A Wiki for Executable Open Vocabulary English

with an example semantically linking DOE data

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Presentation for the W3C eGov Virtual Meeting

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Agenda

• Making smart connections
  – Apps connect people and data

• A wiki for content in open vocabulary, Executable English
  – write applications as rules in English, run them, and get explanations

• An example semantically linking DOE and other data
  – energy independence

• Summary
Making Smart Connections

Good things happen when we make smart connections:

Software-------- Linux ------------------------hardware

People-------- Google ------------------------all the web pages on the net

Buyers-------- Ebay -------------------------sellers

People-------- Executable English Apps --------open networked data
Making Smart Connections

data.gov

data.gov has about 400,000 datasets

- Raw data in many different formats
- Plus many data extraction tool UIs
- Mostly useful only to developers
- More than 1,000 apps and counting

Applications assign useful *meaning* to data
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  – energy independence

• Summary
A Wiki for content in executable open vocabulary English

If we replace imported oil with wind energy then we could save.... based on this data

Semantics3

Wants Business Rules in open vocabulary English Directly into a browser

Runs the Rules Using the browser

Sees English explanations of the Results

End User / Business Analyst
A Wiki for content in executable open vocabulary English

If we replace imported oil with wind energy then we could save.... based on this data

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Semantics3

Writers Business Rules in open vocabulary English Directly into a browser

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Semantics2

Theory of Declarative Knowledge

Programmer
If we replace imported oil with wind energy then we could save.... based on this data.

Semantics3

Internet Business Logic

Application Independent Engine

End User / Business Analyst

Theory of Declarative Knowledge

Programmer
A Wiki for content in executable open vocabulary English

How much can we save in 2030 by switching to …?

End User / Business Analyst

Semantics3

Internet Business Logic

Application Independent Engine

SQL

RDF

Semantics1

Theory of Declarative Knowledge

Programmer
A Wiki for content in executable open vocabulary English

- The vocabulary is open, and so -- to a large extent -- is the syntax
  - *not* yet-another-controlled-English-system
- No dictionary or grammar maintenance is needed
- Strict English semantics is achieved via a trade off
  - if you want two English sentences to mean the same thing, you must say so
  - you must use place holders, such as “some-name” and “a-number”
- But, you are free to write executable English knowledge containing...
  - technical terms or jargon -- Wildcat, Upstream, Mud (oil industry)
  - government acronyms and usage -- SRB, Single Regeneration Budget
  - logical expressions -- (A c,t) [ that-C c t => (E c1) [ that-C1 c1 t and c partof c1 at t ] ]
- Although the system is open vocabulary, it can be used to query and manage:
  - controlled vocabularies, taxonomies and ontologies
  - Data in RDF (Resource Description Format) – single table with 3 columns
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• Summary
Semantically linking DOE and other data

Potential savings from energy independence

Data from DOE and other sources

Levelized Cost Comparison for New Generating Capacity in the United States
(2004 Dollars per Megawatthour)

<table>
<thead>
<tr>
<th>Cost Element</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Wind</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>30.4</td>
<td>11.4</td>
<td>40.7</td>
<td>42.7</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>4.7</td>
<td>1.4</td>
<td>8.3</td>
<td>7.8</td>
</tr>
<tr>
<td>Fuel</td>
<td>14.5</td>
<td>36.9</td>
<td>0.0</td>
<td>6.6</td>
</tr>
<tr>
<td>Total</td>
<td>53.1</td>
<td>52.5</td>
<td>55.8</td>
<td>59.3</td>
</tr>
</tbody>
</table>

-- www.eia.doe.gov/iaaf/archive/ieo06/special_topics.html

Some corresponding Internet Business Logic facts:

estimated cost of electricity from this-source is this-amount $/MWh

coal 53.1
natural gas 52.5
wind 55.8
nuclear 59.3
Semantically linking DOE and other data

Potential savings from energy independence

Data from DOE and other sources, plus a simple classification

Internet Business Logic facts:

<table>
<thead>
<tr>
<th>this-fuel</th>
<th>this-type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation Gasoline</td>
<td>Liquids</td>
</tr>
<tr>
<td>Coal Anthracite</td>
<td>Coal</td>
</tr>
<tr>
<td>Coal Bituminous</td>
<td>Coal</td>
</tr>
<tr>
<td>Coal Lignite</td>
<td>Coal</td>
</tr>
<tr>
<td>Coal Subbituminous</td>
<td>Coal</td>
</tr>
<tr>
<td>Distillate Fuel Oil and Diesel</td>
<td>Liquids</td>
</tr>
<tr>
<td>Flare Gas</td>
<td>Natural Gas</td>
</tr>
</tbody>
</table>
Semantically linking DOE and other data

Potential savings from energy independence

Data from DOE and other sources

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**Table A3. Energy Prices by Sector and Source**

(2007 Dollars per Million Btu, Unless Otherwise Noted)

<table>
<thead>
<tr>
<th>Sector and Source</th>
<th>Reference Case</th>
<th>Annual Growth 2007-2030 (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Liquefied Petroleum Gases</td>
<td>23.88</td>
<td>24.96</td>
</tr>
<tr>
<td>Distillate Fuel Oil</td>
<td>18.46</td>
<td>19.66</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>12.70</td>
<td>12.80</td>
</tr>
<tr>
<td>Electricity</td>
<td>31.21</td>
<td>31.19</td>
</tr>
<tr>
<td>Commercial Liquefied Petroleum Gases</td>
<td>21.20</td>
<td>23.04</td>
</tr>
<tr>
<td>Distillate Fuel Oil</td>
<td>15.02</td>
<td>16.05</td>
</tr>
<tr>
<td>Residual Fuel Oil</td>
<td>8.88</td>
<td>10.21</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>11.05</td>
<td>10.96</td>
</tr>
<tr>
<td>Electricity</td>
<td>28.38</td>
<td>28.07</td>
</tr>
</tbody>
</table>

Corresponding Internet Business Logic facts:

```
this-group  this-fuel  this-06 this-07 this-10 this-15 this-20 this-25 this-30 ($/MillionBtu)
-----------------------------------------------
Residential Liquefied Petroleum Gases 23.88 24.96 24.79 32.03 32.52 33.39 34.92
Residential Distillate Fuel Oil 18.46 19.66 17.74 23.46 24.12 24.97 26.71
Residential Natural Gas 13.70 12.69 11.96 11.97 12.50 13.05 14.33
Residential Electricity 31.21 31.19 30.75 31.76 32.70 34.06 35.90
Commercial Distillate Fuel Oil 15.02 16.05 15.22 21.50 22.06 22.93 24.70
Commercial Residual Fuel Oil 8.88 10.21 10.34 16.01 16.66 17.05 17.99
Commercial Electricity 28.38 28.07 27.14 27.11 28.12 29.25 31.10
```
Semantically linking DOE and other data

Potential savings from energy independence

An Executable English rule that semantically links DOE data

as a step towards energy independence, the US would like to reduce oil imports by some-number barrels per year
to convert from Quadrillion Btu to barrels of gasoline, multiply by some-factor
that-number / that-factor = some-quadrillion-btu
to change Quadrillion Btu to gigawatt-hours, multiply by some-btu-gwh-factor
those-quadrillion-btu * that-btu-gwh-factor = some-number-gigawatt-hours
that-number-gigawatt-hours * 1000 = some-number-megawatt-hours
estimated cost of electricity from some-source is some-quantity $/MWh <---- DOE data
that-number-megawatt-hours * that-quantity = some-$amount
that-$amount / 1000000000 = some-long-amount
that-long-amount rounded to 1 place(s) after the decimal point is an-amount

----------------------------------------------------------------------------------------------------------------------------------------------------------
the US could replace imported oil with energy from that-source costing that-amount billion $ per year
Semantically linking DOE and other data

Potential savings from energy independence

The rule in an editable web page

```
as a step towards energy independence, the US would like to reduce oil imports by some-number barrels per year to convert from Quadrillion Btu to barrels of gasoline, multiply by some-factor
that-number / that-factor = some-quadrillion-btu
to change Quadrillion Btu to gigawatt-hours, multiply by some-btu-gwh-factor
those-quadrillion-btu * that-btu-gwh-factor = some-number-gigawatt-hours
that-number-gigawatt-hours * 1000 = some-number-megawatt-hours
estimated cost of electricity from some-source is some-quantity $/MWh according to some-reference (includes cap that-number-megawatt-hours * that-quantity = some-$amount
that-$amount / 1000000000 = some-long-amount
that-long-amount rounded to 1 place(s) after the decimal point is an-amount

the US could replace imported oil with energy from that-source costing that-amount billion $ per year
```

To view, edit and run this example, go to www.reengineeringllc.com and select EnergyIndependence1
Semantically linking DOE and other data

Potential savings from energy independence

Question menu, generated from the rules

EnergyIndependence1 Question Menu

Type a question here, then press Enter to reorder the menu

or select a question from the menu below:

- switching from imported oil to energy from some-source could potentially save the US some-number billion $ per year by 2030
- the US could replace imported oil with energy from some-source costing some-amount billion $ per year as a step towards energy independence, the US would like to reduce the cost of oil imports by some-total billion 2007 $ by 2030 as a step towards energy independence, the US would like to reduce oil imports by some-number barrels per year to convert from Quadrillion Btu to barrels of gasoline, multiply by some-factor to change Quadrillion Btu to gigawatt-hours, multiply by some-btu-gwh-factor liquid fuel has an average price of some-amount in 2030 (2007 $ per Million Btu) the US would like to reduce oil imports from some-country by some-amount barrels per year some-fuel of type Liquids is priced at some-price in 2030 (2007 $ per Million Btu) some-fuel of type Liquids is priced at some-price1 in 2007 and at some-price in 2030 (2007 $ per Million Btu) some-group some-fuel is priced at some-price1 in 2007 and at some-price2 in 2030 (2007 $ per Million Btu) adding some-number1 to some-number2 and rounding to 1 place gives some-number

To view, edit and run this example, go to www.reengineeringllc.com and select EnergyIndependence1
Semantically linking DOE and other data

Potential savings from energy independence

Selected question

EnergyIndependence1 Question Menu

Help  Select a Question to Ask  Go

Type a question here, then press Enter to reorder the menu

or select a question from the menu below:

- switching from imported oil to energy from some-source could potentially save the US some-number billion $ per year by 2030
- the US could replace imported oil with energy from some-source costing some-amount billion $ per year
- as a step towards energy independence, the US would like to reduce oil imports by some-number barrels per year
- to convert from Quadrillion Btu to barrels of gasoline, multiply by some-factor
- to change Quadrillion Btu to gigawatt-hours, multiply by some-btu-gwh-factor
- liquid fuel has an average price of some-amount in 2030 (2007 $ per Million Btu)
- the US would like to reduce oil imports from some-country by some-amount barrels per year
- some-fuel of type Liquids is priced at some-price in 2030 (2007 $ per Million Btu)
- some-fuel of type Liquids is priced at some-price1 in 2007 and at some-price in 2030 (2007 $ per Million Btu)
- some-group some-fuel is priced at some-price1 in 2007 and at some-price2 in 2030 (2007 $ per Million Btu)
- adding some-number1 to some-number2 and rounding to 1 place gives some-number

To view, edit and run this example, go to www.reengineeringllc.com and select EnergyIndependence1
Semantically linking DOE and other data

Potential savings from energy independence

Specialization menu, generated from the rules

To view, edit and run this example, go to www.reengineeringllc.com and select EnergyIndependence1
Semantically linking DOE and other data

Potential savings from energy independence

Answer

<table>
<thead>
<tr>
<th>EnergyIndependence1 Answer (4 rows found)</th>
<th>Printer friendly version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help</td>
<td>Go to the Question Menu</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>switching from imported oil to energy from this-source could potentially save the US this-number billion $ per year by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>coal</td>
</tr>
<tr>
<td>natural gas</td>
</tr>
<tr>
<td>nuclear</td>
</tr>
<tr>
<td>wind</td>
</tr>
</tbody>
</table>

To view, edit and run this example, go to www.reengineeringllc.com and select EnergyIndependence1 20
Semantically linking DOE and other data
Potential savings from energy independence

Explanation -- hypertexted

as a step towards energy independence, the US would like to reduce the cost of oil imports by 414,647 billion 2007 $ by 2030
the US could replace imported oil with energy from coal costing 168.1 billion $ per year
414.647 - 168.1 = 246.547
246.547 rounded to 1 place(s) after the decimal point is 246.5

switching from imported oil to energy from coal could potentially save the US 246.5 billion $ per year by 2030

as a step towards energy independence, the US would like to reduce oil imports by 192,823,200 barrels per year
to convert from Quadrillion Btu to barrels of gasoline, multiply by 1.78571e+08
1928232000 / 1.78571e+08 = 10.7981
liquid fuel has an average price of 38.4 in 2030 (2007 $ per Million Btu)
38.4 * 1000000000 = 3.84e+10
10.7981 * 3.84e+10 = 4.14647e+11
4.14647e+11 / 1000000000 = 414.647

as a step towards energy independence, the US would like to reduce the cost of oil imports by 414,647,009,280,000,01 billion 2007 $ by 2030

To view, edit and run this example, go to www.reengineeringllc.com and select EnergyIndependence1
Semantically linking DOE and other data

Data Sources Used

www.eia.doe.gov/oiaf/aeo/pdf/appa.pdf

tonto.eia.doe.gov/dnav/pet/pet_move_impCUS_a2_nus_ep00_im0_mbbl_m.htm

www.eia.doe.gov/oiaf/archive/ieo06/special_topics.html

www.physics.uci.edu/~silverma/units.html

this-fuel can be classified as being of type this-type

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Category</th>
</tr>
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<tr>
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<td>Flare Gas</td>
<td>Natural Gas</td>
</tr>
</tbody>
</table>
Google indexes and searches applications that are written in English

**Search:** for estimated demand that-id fraction of the order

---

**Web**

Results 1 - 10 of about 679 for *for estimated demand that-id fraction of the order*. (0.33 seconds)

Did you mean: *for estimated demand that-is fraction of the order*

Scholarly articles for *for estimated demand that-id fraction of the order*

- Data-Driven and Demand-Driven Computer Architecture - by Treleaven - 102 citations
- Budget constrained frontier measures of fiscal equality... - by Grosskopf - 48 citations
- Underinvestment, Debt Financing, and Long-Term Supplier... - by Subramaniam - 1 citations

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An Oil Industry Supply Chain Example Version 20050524 | | You can...

... in some-month of some-year for estimated demand that-id some-fraction of the order will be some-product from some-refinery that-quantity * that-fraction ...

www.reengineeringllc.com/demos_agent/Oil_IndustrySupplyChain1.agent 71k Cached Similar pages

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[PDF] Oil Industry Supply Chain Management Using English Business Rules...

File Format: PDF/Adobe Acrobat - View as HTML

for estimated demand that-id some-fraction of the order will be some-product from some-refinery that-quantity * that-fraction = some-amount...

www.reengineeringllc.com/Oil_Industry Supply Chain by_Kowalski_and_Walker.pdf - Similar pages
Google indexes and searches applications that are written in English.

**Search:** for estimated demand that-id fraction of the order

The executable English rules and facts that define the application.

A paper that describes the application.
Summary

• Making smart connections
  – apps connect people and data

• A wiki for content in Executable open vocabulary English
  – socially write apps in English using a browser
  – run the apps, and get explanations, again using a browser
  – (also, run the system in SOE mode from Java client programs)

• An example semantically linking DOE and other data
  – energy independence

• Google indexes and searches apps that are written in English
1. There is an overview paper at

2. Semantics2 -- what a reasoner **should** do:
   Backchain iteration: towards a practical inference method that is simple enough to be proved
   Terminating, sound and complete. Journal of automated reasoning, 11:1-22

3. The English inferencing example

   *EnergyIndependence1*

   (and many other examples provided) can be run, changed, and re-run as follows:
   1. Point a firefox or chrome browser to www.reengineeringllc.com
   2. Click on Internet Business Logic
   3. Click on the go button
   4. Click on the help button to see how to navigate through the pages
   5. Select *EnergyIndependence1*

4. You are cordially invited to write and run your own examples. Shared use of the system is free

5. To make the system part of an SOA architecture, you can download and extend the java client stub http://www.Reengineeringllc.com/iblclient1.java
About Adrian Walker

• Author of over 20 papers, and an Addison-Wesley book, on rules systems and databases

• Assistant professor at Rutgers university

• Manager of principles and applications of logic programming, IBM Yorktown research laboratory

• Manager, internet development at Eventra
  (A manufacturing supply chain company)

• http://en.wikipedia.org/wiki/Adrian_Walker_%28computer_scientist%29