BioAgent A Mobile Agent System for Bioscientists



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Outline

- motivation
- brief history of BioAgent
- Bioagent architecture
- Bioagent abstract model
- Preliminary results
- on-going work



Why Agent

- To support Bioscientists during the genome data analysis
 - Available data growth exponentially: many research institutes are publishing data on line
- To decentralize the coordination of local tasks processing that characterize a workflow of an experiement
- To allow the use of remote data, usually prohibitive for the complex interaction
- To allow the use of interesting experiments that might contain relevant information but may have been carried out in locations which have escaped notice



Why Mobile

- Biological experimental workflow
 - not necessarily need to transfer all data
 - could only move code
 - could process its tasks by traveling over the network using remote data and services



Could be Intelligent ?

 Intelligence in an agent concers the ability to perceive the environment (context) where its mission must be achieved using a conceptual map of the workflow



Intelligent mobile agent

An agent is a program capable of acting exactingly in order to accomplish one o more tasks on behalf of its user

A mobile agent is a program that can move from host to host in a network by keeping its state while travelling

An intelligent mobile agent is program that perciving the working context and perform its mission in a dynamic environment can decide to move between nodes preserving its status.



Why another Mobile Agent System?

- Many mobile agent systems have been developed in both industry and research:
 - Aglets, D'Agents, Mole, Ara, NOMADS, ...
- We propose a new one starting from application point of view: Biological domain
- Biological Application requirements
 - simplicity
 - scalability
 - modularity
 - usability



History

- May 2001: Nettab 2001
- June: first prototype, we accept the challenge send to us by L. Toldo
- July: Bioagent has been announced at BOSC 2001 Copenhagen
- December: braimstorming on our idea of mobility
- January: 5 students are committed to the project
- July 2002: Nettab 2002 first release of the system



Main choices

- All Java
- All XML + DTD + RDF + XOL
- All declarative
- Two Agent model
 - Service agent
 - User agent

System architecture







Introduction to the system

The BioAgent is a 4-layered architecture

- Core Layer
 - Security management
 - Resourse management
 - Mobility management
 - Agent management communication management
- Service agent Layer
 - Broker agent
 - Web interface agent
 - Wrapper service
 - Ontology service
- BioAgent Layer:
 - User agent
- Workflow Layer





security manager intercepts any agent's request and verifies the caller's credentials for execution of the requested operation.

<u>resource manager</u>: provides all basic primitives with access stored data <u>mobility manager</u>: supports agents migration

<u>communication manager</u>: allows hierarchical communication between agent parent and agent children. Communication is independent of the location where agents are active.

Bioagent manager: supports creation and cloning of agents



Service agent Layer

Broker agent: keeps track of each running service agent and provides any new agent with a list of locally accessible services

- <u>Web service</u>: manages interaction between users and platform, by this service a user can direcly interact with location services
- <u>Wrapper</u>: provides access to local resources by abstracting from the nature, providing a uniform representation using XML
- <u>Ontology service</u>: manages ontologies using integration tools.

BioAgent layer



BioAgent Layer is populated by user agents, it concerns with management of user agents.

The BioAgent layer consists of all those functions related to the "intelligence" agent planning, coordination, perception ...



Workflow Layer

In the BioAgente context:

- the term *workflow* means the coordinated execution of multiple tasks or activities. Thus a
- Biological experiment can be seen as a workflow

The Workflow Layer provides BioAgent-*l* a suitable language and tools suitable for defining and managing workflow

System architecture







The network





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Service agents directly access the local resources



User agents access the local resourses by interactiong with service agents i.e. wrappers









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Cloning



Cloning and Moving



Protocol between UserAgent and ServiceAgent



User knows protocol from service
User uses istance for query
User uses only istance DOM for all service XML_{in}







Implementation Hints

- BioAgent is a platform completely developed in Java based on simplicity, modularity and ease-of-handling
- simplicity is provided by
 - the unique abstract class *Agent* which assigns the basic features to each agent
 - there are two usable extensions of *agent*: UserAgent and ServiceAgent
 - *The security manager* defines constrains for each istance of *ServiceAgent* and *UserAgent*
- modularity is based on
 - services are plug-in
 - Platforms interction via *serialization reflection* not RMI
- Ease-of-handling
 - Web interface for common user agent



BioAgent abstract model

 Ontological level – domain
 It models the application domain using Common ontology

→ workflow (conceptual map)

Environmental level – context

 it models the environment in which the agent is going to work using

 \rightarrow user and service agent

Preliminary model v.1





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On-going works

- Complete the specification and development of the two architectural highest layers functionalities and to prove the system in a complex real applications.
- Compare efficiency and effectiveness of our mobile system with those not mobile but proposed to support automated genomic annotation problem
- Development of Darwin service to support BioAgent –l
- Development EnsEmbl,
- Development of BioAgent- *l* compile
- Try to become FIPA compliant



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www.BioAgent.net

