

Program Library for Development and Research of Distance Learning Courses

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Abstract: A library of tools for development and research of distance learning courses is represented. The library includes generators of terms and relationships between them, program modules for the purpose of structuring of the educational materials, grouping of terms, establishing of input and output relationships between the disciplines and others. The tools possess graphic interface and can be used independently or in graphic environment for design and research.

Keywords: program library, graph properties in terms of theory of sets, optimization algorithms, grouping, structuring, modelling.

I. INTRODUCTION

One of the most progressively developing types of educational processes is the distance learning. The advantages and the disadvantages of distance learning are well known [6,7]. The major problems that have to be solved are connected with the following directions:

- Development of program tools for organization and maintenance of the educational process, based on the principles of distance learning.
- Development of theoretical concepts and methodical support for design, research and organization of group and individual education [1].
- Development and research of practical courses for different fields of education.

The present paper concerns the development of library of tools for development and research of courses for distance learning.

II. FORMAL CONCEPT OF INSTRUMENTAL TOOLS

The instrumental tools are based on the following concept[2-5]:

- The educational material which is to be included in the process of distance learning is presented as a logical sequence of interconnected terms subsequently situated on the axis of time.
- Every term is categorized according to its difficulty of

learning measured in time

- A term which is necessary for the clarification of another term is regarded as a basic term, and the other one is regarded as its consequence.
- The basic terms have to be put on the axis of time before their consequences.
- The distance between the terms is measured by the total time necessary for the clarification of the terms situated between them on the axis of time.

The formalization of the concept is put down to its presentation as a finite directed graph $G(X,U,P,W,F)$ [2] where:

$X = \{x_i\}$, $|X| = N$ – the set of terms described by the discipline.

$U = \{u_{ij}\}$ – the set of connections between the terms, where x_i is the basic term of the term x_j .

$W = \{w_{ij}\}$ – the set of weighting factors of the terms $X \leftrightarrow W$

The ordered set $G(X,U,P,W,F)$ can be interpreted as a finite directed graph, where $P(x_{ij}, u_{ij}, x_j)$ is an incidentor which is a predicate with value true, if x_i is a basic term of x_j .

On that basis there are many algorithms used for structuring the educational materials as logical subsequences of interconnected terms, there are algorithms for restructuring, for reduction of the consequences of wrong arrangements, for bringing the interconnected terms closer in terms of time, for grouping and arranging the terms connected with the previous/next discipline of the educational plan, for grouping the terms for individual learning, for carrying out tests, for adapting the teaching rate in accordance with the level of knowledge, for statistical research etc.

III. PROGRAM LIBRARY OF INSTRUMENTAL TOOLS FOR DEVELOPING AND RESEARCH OF COURSES FOR DISTANCE LEARNING

The program implementation of the algorithms is presented as a program library of instrumental tools for developing and research of courses for distance learning. The library is structured to be used in two program environments (Fig.1.):

- *Library of major classes without graphic interface.* These tools can be applied to already developed projects with graphic interface or to the graphic environment of the visual studio.

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- *Library of upgrades of the major classes.* The graphic interface uses the already defined classes in the library which are using now custom controls for visualization.

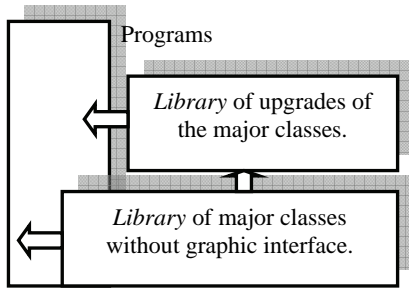


Fig.1.The main structure of the library

The classes in the library are grouped in the following way (Fig.2.):

1. *Classes used for generation of graphs.* Random number generators are used for this purpose. The generated values are interpreted as numbers of the vertices (terms), weight factors of each vertex (time for understanding/learning), weight factors of the edges and others.
2. *Classes used for structuring of the educational material.* The classes are based on various algorithms for arranging the vertices on the axis of time. For this purpose the dynamical weight factors of the vertices are defined which are the sum of the contiguous vertices multiplied by the static weight factor of the edge. The edges having a negative direction increase their dynamical weight factor by a negative coefficient. The classes can be executed with or without the negative coefficient used for the edges with negative directions.
3. *Classes used to define the starting and the final package.* These classes analyze the interdisciplinary connections between the terms. The purpose of the analysis is to separate the terms in groups (starting and final). Applying classes of the previous group will optimize their arrangement on the axis of time. These additional options can rearrange the packages depending on the interconnections between the terms. As a result the starting and the final terms are situated optimally close both to the outside and to the inside terms.
4. *Classes used for grouping of the terms.* The purpose of these classes is the formation of educational units for distant learning organization. The initial grouping is connected with previously defined limiting conditions and is used during process of course development. In the process of study the grouping is done under the conditions of individual learning. This helps for the

adaptation of the learning process to the individual specifics of each student. The grouping criteria represent a strong inside connectivity (and a weak outside connectivity) of the terms. The time direction has to be taken into account (edges in straight and opposite direction).

5. *Classes for analysis of testing results.* The process of examination of the acquired knowledge and practical skills is presented as definition of subgraphs. The terms which haven't been learned present a subgraph connected with the previous and the next terms. This raises the question of their rearrangement on the axis of time. In case of an insufficient or critical rate of learning starting and final packages can be formed and analyzed.
6. *Classes used for statistical work.* The test data are saved into a database. The statistical process is connected with determining of the mathematical dispersion, asymmetry. With famous criteria of Fisher and Student the statistical difference in the results before and after using one of the algorithms is proved.
7. *Interface classes.* These classes are mainly used for input of real data from the examined educational subject. Mainly these are classes for text information analyses, identification of the used terms and definition the synonyms and the homonyms. The classes have also user interface. Their future development is strongly connected with the adaptation to the library of instrumental tools for design and research of the courses for distant learning.
8. *Additional classes.* These classes are used for support of the different presentations of finite oriented graphs and for adaptation to different data bases and program environments.

IV. CONCLUSION

A fully functional system of instrumental tools for developing and research for courses of distance learning is developed.

The library is designed in two levels: one for use in a program environment and the other for use in a graphic environment.

In the first case the major components of the library can be implemented in program systems for distant learning in order to improve their functionality. Such applications require software developers to work together with the teachers. Such systems are characterized by high performance but limited exploitation.

The second type is based on graphic interface. This allows the system to be assembled mainly by teachers not specialized in computer systems. Because of the user interface the system

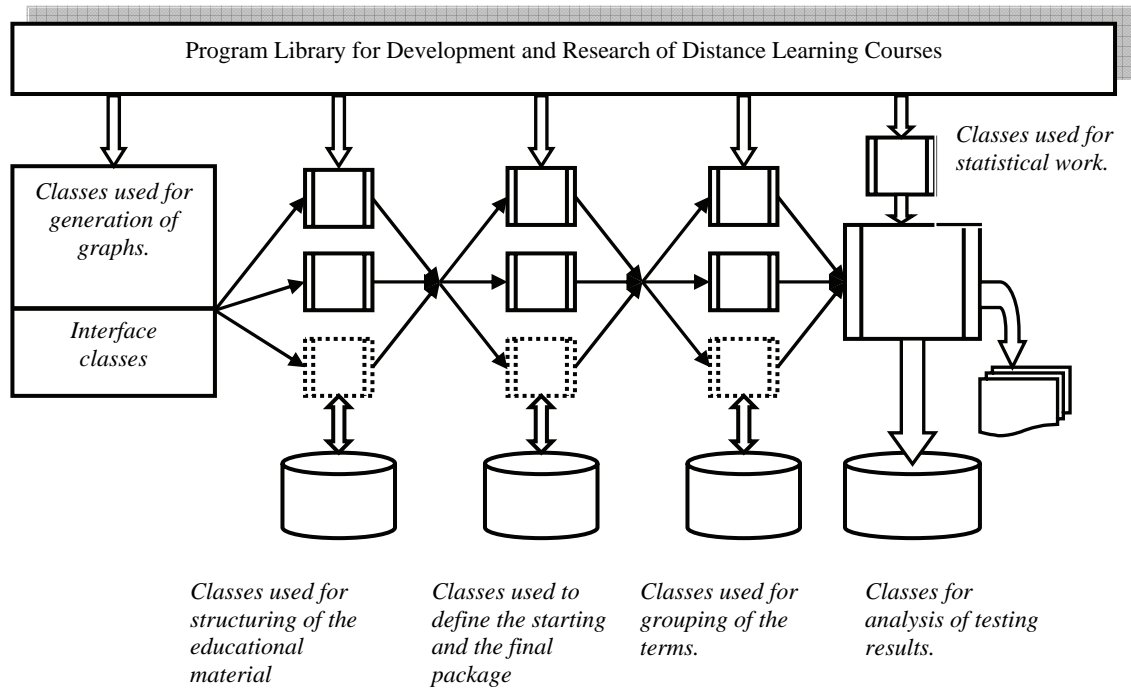


Fig.2.The extended structure of the library

provides high flexibility in structuring and easy achievement of various variations of solutions.

Some components of the library can be used separately for solving of partial problems.

[8] Learning Technology Standards Committee, Draft Standard for Learning Object Metadata. IEEE Standard 1484.12.1, New York: Institute of Electrical and Electronics Engineers.

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