Advanced
Artificial Intelligent Technologies
-에이전트를 중심으로

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Dept. of Computer Science
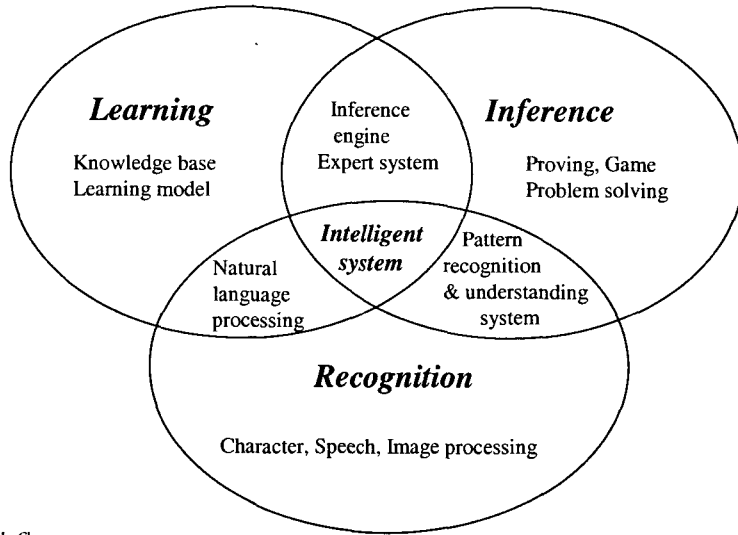The University of Suwon
ycho@suwon.ac.kr

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Contents

1. Intelligent Agent Concept
2. Conventional Intelligent Agent Technologies
3. Advanced Intelligent Agent Technologies
4. TMA에 의한 지능정보시스템
5. Conclusions

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Intelligent Techniques

Learning

Knowledge base
Learning model

Inference
engine
Expert system

Inference

Proving, Game
Problem solving

Intelligent
system

Natural
language
processing

Pattern
recognition
& understanding
system

Recognition

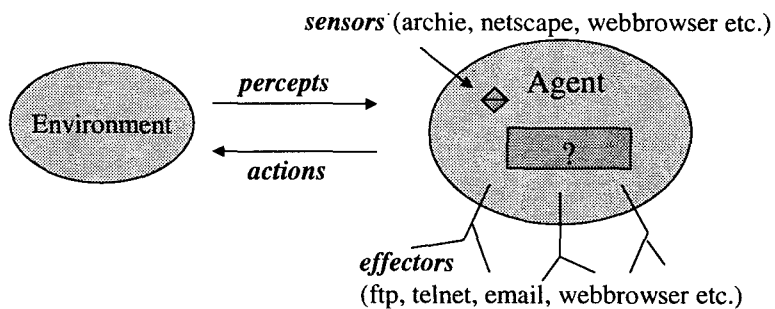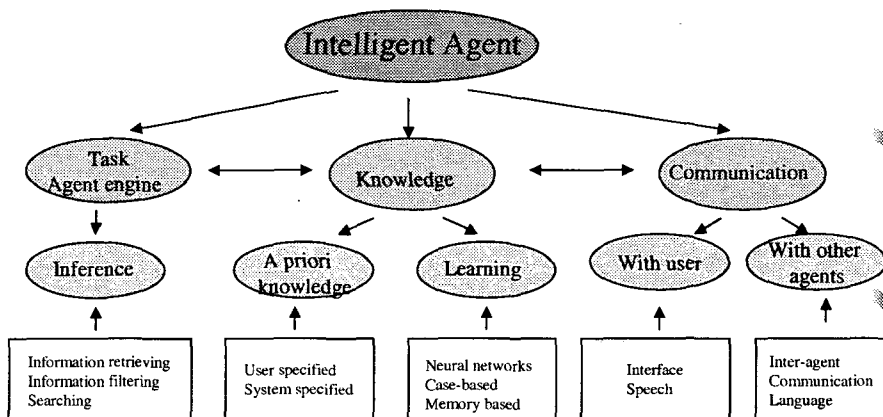Character, Speech, Image processing

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What is an Agent?

- An agent is anything that can be viewed as *perceiving* its environment through *sensors* and acting upon that environment through *effectors* (S.Russell, P.Norvig, 1995)

sensors (archie, netscape, webbrowser etc.)

Environment

percepts

actions

Agent

?

effectors
(ftp, telnet, email, webbrowser etc.)

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Functional Architecture of Intelligent Agent

Information retrieving Information filtering Searching	User specified System specified	Neural networks Case-based Memory based	Interface Speech	Inter-agent Communication Language

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Factors of Intelligent Agent Technology

Intelligence

Agency

Machinery

다양한 intelligence degree를 지원
하는 엔진들
inferencing, learning
validation, representation

Security

분산 컴퓨팅과 관련된 사항
mutual, privacy, payment
public authentication

Content

Machinery에서 쓰이는 추론과
학습용 데이터
rule, context, grammar, ontology

Access

Machinery가 content를 인지하고
추론을 통해 action을 수행할 수
있게 하는 방법
networking, mobility
data & service application

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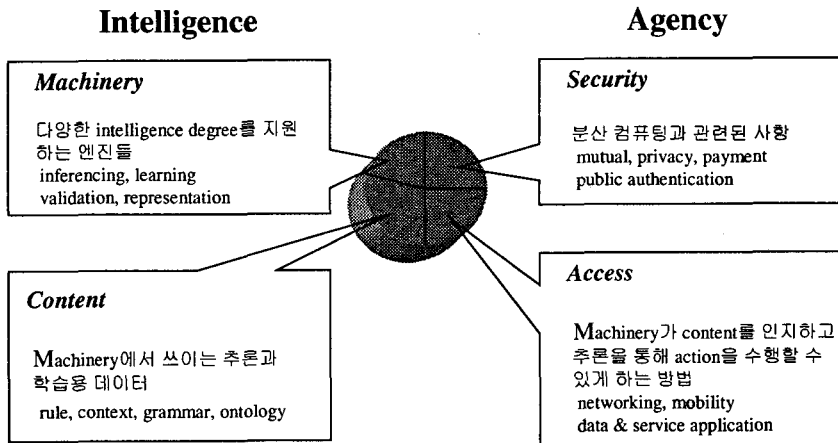
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Conceptual Agent Modeling

Access

Content

Event

Knowledge

Inference Engine

Behavior

Security

Access

Access Control

Machinery

Knowledge Base

Learning Engine

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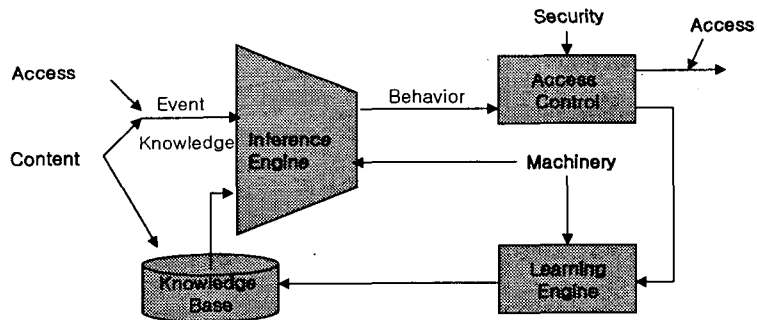
Intelligent Agent Measurement

Agency

에이전트 상호작용

서비스 상호작용

애플리케이션
상호작용

데이터 상호작용

사용자 표현

비동기성

가장
자능적인
에이전트

★ 웹 서치 에이전트(NewsHound, Surfboard)

★ 워크플로우 자동화(Edify Electronic Workforce, IBM FlowMark)

★ Lotus Notes

★ 사용자인터페이스 에이전트
(Charles River Analytics Open
Sesame, IBM)

★ 데이타베이스 에이전트
(Oracle, IBM knowledge utility)

★ 모바일 에이전트(GM Tabiz, FTP CybeAgent)

★ 메일 에이전트(Banyan Beyond Mail, Lotus Notes)
★ IBM 에이전트 구축환경
★ 임베디드 에이전트(Apple Newton PIM,
GM Magicap)

★ SNMP V2

가장
자능적이지
못한 에이전트

Threshold

선호도   추론   학습
(preference)   (reasoning)   (learning)

Intelligence

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Types by Network's Structure

Types of Agents

Coordination Agent

Interface Agent

Mobile Agent

Information Agent

Reactive Agent

Hybrid Agent

Heterogeneous Agent

Smart Agent

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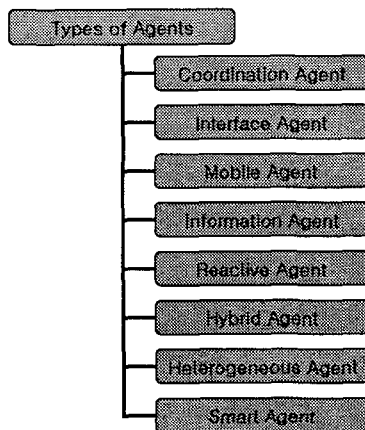
Types by Agent's Environments

Desktop Agents (user assistance)	Operating System Agents Application Agents Application Suite Agents
Internet Agents (information agents)	Web Search Agents Web Server Agents Information Filtering Agents Information Retrieval Agents Information Extraction Agents Notification Agents Service Agents Mobile Agents Middle Agents
Intranet Agents (workflow, customization)	Collaborative Customization Agents Process Automation Agents Database Agents Resource Brokering Agents

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Drawback in Conventional Researches

- Lack of Theoretical Model and Development Methodology
- Lack of Ability to deal with
  - Complexity of User's Requirements (Time/Quality/Cost etc.)
  - Heterogeneous as well as Huge Information in Internet
  - Acquired rather than Retrieved
  - Distributed Processing
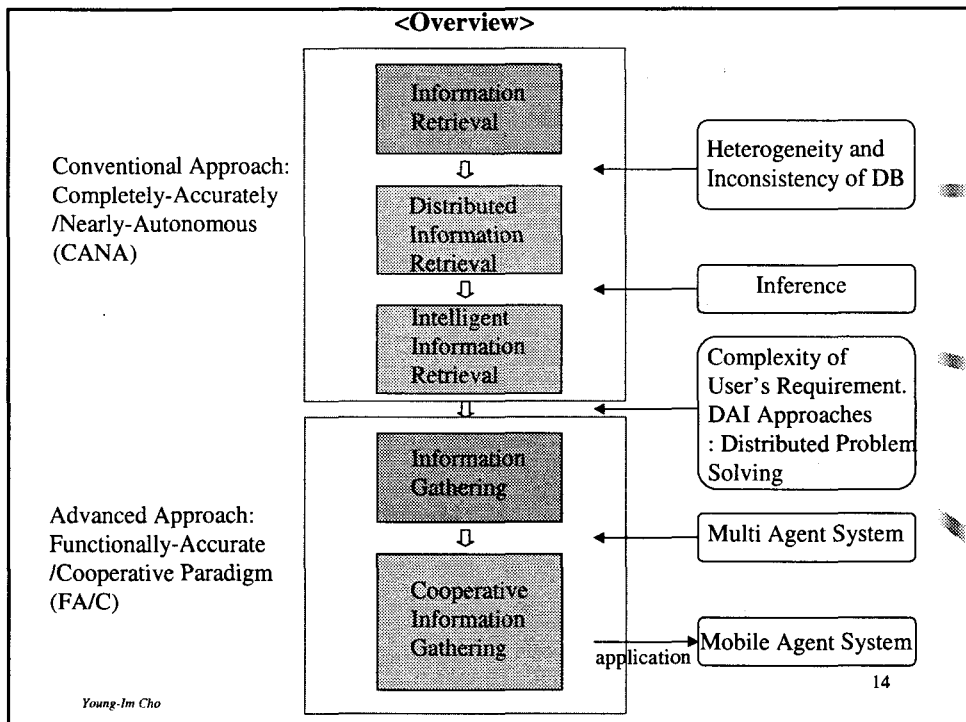 - Large Scale Network (Multiple Wide Area Network)

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3. **Advanced Intelligent Agent Technologies**
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<Overview>

Conventional Approach:
Completely-Accurately
/Nearly-Autonomous
(CANA)

> Information Retrieval
> ⇩
> Distributed Information Retrieval
> ⇩
> Intelligent Information Retrieval
> ⇩

Heterogeneity and Inconsistency of DB

Inference

Complexity of User's Requirement.
DAI Approaches
: Distributed Problem Solving

Advanced Approach:
Functionally-Accurate
/Cooperative Paradigm
(FA/C)

> Information Gathering
> ⇩
> Cooperative Information Gathering

Multi Agent System

application →Mobile Agent System

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Completely-Accurate/ Nearly-Autonomous Approach

- Definition (1980)
  - Assumption: Each decomposed agent has sufficient data to solve its assigned sub-problems completely and accurately with little or no interaction with other agents
  - Little or no communicate with other agents
  - Simply information retrieval
- Limitations
  - Communication bandwidth
  - Delay of synchronization time
  - Reliability
  - Speed etc.

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New Trends

- Distributed AI Approach to Agent System
  - FA/C Paradigm (1991)
  - Mobile Multi Agent System (1998~)
  - Cooperative Information Gathering (1999~)
- Development of Agent Frameworks
  - JAF (Java Agent Framework) (1995)
  - DECAF(Distributed Environment Centered Agent Framework) (1996)
  - Advanced DECAF(2004~)

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Distributed Artificial Intelligence(DAI)

- Modern Approach to Agent System
- Generalization of AI

  DAI is the study, construction, and application of multiagent systems,

  that is, systems in which several interacting, intelligent agents purse, some

  set of goals or perform some set of tasks

  - Gerhard Weiss, Multiagent System

- Types
  - MAS(Multi Agent System)
    - Focus on agents coordination
  - DPS(Distributed Problem Solving)
    - Focus on task decomposition and solution synthesis
  - Hybrid: MAS + DPS ⟹ FA/C Paradigm

    FA/C Paradigm + Mobility⟹ Mobile Agent

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Attributes vs. Potential Range in MAS

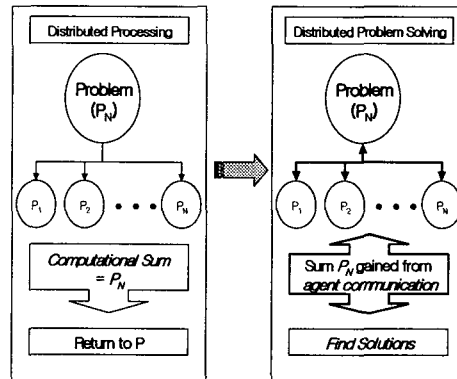|	Attributes	Potential Range
Agents	number uniformity goals architecture abilities (sensors, effectors, cognition)	from two upward homogeneous ... heterogeneous contradicting ... complementary reactive ... deliberative simple ... advanced
Interaction	frequency persistence level pattern(flow of data and control) variability purpose	low ... high short-term ... long-term single-passing ... knowledge-intensive decentralized ... hierarchical fixed ... changeable competitive ... cooperative
Environment	predictability dynamics diversity availability of resources	foreseeable ... unforeseeable fixed ... variable poor .. Rich restricted ... ample

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Distributed Problem Solving(DPS)

- **Distributed Processing**
  - Appropriate when subproblems are *independent*
  - Given a computational problem P

    $P \longrightarrow P_i (1 \le i \le n) \longrightarrow \Sigma P_i$

    $\longrightarrow$ Return to P

- **Distributed Problem Solving**
  - Appropriate when subproblems have *interdependencies* and where there is some benefit to be gained both logically and in terms of the global solution from *agent communication*
  - $P \longleftrightarrow P_i (1 \le i \le n) \longleftrightarrow \Sigma P_i$

    $\longleftrightarrow$ Find Solution
  - Partial results can be exchanged among agents

Distributed Processing
Problem (P_N)
P_1 P_2 • • • P_N
Computational Sum $= P_N$
Return to P

Distributed Problem Solving
Problem (P_N)
P_1 P_2 • • • P_N
Sum P_N gained from agent communication
Find Solutions

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Functionally-Accurate/Cooperative Paradigm (FA/C)

- Approaches to Multi-Agent System by DPS
- Proposed by Victor R.Lesser (Univ. of Mass, 1991)
  - Agents are solving *interdependent, large-grained* subproblems
  - Agents can generate *partial and tentative high-level solutions* in spite of incomplete and uncertain information
  - Agents can *partially resolve inconsistencies and uncertainties* based on constraints derived from partial solutions to interdependent subproblems received from other agents
- Advantages
  - Lower message traffic
  - More system reliability in face of processor, communication and sensor failure
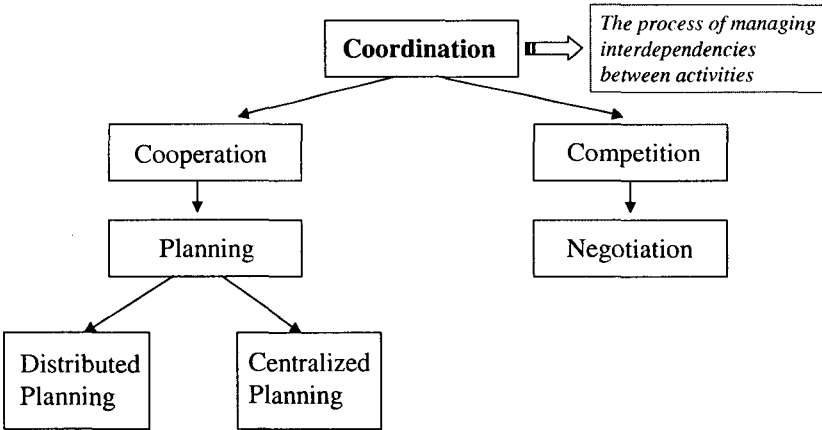 - Less agent idle time and more parallelism
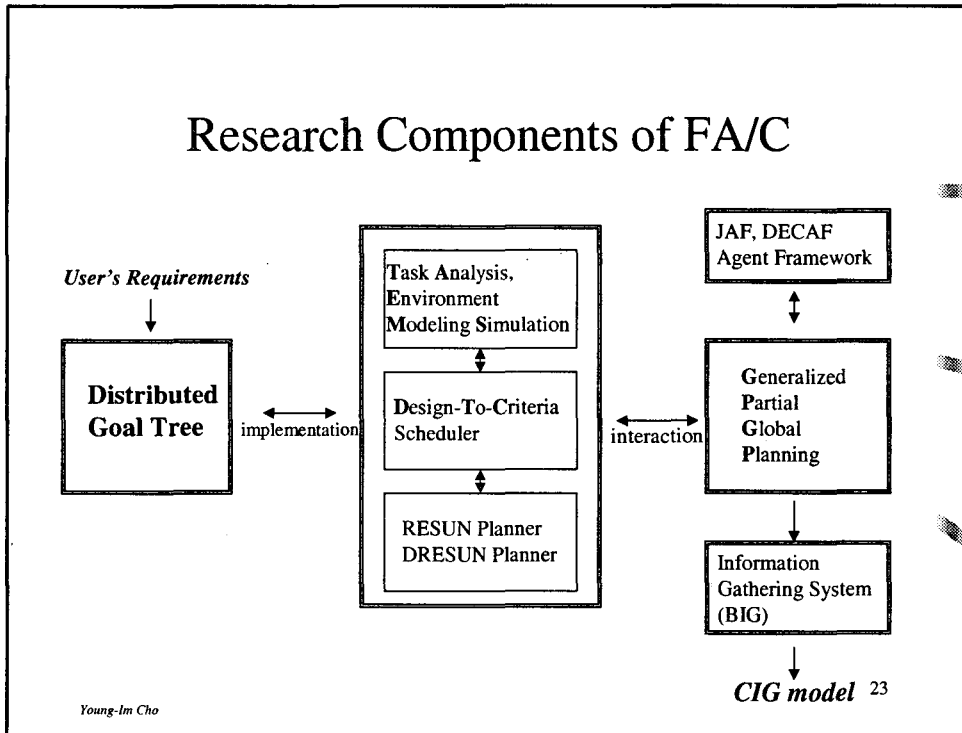
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Example of FA/C

- Two-Agent Distributed Aircraft Monitoring Scenario

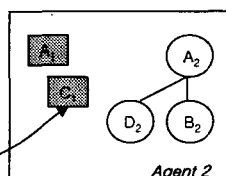| Agents A	DataInput

1A
2A
3A
4A
5A
5B   6A
7A
6B
7B
8B
9B
10B

Agent B

Agents A	Final Solution

1A
2A
3A   Ghost Track
4'A   4A
5A
5B   6A
7A
6B
7B
Vehicle Track   8B
9B
10B

Agent B

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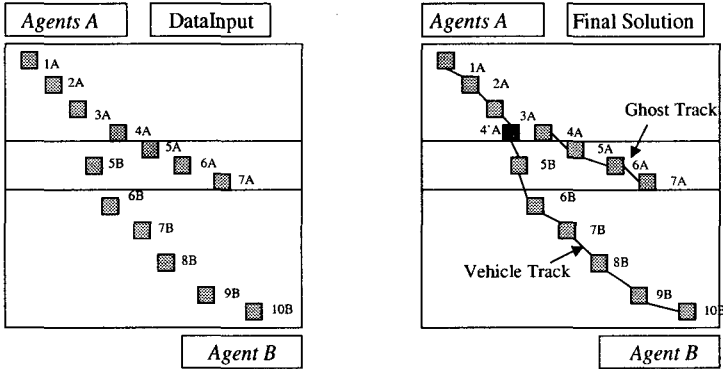
Taxonomy of Coordination

Coordination ⊏⟹ *The process of managing interdependencies between activities*

Cooperation   Competition

Planning   Negotiation

Distributed Planning   Centralized Planning

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Research Components of FA/C

User's Requirements

↓

Distributed Goal Tree ← implementation →

Task Analysis, Environment Modeling Simulation

↕

Design-To-Criteria Scheduler ← interaction →

↕

RESUN Planner
DRESUN Planner

JAF, DECAF Agent Framework

↕

Generalized Partial Global Planning

↓

Information Gathering System (BIG)

↓

CIG model 23

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Agent Negotiation Algorithm

- **GPGP (Generalized Partial Global Planning)**
  - 여러 에이전트들이 있을 때 상호 조정함으로써 하나의 큰 문제를 해결할 수 있도록 제안한 플래닝 알고리즘으로 일반화된 조정 과정에 사용되는 협상 알고리즘
  - Facilitator에 의해 중재

Problem Solver Bean

Agent A

CoordinationEvent

Coordination Bean

FSMEvent

FSM

KQML message

Agent B

Problem Solver Bean

CoordinationEvent

Coordination Bean

FSMEvent

FSM

A₁, A, B₁, C₁ — 조정, 중재 — *Agent 1*

통신

A, C₁, D₂, B₂, A₂ — *Agent 2*

○ : 지역적 목표들
▨ : 원격 목표들

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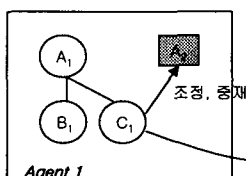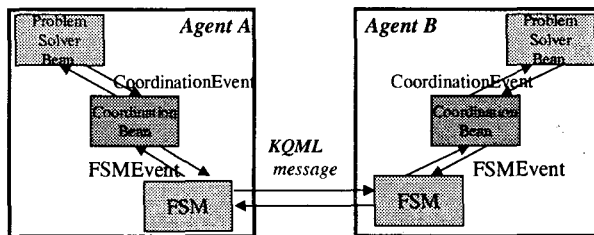
TAEMS

- **TAEMS (Task Analysis Environmental Modeling and Simulation)**
  - 태스크 구조를 형성함으로써 전체 시스템 목표를 수행해 나가기 위한 중요한 분산 목표 트리 구조를 생성하는 시스템 개발도구
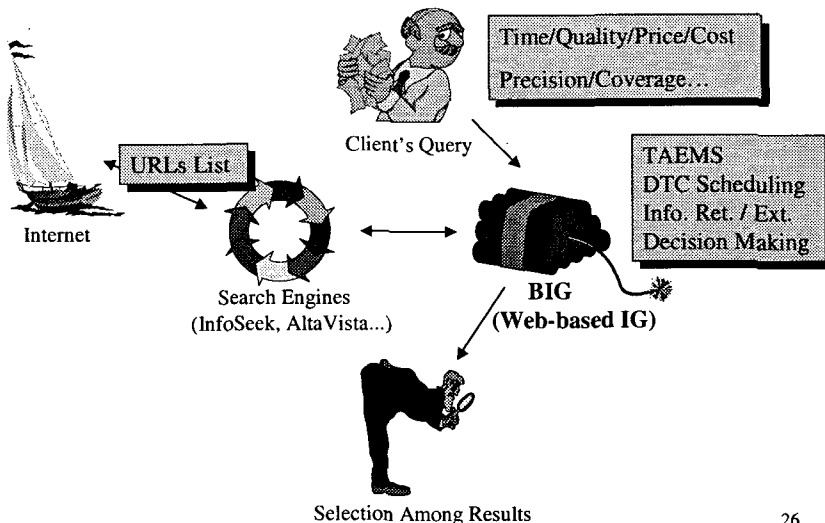 - 분산목표트리: 에이전트 목표(goal)과 메소드간의 상호의존성을 나타낸 것

<Distributed Goal Tree>   <TAEMS Task Structure>

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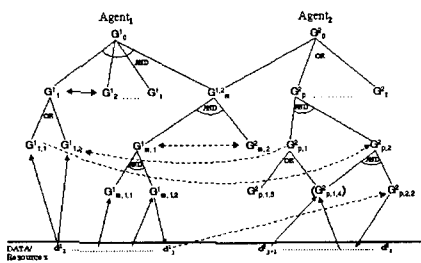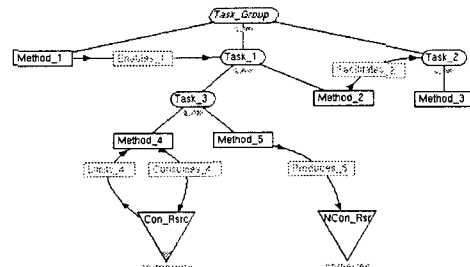
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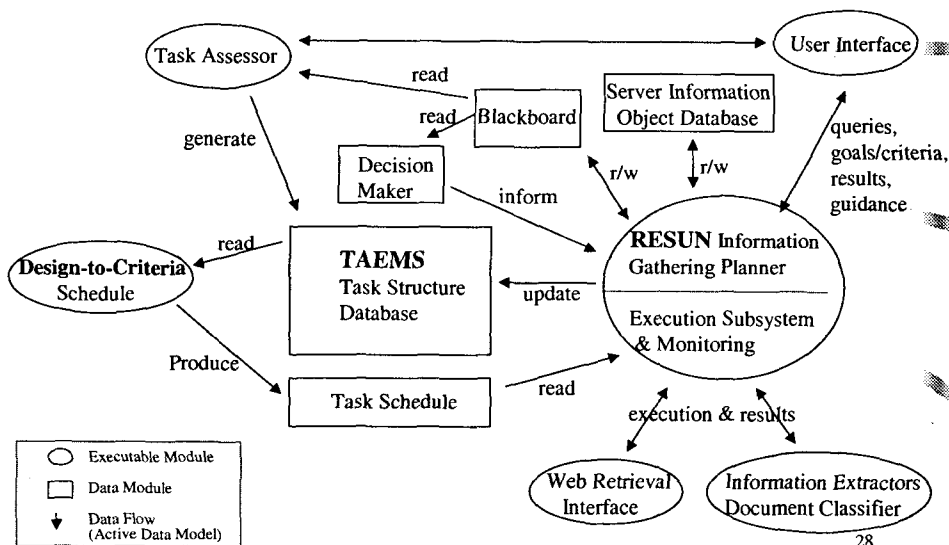# Case Study:BIG
(Resource-*B*ounded *I*nformation *G*athering, 1999)

Time/Quality/Price/Cost
Precision/Coverage...

Client's Query

URLs List

Internet

TAEMS
DTC Scheduling
Info. Ret. / Ext.
Decision Making

Search Engines
(InfoSeek, AltaVista...)

BIG
(Web-based IG)

Selection Among Results

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BIG vs. Web-based Information System

	Meta Search Engine	Personal Information Agent	Shopping Agent
Similarity	- Using multiple different web search tools	- Gathering documents by actively web searching	- Gathering documents with price information
Difference (BIG ability)	- Learning products over time - Reasoning time/quality trade off of different web search options	- Performing information extraction on retrieved data	- Difference in complexity of decision process and information processing facilities
Characteristics	- Supplementation IR technology of search engines - Clustering documents - Too much data	- Search from one or more specific points on web - Selectively pursing links for relevant information - Concept-driven	- Search from built-in library - Development of shopping sites and interaction of relevant information
Types	- SavvySearch - MetaCrawler	- Not as fast as Meta Search Engine - Spider	- BargainFinder - Shopboat - Jango

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BIG Agent Architecture

- Task Assessor
- User Interface
- read
- read — Blackboard
- Server Information Object Database
- generate
- Decision Maker
- queries, goals/criteria, results, guidance
- r/w
- r/w
- inform
- read
- Design-to-Criteria Schedule
- TAEMS Task Structure Database
- update
- RESUN Information Gathering Planner
- Execution Subsystem & Monitoring
- Produce
- Task Schedule
- read
- execution & results
- Web Retrieval Interface
- Information Extractors Document Classifier

○ Executable Module
□ Data Module
↓ Data Flow (Active Data Model)

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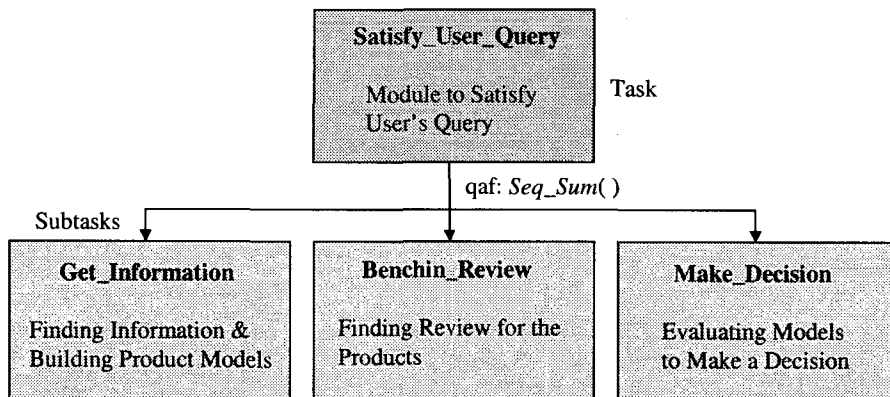*Young-Im Cho*

Execution Trace

< Client >

A student who uses the system to find a *Word Processing Package* which will most closely satisfy a set of requirements and constraints

- Query Formulation : User Interface
- Plan Construction : TAEMS
- Schedule Generation : DTC Scheduling
- Information Retrieval and Extraction : RESUN Planner
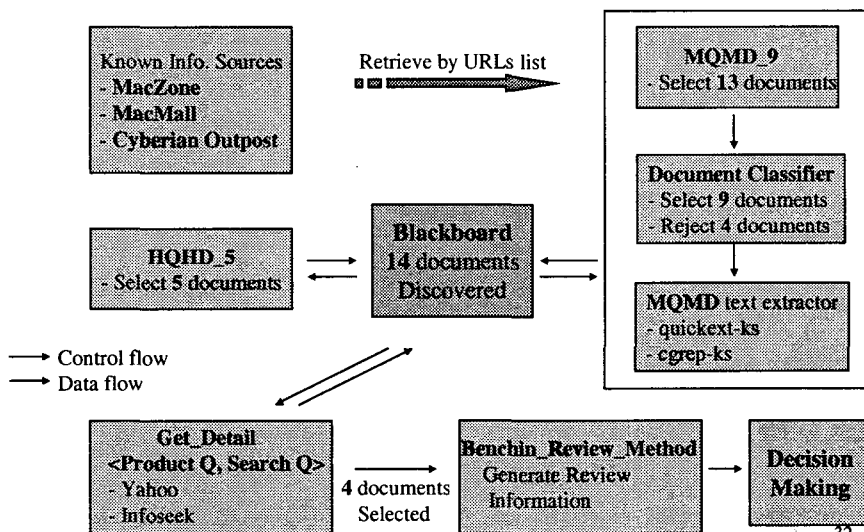- Decision Making : Score Calculation

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TAEMS Task Structure

Satisfy_User_Query

Module to Satisfy
User's Query

Task

qaf: *Seq_Sum( )*

Subtasks

Get_Information	**Benchin_Review**	**Make_Decision**
Finding Information & Building Product Models	Finding Review for the Products	Evaluating Models to Make a Decision

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Schedule Generation

Method Name	Schedule Time	Execution Time
Scheduling		8
Send_Query_maczone	1	1
Send_Query_cybout	2	1
Send_Query_macmall	1	0
Slack_MyTime	27	27
Get_Back_macmall	19	19
Get_Back_cybout	20	22
Get_Back_macmall	19	8
Median_Quality_Duration_9	72	67
High_Quality_Duration_5	51	49
Get_More_Detail_2	34	10
Get_More_Detail_2	35	58
Get_More_Detail_5	76	76
User_Review_Method	127	144
Benchin_Review_Method	137	137
Make_Decision	1	2
Total Time(request time 600)	**622**	**629**

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Information Retrieval & Extraction

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Example

Product Name : Corel WordPerfect 3.5
Price : $159.95
DiskSpace : 6MB
Processing Accuracy (Rating) :
    PRODUCTID=0.8 PRICE=1.0 DISKSPACE=0.8

⟹

Product Name : Corel WordPerfect 3.5
Price : $159.95
DiskSpace : 6MB
Processor : -
Platform : macintosh power_macintosh system_7_or_higher
Processing Accuracy (Rating) :
    PRODUCTID=1.4 PRICE=1.6 PROCESSOR=0.0
    DISKSPACE=0.8 PLATFORM=2.0 MISCREQ=1.2

⇩

http://www.mpp.com/mediasoft/keystone/cwp7off.htm
http://www.osborne.com/whatsnew/corelwp.htm
http://www.cdn-news.com/database/main/1997/2/24/0224010N.html
http://www.corel.com/products/wordperfect/

⇩

Product Name : Corel WordPerfect 3.5   Review Consistence:
Price : $159.95   ((PQUALITY 2) (SQUALITY 3))
DiskSpace : 6MB   ((PQUALITY 1.2857143) (SQUALITY 2))
Processor :   ((PQUALITY 1.2857143) (SQUALITY 2))
Platform : macintosh power_macintosh system_7_or_higher ((PQUALITY 2) (SQUALITY 2))
misc requirement : (cd rom)
Processing Accuracy (Rating) :
    PRODUCTID=3.8 PRICE=1.6 PROCESSOR=0.0
    DISKSPACE=0.8 PLATFORM=2.0 MISCREQ=1.8

Red : Found or updated data   33

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Example of Information Fusion

URLs List

URL_A
URL_B
URL_C
URL_D
URL_E
URL_F

By
MacMall
site

User's Query

1. Generate two metrics of URLs
2. By other search engine(InfoSeek) if needed

Blackboard

< Product Object >

Product name: DRAMATICA....
Company name: screenplay
Increase
Overall quality: PQUALITY of URL_?

Review Consistence:
(PQUALITY value) (SQUALITY value) URL_F
(PQUALITY value) (SQUALITY value) URL_E
     :
(PQUALITY value) (SQUALITY value) URL_A

PQUALITY : Information Quality by Use's Preference
SQUALITY : Degree of Reference

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Example: Evolution of Dramatica Product Object

Product name : DRAMATICA PRO 2.0 3.5IN DSK
Company name : Screenplay
Price   : 289.99
Processing Accuracy : (Genres 0) (PRODUCTID 0.8) (COMPANY 1.0)
                      (PRICE 2.2) (PRODUCTDESC 0) (PROCESSOR 0)
                      (RAMREQ 0) (DISKSPACE 0) (PLATFORM 0)
                      (MISCREQ 0) (OVERALLQUAL 0)

(a) Initial Product Object

Product name : DRAMATICA PRO 2.0 3.5IN DSK
Company name : Screenplay
Price   : 289.99
Processor:
Platform   : macintosh-system_7.0_or_higher windows_95
misc requirement : (mb ram)
overall quality : -0.5714286
Usefulness   : 0
Future Usefulness : -1
Ease of Use   : -1
Power   : -1
Stability   : -1
Enjoy ability : 0
Value   : 0
Processing Accuracy : (Genres 0) (PRODUCTID 0.8) (COMPANY 1.0)
                      (PRICE 2.2) (PRODUCTDESC 0) (PROCESSOR 0)
                      (RAMREQ 0) (DISKSPACE 0) (PLATFORM 0)
                      (MISCREQ 0) (OVERALLQUAL 0)
Review Consistence : (((PQUALITY -0.5714286) (SQUALITY 1)))

(b) Product Object after Two Documents

Product name : DRAMATICA PRO 2.0 3.5IN DSK
Company name : Screenplay
Price   : 289.99
Processor:
Platform   : macintosh-system_7.0_or_higher windows_95
misc requirement : (mb ram)
overall quality : 2.857143
Usefulness   : 3
Future Usefulness : 2
Ease of Use   : 5
Power   : 2
Stability   : 0
Enjoy ability : 4
Value   : 4
Processing Accuracy : (Genres 0) (PRODUCTID 0.8) (COMPANY 1.0)
                      (PRICE 2.2) (PRODUCTDESC 0) (PROCESSOR 0)
                      (RAMREQ 0) (DISKSPACE 0) (PLATFORM 1.8)
                      (MISCREQ 1.2) (OVERALLQUAL 0)
Review Consistence : (((PQUALITY 2.857143) (SQUALITY 3))
                      ((PQUALITY 0.71428573) (SQUALITY 3))
                      ((PQUALITY 1.4285715) (SQUALITY 1))
                      ((PQUALITY 2) (SQUALITY 2))
                      ((PQUALITY -0.5714286) (SQUALITY 1)))

(c) Final Product Object

Red: Found or updated data

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Agent Platform

• FIPA (Foundation for Intelligent Physical Agents): 에이전트 기술 국제표준화 기구

<FIPA Management Reference Model>

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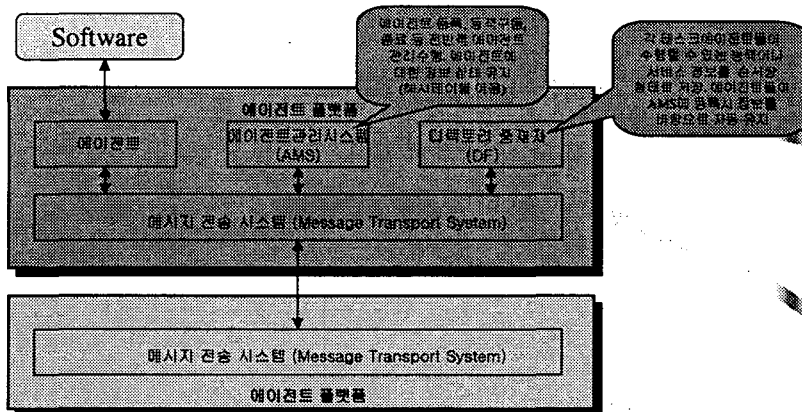
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DECAF Agent Platform

- Proposed by Keith Decker (Univ. of Delaware, 1996)
- DECAF (Distributed Environment Centered Agent Framework
- Agent OS 역할
- Functions
  - 분산 환경에 적합
  - 에이전트 구조 즉, 에이전트 통신, planning, 스케쥴링, 실행 모니터링, coordination, 진단, 학습 등을 평가하고 생성하기 위한 모듈화된 플랫폼 제공
  - 스스로 소켓 프로그램을 생성하고 메시지를 포맷하고 에이전트 통신을 수행하는 building block을 제공
  - API에 대한 지식이 없어도 프로그래밍 가능
- 구성
  - 에이전트 이름서버(Agent Name Server)
  - 플랜편집기(Plan Editor)
  - DECAF 프레임워크

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Agent Name Server

- DNS(Domain Name Server)와 유사한 개념으로 멀티에이전트 시스템내 미들웨어 역할을 담당
- 작업 도메인 내의 에이전트를 식별하는 역할 담당
- 에이전트 등록

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Plan Editor

- 도메인에 속한 전체 작업을 세부작업과 최하위 메소드로 분할할 때 제공되는 GUI 형태의 트리구조 형태의 편집기

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DECAF Structure

- 에이전트 생성, 저장, 외부와 상호작용하는 핵심역할 수행. 자체 스케줄링 모듈 내장.
- KQML 이용하여 통신

Plan File	Incoming KQML Message

Incoming message queue   Objectives queue   Task queue   Agenda queue

Agent Initialization   Dispatcher   Planner   Scheduler   Executor

Task Templates Hashtable   Pending Action queue   Action Results queue

DECAF Task and Control Structure

Domain Facts and Beliefs

Outgoing KQML message

Action Modules...

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Mobile Agent System

- Program, typically written in a *script language*, which may be dispatched from a client computer and transported to a remote server computer for execution
- Basic Model

Client Applications		Server Applications
Mobile Agent Meeting Place		Mobile Agent Meeting Place
Network Interface	Network Cloud	Network Interface
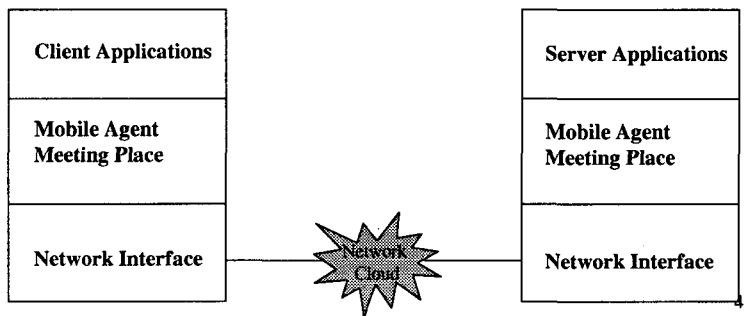
RP vs. RPC

- **RPC(Remote Procedure Call)**
  - 1970년대 고안된 방식으로 컴퓨터간 통신을 한 컴퓨터에서 다른 컴퓨터로의 프로시저를 호출한다는 개념에서 출발한 방식
  - Request / Acknowledge
  - 단방향 서비스
  - 지속적인 통신을 요구

- **RP(Remote Programming)**
  - RPC의 단점을 보완한 기법
  - 컴퓨터들간의 프로시저 호출뿐 아니라 다른 컴퓨터에서 수행할 수 있도록 서버에 있는 프로시저를 제공하는 개념
  - 양방향 서비스
  - 수행해야 할 업무가 많을수록 효율적
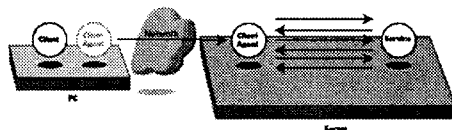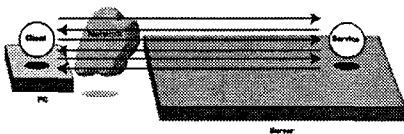
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Mobile Agent

- RP, RPC의 네트워크를 통한 클라이언트 서버간 데이터 전송상의 한계점을 해결하기 위해 제안된 방법
- RP에서 수신측 컴퓨터 혹은 서버에서 수행중인 프로시저와 그의 상태
- 모바일이란 수행중인 프로시저가 수신측에 있으나 송신측 프로시저를 대표해서 수행한다는 것을 의미. 이것의 자율적 행동 주체가 에이전트임
- 전송된 에이전트는 서버에 상주하면서 업무를 수행하고, 생성된 결과는 다시 사용자에게 전송
- 모바일 에이전트 자신이 이동할 때만 네트워크를 사용하므로 대역폭을 많이 차지하지 않으며, 자신이 이동하고 난후 지속적 통신을 요구하지 않음

<Concept of *Agent-Tcl*>
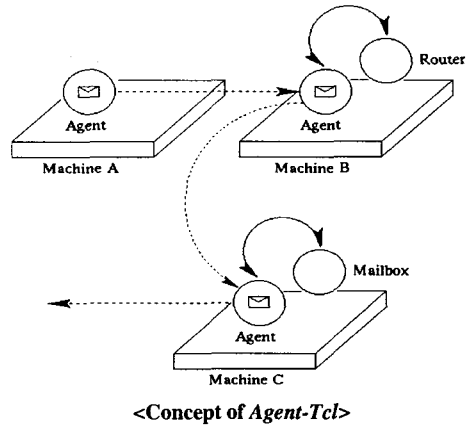
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Types of Mobile Agents by Languages

- Multiple-Language Systems
  - Ara: http://www.uni-kl.de/AG-Nehmer/Ara/
  - D'Agents(Agent Tcl): http://www.cs.dartmouth.edu/~agent/
  - Tacoma: http://www.tacoma.cs.uit.no:8080/TACOMA/
- Java-Based Systems
  - Aglets: http://www.trl.ibm.co.jp/aglets
  - Concordia: http://www.concordia.mea.com/
  - Jumping Beans: http://www.JumpingBeans.com/
- Other Systems
  - Messengers: http://www.ics.uci.edu/~bic/messengers/
  - Obliq:
    http://www.cc.gatech.edu/gvu/people/Phd/Krishna/VO/VOHome.html
  - Telescript: http://www/genmagic.com/technology/mobile_agent.html

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Applet vs. Aglet

- Applet(Moving code)
  - Code that can move across a network from a server to a client
  - Server의 class file 형태로 있는 applet code가 client에서 호출시 client로 copy되어서 client 에서 수행됨

- Aglet(Mobile agent)
  - Running Java program(code and state) that can move from one host to another on a network
  - Halt its execution, move to another host on the network while maintaining their state, and resume execution on the destination host
  - Run as a thread(or multiple thread) inside the context of a host Java application

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Example of Mobile Code Paradigm

- **Interact and cooperate to make a chocolate cake**
  - Two friends (A, B)
  - Make the cake (the result of a service)
  - A recipe is needed
    (know-how about the service)
  - Ingredients (movable resources)
  - An oven to bake the cake
    (a resource that can hardly be moved)
  - A person to mix the ingredients following the recipe
    (a computational component responsible
    for the execution of the code)
  - To prepare cake
    (to execute the service)
  - All these elements must be chocolated
    in the same home (site)

B/A Paradigm	Before		After	
	Client	Server	Client	Server
RPC	A	Know-how Resources B	A	Know-how Resources B
RP	Know-how A	Resources B	A	*Know-how* Resources B
Mobile Agent	Know-how A	Resources		*Know-how* Resources *A*

- A, B: agents
- Know-how: code or procedure
- Resource: database, system resources

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Mobile Multi Agent System

- 기본 개념

Mobile Agent | **Mobile Multi Agents** | Multi Agents

- 장점
  - 네트워트개발과 개별화를 위한 오픈 형태의 일반화된 전역적 프레임워크를 지원한다.
  - 각 개별 에이전트의 기능적 지원을 한다.
  - 기존의 서비스는 물론 새로운 서비스와 새로운 비즈니스를 지원한다.
  - 인터넷 사회에 대단히 긍정적인 효과를 제공한다.
- 상용화된 종류
  - CAGIS DIAS
  - Voyager

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Basic Concept of Proposed PDLS System

- Agent based *P*ersonalized *D*igital *L*ibrary *S*ystem

End User	Agent	Author
User Agent	Agent Framework	Editing tool

Suggestion

Suggestion   management

Database

DBMS

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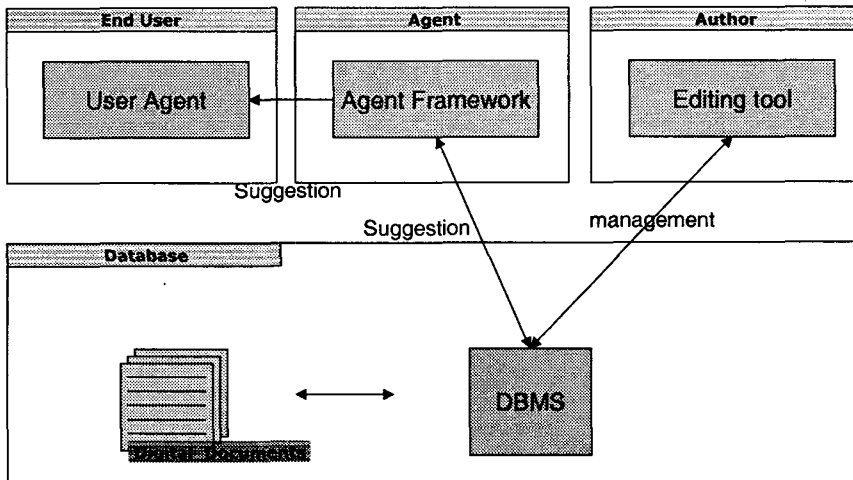
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Structure of PDLS System
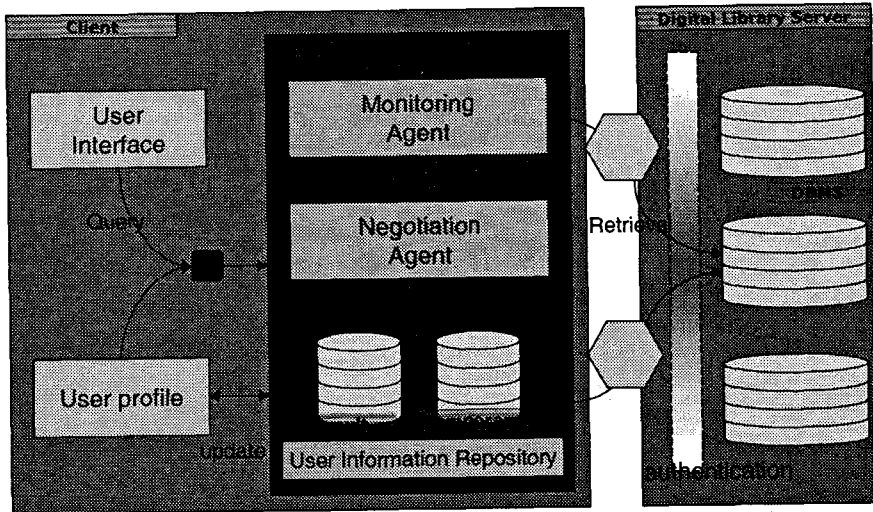
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GUI of PDLS
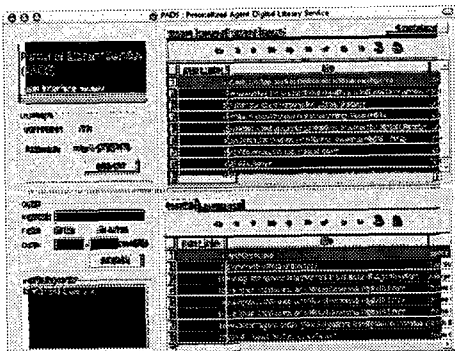
3 panes
- Query / Monitoring window
- Remote library window
- Local library window
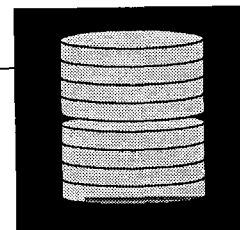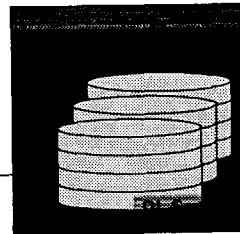
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User Profile of PDLS
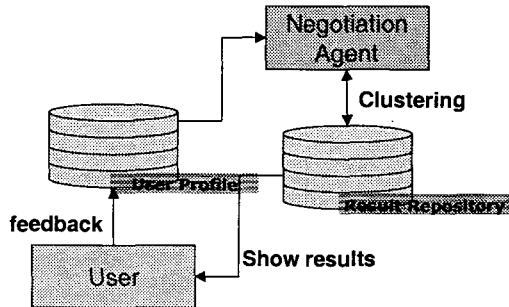
- Construction of initial user profile by user's first input information
- Weight according to user's keywords
- Updates user's profile information by Kohonen's Self Organized Neural Network
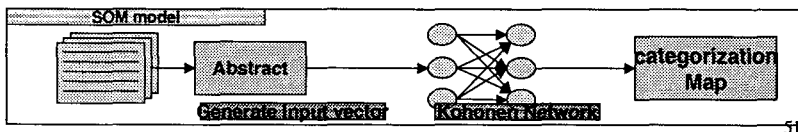
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Simulation Scenario of PDLS
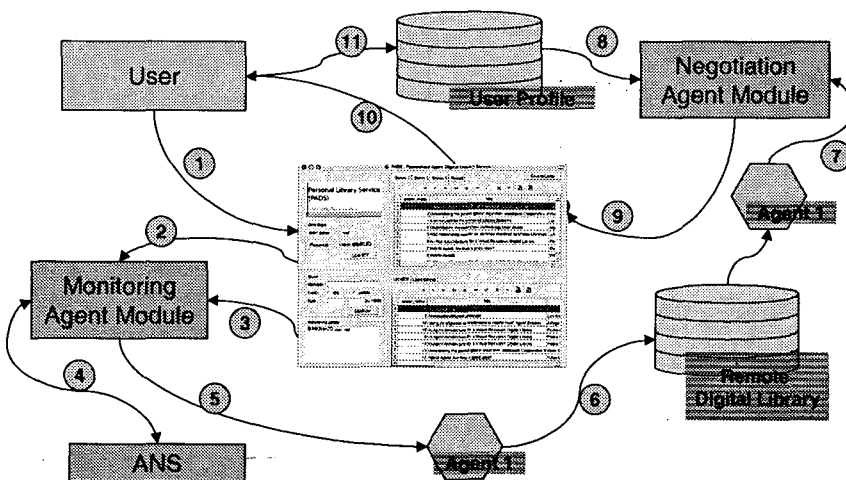
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Simulation Results

Category	Agent System	Neural Network	Digital Library
1	framework	learning	virtual
2	mobile	neural	library
3	java	architecture	indexing
4	multi	network	structure
5	personalized	simulation	distributed
6	distributed	layer	agent
7	environment	agent	retrieval
8	neural	artificial	autonomous
9	architecture	associative	neural
10	autonomous	algorithm	multi
Reserved keyword of documents according to categories in PDLS			
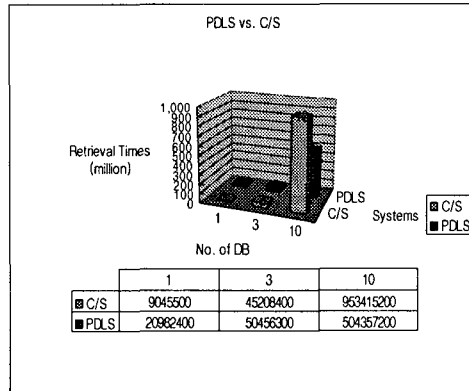
PDLS vs. C/S

Retrieval Times (million)

No. of DB

	1	3	10
C/S	9045500	45208400	953415200
PDLS	20982400	50456300	504357200

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Contents

1. Intelligent Agent Concept
2. Conventional Intelligent Agent Technologies
3. Advanced Intelligent Agent Technologies
4. TMA에 의한 지능정보시스템
5. Conclusions

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TMA(Tissue Mineral Analysis)

❑ 인체의 영양상태 평가를 위한 스크리닝 방법

세포 외액의 영양상태 나타냄 세포내 영양상태 반영 못하고 일과성 변화가 심함	⟹	세포내의 대사상태를 가장 정확하게 반영 10대 사망원인 측정 (세계48개국 도입)	⟸	인체의 배설상태를 나타냄 세포내의 대사 정확하게 반영하지 못함
혈액 검사		TMA		요 검사

❑ TMA
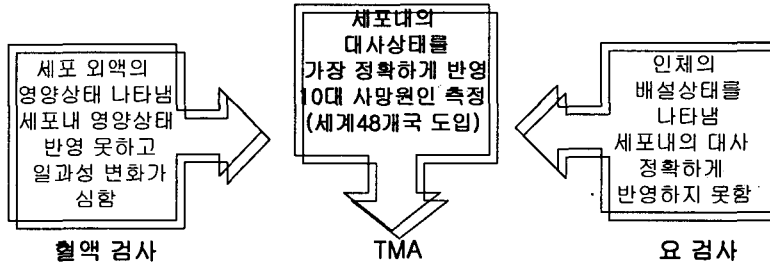
Tissue Mineral Analysis

- ✪ What is Tissue Mineral Analysis?
- ✪ What does Hair Reflect ?
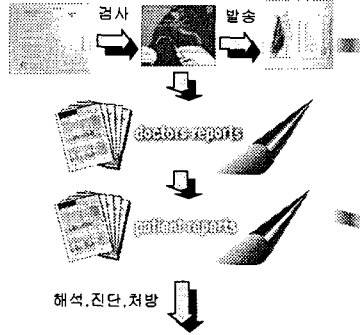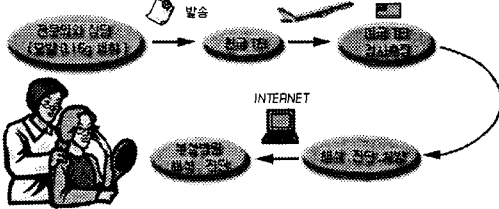- ✪ Is Blood as good an indicator of Mineral Status as Hair ?
- ✪ Why test for Minerals ?
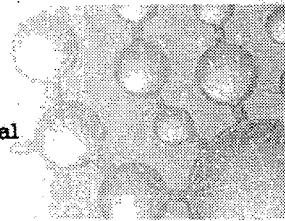
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미네랄과 내분비선과의 관계
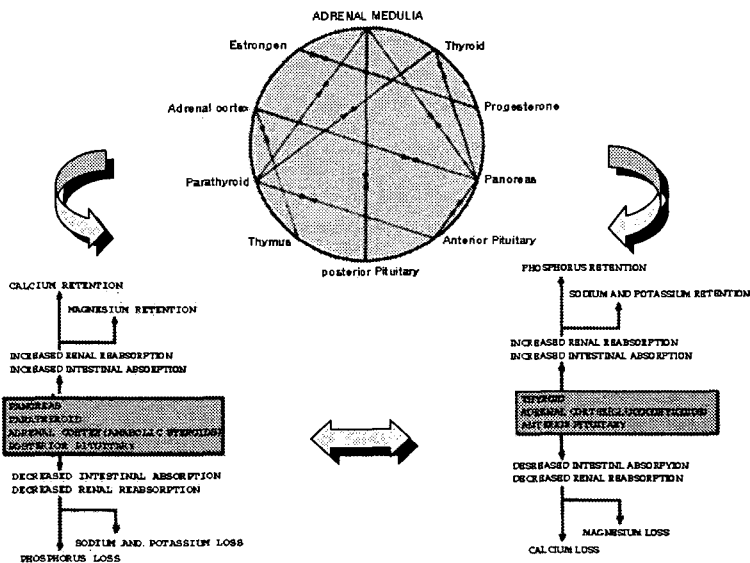
TMA 방법

□ 국내의 TMA 검사방법 및 절차

검사방법

□ TMA의 장점

- □ 샘플링 용이하고 다른 검사보다 저렴
- □ 혈액보다 장기간 정확한 영양상태(미네랄) 반영
- □ 과거 및 현재의 영양상태(미네랄) 반영
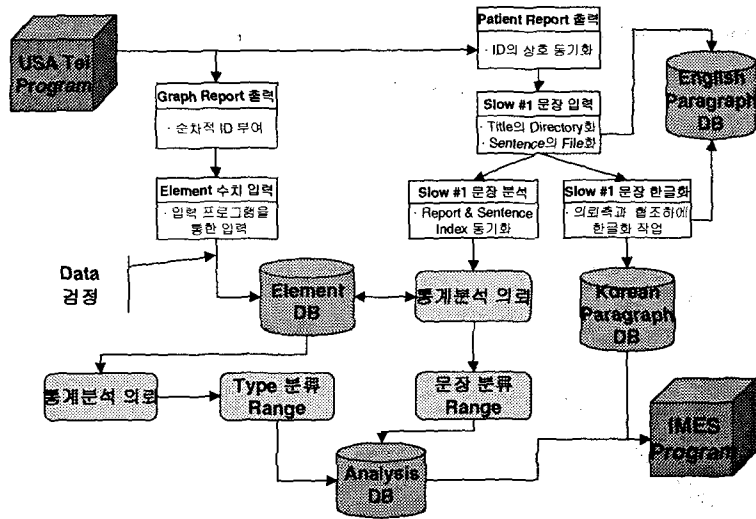- □ 혈액 및 외부에서 유입되는 미네랄의 정보제공
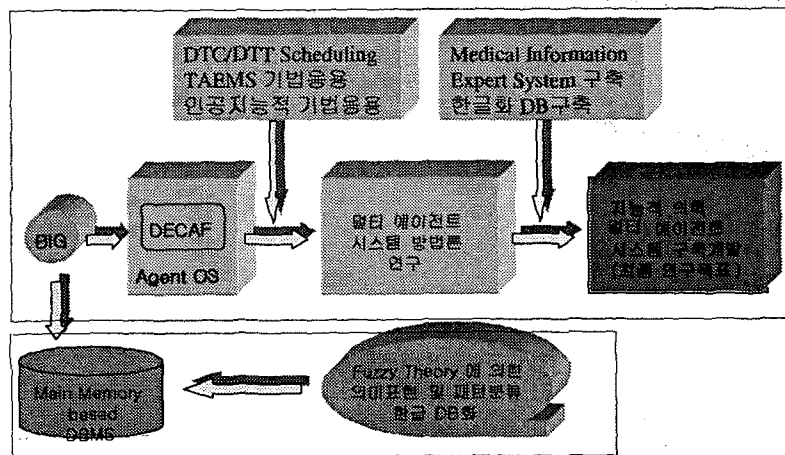- □ 중금속 평가에 매우 유용
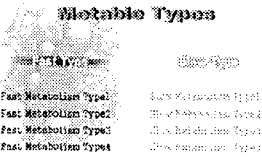
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주요시스템 구성
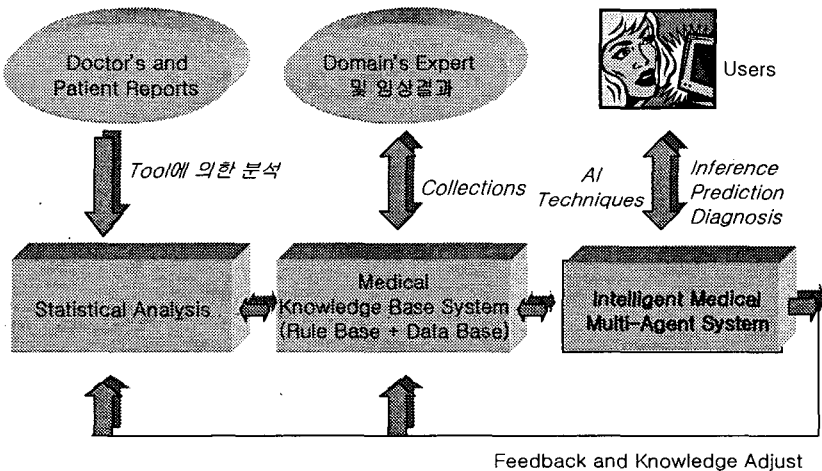
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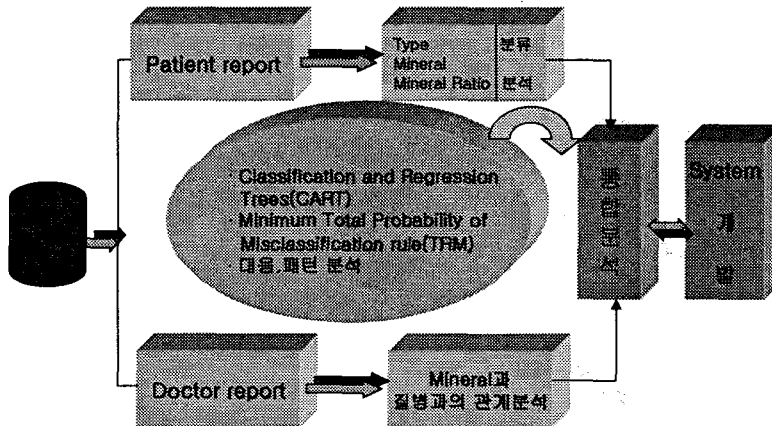
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주요 DB구성

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에이전트에 의한 주요시스템구성

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통계분석

* 오 분 류 (Misclassification) 률 의 최 소 화
* 다 변 량 분 석

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Conclusions

- Comparison between Conventional Agent and Advanced Intelligent Agent Technologies

- Future Research
  - Mobile Multi Agent System
  - Theoretical Research about Agents
  - Intelligent Ubiquitous Computing with Agents

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