Developing High School Information System Using Artificial Intelligence Methods

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Abstract: *The article deals with the software tools for organizing and planning educational process using models, methods and algorithms of artificial intelligence.*

Keywords: artificial intelligence, genetic algorithm, evolutionary process

1. Introduction

Scheduling of classes is one of the most important tasks of educational process management. Therefore, automation of scheduling of classes in systems of mass education is still a topical problem of organisation of educational process. Good schedule of classes helps improve:
a) Quality of training;
b) Economic efficiency of training;
c) Convenience of training of students and work of teachers.

Automation of scheduling procedure enables to:
a) Consider a number of timetable conditions and requirements;
b) Strictly formalise a procedure for making a timetable, which is the best in a determined sense;
c) Implement a criterion or optimisation approach to scheduling;
d) Reduce scheduling time considerably.

Timetable is defined with subset S of Cartesian product of five discrete sets: training groups (set G), teachers (set P), subjects (set D), time (academic hours) of classes (set T), and classrooms (set A):

$$R=\{GxPxDxTxA\}$$

Then, the scheduling problem on the quality level can be formulated as follows: for each training group it is necessary to make a schedule of classes within a semester with specification of classrooms and times of classes for each subject under study.

To describe a classroom located in i^{th} building under number j with the type t, a three-component sequence is introduced:

$$A = \{a_j\}, \quad a_j = \left(a_j^v, a_j^s, a_j^{type}\right) \quad (1)$$

The description of time intervals of classes like this involves the use of consequence numbering of academic hours in a semester. The time intervals are described with a set T, each element of which is a three-component sequence of the form:

$$t_k = \left(t_k^w, t_k^d, t_k^p\right) \quad (2)$$

where t_k^w is a week number, $t_k^w = \overline{1, N_{wps}}$; where t_k^d is a week number, $t_k^d = \overline{1, N_{dpw}}$; where t_k^p is a week number,

$t_k^p = \overline{1, N_{cpd}}$. Here, N_{wps} is a number of academic weeks in a semester, N_{dpw} is a number of academic days in a week, N_{cpd} is a number of academic hours in an academic day. Teacher object $P = \{p_i\}$,

$$p_i = \{d_1, d_2, ..., d_m\} \quad (3)$$

where

p_i is a teacher code, d_j is one of the subjects taught by the teacher, and m is a total number of subjects he/she can teach.
Limitations imposed on the timetable are described as follows:
1) Mathematical expression describing the absence of classroom clashes.
2) Absence of clashes for teachers describes that for each ordered pair of elements including academic hour and teacher, either there is the only block of classes conducted by this teacher within the given hour, or there is no such a block at all.
3) Absence of clashes for training groups.
4) Conformance of a classroom type to a class conducted.
5) Limitation imposed on the number of academic hours conducted within an academic day means that for each pair of elements including group and day, the number of classes may not exceed the maximum allowed value N_{nap_max}.
6) The requirement of absence of gaps for training groups.

Under the above requirements, a target function is defined on the basis of minimisation of penalty indicators. Each violation of a limitation or a desirable requirement increases the value of the target function according to a requirement's importance coefficient.

Following the timetable mathematical model, when solving a scheduling problem, a specimen consisting of three chromosomes is considered. Each chromosome, in turn, consists of genes designated with whole numbers $1, 2, ..., i, ..., N$, whereby a gene number of each chromosome corresponds to a number of class block, e.g., z^{th} gene in the first, second, and third chromosome characterises the block of class z from the set Z.

The information content of the first chromosome is classrooms used in the educational process, the second chromosome – time of classes (academic hours), the third chromo-

some – teachers conducting this block of classes. In the first chromosome, the value of the ith gene is a number (code) of classroom from the subset of allowable classrooms, in which the class is to be conducted. Similarly, in the second chromosome, the value of the ith gene is a number of the second academic hour (academic unit of time) from the allowable subset of training time intervals (academic hours).

To continue, in the third chromosome, the value of the ith gene is a number of teacher from the allowable subset of teachers. It means that the first, second, and third chromosomes are connected to a set of blocks of classes with a special link called "one-to-one correspondence".

In order to automate the operation of an educational institution, it is necessary to develop a database and a web interface thereto. The database should contain information on the following objects: faculties, departments, teachers, students, exams, subjects.

The web interface should provide for the performance of the following functions: adding and editing main data; displaying statistical data of the educational institution; authorisation and multi-level separation of users. Besides, Mysql system should be used as a DBMS.

2. Conclusions

The first part of the analysis deals with the database creation problem. The development of the database should be started with the main substances "faculty" and "department". Substance "faculty" should have such properties as "name", "faculty code", and "number of students and teachers". "Departments" should be characterised with such properties as "name", "department code", and "number of students and teachers". These substances should play only informative roles. "Teachers" should be characterised with such properties as "teacher code", "surname and name", "his/her faculty code", "his/her department code", and "address". "Students" should be characterised with such properties as "student code", "surname and name", "his/her faculty code", "his/her department code", "address", "year of study", and "enrolment year". "Subject" should be characterised with such properties as "subject code", "subject name", "faculty code", "department code", "semester", "number of hours", and "year of study". "Exams" should be characterised with such properties as "exam code", "name of student passing the exam", "name of examining teacher", "examination date", "subject code", "faculty code", "department code", "exam mark", and "year of study".

As for the web application, it should have a modular structure for convenience of development and maintenance. Combination PHP+MySQL+HTML has been selected as a means for fulfilment of the objectives specified. The functional chart of the software package can be as follows:
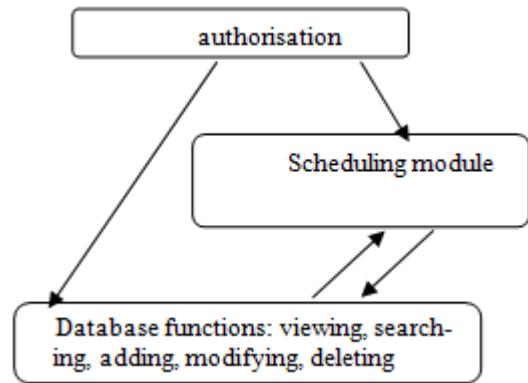
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