Semantics and the Web: e-Government Implications of some Emerging Technology Beyond W3C

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Presentation for the Collaborative Expedition Workshop #35, September 14, 2004, at NSF: Design Workshop to Frame National Dialogue on Intelligent Information Use in Manufacturing and Implications for e-Government

http://colab.cim3.net/cgi-bin/wiki.pl?ExpeditionWorkshop/DesignWorkshopforNationalDialogueOnIntelligentManufacturing

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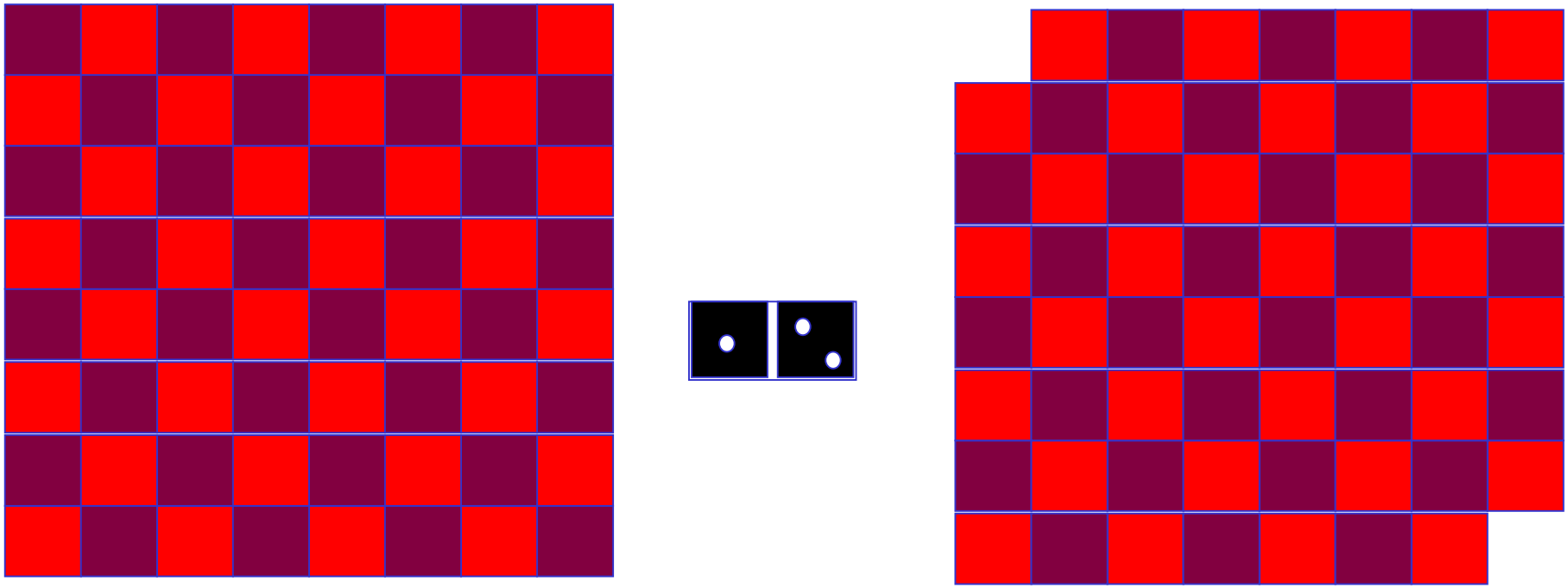
- Will automated integration be achieved as trusted relationships mature?
- What lessons from the manufacturing sector offer valuable context for intergovernmental agreements around knowledge-sharing and enterprise innovations?
- What is the role of Communities of Practice in using web tools to support connection-making and accelerate learning that contributes to global competitiveness?

- How can the tools needed by diverse people to augment their "collective intelligence" around manufacturing be designed to support and not hobble people's natural forms of expertise?

Outline

- Work harder, or use emerging technology to work smarter?
- Why we need Natural Language Based Tools
  - even for simple semantic tasks
- Natural Language Processing need not be a resource sink
  - A lightweight, open vocabulary, low maintenance technology
  - A Resource Description Framework (RDF) example
  - A manufacturing example
  - A Process Specification Language example
- Conclusions

Work harder, or Use Emerging Technology to Work Smarter?



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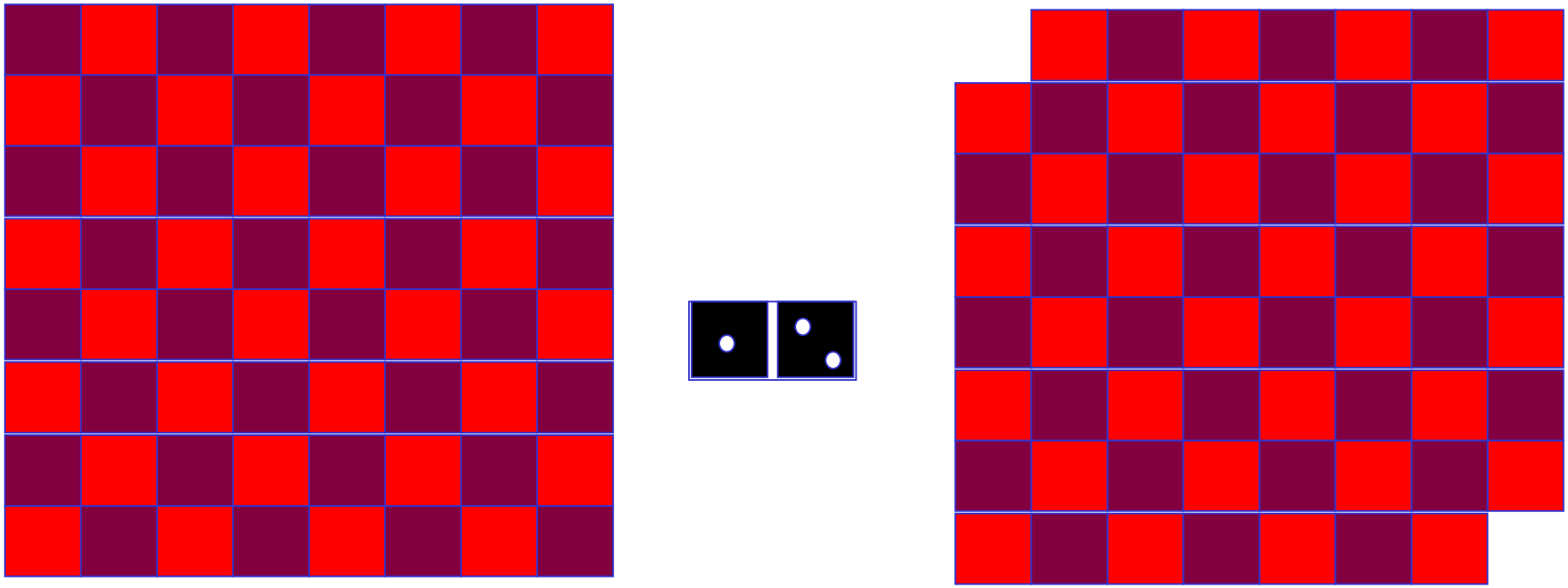

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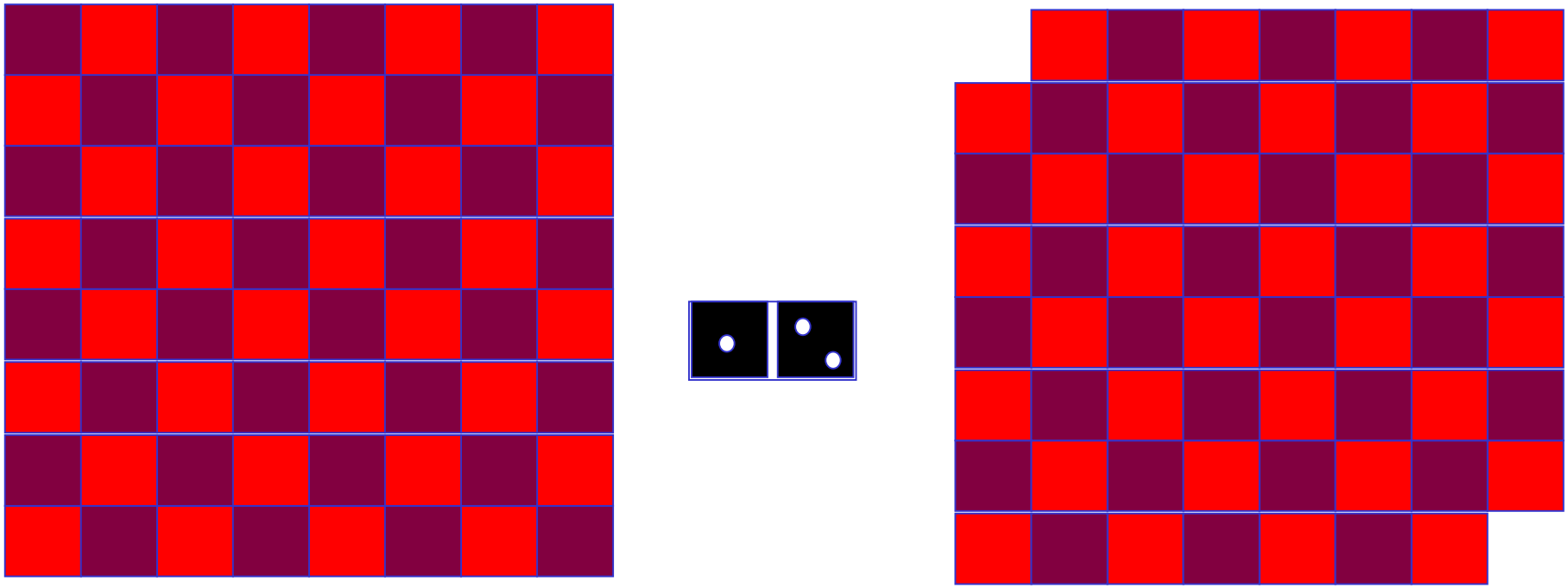

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Try some math to prove it cannot be tiled exactly, or

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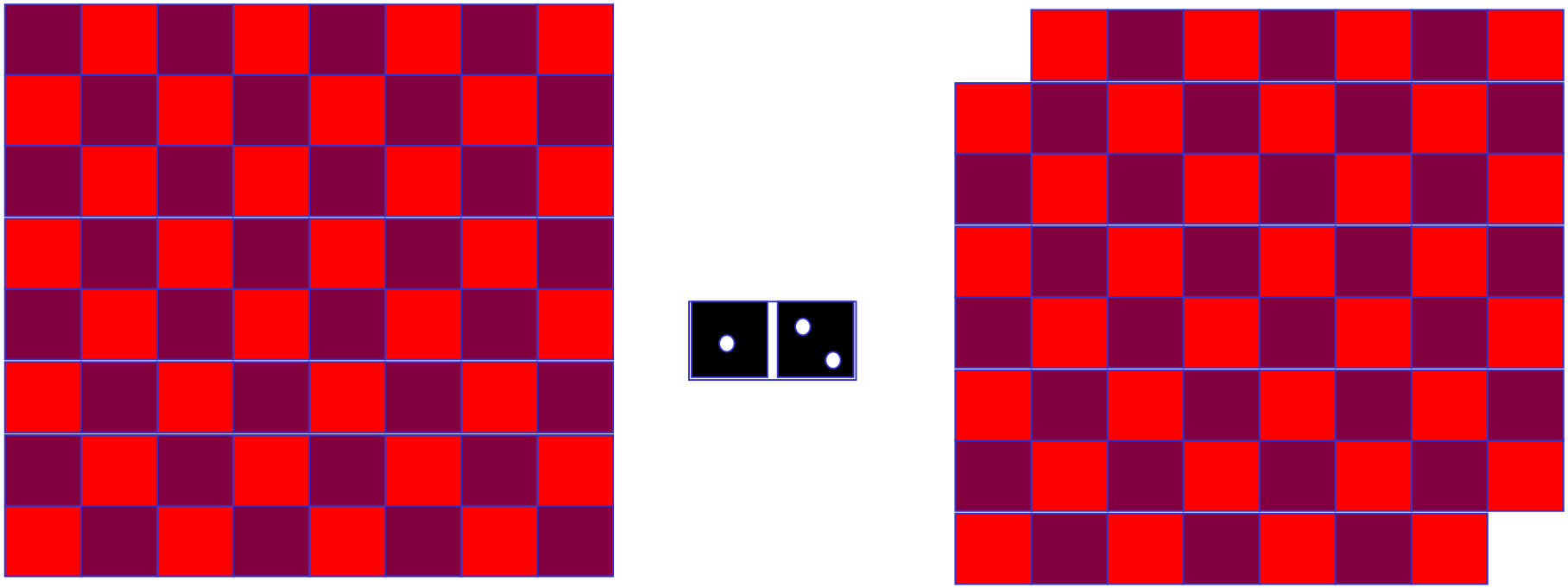

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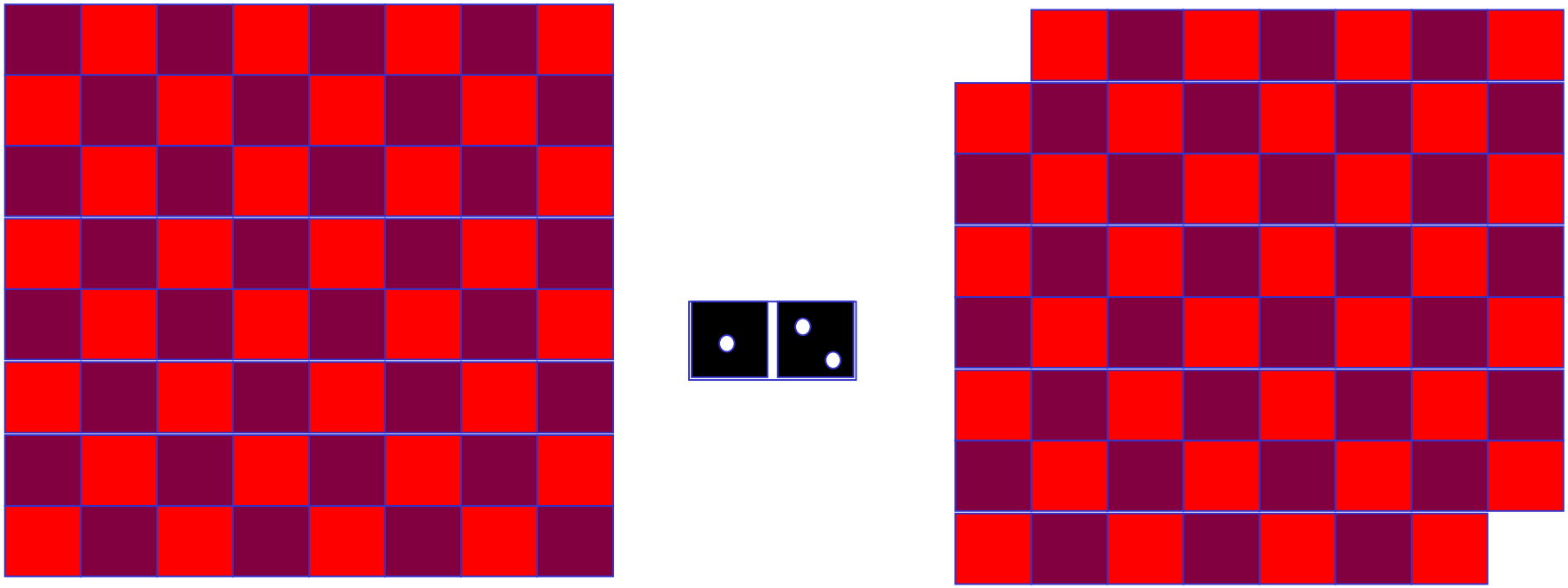

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Bottom Line: Work Smarter by shifting the way you represent requirements

Work harder, or Use Emerging Technology to Work Smarter?

- W3C Standards for machine interoperability
  - RDF, OWL, … and coming next year to a screen near you…. Rules
  - Silent on ease of application authoring and ease of use
  - Silent on human-machine interoperability

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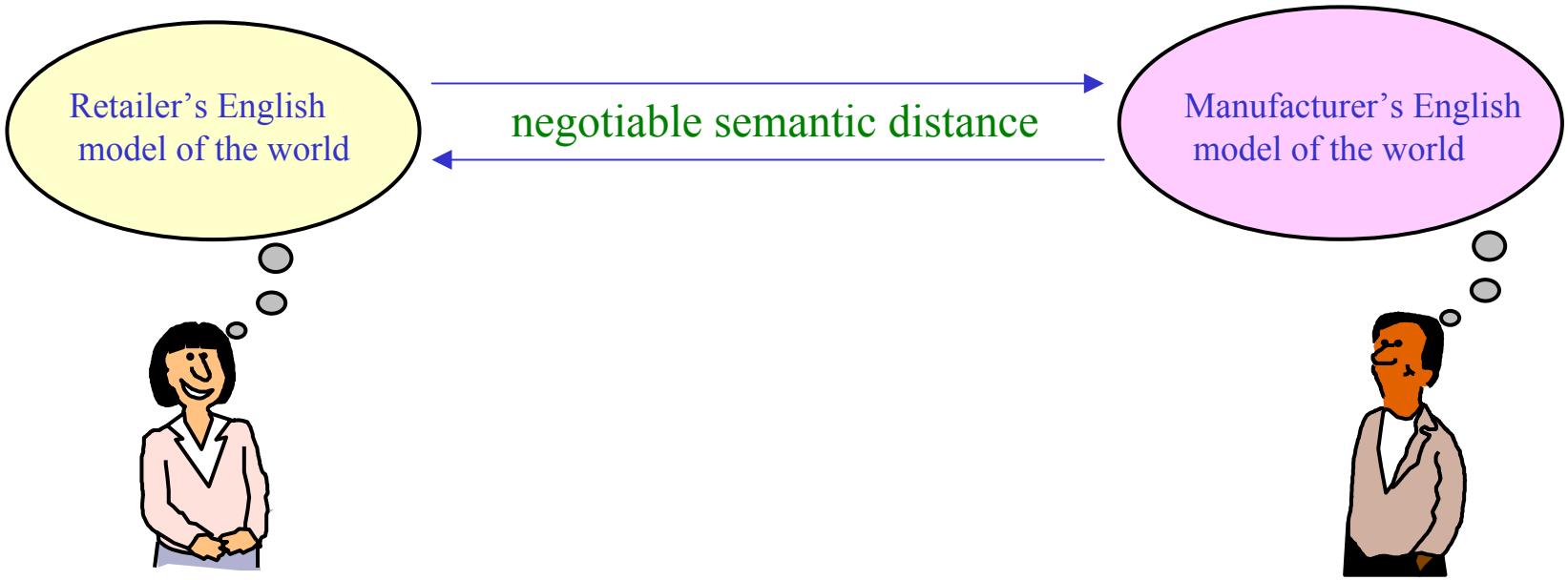
- Meanwhile, from darkest middle-Connecticut….
  - Emerging technology that complements the W3C standards
  - Addresses the need for (non-geek) human-machine interoperability
  - A lightweight, open vocabulary, low maintenance English technology
  - The author- and user-interface is simply a browser
  - Supports Wiki-like collaboration for writing applications as business rules
  - Automatically generates and runs SQL for networked database interoperation

Why we need Natural Language, even for simple semantic tasks



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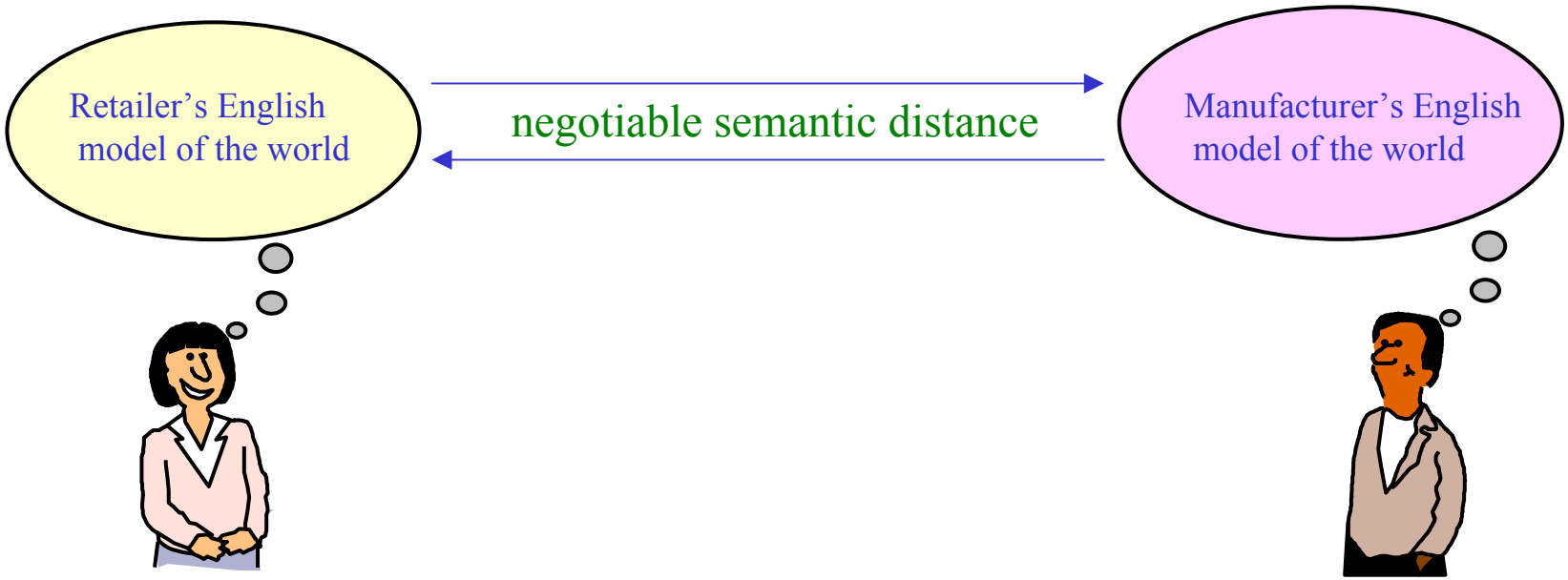

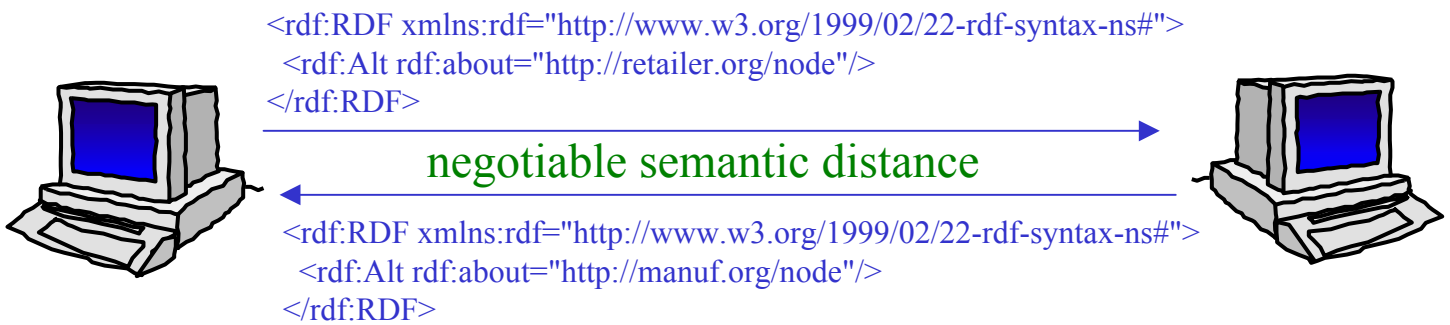

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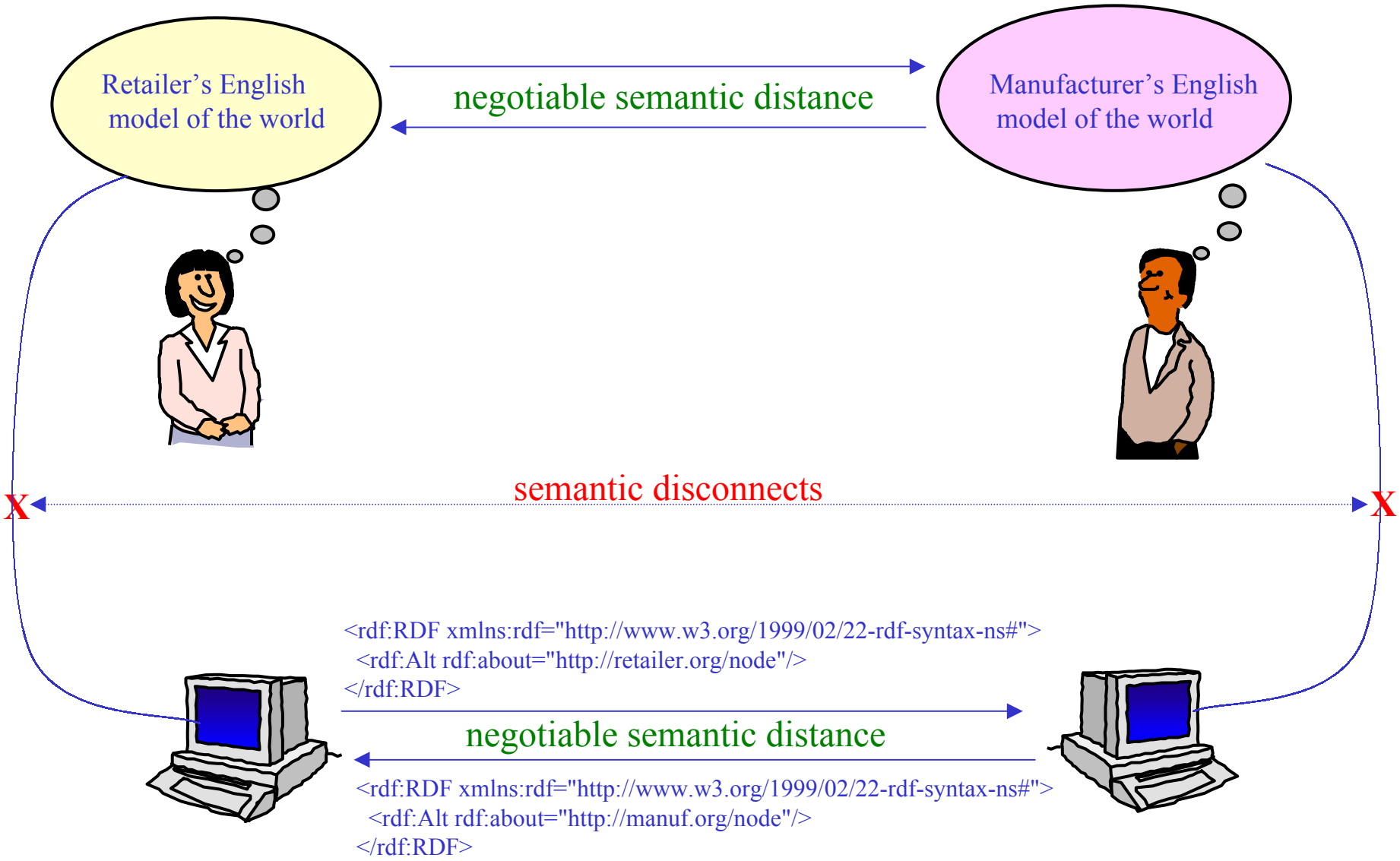

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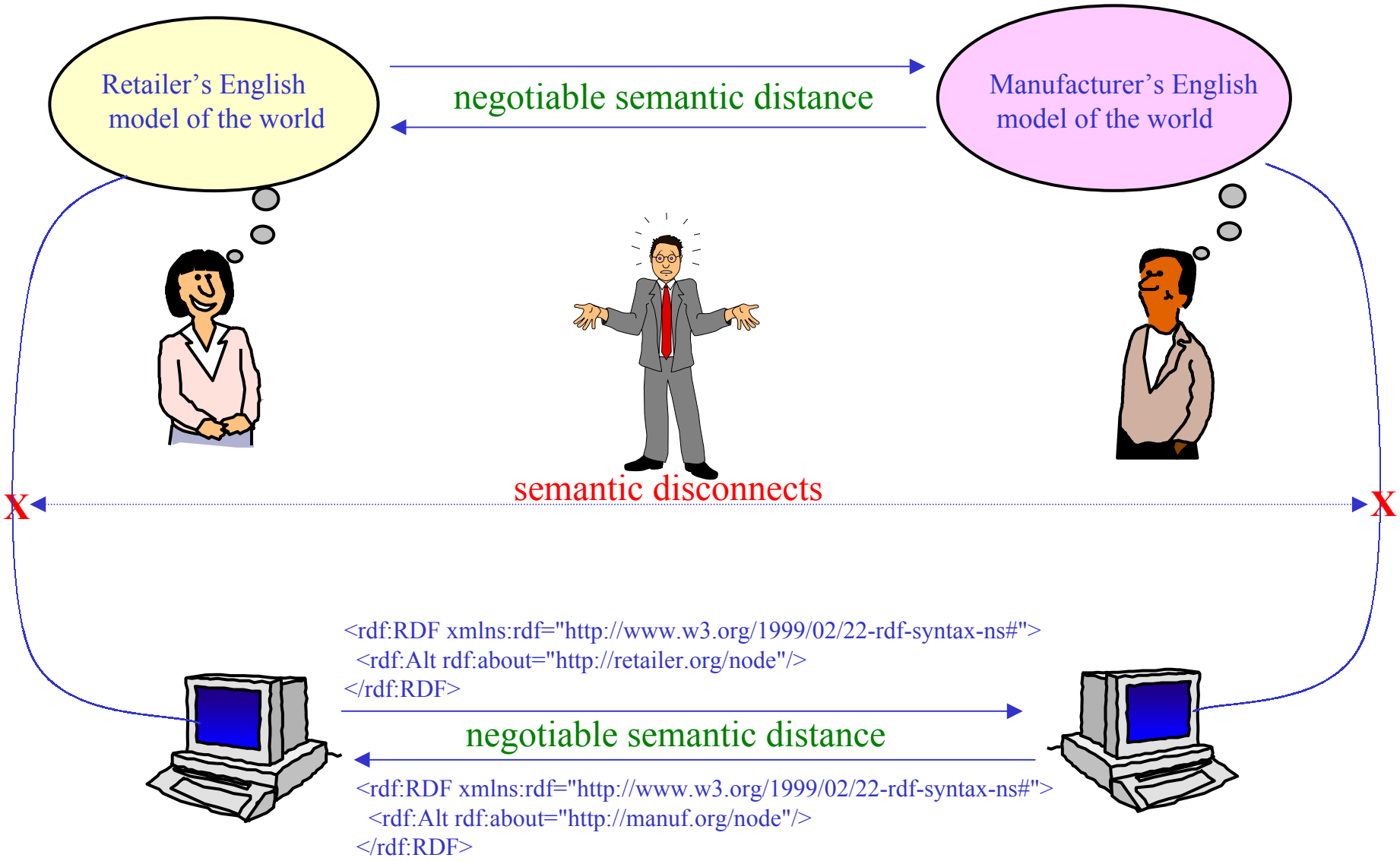

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  - plus related-by-taxonomy info
  - plus machine-friendly KIF, RDF, etc...
- A term is defined by the set of its superclasses in the taxonomy, and by its properties
- Ontologies do not contain human-friendly sentences, or relations between sentences

  -- Except as comments that are ***not*** used by machines

Why we need Natural Language, even for simple semantic tasks

"...the current KIF-based syntax [of PSL] is not easily understandable for ‘nongeeks’ and in the future a more human readable language representation is needed."

-- *Ontology-Based Translation: A Case of Process Specification Language (PSL)*
Teppo.Pirttioja@hut.fi

Why we need Natural Language, even for simple semantic tasks

"... As we read and write N3, communicating in RDF, we need to share an understanding of what each URI means. We often pick URIs which offer clues about meaning, such as

http://www.w3.org/2000/10/swap/test/demo1/biology#Dog

but the text of the URI still gives only a clue…..

---*http://www.w3.org/2000/10/swap/doc/ontologies*

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but the text of the URI still gives only a clue. Would a wolf qualify as a one of these? How about a Dingo? We can't tell just by looking at the name. It's even possible the URI text is misleading, and the intended meaning has nothing to do with dogs."

---*http://www.w3.org/2000/10/swap/doc/ontologies*

Why we need Natural Language, even for simple semantic tasks

John Sowa's example :

Clyde is an elephant,
elephant is a species
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RDF to the rescue ?

X verylongoverloadedURI1 Y
Y verylongoverloadedURI2 Z ==>
X verylongoverloadedURI3 Z

Not much help either

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Facts

this-item is a member of the set this-set

Clyde	The Elephants

this-item is a named subset of the set this-set

The Elephants	All Species Of Animals

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General rule

some-item is a member of the set some-set
that-set is a named subset of the set some-superset
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that-item is a member of a named subset of that-superset

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Explanation

Clyde is a member of the set The Elephants
The Elephants is a named subset of the set All Species Of Animals
---
Clyde is a member of a named subset of All Species Of Animals

-- To run or change this example, please point IE6, Netscape7 or Mozilla to the demo ClydeElephant1 at www.reengineeringllc.com

NLP need not be a resource sink

Example Reasoning Using RDF

If some first thing is related by rdf:type to a second thing,
and that second thing is related by rdfs:subClassOf to a third thing,
then that first thing is related by rdf:type to that third thing

some-subject is related by rdf:type to some-subclass
that-subclass is related by rdfs:subClassOf to some-object
rdf:type can be expanded to some-URI1:name1
rdfs:subClassOf can be expanded to some-URI2:name2
ns is shorthand for this-URI
---
that-subject is related by rdf:type to that-object

(Note that this kind of inheritance reasoning does not always seem to be valid in the real world, as indicated in the "Clyde is a species" example. That's why we need lightweight English)

-- To run or change this example, please point IE6, Netscape7 or Mozilla to the demo RDFreasoning1 at www.reengineeringllc.com

-- Example based on "Using Inference Rules" at http://www.interprise.com

Reasoning Using RDF -- some facts

some-subject is related by rdf:type to some-subclass
that-subclass is related by rdfs:subClassOf to some-object
rdf:type can be expanded to some-URI1:name1
rdfs:subClassOf can be expanded to some-URI2:name2
ns is shorthand for this-URI

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that-subject is related by rdf:type to that-object

this-subject is related by this-predicate to this-object

==========

ns:_0123456789	rdf:type	ns:Car
ns:Car	rdfs:subClassOf	ns:LandVehicle
ns:LandVehicle	rdfs:subClassOf	ns:Vehicle

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Reasoning Using RDF -- An Answer

this-subject	is related by this-predicate	to this-object
ns:Car	rdfs:subClassOf	ns:LandVehicle
ns:LandVehicle	rdfs:subClassOf	ns:Vehicle
ns:_0123456789	rdf:type	ns:Car
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Reasoning Using RDF -- An Explanation/Proof

ns:_0123456789 is related by rdf:type to ns:LandVehicle
ns:LandVehicle is related by rdfs:subClassOf to ns:Vehicle
rdf:type can be expanded to http://www.w3.org/1999/02/22-rdf-syntax-ns#:type
rdfs:subClassOf can be expanded to http://www.w3.org/2000/01/rdf-schema#:subClassOf
ns is shorthand for http://www.reengineeringllc.com/namespaces/ns#
---
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NLP need not be a resource sink

Example A retailer orders computers from a manufacturer

In the retailer's terminology, a computer is called a *PC for Gamers*, while in the manufacturer's terminology, it is called a *Prof Desktop*.

The retailer and the manufacturer agree that both belong to the class Worksts/Desktops

Use semantic resolution to find out to what extent a *Prof Desktop* has the required memory, CPU and so forth for a *PC for Gamers*

-- Example based on "Semantic Resolution for E-Commerce",
by Yun Peng, Youyong Zou, Xiaocheng Luan (UMBC) and
Nenad Ivezic, Michael Gruninger and Albert Jones (NIST)

NLP need not be a resource sink

A retailer orders computers from a manufacturer -- facts

for the retailer the term PC for Gamers has super-class this-class in the this-ns namespace

Computers to order	retailer
Worksts/Desktops	shared
Computers	shared

NLP need not be a resource sink

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Computers to order	retailer
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for the manufacturer the term Prof Desktop has super-class this-class in the this-ns namespace

Desktop	manufacturer
Worksts/Desktops	shared
Computer Systems	manufacturer
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A retailer orders computers from a manufacturer -- facts and a rule

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for the manufacturer the term Prof Desktop has super-class this-class in the this-ns namespace

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for the retailer the term some-item1 has super-class some-class in the some-ns namespace
for the manufacturer the term some-item2 has super-class that-class in the that-ns namespace

---

the retailer term that-item1 and the manufacturer term that-item2 agree - they are of type that-class

-- To run or change this example, please point IE6, Netscape7 or Mozilla to the demo SemanticResolution1 at www.reengineeringllc.com

NLP need not be a resource sink

A retailer orders computers from a manufacturer -- answer table

this-result : retailer this-item1 is matched by manufacturer this-item2 on the property this-prop for part this-comp

NEED	PC for Gamers	*missing-item*	Size	Graphics Card
OK	PC for Gamers	Prof Desktop	Size	CPU
OK	PC for Gamers	Prof Desktop	Size	Memory
OK	PC for Gamers	Prof Desktop	Size	Sound Card

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NLP need not be a resource sink

A retailer orders computers from a manufacturer -- explanation/proof of an answer

retailer PC for Gamers is matched by manufacturer Prof Desktop on the property Size for part Memory

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OK : retailer PC for Gamers is matched by manufacturer Prof Desktop on the property Size for part Memory

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OK : retailer PC for Gamers is matched by manufacturer Prof Desktop on the property Size for part Memory

the retailer term PC for Gamers and the manufacturer term Prof Desktop agree - they are of type Worksts/Desktops
for the retailer the term PC for Gamers has part Memory with property Size >= 256 in the shared namespace
for the manufacturer the term Prof Desktop has part Memory with property Size = 512 in the shared namespace
= 512 meets the requirement >= 256

---

retailer PC for Gamers is matched by manufacturer Prof Desktop on the property Size for part Memory

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512 is greater than or equal 256

= 512 meets the requirement >= 256

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NLP need not be a resource sink

Example Process Specification Language -- food service

A food service process must include ordering, preparing, serving, eating, and paying, but not necessarily in exactly that order

The constraints are:

- Ordering, preparing, and serving always happen before eating
- Serving happens after preparing and ordering
- Paying can happen any time in the process

-- Example based on "PSL: A Semantic Domain for Flow Models"
by Conrad Bock (NIST) and Michael Gruninger (NIST)

NLP need not be a resource sink

Process Specification Language -- facts

this-activity1 must occur before	this-activity2
ordering	eating
preparing	eating
serving	eating
preparing	serving
ordering	serving

-- To run or change this example, please point IE6, Netscape7 or Mozilla to the demo ProcessSpecificationLanguage1 at www.reengineeringllc.com

NLP need not be a resource sink

Process Specification Language -- facts

this-activity1 must occur before this-activity2	
ordering	eating
preparing	eating
serving	eating
preparing	serving
ordering	serving

in scenario this-number step this-step is this-activity

1	1	ordering
1	2	paying
1	3	eating

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NLP need not be a resource sink

Process Specification Language -- rules

Rule for checking a given scenario (1)

in scenario some-number step some-step2 is some-activity2
some-activity1 must occur before that-activity2
not : in scenario that-number that-activity1 occurs before that-activity2

---

in scenario that-number step that-activity1 should have happened before that-activity2 but did not

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Simplified rule for finding a new scenario (2)

in scenario 2 step some-step is some-activity
that-activity must occur before some-activity2
not : there is an activity that must occur between that-activity and that-activity2
that-step + 1 = some-step2

---

in scenario 2 step that-step2 is that-activity2

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NLP need not be a resource sink

Process Specification Language - Checking the given scenario (1)

Answer

in scenario this-number step this-activity1 should have happened before this-activity2 but did not

==========

1	preparing	eating
1	serving	eating

Explanation/proof

in scenario 1 step 3 is eating
preparing must occur before eating
not: in scenario 1 preparing occurs before eating

---

in scenario 1 step preparing should have happened before eating but did not

.....

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NLP need not be a resource sink

Process Specification Language - finding a new scenario (2)

Answer / Process Plan with Parallel Steps

in scenario 2 step this-step is this-activity

1	ordering
1	paying
1	preparing
2	serving
3	eating

Explanation/proof

in scenario 2 step 2 is serving
serving must occur before eating
not: there is an activity that must occur between serving and eating
2 + 1 = 3

---

in scenario 2 step 3 is eating

.....

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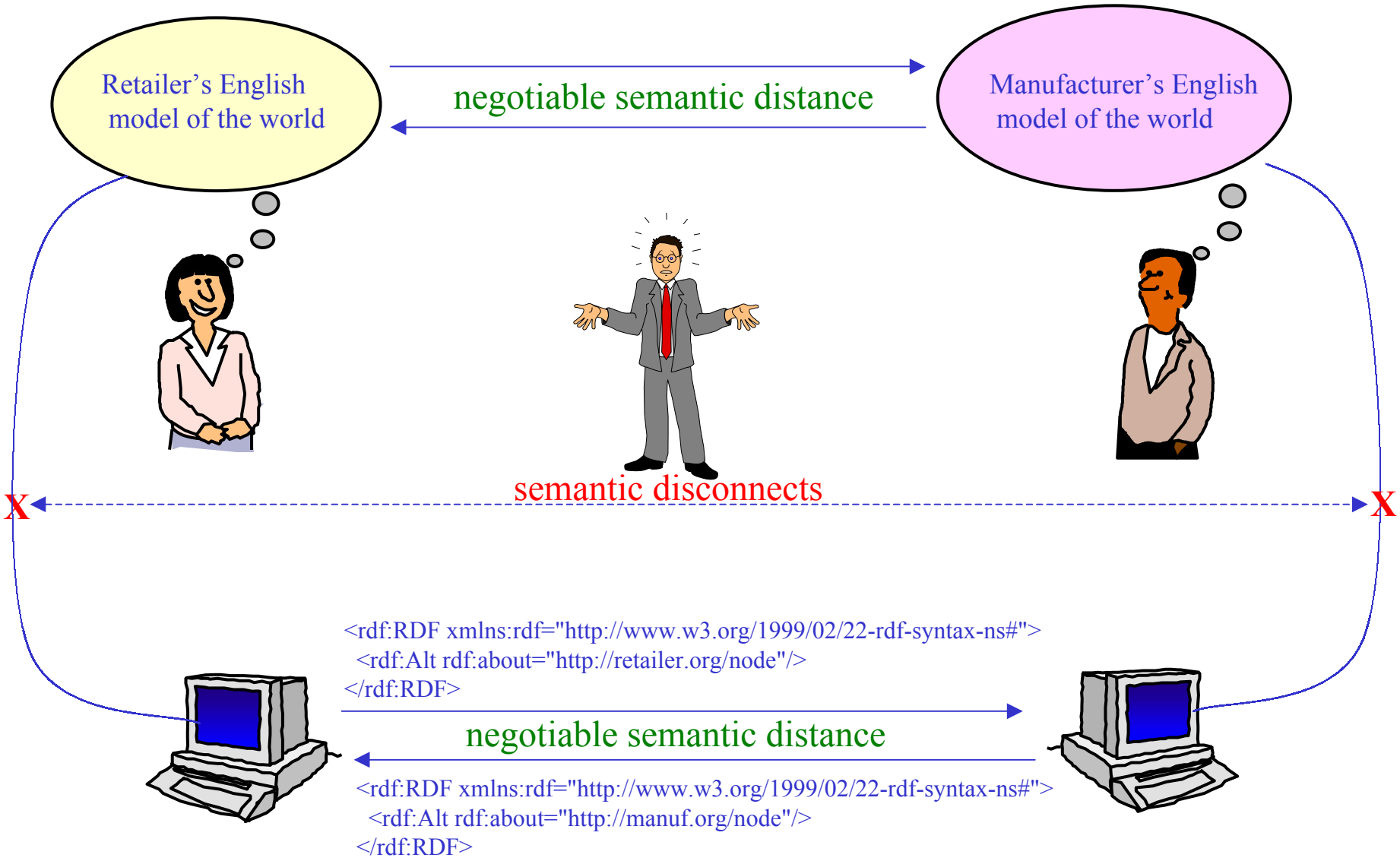
Conclusions



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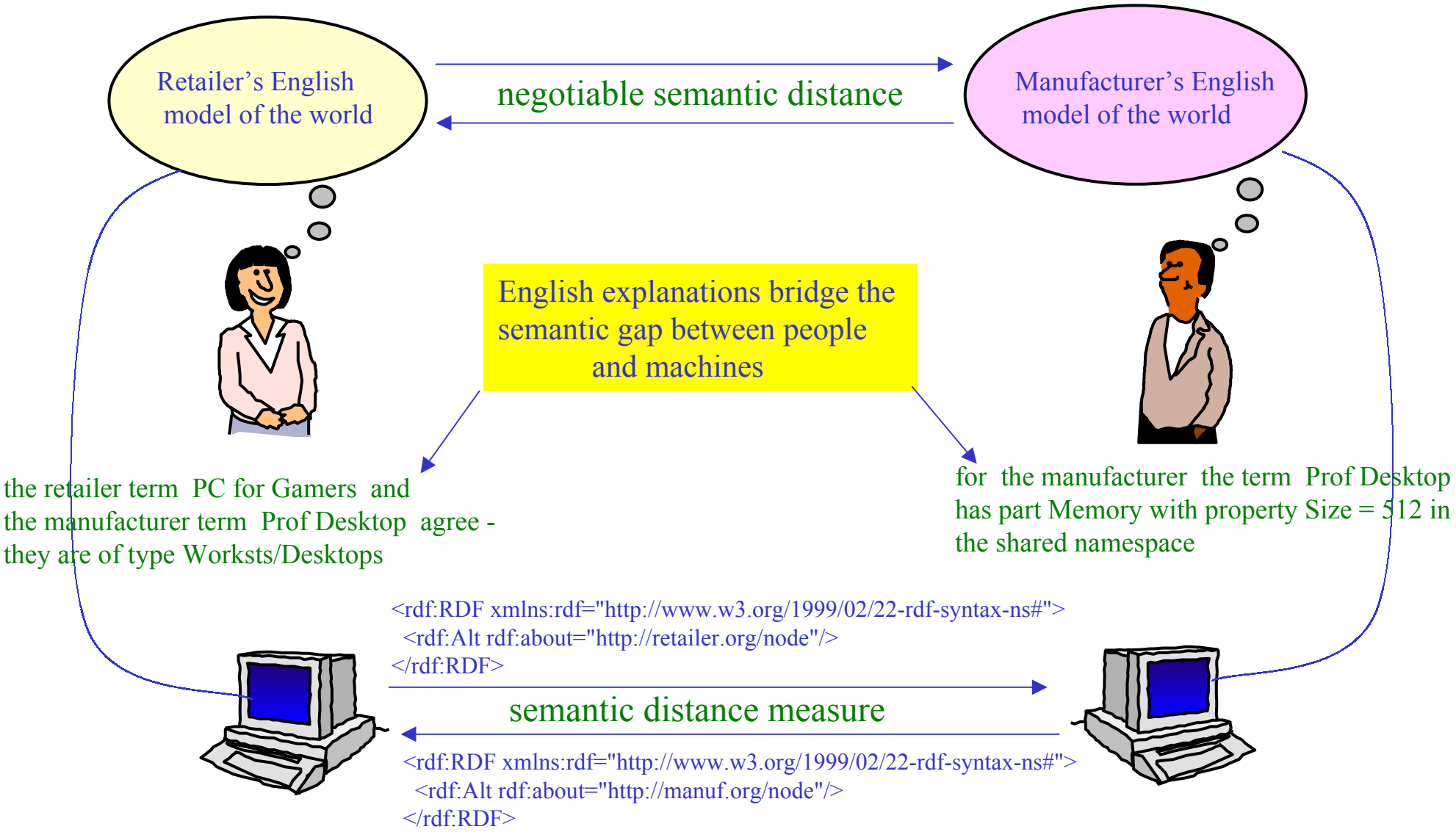

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- We need Natural Language
  - even for simple semantic tasks, like "Clyde is an elephant"
  - to remove the semantic disconnect between people and ontology notations
- NLP need not be a resource sink, even with an ***open*** vocabulary
  - "Just enough" lightweight NLP, combined with heavyweight inferencing
  - Can use the lightweight NLP for English, German…
  - No grammar or dictionary work, yet precise English meanings
  - Can use standard information retrieval for (parts of) lightweight English ontologies

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  - "Just enough" lightweight NLP, combined with heavyweight inferencing
  - Can use the lightweight NLP for English, German…
  - No grammar or dictionary work, yet precise English meanings
  - Can use standard information retrieval for (parts of) lightweight English ontologies
- Shift the way we represent requirements -- to Executable English
  - Helps to achieve trusted automated integration
  - Helps to support Communities of Practice by Wiki-like application authoring
  - Helps to support direct use of people's natural forms of expertise

Conclusions

- We need Natural Language
  - even for simple semantic tasks, like "Clyde is an elephant"
  - to remove the semantic disconnect between people and ontology notations
- NLP need not be a resource sink, even with an ***open*** vocabulary
  - "Just enough" lightweight NLP, combined with heavyweight inferencing
  - Can use the lightweight NLP for English, German…
  - No grammar or dictionary work, yet precise English meanings
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- Shift the way we represent requirements -- to Executable English
  - Helps to achieve trusted automated integration
  - Helps to support Communities of Practice by Wiki-like application authoring
  - Helps to support direct use of people's natural forms of expertise
- The bottom line: Work smarter, not harder

Links

1. The NIST / UMBC papers listed in the presentation can be downloaded from :

http://www.mel.nist.gov/msidlibrary/publications.html

2. The English inferencing examples

ClydeElephant1

RDFreasoning1

SemanticResolution1

ProcessSpecificationLanguage1

can be run, changed, and re-run as follows:

1. Point Internet Explorer 6, Netscape 7 or Mozilla 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 *ClydeElephant1*

You are cordially invited to write and run your own examples.