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The title of the paper* †

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Abstract

This paper describes the architecture of an Interactive Learning Environment (ILE) on internet using companions, one of which is a human and geographically distant from the learning site. The achieved system rests on a three-tier customer/server architecture (customer, web server, data and applications server) where human and software actors can communicate via the internet and use the DTL learning strategy. It contains five main actors: a tutor actor in charge to guide the learner; a system actor whose role is to manage and to control the accesses to the system; a teacher actor in charge of the management and the updating of the different bases; a learner actor who represents the main actor of the system for whom is dedicated the teaching. Also, a learning companion actor whose role can be sometimes as an assistant, and other times as a troublemaker.

Keywords: Interactive learning environment, LCS, DTL strategy, companion, distance learning, troublemaker.

MSC 2010: 68R10, 68Q25, 05C35, 05C05.

1 Introduction

The distant teaching pedagogy differs from the teaching in a classroom. Indeed, the absence of the teacher influences the incentive and the concentration of the learner, what encourages the isolation feeling and so, moves him away of the stimulating context as in a real classroom.

[†] To prepare the text for this template, parts of the texts from articles published in previous issues of CSJM were taken.

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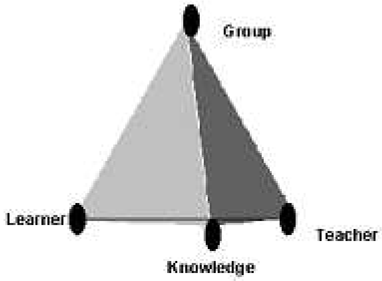

Figure 1. The pedagogical triangle

In a distant learning context, the pedagogical triangle [1],[2] must take into account two elements that, in this case, take a particular importance: the group and the mediation context (Figure 1).

The group is an instituted set of learners and teachers in interaction, sharing some common objectives. The introduction of the group element puts in evidence the social character of the knowledge construction [3]. Indeed, the group constitutes a psychological support factor [4]. The mediation context constitutes the material or a virtual environment in which occurs the interactions.

In the present work, we describe an interactive learning environment (ILE) in a distant-teaching context with learning companions and using Internet as the environment of communication and interaction. The achieved system is a software framework dedicated to the learning of the relational databases whose customer/server architecture is based on multi-agents approach. For the communication between the learners, we used tools, more powerful, as the electronic mailing, the forums, that have already been integrated in many distant-training frameworks as support for collective learning activities [5],[6].

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2 Definition of the diagnosis

Diagnosis is defined as a process of exact failure cause localization. Once the failure is detected, it is the responsibility of the maintenance engineer to recognize the effects, to analyze information, to interpret the various error messages and indications, and to leave with the true diagnosis of the situation in term of components having caused the failure and the reason of their failures. When the diagnosis is completed, the replacement or the repair of the component at the origin of the failure is the following defect correction stage. The companies are thus confronted with this double economic challenge:

- to increase the productivity by increasing availability of their equipments production;
- to reduce the maintenance costs.

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Corollary 2.4 - *For a graph* $\mathbf{K}_n$ *with* $n \geq 3$, *we have*:

$$\begin{cases} \overline{\chi}(\mathbf{K}_n) = \frac{9k^2-7k}{3} & \text{if} \quad n = 3k \\ \overline{\chi}(\mathbf{K}_n) = \frac{9k^2+k-2}{2} & \text{if} \quad n = 3k+1 \\ \overline{\chi}(\mathbf{K}_n) = \frac{9k^2+5k-2}{2} & \text{if} \quad n = 3k+2 \end{cases}$$

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At each iteration, the algorithm computes the overall minimum distance between clusters and merges those being at that distance from each other. Thus, for any $i < j$, we have

$$d(C_i, C_j) = d_{\min} \Rightarrow C_i := C_i \cup C_j, C_j := \phi \tag{1}$$

where

$$d_{\min} = \min_{i \neq j \in [1,n]} d(C_i, C_j), \tag{2}$$

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3 Dimension of d-Convex Simple Planar Graphs

3.1 Example of subsection A

Next, the feature extraction procedure described in section 2 is performed on the five images. For each image we consider square blocks of size $a = 8$ and compute their standard deviation. The resulted dispersion-based graphical feature set, $\{V(I_1), ..., V(I_5)\}$ is represented in Fig. 2. Each image feature vector $V(I_i)$ constitutes a [31x41] matrix. It is displayed as a $3D$ surface plot in Fig. 2, being indicated by its number, i.

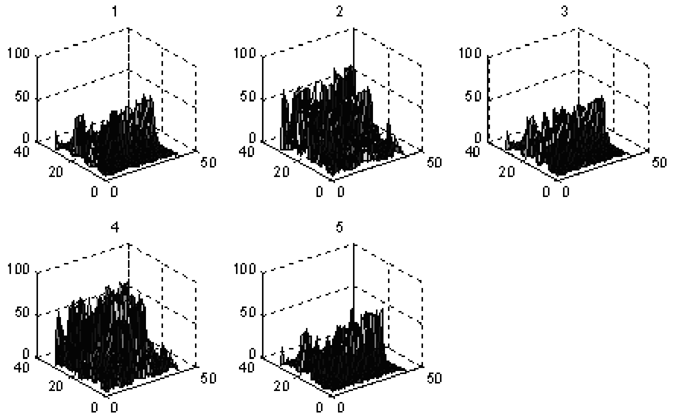

Figure 2. The feature vector set

The automatic classification provided in section 3 is applied to this feature set. The Euclidean distance is used in the classification process, because the image feature vectors have identical sizes. In the next table there are registered the computed distance values between all the pairs of feature vectors.

Table 1. Distances between image feature vectors

	$V(I_1)$	$V(I_2)$	$V(I_3)$	$V(I_4)$	$V(I_5)$
$V(I_1)$	0	571.3183	293.0381	675.6527	319.3169
$V(I_2)$	571.3183	0	599.5098	359.3718	618.9163
$V(I_3)$	293.0381	599.5098	0	686.5573	361.6215
$V(I_4)$	675.6527	359.3718	686.5573	0	712.8829
$V(I_5)$	319.3169	618.9163	361.6215	712.8829	0

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3.2 Example of subsection B

In case of d-convex graph here we have always equality $|D| = n+m+2$. Let us denote by $\Gamma(x)$ the neighborhood of vertex x, i.e. $\Gamma(x) = \{y \in X | x \sim y\}$.

Definition 1. [5]. *A vertex y is called copy for vertex x $(x \neq y)$, in graph $G = (X;\, U)$ if $\Gamma(x) = \Gamma(y)$.*

Let T be a tree with at least 3 vertexes and T_0 a sub-graph of T, that consists of all vertexes and edges of T, without those suspended. So, for each unsuspended vertex x from T, we have a uniquely correspondent vertex $\bar{x}$ from T_0, and for each vertex of T_0 we have a uniquely correspondent vertex from T. Let $L(T,\, T_0)$ be a graph obtained from T, T_0 and by adding the following edges: every vertex $\bar{x}$ of T_0 will be adjacent with all vertexes from $\Gamma(x)$ from T, where x and $\bar{x}$ are correspondent vertexes. It is easy to see that in graph $L(T,\, T_0)$ every vertex of degree at least 3 has a unique copy and there are no suspended vertexes.

The next theorem is true:

Theorem 1. [6]. *If T is a tree with at least 3 vertexes, then graph $G = L(T,\, T_0)$ is d-convex simple and planar.*

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Let $\mathcal{V}$ be a finite generating set of the monoid of nonnegative integer solutions $(\psi_0, \psi_1, \dots, \psi_m, \eta_1, \dots, \eta_m, \eta_0)$ of:

$$\psi_0 \mathrm{mdeg}(g) + \sum_{\nu=1}^{m} \psi_\nu \mathrm{mdeg}(f_\nu) = \sum_{\nu=1}^{m} \eta_\nu \mathrm{mdeg}(f_\nu) + \eta_0 \mathrm{mdeg}(h). \qquad (3)$$

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Algorithm 1.

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Input: $g, h \in A$, a finite SAGBI basis $F$ for $A$
Output: A syzygy family $\mathrm{SyzFam}(g,h)$ for $g$ and $h$
Initialisation: $\mathrm{SyzFam}(g,h) := \emptyset$, $\mathcal{PV} := \emptyset$
Compute a generating set $\mathcal{V}$ for the solutions of system (3).
$\mathcal{PV} := \{\vec{v} \in \mathcal{V} : c_0 = d_0 = 1\}$
For Each $\vec{v} \in \mathcal{PV}$:
    $s_{\vec{v}} := \mathrm{lc}(H^{\vec{v}^r}) \cdot G^{\vec{v}^l} - \mathrm{lc}(G^{\vec{v}^l}) \cdot H^{\vec{v}^r}$
$\mathrm{SyzFam}(g,h) := \bigcup_{\vec{v} \in \mathcal{PV}} \{s_{\vec{v}}\}$
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An implementation of this algorithm is included in the author's Maple package for SAGBI and SAGBI-Gröbner computations, see [92]. For calculating the Hilbert bases the Maple package uses Dmitrii V. Pasechnik's implementation of the algorithm described in [16].

As an application of Algorithm 1 we consider example 4.7 and 5.2 in [35].

Example 1. *Let* $A = \mathbb{Q}[x^2, xy] \subseteq \mathbb{Q}[x, y]$ *and use the degree lexicographical order with* $x > y$*. The set* $F = \{x^2, xy\}$ *is a SAGBI basis for* A*. Let* $g = x^3y + x^2$ *and* $h = x^4 + x^2y^2$ *in* A*. A Hilbert basis for the set of solutions of the equation (3) is:*

$$\vec{v_1} = (0,0,1,0,1,0), \quad \vec{v_2} = (0,1,0,1,0,0), \quad \vec{v_3} = (0,2,0,0,0,1),$$
$$\vec{v_4} = (1,0,0,1,1,0), \quad \vec{v_5} = (1,1,0,0,1,1), \quad \vec{v_6} = (2,0,0,0,2,1).$$

Thus $\mathcal{PV} = \{\vec{v_5}\}$*, so by Algorithm 1 a syzygy family for* (g, h) *is* $\{G^{(1,1,0)} - H^{(0,1,1)}\} = \{-x^3y^3 + x^4\}$*.*

In the original version of this example (example 4.7 in [35]) the syzygy family was $\{-x^5y^3 + x^6, -x^3y^3 + x^4\}$ *instead. It should however be noted (as proved in example 5.2, [35]) that the extra syzygy* *polynomial* $-x^5y^3 + x^6$ *SI-reduces to zero over* $\{g, h\}$. *Thus this extra polynomial does not affect the final result of SAGBI-Gröbner basis computations.*

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