

ASSIGNMENT OF AUTOMATIZATION THE AUDITORIUM FUNDS IN INSTITUTIONS OF HIGHER EDUCATION

The formalized tasks of scheduling and distributing the auditorium funds. Scheduling is considered as the assignment task with restrictions. The procedure for the improvement of organizational support scheduling technology is shown in the article. To visualize the schedule and the state of the auditorium fund the two screen user interface is proposed. The methods of distribution the auditorium funds and the analysis of efficiency were recently developed.

Keywords: the auditorium funds, schedule, organization, documents.

Introduction

Distribution of auditoriums - the main component of the development procedures and surgical management of timetable in educational institutions. The effectiveness of distribution affects on the process of the auditorium fund management. The lack of automation complicates the analysis of the auditorium fund and efficiency of its use [1].

There are several software solutions for the auditorium fund management [2-5]. Most of them cannot allocate the auditorium fund automatically, otherwise [5] distribution occurs without scheduling processes.

Several good solutions are distinguished from the other systems: web-based [2-3], allows the access to the system from any computer, without prior installation of the program, different levels of access to the system [3] allow to distinguish between the right to operate the system for different users, the ability to change the priorities of the factors affecting the distribution of the auditorium fund [5] leads to the best result of the distribution based on the current state of the educational process.

Formulation the task with scheduling the classes

The Formulations given further meet the requirements of Dnipropetrovsk National University of Railway Transport. After adoption the educational imposition the departments' staff can operate the following sets of initial data:

$${}_d P_i = \langle p_i, d_i \rangle \quad {}_d P_i = \langle p_i, d_i \rangle - \text{lecturer - discipline};$$

$${}_D G = \{ {}_d G_i \}, \quad {}_d G_i = \langle g_i, d_i \rangle \quad {}_d G_i = \langle g_i, d_i \rangle - \text{group- discipline};$$

$${}_Z D = \{ {}_z G_i \}, \quad {}_z D_i = \langle d_i, z_i \rangle \quad {}_z D_i = \langle d_i, z_i \rangle - \text{discipline-type},$$

where:

$p_i \in P$ - the lecturer from the plurality lecturers P;

$d_i \in D$ - the subject from the set of subjects D;

$g_i \in G$ - a group from the plurality of groups G;

$z_i \in Z$ - kind of classes from the plurality of classes Z.

On the basis of these relations training department creates a set of educational streams \tilde{g}_i , which may consist of one training group $\tilde{g}_i = \langle g_i \rangle$, subgroup $\tilde{g}_i = \langle \bar{g}_{ij} \rangle$ or several groups $\tilde{g}_i = \langle g_i, g_{i_2}, \dots, g_{i_n} \rangle$. From these data the set of classes U is formed, the elements of it are $u_i = \langle p_i, d_i, \bar{g}_i, z_i \rangle \quad U_i = \langle p_i, d_i, g_i, z_i \rangle$, where: $\bar{g}_i = \langle \tilde{g}_i, k_i \rangle \quad g_i = \langle g_i, k_i \rangle$, k_i - the number of students in stream i. Scheduling is the process of formation the set of classes in the schedule $R = \{ r_i \}$, $R = \{ r_i \}$ де $r_i = \langle u_i, t_i \rangle \quad r_i = \langle U_i, t_i \rangle$, $t_i = \langle c_i, n_i, l_i \rangle$, $t_i = \langle c_i, n_i, l_i \rangle \quad t_i \in T$, $c_i \in C$ - types of the week (numerator/denominator), $n_i \in N$ - the day of the week, $l_i \in L$ - the numbers of lections.

The task of the scheduling is to determine the relation: $U \rightarrow T$.

It is important to note the following limitations: an equal distribution of classes on days of the week, with a minimum number of "windows", wishes and requirements of lecturers, lectures is preferably to be set at the beginning of the day and at the beginning of the week.

The problem of auditorium distribution

The distribution of the auditorium fund is to form a plurality of classes from the set of them in the defined auditorium $\bar{R} = \{ \bar{r}_i \} \quad \bar{R} = \{ \bar{r}_i \}$,

де $\bar{r}_i = \langle r_i, a_i \rangle$, $\bar{r}_i = r_i, a_i \in A$ - auditorium. Formally, the task is to find the function $A = f(R)$.

Moreover that schedule can be devised in the way that is not possible to find the separate auditorium for each class. To reduce the problems associated with impaired scheduling it is proposed to combine the processes of generation and distribution of auditorium fund.

It leads to the combination the set of elements $\bar{r}_i = \langle u_i, t_i, a_i \rangle$, $\bar{r}_i = U_i, t_i, a_i$.

In the process of distributing the auditorium fund several factors must be considered:

- auditoriums should be fully flood:

$$F_1 = \sum_{i=1}^I (\bar{r}_i m - \bar{r}_i k) \rightarrow \min; \quad (1)$$

- the relocation of students between classes should be minimal:

$$F_2 = \sum_{i,j \in \tilde{I}} \bar{r}_i k \cdot \rho(\bar{r}_i a, \bar{r}_j a) \rightarrow \min \quad (2)$$

- weekly classes should be carried out in the same audience in the numerator and denominator:

$$F_3 = \sum_{i,j \in \tilde{I}} |\bar{r}_i c - \bar{r}_j c| \rightarrow \min, \quad (3)$$

where:

I - the total number of lectures;

$\bar{r}_i k$ - the number of students in the appropriate \bar{r}_i ;

$\bar{r}_i m$ - the capacity of appropriate \bar{r}_i auditorium;

$\bar{r}_i a$ - an appropriate auditorium \bar{r}_i ;

$\rho(\bar{r}_i a, \bar{r}_j a)$ - distance between the auditoriums $\bar{r}_i a$ and $\bar{r}_j a$;

$i, j \in \tilde{I}$ if $\bar{r}_i c = \bar{r}_j c$ & $\bar{r}_i n = \bar{r}_j n$ & $\bar{r}_i l = \bar{r}_j l + 1$;

$i, j \in \tilde{\tilde{I}}$ if $\bar{r}_i u = \bar{r}_j u$ & $\bar{r}_i n = \bar{r}_j n$ & $\bar{r}_i l = \bar{r}_j l$.

Thus, the problem of distribution of classrooms: to find $A = f(R)$

when

$$F = w_1 F_1 + w_2 F_2 + w_3 F_3 \rightarrow \min \quad (4)$$

where w_i - weight indexes that are determined by academic department.

Scheduling classes as assignment problem with restrictions

Considering the approach of the formalization the tasks with the formation of schedule based on representation (1) - (3) as an assignment problem [7,8]. The task of planning in form of assignment appears in the following formulation: we have n works and n candidates for performing these works.

An assignment of candidates i for a job j depends on the expenses $c_{ij}(i, j = 1, 2, \dots, n)$. It is necessary to find a destination (reflection $U \rightarrow T$) candidates for all works that give minimum total expenses. This is a typical combinatorial problem [7]. In [8] the various forms of extended assignment problems are given.

When planning your schedule in the in Institutions of higher education, we introduce an additional system of limitations to the assignment model that contains different terms of computation he schedule.

Thus, it is proposed the model based on the links between the elements of decay for automation the process of scheduling. Restrictions can be represented in the following way:

- conditional appointment: restrictions are defined as a set of rules;
- connected executors (if executor is appointed to any work, he is appointed also to the derivative works);
- agent model for data collection about the process of scheduling.

The basic interpretation of the model of designation is as follows: as the order stands $\langle p_i, d_i, z_i \rangle$, and the executor is $\langle t_i, a_i \rangle$.

The orders are formed on the basis of curricula plans and the plans according the organization of educational process. Some separate examples of restrictions the tasks are the following requirements: a minimum number of "windows" for groups and lecturers, taking into consideration the wishes of lecturers (days, number of lectures which are preferred), a limit on the number of consecutive lectures, and others.

Each non-compliance is accompanied by "penalty" points. The aim - to assign an application to executors in order to minimize the size of penalty while satisfying the wishes of the executor. Also scheduling is the process in result of which the solution of current problems must be found by means of several rearrangements.

To solve this problem methods [7] were used, they were modified including the system of restrictions for scheduling.

The modification differs because except the category c_{ij} the common features of all executors that have the form (2) - (3) were included.

The set of indicators (2) - (3) and the function of valuation the model designation $\sum_i \sum_j c_{ij} x_{ij} = P$ may be used in series with the assignments or with (4).

The automation of distribution the auditorium fund

The developed software system allows to automate the process of distributing the auditorium fund. It provides an opportunity for distribution the auditoriums for lectures and practical classes, laboratory classes require specific auditoriums and detailed analysis of each type of lectures.

The distribution takes place on the basis of priorities set (1-3). If you do not have an auditorium with desired type and capacity, the program searches for the other type of auditorium that has not been distributed yet. The system is provided by tools and guidelines for the use of the interface to control the distribution of auditoriums while working with two monitors.

After distribution system creates the file of auditorium schedule in *.xls format. The file has the format which is used in manual division by staff in the department of education, therefore this file can be printed and used in further work. A separate file is the list of auditoriums which are free. Intermediate level of automated distribution of auditorium fund is 98%.

Organizational support for advanced technologies

One of the components of auditorium fund management is organizational support. The advanced technology provides the following changes.

The dispatchers of teaching- management department form the templates of document that are transmitted to the department to fill the "Workload distribution by department", "Requirements and wishes of the lecturers concerning the schedule." The above documents can be passed in both paper and electronic way.

The latter option is more convenient because the templates of documents filled with information about the lecturers, department and faculty disciplines. The completed electronic version of this document may automatically be uploaded to the developed system to reduce the load on dispatchers. Another possibility to optimize the use of the auditorium fund is to manage it beyond the schedule.

The analysis of usage of the auditorium fund

The system provides the function of analyzing the effectiveness of the use of the auditorium fund of the university, where auditoriums are a set of objects with their features (capacity, type of equipment). However, some of these features never change (location) or change very rarely (belonging to some department), and some are changing constantly (flooding while lectures).

By changing these features it is possible to make the university auditorium fund much adapted to current needs. One of the tasks of analysis is the evaluation of fullness audiences. The purpose of this analysis - determination the auditoriums with the sufficient fullness they are candidates for re-equipment, including the division into two parts.

To solve this problem, the clusterization according to the features is used. The flooding of the auditoriums while each lectures is taken as measurements in multidimensional Euclidean area. The cluster that is the closest to the beginning of the coordinate system is a cluster, of the auditoriums which has a tendency to lack fullness. The lecture auditoriums of Dnipropetrovsk National University of Railway Transport were clusterised, based on the current schedule, 21 clusters were selected consisting from 1 to 8 auditoriums.

Conclusions

The means of automation together with the saved auditorium fund and time, which is spent on the management processes, made it possible to show the statistical information for the analysis of quality of educational process, to formulate the of conclusions and recommendations based on these data.

The periodic analysis of the auditorium fund using automated methods allows to identify weak points in the use of the auditorium fund and take current decision leading to the elimination of defects.

The completed scenarios of auditorium fund management division in organization and interaction reflect of two monitors.

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