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Contents

Hybrid Systems of Computational Intelligence

Modeling of Animator Studio Control Service Functionality Using Data Mining Tools

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Abstract. The research addresses to the animation studio services issues, advantages and disadvantages of their functioning, both for the ordinary user and the developer. It makes sense to provide the client with information about two areas: pricing policy and content of services. The services automation methods within animation studios are researched using modern methods of Data Mining. It is proposed to create the work logic using data mining methods, Decision Trees methods, for the animation studio management services effective functioning. It is determined that in case of client priority search criteria choice is related to pricing policy, it makes sense to organize the operation of the animation studio management service based on the backtracking algorithm. In the case of client's search criteria choice priority are content-related topics of services, apply algorithms for constructing decision-making tree. It is proposed to solve the problem of comparing the services of different animation studios, their pricing policy, location, etc. by building a composite web application - data mashup of children's animation studios.

Keywords: Information technology · Data Mining · Decision Trees · Mashup · Animation studio · Entertainment

1 Introduction

Recently, there has been a rapid development of the entertainment industry worldwide. This is the entry into a post-industrial stage of development, for most of the developed countries in the world, a characteristic feature is the significant growth of services and service industries. After all, quality of life is a priority of post-industrial society. In addition, the crazy rhythm of the modern world requires constant recreation of the psychophysiological state of the individual, ie requires rest and change of activities. That is why today, the leisure and

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entertainment industry, which provides us with space for our leisure, is one of the most important areas of everyday life. The entertainment industry allows members of society not only to meet their spiritual needs, but also to form an idea of their well-being and social status. Given the complexity and diversity of services provided by the industry, it is able to reach different segments of the population, with different needs, interests and different social status. Despite the fact that the entertainment industry is one of the youngest sectors of the socio-cultural sphere, it accounts for about 6% of the world's capital [23].

In today's conditions of informatization and computerization of the society [21] and the rapid increase in demand for services of the entertainment industry [19,22]. Business development in this area requires new approaches to information processing and decision-making. The most notable change can be observed in the travel companies that actively involve organizations to process activities, advanced digital technology [1,2,7,8,20]. These include global computer reservation systems, integrated communications networks, multimedia systems, smart cards, management information systems, and more.

The demand for the children's animation studios services is constantly growing. Modern animation is the activity of developing and implementing special leisure programs [11]. With a data web - site for parents Britain Netmum, parents spend on children's holiday from $200 to several thousands of dollars, and in general, the market value of children's parties is over $1.5 billion [10]. Similarly, in Ukraine, on average, the organization of children's holidays costs about $200 [22].

Given the high demand, the number of children's animation studios and the variety of services they provide are steadily increasing. It is quite difficult for the average consumer to navigate this diversity. It takes a long time to analyze all the information provided by animation studios and their clients (customer feedback) and to choose exactly the suggestions that addresses his/her needs and capabilities. Providing quality service without rapid response to user requests and needs is impossible for animation studios, without modern informational systems and technologies [14].

2 Problem Statement

As of today, most animation studio, event-agency etc. have their own web sites, where the highlight information about their services and show potential customers their own successful experiences conducting their activities, etc. However, this is not enough. The client (animation customer) needs the ability to quickly and conveniently view the offerings of different animation studios with the ability to compare their services, pricing, quality of service and the ability to provide these services in the right location and time range, etc.

Analyzing typical for the Ukrainian market, web services animation studio "Children's Planet" [16], "Igroland" [17], "Papashon" [15], event - agency "Empire holidays" [18] it is difficult not to notice, that the data the services are not convenient and do not meet the above requirements. Obviously, all four main

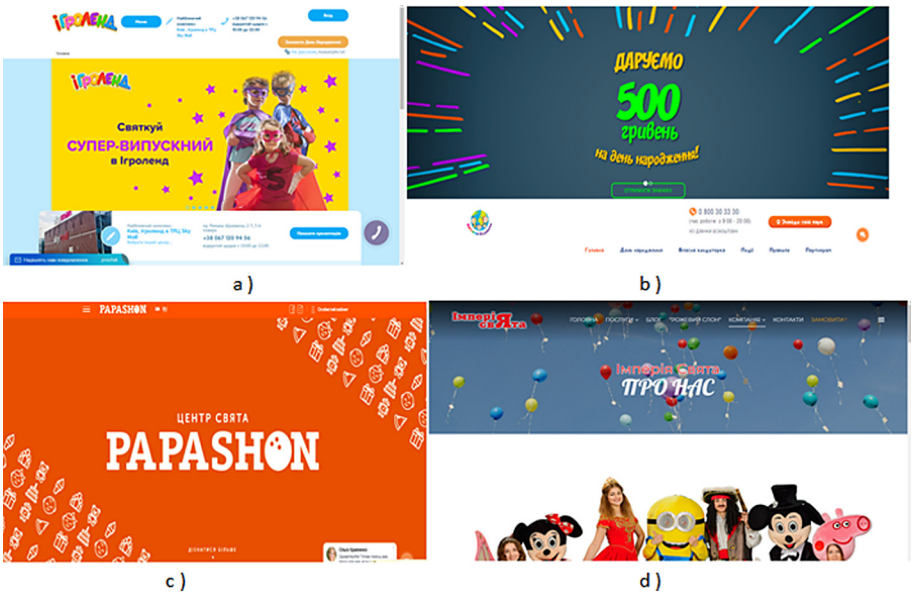

Fig. 1. View of the main pages of services of children's animation studios: a) children's animation studio "Igroland"; b) children's animation studio "Children's Planet"; c) the PAPASHON entertainment complex; d) "Empire of the Holiday" event-agency

pages of web services (Fig. 1) are not very different and do not display information regarding the choice of possible services. They do not have an intuitive or adapted interface. After pressing certain buttons and selecting menus, which, by the way, are not easy to find, the information doesn't get much more.clear. So, for example, to find the list of services of the children's animation studio "Children's Planet", you must use the page scrolling, on the website of the children's animation studio "Igroland" you need to find the "Menu" button, and click on the "Details" button on the main page of the entertainment complex PAPASHON. However, even after that. not much more information is displayed. None of these services are immediately accessible to the complex of services that can be obtained based on a certain budget. Also, none of these services has the opportunity to introduce, for example, topics that are interesting for the child to get information about the range of services that the company can provide and the price range of these services, it is difficult to find differentiation of services by age categories and so on.

In addition to imperfect client-side work, these services are not functional enough to meet the needs of animation studio staff. Here are some of the main unsolved problems:

- does not have a cumulative database of customer preferences and needs;
- there is no service of forming comparative characteristics (cost, duration in time, age restrictions and number of participants, etc.) of different offers;

- when the client posts an order the administrator receives a notification about this event, which is not processed by the service itself, respectively, with a large influx of people who want to order the same service, the service will not help the administrator with this problem;
- there is no dynamic selection of the set of possible offers for the client according to the criteria he/she has set;
- there is no dynamic selection of possible offers for the client, taking into account time and quantitative parameters, the possibilities of the studios themselves, etc.

Survey questions introducing information technology in the entertainment industry dedicated work of many domestic and foreign researchers, scientific publications is Pauline J. Sheldon and P. Benckendorff [3] Rob Law and Ulrike Gretzel [5,9], R. Egger and D. Buhalis [4], M. M. Skopen [13], S. Melnichenko [12].

However, they are mostly dedicated to addressing the digitization of tourism animation services and, unfortunately, very little attention has been paid to digitizing the children's animation studio segment.

3 The Method of Improving the Work of Children's Animation Studio Services with the Use of Data Mining Technique

The problem of comparing different animation studios services, their pricing policy, the convenience of their location for the client and the quality of services, in our opinion, can be solved by building a composite web application - mashup data of children's animation studios [7]. Travature, which is a popular portal about tourism. Mashup Travature integrates flight search, hotel reviews and acts as a travel guide. Graphic, text, formal, etc. can be used to specify web services and their compositions ways. The main difference between a composite web application and web services that use dynamic server-side content generation with Java, CGI, PHP, or ASP technologies is that mashup content can be generated on the client browser side through client scripts. The logic of generating content on the client side is a combination of code embedded directly in the mashup web page.

To solve the problem of fast and high-quality data sampling, according to certain criteria set by the client (customer of animation services), it is necessary to use modern methods of intellectual data analysis. We believe that it is most appropriate for the organization of the effective operation of a service for managing the work of animation studios to use the Decision Trees methods, such as to enable, step by step, based on the client's request, to form from the existing set of services, the set of the most client-friendly solutions.

To construct Decision Trees most widely used in practice: algorithms binary search tree (BST), returning search algorithm (backtracking algorithm) and algorithms decision tree.

Obviously, the most effective way to search is to view all the data consistently. In fact, if you don't have the data you need, then you need to look through the entire list to find out. The binary search tree avoids this. The only requirement is the introduction of some linear order for the data [6], However, this way of organizing a children's animation studio service is not efficient, since many services providing these services are quite diverse in many aspects (age, price, preference, etc.) and arranging many of these different types of elements into a clear linear sequence is quite difficult and makes no sense. To our opinion, to sample a variety of possible services, it is advised to use the backtracking algorithm when choosing a client as a priority, the direction of pricing.

The main idea behind the backtracking algorithm is that the solution is built up gradually, starting with an empty sequence ∅ (length 0). In general, if there is a partial (incomplete) solution $(x_1, ..., x_i)$, where i< n, then we try to find such an admissible value of x_{i+1} that can be continued $(x_1, ..., x_i, x_{i+1})$ pending full resolution. If such a valid but not yet used value of x_{i+1} exists, then we add this new component to the partial solution and continue the process for the sequence $(x_1, ..., x_i, x_{i+1})$. If there is no such value of x_{i+1} , then we go back to the previous sequence $(x_1, ..., x_{i-1})$ and continue the process, looking for a new, not yet used value of x'_i [6].

The operation of this algorithm can be interpreted as a process of bypassing a tree. Each peak corresponds to it a sequence $(x_1, ..., x_i)$, with peaks that correspond to sequences of the form $(x_1, ..., x_i, y)$, sons of the summit. The root of the tree corresponds to an empty sequence. This tree is being traversed by searching deep. In addition, a predicate P is specified on all tree vertices. If $P(v) = False$, then the subtree vertices with root at vertex v are not considered, and the volume of the bust decreases. The predicate $P(v)$ acquires the value $False$ when it becomes clear that the sequence $(x_1, ..., x_i)$, corresponding to vertex v cannot be added to the complete solution. To apply this method, the solution of the problem must look like a finite sequence of elements $(x_1, ..., x_n)$.

In our case, the elements $(x_1, ..., x_n)$ of this sequence are the cost of the services that can be provided to the client within the budget that he or she determines (predicate P). This is exactly what a client wants, based on a specific budget. Initially, the client is offered a set of services that can be provided within a given budget, the client is able to remove/add certain of them, then the budget for other services increases/decreases. The algorithm returns the customer to the previous selection step, with the other set of service elements until the desired set of services within the client's budget is formed.

3.1 Description of the Backtracking Algorithm

After entering in the search window the "budget" of the amount that the client focuses on, the logic of the system employs a backtracking algorithm, which allows to form the set of services that can be provided within the specified budget.

Let us illustrate the algorithm for generating multiple offers (search with returns) in case the client chooses as a priority, the direction of the pricing

policy, that is, according to the criteria "budget", in a specific example. Suppose that Table 1 sets the sets of services $(p_1, ..., p_n)$.

Table 1. Set of existing services

Code	Service	Cost	Duration
p1	Costume photoshoot	50 USD	1 h
p2	Rolledrome	30 USD	1 h
p3	Birthday greetings with cake	27 USD	30 min
p4	Weaving of African pigtails	25 USD	1 h
p5	Soap bubbles show	25 USD	1 h
p6	Trampoline arena	6 USD	1 h
p7	Aqua makeup	5 USD	30 min
p8	Trampoline "Treasure Island"	4 USD	30 min
p9	Maze	3 USD	unlimited

Each service is matched by its cost. You need to find a subset of which the cost of the elements does not exceed the client's criterion "budget" (CB). If the sum is so large that the addition of any new number exceeds CB then we go back and change the last addition of the sum. Let CB = 50 USD. Figure 2 illustrates part of the backtracking algorithm for the problem of finding a subset of a set of services $(p_1, ..., p_n)$ with the criterion "budget" equal to 50 USD. In

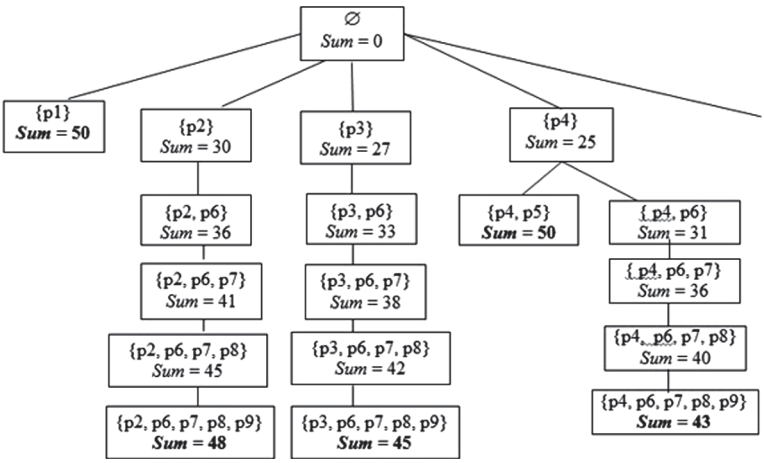

Fig. 2. Part of the backtracking algorithm for problem of finding the subset of a set of services $(p_1, ..., p_n)$ with the CB = 50 USD

general, when a subset of the set of services $(p_1, ..., p_n)$, given in Table 1 from the criterion "budget" is equal to 50 USD. The client may be offered 6 possible service options. Formed variants of subsets of possible services are given in Tables 2, 3, 4, 5, 6 and 7, respectively. And it should be noted that these options are provided, with information on the possible duration of the organized holiday.

Table 2. Set of existing services

Code	Service	Cost	Duration
p1	Costume photoshoot	50 USD	1 h
	Sum	**50 USD**	**1 h**

Table 3. Set of existing services

Code	Service	Cost	Duration
p2	Rolledrome	30 USD	1 h
p6	Trampoline arena	6 USD	1 h
p7	Aqua makeup	5 USD	30 min
p8	Trampoline "Treasure Island"	4 USD	30 min
p9	Maze	3 USD	unlimited
	Sum	**48 USD**	**unlimited**

Table 4. Set of existing services

Code	Service	Cost	Duration
p3	Birthday greetings with cake	27 USD	30 min
p6	Trampoline arena	6 USD	1 h
p7	Aqua makeup	5 USD	30 min
p8	Trampoline "Treasure Island"	4 USD	30 min
p9	Maze	3 USD	unlimited
	Sum	**45 USD**	**unlimited**

Once the client selected, a subset of the solutions that are most appropriate for him/her, he/she can make changes by removing/adding certain services (this will result in a certain budget change) and place an order.

If the client chooses as a priority, the content area of services, the most appropriate is to use the algorithm of building a decision tree. In this case, we need to solve the typical classification problem.

Table 5. Set of existing services

Code	Service	Cost	Duration
p4	Weaving of African pigtails	25 USD	1 h
p5	Soap bubbles show	25 USD	1 h
	Sum	**50 USD**	**2 h**

Table 6. Set of existing services

Code	Service	Cost	Duration
p4	Weaving of African pigtails	25 USD	1 h
p6	Trampoline arena	6 USD	1 h
p7	Aqua makeup	5 USD	30 min
p8	Trampoline "Treasure Island"	4 USD	30 min
p9	Maze	3 USD	unlimited
	Sum	**43 USD**	**unlimited**

Table 7. Set of existing services

Code	Service	Cost	Duration
p5	Soap bubbles show	25 USD	1 h
p6	Trampoline arena	6 USD	1 h
p7	Aqua makeup	5 USD	30 min
p8	Trampoline "Treasure Island"	4 USD	30 min
p9	Maze	3 USD	unlimited
	Sum	**43 USD**	**unlimited**

After all, when we consider a client's request in terms of the content topics of animation studio services, we need to make decisions about the set of existing objects (animation studio services), assigning them to certain thematic classes, that is, providing these objects with classification features. So we need to solve a typical classification problem whose set of conditional attributes A will be made up by the client's requirements. The set W is an active animation studio service; the set d is a decision attribute - two elements {"good luck", "bad luck"}.

3.2 Description of the Algorithm for Building a Decision Tree

After selecting a search box of your request priority area "subject", the customer will be asked to answer a few questions that are conditional attributes and accordingly help shape due to the algorithm for constructing Decision Tree, the set of possible proposals for a client under given his attributes.

Let's use one of the algorithms for building a Decision Tree, namely the algorithm ID3 (Iterative Dichotomiser-3 algorithm) [6]. To illustrate the algorithm for generating set of proposals using the algorithm for constructing Decision Tree to a specific example.

Let Table 8 provide information on options for a children's holiday. We construct Decision Tree for given Table 8.

A holiday is a decision-making attribute. The set of all conditional attributes $A = \{$"age", "gender", "number of participants", "subject matter", "type of entertainment", "duration of entertainment", "budget"$\}$ corresponds to the root node. Select the attribute "age" and mark it the root vertex. The set of values of this attribute consists of three elements: up to 5 years, 5–10 years, more than 10 years. Put the root vertex in correspondence with three edges, each of which is attributed to the value of the attribute "age". Set examples will be divided into three subsets that correspond to the values of the attribute "age"; these subsets correspond to each of the vertices 2, 3, 4 of the tree shown in Figs. 3 We remove the attribute "age" from the set A and get the set $A = \{$"gender", "number of participants", "subject matter", "type of entertainment", "duration of entertainment", "budget"$\}$.

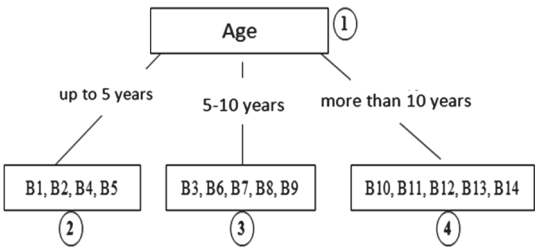

Fig. 3. The first step of the ID3 algorithm (removing the "age" attribute)

Consider the vertex number 3. It is matched by the subset of examples {B3, B7} that have the value of the decision attribute "Yes" and the subset of examples {B6, B8, B9} that have the value of the attribute of the decision "No". We select the following attribute from the set A; let it "gender". Denote by vertex 3, construct two edges with the values of this attribute, and divide the set of examples in vertex 3 into two subsets, in each of which the values of gender are the same (Fig. 4).

Consider the vertex number 6. It corresponds to the subset {B3}, which has the value of the decision attribute "Yes", and the subset of examples {B8, B9}, which have the value of the decision attribute "No". We select the following attribute from the set A; let it be the "number of participants". Denote by vertex 6, construct three edges with values of this attribute and divide the set of examples in vertex 3 into two subsets, in each of which the values of the number of participants are the same.

Table 8. Set of options for organizing holidays

Version	Age	Gender	Number of participants	Subject	Type of entertainment	Duration of entertainment	Budget	Holiday
1	up to 5 years	boy	up to 4	not thematic	are active	unlimited	unlimited	Yes
2	up to 5 years	boy	up to 4	ninja	science	30 min – 1 h	100–200	No
3	5–10 years	boy	4–8	ninja	science	30 min – 1 h	100–200	Yes
4	up to 5 years	boy	more than 8	Peppa	art	up to 2 h	unlimited	No
5	up to 5 years	girl	more than 8	Peppa	art	unlimited	100–200	Yes
6	5–10 years	girl	4–8	ninja	team entertainment	unlimited	100–200	No
7	5–10 years	girl	4–8	Lady Bug	team entertainment	unlimited	100–200	Yes
8	5–10 years	boy	more than 8	Lady Bug	team entertainment	unlimited	100–200	No
9	5–10 years	boy	more than 8	pirates	team entertainment	unlimited	up to 100	No
10	10 years	girl	more than 8	Peppa	art	up to 2 h	100–200	No
11	10 years	girl	up to 4	Peppa	art	up to 2 h	100–200	Yes
12	10 years	girl	more than 8	Peppa	are active	unlimited	100–200	No
13	10 years	girl	more than 8	not thematic	beauty and fashion	up to 2 h	unlimited	Yes
14	10 years	boy	more than 8	not thematic	beauty and fashion	up to 2 h	unlimited	No

In Fig. 5 in verse 7 we have an empty set, which indicates that under such criteria given by the client, we will not be able to offer him anything, that means that the holiday cannot be organized, so we will mark this vertex “no” and it will become a leaf. In verse 9, examples B8 and B9 have the same attributes of the game attribute - “No”. Therefore, we denote this vertex by “No” and it will become a leaf. Similarly, we denote vertex 8 as “Yes” and it will also become a leaf.

Based on the decision tree we can define many rules. For example, the set of rules for the tree shown in Fig. 6 would look like this:

1) if (age = 5–10 years) and (gender = boy) and (number of participants = up to 4), then (holiday = no);
2) if (age = 5–10 years) and (gender = boy) and (number of participants = 4–8), then (holiday = yes);
3) if (age = 5–10 years) and (gender = boy) and (number of participants = over 8), then (holiday = no);

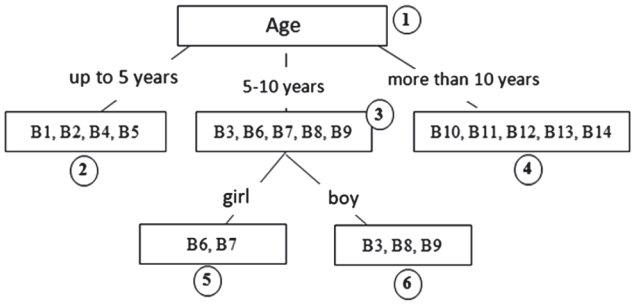

Fig. 4. The second step of the ID3 algorithm (removing the "gender" attribute)

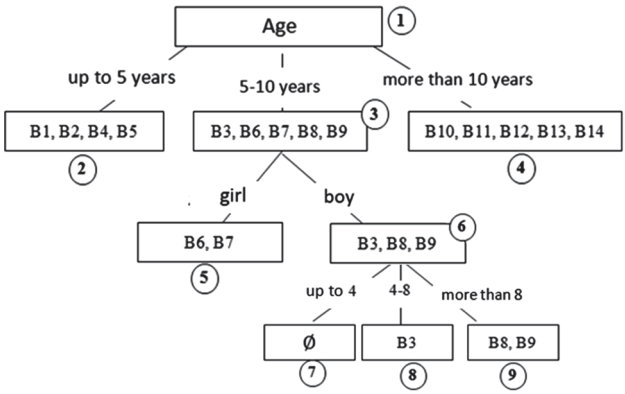

Fig. 5. The third step of the ID3 algorithm (removing the "number of participants" attribute)

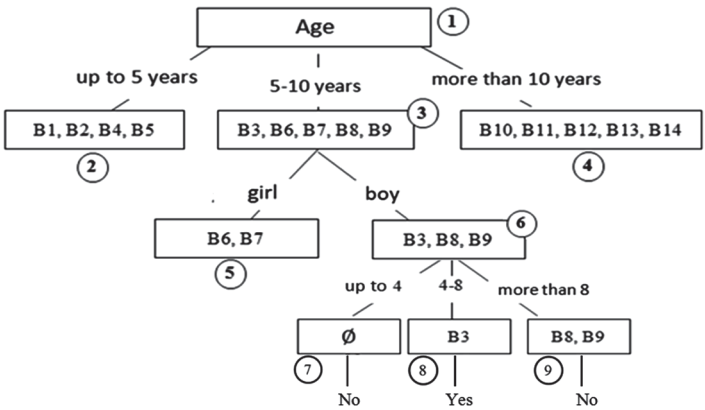

Fig. 6. The fourth step of the ID3 algorithm

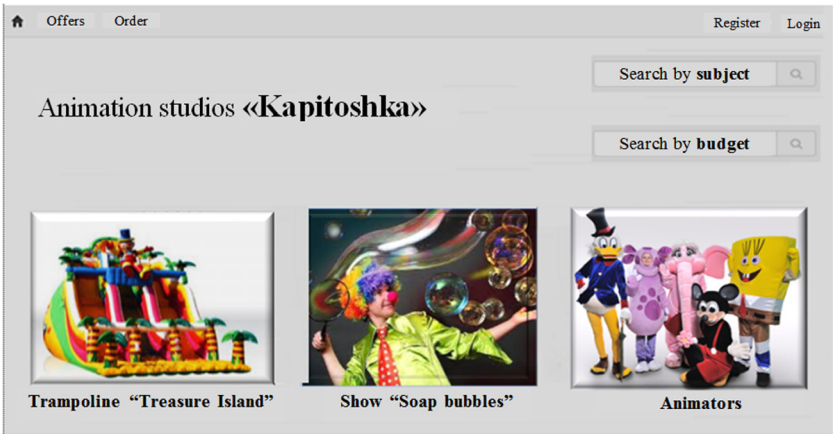

Fig. 7. The main page web service

4 Results Analysis and Discussion

The main page (see Fig. 7) of the service for managing the work of children's animation studios, includes buttons: "Offers" - for viewing, all available offers, "Order" - go to the window where you can place an order, "Register" - to register for service, "Login" - to enter the service and also 3 offers that can be accessed by clicking on the "Details" button.

After the user logged in to the site, chooses a budget search option and enters the amount he's willing to spend to organize a holiday, he will be offered as many services as possible within the selected budget, as shown in the Fig. 8.

If someone at the login page of the site selects the "search offers" option the direction of "subjects" and introduce the desired subjects of the holiday, he will be asked to respond to several questions, such as: the age of the child; budget, the number of children invited, he will be offered as many services within the chosen subject. One of the variants of the proposals when choosing the theme "Active entertainment" and given attributes: "age" - 11 years; "gender" - boy", budget - 50 USD, shown in the Fig. 9. After the user chooses a "budget search" option and enters the amount he's willing to spend to organize a holiday, he will be offered as many services as possible within the selected budget, as shown in the Fig. 8.

Having determined the optimum number of services, the user can order the selected offers.

Fig. 8. A list of suggested holiday options

Fig. 9. A list of the proposed "Active Entertainment" holiday option

5 Conclusions

The demand for the services of children's animation studios is constantly growing. The number of children's animation studios and the variety of their services is growing in direct proportion to the growth in demand. Accordingly, the search for the best option for organizing a children's holiday, with a set of acceptable (thematically/financially) services takes a long time. Building a composite web application for animation studios will allow you to solve several tasks at once, such as processing data from several sources, analyzing them, comparing them and, as a result, choosing the suitable one. By combining various data (photos, videos, text information) about animation studios services, with people's

feedback on the services from these studios using Google Maps and applying information about the location of animation studios, you can create a unique web service.

To organize the effective functioning of animation studio management services, taking into consideration the specifics of their work, the logic of query processing systems must be built using modern methods of Data Mining, namely the "Decision Tree" methods.

In order to provide quality services, in a user-friendly format, it is most appropriate to provide information to the customer in the context of two areas: pricing policy and content of services. If the client chooses as a priority direction - pricing policy, it is advisable to build the logic of query processing systems using the backtracking algorithm. If the client believes that the priority area is the content of the services of animation studios, then when developing the logic of query processing systems, it is necessary to use algorithms to build a decision tree.

This approach to modeling the operation of animation studio management services provides an opportunity to save time for the client (customer), to make the optimal selection of services for each client from a set of possible services and reduce the burden on administrators of animation studios.

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