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Cognitive aspects of timetable visualization: support decision making

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Abstract

This paper demonstrates timetabling visualizations – timetables, transport timetables, multi-project schedules. These visualizations present an allocation of system resources. The visualization of high-school timetable demonstrates a timetable of student groups. The visualization of transport timetable shows arrivals/departs across stations and lines. The visualization of multi-project schedule includes Gantt chart and an allocation of system resources. These visualizations are provoked a new approach to timetable optimization. The timetabling problems can be solved efficiently by two-stage algorithm developed in database system. The first, a set of demands must be developed as initial timetable. A set of local and global resources are available for carrying out the activities of the systems. The solutions obtained by the first stage algorithm with the best resource allocation rule are used as a baseline to compare those obtained by the latter. The second, the initial timetable must be optimized. The basic criterion for optimization operations is demanded as criterion of resource equability. The latter is equal a root-mean-square deviation from a middle value.

Keywords: cognitive visualization, timetable, transport timetable, multi-project scheduling, root-mean-square deviation, multi-vectorial ranking.

1. Introduction

Cognitive graphics images allow representing the contents of studied object or process on a computer screen[1]. A cognitive graphics image visually and clearly reflects the essence of a complex object, and is also capable of providing a fundamentally new decision. Thus, an important feature of cognitive graphics image is targeted influence on the intuitive thinking mechanisms. Creation of information technologies, based on the use of cognitive graphics images, implemented in intelligent systems for decision-making of different problems in various concrete

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and interdisciplinary problem areas. Cognitive graphics images are used in a variety of in intelligent systems for optimization of the learning process, for visualization and prediction of education process results, etc.nalysis of information structures of knowledge and data, identification of different kinds of regularities in data and knowledge, and decision-making and decision justification, in intelligent training and testing systems for.

Scheduling is an arrangement of entities into a pattern in space-time in such a way that constraints are satisfied and certain goals are achieved. Constructing a schedule is the problem in which time, space and other resources have to be considered in the arrangement. The class of scheduling problems includes a wide variety of problems such as multi project scheduling, transport scheduling, educational timetabling and many others. Many real world scheduling problems are multiobjective by nature, i.e. several objectives should be achieved simultaneously. A number of multiobjective metaheuristics have been proposed to obtain solutions for multiobjective optimization problems[2]. Metaheuristics include tabu search, genetic algorithms, neural networks, ant colony optimization and many others.

The purpose of the paper is demonstration different timetable visualizations provoking new metaheuristic approach to timetable optimization.

2. Timetable visualization techniques

Schedule task software solution uses a two-step approach[3] - forming primary schedule and its subsequent optimization. The initial timetable is any timetable that satisfies the hard constraints. Both phases required one visualization image just schedules for qualitative analysis. Image schedule represents the allocation of system resources in time within the schedule interval. Visualization analysis of the initial schedule allows define approaches to optimization and visualization of the resulting schedule provides an opportunity to evaluate hypotheses put forward.

A high school timetable distributes three kinds of resources - student groups, teachers and audience. Figure 1 presents the results of formative software 927 schedule sessions for 50 student groups[4]. Figure. 1 represents the distribution of a system resource - groups of students within the two-week schedule interval. Classes in each group for a "couple" of the two weeks of the schedule are one under the other. The color represented various occupations: red - lecture, blue - practical, green - laboratory. Compact presentation allows to reach a glance results and generate some conclusions. The main consumers of class schedules are students whose initial timetable (Fig. 1) is non comfortable. Firstly, the number of group lessons on different days of the week varies from one to four. Secondly, the start time of the first classes on different days is different. Thirdly, the number of lessons the same day in different schedule weeks, too, is different. These considerations have made it possible to formulate equability grades of group lessons. These grades form the equability criteria classes schedule and strategy optimization of initial schedules[4]. Figure 2 shows the results of the optimization of the initial schedule. Visual comparison shows the removal of most of the listed flaws.

Mutual permutation classes optimized schedules (Fig. 2) the possible solution to secondary tasks satisfying the wishes of teachers and classroom efficiency fund. Resource heterogeneity - specificity groups, teachers and audiences prevents the formation of integral assessment of resource allocation in the high school timetable.

For transport systems as opposed to educational institutions cannot be generating views schedules throughout the system. The traffic gives rise to several kinds of schedules for different types of system resources. Schedule of the particular vehicle can be represented as a vector of times of arrival/departure stops at various points. Transport schedules through a particular stopping point is usually the details view arrival/departure times. It is necessary to schedule the movement of vehicles between the separate paragraphs. For transport systems formed work schedules-airplane crew, locomotive crews, etc.

For schedules of stations and hauls between them stopovers used spiral presentation (Fig. 3), which is a temporary spiral axis, and its length is equal to the interval schedule. Spiral turn - the smallest period schedule. Showing spiral possibly representation of arrival/departure of the vehicle.

In Figure 3 presented the initial schedule of passenger transport via the most loaded station railway network test[5]. The timetable is shown weekly, and each spiral turn consistently represents the per diem schedules. The first internal turn is schedule for Monday. Blue presents the arrival/departure to the station of trains, yellow-two trains, while staying at the station. In the upper-right corner of the specified value of the root-mean-square (RMS) deviation from the mean interval arrivals/departures at the station.