Semantic Description and Discovery of Garuda Resources

R.A. Balachandar
Grid Computing Laboratory
Madras Institute of Technology
Anna University
balsonra@yahoo.co.in
Objective

Knowledge layer – A semantic Component that supports semantic description and discovery of Grid Resources
Motivation

- Conventional mechanisms
  - UDDI
  - MDS

- They support searching mechanisms based on keywords.

- The node providers need to agree upon attribute names and values.

- In grid-like environment, where resources come and go there is always a demand for framework to support semantic description and discovery of services and resources.
Background

Grid

A kind of distributed infrastructure that enables flexible, secure, coordinated resource sharing among dynamic collections of individuals, institutions, and organizational resources. *(This is what Virtual Organization is)*

Semantic Grid

The **Semantic Grid** is an extension of the current Grid in which information is given a well-defined meaning, better enabling computers and people to work in cooperation.
Semantic Component

- Comprises two modules – **Semantic Description** and **Discovery**

**Semantic Description**

- Domain Knowledge of grid is represented in ontology template
- MDS is used to ‘plug’ grid resource information
- Protégé-OWL APIs are used to build knowledge base of the grid using ontology template

**Semantic Discovery**

- Algernon inference is used to retrieve resource information
Related Tools

- **Ontology**

  You need an Editor to Create Ontology

- **Inference Engine**

  To retrieve Knowledge from Ontology
Ontology

- Ontologies are used to capture knowledge about some domain of interest.
- Ontology describes the concepts in the domain and also the relationships that hold between those concepts.
- An ontology together with a set of individual instances of classes constitutes a knowledge base.
- Web Ontology Language (OWL) is widely used to create Ontology.

Ex: Protégé, an OWL editor
Ontology Template

Definition - 1

Any resource can be modeled as an instance of a specific class provided that the resource can be described using the properties defined in that class.

Definition - 2

An ontology template is the domain specific ontology that provides hierarchy of classes with properties to define characteristics.
Semantic Description – Creating Knowledge Base

- GIIS/GRIS service runs on globus machine will retrieve resource information of the local host and stores it in LDAP server from where we can query the information.

- Protégé-OWL provides versatile libraries with which one can manage ontology and knowledge base. With those APIs insertion and removal of resources are possible

```java
OWLNamedClass computerC=owlmodel.getOWLNamedClass("WorkStation");
OWLDatatypeProperty hasIP = owlModel.getOWLDatatypeProperty("hasIP");
cpuI.addPropertyValue(owlModel.getOWLObjectProperty("hasCPUVendor"),cVendorI);
computerI.addPropertyValue(owlModel.getOWLObjectProperty("hasCPU"),cpuI);
```
Semantic Discovery

- Exploits the expressive power of ontology for better information retrieval
- Retrieves ‘More closer’ resources
- Algernon Reasoner

*For Ex, if the user request a resource with AIX OS and Release 5.0, the discovery portal retrieves AIX machines with 5.1 release if the machine with 5.0 release is not available. This is because, the portal understands that release 5.1 has backward compatibility and hence it can run the jobs compiled with 5.0. (The concept of ontology establish this relationship that can be reasoned using algernon inference engine*
Garuda Semantic Component

Semantic Component

Resource Information

Background Resource Ontology

Resource Discovery Module

Garuda Middleware

Garuda Resources

User Request

Resource + Job

Refers
Tools and Technologies used

* Protégé Editor – An Ontology Editor

* Protégé-OWL APIs – To create/modify/save ontology knowledge base

* Algernon Inference Engine – Information retrieval from ontology

  Knowledge base
Resource Request Form

Select Operating System: Linux
Select Release: 2.2
Processor Type: Intel
Select Search Level: Compatible Release

List of Matching Resource(s):
- MIT/Linux_2.6
- Bangalore/Linux_2.4
- Pune/Linux_2.4

Submit
Select
Reset
Conclusion

- The Discovery Module can further be extended to ‘pull’ out resource information from Middleware itself?
- Ontology Representation can also be extended to other ‘Metadata’ such as Policies, Status of resources etc..
- Larger the ‘Vocabularies’, greater the scope of Reasoning (Implementing ‘Rule’ based inferences also possible)
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Questions