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[RULE RESPONDER GUIDE]

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. This guide to Rule Responder @@@perhaps add Intro section breaking material out of this abstract@@@ 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@@@Insert section@@@. 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@@@add section@@@, OO jDREW with POSL, Euler with N3, and DR-Device with DR-POSL@@@check and add section@@@. 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. The appendix gives the knowledge base signatures of the official Rule Responder instantiations.

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1 Setting up Rule Responder

1.1 Windows Environment

1.1.1 Prerequisites

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)

1.1.2 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.

1.1.3 Eclipse & Mule

Prerequisites:

- Latest Version of Subclipse:
  Instructions: http://subclipse.tigris.org/servlets/ProjectProcess?pageID=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
                      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"

1.1.4 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/”)

1.1.5 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"

1.2 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.

1.2.1 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).

1.2.2 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.

1.2.3 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.

1.2.4 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.

1.2.5 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.

2 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"/>

3 Organizational Agent

3.1 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_case*Instance**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

3.2 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>

...
```

4 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.

4.1 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".

4.2 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**

4.3 Profile Responsibility

Personal Agents – Profile Responsibility Matrix:

The Profile Responsibility Matrix (PRM) is a new concept introduced to Rule Responder via the newest insanitation, 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)
```

4.4 Javadoc - Servlets

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

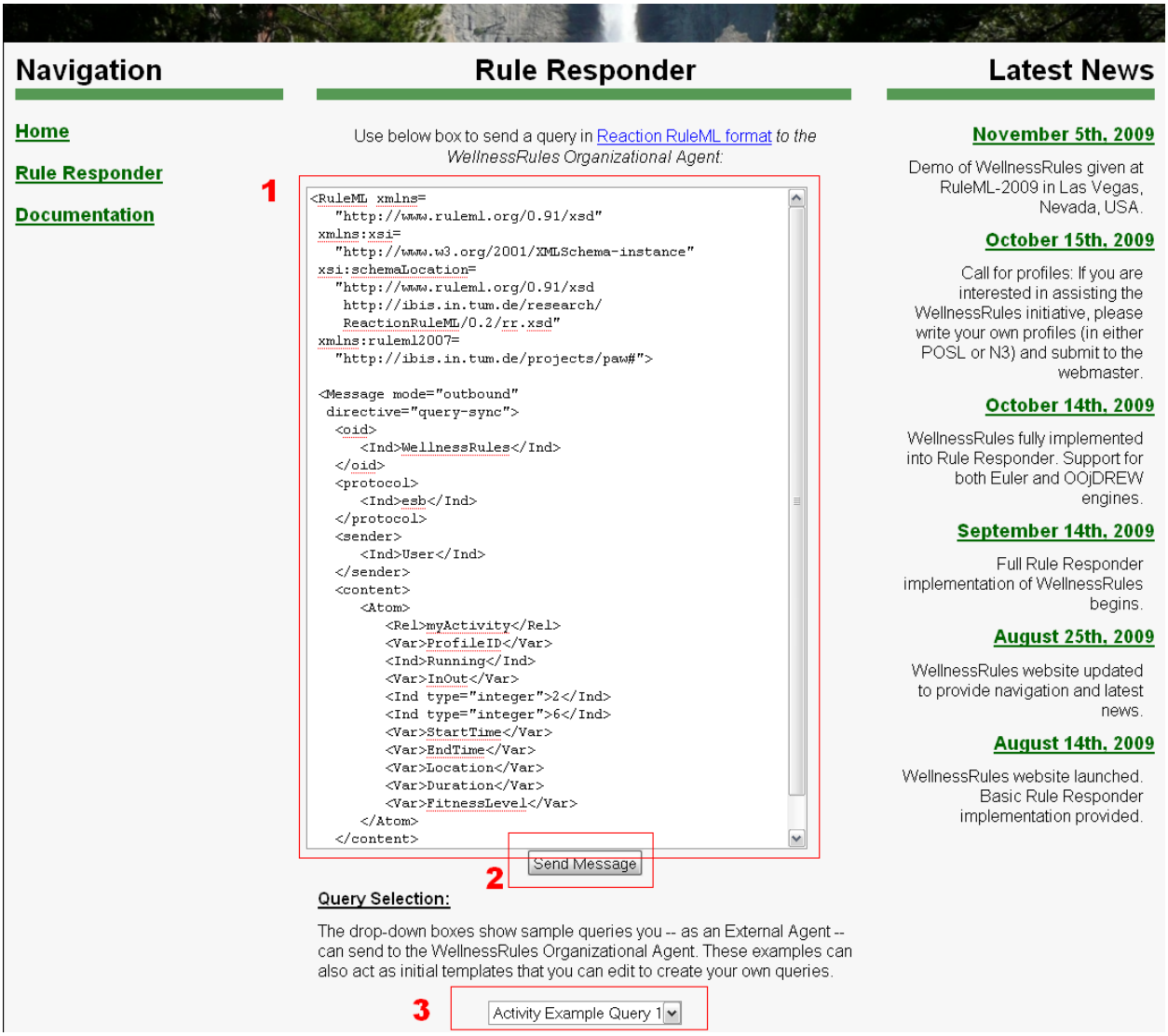
5 External Agents

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.

5.1 Websites

Rule Responder - Websites:

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



(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:IP:8888">
        <input name="Horde" value="3a466331bca877eeb014be19eee68790" type="hidden">
        <textarea name="box1" cols="57" rows="36" WRAP=OFF></textarea>
```

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=\"outbound\"" + "\n  " +
        "directive=\"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;
    }
```

5.2 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.
```

6 Instantiations

6.1 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.

6.1.1 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/oojdrew/**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. Foy 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.

6.2 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.

6.2.1 Knowledge Base Signatures

See Appendix A.1

6.3 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.

6.3.1 Knowledge Base Signatures

See Appendix A.2

6.4 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.

6.4.1 Knowledge Base Signatures

See Appendix A.3

7 Supported Reasoning Engines and Languages

7.1 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).

7.1.1 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.

7.1.2 Running OO jDREW Within Eclipse

Running OO jDREW Within Eclipse

1) To obtain OOjDREW, go to the OOjDREW downloads page (http://www.jdrew.org/oojdrew/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.

7.2 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.

7.2.1 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.

7.2.2 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 (Windows)

4) Download EulerSharp:
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.

8 RuleML Query Generation

8.1 Preliminaries

8.1.1 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. Sections 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.

8.1.2 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.

8.2 JavaScript

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

8.2.1 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.

8.2.2 Variable Functions

In this section, each RuleML query variable has a function associated with it. The naming scheme in this section is: *elementSelected***NameOfVariable***()*. 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.

8.2.3 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*.

8.2.4 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.

8.2.5 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).

8.3 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

8.4 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 modfications, 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.

8.5 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.

9 PatientSupporter Profile Generator

9.1 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.

9.2 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.

9.3 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.

10 Rule Responder Benchmarking Tool

10.1 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.

10.2 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.
```

```
-----------------------------
=============================================
```

10.3 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.

11 Troubleshooting Rule Responder Instantations

11.1 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.

11.2 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 ProvaUMOImpl.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.

11.3 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)

11.4 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).

11.5 Issues and Workarounds

Fixed (since December 16th, 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 15. 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 '.' Inbetween a type and its variable.
  - Reason:
    The XSLT translation was causing Prova to throw errors.
  - Location:
    PragmaticAgentWeb->src->main->resources->rml2prova.xsl

- Prova substitutions are currently hard-coded in the knowledge base, and would in theory require hundreds or thousands of rules.
  - 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.

  - 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)):-

- Typed variables are not recognized during ProvaToRuleML serialization. A special case was added which checks for '<' and ':' in the String, which should indiciate it is 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.
  - 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>

  - Location:
    PragmaticAgentWeb->src/main/java->ws.prova.mule.impl->Prova2RuleMLTranslator.java
    Method:
    private String serializeConstantTerm(Object ct, String spacer) {}

SymposiumPlanner - Workarounds and Not Yet Working:

Workarounds:

- Variables are excluded from complex terms.
  - Reason:
    Complex terms had variable names included, where non-complex terms do not. To be consistent this was removed.
  - 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.
  - 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.
  - Location:
    PragmaticAgentWeb->personalAgents->pa_WellnessRules2->MessageGenerator.java
    Method:
    public String[] Messages2() {}

- Rule Responder now creates the required query predicates to simulate the input of Min and Max RSVP.
  - 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.

  - **Location:**
    PragmaticAgentWeb->personalAgents->pa_WellnessRules2->N3Message.java
    Method:
    private String parseRuleMLQuery() {}

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.
  - 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.

  - 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.
  - 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.

  - 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.
  - 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) {}

WellnessRules 1 - Workarounds and Not Yet Working:

Workarounds:

- 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.

- 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.

- **Location (of N3 workaround):**
  oojdrew->src->default->N3Handler.java
  Method:
  public static Vector<String> parseRuleMLQuery(DefiniteClause ruleMLQuery) {}

- For N3 query parsing, type values are currently ignored. Types may be supported later with rdf:type.
  - Reason:
    N3 does not require type declaration for integers or literals.

  - 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) {}

Not Yet Working (i.e. no workaround either):

- Cannot provide duration values as constants.
  - Reason:
    A workaround can be created for N3 (similar to above, but recognizing the “integer” format), but POSL does not automatically place quotes around this constant, like it does to the other date-time.

Appendix A - Knowledge Base Signatures

WellnessRules

Note: With regards to N3 syntax, "_:" represents all instances of the subject. In actual implementation, the following format is used:

":subject_1 …."
":subject_2…."
Etc.

Season:

Defines the Season corresponding to the start time. Intended for use in a date-time system, but currently uses specific moment in time.

POSL Syntax:
season(?StartTime,?Season).

N3 Syntax:

```
_:season
        rdf:type        :Season;
        :startTime      ?StartTime;
        :value          ?Season.
```

Usage:
StartTime = The time of day that represents the season.
Season = The season corresponding to the StartTime.

Forecast:

Defines the weather corresponding to the type and start time. Intended for use in a date-time system, but currently uses specific moment in time.

POSL Syntax:
forecast(?StartTime,?Type,?Weather).

N3 Syntax:

```
_:forecast
        rdf:type        :Forecast;
        :startTime      ?StartTime;
        :aspect         ?Type;
        :value          ?Weather.
```

Usage:
StartTime = The time of day that represents the forecast.
Type = The type of weather forecast. Currently, types are **sky** or **temperature**.
Weather = The value corresponding to the sky or temperature at the given StartTime.
(i.e. sunny corresponds to sky. 27 corresponds to temperature).
Note: Temperature measured in **Celsius**

Meetup:

Defines the possible locations for individuals to "meet up" for their activities. Each location is tied to its map and activity type.

POSL Syntax:
meetup(?MapID,?Activity, ?Ambience,?Location).

N3 Syntax:
_:meetup
rdf:type :Meetup;
:mapID ?MapID;
:activity ?Activity;
:inOut ?Ambience;
:location ?Location.

Usage:
MapID = The map that the meetup location is assigned to. In order for profiles to share meetup locations, their MapID's must be the same.
Activity = The kind of activity being performed.
Ambience = Whether the activity is being performed inside or outside.
Location = The name of the meetup location.

GoodDuration:

Ideally, this would determine whether or not an activity can be carried out based on the event time differences and the duration, via date time functions. But as this is not realized, each event time is stored as fact to inform the knowledge base as to whether or not it is a suitable duration time for the event.

POSL Syntax:
goodDuration(?Duration,?StartTime,?EndTime).

N3 Syntax:
_:goodDuration
rdf:type :GoodDuration;
:duration ?Duration;
:startTime ?StartTime;
:endTime ?EndTIme.

Usage:
Duration = The duration of the activity.
StartTime = The start time of the event.
EndTime = The end time of the event.

Yesterday:

Again, because the date time implementation is not yet realized, a yesterday value must be manually assigned for each event that will use a rule utilizing the yesterday fact.

POSL Syntax:
yesterday(?StartTime,?StartTimeYDay,?EndTime,?EndTimeYDay).

N3 Syntax:
_:yesterday

rdf:type :Yesterday;
:startTime ?StartTime;
:startTimeYDay ?StartTimeYDay;
:endTime ?EndTime;
:endTimeYDay ?EndTimeYDay.

Usage:
StartTime = The start time.
StartTimeYDay = The previous day's start time.
EndTime = The end time.
EndTimeYDay = The previous day's end time.

Calendar:

Each individual profile has a calendar which will have activities (separated by types) penciled in at times of their choice.

POSL Syntax:
calendar(?ProfileID,?CalendarID).

N3 Syntax:
_:calendar
rdf:type :Calendar;
:profileID ?ProfileID;
:calendarID ?CalendarID.

Usage:
ProfileID = The profile identification tied to the calendar.
CalendarID = The calendar identification tied to the profile.

Events:

As a user performs events, or plans to perform events, they will be registered in the knowledge base as **Possible, Planned,** (**Performing**), or **Past** events. Possible events are events that do not have a specific activity assigned to them, but the user has indicated that he/she would like to perform an activity between the times registered. Planned refers to an event that has not happened yet, but has a specific activity assigned to it. Past events are events that have already occurred.

POSL Syntax:
event(?CalendarID,?Aspect,?Tense,?StartTime,?EndTime).

N3 Syntax:
_:event
rdf:type :Event;
:calendarID ?CalendarID;
:aspect ?Aspect;
:tense ?Tense;
:startTime ?StartTime;
:endTime ?EndTime.

Usage:
CalendarID = The calendar identification tied to the event.

Aspect = The type of event planned. Typically an activity.
Tense = Possible, Planned, or Past. (As described above).
StartTime = The start time of the event.
EndTime = The end time of the event.

Map:

Each individual can have multiple maps to use for their meet up locations (which would be based on where they intended to be for the time they have chosen).

POSL Syntax:
map(?ProfileID,?MapID).

N3 Syntax:

```
_:map
        rdf:type        :Map;
        :profileID      ?ProfileID;
        :mapID          ?MapID.
```

Usage:
ProfileID = The profile identification assigned to the map.
MapID = The map identification assigned to the profile.

Fitness:

A user will define their expected fitness levels (on a scale from 1-10) for each day or time, so that an appropriate activity and location can be chosen.

POSL Syntax:
fitness(?ProfileID,?StartTime,?ExpectedFitnessLevel).

N3 Syntax:

```
_:fitness
        rdf:type            :Fitness;
        :profileID          ?ProfileID;
        :startTime          ?StartTime;
        :expectedFitness    ?ExpectedFitnessLevel.
```

Usage:
ProfileID = The profile identification corresponding to the fitness level.
StartTime = The time of day when the user has the expected fitness level.
ExpectedFitnessLevel = The user's expected fitness level for that time of day (on a scale from 1-10).

Level:

Each location will have its own defined fitness level set by the user or calculated previously based on the duration of the activity. It will be unique to the individual, activity, and location. Again, duration is stored as date time but is not implemented, so strings must be matched identically.

POSL Syntax:
level(?ProfileID,?Activity,? Ambience,?Location,?Duration,?FitnessLevel).

N3 Syntax:

```
_:level
```

rdf:type :Level;
:profileID ?ProfileID;
:activity ?Activity;
:inOut ? Ambience;
:location ?Location;
:duration ?Duration;
:fitnessLevel ?FitnessLevel.

Usage:

ProfileID = The profile identification corresponding to the fitness level.
Activity = The type of activity being performed for the fitness level.
Ambience = Whether the activity is indoors or outdoors.
Location = The meet up location where the activity is being performed.
Duration = How long the activity is performed (recorded as date time).
FitnessLevel = The required fitness level required by the user for the corresponding values.

GroupSize:

Each user may define minimum and maximum extremes for the number of participants required in a group to corresponding to a specific activity. When activities are queried, the requested group min and max values are checked against the user's recorded preferences.

POSL Syntax:

groupSize(?ProfileID,?Activity,?Ambience,?Min,?Max).

N3 Syntax:

_:groupSize
rdf:type :GroupSize;
:profileID ?ProfileID;
:activity ?Activity;
:inOut ?Ambience;
:min ?Min;
:max ?Max.

Usage:

?ProfileID = The profile identification corresponding to the group size requirements.
?Activity = The activity for which the group size requirements are focused on.
?Ambience = Whether the activity is indoors or outdoors.
?Min = The minimum number of participants.
?Max = The maximum number of participants.

MyActivity:

The objective of the previous wellness rules is to accurately suggest a wellness activity to the user according to their profile preferences. Each activity's requirements can be described by the user, adding or removing as many as they like. Although, each activity must have certain base rules in order for them to follow the wellness profile schema.

POSL Syntax:

activity(?ProfileID,?Activity,?Ambience,?MinRSVP,?MaxRSVP,?StartTime,?EndTime,?Location,?Duration,?FitnessLevel).

N3 Syntax:

```
_: myActivity
        rdf:type        :MyActivity;
        :profileID      ?ProfileID;
        :activity       ?Activity
        :inOut          ? Ambience;
        :minRSVP        ?MinRSVP;
        :maxRSVP        ?MaxRSVP;
        :startTime      ?StartTime;
        :endTime        ?EndTime;
        :location ? Location;
        :duration       ?Duration;
        :fitnessLevel   ?FitnessLevel.
```

Usage:

ProfileID = The profile identification corresponding to the suggested activity.
Activity = The type of suggested activity determined.
Ambience = Whether the suggested activity is indoors or outdoors.
MinRSVP = Submitted minimum number of participants.
MaxRSVP = Submitted maximum number of participants.
StartTime = The start time of the suggested activity.
EndTime = The end time of the suggested activity.
Location = The meet up location for the suggested activity.
Duration = The duration of the suggested activity.
FitnessLevel = The required fitness level of the suggested activity.

Required Rules to Fit Schema:

```
calendar(p0001,?Calendar),
event(?Calendar,Run:Activity,possible,?StartTime,?EndTime),
participation(1:Integer,6:Integer,?MinRSVP,?MaxRSVP),
 map(p0001,?Map),
 meetup(?Map,run,out,?Place),
 level(p0001,run,out,?Place,?Duration,?Level),
greaterThanOrEqual(?ExpectedFitness,?Level),
goodDuration(?Duration,?StartTime,?EndTime.
```

* Many other rules can be implemented such as seasonal requirements, whether requirements, temperature requirements etc… *

Currently Used Activity Types:

Walk
Run
Swim
Skate
Yoga

Hike
Baseball

WellnessRules2

Note: With regards to N3 syntax, "_:" represents all instances of the subject. In actual implementation, the following format is used:

":subject_1 …."
":subject_2…."
Etc.

Season:

Defines the Season corresponding to the given time comprised of Month and Day.

POSL Syntax:
season(?StartDay, ?StartMonth, ?Season).

N3 Syntax:

```
_:season
        rdf:type        :Season;
        :day            ?StartDay;
        :month          ?StartMonth;
        :value          ?Season.
```

Usage:
StartDay = The day that represents the season.
StartMonth = The month that represents the season.
Season = The season corresponding to the StartTime.

Forecast:

Defines the weather corresponding to the type and start time.

POSL Syntax:
forecast(?Location, dateTime[?Year, ?Month, ?Day, ?Hour, ?Minute, ?Second),?Type,?Weather], ?LowTemp, ?HighTemp, ?AvgTemp, ?Conditions).

N3 Syntax:

```
_:forecast
        rdf:type        :Forecast;
        :location ?Location
        :dateTime       [rdf:type :DateTime;
                         :year ?Year;
                          :month ?Month;
                          :day ?Day;
                         :hour ?Hour;
                         :minute ?Minute];
        :lowTemp        ?LowTemp;
        :highTemp       ?HighTemp;
        :avgTemp        ?AvgTemp;
        :conditions     ?Conditions;
```

Usage:

Location: City for the forecast.
Year = The current year that represents the date of the forecast.
Month = The current month that represents the date of the forecast.
Day = The current day that represents the date of the forecast.
Hour = The time of day that represents the time of the forecast.
LowTemp= The lowest temperature during the forecasted day.
HighTemp= The highest temperature during the forecasted day.
AvgTemp= Average temperature for the forecasted day.
Conditions = The value corresponding to the sky at the given dateTime.

Note: Temperature measured in **Celsius**.

Meetup:

Defines the possible locations for individuals to "meet up" for their activities. Each location is tied to its map and activity type.

POSL Syntax:
meetup(?MapID,?Activity, ?Ambience,?Location).

N3 Syntax:

```
_:meetup
        rdf:type        :Meetup;
        :mapID          ?MapID;
        :activity       ?Activity;
        :inOut          ?Ambience;
        :location ?Location.
```

Usage:
MapID = The map that the meetup location is assigned to. In order for profiles to share meetup locations, their MapID's must be the same. Correlate to locations from forecast
Activity = The kind of activity being performed.
Ambience = Whether the activity is being performed inside or outside.
Location = The name of the meetup location.

GoodDuration:

This determines whether or not an activity can be carried out based on the event time differences and the duration, via date time functions.

POSL Syntax:
goodDuration(dateTime[?DurYear, ?DurMonth, ?DurDay, ?DurHour, ?DurMinute], dateTime[?StartYear, ?StartMonth, ?StartDay, ?StartHour, ?StartMinute], dateTime[?EndYear, ?EndMonth, ?EndDay, ?EndHour, ?EndMinute]).

N3 Syntax:

```
_:goodDuration
        rdf:type        :GoodDuration;
        :duration       [rdf:type :DateTime;
                         :year ?DurYear;
                         :month ?DurMonth;
                         :day ?DurDay;
```

```
                    :hour ?DurHour;
                    :minute ?DurMinute];
    :startDateTime  [rdf:type :DateTime;
                    :year ?StartYear;
                     :month ?StartMonth;
                    :day ?StartDay;
                    :hour ?StartHour;
                    :minute ?StartMinute];
    :endDateTime    [rdf:type :DateTime;
                    :year ?EndYear;
                    :month ?EndMonth;
                    :day ?EndDay;
                    :hour ?EndHour;
                    :minute ?EndMinute].
```

Usage:

DurYear = The number of years in the duration of the event.
DurMonth = The number of months in the duration of the event.
DurDay = The number of days of duration in the event….
DurHour = The number of hours of duration in the event.
DurMinutes = The number of minutes of duration in the event.
StartYear = The year for the starting date of the event.
StartMonth = The month for the starting date of the event.
StartDay = The day for the starting date of the event.
StartHour = The hour for starting time of the event.
StartMinute = The minute for starting time of the event.
EndYear = The year for the ending date of the event.
EndMonth = The month for the ending date of the event.
EndDay = The day for the ending date of the event.
EndHour = The hour for ending time of the event.
EndMinute = The minute for ending time of the event.

Yesterday:

The dateTime of the day before the specified dateTime. A yesterday value must be assigned for each event that will use a rule utilizing the yesterday fact.

POSL Syntax:

```
yesterday(dateTime[?Year, ?Month, ?Day, ?Hour, ?Minute]).
```

N3 Syntax:

```
_:yesterday
        rdf:type        :Yesterday;
        :dateTime       [rdf:type :DateTime;
                        :year ?Year;
                         :month ?Month;
                         :day ?Day;
                        :hour ?Hour;
                        :minute ?Minute];
```

Usage:
Year = The year for yesterday's date.
Month = The month for yesterday's date.
Day = The day for yesterday's date.
Hour = The hour for yesterday's time.
Minute = The minute for yesterday's time.

Calendar:

Each individual profile has a calendar which will have activities (separated by types) penciled in at times of their choice.

POSL Syntax:
calendar(?ProfileID,?CalendarID).

N3 Syntax:

```
_:calendar
        rdf:type        :Calendar;
        :profileID      ?ProfileID;
        :calendarID     ?CalendarID.
```

Usage:
ProfileID = The profile identification tied to the calendar.
CalendarID = The calendar identification tied to the profile.

Events:

As a user performs events, or plans to perform events, they will be registered in the knowledge base as **Possible, Planned,** (**Performing**), or **Past** events. Possible events are events that do not have a specific activity assigned to them, but the user has indicated that he/she would like to perform an activity between the times registered. Planned refers to an event that has not happened yet, but has a specific activity assigned to it. Past events are events that have already occurred.

POSL Syntax:
event(?CalendarID,?Aspect,?Tense, dateTime[?StartYear,?StartMonth, ?StartDay, ?StartHour, ?StartMinute], dateTime[?EndYear,?EndMonth, ?EndDay, ?EndHour, ?EndMinute]).

N3 Syntax:

```
_:event
        rdf:type        :Event;
        :calendarID     ?CalendarID;
        :aspect         ?Aspect;
        :tense          ?Tense;
        :startDateTime  [rdf:type :DateTime;
                        :year ?StartYear;
                        :month ?StartMonth;
                         :day ?StartDay;
                         :hour ?StartHour;
                        :minute ?StartMinute];
        :endDateTime    [rdf:type :DateTime;
```

:year ?EndYear;
:month ?EndMonth;
:day ?EndDay;
:hour ?EndHour;
:minute ?EndMinute];

Usage:
CalendarID = The calendar identification tied to the event.
Aspect = The type of event planned. Typically an activity.
Tense = Possible, Planned, or Past. (As described above).
StartYear = The year for the starting date of the event.
StartMonth = The month for the starting date of the event.
StartDay = The day for the starting date of the event.
StartHour = The hour for the starting time of the event.
StartMinute = The minute for the starting time of the event.
EndYear = The year for the ending date of the event.
EndMonth = The month for the ending date of the event.
EndDay= The day for the ending date of the event.
EndHour = The hour for the ending time of the event.
EndMinute = The minute for the ending time of the event.

Map:

Each individual can have multiple maps to use for their meet up locations (which would be based on where they intended to be for the time they have chosen).

POSL Syntax:
map(?ProfileID,?MapID).

N3 Syntax:
_:map
rdf:type :Map;
:profileID ?ProfileID;
:mapID ?MapID.

Usage:
ProfileID = The profile identification assigned to the map.
MapID = The map identification assigned to the profile.

Fitness:

A user will define their expected fitness levels (on a scale from 1-10) for each day or time, so that an appropriate activity and location can be chosen.

POSL Syntax:
fitness(?ProfileID, dateTime[?Year, ?Month, ?Day, ?Hour, ?Minute,],?ExpectedFitnessLevel).

N3 Syntax:
_:fitness

```
rdf:type            :Fitness;
:profileID          ?ProfileID;
:dateTime           [rdf:type :DateTime;
                    :Year ?DurYear;
                    :Month ?DurMonth;
                    :Day ?DurDay;
                    :Hour ?DurHour;
                    :Minute ?DurMinute];
:expectedFitness  ?ExpectedFitnessLevel.
```

Usage:

ProfileID = The profile identification corresponding to the fitness level.
Year = The year for the date of when the user has the expected fitness level.
Month = The month for the date of when the user has the expected fitness level.
Day = The day for the date of when the user has the expected fitness level.
Hour = The hour for the time of day when the user has the expected fitness level.
Minute = The minute for the time of day when the user has the expected fitness level.
ExpectedFitnessLevel = The user's expected fitness level for that time of day (on a scale from 1-10).

Level:

Each location will have its own defined fitness level set by the user or calculated previously based on the duration of the activity. It will be unique to the individual, activity, and location. Again, duration is stored as date time but is not implemented, so strings must be matched identically.

POSL Syntax:

level(?ProfileID,?Activity,? Ambience,?Location, dateTime[?Years, ?Months, ?Days, ?Hours, ?Minutes], ?FitnessLevel).

N3 Syntax:

```
_:level
        rdf:type        :Level;
        :profileID      ?ProfileID;
        :activity       ?Activity;
        :inOut          ? Ambience;
        :location?Location;
        :duration       [rdf:type :DateTime;
                        :year ?DurYear;
                        :month ?DurMonth;
                         :day ?DurDay;
                        :hour ?DurHour;
                        :minute ?DurMinute];
        :fitnessLevel   ?FitnessLevel.
```

Usage:

ProfileID = The profile identification corresponding to the fitness level.
Activity = The type of activity being performed for the fitness level.

Ambience = Whether the activity is indoors or outdoors.
Location = The meet up location where the activity is being performed.
DurYear = The number of years in the duration of the event.
DurMonth = The number of months in the duration of the event.
DurDay = The number of days of duration in the event.
DurHour = The number of hours of duration in the event.
DurMinutes = The number of minutes of duration in the event.
FitnessLevel = The required fitness level required by the user for the corresponding values..

GroupSize:

Each user may define minimum and maximum extremes for the number of participants required in a group to corresponding to a specific activity. When activities are queried, the requested group min and max values are checked against the user's recorded preferences.

POSL Syntax:
groupSize(?ProfileID,?Activity,?Ambience,?Min,?Max).

N3 Syntax:

```
_:groupSize
        rdf:type        :GroupSize;
        :profileID      ?ProfileID;
        :activity       ?Activity;
        :inOut          ?Ambience;
        :min            ?Min;
        :max            ?Max.
```

Usage:
?ProfileID = The profile identification corresponding to the group size requirements.
?Activity = The activity for which the group size requirements are focused on.
?Ambience = Whether the activity is indoors or outdoors.
?Min = The minimum number of participants.
?Max = The maximum number of participants.

MyActivity:

The objective of the previous wellness rules is to accurately suggest a wellness activity to the user according to their profile preferences. Each activity's requirements can be described by the user, adding or removing as many as they like. Although, each activity must have certain base rules in order for them to follow the wellness profile schema.

POSL Syntax:
activity(?ProfileID,?Activity,?Ambience,?MinRSVP,?MaxRSVP, startDateTime(?StartYear, ?StartMonth, ?StartDay, ?StartHour, ?StartMinute), ?EndDateTime(?EndYear, ?EndMonth, ?EndDay, ?EndHour, ?EndMinute) ,?Location, ?Duration, ?FitnessLevel).

N3 Syntax:
_: my*Activity*

```
rdf:type        :MyActivity;
:profileID      ?ProfileID;
:activity       ?Activity
:inOut          ? Ambience;
:minRSVP        ?MinRSVP;
:maxRSVP        ?MaxRSVP;
:startDateTime  [:year ?StartYear;
                :month ?StartMonth;
                 :day ?StartDay;
                 :hour ?StartHour;
                :minute ?StartMinute];
:endDateTime    [:year ?EndYear;
                :month ?EndMonth;
                 :day ?EndDay;
                 :hour ?EndHour;
                :minute ?EndMinute];
:location ? Location;
:duration       [:year ?DurYear;
                :month ?DurMonth;
                 :day ?DurDay;
                :hour ?DurHour;
                :minute ?DurMinute];
:fitnessLevel   ?FitnessLevel.
```

Usage:

ProfileID = The profile identification corresponding to the suggested activity.
Activity = The type of suggested activity determined.
Ambience = Whether the suggested activity is indoors or outdoors.
MinRSVP = Submitted minimum number of participants.
MaxRSVP = Submitted maximum number of participants.
StartYear = The year for the starting date of the event.
StartMonth = The month for the starting date of the event.
StartDay = The day for the starting date of the event.
StartHour = The hour for the starting time of the event.
StartMinute = The minute for the starting time of the event.
EndYear = The year for the ending date of the event.
EndMonth = The month for the ending date of the event.
EndDay= The day for the ending date of the event.
EndHour = The hour for the ending time of the event.
EndMinute = The minute for the ending time of the event.
Location = The meet up location for the suggested activity.
Duration = The duration of the suggested activity.
FitnessLevel = The required fitness level of the suggested activity.

Required Rules to Fit Schema:

```
calendar(p0001,?Calendar),
```

event(?Calendar,Run:Activity,possible,?StartTime,?EndTime),
participation(1:Integer,6:Integer,?MinRSVP,?MaxRSVP),
map(p0001,?Map),
meetup(?Map,run,out,?Place),
level(p0001,run,out,?Place,?Duration,?Level),
greaterThanOrEqual(?ExpectedFitness,?Level),
goodDuration(?Duration,?StartTime,?EndTime).

* Many other rules can be implemented such as seasonal requirements, whether requirements, temperature requirements etc… *

Currently Used Activity Types:

Walking
Running
Swimming
Skating
Yoga
Hiking
Baseball

Current Weather Conditions:

Sunny
Partly Sunny
Mostly Sunny
Clear
Cloudy
Partly Cloudy
Mostly Cloudy
Mist
Overcast
Dust
Fog
Smoke
Haze
Rain
Chance of Rain
Showers
Light Rain
Scattered Showers
Freezing Drizzle
Thunderstorm
Chance of TStorm
Scattered Thunderstorms
Snow
Sleet
Light Snow
Rain and Snow
Chance of Snow

Storm
Chance of Storm
Icy

PatientSupporter

PatientSupporter Rule Signatures (v1.0):

Note: With regards to N3 syntax, "_:" represents all instances of the subject. In actual implementation, the following format is used:

":subject_1 …."
":subject_2…."
Etc.

Age:

Identifies the user's age for each individual profile.

POSL Syntax:
age(?ProfileID,?Age).

N3 Syntax:
_:age
rdf:type :Age;
:profileID ?ProfileID;
:age ?Age.

Usage:
ProfileID = The profile the age pertains to.
Age = The age associated with the profile.

AgeGroup:

Used to check to see if a profile associated age is within the specified age group.

POSL Syntax:
ageGroup(?ProfileID,?MinAge,?MaxAge,?Age).

N3 Syntax:
_:ageGroup
rdf:type :AgeGroup;
:profileID ?ProfileID;
:injury ?Injury;
:minAge ?MinAge;
:maxAge ?MaxAge.

Usage:
ProfileID = The profile identification corresponding to the age group requirement.
Injury = The type of injury the age group requirement pertains to.
MinAge = The minimum age of patients allowed in the profile's group of the given injury type.
MaxAge = The maximum age of patients allowed in the profile's group of the given injury type.

Category:

Defines whether the user of the profile is either an outpatient or inpatient.

POSL Syntax:
category(?ProfileID,?Category).

N3 Syntax:
_:category
rdf:type :Category;
:profileID ?ProfileID;
:category ?Category.

Usage:
ProfileID = The profile which the category pertains to.
Category = The category that patient profile falls under.

Communication:

Specifies available communication channels that the user of the profile uses.

POSL Syntax:
communication(?ProfileID,?Channel).

N3 Syntax:
_:communication
rdf:type :Communication;
:profileID ?ProfileID;
:channel ?Channel;
:contact ?Contact.

Usage:
ProfileID = The profile identification corresponding to the communication channel contact.
Channel = The type of communication device or program.
Contact = The user name for the given channel.

Duration:

The user specifies in their profile what duration a particular kind of group meeting can last for them.

POSL Syntax:
duration(?ProfileID,?Injury,dateTime[?DurYear,?DurMonth,?DurDay,?DurHour,?DurMinute]).

N3 Syntax:
_:duration
rdf:type :Duration;
:profileID ?ProfileID;
:injury ?Injury;
:duration [rdf:type :DateTime;
:year ?DurYear;

:month ?DurMonth;
:day ?DurDay;
:hour ?DurHour;
:minute ?DurMinute].

Usage:

ProfileID = The profile identification which the duration pertains to.
Injury = The type of injury group the duration is meant for.
DurYear = The number of years in the duration.
DurMonth = The number of months in the duration.
DurDay = The number of days of duration.
DurHour = The number of hours of duration.
DurMinutes = The number of minutes of duration.

Events:

As a user performs events, or plans to perform events, they will be registered in the knowledge base as **Possible, Planned,** (**Performing**), or **Past** events. Possible events are events that do not have a specific injury assigned to them, but the user has indicated that he/she would like to perform a group meeting between the times registered. Planned refers to an event that has not happened yet, but has a specific injury assigned to it. Past events are events that have already occurred.

POSL Syntax:

event(?ProfileID,?Injury,?Tense, dateTime[?StartYear,?StartMonth, ?StartDay, ?StartHour, ?StartMinute], dateTime[?EndYear,?EndMonth, ?EndDay, ?EndHour, ?EndMinute]).

N3 Syntax:

_:event
rdf:type :Event;
:calendarID ?ProfileID;
:injury ?Injury;
:tense ?Tense;
:startDateTime [rdf:type :DateTime;
:year ?StartYear;
:month ?StartMonth;
:day ?StartDay;
:hour ?StartHour;
:minute ?StartMinute];
:endDateTime [rdf:type :DateTime;
:year ?EndYear;
:month ?EndMonth;
:day ?EndDay;
:hour ?EndHour;
:minute ?EndMinute];

Usage:

ProfileID = The profile identification tied to the event.
Injury = The type of injury the event is planned for.

Tense = Possible, Planned, or Past. (As described above).
StartYear = The year for the starting date of the event.
StartMonth = The month for the starting date of the event.
StartDay = The day for the starting date of the event.
StartHour = The hour for the starting time of the event.
StartMinute = The minute for the starting time of the event.
EndYear = The year for the ending date of the event.
EndMonth = The month for the ending date of the event.
EndDay= The day for the ending date of the event.
EndHour = The hour for the ending time of the event.
EndMinute = The minute for the ending time of the event.

Gender:

Identifies the user's gender for each individual profile.

POSL Syntax:
gender(?ProfileID,?Gender).

N3 Syntax:

```
_:gender
        rdf:type        :Gender;
        :profileID      ?ProfileID;
        :gender         ?Gender.
```

Usage:
ProfileID = The profile identication corresponding to the gender fact.
Gender = The gender associated with the profile.

GoodDuration:

This determines whether or not an event can be carried out based on the event time differences and the duration, via date time functions.

POSL Syntax:
goodDuration(?ProfileID, dateTime[?DurYear, ?DurMonth, ?DurDay, ?DurHour, ?DurMinute], dateTime[?StartYear, ?StartMonth, ?StartDay, ?StartHour, ?StartMinute], dateTime[?EndYear, ?EndMonth, ?EndDay, ?EndHour, ?EndMinute]).

N3 Syntax:

```
_:goodDuration
        rdf:type        :GoodDuration;
        :profileID      ?ProfileID;
        :duration       [rdf:type :DateTime;
                         :year ?DurYear;
                         :month ?DurMonth;
                         :day ?DurDay;
                         :hour ?DurHour;
                         :minute ?DurMinute];
```

:startDateTime [rdf:type :DateTime;
:year ?StartYear;
:month ?StartMonth;
:day ?StartDay;
:hour ?StartHour;
:minute ?StartMinute];
:endDateTime [rdf:type :DateTime;
:year ?EndYear;
:month ?EndMonth;
:day ?EndDay;
:hour ?EndHour;
:minute ?EndMinute].

Usage:

ProfileID = The profile identification corresponding to the duration check.
DurYear = The number of years in the duration of the event.
DurMonth = The number of months in the duration of the event.
DurDay = The number of days of duration in the event.
DurHour = The number of hours of duration in the event.
DurMinutes = The number of minutes of duration in the event.
StartYear = The year for the starting date of the event.
StartMonth = The month for the starting date of the event.
StartDay = The day for the starting date of the event.
StartHour = The hour for starting time of the event.
StartMinute = The minute for starting time of the event.
EndYear = The year for the ending date of the event.
EndMonth = The month for the ending date of the event.
EndDay = The day for the ending date of the event.
EndHour = The hour for ending time of the event.
EndMinute = The minute for ending time of the event.

GroupSize:

User specifies in their profile what range of group sizes they'd like to be in while participating in specific activities.

POSL Syntax:

groupSize(?ProfileID,?Injury,?Min,?Max).

N3 Syntax:

_:groupSize
rdf:type :groupSize;
:profileID ?ProfileID;
:injury ?Injury;
:min ?Min;
:max ?Max.

Usage:
ProfileID = The profile identification corresponding to the fitness level.
Injury = The type of injury the group size pertains to.
Min = The minimum amount of patients for a group of the given injury type.
Max = The maximum amount of patients for a group of the given injury type.

Healing Stage:

Indicates what stage the user's healing is at for each specific injury they have.

POSL Syntax:
healingStage(?ProfileID,?Injury,?HealingStage).

N3 Syntax:

```
_:healingStage
        rdf:type        :HealingStage;
        :profileID      ?ProfileID;
        :injury         ?Injury;
        :healingStage   ?HealingStage.
```

Usage:
ProfileID = The profile identification corresponding to the healing stage.
Injury = The type of injury the healing stage pertains to.
HealingStage = The current healing stage of the injury.

MyDiscussion:

The profile rule to determine if the search fits one of it's injury group requirements.

POSL Syntax:
myDiscussion(?ProfileID,?Injury:Type,?MinAge,?MaxAge,?MinRSVP,?MaxRSVP, ?Category, ?Treatment, ?HealingStage, dateTime[?StartYear,?StartMonth,?StartDay,?StartHour,?StartMinute], dateTime[?EndYear,?EndMonth,?EndDay,?EndHour,?EndMinute] , dateTime[?DurYear,?DurMonth,?DurDay,?DurHour,?DurMinute] , ?Channel,?Contact,?Gender, ?TimeZone).

N3 Syntax:

```
_:myDiscussion
        rdf:type            :MyDiscussion;
        :profileID          ?ProfileID;
        :injury             ?Injury;
        :minAge         ?MinAge;
        :maxAge         ?MaxAge;
        :minRSVP            ?MinRSVP;
        :maxRSVP            ?MaxRSVP;
        :category           ?Category;
        :treatment          ?Treatment;
        :healingStage       ?HealingStage;
```

```
:startDateTime      [rdf:type :DateTime;
                    :year ?StartYear;
                     :month ?StartMonth;
                    :day ?StartDay;
                    :hour ?StartHour;
                    :minute ?StartMinute];
:endDateTime        [rdf:type :DateTime;
                    :year ?EndYear;
                    :month ?EndMonth;
                    :day ?EndDay;
                    :hour ?EndHour;
                    :minute ?EndMinute];
:duration           [rdf:type :DateTime;
                    :year ?DurYear;
                    :month ?DurMonth;
                    :day ?DurDay;
                    :hour ?DurHour;
                    :minute ?DurMinute]
:channel        ?Channel;
:contact        ?Contact;
:gender             ?Gender;
:timeZone           ?TimeZone.
```

Usage:

ProfileID = The profile identification corresponding to the suggested injury event.
Injury = The type of injury that the group pertains to.
Category= The category of the group the duration is meant for.
MinAge = Minimum age of participants.
MaxAge = Maximum age of participants.
MinRSVP = Minimum number of participants.
MaxRSVP = Maximum number of participants.
StartYear = The year for the starting available date for the event.
StartMonth = The month for the starting date available for the event.
StartDay = The day for the starting date available for the event.
StartHour = The hour for the starting time available for the event.
StartMinute = The minute for the starting available time for the event.
EndYear = The year for the ending date available for the event.
EndMonth = The month for the ending date available for the event.
EndDay= The day for the ending date available for the event.
EndHour = The hour for the ending time available for the event.
EndMinute = The minute for the ending time available for the event.
DurYear = The number of years in the duration of the event.
DurMonth = The number of months in the duration of the event.
DurDay = The number of days of duration in the event.
DurHour = The number of hours of duration in the event.
DurMinutes = The number of minutes of duration in the event.
Channel = The type of communication device or program.

Contact = The user name for the given channel.
Gender = Gender of participants.
Time Zone = Time zone of participants.

Participation

Used to check to see if a profile associated groupSize requirements is within the specified group size.

POSL Syntax:
participation(?ProfileID,?Injury,?MinRSVP,?MaxRSVP).

N3 Syntax:
N/A

Usage:
ProfileID = The profile identification corresponding to the fitness level.
Injury = The type of injury that the group pertains to.
MinRSVP =The given minimum group size to compare against the profile's preferences.
MaxRSVP = The given maximum group size to compare against the profile's preferences.

TimeZone:

Identifies the user's time-zone for each individual profile.

POSL Syntax:
timezone(?ProfileID,?TimeZone).

N3 Syntax:

```
_:timeZone
        rdf:type  :TimeZone;
        :profileID        ?ProfileID;
        :timeZone         ?TimeZone.
```

Usage:
ProfileID = The profile identification which the time zone pertains to.
TimeZone = The time zone relevant to the profile.

Treatment:

Indicates what treatment the user is receiving for each specific injury they have.

POSL Syntax:
treatment(?ProfileID,?Injury,?Treatment).

N3 Syntax:

```
_:treatment
        rdf:type          :Treatment;
        :profileID        ?ProfileID;
        :treatment        ?Treatment.
```

Usage:

ProfileID = The profile identification corresponding to the fitness level.

Injury = The type of injury that the treatment pertains to.

Treatment = The treatment type of the given injury.

Currently Used Body Partonomy