Research Paper for the CIS203 Introduction to Artificial Intelligence

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Semantic Web Agent

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1. Introduction:

The emergence of the Internet has revolutionize almost every conceivable aspect of our lives. We can simply conduct various activities such as shopping, chatting and study online on the Net. However, the potential of the Internet is not fully realized. It is mainly because the Net only harbors data that can be understood by human beings. The in competency of the current Internet structure undermines the growth of the Net as an mechanism for human to share an universal space where everyone is allowed to express and retrieve ideas freely. Semantic Web,considered as the next Internet, would not only presents human readable data, but also provides a way for machine to manipulate data meaningfully. Ideally, Semantic web would acts as the extension of the current Internet if we can find a way to establish a mechanism that is compatible with the current Net architecture. Sets of inference rules and collection of information is required to induce automated reasoning. If a machine is able to understand part of the content of the data it presents, then "Semantic Web agent" would become a feasible goal. The Implication behind the creation of Semantic web agent is extraordinary, In the future, Semantic web agent would be able to set up clinical appointment, enhance the reliability of the current search engine and exchange data with different agents on the Net. Semantic web agents, like the steam-engine , could freed us from daily drudgery. Therefore human beings would have more time to attack the unanswered problems. This project is prepared for the undergraduate class; CIS203 Introduction to Artificial

Intelligence, therefore the paper wouldn't present or discuss highly technical question or lengthy codes, the paper is meant to provide a theoretical approach to issues of the AI application of Semantic Web.The main concern of the project is to explore the relation between semantic web and Artificial Intelligence ,Some samples of codes and graphics would be given to better illustrate the concepts in this paper. Also I would propose to create a A.I. middleware agent, which would help mapping ontology for the Semantic web. I sincerely hope that the paper would provide some insights of A.I. and Semantic Web.

1.1 Defining Artificial Intelligence

Before getting to the core of the paper, it's natural to ask "what's Artificial Intelligence"? How do we define "something" to have an artificial intelligence? Academic and Scientific institutions alike still can not provide a complete definition for the term A.I. . Some Pro-A.I. scholars would argue a machine that can perform humanlike behavior or illustrate intelligence constitute the term "Artificial Intelligence". While the Anti-A.I. people fire back by saying only a living mechanism can possibly possess intelligence. It seems like this fuzzy definition of AI would exist for decades until human beings have deeper understanding of the neuroscience and cognitive science. The irony is, the ultimate goal for A.I. is to generate a man-made machine that is capable of learning, reasoning, and creating. But can the majority of human beings capable of satisfying all these requirement?

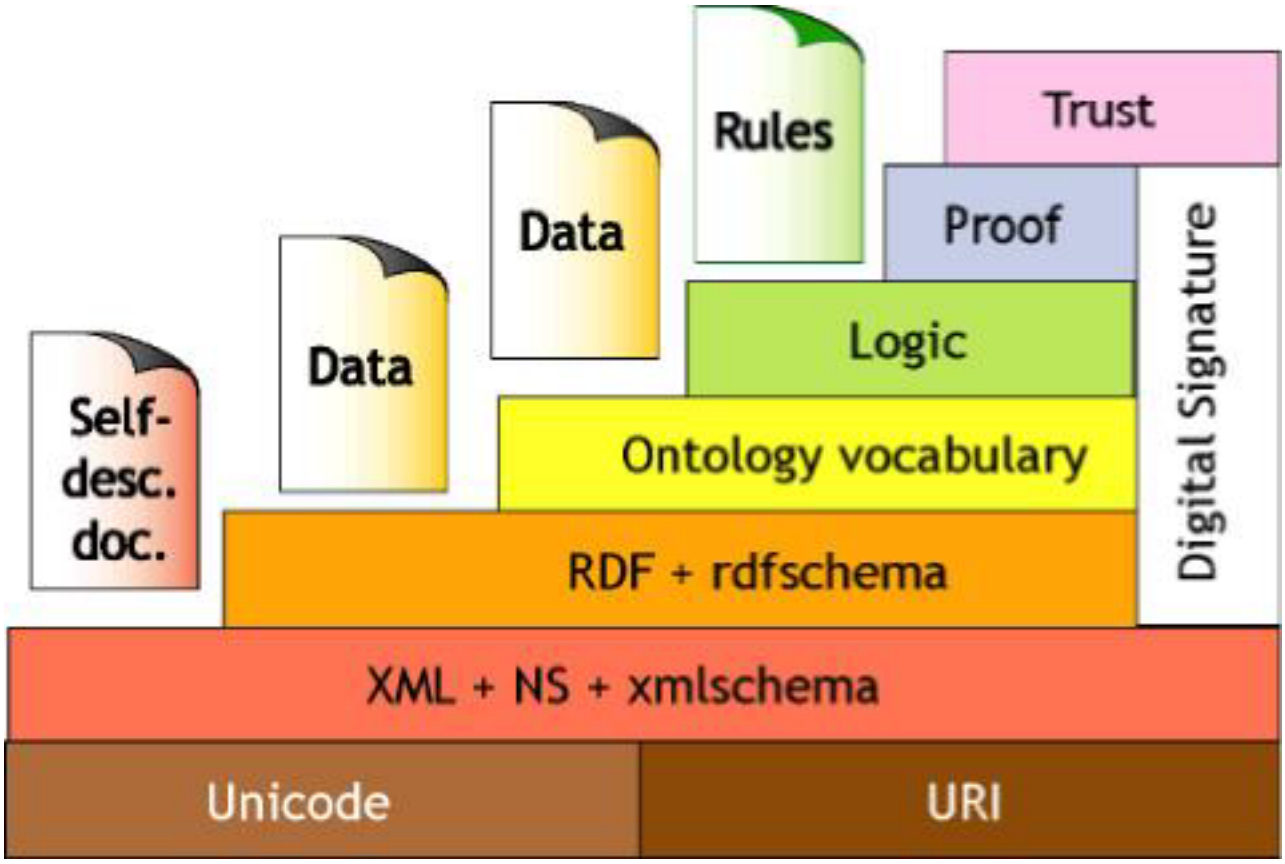
The Chinese Room and Turing Test illustrate that people can always solve some tasks without having to truly understand the meaning behind their reasoning. The phenomenon , in certain extents, displayed that people should be able to survive without having to contemplate the meaning of our thinking. In order to solve certain problems. For instance, every knows that '1+1=2', but only the logicians would have the patience and ability to prove the '1+1=2'. Does it mean that everyone has to truly understand everything about a specific field in order to work on it? Clearly, a driver does not have to know the design of the transmissions and braking system in order to use them. However, every driver must understand the function of transmission and brakes. Here we are about to get to the controversy of A.I. .

Deep Blue, the supercomputer from IBM, demonstrates that computer is able to perform rule-based tasks far more efficiently than human beings (in this case the Russian Chess champion). It's not surprising to know that there are hundred of game programs on the Internet that would occasionally defeat human player. But it does not necessary means that a game program is intelligence, it merely implies that these programs are able to perform at least intelligently within the "game universe". Sadly, we live in a dynamic world where rules change rapidly. The real world is much more complicated than broad games. An ideal A.I. program should be able to modify, learn and renew itself in order to survive or fit in the world. Bacteria demonstrate it can grow to fight against the strongest antibiotics

and medicine. It behaves like a seamless A.I. program that ready to interact with the outside environment in order to proliferate. Our brain may act like a enormous operating system that coordinate all these sub programs on our minds. The details have to be extracted by the scientists.

1.2 World Wide Web and Semantic Web

The current World Wide Web provides a medium for anyone to communicate in a special way. In a sense, the Net itself is a abstract universal space where everyone with a terminal and client can get accessed to. It is not longer a dream for computer user to conduct various activities on line, such as distant learning, E-commerce, and grid computing. But HTML per se, is not able to build up a foundation for the next Internet - the Semantic Web. The Semantic web, unlike the current web, would allows webmaster to define their definition tags. A machine-under stable semantic web would opens up a thousand possibilities for computer science. And therefore it may allow Semantic web agent to understand the content of web. Semantic web environment would allow search engine to search more precisely and even assist human beings on dueling with daily tasks such as making appointment or paying check. Information retrieval is not only the basic function of the Net, but it is also a crucial function of the web. Without a effective way of retrieving information, the potential of the Semantic web would be undermined. (see the illustration of the structure of Semantic Web structure).



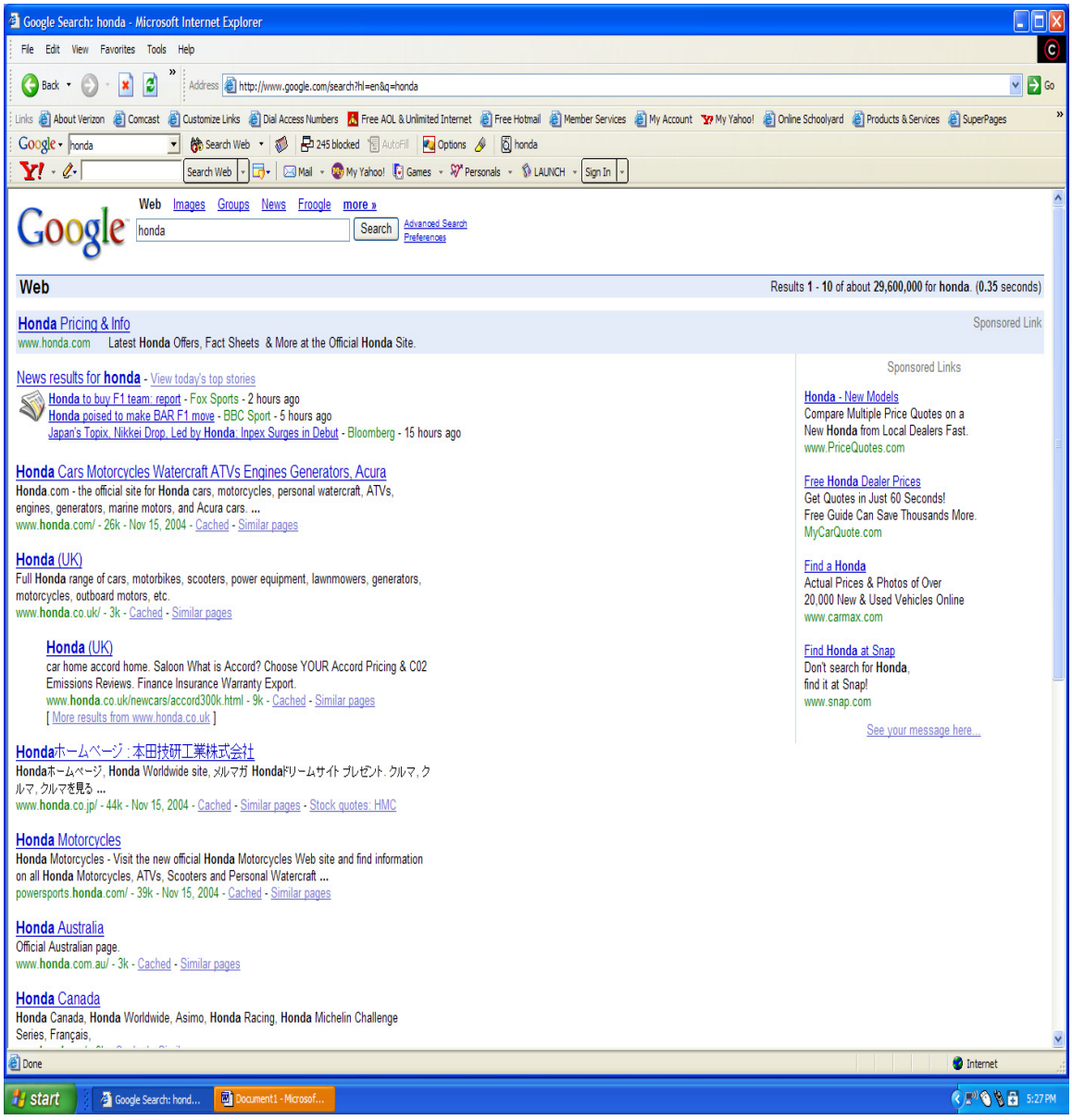
Graph taken from Tim Berners-Lee web.

1.3 Information retrieval on the current Internet

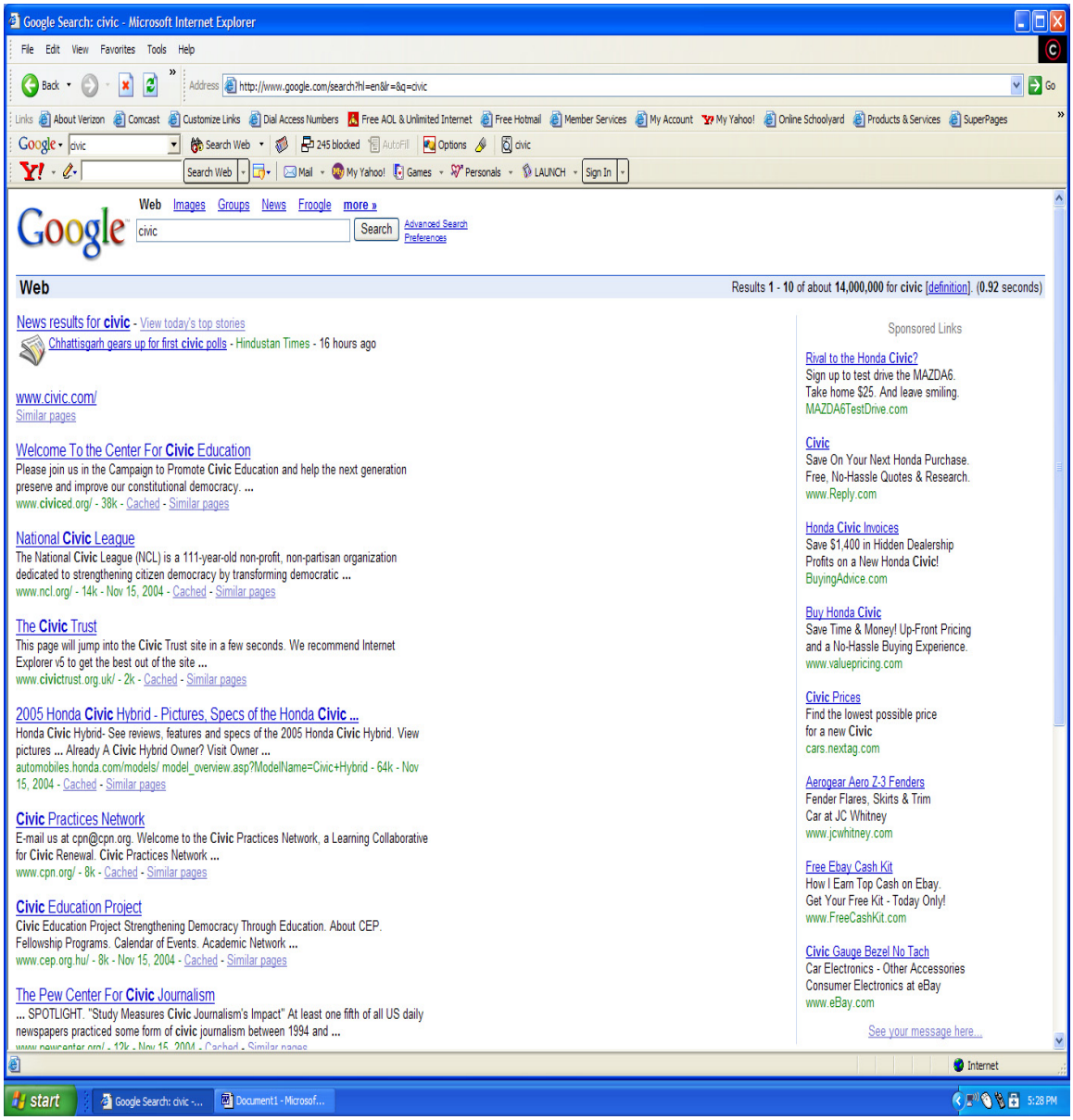
Google's success is contributed to its unique combination of link evaluation, text-matching and page ranking. Its algorithm evaluate web pages by checking how many links are linked to it. The more links that are pointed to a specific web pages implies that the content of the web page is what people seek. Then, the web robot would rank that page base on its popularity. Unfortunately, due to the infrastructure of the web page. Web content is not understood by any program. For instance, if I want to search keyword "CIVIC" on the Internet. I would get clusters of search result. With the help of the Boolean and clear search target expression, ("CIVIC & HONDA") I would have a better chance to get to the desired web. User can also search within the web page by inputting www.honda.com"civic". This experiment illustrate a flaw within the current world wide web. Ontology-Based knowledge discovery on the World Wide Web. Search engine approach is to use lexical and syntactic content as the textmatching. Yahoo uses another approach, the company hires on-line expect to categorize each web on the Internet. It is obviously not a best answer for the exponential growth of the web pages. Most of the conventional search engine use Ad-hoc robots: Gathering information by checking the existing HTML tags. This method allow Webmaster to embedded a specific keyboard in

their homepage. Web-wandering robot with ad-hoc machinery for specialized search tasks. A better search engine would be born with the help of the Semantic web agents. (see graph for search result by using Google)

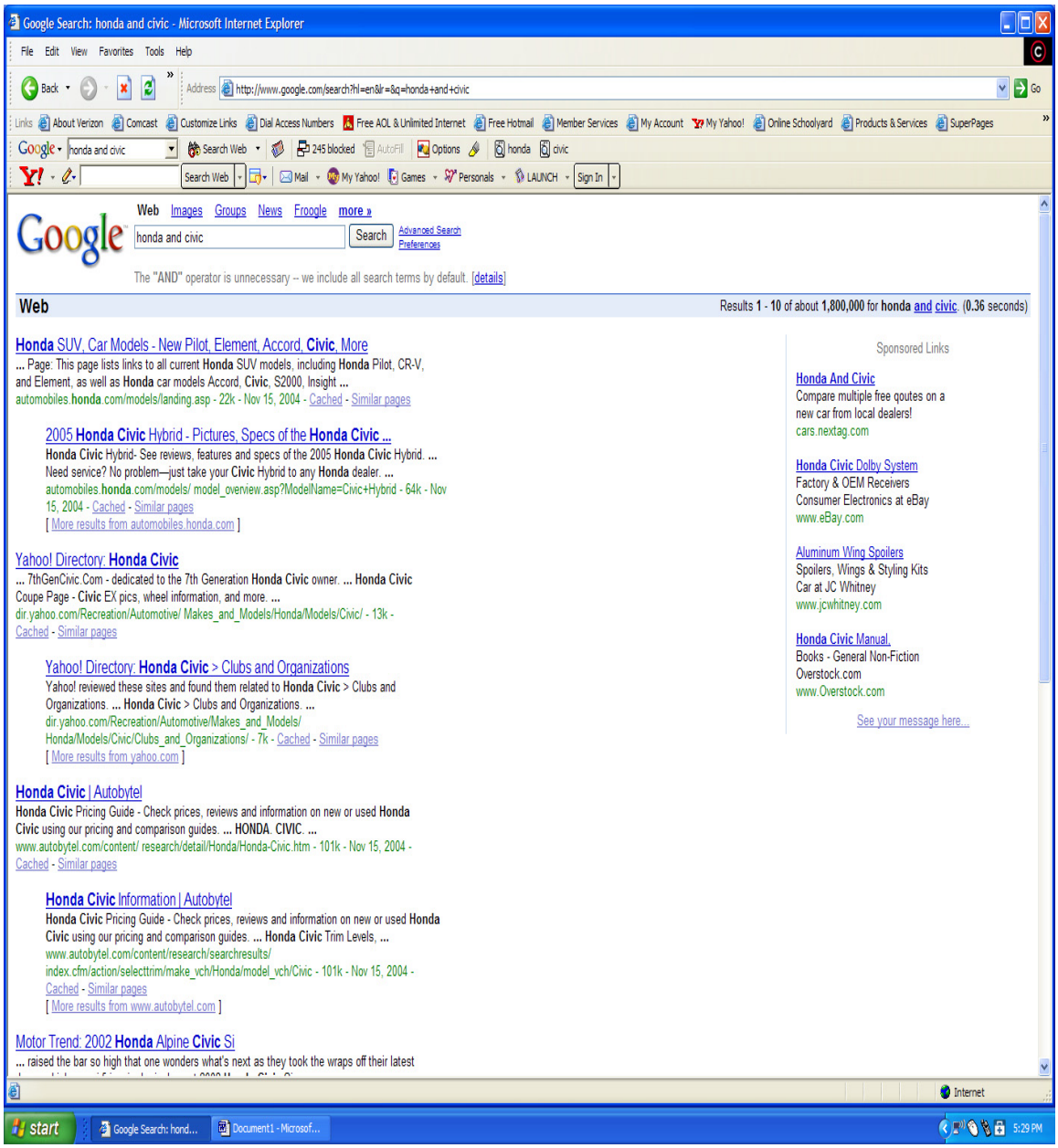
Graph 1



Search result of the keyword “Honda” by using Google Search Engine.

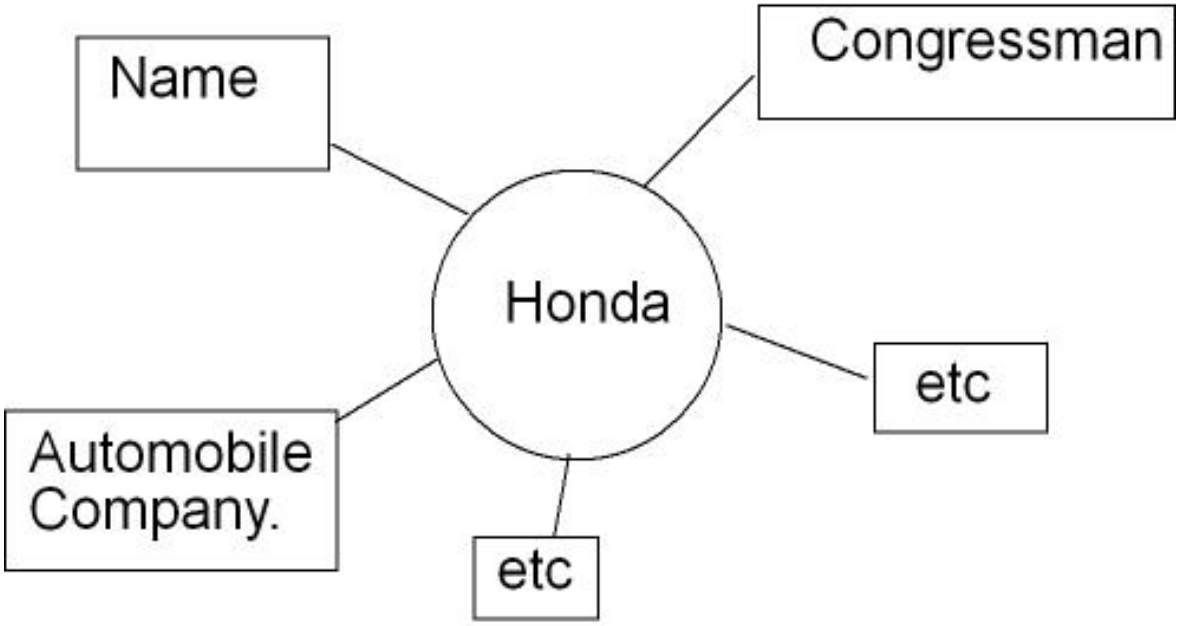


Search result of the keyword “civic” by using Google Search Engine.

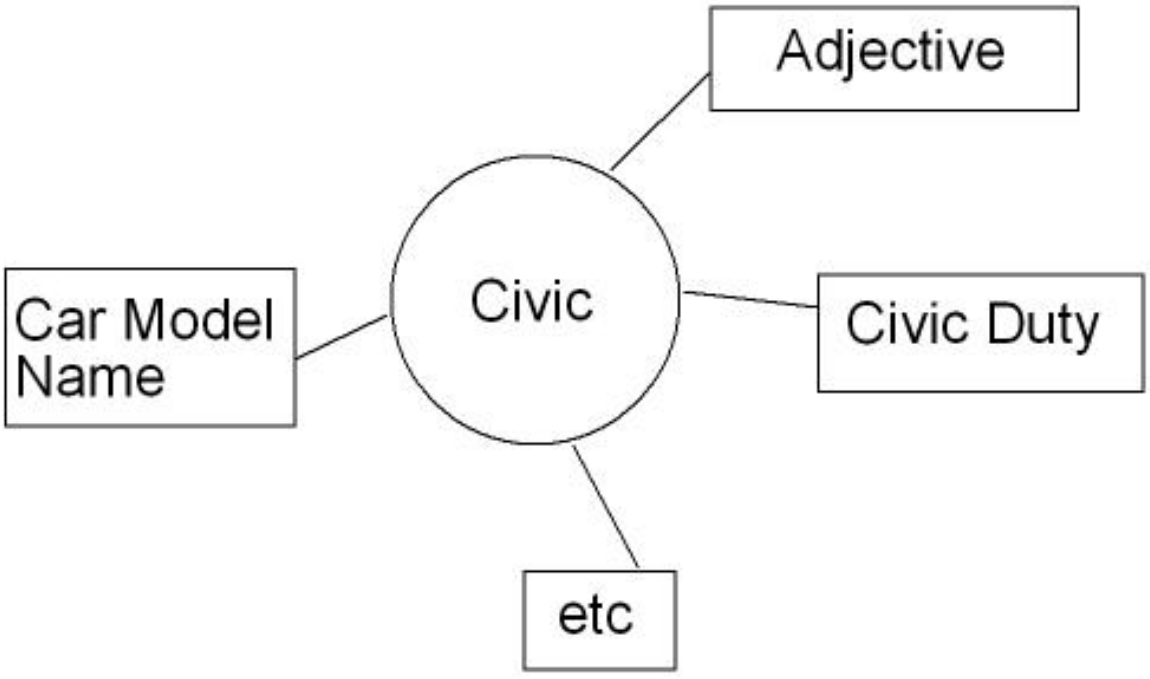


Search result of the keyword “Honda” and “civic” by using Google Search Engine.

G r a p h y 2



Everything related to “Honda”



Everything related to “Civic”

1.4 Data representation of the web

HTML(Hypertext Markup language)

HTML - simple markup language for specifying the structure and content of information in Web documents.Tim Bernets-Lee created the first version of the World Wide Web program at CERN in 1990. A protocol was created to allow different machines to communicate and describe the document. Hypertext is a collection of documents with cross-reference (links) between them. In a sense, it resembles human brain, our senses could act as a link to retrieve our memory of our brain. For instance, the color of Red may remind Chinese-descended Chinese new year. And the smell of kielbasa may remind a Polish-descended of his/her factors act as links that would HTML is still the predominant language to create web page and is defined by DTD (Document Type Definition), within the context of SGML. HTML allows us to format the basic structure of the web by declaring contents within different tags (<tag>). A valid HTML declaration includes an open tag (e.g. <HTML>) and end tag (</HTML). User can define font size ,color ,background, table by utilizing HTML. But there's no understanding between computer and tags.

(See graph)

HTML code sample:

```
<HTML>
<HEAD>
<TITLE> HONDA Humanoid ROBOT </TITLE>
</HEAD>
<BODY BACKGROUND = "Blue Hills.jpg">

<FONT COLOR = "#FFFFFF">
<H1><CENTER> Power of Mother Nature </CENTER></H1>
<P ALIGH = "center"><B> This page is dedicated to HTML development !
<BR><IMG SRC = "honda-robot.jpg" ALIGH = "center" BORDER = "10">
<BR> Honda robot is designed to serve human beings!
<BR><I>HONDA ROBOT</I></B></P>

</FONT>
<A HERF="fredkwok@temple.edu ?subject=comments">Send me your
comments!</A>
</BODY>
</HTML>
```

Cascading Style Sheet:

CSS declare how document is displayed in web browser. It can be applied to HTML and XML-based language. It is created by W3C. CSS rules determine the color, front, text formatting and colors and numerous background setting. CSS only works with what is presented in the markup file and is backward compatible. The look of the web page can be displayed independently from the information on the page.

CSS rules: each rule is a single statement that identifies how and what to display.
The basic structure of CSS is:
-structure: It consists of two part,
-selector(s) and declaration(s). eg : selector { property: value;}

Here's a basic CSS style sheet with color, size, and font declaration.

```
/* basicCss.css
/* written by S.F.Freddie Kwok <fredkwok@temple.edu>

   body{ font-family: Arial;
         color: Orange;
         background-color: Black;}
/* orange headlines */
h1,h2,h3,h4,h5,h6{ font-family: orange, sans-serif;}

/* This puts the second level heading in read */
h2{color: black;}

address{font-family:Verdana, sans-serif;
        font-size: smaller;}
```

we can link the style sheet to XML by using <link> in both

HTML and XML

```
<?xml-stylesheet type = "text/css" href="filename"?>
```

in the XML document.

XML (Extensible Markup Language):

Sir Barnets-Lee also created the XML which is more likely a extension of the current HTML, and is also human-readable and self-describing. XML is to create a more solid and flexible foundation for the current Net. Web master can descript a syntax that user create his own language. XML documents are able to represent hierarchies of concept. It descript the structure of data and is built upon Unicode characters and URL which identifies concepts .XML only provides syntactic interoperability. One of the advantage of using XML is it allows Web authors to focus on structure rather than the format of documents to style sheets. The disadvantage of XML is it doesn't tell the web browser how to display information. Therefore it needs style sheet. Both HTML and XML are standards from World Wide Web Consortium. Information is useless without a lot of work to decipher it. XML was Computer scientist's effort to answer this question of Repackaging data. Flexibility, longevity and accessibility of data.

XML and the role of interoperability mechanism.

Data Metadata
Freddie Name
Narberth City
Pennsylvania State

The basic structure of XML includes tags, element, head, footing and body

XML schema(replacement of DTD) , like RDF, is a separate document whose purpose is to define the legal elements, attributes and structure of XML instance

document.(XML schema, like HTML and XML, is recommended by W3C.)

XML sample code and graph

```
<?xml version="1.0"?>

<INVENTORY>
<BOOK>
        <TITLE>OLENKA IN POLSKA</TITLE>
        <AUTHOR>Sung Fat Freddie Kwok</AUTHOR>
        <BINDING>mass market paperback</BINDING>
        <PAGES>298</PAGES>
        <PRICE>$5.49</PRICE>

</BOOK>
```

Cascading Style Sheets(CSS) specify the format and layer for an XML document. The new version of Internet browser needs to understand the content of XML.

```
<name nickname = "Fat">
        <first> Sung Fat Freddie </first>
        <middle> none </middle>
        <last> Kwok </last>
</name>
```

Tags, elements and attributes in XML.XML as simple form of SGML. Web master use different Attributes to separate different type of information, though it adds complexity to the data structure.meta data is the description of the data. RDF (Resource Descripting Framework):RDF: Resource Description Framework is a W3C recommendation that attempts to address XML's semantic limitation. It represents node connected by labeled arcs,

nodes = resource, arc = properties.

RDF allows the interchange of XML more effectively.

<rdf:Description about='http://www.temple.edu/RDF/Why-RDF.html'>
<Author>Sung Fat Kwok</Author>
<Home-Page rdf:resource='http://www.temple.ed' />
</rdf:Description>

Containers for objects

: bag, sequence and alternative.
reification: descripting data (metadata)

RDF schema allows user to create schemas of standard classes

and properties using RDF.

URI identify resource such as classes and properties.

- no polysemy problem, it gives resource an ID.
- definition of class is a collection of statement about its properties.

Axiom could be used to infer data that has not been presented

implicitly. It can map definition of different concepts and

layers of Semantic web.

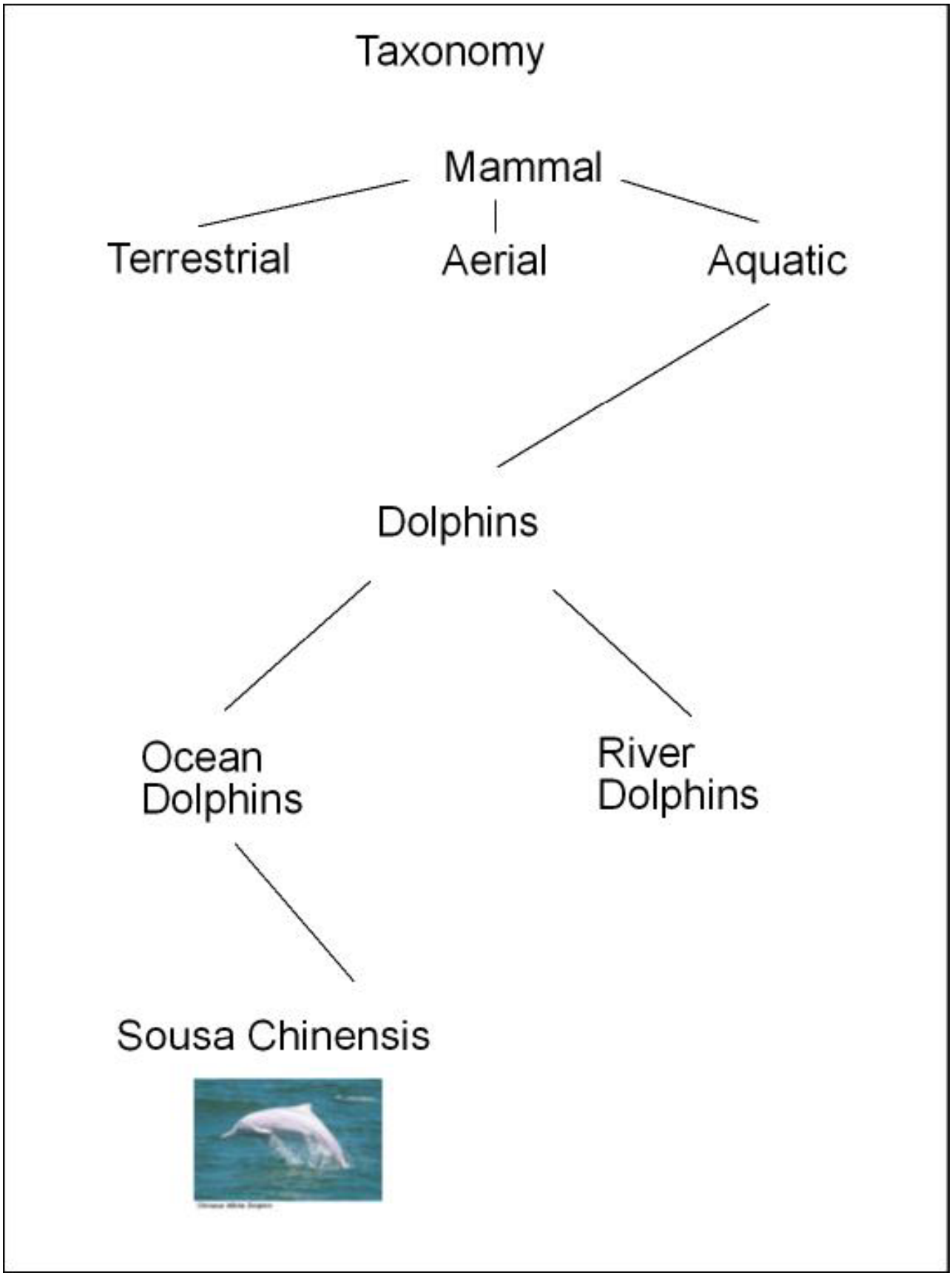
Paper Overview:

The paper would investigate the feasible solution to achieve a Semantic Web agent which would further assist human beings to free up their time for leisure or intellectual activities. To achieve this goal , the paper would analyses the web markup language (HTML,XML) and the relation between XML and ontology. And how a middleware may solve this problem. At last the paper would discuss a

potential usage of A.I. Semantic web agent, so the reader would have a clear vision of the power of the next generation of Internet.

2.Background

2.1 Representing information on the Semantic Web. The self-defining tags of XML also makes it extremely difficult to unifies standard, and cope with the problem synonymy(same word used for different meaning) and polysemy (same word used for different meaning).But the freedom of XML is a threat to the reliability of information on the Net. Semantic web is a net with infinite capacity. Kurt Godel, the famous logician, once said that human thoughts are sophisticated that sometimes human languages fail to capture the essence of the thought. What the paper is trying to do achieve is to create an agent that changes with the different contents of the Semantic web. The Net is a billion-web-page database would expand nonstop as long as computer exist. The current best search engine only crawl one fourth of the indexed web. An agent in a Semantic Web environment would revolutionize the everything from effective search to new level of E-commerce and Net application. Semantic Web harbors plenty of concepts, and each concept can be represented by a node in a graph. The nodes is connected by arcs which stands for relation. For instance, instance-of , has-a use arc to represent concepts. is-a represent subset relation, instance-of represent element of relation. (in set theory).
(see graph)


Taxonomy
Mammal
Terrestrial
Aerial
Aquatic
Dolphins
Ocean Dolphins
River Dolphins
Sousa Chinensis

Predicate logic/calculus:

Many things can be represented as objects and relationship in the world. For instance, Temple University has a Computer Science department and the department itself has Professor Wang.

Logical symbols: quantification, implication, conjunction, disjunction.

Non-logical symbols: constants, predicates, function and variable.

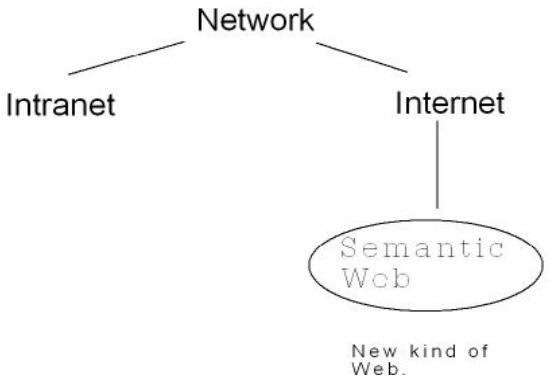
Ontology:

If two web document Shared understanding of the relevant domain and structure, Then it should be possible for them to reuse and share their knowledge. When two parties are agree on ontology, they agree on the shared insights. The term ontology is vague. Reusable components. Large ontology can be constructed by assembling and refining existing tag components. product(S,T,G) S is a student identifier, T is the school he/she graduated from. G is the graduate GPA of the student. Let us assume US education is used. Then 4.0 would be the highest possible GPA. But what if the website want to include student from different nations? The web agent has to convert different GPA to US standard. product(S,T,G,C) But then an evaluating agent has to be created to due with this situation. A Semantic Web semantic web agent would be sent to evaluate ontology on the web and combine them if needed, The Domain Difference increases the semantic heterogeneity. It requires sophisticated language

defining program and functions.

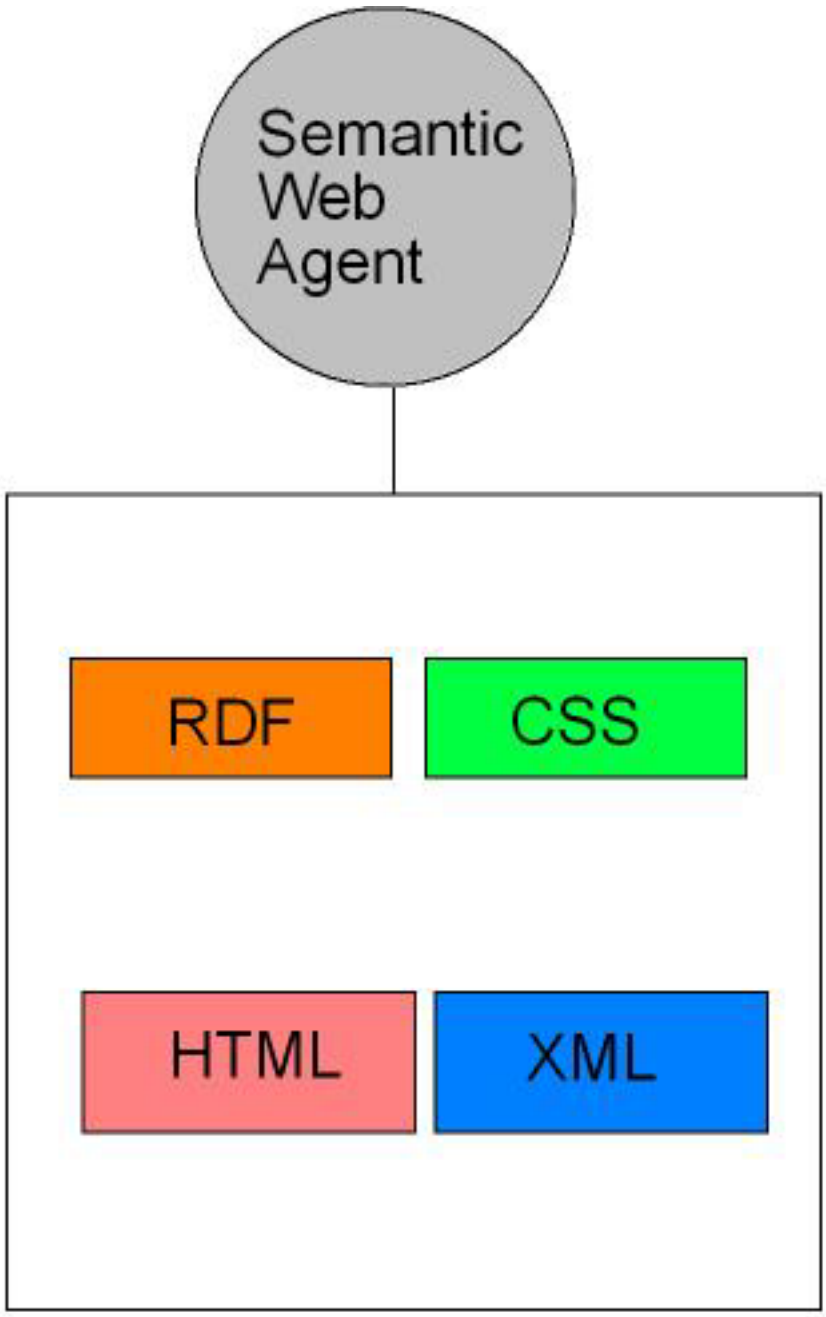
Graph 3

Ontology Extension



2.2 Concept of Semantic Web agent

If most of the existing ontology can be captured and mapped by a Semantic Web agent. Then Internet user would be able to extract information from the web. More precise data-mining ability means that different academic institution can interchange data dynamically. The Semantic Web would definitely empower super-size grid computing .which allows each personal computer to tackle a tiny piece of a complex problem such as studying drug resistance of various disease.
(see graph)



Agent to map ontologies on Semantic Web.

2.3 Architecture of Semantic Web

LOGICAL FOUNDATION OF THE SEMANTIC WEB:

Giving out denotation semantics for web pages. Use predicate calculus to describe website. Domain, objects of interest. Internet source as IS, the domain of discourse. potential Internet resource : PIR, Infinite set of well-formed formulas could be constructed within IS.

3. Hypothetical Case study

Case application in influenza:

Different web page provides certain degree of information accuracy, sometimes, even rumors. It is difficult to allocation relevant information. Map between terminology and contextual information. Rule to identify the symmetric, inverse, and transitive relationship .Source material for TSE risks: source material, processing, and end-product use.

```
...
<body>
<ontology id="flu ontology" version ="1,0">
<use-ontology id="base ontology" versoin = "1.0" prefix="base">

<def-category name="disease_agent" ISA="base.shoeentity:>
<def-category name="disease_agent" ISA="disease_agent">

....
<relation name="hasInput">
        <ARG POS = 1 TYPE="Process">
        <ARG POS = 2 TYPE="Material">
</relation>
<RELATION NAME = "hasOutput">
        <ARG POS=1 TYPE="Process">
        <ARG POS=2 TYPE="Material">
</RELATION>
```

...
</ONTOLOGY>
</BODY>

3.1.1 The ontology

A well-defined Ontology Design reflects category hierarchies, relation, and inference rule. The source code of the case study defines names that are attached with categories and relations. Declaring and extending ontology is critical to the success of the Semantic Web, the code from the case study determines:

- -Defining has-a and is-a relations between concepts and objects.
- What sorts of answer to be presented to users.
- Relationship between objects and ontology.

The code also shows rules that try to map tags with same meaning together. Defining classes and relationship is a good start to establish a workable ontology. Includes similar meaning to the oncology. It is devious to construct a well-defined ontology mechanism. Use inclusion-exclusion theory.The challenger comes when ontology software need rule to identify the symmetric, inverse, and transitive relationship .
(e.g.: x=y, y=z, x=z , a transitive property)

3.1.2 Annotation

ANNOTATION is the process of adding semantic markup to a web page. An instance would be identified by a key,(form by URL).Knowledge annotator display instances ,ontology and claims.

-Different objects can exist in different categories.

-Every single meaningful words.

-Relationship between ontology would also be descried as well.

Category and Relation and Instance.

```
<HTML>
<BODY>
..
<INSTANCE KEY="http:://www.health.temple.edu">
<USE-ONTOLOGY ID = "flu-Ontology" VERSION="1.0" PREFIX="flu"
<CATEGORY NAME="flu.Process">
<RELATION NAME="flu.name">
        <ARG POS="TO" VALUE="Rendering">
</RELATION>

....
</RELATION>
</INSTANCE>
</BODY>
</HTML>
```

3.1.3 How to process the annotation.

The most challenging part of the creation of Semantic Web is to process the annotation. Annotation describes URL or the relation between objects that web master creates. An manual web annotation maybe a workable solution. But processing them requires a much more effective approach.

3.1.4 Information analysis

Software such as SHOE (Simple HTML Ontology Extensions) and OWL can work out a certain amount of ontology. But they're still far from perfect. If Computer

scientists can find a way to establish a program that analysis contents of web sites, then a Semantic Web agent should be able to map ambiguous ontology and even combine them.

3.1.5 Summary of the case study

4. Proposal of the Semantic Web middle agent.

I propose to create a web middle agent that could distinguish the relationship and hierarchy of different tags on the Semantic web. Mapping, reusing and dynamic communicating with different web. By embedding the software like WordNet, a human lexical memory developed by Princeton University, in the functions of the Semantic Web agent, a more accurate mapping between web ontology may become possible. In addition, a better software has to be developed to meet the almost infinite ontology and information in the world. Hopefully, an agent can act as a "middle-man" between all these communication layers.

5. Summary

Due to the complexity of both human and computer language and its flexibility ,It is extremely difficult to accomplish Semantic web agent at this time. The progress of transferring from the current Net to the Semantic Web would speed up if everyone starts annotating his/her web pages. The application of Semantic web by using Semantic web middle agent may be feasible. Similar to the emergence of

popularity of computer, it may take several years for the general public to recognized its importance. To realize the potential of the Internet, an Semantic Web agent is needed to solve the problems of communication levels. A workable Semantic Web agent is indeed a complicated problem that requires lots of effort from the Computer Science community. We not only have to work out the infrastructure of the net, but also a standard medium to make them work. I believe that successful implementation of Semantic web agent would be another breakthrough for the Computer science community. It would transform any field that uses computer system.

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San Jose.

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