Distributed Applications

Agents

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Intelligent Components

- We have so far looked at Components and Component oriented development (such as CORBA, DCOM etc)
- Now, we go one stage further
- Components with “Intelligence” two types:
  - Intelligent (Stationary) agents
  - Mobile agents

Information sources

The EU agentlink site is a good start [age,]. Ince [Ince, 2004] has a good outline.

Mobile Agents

Components which are no longer restricted to reside on a single machine.

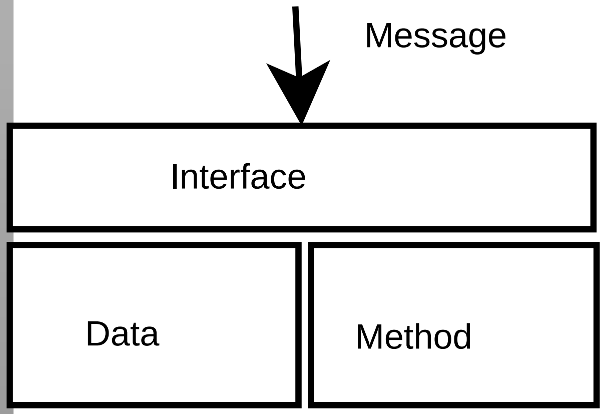
Components can migrate from one machine to another

Components execute on each host they land

Agent definition

- An agent is a suite of programs
- An agent can interact
- An agent can be built from simpler objects
- Agents can interact with other agents
- Agents can co-operate
- An agent can move across hosts

Agent and object architectures



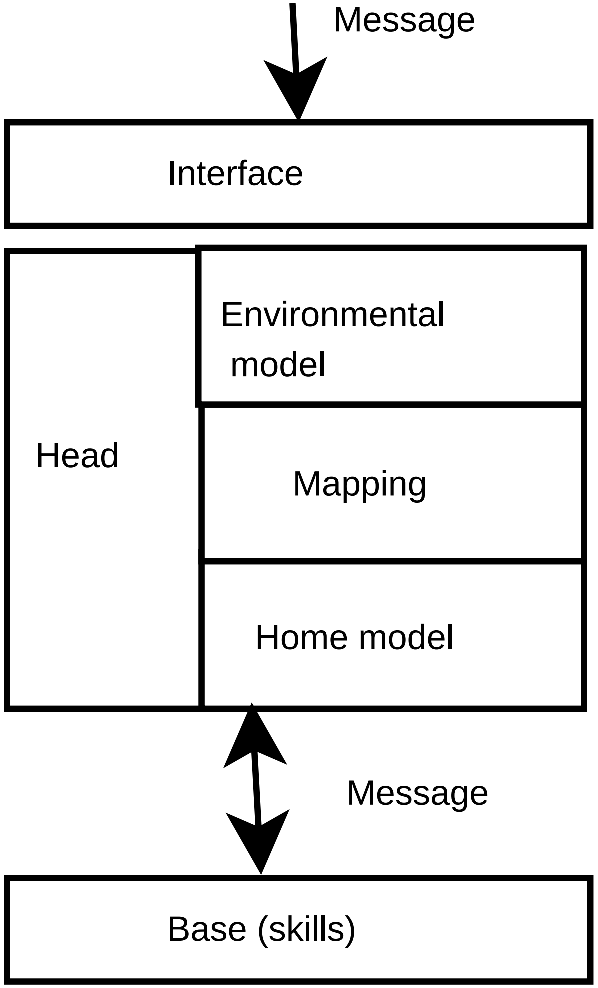
Message

Interface

Data

Method

Object architecture



Message

Interface

Head

Environmental model

Mapping

Home model

Message

Base (skills)

Simple agent architecture

Communication between agents

Co-operation between otherwise autonomous agents requires a basic protocol

- Agreement to perform a task
- Interaction
- Termination

Communication models

- hierarchical, centralised
- authority structures
- market-like organisation
- rules of behaviour

Agent Communication Language

ACL consists of:

- Vocabulary
- Inner language (Knowledge Interchange Format)
- Outer language (Knowledge Query and Manipulation Language (KQML) or FIPA ACL)

Mobile agents

- Mobile Agents are components which move from one machine to another over the network
- Mobile Agents carry their state their code, and a routing table
- Mobile Agents introduce problems: Security, Performance, Granularity etc
- Mobile Agents can also contain intelligence
- Examples: Voyager, Kafka (Libraries for mobile Java components)

Mediators

- Transformation / subsetting of databases
- Gathering “an appropriate amount of information”
- Access and merge data from different knowledge schemas
- Abstraction and generalisation
- Impose knowledge structures on flat text
- Maintaining derived data

Facilitators

Facilitators require:

- metadata about information sources,
- definitions for disparate concepts
- format descriptions

Facilitator functions

- White pages
- Yellow pages
- Direct communication
- Content based routing
- Problem decomposition
- Translation
- Monitoring

Why agents?

- Simplifying distributed computing
- Overcoming user interface problems
- Research paradigm for AI

Agent-enabling technologies

- Java (language)
- CORBA (infrastructure)
- Knowldedge Query Manipulation Language (KQML) (protocol)

Agent types

1 Nwana's classification

- Mobility: static or mobile
- Reasoning model: deliberative or reactive
- Ideal attributes: autonomy, learning and cooperation
- Role: information, management
- Hybrid: combination of the above

Source: H. Nwana, Software Agents: An Overview

Collaborative agents

- Modular
- Agents negotiate
- Some agents collaborate
- Agents wrap around legacy systems
- Provide solutions to inherently distributed problems
- Protocols: eg, Contract Net

Interface agents

- Support and provide assistance.
- Cooperates with the user in accomplishing task
- Interface agents learn:
  - by observing and imitating the user
  - through feedback from the user
  - by receiving explicit instructions
  - by asking other agents for advice

Some functions

- Filters
- Eager assistant
- Social filtering

Reactive agents

- Reactive agents do not have internal symbolic models.
- Act by stimulus-response to current state of environment.
- Each reactive agent is simple
- Complex patterns of behavior emerge from their interaction.
- Benefits
- Challenges: scalability

Mobile agents

- Programs that can migrate
- Execute in platform-independent environment
- Require agent execution environment (places)
- Practical but non-functional advantages:

Agent architecture

- One-hop mobile agents (migrate to **one** other place)
- Multi-hop mobile agents (roam the network from place to place)

Aplications

- Distributed information retrieval.
- Telecommunication network routing.

Issues in Agent Design

Selfawareness

Protocols and languages

Disparity of agents

How autonomous should an agent be?

Friend, foe or nuisance?

References

[age,] `http://www.agentlink.org`.

[Ince, 2004] Ince, D. (2004). *Developing Distributed and E-commerce Applications*. Addison-Wesley, second edition.