A NOVEL LEARNER SELF-ASSESSMENT APPROACH
Application to Pratical Works

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Abstract: This paper presents a novel approach for learner self- Assessment. The aim of this approach is to offer to learners an evaluation tool as a CEHL (Computing Environment for Human Learning) allowing comparing their productions (C++ object-oriented programs) with those elaborated by teacher. Considered as part of our platform E-TéléTP@AALP (Environnement des TéléTP Appliqués A l'Apprentissage des Languages de Programmation), the tool we are developing allows essentially: (1) generating two UML diagrams (UML class diagram and communication diagram) from the learner's program, and (2) applying some matching algorithms for measuring degrees of similarity and dissimilarity between learner's diagrams and teacher's diagrams.

1 INTRODUCTION

Computing Environment for Human Learning (CEHL) is an important research domain. Its educational, social and economic importance has attracted much interest from different research communities.

Using novel technologies, the purpose of a CEHL is to help and assist learners, teachers and tutors. With the development of platforms, teachers are required to make available to learners courses and class rooms in various disciplines (Tchounikine, 2009).

Actually, the number of distance courses and class rooms has dramatically increased. Consequently, platforms' designers are generally more concerned about courses and class rooms, practical works are completely omitted.

The teaching of practical works is revealed essential in the scientific and technical trainings, in presential as in distance, and answers a true need. Often, learners are deprived from this essential teaching and this is due to the problem of availability of the assistants, the problem of obstruction of learners, the material is expensive and cannot be duplicated. In order to minimize these remote problems, thus teaching must answer to these needs (Guillaume, 2006).

Although it represents an important activity during learner training, learner assessment has not yet been adequately addressed. In this context, a very few works have been emerged in the literature. We quote among others the works of Auxepaules (2009) and Tanana, Delestre, Pécuchet and Bennouna (2009).

Auxepaules (2009) developed a CEHL called "Diagram" dedicated to the training of OOM (Object-Oriented Modelling) concepts starting from a textual specification. It proposes an automatic method for analyzing learner's diagram by comparing and matching class diagram components. The proposed method is implemented as an integrated component of "Diagram" called "ACDC" (Automatic Class Diagram Comparator).

Tanana et al. (2009) proposed a formative assessment method of learner's skills using algorithms of supervised classification. In order to validate their method, they chosen numerical electronics as application domain, essentially, the assessment of numerical electronic diagrams produced by learner during its practical works.

Of course, those works have considerably forwarded the domain by proposing novel strategies for leaner assessment. However, they don't deal with learning programming languages. Furthermore, they only use matching methods which are based on simple matchers.

We present, in this paper, a novel approach for

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learner self-assessment which extends our platform E-TéléTP@AALP introduced in a previous paper. The main objective of our approach is to evaluating learners' practical works about development of C++ object-oriented programs. The proposed approach consists of four main phases: (1) generating UML diagrams (class and communication diagrams) form learner's and teacher's programs, (2) decomposing of the generated diagrams into subdiagrams, (3) applying hybrid matching techniques for diagrams (class and communication) mapping, and (4) applying composite matching techniques for combining the results of the third phase.

The remainder of the paper is organized as follows. In section 2, we give a brief overview of the platform we developed. Section 3 briefly presents the kinds of matchers we use. Section 4 presents the self-assessment approach we propose. Finally, we give a conclusion and future work directions in section 5.

2 OVERVIEW OF THE PLATFORM E-TÉLÉTP@AALP

Realized in 2009, E-TéLéTP@AALP (figure 1) is a platform for teaching and training of remote practical works in programming in data processing. Its architecture is organized into three levels (e-learning, remote programming interfaces). The platform is developed in ASP/MYSQL and it works on any operating system. It offers the following services:

- **For learner**

It allows learner to carry out remote practical work, to fit in the platform, to seek collaborators, to choose a computer programming language, to download a programming language and to consult the statements of remote practical work.

- **For teacher, originator of remote practical works**

It allows teacher to register, to consult remote practical work envisaged in the formation, to create a new remote practical work and to contact other teachers.

- **For tutors**

It allows tutor to monitor learners and offers multiple choices questionnaires in order to help learners to remember the main concepts of programming languages.

2.1 Architecture of E-TéLéTP@AALP

As quoted above, the proposed platform (figure 1) is organized into three levels:

- E-learning level: This level describe interactions between human actors (learner, tutor, teacher), interaction models in remote practical works, all possible configurations (various training situations between actors) in remote practical works on programming languages, the teaching situations in remote practical works, collaboration between actors, etc.
- Interfaces level: it plays the role of intermediary between the e-learning and remote programming levels.
- Remote programming level: It presents the activities related to remote programming (code edition, compilation, error correction, execution, etc).

Whether in class or within the CEHL, the assessment is a key means of determining learner's forces and weaknesses during a training process. Thus we extended the platform E-TéléTP@AALP by integrating a new component (figure 1, in red) into its architecture that allows learner to evaluate his programming skills.

3 HYBRID AND COMPOSITE MATCHERS

3.1 Hybrid Matchers

The hybrid matchers combine various matching approaches to determine the candidates for matching by focusing on criteria and multiple information sources. They can provide better matching with a better performance than executing in a separate way several matchers (reducing the number of passes made on the models) (Bunke, 2000).

3.2 Composite Matchers

The composite matchers combine the results evaluated independently by several hybrid matchers. This capacity to combine matchers is more flexible than the "hard" combination of particular matching techniques that are executed simultaneously or in a fixed order (in hybrid matchers). In contrast, a composite matcher selects from a set of modular matchers those based, for example, on the application domain or the formalism of the considered models. Moreover, a composite matcher may allow a flexible scheduling of matchers by running them both simultaneously and sequentially.

In the latter case, the result of a first matcher is consumed and extended by a second matcher to perform iterative improvement of the result of matching (Auxepaules, 2009).

4 THE PROPOSED SELF-ASSESSMENT APPROACH

The proposed approach for leaner self-assessment consists in four main phases (figure 2).

- **Phase 1:** During this phase, learner and teacher have to develop two C++ object-oriented programs that undergo an analysis process for generating UML diagrams (class and communication diagrams). Class diagram expresses the static structure of the program, in terms of classes and relationships between classes. Classes are essentially organized through aggregation, inheritance or association relationships. Communication diagram describe how a set of objects collaborate to accomplish a specific task. They emphasize the dynamic interactions between those objects (message exchanges) as well as their synchronization.
- **Phase 2:** In the second phase, the generated diagrams must undergo a decomposition process. It consists in breaking each diagram into its component subdiagrams.
- **Phase 3:** This phase consists in applying the matching technique we adopted which offers two kinds of hybrid matchers. The first matcher is applied to class diagrams, while the

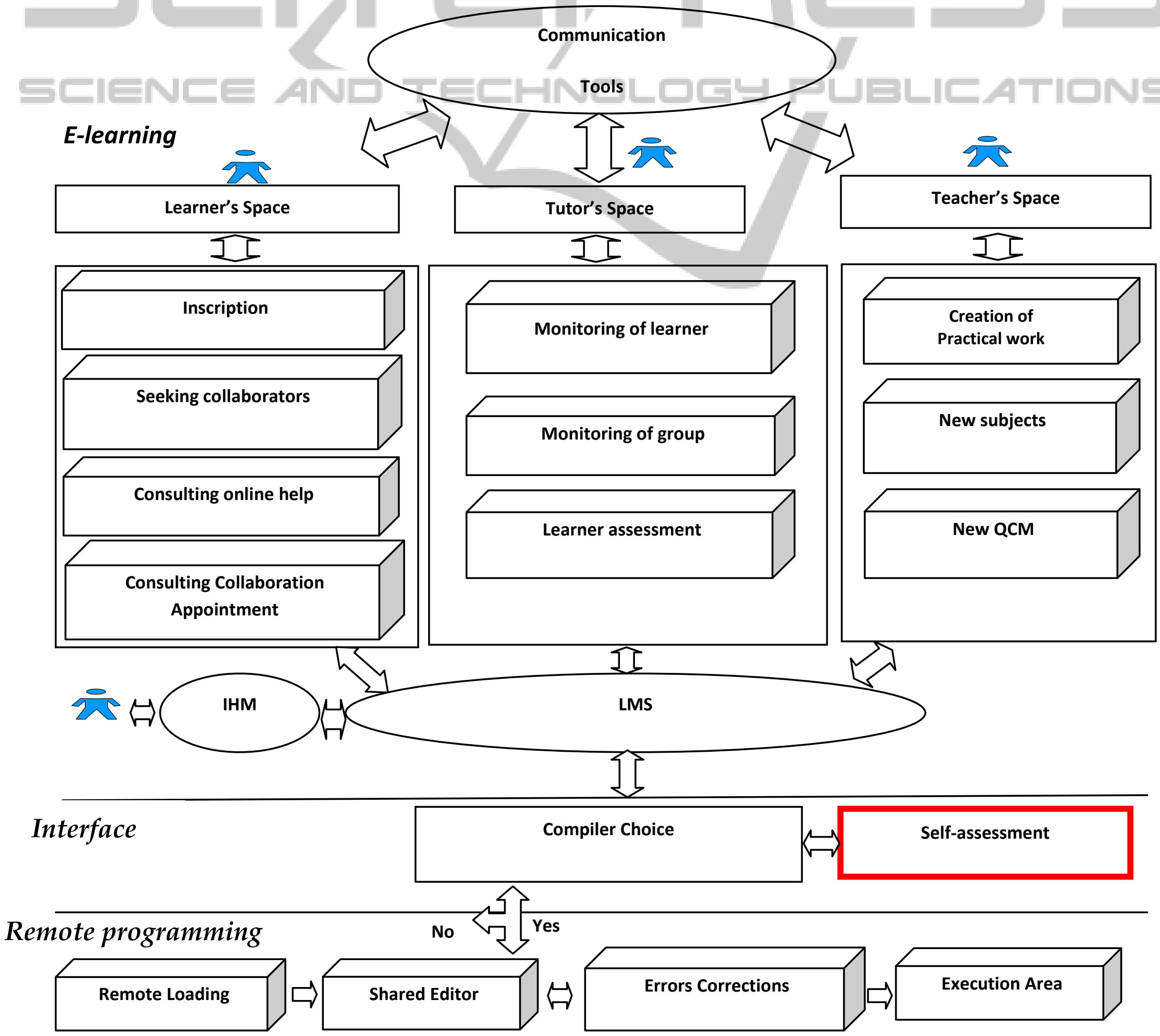

Figure 1: The proposed platform's Architecture.

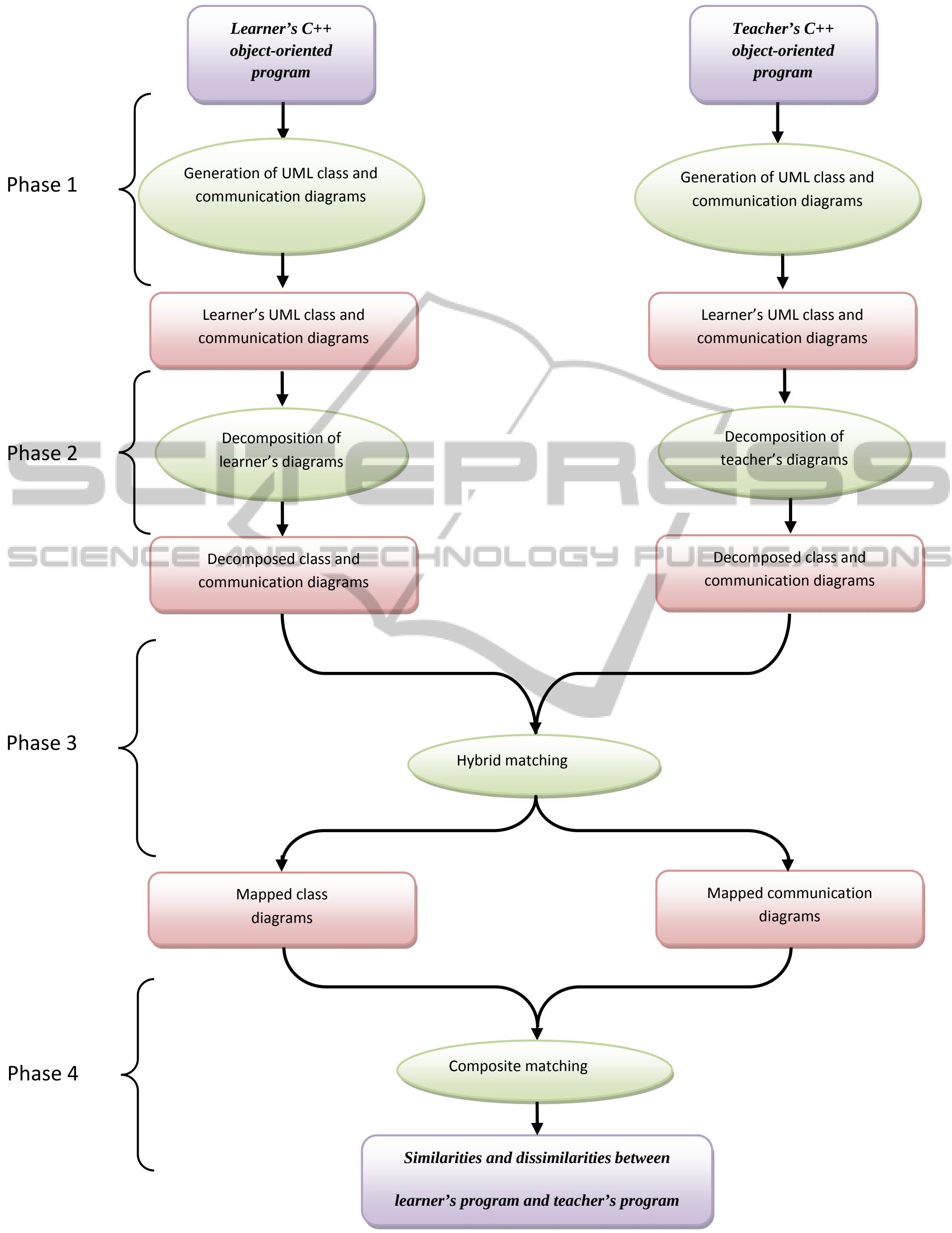

Figure 2: Methodology of the approach.

second one is applied to communication diagrams. In this phase a hybrid matcher is applied between each pair of subdiagrams (learner subdiagram, teacher subdiagram). As output of this phase we quote the following results:

- Mapped class diagrams (learner, teacher): this result is obtained after applying the first hybrid matcher to each pair of class subdiagrams (learner's class subdiagram, teacher's class subdiagram).
- Mapped communication diagrams (learner, teacher): this result is obtained after applying the second hybrid matcher to each pair of communication subdiagrams (learner's communication subdiagram, teacher's communication subdiagram).

- **Phase 4:** At the last phase, we apply a composite matcher for combining the results of hybrid matching of the third phase in order to obtain a list of similarities and dissimilarities between learner's program and teacher's program.

It should be noted that we are currently working on developing specific matching algorithms for our approach and on its validation through a concrete case study.

5 CONCLUSIONS AND FUTURE WORK

Assessment activity plays a crucial role in improving learners' skills. Several approaches helping learners during his training stage have been developed. However, the majority of those approaches did not consider learner assessment during its practical works. In this paper, we proposed a novel approach for learner self-assessment that allows comparing two C++ object-oriented programs (learner's program and teacher's program). The purpose of this approach is to evaluate similarities and dissimilarities between learner's program and teacher's program through applying hybrid and composite matching techniques to UML class and communication diagrams that are generated from the developed C++ programs. Our approach is however limited to basic class and communication diagrams, modelling only the most common features. As future directions to this work, we plan on extending our approach by introducing others UML diagrams in order to capturing more programs' aspects.

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