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[Previous version](#)

# [RULE RESPONDER GUIDE]

Rule Responder is an open source framework for creating virtual organizations as multi-agent systems. This guide shows how to set up Rule Responder on top of the Mule Enterprise Service Bus (ESB) as well as the four kinds of agents used by Rule Responder, i.e. Organizational Agents, Personal Agents, External Agents, and Computing Agents. It describes the instantiations SymposiumPlanner (2008-2010), WellnessRules(2), and PatientSupporter. The supported reasoning engines (with their languages) are Prova, OO jDREW with POSL, and Euler with N3. The guide discusses RuleML Query Generation, the PatientSupporter Profile Generator, and the Rule Responder Benchmarking Tool. It also explains troubleshooting of Rule Responder instantiations.

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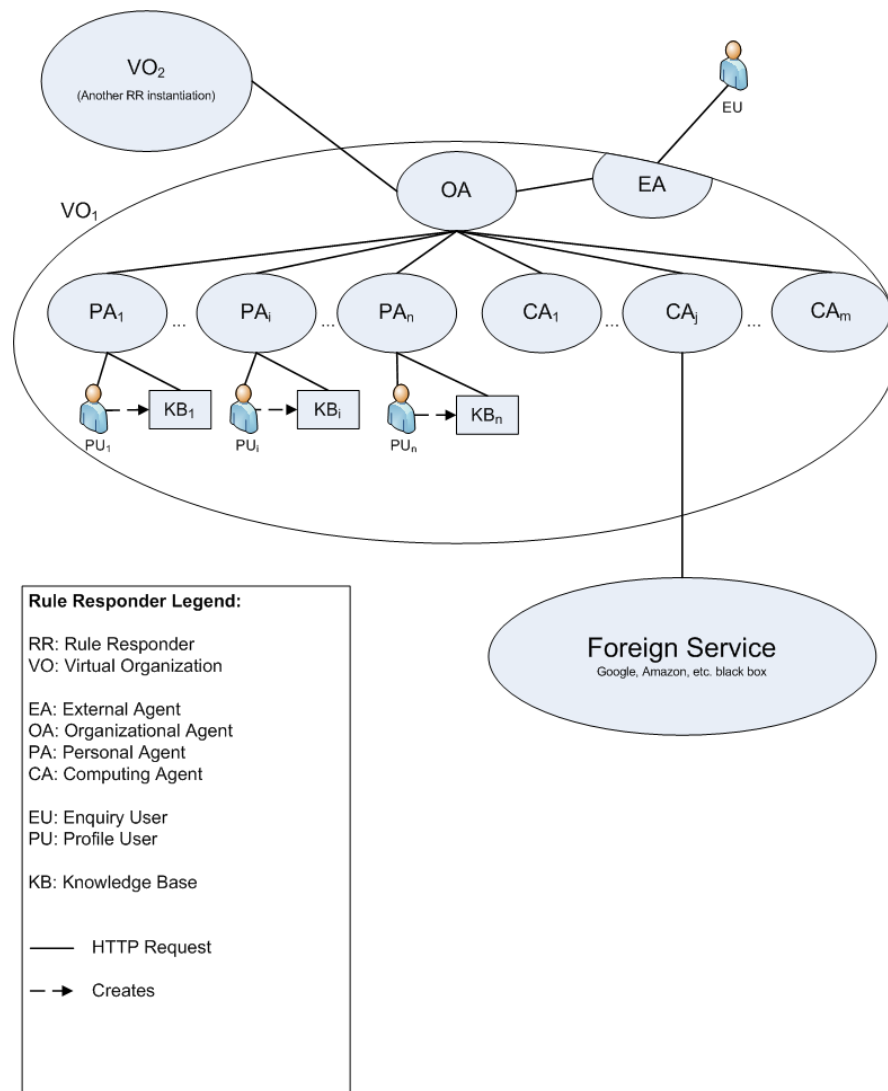
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## 1 Introduction

Rule Responder is an open source framework for creating virtual organizations as multi-agent systems that support collaborative teams on the Semantic Web. It comes with a number of official instantiations implementing virtual organizations such as SymposiumPlanner for supporting the chairs of the RuleML Symposia. Rule Responder provides the infrastructure for rule-based collaboration between the distributed members of such a virtual organization. Human members are assisted by semi-autonomous rule-based agents, which use Semantic Web rules that describe aspects of their owners' derivation and reaction logic. The diagram below shows the architecture of a Rule Responder system.



Note: that the PA's shown can be considered holonic-recursive meaning the PA itself could be VO within itself.

This guide to Rule Responder shows how to set up Rule Responder on top of the Mule Enterprise Service Bus (ESB) as well as the four kinds of agents used by Rule Responder, i.e. Organizational Agents, Personal Agents, External Agents, and Computing Agents. The guide then describes the official instantiations SymposiumPlanner (2008-2010), WellnessRules(2), and PatientSupporter. Next are the supported reasoning engines (with their

languages), namely Prova, OO jDREW with POSL, Euler with N3, and DR-Device with DR-POSL. Subsequently, the guide discusses RuleML Query Generation, the PatientSupporter Profile Generator, and the Rule Responder Benchmarking Tool. The final guide section explains troubleshooting of Rule Responder instantiations.

## 2 Setting up Rule Responder

### 2.1 Windows Environment

#### 2.1.1 Prerequisites

**Note for Windows Vista Users:** Be advised that several communication errors between the OA and PA may occur due to Vista security issues. These will hopefully be remedied in future versions of Rule Responder. It is advisable to not use Windows Vista at this time. See more information in [Section 14.5 Issues and Workarounds](#).

Take note of the IP of your PC. In the following referred to it as **%local-ip%**.

**Java JDK:**

<http://java.sun.com/javase/downloads/widget/jdk6.jsp>

1. Select windows and click download.
2. Skip the registration step
3. Download and install to the directory of your choice (I now will call **%jdk-dir%**)

**Apache HTTP Server:**

<http://httpd.apache.org/download.cgi>

1. Select the new stable (non-alpha) version
2. Select the "Win32 Binary without crypto"
3. \*Note: There will be a conflict between this service and Skype if you are using it. Please turn Skype off before installation.\*
4. Install to the directory of your choice (I now will call **%apache-http-dir%**)

**Apache Tomcat:**

<http://tomcat.apache.org/download-55.cgi>

1. Select the "zip" option under "Core:"
2. Download and extract to a location (I now will call **%apache-tomcat-dir%**)

**Eclipse:**

<http://www.eclipse.org/downloads/>

1. Select the appropriate package for you (typically "Eclipse IDE for Java Developers") and Windows (32-bit or 64-bit).
2. Select the appropriate mirror, download, and then extract to the directory of your choice (I now will call **%eclipse-dir%**)

**Ports:**

\*Note: these steps can be done automatically by running **WinXPVista7FirewallConfig.bat** once the Rule Responder project has been downloaded from the SVN (located in the Rule Responder folder).

To Open a Window's Firewall Port (Windows XP):

\*Note: these steps will be very similar for Vista or 7\*

1. Control Panel, Security Center, Windows Firewall
2. Exceptions tab. This contains all forwarded ports.
3. Click add port, give it a name, and the port number, as well as TCP or UDP (do one of each just in case).

Ports Required by Rule Responder:

- Apache-HTTP-Server: 80
- Apache-Tomcat: 8080
- Mule: 8888, 60504
- RR OA's: 9993(SP2010),9994(PS),9995(WR),9996(SP2009),9997(SP2008),9999(WR2)

### 2.1.2 Apache HTTP Server

#### Installing the EA:

The Apache HTTP server starts its file directory under “%apache-http-dir%/htdocs”. This is where you need to place any websites you wish to be installed.

\*Remember that an HTML file labeled “index.html” located under root will be defaulted to when your IP is navigated to.\*

1. Choose the EA scheme you wish to use:  
 RuleML-2009: <http://ruleml.org/RuleML-2010/RuleResponder/>  
 WellnessRules2: <http://ruleml.org/WellnessRules2/RuleResponder.html>  
 PatientSupporter: <http://ruleml.org/PatientSupporter/RuleResponder.html>  
 Additional examples can be found through: <http://ruleml.org/RuleResponder>
2. Download the webpage source + files (varies depending on your browser), to “%apache-http-dir%/htdocs”. If you wish to have it as default, save as index.html, otherwise you may navigate to it.  
 Firefox: File, save page as...
3. The page must now be told to direct its message to your PC and not the previous server. Edit the page and find the old IP address (approximately halfway down), replace it with “%local-ip%:8888” with the same port.

### 2.1.3 Eclipse & Mule

#### Prerequisites:

- Latest Version of Subclipse:  
 Instructions: <http://subclipse.tigris.org/servlets/ProjectProcess?pagelD=p4wYuA>
- Latest Version of Maven:
  1. Inside eclipse go to Help->Software Updates->Available Software
  2. Instructions: <http://m2eclipse.sonatype.org/installing-m2eclipse.html>
  3. Install all Maven components you see to be safe.
  4. Enable VM option for eclipse: Create a shortcut for eclipse or use an existing one and properties it  
 Under target add at the end:  
 -vm “%jdk-dir%\bin”
  5. Create a “settings.xml” file under the .m2 folder located in your user home directory (e.g. “C:\Documents and Settings\Administrator\.m2”) with the following contents:

```
<settings xmlns="http://maven.apache.org/SETTINGS/1.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/SETTINGS/1.0.0
```



```

<localRepository>http://maven.apache.org/xsd/settings-1.0.0.xsd>
  <localRepository>${user.home}/.m2/repository</localRepository>
  <interactiveMode>true</interactiveMode>
  <usePluginRegistry>false</usePluginRegistry>
  <offline>false</offline>

  <pluginGroups/>
  <servers/>
  <mirrors/>
  <proxies/>
  <profiles/>
  <activeProfiles/>
</settings>

```

### Obtaining the Source Code:

1. Windows->Show View->Other->SVN->SVN Repositories
2. Right Click->New->Repository Location...
3. Add the Rule Responder SVN repository:  
<https://mandarax.svn.sourceforge.net/svnroot/mandarax>
4. Navigate to the root -> Right click on PragmaticAgentWeb -> Checkout  
(leave everything as default)  
\*The project is now located under “%eclipse-dir%/PragmaticAgentWeb - Rule Responder”  
I will now refer to this as **%RR-dir%**\*

### Configuring Mule:

1. Open the mule-all-config.xml file:  
“%RR-dir%/conf/mule-all-config.xml”
2. The most important piece to configure is the TOMCAT variable. Please make sure this reflects your Tomcat IP and port.
3. **Note:** The remaining settings need not be changed unless you make specific changes to the instantiations (e.g. the addition of an endpoint, modification of Prova location, OA port change, etc.).
4. Save, and compile the JAR.

#### If Maven is installed correctly:

- a. Right click on project -> Run as -> Maven install
- b. Copy the produced “pragmatic-agent-web-1.0-SNAPSHOT.jar”  
(located under %RR-dir%/target) file to “%RR-dir%/lib”

#### If not:

- a. Select the packages “rules, src, repository, src/test/java, src/main/java, /src/main/resources, conf” -> Right click -> Export -> Java -> JAR File
- b. Name the jar file “pragmatic-agent-web-1.0-SNAPSHOT.jar” and place in “%RR-dir%/lib”

### 2.1.4 Tomcat

All servlets are located under the webapps folder ("%apache-tomcat-dir%/webapps"). This is where we will be working.

All source code for the PAs is located under "%RR-dir%/personalAgents/%package%", where %package% corresponds to the instantiation package.

Class files for the PAs are located under "%RR-dir%/target/classes/%package%", where %package% corresponds to the instantiation package.

#### Add the JAVA\_HOME environment variable to point to java install directory:

Properties on My Computer->Advanced->Environment Variables System Variables->New Variable Name:

JAVA\_HOME Variable Value: (JDK install directory, not bin just root of it, no quotes needed)

#### Configuring the PA Source:

1. Navigate to the PA configuration file  
(e.g. %RR-dir%/personalAgents/pa\_Configuration/PAConfiguration.java")
2. Change the "tomcat" global variable to %local-ip%
3. If you made any other changes along the way or wish to change the location of online repository files, this is the place to reflect such changes.  
Additionally, the Prova file will need to be changed if the OWL ontology location has been modified.
4. Save, and now the class file is located in the target directory mentioned above.

#### Creating the Tomcat Servlets:

There are two ways to create the tomcat servlets, manually or automatically. It is not required to do both.

##### Automatically:

1. To install all the servlets from all the current Rule Responder instantiations (WellnessRules, PatientSupporter, SymposiumPlanner, etc) navigate to the %RR-dir% and run the batch file **InstallAllServlets.bat**.
2. You will be immediately prompted to enter %local-ip%
3. Once the batch file has completed its operation (takes about 2-3 minutes) copy all the folders that were just generated from %RR-dir%/PAServlets and paste them into the "%apache-tomcat-dir%/webapps" directory.

##### Manually (this series of steps must be done for each PA):

Most of these steps are general steps used from creating Tomcat servlets.

1. Create a new directory under "%apache-tomcat-dir%/webapps" which has the same name as the PA which you are implementing (e.g. "GeneralChairRuleML2009").
2. Create two more directories under the new one: "META-INF" & "WEB-INF"
3. Navigate to META-INF and create a new file "MANIFEST.MF" with the following contents:

Manifest-Version: 1.0

Ant-Version: Apache Ant 1.6.5

Created-By: 1.5.0\_06-b05 (Sun Microsystems Inc.)

Built-By: %your-name%

Main-class: %main-class-name%

**%main class name%** = the name of the PA class (e.g. GeneralChairRuleML2009.class)

4. Navigate to the WEB-INF folder and create the file “config.xml” with the following contents:

```
<sign>
  <url>%local-ip%</url>
  <context>%class-name%</context>
  <delay>5000</delay>
  <log>yes</log>
</sign>
```

**%class-name%** = The main class name (e.g. GeneralChairRuleML2009)

5. Navigate to the WEB-INF folder and create the file “web.xml” with the following contents:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
  <!DOCTYPE web-app
    PUBLIC "-//Sun Microsystems, Inc.//DTD Web Application 2.2//EN"
    "http://java.sun.com/j2ee/dtds/web-app_2_2.dtd">
  <web-app>
    <display-name>%class-name%</display-name>
    <description>Takes incoming messages and excutes queries</description>
    <servlet>
      <servlet-name>%class-name%</servlet-name>
      <servlet-class>%package%.%class-name%</servlet-class>
    </servlet>
    <servlet-mapping>
      <servlet-name>%class-name%</servlet-name>
      <url-pattern>.</url-pattern>
    </servlet-mapping>
  </web-app>
```

**%package%** = The package which the main class is contained within (if any)

**%class-name%** = The main class name (e.g. GeneralChairRuleML2009)

**Note:** If you wish to run the servlet at startup (e.g. the WeatherUpdater) you need to add the following parameters:

```
<servlet>
  ...
  <load-on-startup>1</load-on-startup>
</servlet>
```

6. Navigate to the WEB-INF folder and create the folders “classes” and “lib”
7. Under the lib folder, copy all contents from “%RR-dir%/personalAgents/lib” to it.
8. Under the classes folder, copy the PA package you want to use (e.g. “%RR-dir%/target/classes/pa\_SymposiumPlanner/”)
9. Under the classes folder, copy the PA configuration package (e.g. “%RR-dir%/target/classes/pa\_Configuration/”)

### 2.1.5 Startup

**\*\*It is recommended that you create your own batch file which takes care of this in single steps\*\***

**Starting Up:**

1. Start Apache-HTTP-Server:  
"%apache-http-dir%\bin\httpd.exe"
2. Start Tomcat Server:  
"%apache-tomcat-dir%\bin\startUp.bat"
3. Start Mule Server:  
"%RR-dir%\startUp.bat"

## 2.2 Linux Server Environment

This section explains the various processes required to use the Rule Responder system. It details installing, starting up, shutting down, and debugging the Rule Responder system.

### 2.2.1 General Prerequisites

Before attempting any procedure below, insure the following:

1. Your Linux account has the proper privileges on the server. It should have permission to start and stop Tomcat from running as well as have access to the location of the Rule Responder folder (or soon to be location of it if you are installing for the first time).
2. You are logged into the server using an SSH client (For Windows, [Putty](#) is recommended, most Linux distributions already have an SSH client integrated in).

### 2.2.2 Installing Rule Responder

**Prerequisites**

1. You have gone through the section 1.1 documentation intended for a local installation.
  2. FTP client must be installed. [Filezilla](#) is recommended.
  3. The system administrator for the server has allowed external access to port 8888.
- 
1. In the Mule configuration file (mule-all-config.xml) change the TOMCAT and MULE\_PORT variables to match the server's local IP.
  2. In PAConfiguration, replace the current IP with the server's local IP. The operating system variable should be changed to "Linux" and the WeatherRespositoryVariables should have their IP changed to the local IP of the server as well.
  3. Once everything has been updated with server information, perform a maven install and move the result file into the lib folder like you normally would.
  4. FTP into the server and go to the folder where you are going to put Rule Responder. Locally, open up the Rule Responder folder. Copy over all the files (not folders) in the Rule Responder folder over to the server. Additionally, copy the lib folder as well.
  5. Go to the local versions of your tomcat PA servlets in your tomcat webapps folder. Backup the current versions for future use.
  6. Go through and change all the IP's in the servlets to the local IP for the server.
  7. On the server, navigate to the tomcat webapps directory. The default installation folder for this is "/usr/local/tomcat/webapps". Place all of the updated PA servlets on the server.

8. Proceed to Section 1.2.3 **Starting Rule Responder** section.

### 2.2.3 Starting Up Rule Responder

1. Build the your project with Maven via:  
Right Click on Project->Maven->Install  
Copy "target/pragmatic-agent-web-1.0-SNAPSHOT.jar" to "lib"
2. To start up Mule, navigate to the Rule Responder folder and enter the command `./startup 0 &`. Note: If Mule is running and needs to be restarted, consult the next section 1.2.4 Shutting Down Rule Responder as to how to shut down Mule before starting it again.
3. To startup tomcat enter the command `/etc/init.d/tomcat start`. Reminder: This will not work if you do not have the correct permissions.

### 2.2.4 Shutting Down Rule Responder

1. As of right now, the best way to stop Mule is to find its process ID in the list of running processes (this is being worked on). Enter the command `ps aux`.
2. Look for the process ID of the command called `"java -Xms512m -Xmx512m -XX:NewSize=256m -XX:MaxNewSize=256m ws.prova.mule.impl.ESBManager start mule-all-config.xml"`.
3. Enter command `"kill -9 <ProcessIDHere>"`. Example: `"kill -9 14759"`.
4. To stop tomcat enter the command `/etc/init.d/tomcat stop`. Reminder: This will not work if you do not have the correct permissions.

### 2.2.5 Debugging Rule Responder

1. Open 2 instances of your SSH client and log into the server on both of them. For the rest of these instructions we will call these instances **terminal 1** and **terminal 2**.
2. In terminal 1, navigate to your Rule Responder installation folder. Enter the command `"tail -f mule.log"`. Terminal 1 now presents all log activity as it happens. This shows us what the Organizational Agent is doing in the system.
3. In terminal 2, enter `"tail -f <tomcat directory>/logs/catalina.out"`. In most cases, this is will look like `"tail -f /usr/local/tomcat/logs/catalina.out"`. This presents all log activity on the Personal Agent side of the system.
4. With both of these windows open, you can now view all error messages generated by the Rule Responder system as it is running.

## 3 Enterprise Service Bus (ESB) - Mule

### **The Enterprise Service Bus (ESB): Mule**

Rule Responder uses an Enterprise Service Bus (ESB) called Mule to transfer data. Mule transfers this data via "data endpoints". In the case of Rule Responder, each agent (EAs/OA/PAs) has their own endpoint for which data will travel upon. Additionally, Rule Responder only uses HTTP as a transfer protocol but others can certainly be implemented. For a more thorough description and implementation of Mule ESB please see this presentation: <http://ruleml.org/RuleResponder/UsingMuleESB>.

Rule Responder requires Mule running on your host server. It is provided in the source package. Otherwise, the full ESB download of Mule should contain all of the information needed to install the Mule ESB on your server: <http://www.mulesoft.org/display/MULE/Download+Mule+CE>.

- **The Mule Config File:**

All endpoints and descriptors used with Mule are defined in the mule-all-config.xml file. Therefore, any changes must go here. Changes are then applied when the PragmaticAgentWeb.jar is rebuilt and implemented. The config file is located under:

PragmaticAgentWeb - Rule Responder->conf->mule-all-config.xml

- **Endpoint Identifiers:**

Endpoint identifiers describe the endpoints that are used in the ESB. Each identifier has a name and an address.

- **Endpoint Identifiers - name:**

The name of the endpoint is **identically** linked to the agent name that is derived by both the OWL ontology and Prova. Therefore, they must be the same.

(Note that the names must be unique as well)

- **Endpoint Identifiers - value:**

The value of the endpoint is the address. In the case of Rule Responder, we always use:

“http://%local-ip%/...” where “...” represents the name of the tomcat servlet.

- **Mule Descriptors:**

Each OA is defined in the mule config file as a mule-descriptor. For example, WellnessRules is described as:

```
<mule-descriptor name="WellnessRules"
  implementation="ws.prova.mule.impl.ProvaUMOImpl" singleton="true">
  <inbound-router>
    <endpoint address="jms://topic:wellnessRules"/>
    <endpoint name="httpEndpointWR" address="http://localhost:9995">
  </endpoint>
</inbound-router>
  <properties>
    <property name="rulebase" value="/use_caseWellnessRules/Wellness-
      Rules/WellnessRules-Responder.prova" />
  </properties>
</mule-descriptor>
```

- **Mule Descriptors - name:**

The name of the descriptor corresponds to the “XID” that is passed in with Rule Responder queries. It is the name of your Organizational Agent.

```
<mule-descriptor name="WellnessRules"
```

(Note that the names must be unique)

- **Mule Descriptors - Implementation:**

The implementation attribute of the descriptor is the java file that is executed when a message is received. In the case of RuleResponder, *ws.prova.mule.impl.ProvaUMOImpl.java* is used. It will use the OA's Prova knowledge base (defined under property) to handle the message.

```
implementation="ws.prova.mule.impl.ProvaUMOImpl" singleton="true"
```

Additionally, some instantiations need a longer period of time for their longest query. This time should be tied to the time it takes for the OA to time-out. Ideally the time-out time should be as short as possible so the user knows the query was not successful. Timeout times can be changed for an individual use-case in *ws.prova.mule.impl.ProvaUMOImpl.java* as well. For example:

```
if(temp.contains("RuleML-2010")) {  
    System.out.println("Timeout  
increase to 5 minutes for RuleML-2010. Will be reset  
upon new query.");  
    timeout=300000;  
}
```

- **Mule Descriptors - endpoint name:**

This endpoint name will be specific for every OA. For example, RuleML-2009 uses *http://localhost:9996* while WellnessRules uses *http://localhost:9995*. Consult with the server admin to see which port is best for you to use.

```
<endpoint name="httpEndpointWR" address="http://localhost:9995">
```

(Note that the endpoint name must match the endpoint definitions described previously)

- **Mule Descriptors - properties:**

Properties are used to further define the descriptor. In the case of Rule Responder, they are used to point to the Prova knowledge base to be used.

```
<property name="rulebase" value="/use_caseWellnessRules/Wellness-  
Rules/WellnessRules-Responder.prova"/>
```

## 4 Organizational Agent

### 4.1 Prova Knowledge Base

#### **Organizational Agent – Prova Knowledge Base:**

The Prova knowledge base describes rules that help the Organizational Agent delegate queries to the appropriate Personal Agents in the community. This document describes the framework that Rule Responder uses and some of the general performatives.

- **Location:**

Each Prova knowledge base file is pointed to by the Mule config file. Generally the KB location has the following format:

```
%RR-dir%\rules\use_caseInstance\NameOfKB.prova
```

- **Committing Changes:**

To commit a change to the KB, you need to rebuild the .jar via Maven, copy it to “%RR-dir%/lib” and restart Rule Responder.

- **Assigning the OWL Ontology:**

A fact is used to point Prova to the OWL ontology used with the particular Rule Responder instance.

e.g.:

```
%import external ontology of responsibility assignment matrix
import("http://ruleml.org/WellnessRules/files/WellnessRules.owl").
```

- **Defining Interfaces:**

Interfaces describe what queries are expected to be issued to the Rule Responder. They have the following format:

```
interface(performative(Performative),performative("?"),"description").
```

For example:

```
interface(getContact(Topic,Request,Contact),
getContact("+","+", "-"),"request personal contact information for a certain Topic and Request regarding RuleML-2008").
```

The first argument is the performative. The second is the relation, with +’s and -’s to represent constants and variables, respectively. The last argument is the description of the performative.

These interfaces must be written as facts for every expected query, otherwise a “no public interface” message will be returned.

- **General processMessage Rule:**

A query is handled by the processMessage rule and its conclusion looks like the following:

```
processMessage(XID,From,UserName,performative(Performative)) :-
```

**XID** = The name of the OA (e.g. WellnessRules).

**From** = The name of the endpoint



**Primitive** = Username (e.g. User)

**performative** = The relation name surrounded by <Rel>

**Performative** = The contents of the relation (<Ind>'s, <Vals>'s, <Expr>'s, <Plex>'s, etc.)

Optionally, you then can check the free and bound variables to restrict the rule to certain <Ind>'s (constants) and <Var>'s (variables):

```
free(ProfileID),
bound(InOut,
```

**free** = A variable (<Var>)

**bound** = A constant (<Ind>)

A rule is then used to “look up” the responsible Agent:

```
assigned(XID,Agent,Responsibility,Role),
```

**XID** = The name of the OA (e.g. WellnessRules)

**Agent** = Will be the name of the found Agent

**Responsibility** = A responsibility name for the query (provided in the query somehow).

**Role** = What kind of role the responsibility will be matched to.

The query is then sent to the Agent that was found:

```
sendMsg(XID,esb,Agent,Type,performative(Performative)),
```

**XID** = The name of the OA (e.g. WellnessRules)

**Agent** = Will be the name of the found Agent

**Type** = “query”

**performative** = The relation name of the query

**Performative** = The contents of the relation

The answer is then received from the Agent:

```
rcvMult(XID,esb,Agent,Type,performative(Performative)),
```

**XID** = The name of the OA (e.g. WellnessRules)

**Agent** = Will be the name of the found Agent

**Type** = “answer”

**performative** = The relation name of the query

**Performative** = The contents of the relation

The answer is then sent back to the EA:

```
sendMsg(XID,esb,From,"answer",performative(Performative),
```

**XID** = The name of the OA (e.g. WellnessRules)

**Agent** = Will be the name of the EA endpoint

**Type** = “answer”

**performative** = The relation name of the query

**Performative** = The contents of the relation

## 4.2 OWL Ontology

### **Organizational Agent - OWL Ontology:**

The OWL ontology is used to delegate queries to the responsible Personal Agents. It is called upon by the Prova knowledge base.

- **How to Implement Changes:**

Simply replace the file.

- **Responsible:**

This is the most commonly used aspect of the OWL ontology. Each topic queried in the ontology has a PA which is responsible for it. It is defined by:

...

```
<owl:ObjectProperty rdf:ID="responsible">
  <rdfs:comment>
    This role conducts the actual work/owns the problem. There should
    be only one R. If multiple R s are listed, then the work needs to be further subdivided to a lower level.
  </rdfs:comment>
  <rdf:type rdf:resource="owl:FunctionalProperty"/>
  <rdfs:domain rdf:resource="#WhatDomainResponsibilityIsIn-eg-OAName"/>
  <rdfs:range rdf:resource="#Responsibility"/>
</owl:ObjectProperty>

<owl:Class rdf:ID="Responsibility">
  <rdfs:subClassOf rdf:resource="#TheOrganizationalAgentName"/>
</owl:Class>

<Responsibility rdf:ID="A-PA-Name"/>

<SomeUniqueName rdf:ID="TheOrganizationalAgentName ">
  <responsible rdf:resource="#A-Responsible-Topic"/>
</SomeUniqueName>
```

...

Note that the hash (#) sign denotes the remainder of the ontology, e.g.:

*"TheOrganizationalAgentName\_A-Responsible-Topic"*

Here is an **example** for **WellnessRules** following the one seen above:

...

```
<owl:ObjectProperty rdf:ID="responsible">
  <rdfs:comment>
    This role conducts the actual work/owns the problem. There should
    be only one R. If multiple Rs are listed, then the work needs to
    be further
    subdivided to a lower level.
  </rdfs:comment>
```

```
<rdf:type rdf:resource="owl#FunctionalProperty"/>
<rdfs:domain rdf:resource="#Activity"/>
<rdfs:range rdf:resource="#Responsibility"/>
</owl:ObjectProperty>

<owl:Class rdf:ID="Activity_Walking">
  <rdfs:subClassOf rdf:resource="#Activity"/>
</owl:Class>

<Activity_Walking rdf:ID="Walking">
  <responsible rdf:resource="#Walking"/>
</Activity_Walking>

...
```

## 5 Personal Agents

### Personal Agent Requirements:

**Tomcat** installed on host server (see Section 1 for installation information).

You can find the tomcat documentation here: <http://tomcat.apache.org/index.html>

**Knowledge base hosting** is also required (e.g. for WellnessRules profiles). These can be on any host server as they are transferred via HTTP. For detailed implementation information and other tips, please see the remaining documentation.

### 5.1 How to Implement

#### Personal Agents – How to Implement:

Personal Agent servlets are used by Tomcat, which makes them accessible through HTTP.

- **Location on Server:**

Every servlet has their own unique folder on your Tomcat server:  
%apache-tomcat-dir%/webapps/

e.g.

%apache-tomcat-dir%/webapps/GeneralChairRuleML2009

Generally, the folder names match the main Class of the servlet  
(typically a PA has only one “unique” Class).

- **Contents of the Servlet Folder:**

- **META-INF:**

The META-INF folder contains the MANIFEST.MF.

- **META-INF/MANIFEST.MF:**

This file must contain the main class, e.g.: Main-class: GeneralChairRuleML2009.class  
If this is not correctly written, then the servlet will fail.

- **WEB-INF:**

This folder houses the config files of the servlet, as well as the main Classes and libraries.

- **WEB-INF/config.xml:**

This file must have the following format. If this is not correctly written, then the servlet will fail.

```
<sign>
  <url>Address</url>
  <context>MainClass</context>
  <delay>integer</delay>
  <log>yes/no</log>
</sign>
```

e.g.

```
<sign>
  <url>http://localhost:8080</url>
  <context>GeneralChairRuleML2009</context>
  <delay>5000</delay>
  <log>yes</log>
</sign>
```

- **WEB-INF/web.xml:**

This file must have the following format. If it is not correctly written, then the servlet will fail.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE web-app
  PUBLIC "-//Sun Microsystems, Inc.//DTD Web Application 2.2//EN"
  "http://java.sun.com/j2ee/dtds/web-app_2_2.dtd">
<web-app>
<display-name>NameToAppearInURL</display-name>
<description>ADescription</description>
  <servlet>
    <servlet-name> MainClassName </servlet-name>
    <servlet-class> MainClassName </servlet-class>
  </servlet>
  <servlet-mapping>
    <servlet-name>NameToAppearInURL</servlet-name>
    <url-pattern>/</url-pattern>
  </servlet-mapping>
</web-app>
```

e.g.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE web-app
  PUBLIC "-//Sun Microsystems, Inc.//DTD Web Application 2.2//EN"
  "http://java.sun.com/j2ee/dtds/web-app_2_2.dtd">
<web-app>
  <display-name>GeneralChairRuleML2009</display-name>
  <description>Takes incoming messages and excutes queries</description>
  <servlet>
    <servlet-name>GeneralChairRuleML2009</servlet-name>
    <servlet-class>GeneralChairRuleML2009</servlet-class>
  </servlet>
  <servlet-mapping>
    <servlet-name>GeneralChairRuleML2009</servlet-name>
    <url-pattern>/</url-pattern>
  </servlet-mapping>
</web-app>
```

- **WEB-INF/lib:**

This folder contains all of the .jars that the Class will use. These library .jars can be found under “%RR-dir%/personalAgents/lib”

If ANY .jar’s are missed, the servlet will fail.

- **WEB-INF/classes:**

This is where the main Class file is to be placed as well as any supporting Classes. If packages exist, then folders must be used accordingly. For example, SymposiumPlanner-20XY and WellnessRules use the resources\_PA package and so the class folder must be copied over which is located in

“%RR-dir%/target/classes/resources\_PA”. Additionally, the PAs themselves can be found under “%RR-dir%/target/classes”.

## 5.2 Servlets

### **Personal Agents – Servlets:**

Each personal agent in the Rule Responder system is implemented via a Java servlet. However, there is a major difference between them. For an example we examine the SymposiumPlanner and WellnessRules (PatientSupporter and WellnessRules2 generally have the same servlet layout as WellnessRules) instantiations.

- **SymposiumPlanner Servlets:**

SymposiumPlanner servlets are much less complex, yet more unorganized than their WellnessRules counterparts. They have the following format:

#### **MainClass**

*MessageGenerator*

*MessageParser*

*QueryBuilder*

**MainClass:** This Class handles the incoming query by converting it to POSL, executing POSL on it, and converting the answer(s) to RuleML before sending them back to the OA. It does so via the three supporting classes:

**MessageGenerator:** Generates messages for HTTP transfer from the provided RuleML. There is no particular format in the main class itself. It calls upon OO jDREW after first retrieving its knowledge base.

**MessageParser:** Parses the RuleML query.

**QueryBuilder:** Helps convert RuleML to an object oriented format.

\*\* Please see the documentation within the code for detailed information\*\*

- **WellnessRules Servlets:**

Like SymposiumPlanner, WellnessRules servlets consist of a main class and many supporting classes. However, the main class and supporting classes are now capable of both OO jDREW and Euler executions.

#### **MainClass**

*MessageGenerator*

*MessageParser*

*QueryBuilder*

Now introduces additional supporting classes:

*GeneralHandler*

*N3Handler*

*POSLHandler*

**GeneralHandler:** This class handles general method calls for PA's such as retrieving the time and date, and determining a PA's responsible profiles and user's requested profile.

**N3Handler:** This class handles N3 method calls for PA's such as generating N3 profiles parsing a RuleML query, and answering an N3 query with Euler EYE.

**POSLHandler:** This class handles POSL method calls for PA's such as generating POSL profiles parsing a RuleML query, and answering a POSL query with OO jDREW.

\*\* Please see the documentation within the code for detailed information\*\*

### 5.3 Profile Responsibility

#### **Personal Agents – Profile Responsibility Matrix:**

The Profile Responsibility Matrix (PRM) is a new concept introduced to Rule Responder via the newest instantiation, WellnessRules. Very similar to the OWL ontology used with the OA, this is an XML file similar to an ontology, which designates engine execution to specific profiles.

- **Format:**

For WellnessRules, the PRM has the following format:

```
<WellnessRules>
  <Activity>
    <Walking>
      <ResponsibleProfile name="p0001" format="posl"/>
      <ResponsibleProfile name="p0002" format="n3"/>
      <ResponsibleProfile name="p0003" format="posl"/>
    </Walking>
  </Activity>
</WellnessRules>
```

This means that the “Walking” PA is responsible for p0001, p0002, and p0003. Additionally, it will use the format information to execute the appropriate engine (OO jDREW for POSL and Euler for N3).

- **Implementation:**

The retrieval of this XML file and its handling is done via the calling of `getResponsibleProfiles()` in `GeneralHandler.java`.

```
public static String[] getResponsibleProfiles
(String, configXML,String activity)
```

### 5.4 Javadoc - Servlets

<http://ruleml.org/WellnessRules/PADocumentation/index.html>

## 6 Computing Agents

Computing agents (or CAs) can be seen as an (often low level) agent that performs an automated (computing) task. Often, CAs are used to gather and transform data from (Google, Amazon, ...) services. The WellnessRules2 use case of Rule Responder (<http://ruleml.org/WellnessRules2/RuleResponder.html>) employs one agent of this category: the 'dynamic weather' CA. Invoked by the Organizational Agent (OA), the CA queries and wraps the Google Weather service, then parses and returns the 7 day forecast as a knowledge base in N3 and POSL. (Any data that was retrieved previously that is no longer correct is overwritten.) The CA acts as an extension to a global knowledge base (for example: <http://ruleml.org/WellnessRules2/resources/OA/WR-Global.posl>). Computing Agents generally run by themselves periodically. The time between intervals is specified in `pa_Configuration.java`. Implementation source code can be found with comments at (<http://mandarax.svn.sourceforge.net/viewvc/mandarax/PragmaticAgentWeb/>).

CAs are comparable to Personal Agents. Their output is meant to assist the OA (in the example, expanding the global knowledge base with weather information) in answering the query from the EA. They are designed to perform very specific tasks (like the weather example above) that may involve invoking services independently from the rest of the virtual organization.

Tomcat implementation of CAs is identical to PAs. Please see the section 5 on [Personal Agents](#) for more information.

## 7 External Agents

You may set up your own version of an EA for Rule Responder; be it a website (typically), stand-alone application, etc. However, the documentation for the EA in this package pertains to the website implementation.

### 7.1 Websites

#### ***Rule Responder - Websites:***

Each Rule Responder uses a website as its EA which will accept a query in RuleML format:



Navigation

[Home](#)

[Rule Responder](#)

[Documentation](#)

Rule Responder

1

```

<RuleML xmlns=
"http://www.ruleml.org/0.91/xsd"
xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation=
"http://www.ruleml.org/0.91/xsd
http://ibis.in.tum.de/research/
ReactionRuleML/0.2/r.r.xsd"
xmlns:ruleml2007=
"http://ibis.in.tum.de/projects/paw#">

<Message mode="outbound"
directive="query-sync">
  <oid>
    <Ind>WellnessRules</Ind>
  </oid>
  <protocol>
    <Ind>esb</Ind>
  </protocol>
  <sender>
    <Ind>User</Ind>
  </sender>
  <content>
    <Atom>
      <Rel>myActivity</Rel>
      <Var>ProfileID</Var>
      <Ind>Running</Ind>
      <Var>InOut</Var>
      <Ind type="integer">2</Ind>
      <Ind type="integer">6</Ind>
      <Var>StartTime</Var>
      <Var>EndTime</Var>
      <Var>Location</Var>
      <Var>Duration</Var>
      <Var>FitnessLevel</Var>
    </Atom>
  </content>

```

2

Send Message

Query Selection:

3

Activity Example Query 1

Latest News

November 5th, 2009

Demo of WellnessRules given at RuleML-2009 in Las Vegas, Nevada, USA.

October 15th, 2009

Call for profiles: If you are interested in assisting the WellnessRules initiative, please write your own profiles (in either POSL or N3) and submit to the webmaster.

October 14th, 2009

WellnessRules fully implemented into Rule Responder. Support for both Euler and OOJDREW engines.

September 14th, 2009

Full Rule Responder implementation of WellnessRules begins.

August 25th, 2009

WellnessRules website updated to provide navigation and latest news.

August 14th, 2009

WellnessRules website launched. Basic Rule Responder implementation provided.

**(1) Query Window:**

The query window is where the RuleML query is written. It is implemented via the following HTML code:

```

<form name="form2" method="get" action="http://P:8888">
  <input name="Horde" value="3a466331bca877eeb014be19eee68790" type="hidden">
  <textarea name="box1" cols="57" rows="36" WRAP=OFF></textarea>

```

Updated: December 15, 2010

**action** = The address of the recipient of the message. (This is the Mule instance on the external development server).

**IP** = Replace this with the IP of the Rule Responder server

**cols** = The width of the query box

**rows** = The height of the query box

**WRAP** = Word wrapping

## (2) Submit Button:

Submits the query to the OA via the following HTML code:

```
<input value="Send Message" type="submit">
```

## (3) Query Selection:

Every Rule Responder website provides examples for users to try out. They are full-fledged RuleML queries which are guaranteed to work with the system. It is implemented via the following HTML code (example):

```
<form name="form1" method="post">
  <div align="center">
    <select name="select1" onchange="elementSelected()">
      <option value="A">Activity Example Query 1</option>
      <option value="B">Activity Example Query 2</option>
      <option value="C">Activity Example Query 3</option>
    </select>
  </div>
</form>
```

**elementSelected()** is implemented via javascript:

```
function elementSelected(){

  var choice = document.form1.select1.selectedIndex;

  var choice0 = "<Atom>" + "\n      " +
    "<Rel>myActivity</Rel>" + "\n      " +
    "<Var>ProfileID</Var>" + "\n      " +
    "<Ind>Running</Ind>" + "\n      " +
    "<Var>InOut</Var>" + "\n      " +
    "<Ind type=\"integer\">2</Ind>" + "\n      " +
    "<Ind type=\"integer\">6</Ind>" + "\n      " +
    "<Var>StartTime</Var>" + "\n      " +
    "<Var>EndTime</Var>" + "\n      " +
    "<Var>Location</Var>" + "\n      " +
    "<Var>Duration</Var>" + "\n      " +
    "<Var>FitnessLevel</Var>" + "\n      " +
    "</Atom>" + "\n";
```

```

var messageHeader =
"<RuleML xmlns=\n \"http://www.ruleml.org/0.91/xsd\""+\"\\n\"+
  \"xmlns:xsi=\n \"http://www.w3.org/2001/XMLSchema-instance\""+ \"\\n\"+
  \" xsi:schemaLocation=\n \"http://www.ruleml.org/0.91/xsd\"+ \"\\n \" +
  \"http://ibis.in.tum.de/research/\"+\"\\n\" + \"ReactionRuleML/0.2/rr.xsd\""+\"\\n\"+
  \"\\n \" + \"<Message mode=\n \"outbound\""+ \"\\n \" +
  \"directive=\n \"query- sync\">\" +
\"\\n \" + \"<oid>\" + \"\\n \" +
\"<Ind>WellnessRules</Ind>\" + \"\\n \" +
\"</oid>\" + \"\\n \" +
\"<protocol>\" + \"\\n \" +
\"<Ind>esb</Ind>\" + \"\\n \" +
\"</protocol>\" + \"\\n \" +
\"<sender>\" + \"\\n \" +
\"<Ind>User</Ind>\" + \"\\n \" +
\"</sender>\" + \"\\n \" +
\"<content>\" + \"\\n \" ;

var messageFooter = \" \" + \"</content>\" + \"\\n \" +
  \"</Message>\" + \"\\n \" +
  \"</RuleML>\";

if(choice == 0){
  document.form2.box1.value = messageHeader + choice0 + messageFooter;
  document.getElementById('description1').innerHTML = dChoice0;
}

```

## 7.2 RuleML Queries

### **Rules Responder - RuleML Queries:**

Rule Markup Language (RuleML) is the language used for rule interchange. In the case of Rule Responder, RuleML is used as a generic query language, which will be transformed to Prova, POSL, and N3. The following are the basics for Rule Responder's use of RuleML:

- **Message Header:**

Contains the namespaces used in the query (they are the same across all Rule Responder).

```

<RuleML xmlns=http://www.ruleml.org/0.91/xsd
  xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance
  xsi:schemaLocation=http://www.ruleml.org/0.91/xsd
  http://ibis.in.tum.de/research/ReactionRuleML/0.2/rr.xsd
  xmlns:ruleml2007="http://ibis.in.tum.de/projects/paw#">

```

- **Message Footer:**

Contains the remainder of the message following the payload.

```

  </Message>
</RuleML>

```

- **Message Payload:**

This is where the query is held.

- **Message Payload - Header:**

The head of the message payload is the same throughout.

```
<Message mode="outbound" directive="query-sync">
```

- **Message Payload - OID:**

Contains the name of the Organizational Agent as a constant.

```
<oid>
    <Ind>WellnessRules</Ind>
</oid>
```

- **Message Payload - Protocol:**

The protocol used for message transfer (almost always esb).

```
<protocol>
    <Ind>esb</Ind>
</protocol>
```

- **Message Payload - Sender:**

The message must have a unique sender (username). Functionality has yet to be implemented.

```
<sender>
    <Ind>User</Ind>
</sender>
```

- **Message Payload - Content:**

This is the query itself. It can contain X number of Atoms.

```
<content>
...
</content>
```

- **Message Payload - Atom:**

An atom of the query (all instances only use one).

```
<Atom>
...
</Atom>
```

- **Message Payload - Query:**

A query has a single relation name, followed by constants, variables and complex expressions.

```
<Rel> = The relation name
<Ind> = Individual constant
<Var> = Variable
<Expr> = Complex expression
e.g.:
```

```
<Rel>myActivity</Rel>  
<Var>ProfileID</Var>  
<Ind>Running</Ind>  
<Var>InOut</Var>
```

Looks like the following in Prolog:  
myActivity(ProfileID,running,InOut).

or in POSL:  
myActivity(?ProfileID,Running,?InOut).

or in N3:  
\_:myActivity  
 rdf:type :MyActivity;  
 :profileID ?ProfileID;  
 :activity :Running;  
 :inOut ?InOut.

## 8 Instantiations

### 8.1 SymposiumPlanner

As the semantic web becomes more prominent, it is important to apply these new ideas to existing organization models to demonstrate efficiency and effectiveness. SymposiumPlanner is a series of use cases based on the RuleML Symposium series created with Rule Responder (RR).

Using Friend of a Friend (FOAF) profiles, each chair position (general chair, panel chair, etc) has a Personal Agent (PA). Each PA has a knowledge base containing the responsibilities of the position in order to answer queries relevant to the chair's role.

#### 8.1.1 Upgrading SymposiumPlanner

Upgrading SymposiumPlanner:

**Mule:**

**Changing ConfigFile:**

1. You must add a new OA (e.g. RuleML-2010) as a Mule Descriptor. It will be placed on a new port (see ESB guide for an example).
2. You must add a new PA endpoint for each PA you are adding (see ESB guide for an example).

**PAs (example: PublicityChair): Initial SetUp**

1. Create the following directories on your tomcat server:  
%apache-tomcat-dir%/webapps/**PublicityChairRuleML20XY**
2. Copy and paste all files and folders from a previous version's corresponding root folder (as named above).
3. Modify the file: %apache-tomcat-dir%/webapps/PublicityChairRuleML2009/WEB-INF/**config.xml** By changing the context to contain the correct version year. I.E: <context>PublicityChairRuleML2009</context> => <context>PublicityChairRuleML2010</context>
4. Modify the file: /usr/local/apache-tomcat-6.0.10/webapps/PublicityChairRuleML2009/WEB-INF/**web.xml** By finding and replacing all occurrences of the old version year and replace with the new version year.
5. Modify the file: /usr/local/apache-tomcat-6.0.10/webapps/PublicityChairRuleML2009/META-INF/**MANIFEST.MF** By changing the "Main-class" declaration to correspond to the new version year. I.E: Main-class: PublicityChairRuleML2009.class => Main-class: PublicityChairRuleML2010.class

**New Servlet**

1. Create a new java class named "**PublicityChairRuleML20XY**" to correspond to the new version year.
2. Copy and paste all information from a previous PublicityChair servlet to the new class.
3. Find and replace all occurrences of the old version year with the new version year.
4. Modify the global "port" value to correspond to the port chosen to use in the mule config file.

**POSL & RDF Files**

1. Create a new directory for the new version's POSL and RDF files which are referenced by the servlet:  
/var/www/jdrew.org/ojdrew/**ruleSetsRuleML-20XY**
2. Create a new file in this directory named "**publicityChairOntologyRuleML-20XY.rdf**".
3. Copy and paste a previous version's contents to this new file. (no changes need be made)
4. Create a new file in this directory named "**publicityChairRuleML-20XY.posl**".
5. Copy and paste a previous version's contents to this new file.

6. Find and replace all occurrences of the old version year with the new version year.

#### OA Changes:

##### Adding a new use case:

1. Create a new folder under “PragmaticAgentWeb/rules/” which will contain the prova file your mule descriptor points to.
2. Replicate a previous SymposiumPlanner file system (e.g. copy paste).
3. Modify the “RuleML-20XY-Responder.prova” (which the mule descriptor points to) to the appropriate year.
4. Now, you may modify the queries and interfaces, owl files, etc. to reflect changes you are making to 2010. For symmetry, all references for 20XY should reflect the current year.

**ALL CHANGES ARE COMPLETE FOR PUBLICITYCHAIR. Now you can create your own knowledge bases and rules in the OA/PA.**

## 8.2 WellnessRules

With an ever-increasing emphasis on exercise and diet for individuals around the world, it becomes necessary to find new and innovative means to provide support for these wellness-related practices. WellnessRules (WR) is a new use case created with Rule Responder (RR) with the intention of forming an online- interactive wellness community.

As in Friend of a Friend (FOAF), people can choose a (community-unique) nickname and create semantic profiles about themselves, specifically their wellness practices, for their own planning and to network with other people supported by a system that ‘understands’ those profiles.

These profiles can currently be written in either **POSL** or **N3**, which are handled by the engines OO jDREW and Euler respectively. Therefore, the interoperation between Prolog and N3 is realized via this unique use case.

### 8.2.1 Knowledge Base Signatures

Knowledge base signatures are available through the WellnessRules website.

(<http://ruleml.org/WellnessRules/Signatures>)

## 8.3 WellnessRules2

WellnessRules2 continues the work of [WellnessRules](#) using Rule Responder (RR) to form an online-interactive wellness community. It presents new features such as the ability to use dynamic weather data parsed into a rule format, complex expressions which allow facts to be much more useful in regards to being used in rules, and typed variables which allows users to use the Wellness Taxonomy to query for subclasses of activities (not yet fully implemented).

All further development of WellnessRules will be completed in WellnessRules2.

### 8.3.1 Knowledge Base Signatures

Knowledge base signatures are available through the WellnessRules2 website.

(<http://ruleml.org/WellnessRules2/Signatures>)

## 8.4 PatientSupporter

Patients are increasingly seeking interaction in support groups, which provide shared information and experience about diagnoses, treatment, etc. We present a Social Semantic Web prototype, PatientSupporter, that will enable such networking between patients within a virtual organization. PatientSupporter is an instantiation of Rule Responder that permits each patient to query other patients' profiles for finding or initiating a matching group. Rule Responder's External Agent (EA) is a Web-based patient-organization interface that passes queries to the Organizational Agent (OA). The OA represents the common knowledge of the virtual patient organization, delegating queries to relevant Personal Agents (PAs), and hands validated PA answers back to the EA. Each PA represents the medical subarea of primary interest to a corresponding patient group. The PA assists its patients by advertising their interest profiles employing rules about diagnoses and treatments as well as interaction constraints such as time, location, age range, gender, and number of participants. PAs can be distributed across different rule engines using different rule languages (e.g., Prolog and N3), where rules, queries, and answers are interchanged via translation to and from RuleML/XML. We discuss the implementation of PatientSupporter in a use case where the PA's medical subareas are defined through sports injuries structured by a partonomy of affected body parts.

### 8.4.1 Knowledge Base Signatures

Knowledge base signatures are available through the PatientSupporter website.

(<http://ruleml.org/PatientSupporter/Signatures>)

## 9 Creating an Instantiation

@@@Describe steps of copying WellnessRules2@@@



## 10 Supported Reasoning Engines and Languages

### 10.1 OO jDREW

OO jDREW, a deductive reasoning engine for the RuleML web rule language, is an Object Oriented extension to jDREW. OO jDREW implements Object Oriented extensions to RuleML which include:

- Order Sorted Types
- Slots
- Object Identifiers

OO jDREW is written in the Java programming language (Tested with Version 1.6.0).

#### 10.1.1 POSL (*Positional-Slotted Language*)

A presentation, shorthand, and exchange syntax is described that integrates Prolog's positional and F-logic's slotted syntaxes for representing knowledge (facts and rules) in the Semantic Web. This positional-slotted (POSL) language accommodates various assertional-logical and object-centered modeling styles, yet strives for maximum conciseness and orthogonality. After an introduction, the document covers POSL selectors, unification, webizing, typing, and implementation. Webizing takes up and extends the use of URIs in N3. For humans, the POSL language is faster to write and easier to read than any XML syntax. However, since a parser and a generator map the POSL syntax to Object-Oriented RuleML and back, the machine advantages of XML can be preserved.

#### 10.1.2 Running OO jDREW Within Eclipse

##### *Running OO jDREW Within Eclipse*

- 1) To obtain OOjDREW, go to the OOjDREW downloads page (<http://www.jdrew.org/ooidrew/download.html>) and download the source.
- 2) Import the source package into whatever IDE you prefer (I use eclipse)
- 3) To run OO jDREW, run:  
OO jDREW - Rule Responder->src/jdrew->jdrew.oo.gui->TopDownGUI.java
- 4) Place your taxonomy in the Type Definition window and load the type information. Make sure to select RDFS if the taxonomy is in RDF/RDFS.
- 5) Place the POSL knowledge base(s) in the Knowledge Base window and Parse Knowledge Base. Again, make sure to select POSL if your knowledge base is in POSL.
- 6) Type your query in the Query window and click Issue Query.

### 10.2 Euler

Euler is an inference engine supporting logic based proofs. It is a backward-chaining reasoner enhanced with Euler path detection. It has implementations in Java, C#, Python, Javascript and Prolog. Via N3 it is interoperable with W3C Cwm.

### 10.2.1 Notation 3 (N3)

Notation3, or N3 as it is more commonly known, is a shorthand non-XML serialization of Resource Description Framework models, designed with human-readability in mind: N3 is much more compact and readable than XML RDF notation. The format is being developed by Tim Berners-Lee and others from the Semantic Web community.

#### **Notation 3 (N3) rule language:**

- Standard N3 triple format:  
**SUBJECT PROPERTY OBJECT**
- Using prefix's:  
Prefixes can be used to abbreviate url's used in a given N3 file. For example:  
Instead of using:

```
<example#Bob>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
    <example#Person>.
```

The following prefixes can be implemented to shorten the statement:

```
@prefix : <example#>.
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
:Bob rdf:type :Person.
```

- Representing variables:  
When using rules, variables can be used to test subjects against them. In N3, a variable is represented with a ? followed by characters used to represent it. For example:

```
@prefix : <example#>.
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
{?S rdf:type :Swan} => {?S :color :White}.
```

This means that all subjects who have a rdf:type of :Swan, then they also will have the :color property of object:White.

Triples written for Euler generally follow the format of axioms and queries, where the axioms contain relations and facts regarding the knowledge base, and the query is to retrieve the triples from it.

#### **Axioms:**

A standard axiom contains a "facts" and a "relations" file.

- Relations:  
The relations file lists all the relationships between the triples in the knowledge base (using inference). It can also be used to define any initial properties associated to subjects. All relations and initial values are written in the form of rules and have this form:

```
{SUBJECT PROPERTY OBJECT} => {SUBJECT PROPERTY OBJECT}.
```

For example, this relation will imply that if a certain individual C, has a father F, then F must have a child C:

@prefix : <example#>.  
 @prefix log: <http://www.w3.org/2000/10/swap/log#>.

{?C :father ?F} log:implies {?F :child ?C}

The ? symbol indicates a variable used in the formula. Therefore, ?C means every subject in the facts file is checked to see if they have a property of :father and if it has a value.

log:implies is equivalent to => in the N3 language. Therefore, => can be used in rules to represent an implication.

#### Facts:

A facts file could be thought of as creating an instance of a class such as in object-oriented programming. New subjects are created, which are generally given an rdf:type and other property values. These will be used with the query later to draw conclusions about these facts.

### *10.2.2 Running Euler (EYE) Within Eclipse:*

- 1) Download YAP and install:  
<http://www.dcc.fc.up.pt/~vsc/Yap/current/yap-5.1.3-installer.exe> (Windows)
- 2) Add the 'Yap\bin' folder to the Paths environment variable
- 3) Download WGet and install:  
[http://sourceforge.net/project/downloading.php?groupname=gnuwin32&filename=wget-1.11.4-1-setup.exe&use\\_mirror=voxel](http://sourceforge.net/project/downloading.php?groupname=gnuwin32&filename=wget-1.11.4-1-setup.exe&use_mirror=voxel) (Windows)
- 4) Download EulerSharp:  
[http://sourceforge.net/project/showfiles.php?group\\_id=77046](http://sourceforge.net/project/showfiles.php?group_id=77046)
- 5) Copy the '\bin\Euler.jar' file to a safe location on your hard drive.
- 6) Create a new project in eclipse.
- 7) Copy the Euler.jar file to BOTH the Java JRE and JDK external libraries. For Windows, they are typically under:  
 "C:\Program Files\Java\jre6\lib\ext"  
 and  
 "C:\Program Files\jdk1.6.x\_yz\jre\lib\ext"

#### Alternatively:

You may also add the jar file as an "external JAR" under:  
 Project->Properties->Java Build Path->Libraries->Add External JARs

- 8) The command to execute the Euler EYE engine is as follows:

```
euler.Eye.runEye(args);
```

Where 'args' are the arguments (explained next). Typically you will want to use a print statement to view the results of the execution.

## 10.3 Prova

@@@To be completed@@@

### 10.3.1 Prova (Rule Language)

### 10.3.2 Running Prova in Eclipse

## 10.4 DR-Device

@@@To be completed@@@

### 10.4.1 DR-POSL

### 10.4.2 Running DR-Device in Eclipse

# 11 RuleML Query Generation

## 11.1 Preliminaries

### 11.1.1 Introduction

This documentation explains the RuleML Query Generation (RQG) GUI used in systems such as PatientSupporter and WellnessRules2 to create a wide variety of different RuleML queries. It is built upon HTML using JavaScript. Section 2 details the several different sections of the JavaScript file *gui.js*. Section 3 details the HTML side of the RQG GUI. The document concludes with recommendations and some troubleshooting guidelines.

### 11.1.2 Files Involved

**/files/gui.js (JavaScript file)** – This contains all the JavaScript functions required for the RQG GUI. Comments in the file are used to split the file into 5 separate sections which are detailed below.

**RuleResponder.html (HTML file)** – This is the file that contains the HTML form elements referenced in the *gui.js* file. The RQG GUI itself is accessible by opening this file in a web browser. Information regarding this file can be found in section 3.

**/files/datetimepicker\_css.js (JavaScript file)** – A CSS and JavaScript based calendar tool found at <http://www.rainforestnet.com>. How to use the calendar tool is not mentioned in this document; however the referenced website contains many examples and pieces of documentation in some of the code itself.

**/files/layout.css** – A Cascade Style Sheet (CSS) used with *RuleResponder.html*. The only thing of interest to the RQG GUI here is that during error checking, textboxes change their style template to show there is an error or change back when it is corrected. The styles used are noted with comments in this file.

## 11.2 JavaScript

The file *gui.js* is broken down into 5 different parts. Each sub-section below explains its corresponding part.

### 11.2.1 Preliminary Declarations and Functions

At the very start of *gui.js*, the global variables are declared. For each variable in the desired RuleML query (be it a free variable or bound constant), there are two JavaScript variables. One variable is for the RuleML query creation itself, and one is the English representation for the English description creation.

For instance, in *WellnessRules2*, for the *ProfileID* variable used in the RuleML query, we create the JavaScript variables: *profileID* and *englishProfileID*. *profileID* will eventually contain the section of the RuleML query that contains *ProfileID* information. *englishProfileID* will contain a string that represents the contents of *ProfileID* that could be used in a sentence. If the user is querying for any *ProfileID* (*ProfileID* is a free variable in the query), the corresponding values in this situation could be the following:

```
profileID = "<Var>ProfileID</Var>"
englishProfileID = "any profile"
```

The variable *messageHeader* contains a large string of all the static information which comes before the variables in the RuleML query. *messageFooter* contains all the static information that comes after the variables. Some of this static information is different in each use-case such as the id name which is just the use-case name.

Finally, any lower level functions required for the operation of the functions in the next section are placed in the preliminary section. In *PatientSupporter* and *WellnessRules2*, there are several functions used, each one described in commenting of *gui.js*. A few examples of these are:

```
checkTime() – Checks to make sure string matches time format.
pressSubmit() – Runs all functions required when submit button is pressed.
selectQuery() – Sets the dropdown menus to the corresponding example query values.
```

### 11.2.2 Variable Functions

In this section, each RuleML query variable has a function associated with it. The naming scheme in this section is: *elementSelectedNameOfVariable()*. These functions are run when the *RuleResponder.html* page is opened or whenever the function's form element is edited. Based on the user's input in the variable's corresponding HTML form element, the two variables (English description and RuleML variable) are given their proper values.

For example for the variable *ProfileID*, the function name is *elementSelectedProfileID()*. It uses a local variable (usually called *choice*) to store the value of the index number of the element selected in the html form element (which in this case is a drop down box). It then uses *padZeros()* from Section 2.1, to pad the index value to have the correct number of 0's to be a *profileID* value. If the index value is equal to zero that implies "any" was selected in the html form. In RuleML, this would be a free variable so the global variable *profileID* stores the value "<Var>ProfileID</Var>". Otherwise, *profileID* becomes a individual constant which would take the form "<Ind>p(**padded index number here**)</Ind>".

Form elements that require user text input have an additional error function that is invoked in the corresponding variable's function. This is described in Section 2.3. At the end of all variable functions, the *createRuleML()* function is called, which regenerates the RuleML query with the new values, and also calls the function *createEnglish()* to regenerate the English description as well. See section 2.4 for more details.

### 11.2.3 Error Checking

When dealing with HTML form elements that require text input from the user, the chance of user error goes up significantly. Currently the RQG GUI implements simple error checking that informs the user of their mistakes by simply changing the color of the text field that contains the error. When the error is removed, the text field returns to its original color.

Each form element that requires error checking has another function which is called right before *createRuleML()* in its corresponding variable function (see Section 2.2). This function's purpose is to check for possible errors. Some variables require the same error check function as other variables because they are related. Because of this, the naming convention of these error checking functions are *elementError<TopicName>Check()*. An example of variables requiring the same error check function is the *startDate*, *startTime*, *endDate*, *endTime* variables. While these variables may have no standalone errors, together they may have an error. For example, if the user put *endDate* and *endTime* occurring before *startDate* and *startTime*.

### 11.2.4 Query and English Generation

In this section of the code, RuleML query and English generation is done. In *createRuleML()*, all the RuleML global variables (*messageHeader*, *profileID*.....*messageFooter*) are concatenated together as one large string and placed in the RuleML query box. *createEnglish()* is then called which combines all the English variables into a paragraph describing the query. The sentence structure is mostly up to the person creating the GUI.

### 11.2.5 JavaScript Starter

The *startCheck()* function runs when the web page is loaded (see the <body> tag in RuleResponder.html). It runs every form element function to generate a RuleML query. When sample query is chosen, *recompile()* is used (*startCheck()* would cause a loop in this situation).

## 11.3 HTML

As stated in Section 2, each form element function is tied to an HTML form element. That is how the values are generated and how updates to the RuleML query start. Each form element's type depends on the type of information that is required. Generally, the standard currently used is:

**Selection (drop down boxes):** This is used when there are a specific number of values for the variable. The corresponding form element function is triggered when a new selection is made.

**Text box:** This is used for inputting numerical values. The corresponding form element function linked to this type of form element is triggered whenever a key is pressed.

More information regarding various html form object can be found on the W3C site: <http://www.w3.org/TR/html401/interact/forms.html>

## 11.4 Recommendations

If you decide to modify the RQG GUI, it is suggested while you are making your modifications, you keep a very simple barebones html file containing only the required elements for the RQG GUI. This is to insure that while you're modifying the code, no bugs appear that are not related to the RQG GUI. After you are satisfied with the modifications, proceed to integrating it into the actual webpage that it will be accessible from.

The RQG GUI currently uses regular expressions for pattern matching in several places to avoid faulty values and does alert the user when an incorrect value is inputted (the box with the incorrect value turns red). However, further error checking could be used to prevent more kinds of errors in the queries. The large issue with error checking multiple values such as StartTime, StartDate, EndTime and EndDate, is that some of these may be free variables while others are not.

In the future, the ability for the RQG GUI to work "both ways" would prove very useful. This would mean the user could edit the RuleML manually and the user's changes would appear in the HTML form elements. This could be accomplished by having the Atom part of the query in a separate textbox from messageHeader and messageFooter, and then doing performing some form of parsing.

## 11.5 Troubleshooting

### Blank or no result from Rule Responder

Examine the query in the address bar and ensure nothing extra is being added on or removed from the query. Some web browsers have built in address bar character limits (which does not meet the standard for HTML submission forms!). In Internet Explorer this dealt with by removing all unnecessary extra white space right before the query is sent.

### Blank RuleML Query

This can be caused by any kind of coding mistake; however it was mostly found this occurred when a single string had a syntax error.

### Undefined Values in RuleML Query

Most often it is found that the HTML form elements have been given the incorrect or duplicate name.

### Debugging Tips

- Using an IDE that supports JavaScript is very helpful for debugging.
- Having a web browser equipped with a Java console is very useful for understanding script failures. Google Chrome is especially useful for this.

Using the JavaScript `alert("a message here")` is useful for debugging conditional statements.



## 12 PatientSupporter Profile Generator

### 12.1 Overview

A tool have has been developed for PatientSupporter for use with the Rule Responder Benchmarking Tool to test its performance regarding scalability. The Profile Generator tool generates  $n$  amount of random profiles for a use-case along with the corresponding responsibility matrix for the Personal Agents. Assuming you have a Rule Responder PatientSupporter system already installed and running, these files can be quickly inserted into your system for testing purposes.

### 12.2 Example

A sample of output from this tool can be found here (<http://ruleml.org/PatientSupporter/test/>). 10 sample profiles and a responsibility matrix were generated in this instance.

### 12.3 Implementation

The RunMain() class uses the functions from ProfileCreation to make a number of POSL profiles specified by the variable NUMBER\_OF\_PROFILES. The file allProfiles.posl contains all the profiles, concatenated one after the other (for testing use in OO JDrew). legProfiles.posl is another special file containing only the profiles with leg injuries; it is for testing how fast Leg queries would be in OO JDrew without the rest of profiles in the knowledge base. More information regarding the implementation of this tool can be found within the comments of the source code.

## 13 Rule Responder Benchmarking Tool

### 13.1 Overview

The Rule Responder Benchmark and Testing tool can be used to test the response time of the various use cases of Rule Responder. Currently only benchmarking tools are automated, and provide the user with the ability to gather execution time data for specific instantiation queries of their choice.

### 13.2 Example

Using the following Java statement, we can execute the “challenge chair contact” query from SymposiumPlanner2008 on 3 trials, and store the average running time across all trials:

```
Long runTime =
    Utilities.getTimeForSpecificQuery(
        Configuration.symposiumPlanner2008,
        "Challenge_Chair_Contact.txt", 3);
```

Output:

```
=====
SymposiumPlanner2008 BENCHMARKING Challenge_Chair_Contact.txt ON 3 TRIALS
-----
Issuing query Challenge_Chair_Contact.txt, 3 times...
Execution Time for trial 1: 4807 milliseconds.
Execution Time for trial 2: 2851 milliseconds.
Execution Time for trial 3: 2613 milliseconds.
Average Time for 3 trials: 3423 milliseconds.
```

### 13.3 Implementation

There are two main packages in the benchmarking tool project “benchmarkUtilities” and “configuration”.

**Configuration** is of course to configure the benchmarking tool and stores the names of the of the instantiations being used, as well as the server URL of the Rule Responder server being benchmarked/tested.

**BenchmarkUtilities** contains the actual implementation. Currently only the Utilities.java file is used and has methods available to get timing information from sets of queries stored in the project (i.e.

**getTimeForSpecificQuery**, **getTimesForAllQueriesOfInst**). Both of these methods will use the **getQuery** method to build the query from those stored in the “queries” folder, as well as the **executeQuery** to send the built query off to the Rule Responder server defined in the configuration.

## 14 Troubleshooting Rule Responder Instantiations

### 14.1 Installation

Problem:

**Cannot open firewall ports.**

Solution:

Firewall ports can only be opened on administrative accounts. You must switch to a user account with administrative privileges.

Problem:

**Locally created EA does not function properly.**

Solution:

- Ensure that the IP address has been change in your local version of the EA. Also insure that all files used in the EA are pointing to a local and existing file.

Problem:

**After Maven installation, Eclipse gives the message:** “Eclipse is running in a JRE, but a JDK is required”.

Solution:

- Eclipse currently is not pointing to the JDK that was supposed to be installed. Consult [Section 1.3 Prerequisites](#) on how to correct this.

Problem:

**Lost permission on Tomcat Webapps Folders**

Solution:

- This is a known issue for some system setups. While the specifications of the problem are not clear at this time, the best solution to have the system admin restore you privileges to the corresponding files.

## 14.2 Sending Queries (High Level)

Problem:

**I sent a query but my browser returned an error (e.g. "cannot connect to <IP>:8888")**

Solution:

- Ensure that you started the Rule Responder service (see [Section 1.5: Setup](#)).
  - Ensure that the EA is properly configured and pointed to the IP of where the service is running (see [Section 1.1.2: Apache HTTP Server](#))
- 

Problem:

**I sent a query and received a RuleML answer with the relation "noPublicInterface"**

Solution:

- There is no interface set up for the query you sent to the Prova Knowledge Base. Create a fact following the other interface templates which will satisfy your query.
- 

Problem:

**I sent a query and received only a blank, white screen.**

Solution:

- This happened because the server timed out, meaning that there were no answers sent back within the allotted time limit (configured by ProvaUMOIml.java). There are many background reasons for this, so please check your log files in mule.log and catalina.out, and troubleshoot them individually.
- 

Problem:

**I sent a query, Mule receives an error regarding Prova and the browser attempts to download a file called "download".**

Solution:

- This happened because the EA interface being used was not properly downloaded. Redo Section 1.1.2.

## 14.3 Mule

Note: These problems are based on the output generated by the mule.log file

Problem:

**Attempted to start Mule but received the error:**

```
Exception in thread "main" java.lang.NoSuchMethodError:
org.mule.config.i19n.Message<init><Ljava/lang/
String;ILjava/lang/Object;>V
...
```

Solution:

- An instance of Mule is already running. Shut it down and try starting again.
- 

Problem:

**Attempted to start Mule but received the error:**

```
Exception in thread "main" java.lang.NoClassDefFoundError:
ws/prova/mule/impl/ESBManager
```

Solution:

- There is no “pragmatic-agent-web-1.0-SNAPSHOT.jar” file inside the project “lib” folder. Compile one and copy it from “target” to “lib” (see 1 and 2 of [Section 1.2.3: Starting Up Rule Responder](#))

Problem:

**Mule successfully started and I sent a query, but nothing happened (i.e. no acknowledgement messages).**

Solution:

- Make sure that you have configured your mule configuration file such that the descriptor (OA config) is enabled and working (see [Section 2.0: Enterprise Service Bus \(ESB\) – Mule](#))
- If the descriptor is properly configured, check the Prova knowledge base which it points to. The knowledge base must have a rule which matches the query you sent, otherwise it will not be satisfied and no actions will be taken (see [Section 3.1: Prova Knowledge Base](#))

Problem:

**“Sent message to <PA> PA.” shown, but followed by the error:**

```
ERROR http.HttpConnector handleWorkException.1534 - Work caused
exception on 'workCompleted'.
```

...

Solution:

- Ensure that the Tomcat server is setup (see [Section 1.1.4: Tomcat](#)) and running (see [Section 1.1.5: Startup for Windows](#) and [Section 1.2.3: Starting Up Rule Responder](#) for Linux)
- The Mule configuration file may not be pointing to the active servlet, make sure that the endpoint that is returned by OWL is set up in the mule config file (see configuring mule of [Section 1.1.3: Eclipse & Mule](#))
- Ensure that OWL returned the endpoint name that you intended (see [Section 3.2: OWL Ontology](#))

Problem:

**Stuck on “Looking up Responsible Personal Agent”**

Solution:

- Make sure that you are pointing to the OWL file correctly in the Prova knowledge base you are using (see [Section 3.1: Prova Knowledge Base](#))
- Make sure that the OWL ontology is properly configured (see [Section 3.2: OWL Ontology](#))

Problem:

**Stuck on “Sent message to <PA> PA.”**

Solution:

- The PA most likely received the message. Look into issues with either reasoning inside the PA, or how sending the message back is configured (see [Section 4.0: Personal Agents](#))

## 14.4 Personal Agents

Problem:

**Personal Agents (PAs) send a response but the Organizational Agent never receives it.**

Solution:

- The pa\_Configuration source used for that particular OA likely has the wrong IP address. Be sure pa\_Configuration in the Rule Responder project is compiled with the proper IP and then copy the files back into the PA’s servlet. Additionally, insure that config.xml for that specific web servlet contains the correct IP as well (see [Section 1.4 Tomcat](#) for more details).

## 14.5 Issues and Workarounds

### **Fixed (June, 2010):**

- Prova substitutions are currently hard-coded in the knowledge base, and would in theory require hundreds or thousands of rules.
  - o Reason:  
In Prova, there is currently no way to handle any combination of variables (<Var>) and constants (<Ind>), so rules must be created for “expected” inputs as a workaround. Currently working with Adrian in an attempt to resolve.
  - o Location:  
PragmaticAgentWeb->rules->use\_caseWellnessRules->Wellness-Rules->WellnessRules-Responder.prova  
Rule:  
processMessage(XID,From,Primitive,myActivity(ProfileID,Activity,InOut,MinRSVP,MaxRSVP,StartTime,EndTime,Location,Duration,FitnessLevel)):-
  - o **Solution:** Modified MessageGenerator to include a “messages()” method which sends the verbatim RuleML message containing only the Ind’s and Var’s of the results. These are stored in new variables, which are constructed back into the original relation before being sent back to the EA.  
(see WellnessRules2/PatientSupporter PAs for Message sending change)  
(see  
rules->usecaseWellnessRules2->Wellness-Rules2->WellnessRules2-Responder.prova  
&  
rules->usecasePatientSupporter->PatientSupporter->PatientSupporter-Responder.prova  
  
for changes in the Prova knowledge base.

### **Fixed (February, 2010):**

- Rule Responder now creates the required query predicates to simulate the input of Min and Max RSVP.
  - o Reason:  
Because N3 is bottom-up, nothing can be passed in like OO jDREW. So RR must build the query to inject predicates containing the provided numbers.
  - o Location:  
PragmaticAgentWeb->personalAgents->pa\_WellnessRules2->N3Message.java  
Method:  
private String parseRuleMLQuery() {}
  - o **Solution:** Modified “personalAgents->pa\_WellnessRules2->N3Handler.java->parseRuleMLQuery()” so that it now constructs a query such that ?minRSVP and ?maxRSVP use math:notLessThan and math:notGreaterThan to calculate whether or not the proposed min and max RSVP’s are within acceptable limits. It does so by first querying for myActivity with ANY min/maxRSVP and then performing this check; if it succeeds it performs a “select”, removing these constraints and just displaying the query result.
- POSL requires input of MinRSVP and MaxRSVP, while N3 must have variable input. Therefore, the RuleML query uses constants, and N3 treats them as variables.
  - o Reason:  
WellnessRules must fill the MinRSVP and MaxRSVP values in order to pass the premise in the myActivity rule. POSL does so by accepting the values as input from the query because it is top-down.
  - o **Location (of N3 workaround):**  
oojdrew->src->default->N3Handler.java

Method:

```
public static Vector<String> parseRuleMLQuery(DefiniteClause ruleMLQuery) {}
```

- **Solution:** Modified “personalAgents->pa\_WellnessRules2->N3Handler.java->parseRuleMLQuery()” so that it now constructs a query such that ?minRSVP and ?maxRSVP use math:notLessThan and math:notGreaterThan to calculate whether or not the proposed min and max RSVP’s are within acceptable limits. It does so by first querying for myActivity with ANY min/maxRSVP and then performing this check; if it succeeds it performs a “select”, removing these constraints and just displaying the query result.

#### ***Fixed (December 16<sup>th</sup>, 2009):***

- ProfileID must be the name of the variable profiles (to determine profileSpecified).
  - Reason:  
The servlet must determine, from the message, which profile is specified. If it finds “<Var>ProfileID</Var>” then the profile specified is “All”. The alternative is to assume that the ProfileID will be the first given variable following “<Rel>myActivity</Rel>”
  - Location:  
oojdrew->src->default->GeneralHandler.java  
Method:  
public static String getProfileSpecified(String message) {}
- ProfileID no longer needs to start with a ‘p’

#### ***OO jDREW - Workarounds and Not Yet Working:***

##### **Workarounds:**

- Anonymous typed variables caused a warning statement for every possible combination. This caused a slowdown by a factor of greater than 15x. The warning print statement for the debugger has been removed.
  - Reason:  
The usage of anonymous typed variables caused a significant slowdown in execution time.
  - Location:  
oojdrew->jdrew.oo.td->Unifier.java  
Method:  
private boolean unify(Term term1, Term term2, int varBindType) {}

#### ***General Rule Responder - Workarounds and Not Yet Working:***

##### **Workarounds:**

- The RuleML to Prova XSLT translation used a ‘.’ Instead of ‘:’ for types. This resulted in Prova throwing an error during typed variable translation. Therefore, the XSLT was changed to output ‘:’ instead of ‘.’ In between a type and its variable.
  - Reason:  
The XSLT translation was causing Prova to throw errors.
  - Location:  
PragmaticAgentWeb->src->main->resources->rml2prova.xsl
- Typed variables are not recognized during ProvaToRuleML serialization. A special case was added which checks for ‘<’ and ‘:’ in the String, which should indicate it as a typed variable.
  - Reason:  
Typed variables are just assumed to be constants and so are not parsed correctly.

Location:

PragmaticAgentWeb->src/main/java->ws.prova.mule.impl->Prova2RuleMLTranslator.java

Method:

```
private String serializeConstantTerm(Object ct, String spacer) {}
private Object doTransform(Object src, String encoding) {}
```

- RuleML inputs with more than one colon are assumed to not be types, and instead treated as literals.
  - o Reason:
 

Using a literal such as '2009-06-15T10:15:00' results in the following translation:

```
<Ind type=15:00>2009-06-15T10</Ind>
```

When the following is expected:

```
<Ind>2009-06-15T10:15:00</Ind>
```
  - o Location:
 

PragmaticAgentWeb->src/main/java->ws.prova.mule.impl->Prova2RuleMLTranslator.java

Method:

```
private String serializeConstantTerm(Object ct, String spacer) {}
```
- Windows Vista installations of Rule Responder can sometimes have communication issues between the OA and the PAs due to Vista security permission issues. Generally, the OA's message is never received by the PA. Not many details are known on the exact specifications of this issue; however current work on the Rule Responder may lead to a fix for this.

### ***SymposiumPlanner - Workarounds and Not Yet Working:***

#### **Workarounds:**

- Variables are excluded from complex terms.
  - o Reason:
 

Complex terms had variable names included, where non-complex terms do not. To be consistent this was removed.
  - o Location:
 

PragmaticAgentWeb->src/main/java->

ws.prova.mule.impl->Prova2RuleMLTranslator.java

Method:

```
private String serializeComplexTerm(ComplexTerm ct, String spacer) {}
```

### ***WellnessRules2 - Workarounds and Not Yet Working:***

#### **Workarounds:**

- If a variable substitution is returned by OO jDREW or Euler it is ignored. This is to implement typed variables.
  - o Reason:
 

In Prova, the substitutions performative expects Ind's only, so Var's will not work. Therefore, they are simply not included in the answer.
  - o Location:
 

PragmaticAgentWeb->personalAgents->pa\_WellnessRules2->MessageGenerator.java

Method:  
 public String[] Messages2() {}

### ***WellnessRules & WellnessRules2 - Workarounds and Not Yet Working:***

#### **Workarounds:**

- All query-able facts must be hard-coded into the PA servlet, in order to properly translate RuleML to N3 query.
  - o Reason:  
 No slot information is given with the RuleML query (only positional). Therefore, the slot names are coded directly in the servlet, corresponding to the provided relation name.
  - o Location:  
 oojdrew->src->default->N3Handler.java  
 Method:  
 public static Vector<String> parseRuleMLQuery(DefiniteClause ruleMLQuery) {}
- Even for N3 queries, the position of variables matters, and must correspond to the Signatures.pdf.
  - o Reason:  
 Similarly due to the previously mentioned hard-coding, and because slot names are required for N3 but are not provided as input, the input is assumed to be in correct order.
  - o Location:  
 oojdrew->src->default->N3Handler.java  
 Method:  
 public static Vector<String> parseRuleMLQuery(DefiniteClause ruleMLQuery) {}
- ProfileID must correspond to the exact filename of the profile knowledge base.
  - o Reason:  
 The servlet must determine, from the message, which profile is specified. If it finds "<Var>ProfileID</Var>" then the profile specified is "All". The alternative is to assume that the ProfileID will be the first given variable following "<Rel>myActivity</Rel>"
  - o Location:  
 oojdrew->src->default->GeneralHandler.java  
 Method:  
 public static String getProfileSpecified(String message) {}

### ***WellnessRules 1 - Workarounds and Not Yet Working:***

#### **Workarounds:**

- For N3 query parsing, type values are currently ignored. Types may be supported later with rdf:type.
  - o Reason:  
 N3 does not require type declaration for integers or literals.
  - o Location:  
 oojdrew->src->default->N3Handler.java  
 Method:  
 public static Vector<String> parseRuleMLQuery(DefiniteClause ruleMLQuery) {}



- String literals for date-time are assumed, meaning that N3 query parsing automatically places quotes around constants that have greater than 1 colon. Also, for a still unknown reason, POSL automatically places quotes around these date-time constants, so no workaround needed for that.
  - Reason:  
RuleML does not allow its input to contain quotes, but the WR knowledge base requires quotes around date-time values.
  - Location:  
oojdrew->src->default->N3Handler.java  
Method:  

```
public static Vector<String> parseRuleMLQuery(DefiniteClause ruleMLQuery) {}
```