

WellnessRules: The Activity Rule Responder

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Abstract. Rule Responder is an intelligent multi-agent infrastructure for collaborative teams and virtual communities. Within these communities, each participant can be assisted by a semi-automated agent which utilizes rules to respond to messages posed by users. Each Rule Responder instantiation uses three different kinds of agents: An Organizational Agent (OA), Personal Agents (PAs), and External Agents (EAs). This paper describes the implemented Rule Responder instantiation to WellnessRules, supporting online-interactive wellness communities. In WellnessRules, Rule Responder's OA, using the Prova engine, acts as the manager of the community, the PAs execute participants' local wellness rules, and the EAs facilitate Web-based interaction between participants and Rule Responder. Each PA is implemented as a Java servlet which can execute both the OO jDREW and Euler engines for POSL and N3 representations of knowledge bases, respectively.

1 Introduction

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 implemented with Rule Responder (RR) with the intention of forming an online-interactive wellness community. The goal of this system is the following. 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 [BOC09]. These wellness profiles can currently be written as either POSL or N3 rules, which are handled by the engines OO jDREW and Euler, respectively. Users are then able to send messages to WellnessRules, in the form of general or specific queries which use a RuleML subset for interchange. Profile rules may specify when a participant is able to perform a certain activity (e.g. Walking or Running), depending on the weather forecast, season, and time of day. Queries can be posed to these community profiles, and various activity groups of participants be formed. A number of sample queries is provided via the WellnessRules website¹. Such a query is delegated from the OA to the relevant PA. This PA then selects the wellness profile(s) of the appropriate participant(s), containing their preferences with regards to

¹ www.ruleml.org/WellnessRules/RuleResponder/

activity and nutrition. Finally, this knowledge is used to answer the query and send it back to the OA. The above website features live query-answer pairs.

2 Overview of Rule Responder

Rule Responder’s architecture realizes a system of Organizational Agents (OAs) and Personal Agents (PAs), accessed by External Agents (EAs), on top of an Enterprise Service Bus (ESB) communication middleware [Cra08]. Using a hub and spoke architecture style, each OA is able to communicate with every PA in its organization, which in turn allows the user access to the relevant knowledge base. In this implementation of Rule Responder, there exists a single OA with as many PAs as needed. An EA, or user of this system, interacts via a Web-based GUI, which uses the HTTP protocol to send and receive messages (in this case, using the WellnessRules website [WRW]). The OA is the delegator of messages sent to the organization. Using a role assignment matrix (implemented by an OWL ontology) and a Prova knowledge base, it assesses the incoming message, and determines the appropriate PA for its destination. The rule-based PAs represent, as their ‘dynamic profiles’, all of the participating human members of the virtual organization modeled by Rule Responder [Cra08]. The communication middleware used by Rule Responder is an efficient and open source ESB called Mule; it acts as the link between Rule Responder and the user. It allows connection through various protocols such as JMS, HTTP, and SOAP, which in turn permits the communication between many sorts of software such as web-pages, servlets, and rule engines. The role of the EA is to interact with this communication middleware through the API (in the form of a website), which will transfer the message to and from various parts of Rule Responder.

3 Implementation of Distributed WellnessRules Using Rule Responder

Through Rule Responder’s system of PAs, OAs, and EAs, WellnessRules’ wellness community will be fully realized. WellnessRules extends the hub and spoke architecture of Rule Responder such that an OA not only accesses responsible PAs, but also the PAs select (wellness) profiles of participants in the community (see Fig. 1).

So, although WellnessRules is similar to other systems which use Rule Responder, there are major differences and advancements. SymposiumPlanner², an earlier instantiation of Rule Responder, uses the same hub and spoke architecture. The main difference is that the current SymposiumPlanner assists only symposium chairs (not normal participants), while the current WellnessRules only supports normal participants (later also supporting wellness coaches). A slight deviation from the initial concept of RR is the addition of categories for PAs: the OA has the option of either accessing Activity or Nutrition PAs, which

² www.ruleml.org/RuleML-2009/RuleResponder

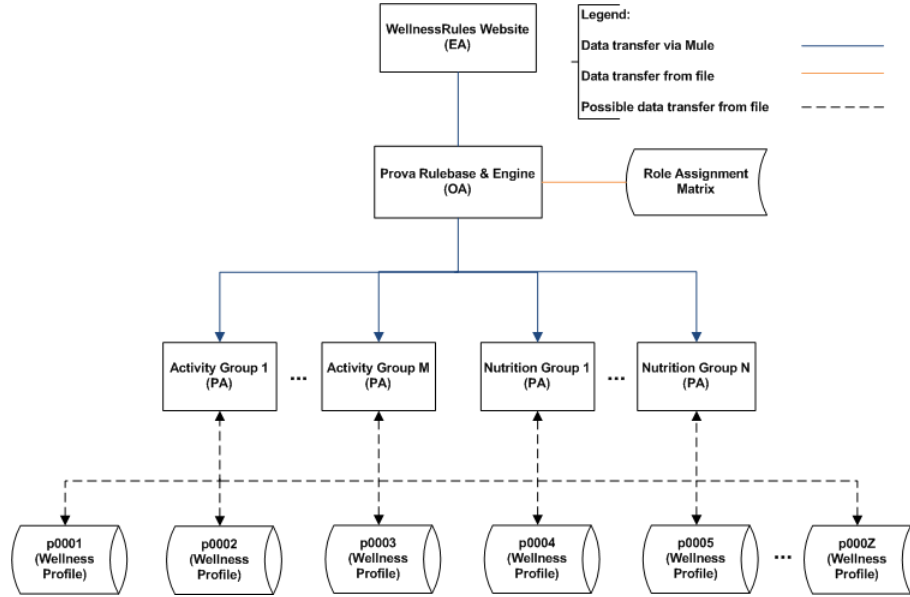


Fig. 1. WellnessRules EA/OA/PA architecture.

makes finding the appropriate agent more efficient. Of course, each agent has a well-defined role in WellnessRules, which is as follows.

The OA is the moderator of the wellness community; it has knowledge of which PAs are responsible for specific activities or nutritional preferences in the community. The PAs themselves are differentiated through Activity and Nutrition topics. For example, an Activity Group PA may be responsible for multiple activities (e.g. Walking and Running), or may be more selective and cover only a single activity (e.g. Skating). Finally, the EA is represented through the WellnessRules website [WRW], which can be viewed in appendix B. Through this interface, the user is able to type their query (represented in RuleML format) and send it through the ESB to the OA by hitting the ‘Send Message’ button. In addition to this, sample queries are provided, which can be used as templates where certain values may be modified to make them specific to the user (e.g. a profile ID).

4 Example Usage of WellnessRules

The following is an example usage of the WellnessRules system, which covers the process from the user issuing a query, to the obtained end result. Using the previously shown Web interface, participants issue queries in RuleML format to the OA of the wellness community. The following is a small RuleML example of such a query:

```

<Atom>
  <Rel>myActivity</Rel>
  <Var>ProfileID</Var>
  <Ind>Running</Ind>
  <Var>InOut</Var>
  <Ind type="integer">1</Ind>
  <Ind type="integer">5</Ind>
  <Var>StartTime</Var>
  <Var>EndTime</Var>
  <Var>Location</Var>
  <Var>Duration</Var>
  <Var>FitnessLevel</Var>
</Atom>

```

The relation name of the query is `myActivity`, with variables `ProfileID`, `InOut`, `StartTime`, `EndTime`, `Location`, `Duration`, and `FitnessLevel` (to be bound by the query). The constants provided are `Running`, and the integers 1 and 5. In English, this query can be summarized as the following question to the wellness community: *Is anyone interested in general Running (indoors or outdoors), with one to five people, for any (start and end) time, location, duration, and fitness level?*

This query is passed to the OA, which uses its Prova knowledge base³, to handle it via the following reaction rule:

```

processMessage(XID,From,Primitive,
  myActivity(ProfileID,Activity,InOut,MinRSVP,MaxRSVP,
    StartTime,EndTime,Location,Duration,FitnessLevel)) :-

```

The `myActivity` argument in the rule represents the query that was explained earlier, while the remaining information is given via the full query found in appendix A.1. Prova then looks up the responsible PA for the query which is found through the OWL ontology, located on the Web⁴. The agent in question is the PA named ‘wellnessRules_Running’, which is responsible for all Running activities. This agent is defined via a Java servlet, which will receive an HTTP message through the ESB (Mule), and via its various methods, retrieve all relevant information for Running. This process involves selecting the required profile knowledge bases (in this case, those which pertain to Running activities within the wellness community), and issuing the query to either OO jDREW (for POSL files) or Euler (for N3 files). Example knowledge bases for p0001 are represented in both POSL⁵ and N3⁶ online. The answers of all PAs are collected and sent back through the ESB to the OA, which then sends them back to the website/user. A sample of such an answer is the following, with the full version being found in appendix A.2:

³ <http://ruleml.org/WellnessRules/files/WellnessRules-Responder.prova>

⁴ www.ruleml.org/WellnessRules/files/WellnessRules.owl

⁵ <http://ruleml.org/WellnessRules/PA/p0001.posl>

⁶ <http://ruleml.org/WellnessRules/PA/p0001.n3>

```

<Atom>
  <Rel>myActivity</Rel>
  <Ind>p0001</Ind>
  <Ind>Running</Ind>
  <Ind>in</Ind>
  <Ind type="integer">1</Ind>
  <Ind type="integer">5</Ind>
  <Ind>2009-06-10T10:15:00</Ind>
  <Ind>2009-06-10T11:15:00</Ind>
  <Ind>joesGym</Ind>
  <Ind>P10M</Ind>
  <Ind type="integer">5</Ind>
</Atom>

```

Even a single PA can provide multiple answers, but we will consider the above one in particular. This answer tells the user that participant p0001 is interested in going for an indoor run at Joe's Gym between the times of 10:15 and 11:15 on June 10th, for 10 minutes, which will have a difficulty/fitness level of 5. The answer was inferred via Euler's execution on p0001's N3 knowledge base, while answers for other participants may be obtained by OO jDREW through knowledge bases written in POSL. The WellnessRules architecture thus makes users independent from any specific language such as POSL or N3.

5 Conclusion

Rule Responder has been used to implement a number of use cases, including the RuleML-2007/2008/2009 symposium organization and the W3C Health and Life Science (HCLS) [Cra08]. With the new system, WellnessRules, Rule Responder's usefulness has been realized even further. Through it, WellnessRules has the ability to support an online-interactive community, which will assist participants in reaching their healthy-lifestyle goals. This is done via an extended hub and spoke architecture of the agent-oriented Rule Responder system, allowing WellnessRules to connect participants in the community. We plan to further improve WellnessRules, e.g. by adding more supported rule languages and/or engines and a full-fledged graphical user interface.

References

- [BOC09] Harold Boley, Taylor Michael Osmun, and Benjamin Larry Craig. WellnessRules: A Web 3.0 Case Study in RuleML-Based Prolog-N3 Profile Interoperation. 2009.
- [Cra08] Benjamin Larry Craig. Deploying a Distributed Symposium Planner Through Rule Responder. 2008.
- [KBs] <http://www.ruleml.org/WellnessRules/PA>.
- [WRW] <http://www.ruleml.org/WellnessRules/RuleResponder>.

A Sample Query and Result

The below sample query and result are full listings, corresponding to the paper-specific example.

A.1 Full Example RuleML/XML Query

Sample queries are provided online through the EA http interface at the WellnessRules website [WRW].

```

<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 mode="outbound"
  directive="query-sync">
  <oid>
    <Ind>WellnessRules</Ind>
  </oid>
  <protocol>
    <Ind>esb</Ind>
  </protocol>
  <sender>
    <Ind>User</Ind>
  </sender>
  <content>
    <Atom>
      <Rel>myActivity</Rel>
      <Var>ProfileID</Var>
      <Ind>Running</Ind>
      <Var>InOut</Var>
      <Ind type="integer">1</Ind>
      <Ind type="integer">5</Ind>
      <Var>StartTime</Var>
      <Var>EndTime</Var>
      <Var>Location</Var>
      <Var>Duration</Var>
      <Var>FitnessLevel</Var>
    </Atom>
  </content>
</Message>
</RuleML>

```

A.2 Full Example RuleML/XML Solution

This is one of the results that are generated online through the EA http interface at the WellnessRules website [WRW], answered using both POSL and N3 knowledge bases [KBs].

```
<?xml version="1.0" encoding="UTF-8"?>
<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">

  <Message mode="outbound" directive="answer">
    <oid>
      <Ind>RuleResponder@iitfrdextdev01.iit-iti.priv236</Ind>
    </oid>
    <protocol>
      <Ind>esb</Ind>
    </protocol>
    <sender>
      <Ind>RuleResponder</Ind>
    </sender>
    <content>
      <Atom>
        <Rel>myActivity</Rel>
        <Ind>p0001</Ind>
        <Ind>Running</Ind>
        <Ind>in</Ind>
        <Ind type="integer">1</Ind>
        <Ind type="integer">5</Ind>
        <Ind>2009-06-10T10:15:00</Ind>
        <Ind>2009-06-10T11:15:00</Ind>
        <Ind>joesGym</Ind>
        <Ind>P10M</Ind>
        <Ind type="integer">5</Ind>
      </Atom>
    </content>
  </Message>
</RuleML>
```

B WellnessRules Interface: Website

The below website [WRW] is the main interface for user interaction with WellnessRules.



Navigation

- [WellnessRules Home](#)
- [Rule Responder](#)

WellnessRules - The Activity Rule Responder

Use below box to send a query in [Reaction RuleML format](#) to the *WellnessRules Organizational Agent*.

Latest News

[October 15th, 2009](#)
Call for profiles: If you are interested in assisting the WellnessRules initiative, please write your own profiles (in either POSL or N3) and submit to the webmaster.

[October 14th, 2009](#)
WellnessRules fully implemented into Rule Responder. Support for both Euler and OODJREW engines.

[September 14th, 2009](#)
Full Rule Responder implementation of WellnessRules begins.

[August 25th, 2009](#)
WellnessRules website updated to provide navigation and latest news.

[August 14th, 2009](#)
WellnessRules website launched. Basic Rule Responder implementation provided.

```

<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 mode="outbound"
    directive="query-sync">
    <oid>
      <Ind>WellnessRules</Ind>
    </oid>
    <protocol>
      <Ind>esb</Ind>
    </protocol>
    <sender>
      <Ind>User</Ind>
    </sender>
    <content>
      <Atom>
        <Rel>myActivity</Rel>
        <Ind>p0001</Ind>
        <Ind>Running</Ind>
        <Var>InOut</Var>
        <Ind type="integer">1</Ind>
        <Ind type="integer">5</Ind>
        <Ind>2009-06-15T10:15:00</Ind>
        <Ind>2009-06-15T11:15:00</Ind>
        <Var>Location</Var>
        <Var>Duration</Var>
        <Var>FitnessLevel</Var>
      </Atom>
    </content>
  </Message>
  
```

Query Selection:

The drop-down boxes show sample queries you -- as an External Agent -- can send to the WellnessRules Organizational Agent. These examples can also act as initial templates that you can edit to create your own queries.

English Description:

Is p0001 interested in general Running, with one to five people, between 10:15AM and 11:15AM on June 15th, 2009?