Dynamic Agent Communities Facilitating to Distant Learning in a Virtual University Information Space

Vadim Ermolayev

Dept. of Mathematical Modelling and Information Technologies,

Zaporozhye State University,
66, Zhukovskogo st., 330600, Zaporozhye, Ukraine,
tel/fax:+380 61 264 17 24,
E-mail: eva@zsu.zaporizhzhe.ua

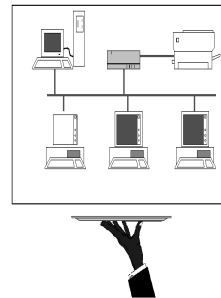## Motivation and Background
VUIS

It's like CA Real World or Microsoft Encarta

I guess I know how to use this!!! It's like doing my everyday work, but electronically!!!

Layered mediator University IS with unified interfaces

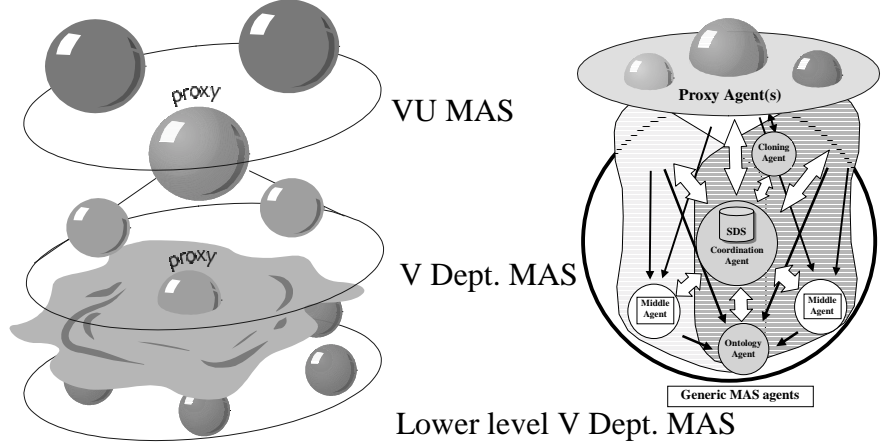Hierarchy of distributed wrapped legacy IS and information resources

VUIS is considered to be a passive media inhabited by active "beings" (agents) representing real life actors…

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Active VUIS Inhabitants
Persistent MAS and Member Agents

VU MAS

V Dept. MAS

Lower level V Dept. MAS

Proxies "wrap" respective MAS
and are the representative members in the higher level MAS

Agents' Interactions – Parametric Feedbacks

$$a = f(X,Y)$$

a – accept a new student
to the class

$\mathbf{A}_i$ $\mathbf{A}_j$

$$\tilde{Y} = \tilde{Y}(\tilde{y}_1(X),...,\tilde{y}_n(X))$$

$\tilde{y}_1(X) -$ Professor's interest in new students

$\tilde{y}_n(X) -$ Entry test difficulty level
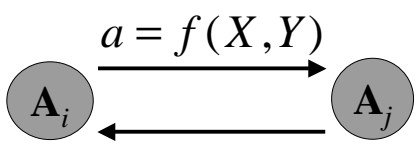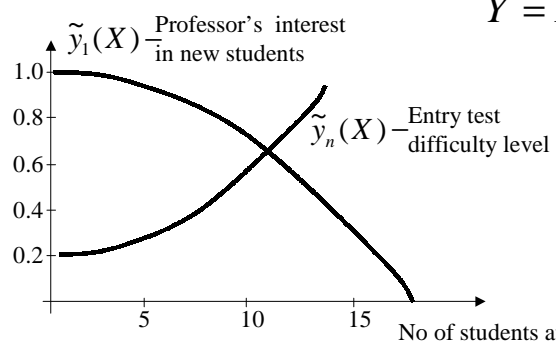
Parametric feedbacks –
expressed **attitude**,
capability to perform
requested action
(policy) at a certain state

No of students at the class

Agent Communities

as dynamic coalitions for performing tasks (sets of works)

Why? – there are MAS already

- tasks emerge and are soon accomplished
- agents join the coalition if they are capable
to contribute to the task execution
- an agent may participate in more than one coalitions
at a time

How? – accept or reject the work, react with parametric feedbacks

What is changing in time?

- the coalition – agents join and move out
- agent's state – capability to perform a work
- agent's knowledge (beliefs) about the capabilities
of the other MAS members

Framework Models

Generic Agent Model

Communication Model

Functional System / Component Model

Coordination Model

Process Model
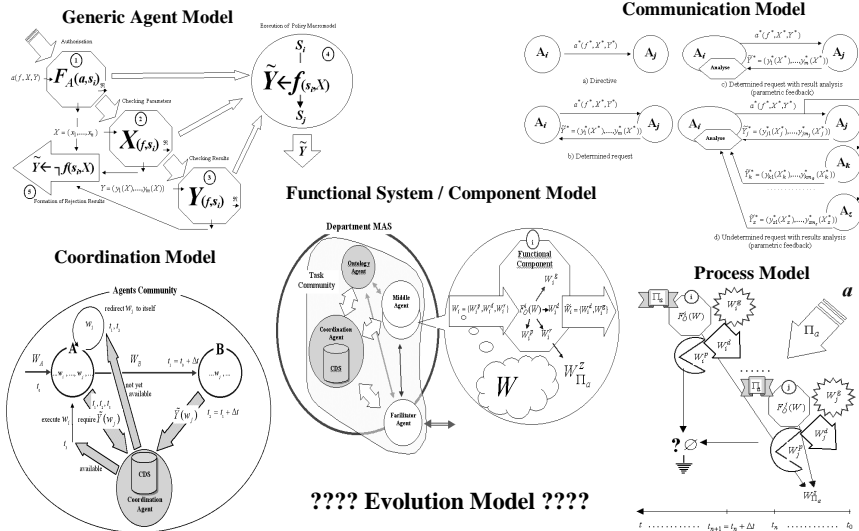
???? Evolution Model ????

Agent's Evolution Model

Agent's proactive self-development and self-adaptation in response to the changes in MAS and environment caused by task(s) execution

Capabilities   Beliefs

$$s_i$$

$$\tilde{Y} \leftarrow f(s_i, X)$$

$$s_j$$

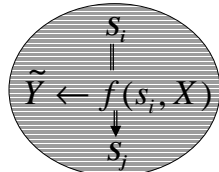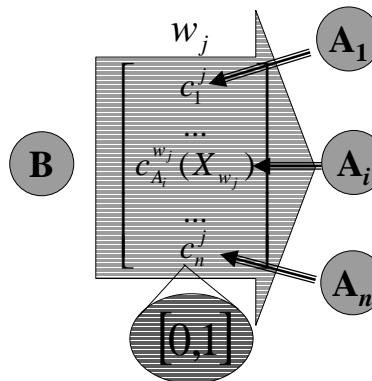$$\tilde{Y}$$

$$s_i, s_j \in S_A$$

$$s_i = \{r(X_A), q(F_A), t(F)\}$$

$r(X_A)$ - *parameter constraints*

$q(F_A)$ - *policy constraints*

$t(F)$ - *transition function*

$$w_j$$

$$c_1^j$$

$$...$$

$$c_{A_i}^{w_j}(X_{w_j})$$

$$...$$

$$c_n^j$$

B   **A₁**   **Aᵢ**   **Aₙ**

$$[0,1]$$

Case Study – VUDE Domain

Proxy Agent (secretary)

Tutor Agent (User)   **Cloning Agent**   **Tutor Agent (User)**

SDS Coordination Agent

Middle Agent   **Middle Agent**

Ontology Agent

Department MAS

External influences and MAS reactions	Co-ordination
Facilitator cloning	Ontology queries
Influences	Task communities

Middle Agent — Professor (**PRA**), Assistant (**AA**), Course master (**CMA**), Librarian (**LA**) agents
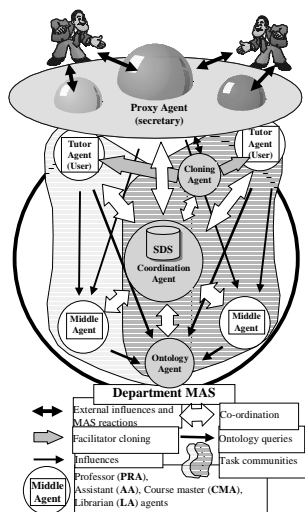
PhD recruiting scenario:

Phase 1: A PhD candidate submits the CV and indicates his/her intention to become a PhD student (**PA**, **CA**, **TA**)

Phase 2: The CV is analysed and the best Professor Match is searched (**TA**, **PRA**-s)

Phase 3: Qualified candidate passes the test from the chosen professor (**TA**, **PRA**, **PA**)

Phase 4: Successful candidate is interviewed and assigned to a research project (**TA**, **PRA**)

Phase 5: The professor and his assistant prepare the individual curriculum for the accepted candidate as well as the list of recommended reading (**TA**, **PRA**, **AA**, **CMA**, **LA**)

Slide 9
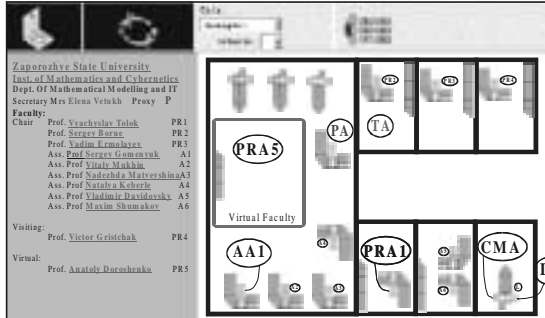
VDept Agents and their Roles
(w.r.t. the Case Scenario)

Proxy Agent: PA – accept outer influences,
order to clone **TA**, pipeline the candidate to his **TA**

Utility Agents:
CA – Clone a TA each time
a new PhD candidate comes
to **PA**
COA – Monitor agents activities,
Accept work results to its SDS,
Provide work params on request.
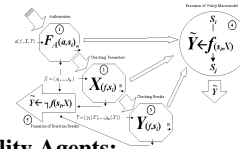**OA** – Provide common dept.
ontologies on request

Middle Agents:
PRA1-PRA5 – evaluate candidates' qualifications; provide a test, evaluate test results,
arrange the interview, provide course recommendations
AA1-**AA6** – prepare working plan, prepare curriculum
CMA – provide electronic courses, issue calls for new courses
LA – provide electronic textbooks, issue calls for new teaching materials

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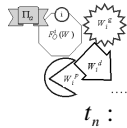
Modelling (How did they play their roles?):

Phase 3. *Testing, Step 1 – Test is ordered.*

$t_n :$

execute :
w_1

$\varnothing$ *No Results*

W_{TA} $w_1 = (Require\_Test, X_1, Y_1)$

TA

$\varnothing$ *No works for redirection*

$\tilde{W}_{TA} = \{W_{TA}^d, W_{TA}^g\}$

$w_2 = ('Provide\_Test', X_2, Y_2),$
$w_3 = ('Test', X_3, Y_3),$
$w_4 = ('Evaluate\_Results', X_4, Y_4),$
$w_5 = ('Analyse\_Marks', X_5, Y_5)\}$

PRA_i

TA
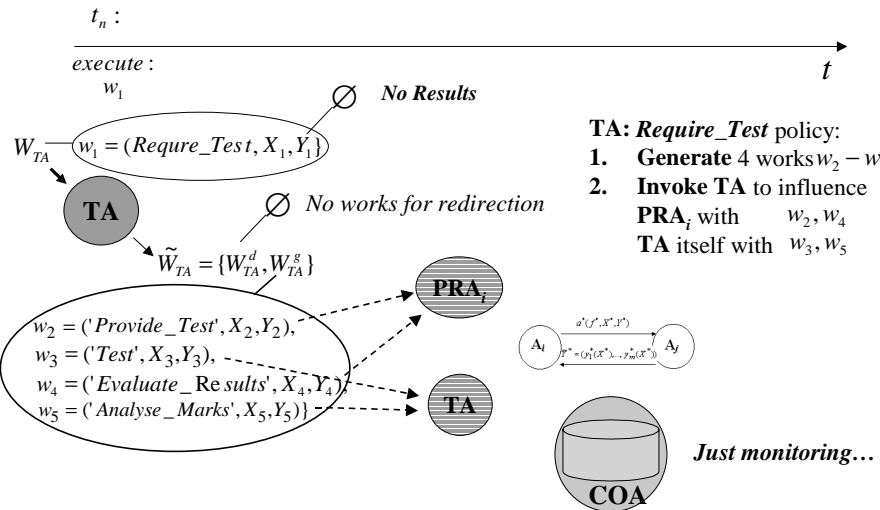
TA: *Require_Test* policy:
1. **Generate** 4 works $w_2 - w_5$
2. **Invoke TA** to influence
   PRA_i with w_2, w_4
   TA itself with w_3, w_5

A_i $a'(f', X', Y')$ A_j

Just monitoring…

COA

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Modelling (How did they play their roles?):
Phase 3. *Testing, Step 2 – Test is provided.*

t_n : t_{n+1} : t

execute : w_1 *delay* w_3, w_5

W_{TA}

TA w_3 / w_5 **TA**   *redirect to itself*
$w_3 = ('Test', X_3, Y_3),$
$w_5 = ('Analyse\_Marks', X_5, Y_5)\}$ **TA**

W_{TA}^g

execute, delay w_2 w_4

w_2 / w_4 **PRA$_i$**   *redirect to itself*
$w_4 = ('Evaluate\_Re\,sults', X_4, Y_4),$ **PRA$_i$**

Results: $\tilde{Y}_{PRA_i}^2 = \{Test\_Form =< FILENAME >\}$

Monitoring and accepting feedback(s)…

COA

PRA$_i$: *Provide_Test* policy:
1. **Generate** test file ($\tilde{Y}_{PRA_i}^2$) according to the ontology and received params X_2
2. **Invoke PRA$_i$** to influence **COA** with: (*'Accept_Results'*, $\tilde{Y}_{PRA_i}^2$)

Modelling (How did they play their roles?):
Phase 3. *Testing, Step 3 – Test is performed.*

t_n : t_{n+1} : t_{n+2} : t

execute : w_1 *delay* w_3, w_5 *execute, delay* w_3 w_5

W_{TA}

TA w_3 / w_5 **TA**   *redirect to itself*
$w_5 = ('Analyse\_Marks', X_5, Y_5)\}$ **TA**

TA   *execute, delay* w_2 w_4 *delay* w_4

PRA$_i$ w_4 **PRA$_i$**   *redirect to itself*
$w_4 = ('Evaluate\_Re\,sults', X_4, Y_4)$ **PRA$_i$**

Results: $\tilde{Y}_{TA}^3 = \{Test\_Results =< FILENAME >\}$

Params: $X_3 = \tilde{Y}_{PRA_i}^2 = \{Test\_Form =< FILENAME >\}$

Monitoring, accepting feedback(s), providing work parameters…

COA

TA: *Perform_Test* policy:
1. **Require and accept** w_3 parameters from **COA**
2. **Invoke** human user to fill in the test form.
3. **Invoke TA** to influence **COA** with: (*'Accept_Results'*, $\tilde{Y}_{TA}^3$)

Slide 1

Modelling (How did they play their roles?):

Phase 3. *Testing, Step 4 – Test results are evaluated.*

$t_n:$ $t_{n+1}:$ $t_{n+2}:$ $t_{n+3}:$ t

$execute:$ w_1

$delay$ w_3, w_5

$execute, delay$ w_3 w_5

$delay$ w_5

W_{TA}

TA → TA → w_5 → TA → *redirect to itself* → TA

$w_5 = ('Analyse \_ Marks', X_5, Y_5)\}$

TA

$execute, delay$ w_2 w_4

$execute, delay$ $delay\, w_4$

$execute$ w_4

PRA_i → PRA_i → w_4 → PRA_i

Params: $X_4 = \widetilde{Y}_{TA}^3 = \{Test \_ Results =< FILENAME >\}$

Results: $\widetilde{Y}_{PRA_i}^4 = \{(m_1,...m_k), (s_1,...s_k)\}$

Monitoring, accepting feedback(s), providing work parameters…

COA

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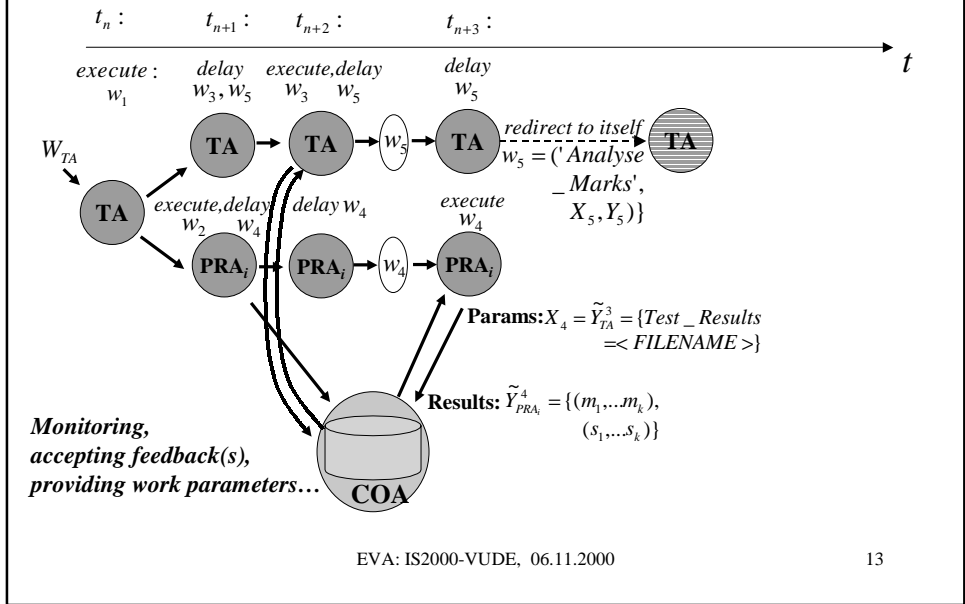
Modelling (How did they play their roles?):

Phase 3. *Testing, Step 5 – Parametric Marks are analysed.*

$t_n:$ $t_{n+1}:$ $t_{n+2}:$ $t_{n+3}:$ $t_{n+4}:$ t

$execute:$ w_1

$delay$ w_3, w_5

$execute, delay$ w_3 w_5

$delay$ w_5

$execute$ w_5

W_{TA}

TA → TA → TA → w_5 → TA → **Negative:** *inform* → TA

W_{TA}^g $w_7 = ('Inform \_ on \_ failure', X_7, Y_7)\}$

TA

$execute, delay$ w_2 w_4

$delay\, w_4$

$execute$ w_4

PRA_i → PRA_i → PRA_i

$\varnothing$

No Results

Positive:

$w_6 = ('Require \_ Interview', X_6 = \{X_1, X_5\}, Y_6)\}$

Interview – Phase 4.

TA

Params: $X_5 = \widetilde{Y}_{PRA_i}^4 = \{(m_1,...m_k), (s_1,...s_k)\}$

Monitoring, providing work parameters…

COA

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Summary

What has been done:

The **processes of DE may be modelled and executed**
        as tasks without pre-defined
        task plans
in frame of the formal
agent-based approach to modelling
and management of the processes
of **information interchange**.

The **particularities of the framework**:
- **generic agent** skeletons,
- **parametric feedbacks**,
- agents **ability to evolve**
provide for the **scalability**
and **pro-active dynamic character**
of the approach.

What has been not, yet:

Planned for short-term:
- **Architectural framework** on the base
of the presented formal approach
- **Semantic issues:** Ontology representation,
interoperability, knowledge sharing
among generic agents, within MAS
and task communities.

Planned for middle-term:
-Design and implementation of the **prototype**
for a Virtual University Department
-Further **evaluation** of the applicability
of the approach to VUDE, BPM, DLIB
domains