at different times using a beginning and ending effective date and time. Each time a process invokes a rule, one and only one rule set is executed.

You can add a rule set from the general tab by clicking the add icon with the rule set list selected. You can then begin to edit the rule set by clicking on its tab or double-clicking its row in the list. When you are editing a rule set, you can click the icons near the top of the rule set tab or you can click the ones (or in the case of the add icon, the labeled rectangles beneath) in the expanded **Rule Assistant** pane.

As you become more familiar with the rule set editor and the rule sets you are developing, you may find it unnecessary to view the property names throughout the display of the rule set. You can toggle the viewing of property names by clicking the green square in the top right of the editor pane.

Also throughout the editing process, if a property does not contain a valid value you see a small red circle containing an exclamation point at the top right of the property box. If you double-click this warning mark, a helpful error message displays.

The following sections describe the editing tasks involved in creating a rule set:

- [Adding Rules](#)
- [Adding Actions](#)
- [Using the Associated Editors](#)
- [Adding Business Rule Notification](#)

3.1 Adding Rules

Each rule set contains one or more rules that you define to satisfy a specific function in a business process.

Rule Properties

When you add a rule, you see the following properties:

Name

You can give this rule an optional name to help you identify it.

Internally, Ensemble names the rules in sequential order in the form `rule#n`. If you enter a value in the Name property, it appears in the class definition and also appears in parentheses next to the internal rule name in the rule log. The value of *n* changes if you reorder the rules in a rule set.

Disabled

You can double-click this item to toggle between disabling and enabling the rule. A value of true means the rule is disabled and therefore skipped when the rule set is executed.

Constraint

(For routing rules only) — The constraint property distinguishes a routing rule. As a message makes its way through the rule set, if it matches the constraint you define for the rule, that rule logic is executed. See “[Using the Rule Constraint Editor](#)” for details on defining the constraint.

Each rule consists of a series of one or more **when** clauses and an optional **otherwise** clause, along with some optional actions. When you add a rule, the editor starts you with a **when** clause and if it is a routing rule, it also provides a **return** action for the clause.

Some general considerations to keep in mind when developing rules in your rule set:

- Once the execution through a rule set encounters a **return** action, the execution of the rule set ends and returns to the business process that invoked the rule definition class.
- You can control the execution of more than one rule in a rule set by omitting the returns. In other words, if you want to check all rules, do not provide a **return** action within any of the rule clauses. You may then provide a value in a **return** action at the end of the rule set for the case where no rule clauses evaluate to true.
- When a rule contains multiple **when** clauses, only the actions indicated by the first **when** that evaluates to true are performed. You can use an **otherwise** clause to perform an action if no **when** conditions are true.
- Each **when** clause has a condition property. A common design for a general business rule set is one that contains one rule with a series of **when** conditions and returning a value depending on which condition is true. If you want to return a default value if none of the conditions is true, you can use the **otherwise** clause with a return.
- A common design for a routing rule set is one that contains several rules each with a different constraint defined and each with one **when** clause describing how and where to route the message that matches the constraint.

3.2 Adding Actions

Every clause within a rule can have zero or more actions associated with it. Actions are executed if and only if the associated **when** condition is true. You can add the following actions to a rule set or a **when** or **otherwise** clause within a rule:


Action	Description
assign	Assigns values to properties in the business process execution context. For details see the <assign> entry in the <i>Ensemble Business Process Language Reference</i> .
return	Returns to the business process without further execution of the rule. For general rules it also returns the indicated value to the result location.
trace	Adds the information you enter into the Event Log when this specific part of the rule is executed. For details see the <trace> entry in the <i>Ensemble Business Process Language Reference</i> .
debug	Adds the expression text and value to the Rule Log when this specific part of the rule is executed. The debug action is executed only if the router business process RuleLogging property specifies the d flag, For details on the RuleLogging property, see “ Rule Logging ” in <i>Ensemble Virtual Documents</i> .

You can add some actions at the rule set level, but they do not always logically make sense. You should contain most actions within the **when** clauses of rules. A time when it may make sense to provide an action outside of these clauses is to set a default return value if no rules are executed in a rule set.

In addition, you can add the following actions to a routing rule:

Action	Description
send	Sends the message to a particular target after optionally transforming it. See “ Selecting the Transformation and Target of a Send Action ” for details.
delete	Deletes the current message.
delegate	Delegates the message to a different rule.

3.3 Using the Associated Editors

When you select a property of any of the items in a rule definition,  (the function icon) becomes enabled if the property has an associated editor. The following table shows which properties exist for a item, clause, or action and which editor opens when you double-click the property or click **fx**.

Item	Property	Associated editor or edit action
rule set	name	<i>Enter text.</i>
	effective begin	Date and Time Selector
	effective end	
rule	name	<i>Enter text.</i>
	disabled	<i>Double-click to toggle between true and false.</i>
	constraint	Rule Constraint Editor
when	condition	Expression Editor

Item	Property	Associated editor or edit action
assign	property	<i>Enter the name of a context property that is the target of this assignment. This must be a property in an execution context object.</i>
	value	Expression Editor
return	value (<i>general rule set only</i>)	Expression Editor
trace	value	Expression Editor
send	transform	Data Transform Selector
	target	Production Configuration Item Selector
delegate	rule name	Finder Dialog for rule classes.

The **otherwise** clause and **delete** action have no properties to edit.

3.3.1 Using the Rule Constraint Editor

Routing rules have a constraint property you use to determine which messages to route through which rules. Use this editor to configure the rule constraint values, which can be made up of the following properties:

Source

Configuration name of *one* of the following items:

- A business service (for a routing interface)
- A message routing process (if another rule chains to this routing rule set)

Click (...) next to the **Source** field to invoke the [Production Configuration Item Selector](#) which displays a list of possible source items in the production you indicate on the general tab. If you have not yet prepared the item you need as a **Source**, you may leave this field blank and return to it when the item is ready.

Message Class

Identifies the Ensemble message object that is being routed by this rule. The value of this field depends on the routing rule type:

- *HL7 Message Routing Rule* — Defaults to `EnsLib.HL7.Message`; you do not have the option of entering this property in a new rule definition.
- *General Message Routing Rule* — Click ... next to the **Message Class** field to invoke the **Finder Dialog** to select the appropriate message class. You can choose the category of message class to narrow your choices.
- *Virtual Document Message Routing Rule* — Choose from the list of defined virtual document classes.

The following fields in the editor apply only when the you are editing an HL7 or virtual document routing rule class, such as X12 or ASTM. For general message routing rules, you are finished entering the constraint fields.

Schema Category

Identifies the message category for the particular message class:

- *HL7 Message Routing Rule* — Choose from the built-in schema category list or the name of a custom schema definition.

- *Virtual Document Message Routing Rule* — Choose from the list of category types defined for your chosen virtual document class; they could be built-in or from an imported custom schema.

Document Name

Identifies the message structure; the acceptable values depend on the message class

- *HL7 Message Routing Rule* — The HL7 message structure that the source application identifies in the MSH:9 field, such as ADT_A08 or ORM_O01. To allow easy retrieval, this MSH:9 value resides in the EnsLib.HL7.Message property called Name.
- *Virtual Document Message Routing Rule* — Choose from the list of category types defined for your chosen virtual document class; they could be built-in or imported.

Enter more than one value in the **Document Name** text entry field. This causes the rule to match any of the specified **Document Name** values, and no others.

If you leave any of the fields blank, Ensemble considers *all* values to be a match for that rule.

The **Constraint Editor** behaves somewhat differently when you are editing a rule set converted from a version older than Ensemble 2012.1. You may see the **Schema Doc Type** field with a box to select an item to append to the list.

Schema Category and **Schema Doc Type** represent the actual HL7 message structure. These values reside in the EnsLib.HL7.Message property called DocType. DocType is a two-part string separated by a colon, such as 2.4:ADT_A08.

- At left is the **Schema Category**. This is the name of a built-in schema category or the name of a custom schema definition.
- At right is the **Schema Doc Type**. This is an HL7 message structure within the identified schema, such as ADT_A08 or ORM_O01.

3.3.2 Using the Production Configuration Item Selector

This editor helps you choose a configuration item as a source of a message or a routing target of a message. You choose from a list of production configuration items defined in the production you enter in the general tab. If you do not choose a production in the general tab of your rule definition, you receive the following warning when you invoke this editor:

No production name has been specified in the General tab of your rule. Be careful and ensure that your chosen target(s) exist in your production.

In this case you choose from a list of production configuration items defined in the current namespace. While developing your production rules, be careful to verify the names of your configuration items.

3.3.3 Selecting the Transformation and Target of a Send Action

When you add a **send** action, you also enter the following properties:

- **Transform** — (*optional*) To transform the message before sending it to the Target, enter the full package and class name of one or more DTL data transformations. You can double-click the **Transform** field to invoke the **Data Transform Selector** to choose one or more defined data transformations in the namespace.
Multiple data transformations are chained in the order in which they appear, from left to right.
- **Target** — Enter the configured name of one or more of the following production items:
 - A business operation, to route the message to an external application
 - A routing process, to chain to another routing rule set

Double-click the **Target** field to invoke the [Production Configuration Item Selector](#) to choose one or more production configuration items.

If you enter items for these field that do not exist yet, make sure to verify you have entered the correct name when the production does contain them.

If you want to pass information to the rule, you can assign a value to the `RuleUserData` property. This value is accessible to the transformation in the `aux.RuleUserData`. For details on using the `aux` variable, see “[Valid Expressions](#)” in the chapter “[Syntax Rules](#)” in *Developing DTL Transformations*.

3.3.4 Using the Expression Editor

When you select a condition or a value and click fx , you invoke the Expression Editor. There are four properties that activate the expression editor:

- **when** condition — See [Defining When Conditions](#) for details.
- **assign** value
- **return** value of a general business rule
- **trace** value — This is the text for the trace message. It can be a literal text string or an expression to be evaluated. If an expression, it must use the scripting language specified by the *language* attribute of the containing `<process>` element.

When defining an expression, you can nest several conditions by using the icons described in the following table.

Icon	Action
↑	Click to move the selected node up in the expression.
↓	Click to move the selected node down in the expression.
←	Click to merge the selected node with the parent node.
<i>op</i>	Click to choose from a list of operators of which to make the selected node an operand.
fx	Click to choose from a list of Ensemble functions to make the selected node an argument of the selected function.
+	Click to add a sibling node.
×	Click to delete the selected node.

If an action is not available, its icon appears dimmed. As you add conditions and values to the expression diagram, you see the text of the expression in the blue bar at the top of the editor.

The following sections provide greater detail for entering expression values:

- [Expression Values](#)
- [Expression Operators](#)
- [Expression Functions](#)

- Expression Examples

3.3.4.1 Defining When Conditions

Within a rule definition, a *condition* consists of two [values](#) and a comparison operator between these values. For example:

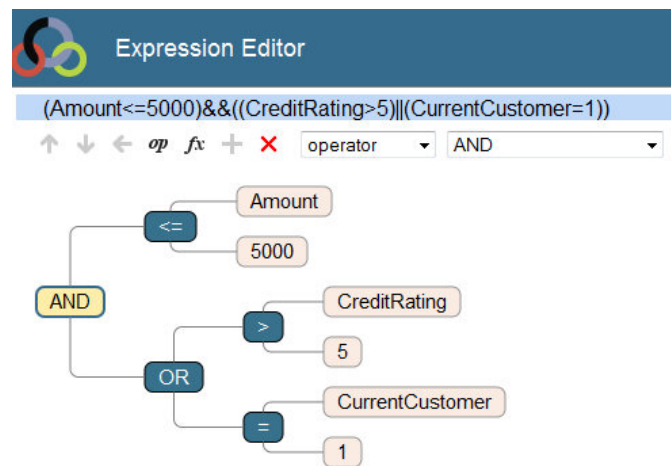
```
Amount <= 5000
```

If a condition is not true, it is false. There are no other possible values for a condition. This type of result is called a *Boolean* result. Ensemble stores a Boolean result either as the integer value 1 (if true) or 0 (if false). In most cases you do not need to be concerned with this internal representation; however, when using the constraint property in a routing rule, you may want to always execute the associated **when** clause when the constraints are satisfied. In this case, enter a value of 1 in the **when** condition property.

There can be more than one condition within a rule. If so, all of the conditions must be evaluated and compared before the rule (as a whole) can be found to be true or false. The logic between each condition is controlled using AND or OR operators. For example:

```
IF Amount <= 5000
AND CreditRating > 5
OR CurrentCustomer = 1
```

For this example, the **Expression Editor** dialog appears as follows:



The preceding rule has three conditions: Amount <= 5000, CreditRating > 5, CurrentCustomer = 1. Each of these conditions could be true or false. All of these conditions are evaluated before the AND or OR operators come into play.

AND and OR operate on true and false values only. The operator is positioned between two Boolean values, and returns a single Boolean result based on those two values, as follows.

Operator	Result is true when...
AND	Both values are true.
OR	At least one of the values is true, or both are true. If one of the values is false and the other is true, and the result (as a whole) is still true.

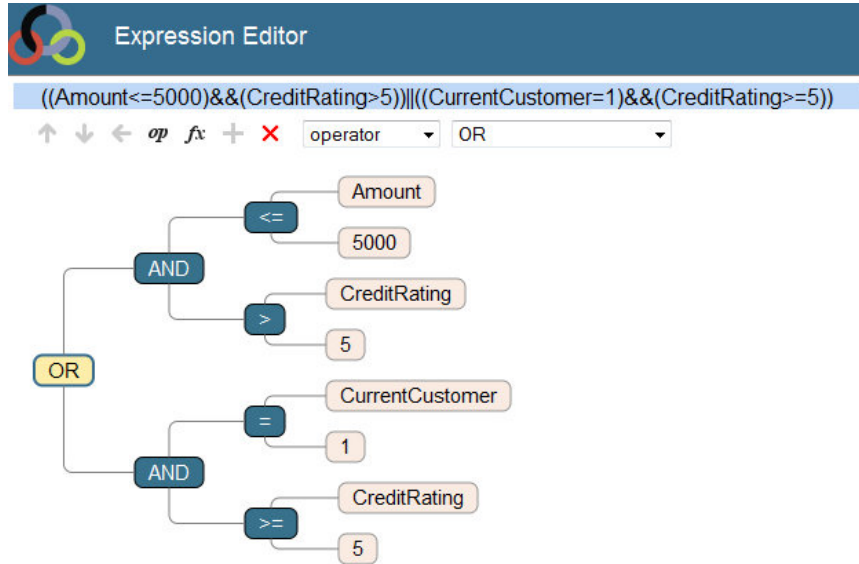
If there are multiple AND or OR operators within a rule, AND operators take precedence over OR operators. This means that all AND operations in the rule are performed first. Only then are the OR operations considered. Thus, logic such as this:

```
IF Amount <= 5000
AND CreditRating > 5
OR CurrentCustomer = 1
AND CreditRating >= 5
```

is handled as follows:

```
IF (Amount <= 5000 AND CreditRating > 5)
OR (CurrentCustomer = 1 AND CreditRating >= 5)
```

For this example, the **Expression Editor** dialog appears as follows:



The preceding rule is true if anyone requests an amount less than 5,000 *and* has a credit rating better than average. The rule is true for any current bank customer requests any amount *and* has a credit rating greater than or equal to the average. Both conditions may be true, or only one or the other of them may be true. If both conditions are false, then the rule (as a whole) is false.

In detail, the preceding rule works as follows:

1. This AND expression:

```
IF Amount <= 5000
AND CreditRating > 5
```

Gives a result, true or false. Call this result “SafeBet.”

2. This AND expression:

```
IF CurrentCustomer = 1
AND CreditRating >= 5
```

Gives a result, true or false. Call this result “KnownEntity.”

3. Once the AND operations in the rule have completed, the OR operation begins, as follows:

```
IF SafeBet is true
OR KnownEntity is true
```

4. From what we know about OR logic, we know that this rule (as a whole) is true if the customer is a SafeBet but not a KnownEntity, or if the customer is not a SafeBet but is a KnownEntity. Additionally, this rule is true if the customer is both a SafeBet and a KnownEntity.

3.3.4.2 Expression Values

Within a [condition](#) or the **assign**, **return**, or **trace** actions, the *values* can be any of the following items:

- A numeric value (integer or decimal), such as 1.1 or 23000.
- A string value, which *must* be enclosed in double quotes: "NY"
- If your production invokes the rule from a BPL business process using the <rule> element, you can specify a property in the general-purpose, persistent variable *context*, which is defined using the <context> and <property> elements in BPL. A property name is case-sensitive, and must *not* be enclosed in quotes, as in:

PlaceOfBirth

- An expression using various permitted [operators](#), literal values, and properties of *context*, as for example:


```
((2+2)*5)/154.3
"hello" & "world"
Age * 4
(((x=1) || (x=3)) && (y=2))
```

- A built-in Ensemble [function](#) such as **Min()**, **Max()**, **Round(n,m)**, or **SubString()**. The function name must include parentheses. It must also include any input parameters, such as the numeric values *n* and *m* for **Round**. If there are no input values for the function, then the open and close parentheses must be present, but empty.
- The *Document* variable, which represents the message object.

When you want to insert a value into a field on the rule set tab, you may type it into the text box directly. If the syntax is incorrect or inappropriate for the type of data expected for that field, you see the red error symbol when you try to save your changes.

If you correctly entered a **Context Class** in your rule definition, when you select a property in the Expression Editor, the text box provides choices of properties from the business process execution context of the identified BPL business process **Context Class**.

3.3.4.3 Expression Operators

In the Expression Editor, you can click  to choose from a list of operators of which to make the selected node an operand.

You may use the following arithmetic operators:

Operator	Meaning
+	Plus (binary and unary)
–	Minus (binary and unary)
*	Times
/	Divide

You may use the following logical operators, which return an integer value of 1 (true) or 0 (false):

Operator	Meaning	Expression is true when...
AND (&&)	And	Both values are true.
OR ()	Or	At least one of the values is true. Both values may be true, or only one true.

Operator	Meaning	Expression is true when...
!	Not (unary)	The value is false.
=	Equals	The two values are equal.
!=	Does not equal	The two values are <i>not</i> equal.
>	Is greater than	The value to the left of the operator is <i>greater</i> than the value to the right of the operator.
<	Is less than	The value to the left is <i>less</i> than the value to the right.
>=	Is greater than or equal to	The value to the left is greater than the value to the right, <i>or</i> if the two values are equal.
<=	Is less than or equal to	The value to the left is less than the value to the right, <i>or</i> if the two values are equal.
[Contains	The string contains the substring to the right. Pattern matching for Contains is exact. If the value at left is “Hollywood, California” and the value at right is “od, Ca”, there is a match, but a value of “Wood” does not match.

You may use the following string operators:


Operator	Meaning
&	Concatenation operator for strings.
—	Binary concatenation to combine string literals, expressions, and variables.

When more than one operator is found in an expression, the operators are evaluated in the following precedence order, from first to last:

1. Any of these logical operators: ! = != < > <= >=
2. Multiplication and division: * /
3. Addition and subtraction: + -
4. String concatenation: &
5. Logical AND: &&
6. Logical OR: ||

3.3.4.4 Expression Functions

Within a rule definition, an expression can include a call to one of the Ensemble *utility functions*. These include mathematical or string processing functions such as you may be accustomed to using in other programming languages.

In the **Expression Editor**, you can click  to choose from a list of functions of which to make the focused node an argument.

For a list of the available utility functions and the proper syntax for using them in business rules or DTL data transformations, see “[Ensemble Utility Functions](#)” in *Developing Business Rules*.

3.3.4.5 Expression Examples

Within a rule definition, an *expression* is a formula for combining values and properties to return a value. For example:

Expression	Computed value
$((2+2)*5)/154.3$	0.129617628
"hello" & "world"	"helloworld"
Age * 4	When Age is a <i>context</i> property (a property in the general-purpose, persistent variable <i>context</i> , which is defined using the <context> and <property> elements in BPL) and has the numeric value 30, the value of this expression is 120.
$1+2.5*2$	6
$2*5$	10
Min(Age,80,Limit)	This expression uses the built-in function Min . When Age is a <i>context</i> property with the value 30 and Limit (likewise a property) has the value 65, the value of this expression is 30.
Round(1/3,2)	0.33. This expression uses the built-in function Round .
$x < 65 \&\& A = "F" \mid x > 80$	This expression uses operator precedence conventions (explained in Expression Operators). When A is a <i>context</i> property with the string value F, and x (likewise a property) has the integer value 38, this expression has the integer value 1. This integer value has the meaning true or false according to Ensemble conventions. That is, an integer value of 1 means true; 0 means false.
Min(10,Max(X,Y))	This expression uses the utility functions Min and Max . When x is a <i>context</i> property with the numeric value 9.125, and y (likewise a property) has the numeric value 6.875, the value of this expression is 9.125.
$((x=1) \mid (x=3)) \&\& (y=2)$	This expression uses parentheses to clarify precedence in a complex logical relationship.

When you select a property that takes an expression as its value, a blank text field displays at the top of the rule set diagram. You may type any string in this field, so take care to enter the correct syntax. The rules for formulating expressions are as follows:

- An expression may involve any [values](#) as described in the preceding topics: numbers, strings, *context* properties, expressions, [functions](#), or any valid combination of these.
- White space in expressions is ignored.
- You may use any of the described [operators](#).
- If you want to override the default operator precedence, or if you want to make expressions easier to read, you can indicate precedence by using parentheses to group parts of the expression. Thus:
 $1+2.5*2 = 6$
Whereas:
 $(1+2.5)*2 = 7$
- Business rules support parentheses to group complex logical expressions such as $((x=1) \mid | (x=3)) \&\& (y=2)$.

When you invoke the **Expression Editor**, a blue bar displays above the graphical representation of the expression that contains the textual representation of the expression.

3.4 Adding Business Rule Notification

It is possible for you to set up rule notification, so that specific actions are taken each time a rule is fired. Unlike most activities related to rules, notification requires programming. You must subclass `Ens.Rule.Notification` and override the **%OnNotify** method in the subclass. The signature of this method is:

```
ClassMethod %OnNotify(pReason As %String,  
                    pRule As Ens.Rule.RuleDefinition)  
                    As %Status
```

Possible *pReason* values are:

- BeforeSave
- AfterSave
- Delete

At runtime, the Ensemble framework automatically finds your subclass of `Ens.Rule.Notification` and uses the code in **%OnNotify** to determine what to do upon firing a rule.

4

Example Rule Classes

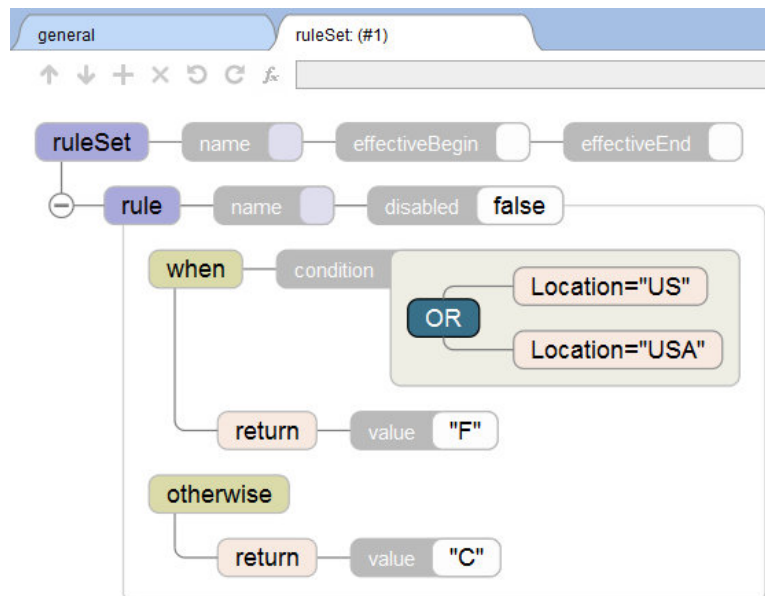
Ensemble contains various demonstration productions that contain examples of the different rule types. The following sections display an example rule class for each type:

- [General Business Rule Example](#)
- [HL7 Message Routing Rule Example](#)
- [General Message Routing Rule Example](#)
- [Virtual Document Message Routing Rule Example](#)

4.1 General Business Rule Example

The `Demo.ZenService.Bproc.WeatherReport.TempScale` class is an example of a general business rule. It is part of the `Demo.ZenService.Prod.GetTheWeather` production in the `ENSDEMO` namespace.

The following figure shows how the rule definition looks in the Ensemble Rule Editor:



The following is the class definition:

Class Definition

```
/// Business rule responsible for mapping an input location
/// to "F" for Fahrenheit or "C" for Celsius temperature scale.
Class Demo.ZenService.Bproc.WeatherReport.TempScale Extends Ens.Rule.Definition
{

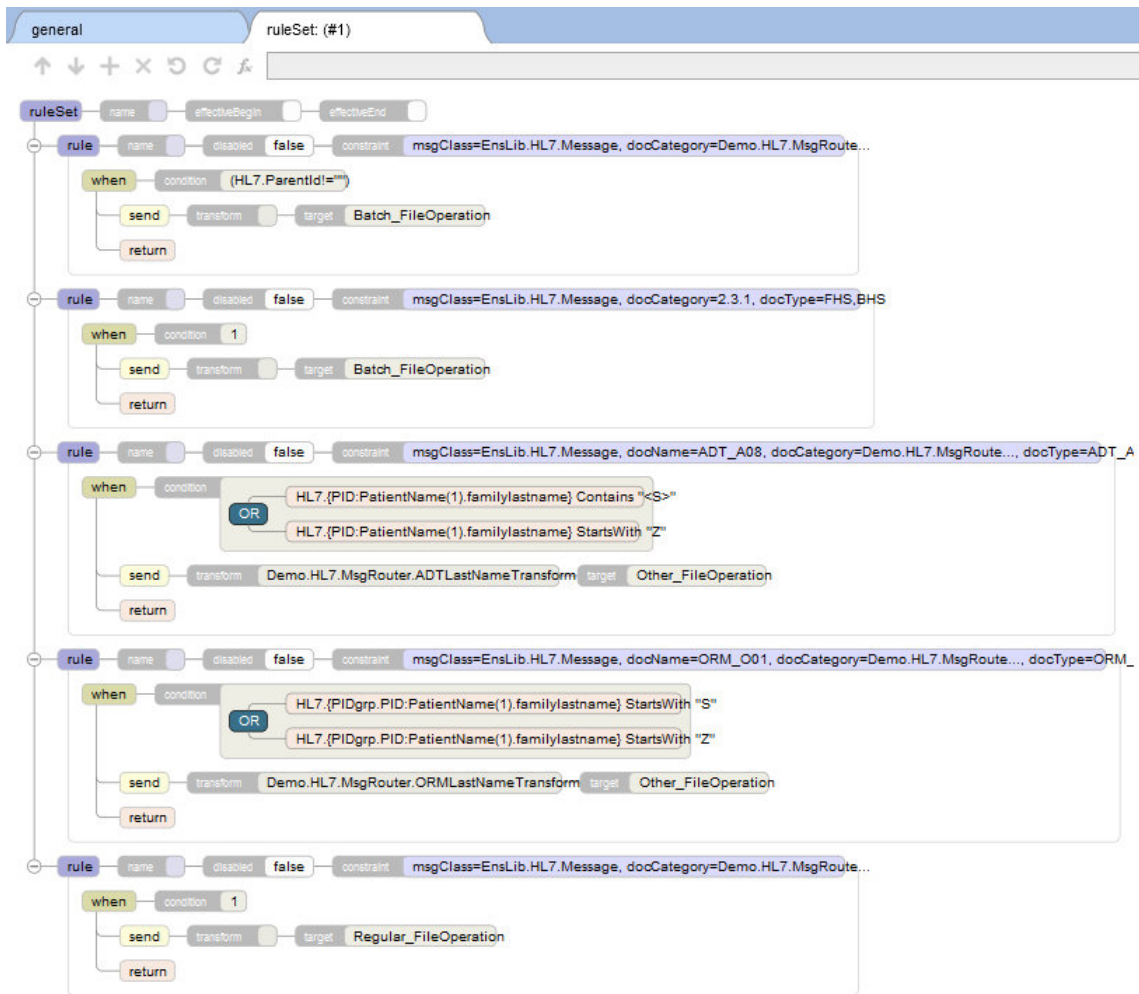
Parameter RuleAssistClass = "Ens.Rule.GeneralBusinessRuleAssist";

XData RuleDefinition [ XMLNamespace = "http://www.intersystems.com/rule" ]
{
<ruleDefinition alias="" context="Demo.ZenService.Bproc.WeatherReport.Context">
<ruleSet name="" effectiveBegin="" effectiveEnd="">
<rule name="" disabled="false">
<when condition="(Location=&quot;US&quot;)|| (Location=&quot;USA&quot;)">
<return>"F"</return>
</when>
<otherwise>
<return>"C"</return>
</otherwise>
</rule>
</ruleSet>
</ruleDefinition>
}
}
```

4.2 HL7 Message Routing Rule Example

The `Demo.HL7.MsgRouter.XYZRoutingRule` class is an example of a HL7 message routing business rule. It is part of the *Demo.HL7.MsgRouter.Production* production in the ENSDEMO namespace.

The following figure shows how the rule definition looks in the Ensemble Rule Editor:



The following code shows the class definition:

```

/// Routing from the XYZ message source.
Class Demo.HL7.MsgRouter.XYZRoutingRule Extends Ens.Rule.Definition
{
    Parameter RuleAssistClass = "EnsLib.HL7.MsgRouter.RuleAssistCompatible";

    XData RuleDefinition [ XMLNamespace = "http://www.intersystems.com/rule" ]
    {
        <ruleDefinition alias="" context="EnsLib.HL7.MsgRouter.RoutingEngine">
        <ruleSet name="" effectiveBegin="" effectiveEnd="">
        <rule name="">
        <constraint name="msgClass" value="EnsLib.HL7.Message"></constraint>
        <constraint name="docCategory" value="Demo.HL7.MsgRouter.Schema"></constraint>
        <when condition="(HL7.ParentId!=&quot;&quot;)">
        <send transform="" target="Batch_FileOperation"></send>
        <return></return>
        </when>
        </rule>
        <rule name="">
        <constraint name="msgClass" value="EnsLib.HL7.Message"></constraint>
        <constraint name="docCategory" value="2.3.1"></constraint>
        <constraint name="docType" value="FHS,BHS"></constraint>
        <when condition="1">
        <send transform="" target="Batch_FileOperation"></send>
        <return></return>
        </when>
        </rule>
        <rule name="">
        <constraint name="msgClass" value="EnsLib.HL7.Message"></constraint>
        <constraint name="docName" value="ADT_A08"></constraint>
        <constraint name="docCategory" value="Demo.HL7.MsgRouter.Schema"></constraint>
        <constraint name="docType" value="ADT_A01"></constraint>
        <when condition="(Contains(HL7.{PID:PatientName(1).familylastname},&quot;&lt;S&gt;&quot;))"
    
```

```

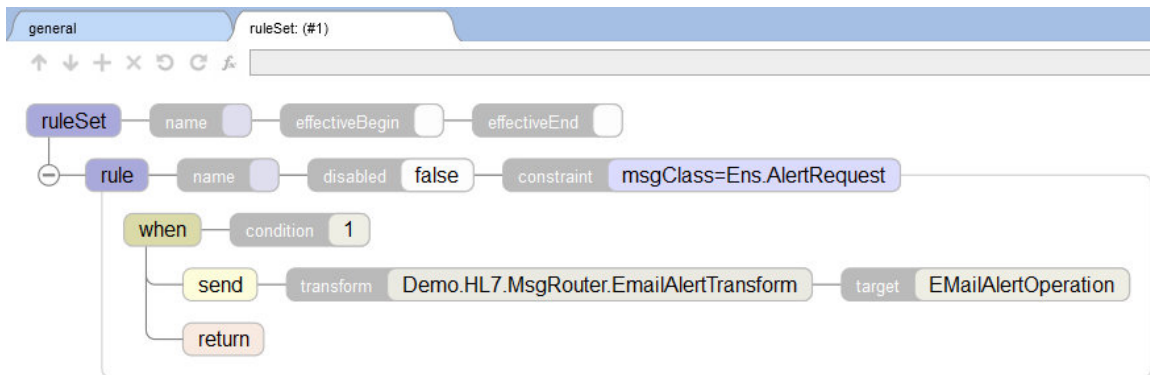
    || (StartsWith(HL7.{PID:PatientName(1).familylastname},&quot;Z&quot;))">
<send transform="Demo.HL7.MsgRouter.ADTLastNameTransform" target="Other_FileOperation"></send>
<return></return>
</when>
</rule>
<rule name="">
<constraint name="msgClass" value="EnsLib.HL7.Message"></constraint>
<constraint name="docName" value="ORM_001"></constraint>
<constraint name="docCategory" value="Demo.HL7.MsgRouter.Schema"></constraint>
<constraint name="docType" value="ORM_001"></constraint>
<when condition="(StartsWith(HL7.{PIDgrp.PID:PatientName(1).familylastname},&quot;S&quot;))
|| (StartsWith(HL7.{PIDgrp.PID:PatientName(1).familylastname},&quot;Z&quot;))">
<send transform="Demo.HL7.MsgRouter.ORMLastNameTransform" target="Other_FileOperation"></send>
<return></return>
</when>
</rule>
<rule name="">
<constraint name="msgClass" value="EnsLib.HL7.Message"></constraint>
<constraint name="docCategory" value="Demo.HL7.MsgRouter.Schema"></constraint>
<when condition="1">
<send transform="" target="Regular_FileOperation"></send>
<return></return>
</when>
</rule>
</ruleSet>
</ruleDefinition>
}
}

```

4.3 General Message Routing Rule Example

The `Demo.HL7.MsgRouter.AlertRule` class is an example of a general message routing business rule. It is part of the `Demo.HL7.MsgRouter.Production` production in the `ENSDemo` namespace.

The following figure shows how the rule definition looks in the Ensemble Rule Editor:



The following code shows the class definition:

```

/// See the AlertTable lookup table for a mapping of alert sources to email addresses.
/// If no match is found in the lookup, EmailAlertTransformation sends the alert
/// to the configured Recipient for the EMailAlertOperation.
Class Demo.HL7.MsgRouter.AlertRule Extends Ens.Rule.Definition
{
    Parameter RuleAssistClass = "EnsLib.MsgRouter.RuleAssist";

    XData RuleDefinition [ XMLNamespace = "http://www.intersystems.com/rule" ]
    {
        <ruleDefinition alias="" context="EnsLib.MsgRouter.RoutingEngine">
        <ruleSet name="" effectiveBegin="" effectiveEnd="">
        <rule name="">
        <constraint name="msgClass" value="Ens.AlertRequest"></constraint>
        <when condition="1">
        <send transform="Demo.HL7.MsgRouter.EmailAlertTransform" target="EMailAlertOperation"></send>
        <return></return>
        </when>
    }
}

```



```

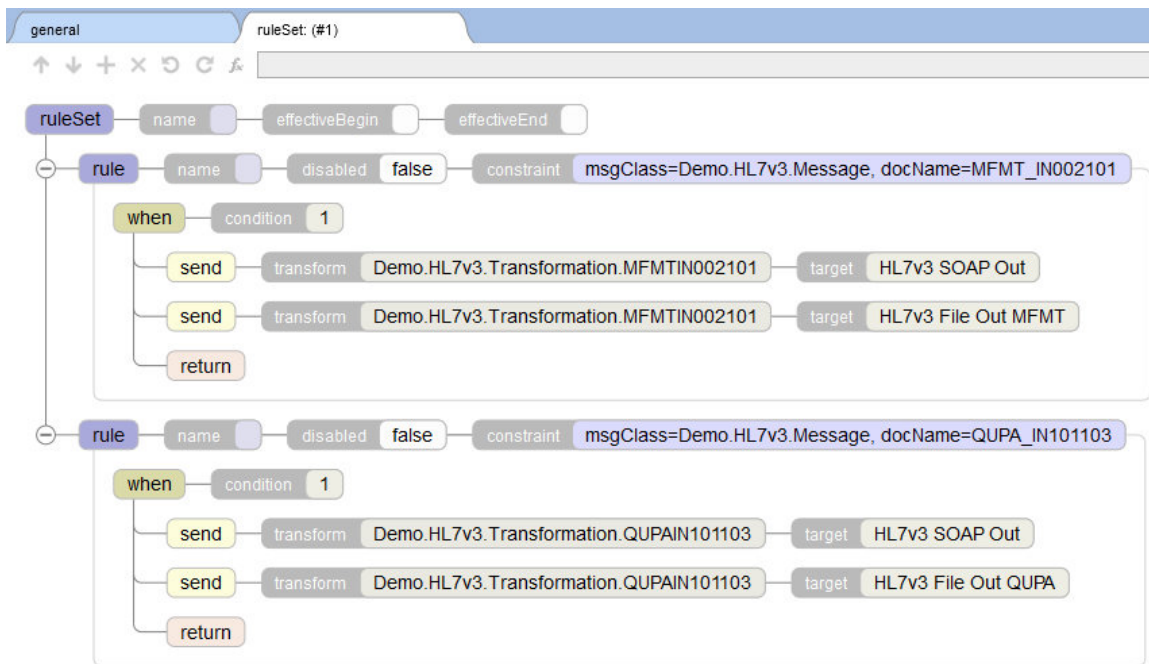
</rule>
</ruleSet>
</ruleDefinition>
}
}

```

4.4 Virtual Document Message Routing Rule Example

The `Demo.HL7v3.Rule.RouteAndTransform` class is an example of a virtual document message routing business rule. It is part of the `Demo.HL7v3.Production.InterfaceEngine` production in the `ENSDEMO` namespace.

The following figure shows how the rule definition looks in the Ensemble Rule Editor:



The following code shows the class definition:

```

/// Test rule for HL7 version 3 productions
Class Demo.HL7v3.Rule.RouteAndTransform Extends Ens.Rule.Definition
{
    Parameter RuleAssistClass = "EnsLib.MsgRouter.VDocRuleAssistCompatible";

    XData RuleDefinition [ XMLNamespace = "http://www.intersystems.com/rule" ]
    {
        <ruleDefinition alias="" context="Demo.HL7v3.Rule.Context">
        <ruleSet name="" effectiveBegin="" effectiveEnd="">
        <rule name="" disabled="false">
        <constraint name="msgClass" value="Demo.HL7v3.Message"></constraint>
        <constraint name="docName" value="MFMT_IN002101"></constraint>
        <when condition="1">
        <send transform="Demo.HL7v3.Transformation.MFMTIN002101" target="HL7v3 SOAP Out"></send>
        <send transform="Demo.HL7v3.Transformation.MFMTIN002101" target="HL7v3 File Out MFMT"></send>
        <return></return>
        </when>
        </rule>
        <rule name="" disabled="false">
        <constraint name="msgClass" value="Demo.HL7v3.Message"></constraint>
        <constraint name="docName" value="QUPA_IN101103"></constraint>
        <when condition="1">
        <send transform="Demo.HL7v3.Transformation.QUPAIN101103" target="HL7v3 SOAP Out"></send>
        <send transform="Demo.HL7v3.Transformation.QUPAIN101103" target="HL7v3 File Out QUPA"></send>
        <return></return>
        </when>
    }
}

```

```
</rule>
</ruleSet>
</ruleDefinition>
}
}
```

5

Debugging Routing Rules

This chapter describes strategies for debugging the routing rules in an EDI message routing production.

The primary symptom for problems in routing rules is that the message does not reach its destination. Perhaps the message reaches a point along the way, such as a business operation or routing process within the routing production, but it does not reach its target destination, which is generally an application server outside Ensemble. In that case you can follow the problem-solving sequence captured in the next four drawings: “Solving Problems with Routing Rules,” Drawings [A](#), [B](#), [C](#), and [D](#).

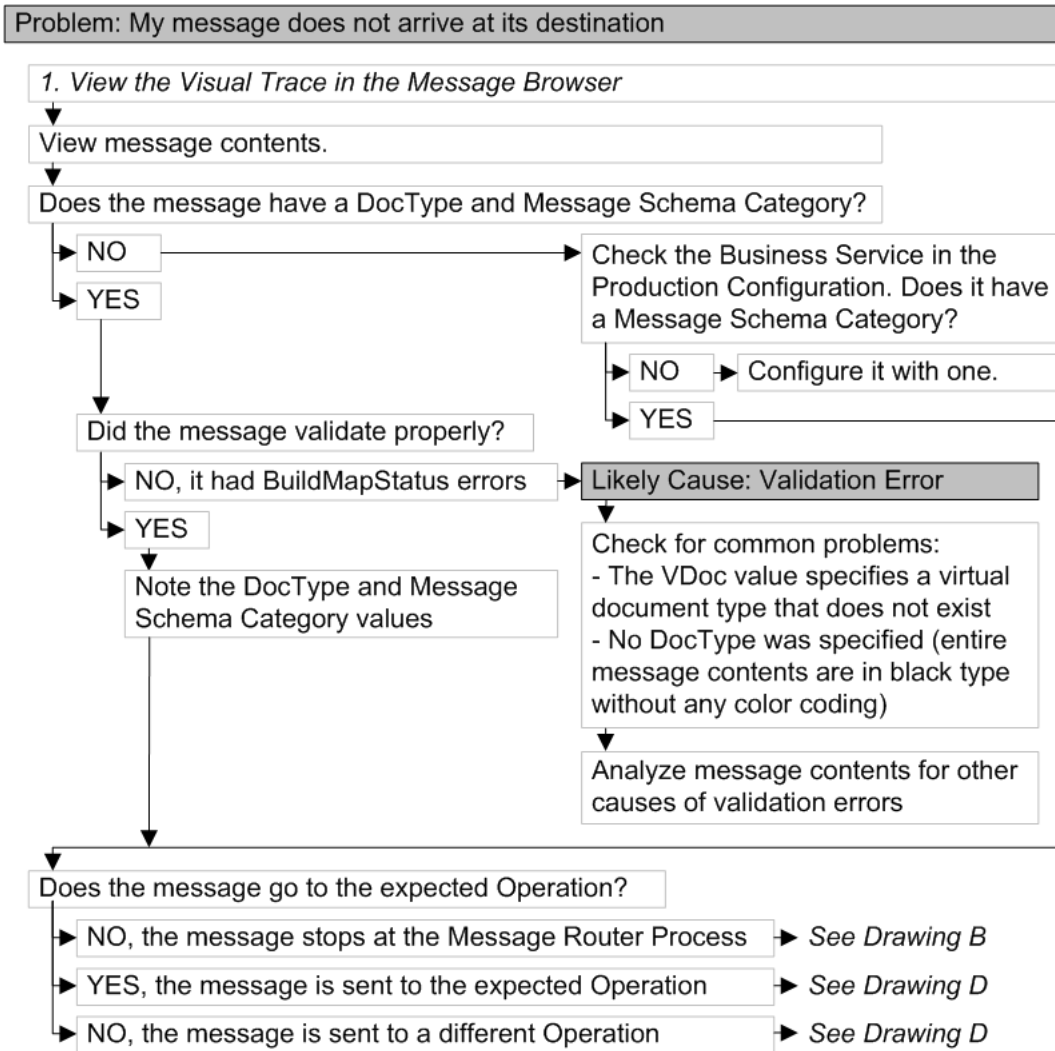
Figure 5–1: Solving Problems with Routing Rules (Drawing A)

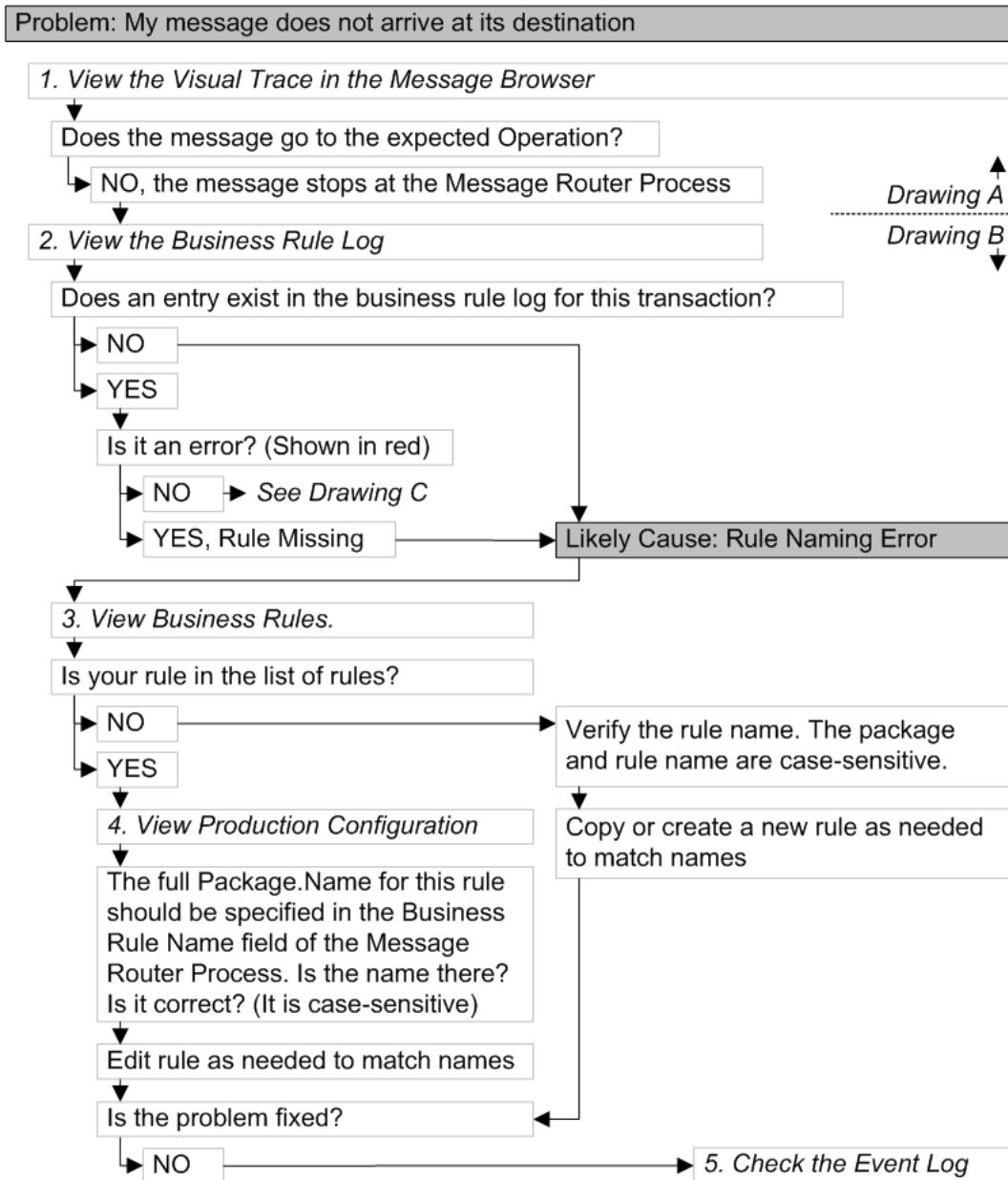
Figure 5-2: Solving Problems with Routing Rules (Drawing B)

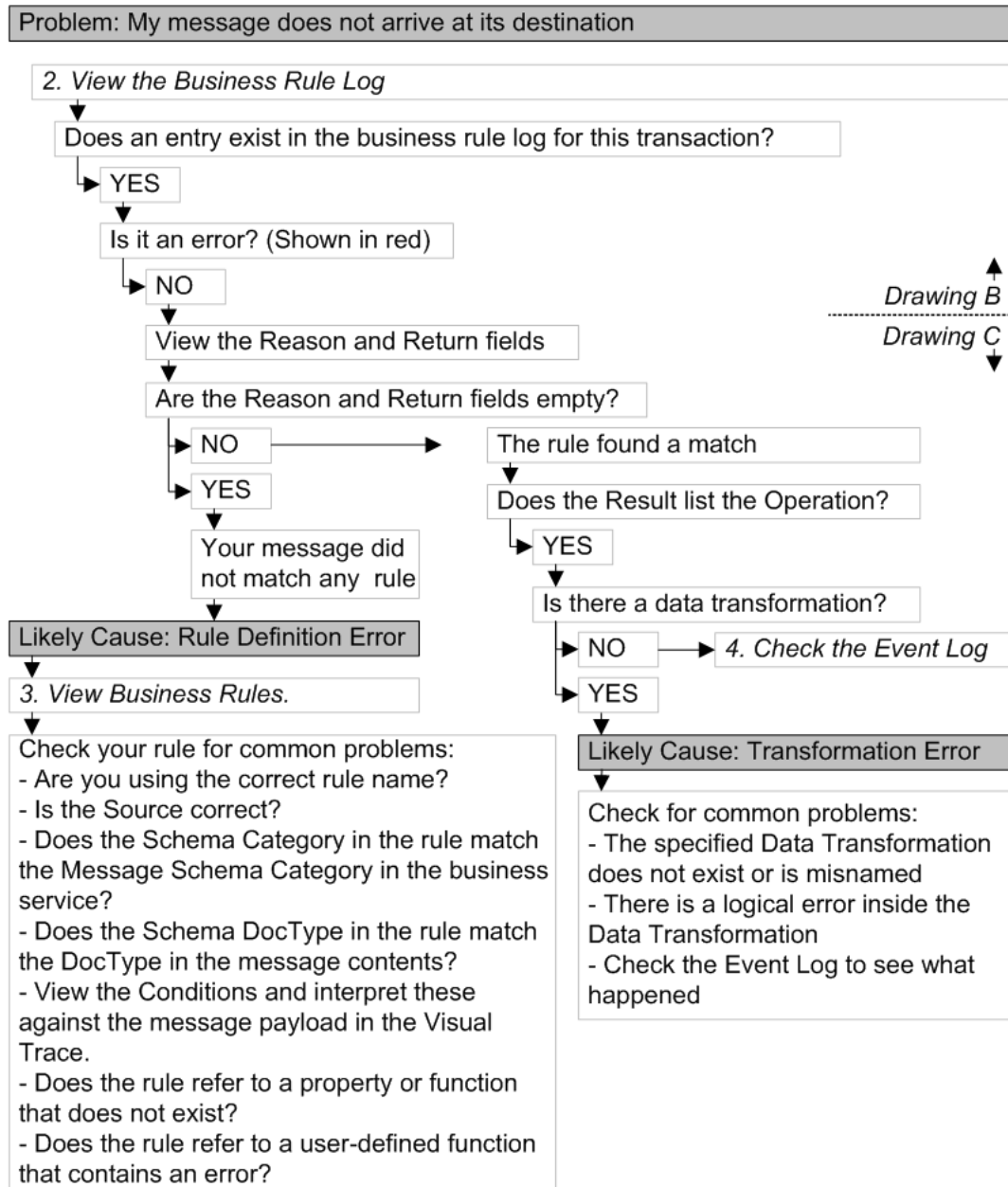
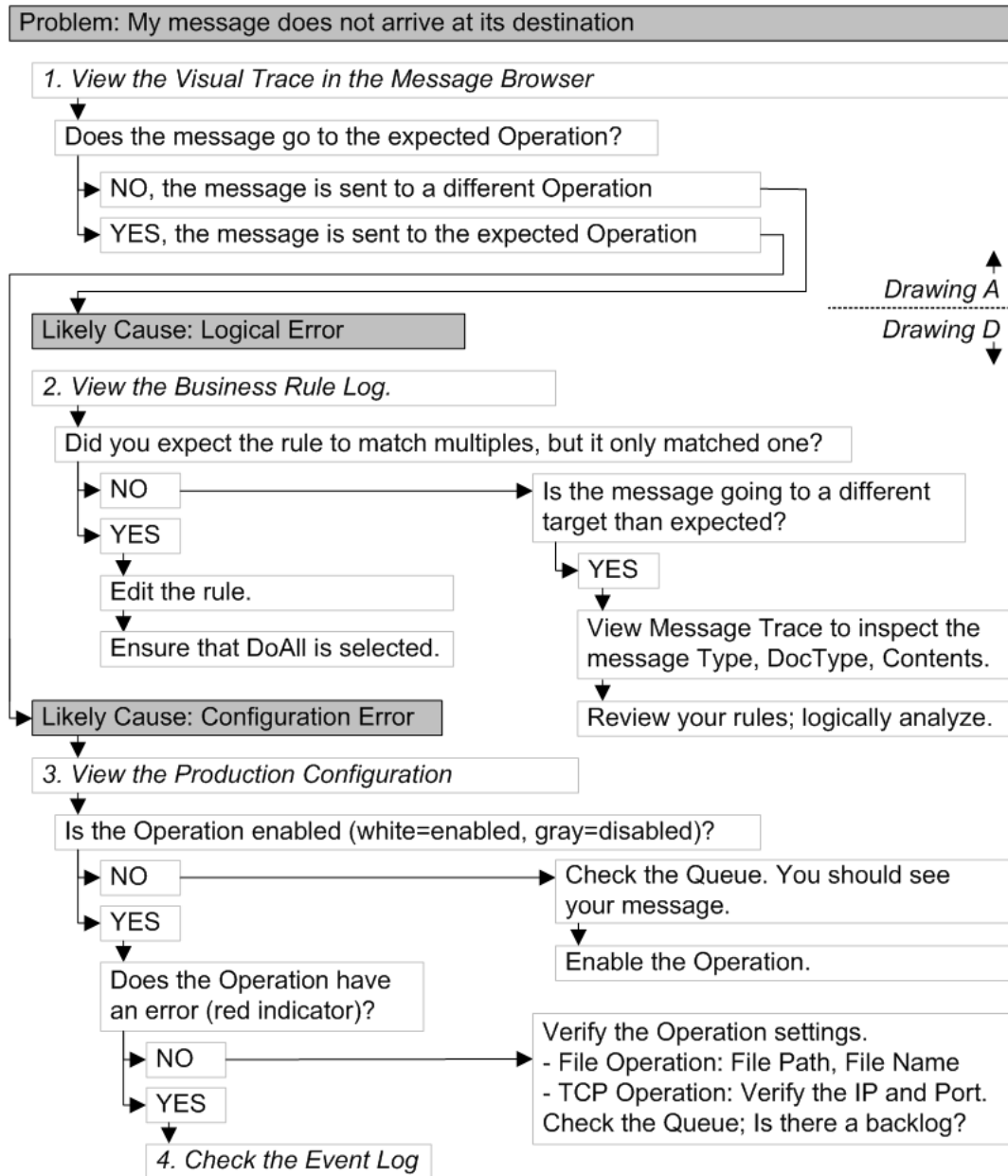
Figure 5-3: Solving Problems with Routing Rules (Drawing C)

Figure 5-4: Solving Problems with Routing Rules (Drawing D)

A

Ensemble Utility Functions

This appendix describes the Ensemble *utility functions* that you can use in business rules and DTL data transformations. These include mathematical or string processing functions such as you may be accustomed to using in other programming languages. This appendix contains the following topics:

- [Built-in Functions](#)
- [Syntax to Invoke a Function](#)

To define your own functions, see “[Defining Custom Utility Functions](#)” in *Developing Ensemble Productions*.

A.1 Built-in Functions

The following lists the utility functions built into Ensemble.

Note: For boolean values, 1 indicates true and 0 indicates false.

Contains(*val*,*str*)

Returns 1 (true) if *val* contains the substring *str*; otherwise 0 (false).

ConvertDateTime (*val*,*in*,*out*,*file*)

Reads the input string *val* as a time stamp in *in* format, and returns the same value converted to a time stamp in *out* format. See “[Time Stamp Specifications for Filenames](#)” in *Configuring Ensemble Productions*.

The default for *in* and *out* is %Q. Any %f elements in the *out* argument are replaced with the *file* string. If *val* does not match the *in* format, *out* is ignored and *val* is returned unchanged.

CurrentDateTime(“*format*”)

Returns a string representing a date/time value in the given format. For a list of possible formats, see the Date and Time Expansion section of the class reference for the **FormatDateTime** method. For example, `CurrentDateTime("%H")` returns the current hour in 24-hour format as a 2-digit number. The default format is ODBC format (%Q) in the server's local timezone.

DoesNotContain(*val*,*str*)

Returns 1 (true) if *val* does not contain the substring *str*.

DoesNotIntersectList(*val*,*items*,*srcsep*,*targetsep*)

Returns 1 (true) if no item in the given source list (*val*) appears in the target list (*items*). For details on the arguments, see `IntersectsList`.

DoesNotMatch(*val*,*pat*)

Returns 1 (true) if *val* does not match the pattern specified by *pat*. *pat* must be a string that uses syntax suitable for the ? pattern matching operator in ObjectScript. For details, see “Pattern Matching” in the chapter “Operators and Expressions” of *Using Caché ObjectScript*.

DoesNotStartWith(*val*,*str*)

Returns 1 (true) if *val* does not start with the substring *str*.

Exists(*tab*,*val*)

The `Exists` function provides a way to predict the results of the `Lookup` function. `Exists` returns 1 (true) if *val* is a key defined within the table identified by *tab*; otherwise it returns 0 (false).

If(*val*,*true*,*false*)

If the argument *val* evaluates to 1 (true), the `If` function returns the string value of its *true* argument; otherwise it returns the string value of its *false* argument.

In(*val*,*items*)

Returns 1 (true) if *val* is found in the comma-delimited string *items*.

InFile(*val*,*file*)

Returns 1 (true) if *val* is found in the identified *file*.

InFileColumn(...)

The function `InFileColumn` can have as many as 8 arguments. The full function signature is:

InFileColumn(val, file, columnId, rowSeparator, columnSeparator, columnWidth, lineComment, stripPadChars)

`InFileColumn` returns 1 (true) if *val* is in the specified column in a table-formatted text *file*. Arguments are as follows:

- *val* (required) is the value.
- *file* (required) is the text file.
- Default *columnId* is 1.
- Default *rowSeparator* is ASCII 10. A negative *rowSeparator* value indicates the row length.
- Default *columnSeparator* is ASCII 9. If *columnSeparator* is 0, the format of the file is said to be “positional.” In this case *columnId* means character position and *columnWidth* means character count.
- Default *columnWidth* is 0.
- Default *lineComment* is an empty string.
- Default *stripPadChars* consists of a blank space followed by ASCII 9.

IntersectsList(*val*,*items*,*srcsep*,*targetsep*)

Returns 1 (true) if any item in the given source list (*val*) appears in the target list (*items*). The arguments *srcsep* and *targetsep* specify the list separators in the source and target lists respectively; for each of these, the default is "><", which means that the lists are assumed to have the form "<item1><item2><item3>"

The `IntersectsList` utility works well with the [square bracket \[\] syntax](#) to match values of a virtual document property. If there is more than one instance of the segment type in a message, the square bracket syntax returns the multiple values in a string like `<ValueA><ValueB><ValueC>` .

If the target list has only a single item, this function is essentially the same as the `Contains` function. If the source list has only a single item, this function is essentially the same as the `In` function.

Length(*string*,*delimiter*)

Returns the length of the given string. If you specify *delimiter*, this function returns the number of substrings based on this delimiter.

Like(*string*,*pattern*)

Returns 1 (true) if the given value (*string*) satisfies a SQL Like comparison with the given pattern string (*pattern*). In SQL Like patterns, % matches 0 or more characters, and _ matches any single character. Note that an escape character can be specified by appending "%%" to the pattern, e.g. "%SYSVAR_#_%%%" to match any value string that starts with "%SYSVAR" followed by any single character, an underscore, and anything else.

Lookup(*table*,*keyvalue*,*default*, *defaultOnEmptyInput*)

The **Lookup()** function searches for the key value specified by *keyvalue* in the table specified by *table* and returns its associated value. This returned value is equivalent to the following global:

```
^Ens.LookupTable(table,keyvalue)
```

If the key is not found in the table, the `Lookup` function returns the default value specified by the *default* parameter. The *default* parameter is optional, so if it is not specified and `Lookup` does not find a matching key, it returns an empty string. An exception is that if either the key value or the lookup table is empty, the **Lookup()** function returns either the default value or the empty string depending on the value of the *defaultOnEmptyInput* parameter as described in the following table. The default value of the *defaultOnEmptyInput* parameter is 0 for compatibility with previous versions of Ensemble.

defaultOnEmptyInput Value	key value and lookup table	Lookup() returns
0	either key value or lookup table is empty	empty string
1	key value is empty	empty string
	lookup table is empty but key value is not	default value
2	lookup table is empty	empty string
	key value is empty but lookup table is not	default value
3	either key value or lookup table is empty	default value

The **Exists()** function returns true if a **Lookup()** function with the same parameters would find the key value in the lookup table.

Matches(*val*,*pat*)

Returns 1 (true) if *val* matches the pattern specified by *pat*. *pat* must be a string that uses syntax suitable for the ? pattern matching operator in ObjectScript. For details, see “Pattern Matching” in the chapter “Operators and Expressions” of *Using Caché ObjectScript*.

Max(...)

Returns the largest of a list of up to 8 values. List entries are separated by commas.

Min(...)

Returns the smallest of a list of up to 8 values. List entries are separated by commas.

Not(*val*)

Returns 0 (false) if *val* is 1 (true); 1 (true) if *val* is 0 (false).

NotIn(*val*,*items*)

Returns 1 (true) if *val* is not found in the comma-delimited string *items*.

NotInFile(*val*,*file*)

Returns 1 (true) if *val* is not found in the identified *file*.

NotLike(*string*,*pattern*)

Returns 1 (true) if the given value (*string*) does not satisfy a SQL Like comparison with the given pattern string (*pattern*). See Like.

Pad(*val*,*width*,*char*)

Reads the input string *val*. Adds enough instances of *char* to widen the string to *width* characters. If *width* is a positive value, the padding is appended to the right-hand side of the *val* string. If *width* is a negative value, the padding is prepended to the left-hand side of the *val* string.

Piece(*val*,*char*,*from*,*to*)

If the delimiter character *char* is present in the string *val*, this separates the string into pieces. If there are multiple pieces in the string, *from* and *to* specify which range of these pieces to return, starting at 1. If multiple pieces are returned, the delimiter in the return string is the same as the delimiter in the input string. For example:

Piece("A,B,C,D,E,F") returns "A"

Piece("A!B!C!D!E!F", "!", 2, 4) returns "B!C!D"

The default *char* is a comma, the default *from* is 1, and the default *to* is *from* (return one piece). For details, see the \$PIECE function in the *Caché ObjectScript Reference*.

ReplaceStr(*val*,*find*,*repl*)

Reads the input string *val*. Replaces any occurrences of string *find* with the string *repl*, and returns the resulting string.

Note: Use ReplaceStr instead of the Replace function, which has been deprecated.

Round(*val*,*n*)

Returns *val* rounded off to *n* digits after the decimal point. If *n* is not provided (that is, *Round(val)*) the function drops the fractional portion of the number and rounds it to the decimal point, producing an integer.

Rule(*rulename*,*context*,*activity*)

Evaluates the rule specified in the *rulename* with the given *context* object and the given *activity* label for the Rule Log and returns the value.

Schedule(*ScheduleSpec*, *ODBCDateTime*)

Evaluates the state of the given *ScheduleSpec* string, named Schedule or Rule at the moment given by *ODBCDateTime*. If *ScheduleSpec* begins with '@' it is a Schedule name or Rule name, otherwise a raw Schedule string. If *ODBCDateTime* is blank, the evaluation is done for the current time.

StartsWith(*val*,*str*)

Returns 1 (true) if *val* starts with the substring *str*.

Strip(*val*,*act*,*rem*,*keep*)

Reads the input string *val*. Removes any characters matching the categories specified in the *act* template and the *rem* string, while retaining any characters found in the *keep* string. Returns the resulting string. For details and examples, see the \$ZSTRIP function in the *Caché ObjectScript Reference*.

SubString(*str*,*n*,*m*)

Returns a substring of a string *str*, starting at numeric position *n* and continuing until numeric position *m*. The number 1 indicates the first character in the string. If *m* is not provided (that is, *SubString(str,n)*) the function returns the substring from position *n* to the end of the string.

ToLower(*str*)

Returns the string *str* converted to lowercase.

ToUpper(*str*)

Returns the string *str* converted to uppercase.

Translate(*val*,*in*,*out*)

Reads the input string *val*. Translates each occurrence of a character in string *in* to the character at the corresponding position in string *out*, and returns the resulting string.

Note: These functions are defined by methods in the class Ens.Util.FunctionSet.

A.2 Syntax to Invoke a Function

When you reference an Ensemble function in a business rule or a DTL data transformation, the syntax must include parentheses. It must also include any input parameters, such as the numeric values for the mathematical functions Min, Max, or Round. If there are no input values for the function, then the open and close parentheses must be present, but empty.

The following are examples of valid function syntax:

Expression	Computed Value
<code>Min(Age, 80, Limit)</code>	When <code>Age</code> is a property with the value 30 and <code>Limit</code> (likewise a property) has the value 65, the value of this expression is 30.
<code>Round(1/3, 2)</code>	0.33
<code>Min(10, Max(X, Y))</code>	When <code>x</code> is a property with the numeric value 9.125, and <code>y</code> (likewise a property) has the numeric value 6.875, the value of this expression is 9.125.

If the value input to any function is a string that starts with a number, nonnumeric characters in the string are dropped and the numeric portion is used. The string "3a" is treated like the number 3, so the function `Min("3a", "20ofThem")` returns the value 2. A string that begins with a nonnumeric character such as "a123" has the numeric value 0.

The business rule syntax for utility functions differs from the DTL syntax in the following significant way:

- Business rules reference the utility functions simply by name:
`ToUpper(value)`
- DTL uses two leading dots immediately before the function name, as if the function were a method:
`..ToUpper(value)`

The following DTL data transformation uses a utility function called **ToUpper()** to convert a string to all uppercase characters. The `<assign>` statement references **ToUpper()** using double-dot syntax, as if it were a method in the class:

Class Definition

```
Class User.NewDTL1 Extends Ens.DataTransformDTL
{
  XData DTL
  {
    <?xml version="1.0" ?>
    <transform targetClass='Demo.Loan.Msg.Approval'
              sourceClass='Demo.Loan.Msg.Approval'
              create='new' language='objectscript'>
    <assign property='target.BankName'
            value='..ToUpper(source.BankName)' action='set' />
    <trace value='Changed all lowercase letters to uppercase!' />
    </transform>
  }
}
```