Knowledge Expert

P1

P2

Preface

A major issue that affects every industry in which products are developed is the retention and reuse of knowledge. While every organization produces data and information about its products, transforming this data into an accessible knowledge base is difficult. The tools used throughout the product development process typically do not help retain the knowledge of how and why decisions are made, nor do they provide convenient access to this knowledge. Knowledge is the embodiment of experience and data in a directly useable form. How you get home from your office is knowledge. A map showing the way is data that has to be interpreted. Through experience, you know to use different routes shown on the map depending on various conditions such as the weather or the time of day. You have used the map and other information to create knowledge. Likewise, in product development, understanding how a product is intended to function and how to apply that understanding to create an appropriate product is knowledge. The models and drawings of the product are part of the data that defines the product, but they don't convey how or why someone created the product in a specific way. It is difficult to embed knowledge in a design. It takes extra effort to write out or codify the decision process so that it can be passed as knowledge from one person to another. The tools that are most often used in product development also need to be capable of capturing knowledge, and they must allow product developers to apply that knowledge to their product designs.

CATIA Version 5, in addition to embodying a significant new architecture that has been evolving over a number of years, also provides some very interesting capabilities that allow designers to drive their design processes from associative specifications and to integrate specifications into their product development processes. It gives product developers ways to create specifications and rules, save them, and reuse them.

The capabilities you might need to develop knowledgeware solutions are divided into four products.

1. **CATIA Infrastructure** provides you with a set of knowledgeware features such as the *parameters*, the *formulas* and the *design tables*.

2. **CATIA Knowledge Advisor** enables you:
   - to create *rule*s and *check*s
   - to study impacts and dependencies with the *Knowledge Inspector* tool.
   - and, for those of you who dabble in VB Script, to associate a set of operations with a feature.

3. **CATIA Generative Knowledge** allows you to create features from a *generative script language*.

4. **CATIA Knowledge Expert** is designed to help you create and manage a rule base.

Getting Started

The scenario which is developed below helps you begin learning new areas of the CATIA knowledgeware capabilities. It is broken down into tasks and all the instructions required by the user are supplied for each task.

An expert rule is a way to specify that, depending on a context, feature attributes are to be modified. An expert rule applies to all the features of a given type. The example below illustrates the expert rule principle.
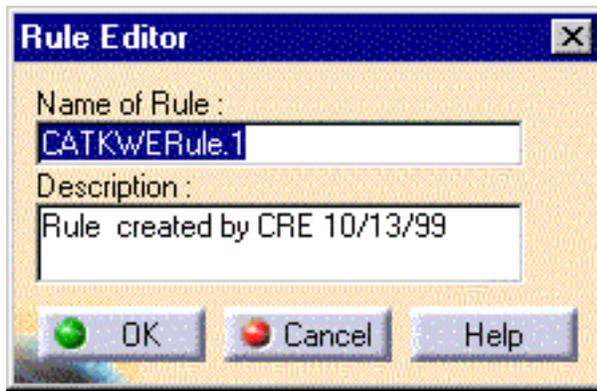
1. Create a two-hole pad or box. One hole must have a 50.0 mm diameter, the other a 10.0 mm diameter.
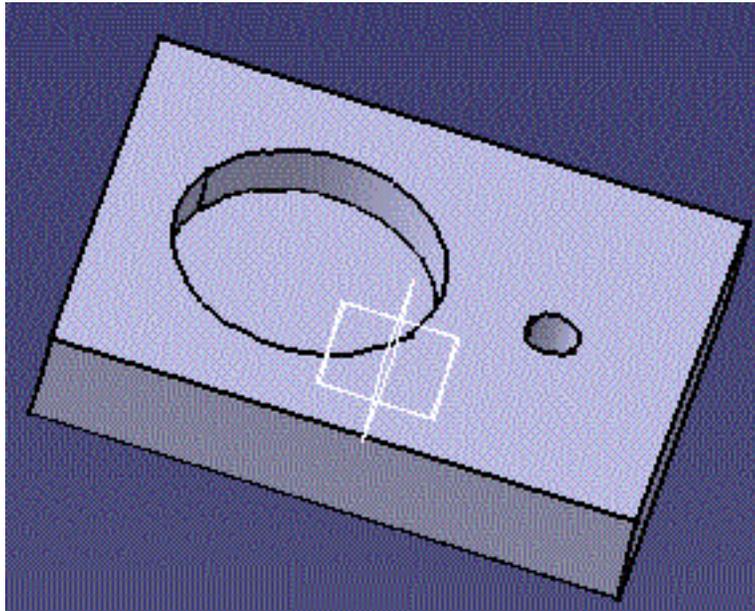
2. Access the Knowledge Expert workbench.

   . Select the root item in the specification tree.

   2. In the Start menu, select Infrastructure-> Knowledge Expert.

3. Click the ![icon] icon.

4. Select the RuleBase relation in the specification tree. The following dialog box is displayed.
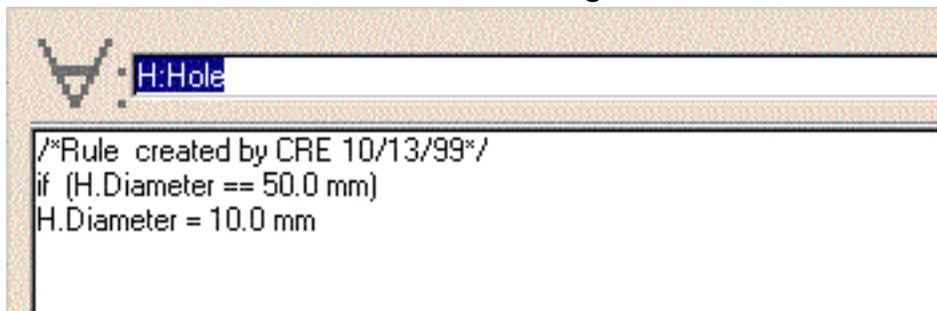
5. If need be, replace the default name and description for the rule to be created, then click OK. The expert rule editor is displayed.

6. Enter the **H:Hole** statement in the field.
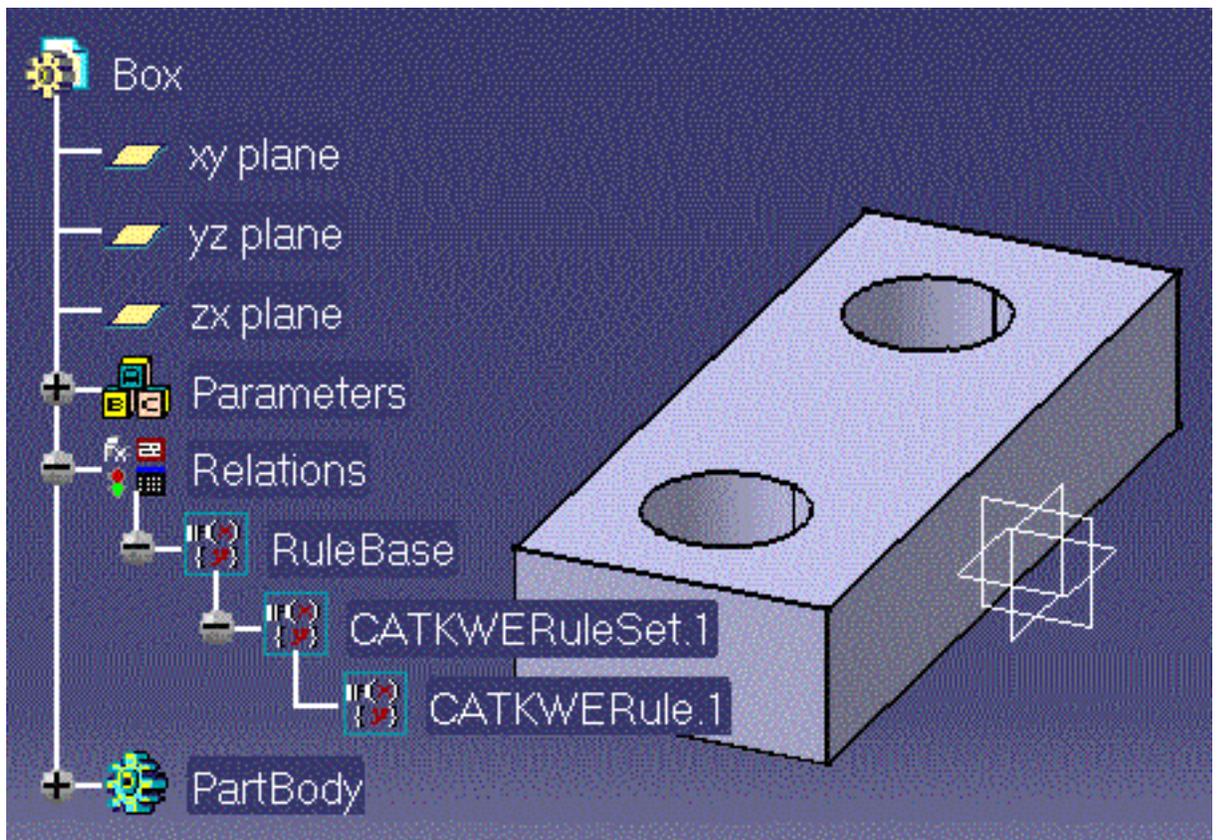
7. Copy/Paste the code below from your browser to the edition box of the editor:

```
if  (H.Diameter == 50.0 mm)
H.Diameter = 10.0 mm
```

   The rule editor now looks something like this:

8. Click OK. A rule is added to the rule set in the specification tree. Click the icon to solve the rule base. If need be, update the document. Here is what you should get onscreen:

9. Keep your document open and proceed to next task.

The solve capability is meaningful in the context of a rule base containing a certain number of rule sets. Each rule set can consist of several expert rules. Solving a rule base consists in applying all the active rules to a document.
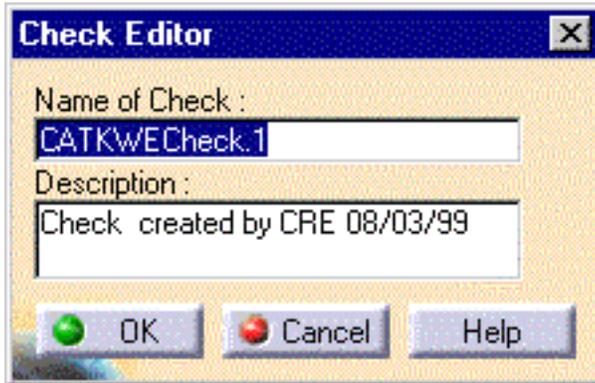

An expert check is a particular expert rule which does not execute any action. It just gives you a clue as to whether an expression is fulfilled or not. A check also applies to all the features of a given type.

1. (Re-)access the Knowledge Expert workbench.
   . Select the root item in the specification tree.
     2. In the Start menu, select Infrastructure-> Knowledge Expert workbench

2. Click the ⬛ icon.

3. Select the RuleBase relation in the specification tree. The following dialog box is displayed.

   Check Editor ✕

   Name of Check :
   `CATKWECheck.1`

   Description :
   `Check created by CRE 08/03/99`

   🟢 OK   🔴 Cancel   Help

4. If need be, replace the default name and description for the check to be created, then click OK. The expert check editor is displayed.

5. Use the field with the ∀ symbol to specify the feature type you want to apply the expert rule. The following syntax should be applied:

   H:Hole

6. Copy/Paste the code below from your browser to the edition box:

   (H.Diameter == 11.0 mm) AND (H.Activity == TRUE)

   The check editor now looks something like this:

   | Condition | Correction | Report |

   ∀ : `H:Hole`

   ```
   /*Check created by CRE 10/13/99*/
   (H.Diameter == 11.0 mm) AND (H.Activity == TRUE)
   ```
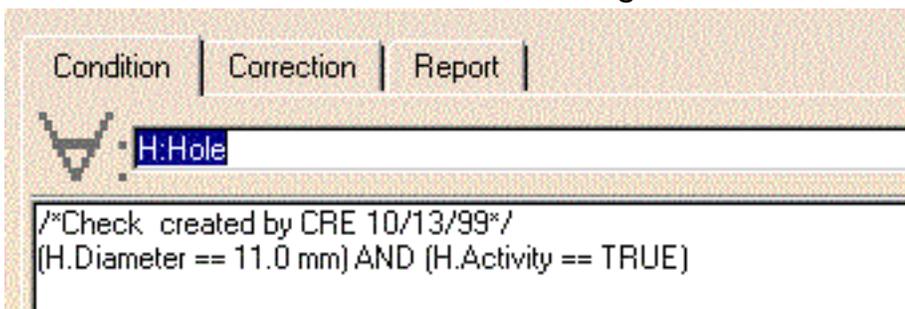
7. Click OK. A check is added to the rule base in the specification tree.

8. Click the 🌀 icon to solve the rule base. Here is what you should get onscreen:
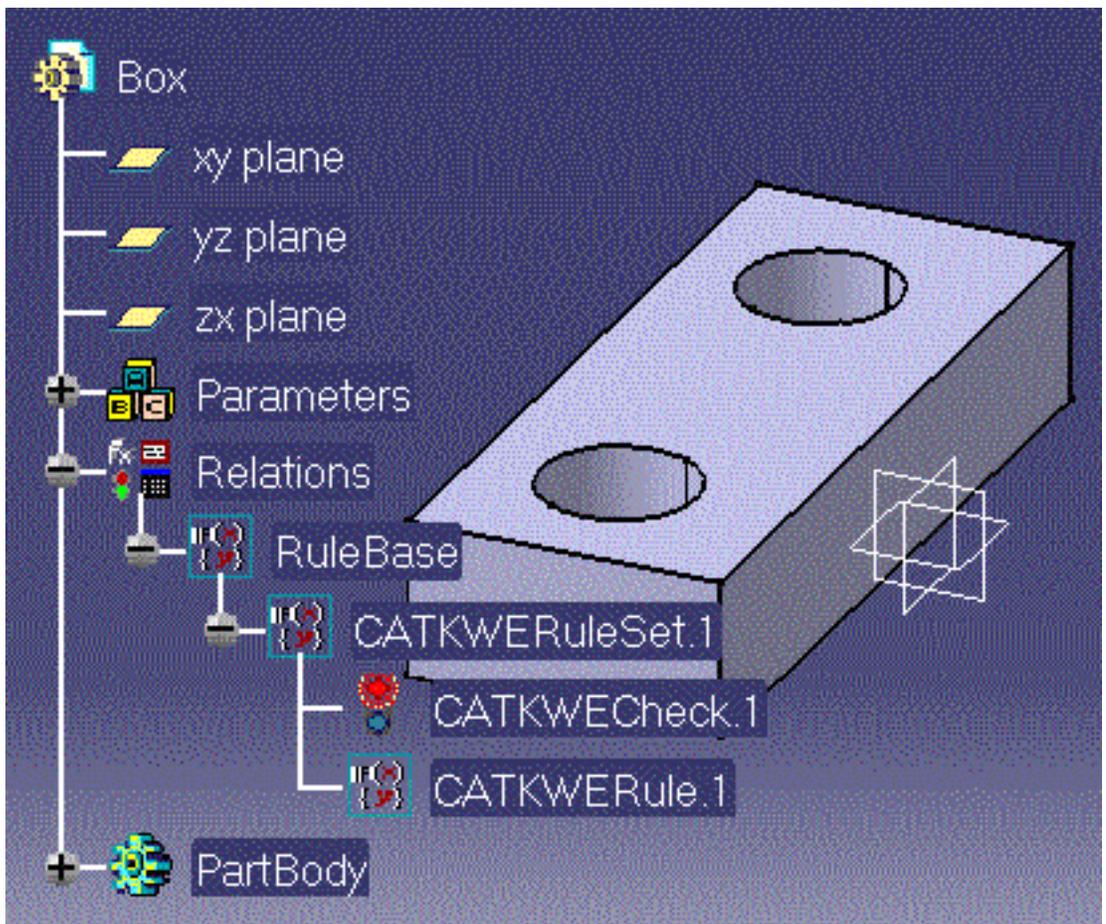
The light icon associated with the check has turned to red, indicating that the check is not valid (all the holes have a diameter of 10.0mm).

Interactive Tasks

Here is the Knowledge Expert feature hierarchy. Click the hyperlinks to display the list of interactive tasks whereby you can create and manipulate these features.

For more information on the Knowledge Expert features which are illustrated in figure below, see About the Knowledge Expert Features.

**In the figure below, click any of the links to
display the related summary of tasks**.

Rule Base tasks
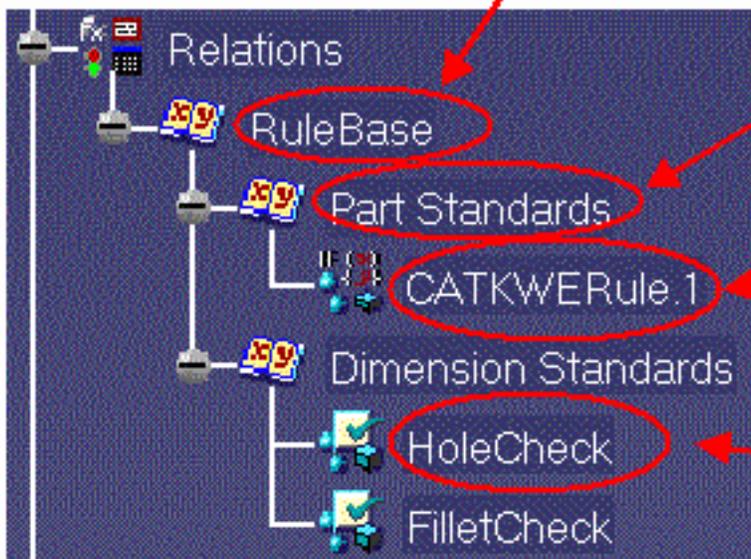
Rule Set tasks

Expert Rule tasks

Expert Check tasks

In the rule base hierarchy, the *activity parameter is inherited from the parent feature*. If a rule set is deactivated, all the features created in this rule set are deactivated. If a rule base is deactivated, all the features created in this rule base are deactivated.

About the Knowledge Expert Features

The Knowledge Expert product allows you to create and manipulate relation-type features. These particular features are arranged into a hierarchy. The **rulebase** object is at the top of this hierarchy, the **expert rules** and **expert checks** are the terminal objects. In between you can find the **rule sets** which gather rules and checks.

The Knowledge Expert features have no representation in the geometry area. You can just access them from the specification tree. They benefit from the behavior common to all CATIA features. They can be copy/pasted, deleted, edited, activated or deactivated from the specification tree.

Looking at the specification tree, a rule base along with all its components, looks something like the figure opposite. By default, the rule base components are prefixed with the CATKWE string. This can be changed by using the Properties function from the contextual menu.
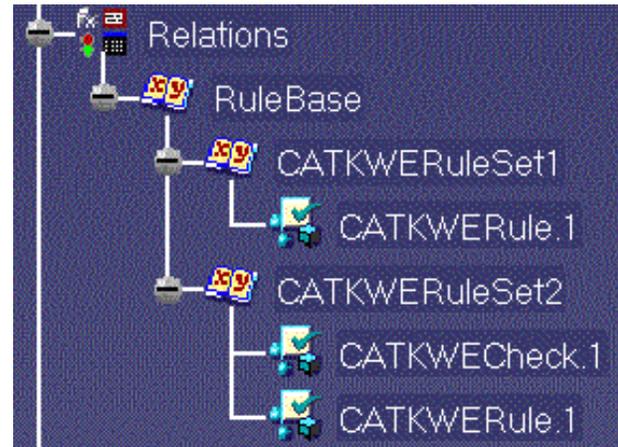
The rules and checks are the only objects you create directly. An empty rulebase is automatically associated with a document when you access the Knowledge Expert workbench. Rule sets are implicitly created upon creation of the rules and checks. Rule sets cannot be nested within a rule base. Here is a description of these objects.

What is an Expert Rule ?

An **expert rule** is a set of instructions which conditionally executes a group of statements, depending on the value of one or more expressions **and** applies to all the features of a given type. An expert rule allows you to manipulate the feature attributes. For example, some attribute values can be tested within a conditional statement and depending on the result, these attributes can be re-evaluated.

The figure opposite is an expert rule which could be written that way:

```
Given S, any object of Shell type
if the S activity value is true
and
if the S inner thickness is positive
then set the S outer thickness to 5.0
```
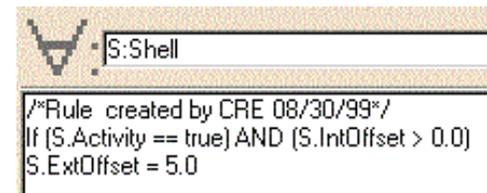
Not all the features and feature attributes can be manipulated in expert rules. Refer to Programming Aspects for more information.

To apply an expert rule to a document, you must solve the entire rule base. Refer to Solving a Rule Base.

A Particular Expert Rule: The Expert Check

An **expert check** is a rule which only verifies that a condition is true for all the objects of a given type.

The figure opposite is an expert check which could be written that way:

```
Given H,  any object of Hole type
tell me whether the Hole activity is true
```
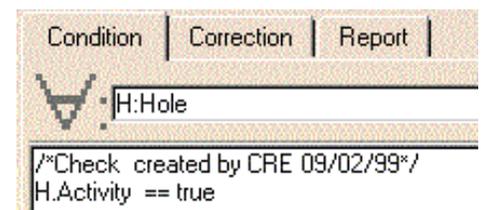
An expert check is valid (the condition specified is fulfilled) or invalid. It does not modify the document it is applied to.

The Rule Base and the Solve Operation

Expert rules as well as expert checks cannot be applied directly and individually to a document. They are all regrouped within the rule base which acts as a parent object and executes globally all its rules and checks.

The event which starts the solve operation depends on whether the Automatic Update mode is selected. The solve operation consists in firing (i.e. executing) expert rules and expert checks according to some principles which are described in [Solving a Rule Base.](#) As a result:

- some feature attributes may be modified

- the check icons in the specification tree turn to green( ) or red( ) depending on whether the checks are valid or invalid.

After the Solve operation has been performed, you can generate a check report by clicking the icon.

Rule Base Interactive Tasks

Create a rule base

An empty rule base is automatically added to a document when you access the Knowledge Expert workbench.

Import a rule base

In the file selection box, select the .CATProduct file which contains the rule base to be imported.
Note:

- the external document must be a .CATProduct
- the rule base is the only feature which is imported from the external document (mechanical features are not imported for example)
- rules/checks are not imported when there are rules/checks with the same name in the importing document
- the importing document maintains a link with the imported document. Removing the external document or the rule base in the external document removes the rule base in the importing document.

Solve a rule base

- *If a rule base has never been solved:*
  In Automatic Update mode, all the active rules and checks are automatically fired the first time a document parameter is modified. In non-automatic mode, all the active rules and checks are automatically fired the first time the solve icon is clicked.
- *After a rule base has been solved:*
  In Automatic Update mode, a new solve operation is executed each time a document parameter is modified but only the rules whose predicate refers to the modified parameter are fired. In non-Automatic Update mode, you have to click the solve icon to re-execute a solve operation after a document parameter has been modified. Only the rules whose predicate refers to the modified parameter are fired.

Activate/deactivate a rule base

In the specification tree, right-click the rule base object, then select the `Rulebase object->(De)activate` function from the contextual menu.

or

In the parameter list of the "Formulas" dialog box, select the rulebase/activity parameter and modify its value in the "Edit name, value or formula" field.

Define the rule base settings (check report)

In the specification tree, right-click the rulebase object, then select the `Rulebase object->Settings` function from the contextual menu.

Importing a Rule Base

A rule base can be imported from an external file. The imported file must be a .CATProduct file while the receiving file can be either a .CATPart or a .CATProduct. The rule base is the only feature which is imported from the external document.

1. Open a document, either a .CATProduct or a .CATPart
2. Access the Knowledge Expert workbench.
3. Click the ⬛ icon. A file selection box is displayed.
4. Select a .CATProduct file (this step is meaningful if the file which is selected contains a non-empty rule base).
5. Click OK to import the rule base from the external file you have just selected. The expert rules/checks are added to the specification tree.

⚠ Only rules/checks with different names are imported. The importing (or receiving) document maintains a link with the imported document. If the latter is deleted, the imported rule base is removed from the former.

Up   Creating Expert Rules   Creating Expert Checks   Generating a Check Report

Importing   Solving

Solving a Rule Base

Creating an expert rule or an expert check does not imply that the feature created is applied to the document. To apply an expert rule/check to a document, you must solve the entire rule base, but if you do this you will apply all the active objects of the rule base to the document. The Solve operation is quite simple, but there are some subtleties behind this operation.

1. When you create a rule base in a document, if you want to apply all the rulebase components to your document without modifying any document parameter, you must solve the rule base by clicking the Solve icon.

2. Then if you modify a document parameter after a solve operation has been carried out, the solve operation will be automatically executed:

   - if the parameter which has just been modified is referred to in a rule predicate
   - **and** if the Automatic Update option in the Tools->Options->General->General tab is checked.

3. If the Automatic Update option is not checked, clicking the Solve ⊘ icon solve the rule base. An Update is required after the Solve operation.

The Case Study illustrates these principles.

Up   Creating Expert Rules   Creating Expert Checks   Generating a Check Report

Importing   Solving

Rule Set Interactive Tasks

Create a rule set

The rule set creation is included in the expert rule/check creation task. When you create an expert rule/check, CATIA prompts you to select either a rule base or a rule set. Selecting a rule base creates a rule set and adds a rule/check to this rule set. Selecting an already existing rule set creates a rule/check in this rule set.

Activate/deactivate a rule set

In the specification tree, right-click the rule set to be activated or deactivated,
then select the `Ruleset.object->(De)activate` function from the contextual menu.

or

In the parameter list of the "Formulas" dialog box, select the ruleset/activity parameter and modify its value in the "Edit name, value or formula" field.

Delete a rule set

In the specification tree, right-click the rule set, then select the Delete function from the contextual menu.

Expert Rule Interactive Tasks

Create an expert rule

1. Select a rule base or a rule set. A dialog box is displayed.
2. Modify the default rule name and comments (optional).
3. Click OK. The Rule Editor is displayed.

4. Enter the feature type in the ∀ field , example: **H:Hole;S:Shell**
    and the rule body, example:
    if H.Diameter > 10.0
    (H.Diameter = False)
5. Click Apply to check the rule syntax.
6. Click OK to add the expert rule to the document.

Edit / modify an expert rule

In the specification tree, double-click the rule to be edited,
then modify its statements in the rule editor.

or

In the specification tree, right-click the rule to be edited,
then select the `Rule.object->Definition` function from the
contextual menu.

Delete an expert rule

In the specification tree, right-click the rule to be deleted,
then select the Delete function from the contextual menu.

Activate/deactivate an expert rule

In the parameter list of the "Formulas" dialog box, select the rule/activity
parameter and modify its value in the "Edit name, value or formula" field.

or

In the specification tree, right-click the rule to be activated/deactivated,
then select the Activate/Deactivate function from the contextual menu.

Creating Expert Rules

Here are the step-by-step instructions you have to follow to create an expert rule. Other operations you can perform on expert rules are summarized in the Quick Reference.   Examples of expert rules are given in the Case Study.

1. Access the Knowledge Expert workbench.
    . Select the root feature in the specification tree.
        2. In the Start menu, select Infrastructure-> Knowledge Expert workbench

2. Click the ![icon] icon. CATIA prompts you to select either the rulebase object or an already existing rule set. Click either in the specification tree:
    - If you select the rulebase object, your rule will be created below a new rule set.
    - If you select an already existing rule set, your rule will be created below this rule set.

3. In the dialog box which is displayed, replace if need be, the default name and description for the rule to be created, then click OK. The expert rule editor is displayed.

4. The trick is now to code your rule. Go to Programming Aspects.   Depending on the rules to be added to your rule base, you may have to set the priority parameter.

5. Click Apply to test your rule and determine whether its syntax is correct.

6. Click OK to add the rule to the document.

The expert rule is added to the specification tree either below a new rule set (if rulebase was selected) or below an already existing rule set (if this rule set was selected). The rule is NOT applied to the document. It is just added to the document.

The "New Parameter of type" field allows you to create a new parameter in an expert rule. It is mainly useful for those of you developing user functions. The task which consists in programming user functions is related to the CAA (CATIA Application Architecture) product which will be part of an upcoming CATIA version.

Creating Expert Checks

Here are the step-by-step instructions you have to follow to create an expert check. Other operations you can perform on expert checks are summarized in the Quick Reference. Examples of checks are given in the Case Study.

1. Access the Knowledge Expert workbench.
   . Select the root feature in the specification tree.
   2. In the Start menu, select Infrastructure-> Knowledge Expert workbench

2. Click the ⬛ icon. CATIA prompts you to select either the release object or an already existing rule set. Click either feature in the specification tree:
   - If you select the release object, your check will be created below a new rule set.
   - If you select an already existing rule set, your check will be created below this rule set.

3. In the dialog box which is displayed, replace, if need be, the default name and description for the rule to be created, then click OK. The expert check editor is displayed.
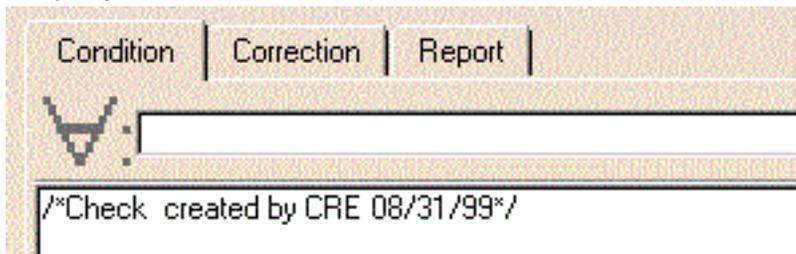
4. Type your check in the rule editor. Refer to Programming Aspects for information about the check syntax.

5. Select the correction tab. Three *correction methods* are proposed:
   a `VB Script` which offers a script editor. If a check is invalid, the VB Script instructions specified in this editor are executed when selecting the *Check*.object->Correct Function from the check contextual menu
   b `Advise correction` which provides you with a means to specify a multiple-line message.
   c `URL` which prompts you to specify the URL of a file to be displayed onscreen if the check is invalid.

6. Select the Report tab to specify a message to be displayed in the check report.

7. Click Apply to test your check and determine whether its syntax is correct.

8. Click OK to add the check to the document.

The expert check is added to the specification tree either below a new rule set (if release was selected) or below an already existing rule set (if this rule set was selected). The check is NOT applied to the document. It is just added to the

document.

Generating a Check Report

After a solve operation has been carried out, you can generate a check report. The data logged in the generated report as well the report format depend on the rule base settings. This task explains how to specify these settings and generate the check report. The Case Study provides you with a check report example.

1. In the specification tree, right-click the rulebase object, then select the rulebase.object->Settings function from the contextual menu. The RuleBase Settings dialog box is displayed:

RuleBase Settings ☒

Ouput Format
● Html
○ File

Output Directory
`G:\BSF\intel_a\reffiles\/CIRCE/` [Select...]

Description Length
● Long
○ Short

○ Passed
○ False
● Both

Show Results
● By Rule
○ By Object
○ By Rule State

Others
☐ Automatic Correct
☐ Traces

[● OK] [● Cancel] [Help]
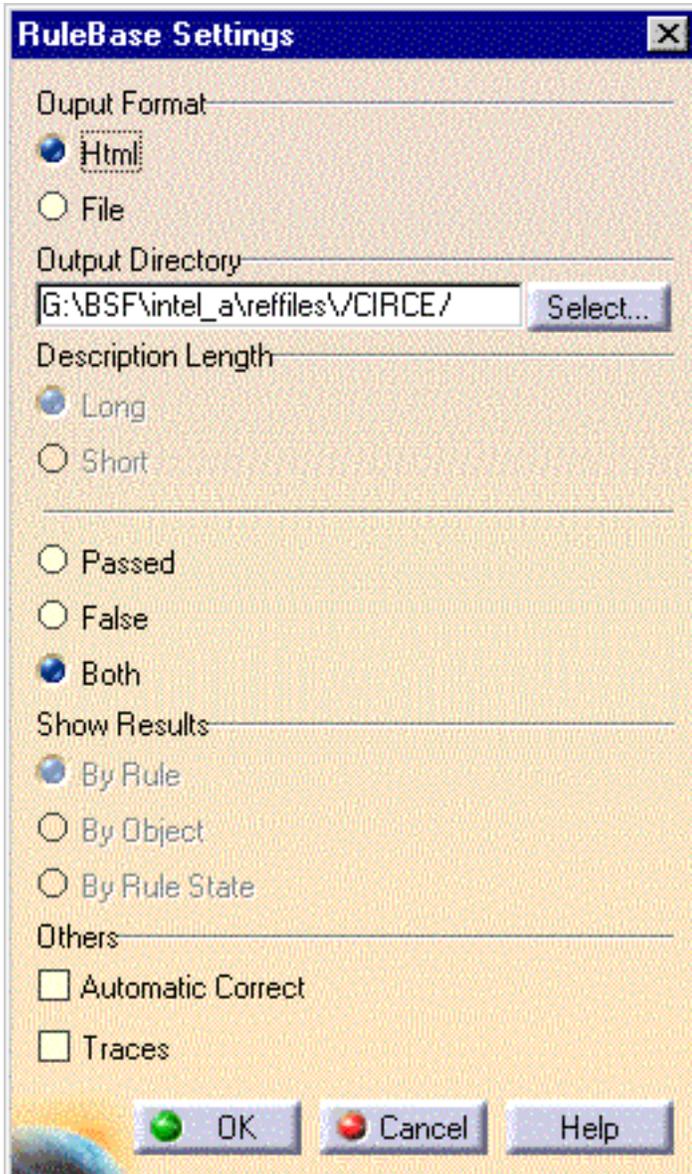
2. Refer to what follows to fill in the fields:

   In html format, check:

   - ● `Passed:` to include in the report only information about the features for which the checks are valid
   - ● `False:` to include in the report only information about the features for which the checks are invalid.

- **Both**: to include in the report all information about all the features on which a check has been applied.
- **Automatic Correct**: to start the user function specified at the check creation (Correction Tab)

In file format (a non editable format), check:

- **Long**: to include the Help message specified at the check creation
- one of the options proposed below **Show Results** to organize your report data into categories.

3. Click OK to apply the settings to the rule base.

4. Click the 📔 icon to generate and display onscreen the check report. Go to [A Check Report Example](#) to get an idea about what is a check report.

ℹ️ Unless you want to modify the check report characteristics, you don't have to re-specify the rulebase settings each time you generate a report.

Current Document Name

/u/users/cre/MyPart.CATPart   09/03/99

List Of Checks :

Validity	RuleSet	Rule Name	Success %	Help	Correct Function
✔	CATKWERuleSet.1	CATKWECheck.3	100%	Check that Pad Lengths are greater than 10	Help
✘	CATKWERuleSet.1	CATKWECheck.2	66%	Check that Hole Diameters are greater than 10	Replace the hole diameter value with 10
✔	CATKWERuleSet.1	CATKWECheck.1	100%	Check that the Holes are active	Activate the hole

Programming Expert Rules & Checks

Syntax Overview

Specify feature types
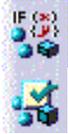
In the ∀ field of the rule editor, use the syntax : *type_identifier:feature_name*
Note that:

- Type declarations should be separated by semi-colons.
- Type identifiers are case-sensitive character strings. They shouldn't conflict with unit names (W and A should be replaced with w and a for example).

Example: **H:Hole ; thefillet:CstEdgeRibbon ; S:Shell**

Specify properties

In the edition box of the rule/check editor, use either syntax:

- type_identifier**.**object_name
- type_identifier****object_name

Example: **if H\Diameter > 10.0 then H.Activity = False**

Objects and properties

Mechanical features

- Chamfer: Activity
- CstEdgeRibbon: Radius
- Draft: Activity
- EdgeFillet: Activity
- Hole: Activity, Diameter, ThreadDepth, StartLimit, ThreadType
- Limit: Length
- Pad: Activity, EndLimit, StartLimit
- Shaft: Activity
- Shell: Activity, IntOffset, ExtOffset
- Solid: Activity

GSM features

- GSMCurvePar: Length
- GSMConnect: Tension1, Tension2
- GSMCorner: Radius
- GSMExtrude: Length1, Length2
- GSMOffset: Length
- GSMRevol: Angle1, Angle2
- GSMRotate: Activity, Angle

- GSMSplit: Activity
- GSMTranslate: Activity, Distance

Sheet Metal features

- ShePart: WallPerLength, ReliefAxialLength, ReliefRadialLength, BendRadius, Thickness, BendExtremityType*, KFactor*
- Wall: Thickness
- Bend: Allowance*, KFactor*, Angle*, BendRadius*, Thickness*
- Bend_FD: Allowance*, KFactor*, Angle*, BendRadius*, Thickness*

* can be checked but not modified

Mathematical operators

- **+,** addition operator & string concatenation
- **-,** substraction operator
- ***,** multiplication operator
- **/,** division operator
- **(),** parentheses (used to group operands in expressions)
- ****,** exponentiation operator
- **=,** assignment operator:

Logical operators

- and, logical conjunction on two expressions
- or, logical disjunction on two expressions

Comparison operators

- **<>,** not equal to
- ==, equal to
- >=, greater than or equal to
- <=, less than or equal to
- <, less than
- >, greater than

Mathematical functions

abs	Calculates the absolute value.	
sqrt	Returns the square root.	
cos, cosh	Calculates the cosine(cos) or hyperbolic cosine(cosh).	
tan, tanh	Calculates the tangent(tan) or hyperbolic tangent (tanh).	
sin, sinh	Calculate the sine or hyperbolic sine.	
asin, asinh	Calculates the arcsine or hyperbolic arcsine.	
acos, acosh	Calculates the arccosine or hyperbolic arcosine.	
atan, atanh	Calculates the arctangent or hyperbolic arctangent.	
log	Returns the logarithm.	
ln	Returns the natural logarithm.	
exp	Returns the exponential.	

Conditional statement

if *predicate* then *actions*
Conditionally executes a group of statements depending on a condition. The keyword then is optional.

Correction Functions in Checks

Specify an "Advise Correction" method

In the Correction tab of the Check Editor, select the "Advise Correction" item in the correction method list, then enter the string you want to display within a message box when a correction method is applied. Multiple-line messages are allowed.

Specify a "VB Script Correction" method

In the Correction tab of the Check Editor, select the "VB Script" item in the correction method list, then enter the VB script to be executed when a correction method is applied.

It is recommended to update your document in the script:
`CATIA.ActiveDocument.Part.Update`

Specify an "URL Correction" method

In the Correction tab of the Check Editor, select the "URL" item in the correction method list, then enter the path of the file to be displayed when a correction method is applied. The file to be displayed should be an .htm or .html file.

Help Message in Check Report

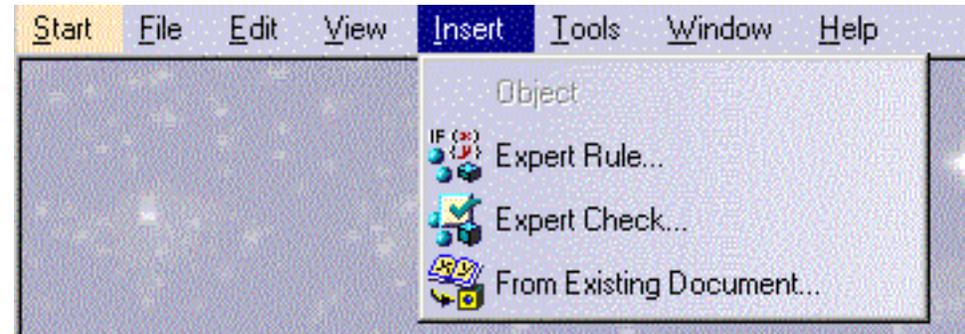**Specify a "Help" to be displayed in the Check Report**

Select the Help tab of the Check Editor and enter the string to be displayed in the check report besides the check. This string is a kind of comment you associate with a check.

Workbench Description

The Knowledge Expert Menu Bar

The menu bar which is available in the Knowledge Expert workbench is the standard one except the Insert command which provides you with the Expert Rule, Expert Check and Insert Rule Base icons.

Start	File	Edit	View	**Insert**	Tools	Window	Help

Object

IF (**) Expert Rule...

Expert Check...

From Existing Document...

The Knowledge Expert Toolbar

The figure below describes the Knowledge Expert toolbar.

ExpertKnowledgeToolBar

On the figure opposite, click an icon to display the documentation of the task associated with the icon.

Here is a brief description of each icon.

The ***Expert Rule*** icon provides access to the rule editor. Click this icon to create an expert rule, write its code, test its syntax and add it to your rule base.

The ***Expert Check*** icon provides access to the check editor. Click this icon to create an expert check, write its code, tests its syntax and add it to your rule base.

The ***Insert Rule Base From Existing Document*** icon allows you to import a rule base from an external document. Click this icon to retrieve in your current document the rule base (expert rules and expert checks) of an external document.

The ***Check Report*** icon is a means to generate a report. Clicking this icon is of interest when you have just solved a rule base with a certain number of checks applying to multiple features. The report gives you information on valid and invalid checks as well as extra information depending on the Rule Base Settings.

The ***Solve*** icon is to be used to solve a rule base. Click this icon to apply the rules and checks created in your rule base to your document.

Case Study

A shell is a mechanical feature defined by two properties: the internal thickness and the external thickness. Both properties can be referred to in expert rules to drive other parameter values. The purpose of this scenario is to explain how a mechanical feature like a shell behaves when it is driven by a rule base, more precisely how the fillet radii as well as the shell length adjust when the shell thickness varies.

Your Initial Document

Create the part which is described below or open the ExpertShellStart.CATPart sample, then access the Knowledge Expert product.
The rule base is already created in the sample. If no rule base is displayed in the specification tree, check that the Tools->Options->Part->Display->Specification Tree options are all selected.

Part Description

The part is a shell created from a rectangular pad. Fillets are added to internal edges. If you decide to create the part from scratch, follow the instructions below:

1. create a rectangular sketch
2. extrude this sketch to create a pad with a First Limit Length of 70mm and a Second Limit Length of 0mm
3. create a shell with an inside thickness of 4mm and an outside thickness of 7mm. Remove the end face of the pad
4. create a 6mm radius fillet on each internal edge of the shell.
5. create the rulebase by using the rulebase information given below.

If need be, refer to the Part Design documentation. The scenario which is described below is only valid when the parameter values vary within a certain range. Unless you have a good knowledge of the Part Design product, modifying these parameter values may result in topology errors.

The Rule Base

The rule base is made up of a single rule set. When you open the sample, the rule base as well as all its components are active.

There are four expert rules which control the fillet radii and pad length parameters and two expert checks. Both checks provide a correction method.

The figure opposite is the rule base representation in the specification tree. Below is a detailed description of the rule base components.
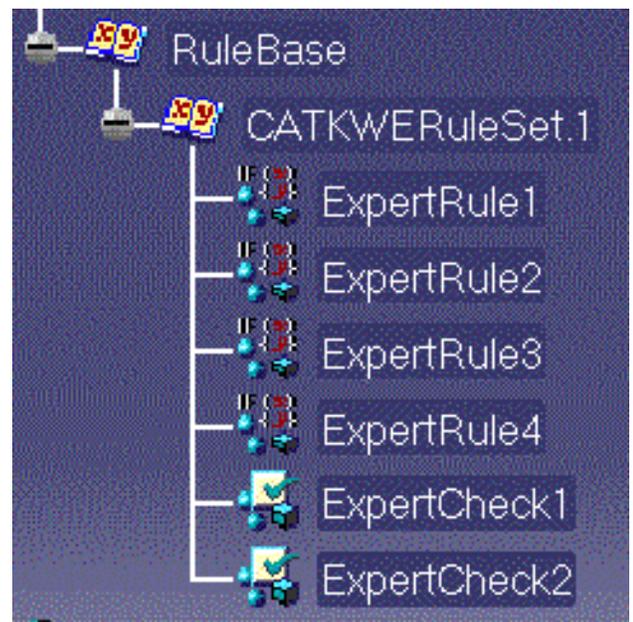
The Expert Rules

Double-click the expert rule objects in the specification-tree to display the rule statements, or select the ExpertRule.Object->Definition... function from the contextual menu.

ExpertRule1

```
S:Shell;C:CstEdgeRibbon;

if (S\IntOffset + S\ExtOffset) >= 10mm
C\Radius = 6mm
```

ExpertRule2

```
S:Shell;C:CstEdgeRibbon;

if (S\IntOffset + S\ExtOffset) < 10mm
C\Radius = 8mm
```

ExpertRule3

```
C:CstEdgeRibbon; P:Pad

if C.Radius == 6.0mm
P.EndLimit.Length = 70.0mm
```

ExpertRule4

```
C:CstEdgeRibbon; P:Pad
if C.Radius == 8.0mm
P.EndLimit.Length = 140.0mm
```

1. ExpertRule1 could also be written:
   ```
   S:Shell; C:CstEdgeRibbon;
   if (S.IntOffset + S.ExtOffset) >= 10mm then C\Radius = 6mm
   ```
2. The **else** syntax is not supported. In ExpertRule1, to specify a fillet radius for a shell thickness less than 10mm, you must create another rule(ExpertRule2).
3. When no units are specified, the system applies the MKS units.

The Expert Checks

An "Advise Correction" method is associated with ExpertCheck1. A "VB Correction" method is associated with ExpertCheck2.

ExpertCheck1

- Check Body

  ```
  P:Pad
  P.EndLimit.Length == 70mm
  ```

- "Advise Correction" Method

  ```
  The Pad Length is not equal to 70mm
  Modify interactively the Length parameter.
  ```

- Report (message to be displayed in the check report)

  ```
  Tests whether the Pad length is 70mm
  ```

ExpertCheck2

- Check Body

  ```
  S:Shell
  S\IntOffset >=7 mm
  ```

- "VB Correction" Method

  ```
  Dim Body0 As AnyObject
  Set Body0 = CATIA.ActiveDocument.Part.Bodies.Item ("PartBody")
  Dim Shell1 As AnyObject
  Set Shell1 = Body0.Shapes.Item ("Shell.1")
  Shell1.InternalThickness.Value =7.5000
  CATIA.ActiveDocument.Part.Update
  ```

- Report (message to be displayed in the check report)

  ```
  Tests whether the shell internal is greater than or equal to 7mm
  ```

The Scenario

This scenario is divided into four steps:
- About Rule Firing
- Applying an "Advise Correction" method
- Generating a check report
- Applying a "VB Correction" method.

About Rule Firing

A rule is said *fired* when it is executed and applied to the document during the solve operation.

Depending on the rule contents and depending on the document modification, your rules may or may not be fired in a solve operation. This first part of the scenario explains the subtleties behind the rule firing.

Check the Automatic Update box in the Tools->Options->General->General tab.

1. Edit the Pad.1 feature. Its First Limit Length is initially equal to 70mm. In the Pad edition box, replace this value with 60mm.

2. Click OK to confirm the value modification. The rule base solve operation is automatically executed. The ExpertCheck1 icon turns to green while the ExpertCheck2 icon turns to red.

3. Re-edit the Pad.1 feature. Its first Limit Length is now equal to 70 mm. In the Pad edition box, replace this value with 60mm (again).

4. Click OK to confirm the modification. The solve operation is automatically re-executed, but the ExpertCheck1 icon turns to red.

5. Re-Edit the Pad.1 feature. The First Limit Length property is now equal to 60mm. Keep your document open and proceed to next task.

The first solve operation executes all the expert rules of your rule base, whatever your document modifications. The subsequent solve operations execute only the rules whose predicate refers to the property which has just been modified. None of the rule base rules refers to Pad Length in its predicate. When a second solve operation is executed, no rule is fired and the pad length is not modified. Expertcheck1 turns to red.

Applying an "Advise Correction" Method

This step explains how to execute an "Advise Correction" method. This type of method displays an information message but does not modify any document parameter.

1. In the specification tree, right-click the ExpertCheck1 object and select the ExpertCheck1.Object->Correct Function command from the contextual menu. The message box below is displayed.

> **Advise Correction**   ☒
>
> **ℹ**   The Pad Length is not equal to 70 mm
>   Modify interactively the Length parameter.
>
>   [OK]

2. Click OK to continue.
3. Edit the Pad.1 feature. In the Pad edition box, replace the 60mm value with 70mm.
4. Click OK. A solve operation is executed. The ExpertCheck1 icon turns to green. Keep your document open and proceed to next task.

Generating a Check Report

This step explains how to generate a check report. A check report can be created after a solve operation has been performed. It gives you information on check validity.

1. In the RuleBase Settings, the 'Output Format' should be `Html` and the 'Visualization Type' `Both` box should be checked. Of course, you have to specify your output directory.
2. If needed, re-access the Knowledge Expert workbench.

1. Click the icon. An Html page is displayed. The ExpertCheck1 check is 100% valid(all the pads have their length equal to 70mm). The ExpertCheck2 check is 0% valid (no document shell has its internal thickness greater or equal to 7mm).
   The Help column contains the message entered in the Report tab at check creation. The Correct Function column contains either the message entered for an "Advise Correction" method or a symbol indicating that a "VB Script" correction method has been defined for the check.
2. In the Check Report, click the ExpertCheck1 or ExpertCheck2 hyperlinks for more information on the checks. Keep your document open and proceed to next task.

Applying a "VB Script Correction" Method

This part of the scenario explains how to execute a correction method of "VB Script" type. In the example below, the script replaces any shell internal thickness value less than 7 mm with a 7.5 mm value. At this stage of the scenario, the status of ExpertCheck2 is red (check invalid).

1. Edit the Shell.1 feature. The initial thickness values are 4mm and 7mm. Replace the Inside Thickness with 5mm and the Outside Thickness with 3mm.

2. Click OK to execute a solve operation. Both expert checks turn to red in the specification tree.

3. Edit the Pad.1 feature and check that the pad length is now equal to 140mm.

4. Edit any fillet and check that its radius is now equal to 8mm. This indicates that the expert rules were fired during the last solve operation.

5. In the specification tree, right-click ExpertCheck2 and select the ExpertCheck2.Object->Correct Function command from the contextual menu. The ExpertCheck2 check icon turns to green. Now the expert check icons are all green in the specification tree.

6. Edit the Shell.1 feature. In the edition box, you can check that the inside thickness is now equal to 7.5mm.

Interactive Tasks

Rule Base

Create a rule base

An empty rule base is automatically added to a document when you access the Knowledge Expert workbench.

Solve a rule base

- *If a rule base has never been solved:*
  In Automatic Update mode, all active rules and checks are automatically fired the first time a document parameter is modified. In non-automatic mode, all active rules and checks are automatically fired the first time the solve icon is clicked.
- *After a rule base has been solved:*
  In Automatic Update mode, a new solve operation is executed each time a document parameter is modified but only the rules whose predicate refers to the modified parameter are fired. In non-Automatic Update mode, you have to click the solve icon to re-execute a solve operation after a document parameter has been modified. Only the rules whose predicate refers to the modified parameter are fired.

Import a rule base

In the file selection box, select the .CATProduct file which contains the rule base to be imported.
Note:

- the external document must be a .CATProduct
- the rule base is the only feature which is imported from the external document (mechanical features are not imported for example)
- rules/checks are not imported when there are rules/checks with the same name in the importing document
- the importing document maintains a link with the imported document. Removing the external document or the rule base in the external document removes the rule base in the importing document.

Activate/deactivate a rule base

In the specification tree, right-click the rulebase object, then select the `Rulebase object->(De)activate` function from the contextual menu.

| **or** | | In the parameter list of the "Formulas" dialog box, select the rulebase/activity parameter and modify its value in the "Edit name, value or formula" field. |

Define the rule base settings (check report)

> In the specification tree, right-click the rulebase object,
> then select the `Rulebase object->Settings` function from the contextual menu.

Rule Sets

Create a rule set

> The rule set creation is included in the expert rule/check creation task. When you create an expert rule/check, CATIA prompts you to select either a rule base or a rule set. Selecting a rule base creates a rule set and adds a rule/check to this rule set. Selecting an already existing rule set creates a rule/check in this rule set.

Activate/deactivate a rule set

> In the specification tree, right-click the rule set to be activated or deactivated,
> then select the `Ruleset.object->(De)activate` function from the contextual menu.

| **or** | | In the parameter list of the "Formulas" dialog box, select the ruleset/activity parameter and modify its value in the "Edit name, value or formula" field. |

Delete a rule set

> In the specification tree, right-click the rule set, then select the Delete function from the contextual menu.

Expert Rules

Create an expert rule

1. Select a rule base or a rule set. A dialog box is displayed.
2. Modify the default rule name and comments (optional).
3. Click OK. The Rule Editor is displayed.

4. Enter the feature type in the ∀ field , example: **H:Hole;S:Shell**
5. Enter the rule body in the edition box
   if H.Diameter > 10.0 mm
   (H.Diameter = False)
6. Click Apply to check the rule syntax.
7. Click OK to add the expert rule to the document.

Edit / modify an expert rule

In the specification tree, double-click the rule to be edited,
then modify its statements in the rule editor.

or

In the specification tree, right-click the rule to be edited,
then select the `Rule.object->Definition` function from the
contextual menu.

Activate/deactivate an expert rule

In the parameter list of the "Formulas" dialog box, select the rule/activity
parameter and modify its value in the "Edit name, value or formula" field.

or

In the specification tree, right-click the rule to be activated/deactivated,
then select the Activate/Deactivate function from the contextual menu.

Delete an expert rule

In the specification tree, right-click the rule to be deleted,
then select the Delete function from the contextual menu.

Expert Checks

Create an expert check

	1. Select a rule base or a rule set. A dialog box is displayed. 2. Modify the default check name and comments (optional). 3. Click OK. The Check Editor is displayed. 4. Enter the feature type in the ∀ field , example: **H:Hole;S:Shell** 5. Enter the check body in the edition box **H.Diameter > 10.0 mm** 6. Click Apply to test the check syntax 7. Specify a correction method and a message to be displayed in the check report (optional) 8. Click OK to add the expert check to the document.

Edit / modify an expert check

	In the specification tree, double-click the check to be edited, then modify its statements in the check editor.
or	In the specification tree, right-click the check to be edited, then select the *Check*.object->Definition function from the contextual menu.

Generate a check report

	The Check Report is generated from the data specified in the RuleBase Settings. To modify the format or the contents of the Check Report, select the `Rulebase object->Settings` function from the contextual menu and check the appropriate options in the "RuleBase Settings" dialog box.

Activate/deactivate an expert check

	In the parameter list of the "Formulas" dialog box, select the check/activity parameter and modify its value in the "Edit name, value or formula" field.
or	In the specification tree, right-click the check to be activated/deactivated, then select the Activate/Deactivate function from the contextual menu.

Apply a correction method

	In the specification tree, right-click the check, then select the 'Correction Function' command from the contextual menu. The rule base must have been solved.

Highlight invalid features

	In the specification tree, right-click the check, then select the 'Highlight Failed Components' command from the contextual menu. The rule base must have been solved.

Delete an expert check

In the specification tree, right-click the check to be deleted,
then select the Delete function from the contextual menu.

Glossary

Many of the definitions included in this glossary are only pertinent within the CATIA knowledgeware context.

A

activity

A property which defines whether a feature is applied to a document or not. The activity value is either `true` or `false`. It is indicated by an icon in the specification tree and can also be read in the document parameter list.

E

expert check

A set of statements intended to give you a clue as to whether certain conditions are fulfilled or not. An expert check applies to all the features of a given type. It does not modify the document it is applied to. An expert check is a feature. In the document specification tree, it is displayed as a relation that can be activated and deactivated. Like any feature, an expert check can be manipulated from its contextual menu.

expert rule

A set of instructions, generally based on conditional statements, whereby the relationship between parameters is controlled. An expert check applies to all the features of a given type. In the document specification tree, it is displayed as a relation that can be activated or deactivated. Like any feature, an expert rule can be manipulated from its contextual menu.

F

formula

A relation specifying a constraint on a parameter. The formula relation is a one-line statement. Its left part is the parameter to be constrained, the right part is a relation taking as its variables other parameters. A formula is a feature. In the document specification tree, it is displayed as a relation that can be activated or deactivated. Like any feature, a formula can be manipulated from its contextual menu.

K

knowledgeware

The set of software components dedicated to the creation and manipulation of knowledge-based information. Knowledge-based information consists of rules and other types of relations whereby designers can save their corporate know-how and reuse it later on to drive their design processes.

M

magnitude type parameter

A parameter whose value is defined by a quantity expressed in specific units. Length, Angle, Time parameters are magnitude type parameters. Boolean, Real, String and Integer parameters are not magnitude type parameters.

P

parameter

A feature defining a document property.

predicate

The condition part in an expert rule. The other part of the expert rule describes the actions to be executed when the predicate is true.

R

relation

A knowledgeware feature which, depending on certain conditions:

- sets parameter values
- displays a message
- or runs a macro.

Knowledgeware relations are formulas, checks, rules and design tables.

rule base

The feature at the top of the expert rule/check hierarchy.

rule set

A group of expert rules or checks

S

solve operation

The operation which consists in applying all the rules/checks of a rule base to a document.

W

wizard

A form of user assistance that guides the user through a difficult or complex task within an application. The formula wizard helps the user typing formulas by picking up parameters either in the dictionary, or in the geometry area or in the specification tree.