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Implementation of the Game Models and Strategies in Education

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Abstract

This research examines the application of game theory approaches of the games in the educational process reflecting the influence of mathematical models in developing information society. The realization of the best selection of game models of game theory in effective selection of good practices in this informative progress.
Development of information society in recent decades requires changes in the overall formulation of research studies both in the field of librarianship and on the advancement of the educational process. That is why the changes provoke scientists a need to develop their studies in a larger range.
The entry of intelligent systems in this information society presumes researchers working in the field of information technology to carry out observations on innovation not only in information communication technologies, but also on educational methods and techniques.
At article discusses game models of game theory and paying particular attention to Markov, bimatrix and evolutional games.
Scientific report provides a synthesis of theoretical models of games and their effective use in developing educational process. Theoretical proposals addressed in this text are based on a terminological analysis and systematization of observations.

Introduction

Advances in information and communication technologies require many changes in the paradigm of the educational process. Some of the leading changes arising from the establishment of the modern information society that are a prerequisite for create of new techniques applicable in innovative learning.

When talking about information society is better to determine the meaning of the term society. Society is a group of people or groups of people linked by a series of relationships involving their social status and positions of these roles. Main feature of society is the creation of a common system of values.

In the 30's of the 20th century gives the beginning of the Information Society. This concept applies always the way information technology affect society and culture. Therefore, it covers the effects of computers and telecommunications in the home, the workplace, schools and universities, and government organizations.

By itself the information society is one in which the production, distribution and use of information are crucial for economic, political and cultural activities.

Benchmarks of this type of society are:

- Use of information and communication technologies in the economic, social and educational fields;
- Higher employment of the working population;
- Reduced mass production.

Rapid development of information and communication technologies gradually change model of training. Along traditional learning in which the main sources of information are the books and teachers, it is currently imposing new approaches, which are widely used web and internet communications. And thus the characteristics of the training and education process change their appearance

Information and its creative use covers all areas of human activity, formed a new socio-economic structure of society and the meaning of a new quality of life of people and technological development.

In this article the author has focused its attention on the introduction of game models and structures in education to improve the quality of the organization of teaching and preparing students for their successful implementation in a public life.

As is known, game models are used everywhere in everyday life - in business, politics, the judiciary, education, libraries. That is why the application of Markov games can be successfully implemented in the educational process

Material and Methods

In the last 20 years of the past century has grown striving for decision-making as much of the research is devoted to game models with transition probabilities. One of research projects dealing with this type of solutions are Markov games. They are stochastic games based on Markov process for decision making. There are several types of Markov games as a particularly large share of global research engaged a zero-sum games. Studies were carried out on probabilistic Markov processes and their implantation in the game structures. In his article "Probabilistic Markov games" Alberto Finzi and Thomas Lukasevich focus on relational Markov games, zero-sum game with two players with diametrically opposed goals by calculating the symbolic value of the iterative algorithm (Finzi, Lukasiewicz, 2004; Howard, 1960).

Michael Littman is researches a Markov process which governing the way of studying the broader framework of an adaptable participant to interact with the environment of the transition (Littman, 1994). Participants in the game with their behavior and describes of Q - learning as algorithm for finding optimal policies.

In realizing the game with two participants probability profit of one is the loss of the other, i. e. there is a zero-sum game - the sum of profits is equal to the sum of the losses. In this case it is subject to certain rules. The game is played so that each player whose order is determined, indicating one of his pure strategies. Realization of one of the strategies is called move the player. The moves can be personal and casual. After all players make their move on a rule define their profits or losses and they are pay off. In the transition from move to move i j is realized transition probability matrix that determines the transition probabilities of the ongoing game model (Getova-Zlateva, 2006). Each player chooses his best moves. Call this optimal strategy that provides maximum profits for participants.

Results and Recommendations

Shall examine game of two players: *A* has m strategies *A1*, *A2*, ..., *Am*, *B* (opponent of *A*) - there are n strategies *B1*, *B2*, ..., *Bn*. Profits player *A* is assigned to the matrix *A* - number a_{ij} is profit player *A*, if he chooses strategy *Ai*, and the opponent - a strategy *Bj*. In each pair of strategies are known, and so the number a_{ij} is composed matrix A.

	B_1	B_2	…	B_n
A_1	a_{11}	a_{12}	…	a_{1n}
A_2	a_{21}	a_{22}	…	a_{2n}
…	…	…	…	…
A_m	a_{m1}	a_{m2}	…	a_{mn}

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix}$$

Profits player *B* is set with the matrix *B* - number b_{ij} is profit player *B*, if he chooses strategy *Ai*, and the opponent - a strategy *Bj*. In each pair of strategies known number b_{ij} and it is composed matrix B.

	B_1	B_2	…	B_n
A_1	b_{11}	b_{12}	…	b_{1n}
A_2	b_{21}	b_{22}	…	b_{2n}
…	…	…	…	…
A_m	b_{m1}	b_{m2}	…	b_{mn}

$$B = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ b_{m1} & b_{m2} & \cdots & b_{mn} \end{pmatrix}$$

If the profit of B in the selection of strategies (*Ai, Bj*) is *bij* = -*aij* game is zero-sum game and the matrix *A* is called a payment matrix of the game, i.e. in this case, the payment matrix of the player *B* is - *A*. If it is the other, the game is non-zero sum.

The numbers *aij* and *bij* may be positive (the player wins), negative (the player loses) or zero (no wins). To determine the rational behavior of game models are used classical approach, consisting of two participants and analyzing their relationship. This approach has its roots in the work of the Russian mathematician Germeyer (Germeier, 1976).

Considered are game models using the classic approach, whose foundations were laid by the fundamental work of John von Neumann in the 30's of last Century. Classification of game models can be realized depending on the different signs. Accepted way in which the participation of players in the game is individually or collectively. Games in which is carried out collective participation of players is necessary to have joint action. These are so-called cooperative or coalition games.

If we look at the educational process and in particular the stages of preparation and implementation of the planned training plans will find ourselves in an environment to search for the most effective choice of many variations in education. Each of these options carries with it a set of tasks that you need to find an effective solution.

Preparation of training program requires the use of restrictions placed by the participants in the game - ***Student*** - ***Teacher***. This game is done collectively and falls within section funfair. Student (Player *A*) has the right to choose whether to participate in training or not, whit State *i = 1*, and the condition *j = 0*. The second participant in the game (Player *B* - trainer) has the right to choose which day to have classes and at what time. Then created a payment matrix using, which demonstrate the probability distribution p_{ij} to move from a current state in any state where *X* is the set of states in which may be located the game.

It was found that the highest attendance of students in student audiences will consider two types of matrices some parties of the transition probabilities, i.e. the probability of students attending a particular subject in a specified time range, while others provide information so what profit will realize each player, i. e. what benefit will have two players.

Table 1: Player A - Matrix of Transition Probabilities

Hour	**Monday**	**Wednesday**	**Thursday**
9-13	a_{12} (0,7)	a_{12} (0,3)	a_{13} (0)
14-18	a_{21} (0,4)	a_{22} (0,2)	a_{23} (0,4)
9-13	a_{31} (0,1)	a_{32} (0,3)	a_{33} (0,6)

Table 2: Player B - Matrix of Transition Probabilities

Hour	**Monday**	**Wednesday**	**Thursday**
9-13	b_{11} (0,8)	b_{11} (0,1)	b_{13} (0,1)
14-18	b_{21} (0,3)	b_{21} (0,5)	b_{22} (0,2)
9-13	b_{31} (0,5)	b_{32} (0,1)	b_{33} (0,4)

Each player chooses strategy, which makes effective use. In positional zero-sum games, also known as antagonistic games player *A* chooses any strategy from the crowd, and the player - any strategy from the crowd. The choice of strategy players are assessed as follows: if player *A* chooses i^{th} strategy A_i, and player B - k^{th} strategy $B_к$ income then player A will be equal to a number a_{ik}, and income to the player of another number b_{ik}. Thus, in the game, each player receives any income.

Considering all the strategies of player *A* and those of the player *B*, creating two different tables setting out the case considered by the author to the attendance of students in the classrooms.

Table 3: Player A - Matrix of Attendance of Students

Hour	**Monday**	**Wednesday**	**Thursday**
9-13	8	6	6
14-18	4	6	6
9-13	6	7	7

Table 4: Player B - Matrix of Presence of the Teacher

Hour	**Monday**	**Wednesday**	**Thursday**
9-13	23	18	20
14-18	21	16	15
9-13	17	13	19

The expected profit is determined by the matrix of the attendance of students and the matrix of transition probabilities using the formula (*Mine*, *Osaki*, 1970) is called a payment function of the game.

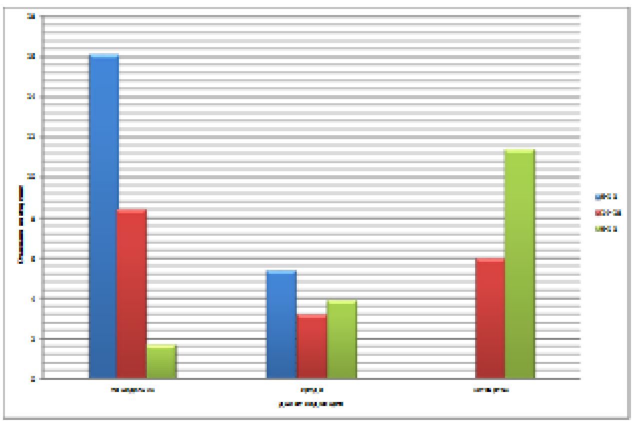
$$q_i = \sum_{j=1}^{N} p_{ij} r_{ij}, \; i = 1, 2, \ldots, N$$

The probability of attendance at selection at Wednesday from 14 to 18 a.m. is p_{A22} = 0,2 and student attendance r_{A22} = 16, then the expected attendance will be $q_A = p_{A22} * r_{A22}$ = 3,2, which gives grounds to assert that attendance of students on Wednesday in the time range of 14-18 a.m., is optimal. It is therefore necessary to consider the entire table of expected visits during the said week to establish the maximum (optimum attendance) and thus take effective decision of the members in school activities when to implement the learning process (which day of the week in which time period of the day).

Table 5: Table of Expected Income Player A, Optimal Their Position q11

	Monday	Wednesday	Thursday
9-13	16,1	5,4	0
14-18	8,4	3,2	6
9-13	1,7	3,9	11,4

Graph 1: The Graph Demonstrated the Expected Attendance of Students

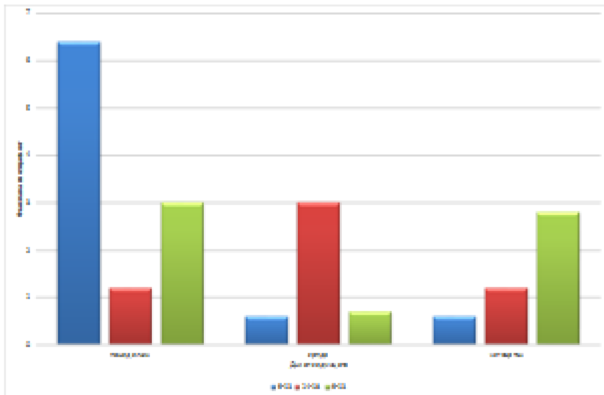


Player *B* is in a neutral position, because in this case, he has a plan for employment at this time span and working day. That is why we are witnessing a game with one player, i. e. participant *A* takes a decision that is in his benefit. Evidence is considered and attendance teacher see table. 6.

Table 6: Table of Expected Income Player B, Optimal Their Position q11

	Monday	Wednesday	Thursday
9-13	6,4	0,6	0,6
14-18	1,2	3	1,2
9-13	3	0,7	2,8

Graph 1: Chart Attendance Player B



Strategies that use both players determine the outcome of the game so created. It could be argued that in the selection of students of strategy a_{11}, and strategy b_{11} from *B* player then we have a game that will end in a draw for both players, i. e. both participants will be satisfied.

Conclusion

The increasing role of knowledge and its application in innovative socio-economic development is growing importance of evolutionary methods for collecting, analyzing and spreading information. The analysis of the mathematical methods from the theory of games at this brief report found that successful implementation of the strategies from two participants at the positional play is the result of their personal decisions. These game models and strategies could be widely used by representatives of organizational and information centers in order to increase the efficiency of work in drawing up the plans set and so to realize the best selection. The report demonstrated scientific theoretical study of game models and their effective use in developing educational process.

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