

# Development of Environment for Generating Personalized Schedules

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**Abstract**—Peculiarities of construction and automation of the information system for forming the schedule for educational institutions were investigated. The web application architecture was built, which combines of analyzed means advantages and generates personalized schedules for students, teachers and classrooms according to developed algorithm for effective groups distribution.

**Keywords**—*schedule, optimization algorithm, modularity.*

## I. INTRODUCTION

There are about more than a quarter of a million students around the world. And each semester the teachers, students and educational departments employees have discomfort. For administration – to create the schedule that will fit the room area, and teachers’ hours and should have a balanced count of lessons. For teachers and students – quickly find the schedule and determine the week’s type. In presented study, various approaches to the automated creation of the schedule are analyzed with their advantages and disadvantages.

One of the main reasons for the deterioration of the quality of professional training is assessment and feedback. Our work will be most focused on this reason, as the student will be able to easily find feedback from the teachers. On the other hand, the teacher will receive notifications about appeals and thus get in touch faster and respond to the student in the shortest possible time.

## II. TYPES OF AUTOMATION APPROACHED

The automation process could be divided into five main types: constraint-based scheduling, genetic algorithms, machine learning approaches, and timetabling software.

### A. Constraint-based scheduling

One of the most popular is constraint-based scheduling based on systematic and rule-based approaches for scheduling. It allows customizing and handling specific requirements for scheduling [1]. But the main disadvantage is that it couldn’t consider the best solution for schedule optimization. Set a schedule in huge room, e.g., for a group of ten students.

### B. Genetic algorithms

That approach creates the algorithms by applying some selections and mutation operations. It can handle numerous scheduling problems and requirements [2]. The roulette wheel selection is frequently employed method for choosing

chromosomes in genetic algorithms. It resembles spinning a roulette wheel, where each chromosome is assigned a portion on the wheel that corresponds to its fitness level. The main disadvantage is that it’s a time-consuming process for the effective optimization of the algorithm and efficiency is based on correct selection.

### C. Machine learning

Machine learning uses technique of learning historical data and some patterns [3]. It could make predictions or some recommendations for possible future schedule based on teachers’ hours, students’ ages, etc. The main disadvantage of machine learning is that often the university doesn’t have or have a small amount of data for AI training and learning.

### D. Timetabling software

That approach uses for building user-friendly applications that will display the schedule for all possible devices and operation systems [4]. According to the high development of technologies, it can fit all requirements and can provide accessibility for people with disabilities. There are fewer disadvantages as to previous approaches. Vain disadvantage is cost of developing and maintaining the application.

## III. ENVIRONMENT SOFTWARE IMPLEMENTATION

After comparing different approaches, it was decided to build a web application architecture that would combine the advantages of above means and automate the personalized schedules generation for students, teachers and classrooms. The main architecture (Fig. 1) is to use .NET as a programming language for building the backend and use JavaScript framework Angular for the frontend side. There will be three types of users: anonymous users (everyone who can access the application), teachers who can add information about groups, schedules, rooms, etc., and the admin who will be able to add access for teachers to the application. For security reasons and to make it impossible that anonymous users will be able to modify the existing data, was decided to use Azure B2C as an identity provider and use JWT Token validation from the backend side. For the saving the data selected the SQL Database. For the storing files (such as pictures, excel files, or PDFs) decided to use Azure Blob Storage. For the mail notifications, such as approved/declined access requests, schedule changes will be used in the Email Domain as the SMTP server. And the finally for the saving logs about data manipulation we are using the Application insights.

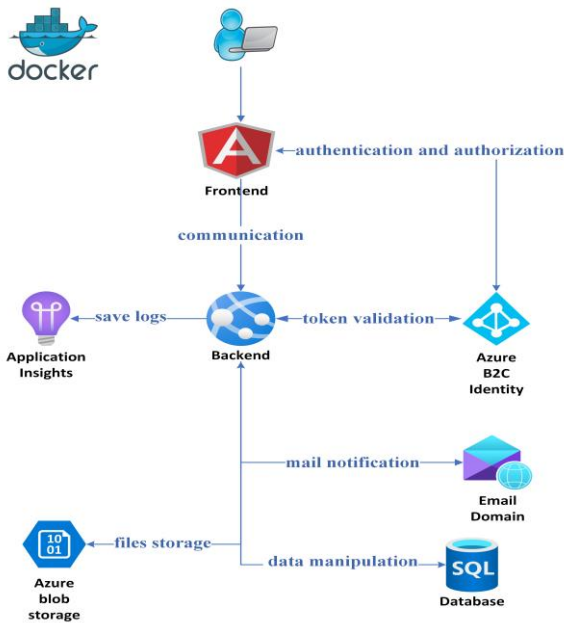


Fig. 1. Architecture of the schedule automation web application

#### IV. THE GROUP SEATING ALGORITHM WITH CAPACITY AND SCHEDULE CONSIDERATIONS

The group seating algorithm with capacity and schedule considerations is designed to efficiently assign groups of students to classrooms based on two important criteria: the capacity of the classroom and scheduling requirements. This algorithm ensures that small groups are not assigned to overly large classrooms, and large groups are accommodated in appropriately sized classrooms.

There is a detailed scheme of this logic that is used in our service on the backend side (Fig. 2). This logic scheme outlines the step-by-step process that the algorithm follows to determine the optimal seating arrangement for the groups. The algorithm considers the capacity of each classroom and avoids assigning small groups to large classrooms, thus preventing wasted space. It also ensures that larger groups are allocated to appropriately sized classrooms to avoid overcrowding and helps maximize space utilization, prevent overcrowding, and meet any scheduling requirements.

In addition to capacity considerations, the algorithm can be extended to incorporate any specific scheduling requirements. It will take into account constraints such as certain groups needing to be assigned to classrooms at particular times or in a specific sequence.

Implementing this algorithm in our service's backend enables us to automate the process of assigning groups to classrooms, saving time and effort for administrators or educators responsible for managing these allocations.

#### V. THE INFRASTRUCTURE ADVANTAGES

Thus, in the presented architecture docker containers provide isolation for applications, ensuring that they run independently of the underlying host system and other containers. This isolation helps prevent conflicts between dependencies and provides enhanced security by limiting the impact of any potential vulnerability.

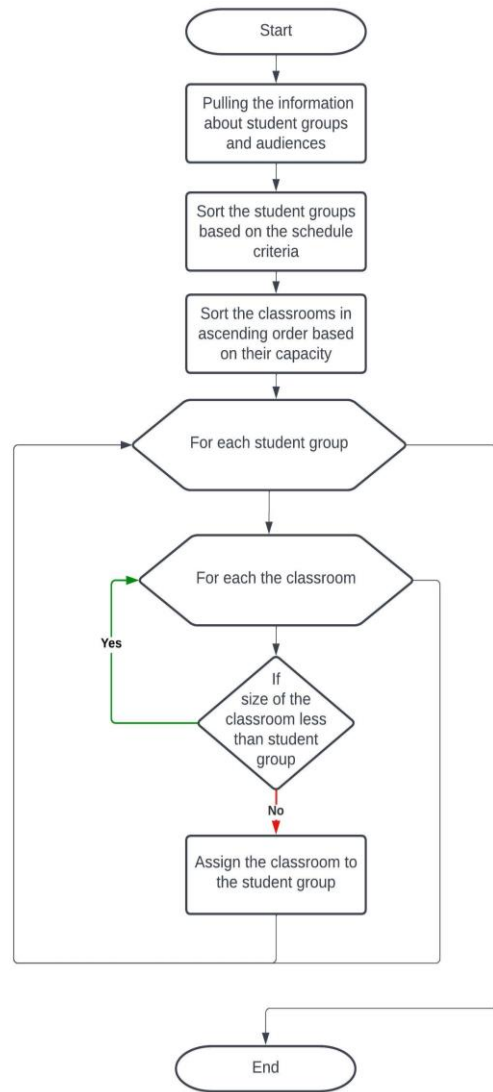


Fig. 2. Algorithm of effective groups distribution

Also will be able to do auto-scale depending on load traffic to the backend part which allows it to keep the high performance of backend system for better client experience. Overall, using Angular with .NET and Docker provides infrastructure advantages in terms of scalability, portability, rapid deployment, isolation, security, development environment consistency, and seamless integration with CI/CD pipelines. These advantages contribute to more efficient and reliable application development and deployment processes.

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