Abstract— a solution of an automated system for ranking is presented in this paper. When candidates are registering to study at Subotica Tech, a ranking problem occurs in certain study programs. A new web service was developed to solve this problem. Algorithm as the main part of this system decides and controls the entire logic of the service. During the decision-making process, the algorithm takes into account a number of parameters. The paper describes the implementation of the algorithm.

I. INTRODUCTION
When candidates are registering to study at Subotica Tech, a ranking problem occurs in certain study programs. When applying, the candidates can choose a study program and for each of them the program assigns a priority. In order to speed up and automate the whole process automate web-based information service was implemented. This service is a part of a complex eco system of E-administration Office (Elektronska referada). The service is implemented using several internet techniques and methods mainly:

- PHP (Hypertext Preprocessor)
- MySQL
- JavaScript with jQuery library
- XHTML (Extensible HyperText Markup Language)
- CSS (Cascading Style Sheets)

The main part of the service is an algorithm that decides and controls the entire logic of the service. During the decision-making process, the algorithm takes into account a number of parameters (priority date, wish list, type of funding, the number of vacancies, the number of (seats) places filled).

II. USED TECHNIQUES AND TECHNOLOGIES
This web service is developed with the use of several web techniques: PHP as server side programming language, MySQL as relational database management system, JavaScript with jQuery library as client side programming language, XHTML for designing the layout of the pages, CSS for styling pages, and Ajax to get more user oriented functions. The underlying development platform for this system is LAMP (Linux-Apache-MySQL-PHP), as the web application hosting platform is too.

Passing through the stages of development and testing, the team worked also on the optimization of the code. Useful information are obtained from the users of this service. Based on those, further optimization was done on critical parts.

III. FRAMEWORK IN WEB DEVELOPMENT
Using frameworks in the world of software development has long been known. However, in the world of web development it has recently come into wide spread use. A software framework is a set of libraries, and an execution environment that allows programmers to develop web applications faster and more organized. The main idea of the framework is observed after the use of frequently used functions and basic structures upon which programmers can develop their applications [1]. This current system uses Zend Framework.

A. Zend Framework
Zend Framework is an open source framework for the development of web applications and it is based on the PHP programming language. It includes a group of tools for design and implementation. Zend Framework also provides a complete implementation of the Model-View-Controller (MVC) pattern. Using modules with MVC is referred as HMVC (Hierarchical Model View Controller) pattern. MVC is a software architecture pattern which separates the representation of information from the user's interaction with it [2]. In our project it separates database and business logic from the presentation layer [1].

IV. PRESENTATION OF THE SYSTEM
A. History
The first version of the E-administration office which is in use at Subotica Tech was developed in 2000. The Service was developed with the then-popular techniques: Active Server Pages (ASP), VBScript and MS SQL server. This version allowed students to apply for exams, review and evaluation of students' marks and other liabilities and it was experimentally used only by the students of the Informatics study programs. The Web service was in offline synchronization with the desktop version of E-Administration which was developed in Visual Basic. The use of this version has contributed to the development team so that the design of the new version became much easier and was carried out without initial problems [3].

B. Current Solution
The current solution contains an overall solution for E-administration Office. It controls all data about students, teachers, stuff, curriculums, exams, etc. The solution contains all necessary data to be able to serve each party from the moment when a potential student registers to
study at Subotica Tech, to the moment when a diploma and a diploma supplement is generated for the student who finished their studies. Additionally, the communication between students and teachers, teachers and staff is also incorporated into the system [3].

V. RANKING PROCEDURE AND ALGORITHM

At Subotica Tech, students can apply for 5 different study programs (Mechanical Engineering, Electrical Engineering, Information Technologies, Mechatronics, and Technical Management), and within these programs for eight different modules (Product Development, Thermotechnics, Electronics, Automation, Technical Informatics, Internet and E-business, Mechatronics, and Technical Management). When applying, students can select up to three different modules, sorted into three levels of priority (1st, 2nd, and 3rd).

The ranking procedure in general is a known problem that has been dealt with a lot in the past [4, 5, 6, 7, and 8]. However, the specific needs considering the ranking of the students, i.e. in what order they will be accepted for studies at Subotica Tech, required the development of a new procedure.

The main rule that is taken into consideration while performing the ranking of the students is defined by the following sub-rules:

- If the student is ranked within budget for the 1st priority module, they are removed from the rankings for 2nd and 3rd priority modules regardless of their rankings;
- If the student is not ranked within budget for the 1st priority module, but is ranked within budget for 2nd priority module, they are removed from ranking for 3rd priority module regardless of their ranking;
- If the student is not ranked within budget for the 1st and 2nd priority modules, they are not removed from any ranking. To be able to perform the ranking, the following input data is needed:
  - Available study programs – modules;
  - Application term;
  - Study year;
  - Capacity for study programs – modules (Budget and self-financing);
  - Required points (Budget and self-financing);
  - Student’s name;
  - 1st priority study program – module for each student;
  - 2nd priority study program – module for each student;
  - 3rd priority study program – module for each student;
  - Points. for each student;
  - Status for each student.

The ranking procedure is initiated manually to obtain the current rankings (Fig. 1). When initiated, ranking is performed for each study program – module, according to the points of the students who applied for it and whose status is unregistered, taking into consideration the remaining available capacities.

After this ranking, a sub-procedure is initiated. For each study program – module, all students who applied for it with the 1st priority and are ranked within budget are one by one removed from all study programs – modules where they priority is higher than the checked priority. After that, the sub-procedure is repeated for the 2nd priority.

The developed procedure takes into consideration whether at least one removal from any study program - module occurred during the sub-procedure. If at least one removal occurred, the sub-procedure is initiated over again. The ranking procedure ends if the sub-procedure is ended without any removal from the study programs – modules. At the end, the ranked students for all study programs – modules within budget, self-financing and outside available capacities are presented.

VI. IMPLEMENTATION OF THE SYSTEM

This section shows the real implementation of the developed system in the case of ranking new students at Subotica Tech for the study year of 2012/2013. Only data for Informatics and Technical Communication Management study programs are shown because great amount of whole data.

From registration tables for the first and second day we can see a significant drop in numbers for the first priority budget. This is because a lot of students want to be registered right away for the study program they choose. We can notice a drop in self financing first priority, this is because the budgeted financing is more tempting. Students will rather choose their second or third priority, on which they has been ranked on budget than to register on first priority for self financing.

The third thing we can notice is that there is a raise on third priority self financing, this is happening because some of the students get registered to budget on other priorities, and they are not ranked anymore on self financing so this raise is from under the line third priorities.

Because students gets ranked on three or two priorities, if the first and second is not ranked under budget, they are appearing two or three times (on two or three different study programs). But if they choose to register on second or third priority, movement will appear for others ranked students. So biggest movements appear when some students get registered to their second or third priorities.
Figure 1. Algorithm of the ranking procedure
TABLE I. FIRST DAY OF REGISTRATION

<table>
<thead>
<tr>
<th>Study program</th>
<th>Budget</th>
<th>Self financing</th>
<th>Under the line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Informatics</td>
<td>33</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Internet and E-commerce</td>
<td>22</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>31</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE II. SECOND DAY OF REGISTRATION

<table>
<thead>
<tr>
<th>Study program</th>
<th>Budget</th>
<th>Self financing</th>
<th>Under the line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Informatics</td>
<td>22</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Internet and E-commerce</td>
<td>15</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>24</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE III. THIRD DAY OF REGISTRATION

<table>
<thead>
<tr>
<th>Study program</th>
<th>Budget</th>
<th>Self financing</th>
<th>Under the line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Informatics</td>
<td>12</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Internet and E-commerce</td>
<td>11</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>17</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE IV. FOURTH DAY OF REGISTRATION

<table>
<thead>
<tr>
<th>Study program</th>
<th>Budget</th>
<th>Self financing</th>
<th>Under the line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Informatics</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Internet and E-commerce</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE V. NINTH DAY OF REGISTRATION – LAST DAY

<table>
<thead>
<tr>
<th>Study program</th>
<th>Budget</th>
<th>Self financing</th>
<th>Under the line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Informatics</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Internet and E-commerce</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

We can distinguish two kinds of movement between budget, self financing and under the line.

- From self financing to budget. This happens when someone wants to be registered for one study program and nothing else matters, so he can accept to be registered for self financing even if he could be on a budget. If this student registers for his, let say first priority on self financing, he is no longer ranked on his second or third priority on budget, so someone from self financing got a chance to be on budget. This rarely happens.

- From under the line to self financing. When students get registered by their second or third priority they are not ranked anymore by their first or second priority. So someone could get a chance to move up in ranking. This happens most often.

There is more kind of movements but those appear when the points are updated. Points are updated once, so we are not analyzing those movements.

VII. CONCLUSION

This paper presents the implementation of the ranking procedure algorithm which is developed for the use in the complex web information system E-administration. This system is implemented at Subotica Tech for three years.

REFERENCES


