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Computer Modelling and New Technologies, 2012, volume 16, no. 2

CONTENTS

Editors' Remarks

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Reality Check

by Celia Berrell[♣]

The frog of human consciousness
is poised upon a puzzle.
He contemplates reality.
It's in a kind of muddle.

The frog of faith assures him
with the light of all creation
to just accept things as they are
and bask in love's elation.

But reptile's super-symmetry
has crept into his life.
Dodecahedron dragons hide
the Higgs and cause some strife.

And what about those space-time rifts?
Could multi-verses lie
entwined in gorgeous tangled greens
where once he saw just sky?

If only he could reach the key.
Unlock that big brown tome.
In case dark matter happens to
invade his humble home.

The frog of human consciousness
is yearning logicality
and wonders if it's possible
to answer: What's Reality?

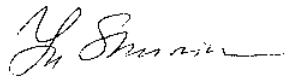
2011

****

This 16th volume no. 2 presents actual papers on two main topics of Journal specialization, namely, Innovative Education Management Models, Computer Simulation and Information Processing and Operation Research and Decision Making Models. Contributors of this issue represent scientific institutions of Ukraine, Bulgaria, Lithuania, Latvia, Israel and Kazakhstan. Our journal policy is directed on the fundamental and applied sciences researches, which are the basement of a full-scale modelling in practice.

This edition is the continuation of our publishing activities. We hope our journal will be interesting for research community, and we are open for collaboration both in research and publishing. We hope that Journal's contributors will consider the collaboration with the Editorial Board as useful and constructive.

EDITORS



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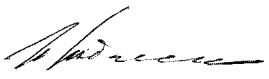

I. V. Kabashkin

[♣]**Celia Berrell** – Born in England, her literary icons include Edward Lear, Alan Milne, Roald Dahl and Isaac Asimov. Celia pursued a career in teaching maths and science for four years before travelling to Australia. That was thirty years ago. She has regarded her life in Australia as a working holiday ever since. Environmental poem *The Beauty of It All* was selected for publication in the secondary school textbook *MacMillan English 7,* released in October 2011. *Battle of the Bulge* has been incorporated in a Science Presentation on gravity by the Australian Science and Mathematics School at Flinders University SA. Celia's articles and poetry have been published in magazines such as *Get Ahead Kids* and *Toastmaster*. A selection of her poems regularly appears in the CSIRO's children's science magazine *Scientriffic* and *The Helix.* They are found in anthologies such as the *Tropical Writers Raining on the Sun* (2008) and *Cracks in the Canopy* (2010). Award-winning poems include *Fat Chance* in the *Cairns Post Inaugural Writing Competition* January 2008 and *Replanting Neurons* in the *California Institute of Regenerative Medicine'*s stem-cell awareness contest in October 2010.

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DEVELOPMENT OF NEW TECHNOLOGIES IN THE EDUCATIONAL PROCESS

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The productivity of higher education is proved to be connected with the search for a complex of measures to improve the future teachers-philologists' professional education, transforming of the didactic system from traditional mainly informative types of training into activate and developing forms, stimulating the creative power and non-standard solution of educational problems, providing students' perspective orientation in the chosen profession. At present, the university practice needs forms, methods and technologies which allow changing the students' position from being just active participants of the learning process. The main mechanism of this process is the proper activity of the individuals, included in the teaching-learning process as a subject and the organizer of the training activity. The article is devoted to the issues on the elaboration of the educational technology, built on the principle of the role perspective. The technology efficiency, which presupposes mastering of the future teachers-philologists' pedagogical training is scientifically grounded.

Keywords: role situation, role perspective, role activity, pedagogical training quality promoting, technology, educational process

1. Introduction

Updating contents of pedagogical education and its structural components must play a key role in teaching staff pedagogical training quality promoting and preserving fundamental pedagogical knowledge. The difficulty of solving this problem is in the fact that the obsolescence of information in all areas of scientific knowledge takes place much faster than the university education completes.

Traditional instruction of transferring the stock of knowledge from a teacher to a student today is meaningless. It is important to train the future teachers who have the skills to acquire knowledge, and do not get them off the shelf. Today not only knowledge in itself is necessary, but future teachers' ability to apply it in order to obtain the projected results of pedagogical work is needed, too.

The main drawback of the traditional training consists in the fact that the students possess only the subject and pedagogical knowledge system and are incapable to use it in practical situations to solve educational problems. As the experience shows, the ability will not be effective as long as the future teachers-philologists do not possess the skill structure, exactly till they get aware of it and grasp the composition of the constituent actions and logical sequence of these actions being fulfilled.

During the teaching practice a certain bias towards the assimilation of knowledge and skills is observed, and students' emotional and valuable attitude to teaching activity loses sight of methodologists and teachers called to share their experience with the students. If there is only scientific subject knowledge in students' professional luggage and the professional values are not available, it is difficult for them to become professional teachers in this case. Harmonization of cognitive and emotional is the basis of the role perspective realization as the strategy of the future teachers-philologists' pedagogical training quality promoting.

The analysis of the scientific literature suggests different approaches of solving the investigated problem and attempts to find rational ways of the future teachers-philologists' pedagogical training quality raising in the system of university education by means of its individual tendency at mastering the pedagogical disciplines content under the conditions, when the educational theory assimilation and pedagogical skills retention are united. The problem is that in order to achieve the unity of all aspects of the educational process, the harmonization of the substantive and procession, intellectual and emotional sides of pedagogical training are to be united.

The main drawback of searching for ways of modernizing teacher education, in particular the future teacher's pedagogical training is their one-sidedness. The researchers are mainly concentrated at the informational-contents or at a processional aspect of the pedagogical training. Nowadays the task consists of combining these aspects during the study of educational disciplines, in order to use the pedagogical knowledge, not only as a source of information, but also as a means of the modern teacher's professional image creation, his active professional attitude and creative style of activity.

2. Application of Role Situation and Role Perspectives Approaches in the Educational Process

Various principles which reveal the theoretical and methodological foundations for pedagogical training optimisation emerge and manifest on the basis of different approaches to its organization [1]. One of these principles should be regarded as the principle of the role perspective.

While developing the technology, grounded on the principle of the role perspective, it is assumed that the paradigm of individually-oriented and activity-based approaches correspond to the value and the goal of the role perspective in the strategy aimed at pedagogical training quality raising. The main idea of this paradigm is that the unambiguous prediction of the result as a certain change in the state of the student in accordance with projected goals fundamentally is impossible because a future specialist as a complex nonlinear system doesn't surrender strict regulation. The role perspective as the purpose in the strategy of students' pedagogical training quality raising serves as a reference for the necessary pedagogical conditions planning, under which the educational process is carried out in practice.

In the process of technology development is relied on the concept of the role activity as a combination of different forms and methods by means of which students plunge into a role-play situation thus acquiring professional values, sense instructions, ways of thinking and creative activity [2–5]. The main attention was concentrated on different aspects of the role activity in the process of pedagogical theory learning, the accumulation of teaching experience and securing the educational process with the necessary means for its organization.

In accordance with the purpose and the theoretical foundations of future teachers-philologists' professional development, the development of technology was based on the logic of the role situations modeling in the pedagogical process. The algorithm of the role activity served as the basis of the strategic plan – the allocation of the main stages of the role activity (analytical, conceptual and technological). In the course of the strategy aimed at the role perspective realization were identified the modules containing the organizational start and the end in the form of the result. The choice of means and methods of achieving the projected goals and results, the definition of role actions of the participants of the educational process is considered to be important for the implementation of the technology [6].

The base of the technology consists of the forms and the methods which provide students with the freedom of choice and action roles, self-expression and reflection, communication and understanding of the others, creative activity and imagination. In connection with the above-mentioned the strategy of the role perspective and its result is built on the basis of problematisation – structuring of pedagogical knowledge and development of skills, as well as deproblematisation – correlation of knowledge with a role situation, with the subject and the pedagogical in particular circumstance; the true unity of the creative and reproductive is reached while teaching students. Role classes and methods of their conduct are not regulated, but they are based on improvisation and students' creative activity [7].

The technology of the role perspective presupposes the interaction of the teacher and students to be situational and organized as in the form of situation role-playing actualising future teachers-philologists' self-determination in the educational pedagogical field.

In the technologies, built on the principle of the role perspective, students have an opportunity to go beyond the everyday teaching practice and to reflect their teaching career as a whole. They can make a choice, have moral certainty and be responsible for their decisions, actions and their consequences.

The use of the technologies of the role perspective encourages professional development as a continuous process of self-projecting of the future teacher-philologist's individuality, which combines the three stages of psychological adjustment: self-determination, self-expression and self-realization.

3. Results

The educational technology is elaborated in such a way that the future teacher-philologist's professional development is set a target in the form of the role perspective, allowing the removal of the focus in pedagogical training from the teaching new ways of pedagogical knowledge mastering to the transformation of motivational, intellectual and affective individuality spheres in the end, behavioural structure of his individuality. In the process of the role perspective technology appliance the transformation of students' adaptive behaviour to the behaviour directed to self-development and creative self-realization in the pedagogical work is transformed [8].

The technology provides:

- Behaviour optimisation stages (changing) behaviour (training, awareness, reassessment, action);
- Motivating, cognitive, affective and behavioural processes that take place at each stage;
- Complex of forms and methods (traditional and active).

Combining the blocks of theoretical and practical, content-driven and processional aspects of pedagogical disciplines, the technology of the role perspective attaches purposefulness, integrity, continuity and organizational and contents basis to the pedagogical training of students.

This technology is aimed at the development of new structural formations of a future teacher's individuality (readiness for risk and non-standard actions, creative activity, reflection, flexibility of thinking, self-reliance), behaviour (poly-role behaviour, freedom of choice of action), communication (dialogue, polylogue, interaction). These new formations have a special role in the conceptualisation and development of educational activities, professional and pedagogical features, capabilities and abilities, goals and meanings of pedagogical work.

The technology of the role perspective is a tool for transformation of educational theory into practical action. It serves as means aimed at creating original programmes and creative projects, mastering the role and poly-subject interaction.

The developed technology was verified in the course of the research in the process of students' role activity mastering while learning pedagogical disciplines. The basis of the experimental work is the analysis of the role situations, which contains the situational (role-modelling situations) methodological (the current state of the role) analysis. This technology was based on the main tenets: the space of pedagogical training; which is, first of all, the reflexive educational environment; reflexive process as a basis for the development of creative practice via the use of the role activity, the management of pedagogical training which intended the target in the form of the role perspective and creation of the necessary conditions for the enabling of reflection in students' learning activity. Students' involvement in the reflexive process was carried out through a variety of forms, methods and means of role activity. They included role-modelling situations, play of situations-exercises, situations-problems, situations-workouts.

The process of formation of a new quality of pedagogical training was accompanied by a questionnaire, interviews, testing, monitoring, surveys of the student activities, reporting, and etc. The final stage of the monitoring process was the holding of the final cut and the comparison of the results with the original data got during the ascertaining experiment. The situation in students' pedagogical training and its effectiveness in ensuring the positive dynamics of their pedagogical professionalism level were analysed on scientific, theoretical and empirical levels.

In the assessment of pedagogical training and professional development of the students' characteristics, all participants of the survey were put in the position of an expert-analyst. The main purpose and direction of the pedagogical training is a positive dynamics of future teachers-philologists' pedagogical professionalism.

Comparative analysis (Table 1 and Figure 1) and statistical data processing of diagnostic tests for the CG and EG presented in the table shows that:

1) The difference of the results obtained in the CG and EG were statistically significant (at the significance p-level = 0.05, 17.04, 7.82,);

2) Despite the fact that at the beginning of the experiment, the students of the CG and EG had approximately the same initial level of training (predominantly low and middle), after completion of the experiment, the majority of the students of the EG demonstrated sufficient and high levels of education, whereas the majority of the CG students showed a middle and a sufficient levels of training.

One may consider a more formal mastering of pedagogical theory be the students the prevalence of reproductive activity as well as the lack of cognitive interest towards the role activity in the teaching process to be the reason of such a state.

Table 1. Comparative results of the students' diagnostic testing in the control and experimental groups when the experiment (data; percentage) was completed

Grades	Levels of students' activity		Formation levels to solve the situations		Manifestation of the students professional individuality qualities	
	CG	EG	CG	EG	CG	EG
low	13,0	5,7	9,8	3,4	15,2	4,5
middle	45,7	26,1	40,2	22,7	39,1	23,9
sufficient	33,7	48,9	43,5	52,3	37,0	54,5
high	7,6	19,3	6,5	21,6	8,7	17,1

Comparative distribution of the activity levels while studying pedagogical subjects is shown on Figure 1.

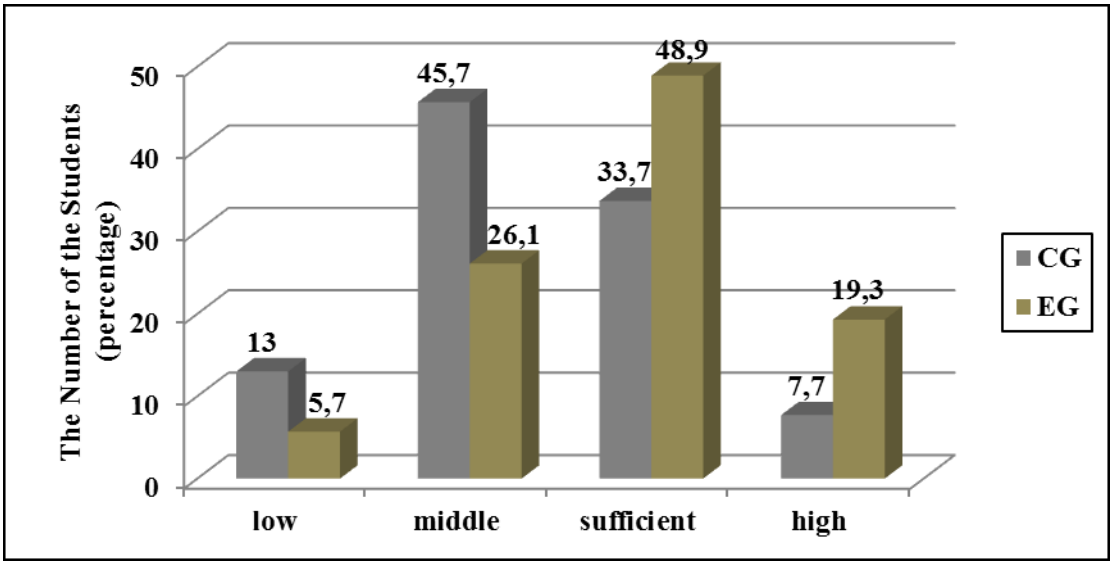

Figure 1. Comparative distribution of students' activity levels within the study of pedagogical subjects (percentage)

Comparative analysis (Table 2 and Figure 2) and statistical analysis of the results in the CG and EG, the dynamics of the students' knowledge:

1) The difference of the results obtained in the CG and EG were statistically significant (at the significance p-level = 0.05, 13.91, 7.82);

2) Most of the students of the EG demonstrated sufficient and high levels of education (63,7%), while the majority of the students showed CG low and medium levels of education (64,1%).

The role situation allows deploying a meaningful basis of pedagogical activity, engaging all students into joint work, analysing and resolving the problems, based on the practical application of pedagogical knowledge and skills. Constructive cooperation, harmonization of intelligence and emotions in the role situation allow us to find the best way to solve the problem of learning in all its objective and social contradictions. In this approach, professional competence and active professional position as well as creative style of future teachers' activity develop.

4. Discussion

The analysis of the experimental results was carried out by comparing the data concerning the formation level of the structural components of the professionalism demonstrated both by the students of the experimental and control groups before and after the end of the formative experiment.

The evaluation of the impact of pedagogical training was based on the criteria that combined:

- The formation of the value-motivational sphere;
- The system of pedagogical knowledge;
- The skills to think educationally and to act in a non-standard way in the role situations, the skills of pedagogical interaction and communication, creative and reflective skills;
- Professional and pedagogical qualities which influence the effectiveness of the implementation of the role perspective as the strategy of the students' quality raising;
- The ability of the future teachers-philologists to use the acquired experience in order to orient themselves and find the best way out of pedagogical situation.

Table 2. The students' level of knowledge in the control and experimental groups

Grades	CG		EG	
	The Number of Students	%	The Number of Students	%
low	10	10,9	5	5,7
middle	49	53,2	27	30,6
sufficient	25	27,2	43	48,9
high	8	8,7	13	14,8

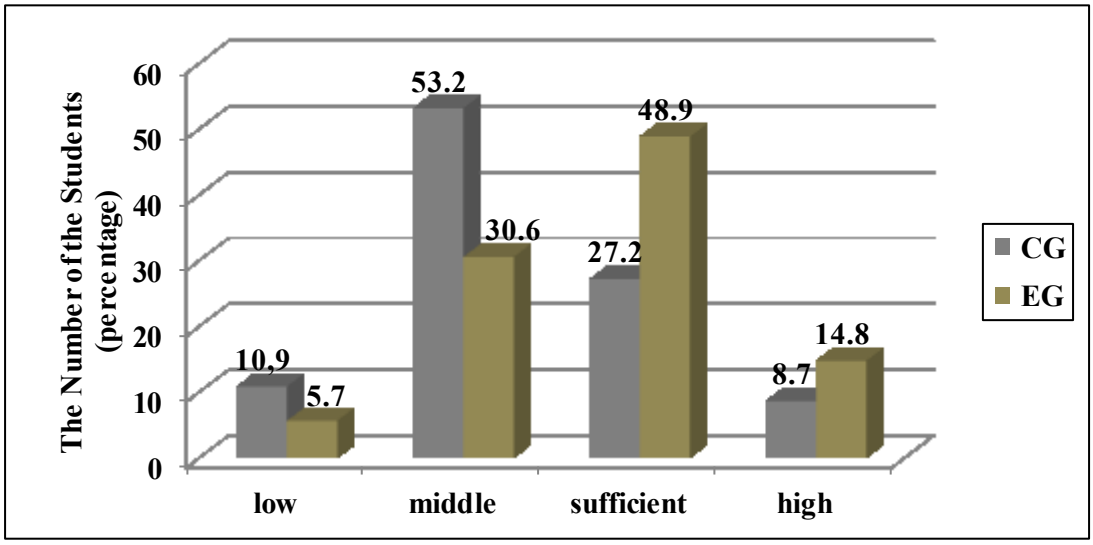

Figure 2. Comparative distribution of the students' knowledge levels in the control and experimental groups (percentage)

Thus, the results of the experiment showed that the organization of the pedagogical training, based on the principle of the role perspective, involving the use of the problem-situational, simulation-and-gaming technologies, increased the students' role activity; provided positive motivation for learning pedagogical disciplines, presence a stable cognitive interest, as well as needs for new knowledge.

5. Conclusions

The implementation of simulation-game approach to learning provides a more productive replacement of traditional learning technology, which was based on game simulation modelling. This technology focuses on the process of a high school student's personality and model of his future profession. By taking part in the implementation of game scenarios of the professional activity near, medium and longer perspectives, the future professionals do not professional knowledge but also gain skills needed.

A simulation-game approach to the organization of the training sessions provides emotional and intellectual environment in the student audience, the atmosphere of psychological comfort for each student, it includes following:

- Psychological security when running the games does not reduce the role of social status does not arouse future specialist's feeling of professional hopelessness and discomfort;
- Vision of professional growth, awareness of the relationship between the quality of performance and the success of the game as a part of professional development;
- Creating a positive setting for simulation and gaming activities, creativity, independence and attitude to choose actions.

Thus, the technology, which is built on the basis of simulation-game approach to learning enables to take into account the specific conditions of professional activity, opportunities and students' abilities and the positive changes in their professional development. When being used, the emphasis of the techniques is made on the ability of imitation and play in the implementation of professional development, the formation of subject positions, and professional image of the future specialist.

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MULTI-PARAMETRICAL OPTIMIZATION MODELS IN STRATEGIC MANAGEMENT

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A two-level consideration – a company engaged in designing and creating a new product and, later on, delivering the new production in large quantities to the market. The product is composed of several sub-products, each of them, in turn, being a subject of several possible versions. The product's utility comprises both the utility of designing and creating the product's pattern example as well as the competitive utility to gain the future commercial success.

The problem is to determine the income versions of designing sub-products in order to maximize the product's competitive utility subject to restrictions related to the design process.

A two-level search algorithm of the problem's solution is suggested. The internal level is faced with optimising the product's competitive utility by means of experts' information, while the external level centres on obtaining a routine feasible solution from the point of designing process.

Keywords: Multi-attribute utility; Competitive utility; Basic project's attributes and competitive attributes; Harmonization model on the basis of expert team's decision-making

1. Introduction

It can be well-recognized (see, e.g., [5–7, 10, 11]) that existing quality techniques in various organization systems (OS) are restricted to market competitive problems only. Those techniques usually centre on analysing the competitive quality of organization systems' outcome products in order to gain future commercial success. But in that capacity they ignore the quality of the OS functioning, e.g., the quality of designing and creating a new unique product. In our recent publications [1, 2] we developed several new utility models to estimate the project's quality in the course of its realization. However, if the company is engaged in designing and creating a new product and, later on, delivering the latter in large quantities to the market, the product's life cycle continues far beyond terminating the design process. Thus, the given paper deals with developing quality models of organization systems in their entirety centres on developing new utility models comprising design and production phases as well as the system divestment phase. Nowadays engineering projects where a new system or product are being designed, developed, manufactured and continuously quality tested, may span years, as applicable for the case of a new automobile, or over a decade for a nuclear power plant [11]. New product development takes anywhere from several months to several years. In lengthy processes of this type, decisions made at the outset may have substantial, long term effects that are usually difficult to forecast. *The trade-off between current objectives and long-term consequences of each decision is a strategic aspect [11] of project management. Thus, the research to be considered refers to strategic management and deals with the most important aspects of that area*. Moreover, special attention is drawn in literature to life cycle costing (see, e.g. [3, 4]) in case a decision having long-term effects deals with *selection of components and parts for a new system or a new product* at the advanced development and detailed design phase.

Thus, an evident conclusion can be drawn that the newly developed utility harmonization models must deal not only with the quality of OS functioning, but with the quality of outcome products as well, especially when subject to severe market competition. In the paper under consideration an attempt will

be made to enhance utility models [5–7] in order to cover the whole life cycle of the regarded product. We suggest developing a more generalized utility harmonization model by implementing in the latter the most essential aspects of the MAUT theory [5–7, 10, 11]. The generalized harmonization model should, thus, be applied to all stages of the product life cycle, namely:

1) MAUT multi-attribute models have to undergo certain modifications to be used at the stage of designing the outcome product, on the basis of experts' decision-making in combination with proper ranking and scaling.
2) Analytical and simulation models which have been already incorporated in partial harmonization algorithms (PHM) in Safety Engineering and Project Management [1, 2], should be applied at the stages of designing and creating the new device.
3) We suggest linking the outlined above MAUT and PHM together in order to optimise the process of designing and creating a new product within its entire life cycle. The suggested optimisation algorithm should be of mixed type, i.e., to comprise both analytical calculations and man-computer dialogs at the stage of decision-making on the basis of experts' interviews. *The backbone of the optimisation algorithm is that all its elements (including analytical calculations and dialogs with experts) are parts of a generalized search procedure to determine the optimal version of the product to be designed and created*.

It is assumed that the product to be manufactured is composed of several sub-products, e.g. a new automobile comprises an engine, a bonnet, a brake system, etc. Each sub-product, in turn, is a subject of several possible versions. The problem is to determine for each sub-product their optimal versions in order to maximize the product's competitive utility subject to restrictions related to the design process. A two-level optimisation algorithm based on the cyclic coordinate search method (CCSM) [1, 8], is suggested. The internal level is faced with optimising the product's competitive utility by means of experts' information, while the external level centres on obtaining a routine feasible solution from the point of designing process.

2. The Problem's Description and Definitions

In order to formalize the harmonization problem we will require some new ***definitions***.

Call a quantitative parameter entering the project of designing and creating a new product, *the basic project attribute* (BPA) together with its corresponding restriction value. The latter serves as *the worst permissible value that may be implemented into the design project*. Several basic project attributes may be independent as well as dependent parameters. BPA restrictive values are already pre-given by the OS management. However, in the course of carrying out the design project, they may be subject to alterations, e.g. owing to changes of the product's demand on the market.

Call a quantitative parameter entering the outcome product, i.e., the designed product to be delivered to market, the *basic competitive attribute* (BCA). *BCA values actually form the product's competitive utility in order to gain future commercial success*. Those values are usually calculated by means of expert information.

As outlined above, the system under consideration comprises:

- the phase of the product's designing and creating the pattern example, and
- later on, the second phase related to delivering the product in large quantities to the market.

It can be well-recognized that both BPA and BCA values depend on the set of versions assigned to each sub-product. Note that BPA values are fully determined by the set of versions, i.e., those values can be calculated analytically or by means of simulation. BCA values are calculated through expert information taking into account the set of versions as well. Assume, further, that when benefiting from commercial success, the profit obtained from delivering the product to the market at the second phase, usually exceeds essentially the project's expenses to design the product at the first phase. Thus, *we suggest developing a multi-attribute utility value on the basis of only BCA values. This generalized value has to be maximized in the course of the suggested CCSM algorithm by means of information obtained from experts. As to BPA values, they have to be incorporated in the search procedure in order to satisfy the pre-given restrictions*.

Referring to MAUT models [5–7, 10–11], we will assume that for each BCA value two opposite estimates have to be pre-given before carrying out the design process:

- the least preferred value having practically very poor chances to win the market competition, and
- the most preferred value which enables the attribute to win the competition.

Note that both opposite estimates for each competitive attribute can be obtained from the expert team on the basis of interview questions. Those estimates play the leading part in the process of questioning experts to obtain the multi-attribute utility values [5–7, 10, 11].

In the model under consideration we will develop a modification of the classical MAUT procedure of both questioning experts and obtaining utility values. This is because the existing MAUT expert models cannot be incorporated in a search harmonization procedure.

3. The Suggested Expert Interview Procedure to Calculate Multi-Attribute Values

As outlined above, the suggested general idea to maximize the multi-attribute utility value centres on undertaking a search procedure in the multi-dimensional state of possible combinations – possible versions assigned to sub-products. The suggested search procedure is carried out by implementing the cyclic coordinate descent method where each i-th coordinate varies from 1 to r_i, r_i being the number of possible versions which can be assigned to the i-th sub-product.

Let the number of sub-products be q. Thus a routine search point is actually a q-dimensional vector $\vec{D} = \left(d_1, d_2, \ldots, d_q\right)$ with integer numbers. In the course of undertaking the search procedure vector $\vec{D}$ has to satisfy all pre-given BPA restrictions (let them be m), otherwise the routine search point is not considered. If all BPA restrictions are honoured, search point $\vec{D}$ has to be passed and later on examined by a team of experts, by means of the following interview procedure. Let the expert team comprise f experts faced with the problem of decision-making on n competitive attributes. It is assumed that (before examining any routine point $\vec{D}$) for each basic competitive attribute BCA two opposite estimates: the least competitive and the most competitive ones – BCA* and BCA** – are already determined.

Each expert E_g, $1 \le g \le f$, after receiving the interview questions, examines and analyses carefully the input information $\vec{D}$ and *for each* k*-th recurrent competitive attribute* BCA_k gives his personal subjective judgment on:

1. The expert's expected value of BCA_k, which will be henceforth designated as BCA_{gk}; note that
   - estimating BCA_{gk} is carried out always for a concrete set of versions assigned to the sub-products, i.e., for the routine search point $\vec{D}$;
   - value BCA_{gk} has to be always placed between the corresponding pre-given opposite estimates BCA_k^* and BCA_k^{**}.
2. The expert's estimated value (order) of importance of attribute BCA_k to win the competition for the product on the market. Denote henceforth this order of importance by η_{gk}.

After obtaining the answers from all experts we suggest to modify values BCA_{gk}, $1 \le g \le f$, $1 \le k \le n$, to their relative equivalents γ_{gk} as follows:

$$\gamma_{gk} = \frac{BCA_{gk} - BCA_k^*}{BCA_k^{**} - BCA_k^*} \ . \tag{1}$$

Note that relation (1) does not undergo any changes, both in case relation $BCA_k^{**} > BCA_k^*$ holds, or otherwise. Value γ_{gk} represents, in essence, the relative competitive ability of the routine set of versions $\vec{D}$ due to attribute BCA_k only. Thus, relation

$$\sum_{k=1}^{n} \left(\gamma_{gk} \cdot \eta_{gk}\right) = W_g \tag{2}$$

denotes the subjective judgment of the g-th expert about the total value of the product's competitiveness. We suggest calculating the more generalized estimate, which we will henceforth call *the product's competitive utility*

$$U_C = \frac{1}{f}\sum_{g=1}^{f} W_g = \frac{1}{f}\sum_{g=1}^{f}\sum_{k=1}^{n}\left(\gamma_{gk}\cdot\eta_{gk}\right). \quad (3)$$

Value U_C calculated by (3) is just the parameter which has to be maximized in the course of implementing the search algorithm. Note that while using the CCSM algorithm, the number of feasible search points to be examined is less than by implementing other methods. Thus, the number of interview questions to the expert team will be diminished as much as possible.

Note, in conclusion, that according to the MAUT models, pairwise comparisons have to be undertaken by experts, in cases, when dependencies between two or more competitive attributes take place [5–7]. Those techniques may also be used by experts in our models, in the course of determining competitive attributes BCA_k. However, other techniques involving subjective judgments can be implemented as well [10].

4. Notation

Let us introduce the following terms:

V – the product to be designed and manufactured;
V_i – the i-th sub-product entering the product, $1 \le i \le q$;
q – the number of sub-products;
V_{ij} – the j-th possible version of the i-th sub-product, $1 \le j \le r_i$;
r_i – the number of possible versions of sub-product V_i;
$\{d_1, d_2, \ldots, d_q\} = \vec{D}$ – a routine search point (a routine set of versions) for the CCSM algorithm, $1 \le d_i \le r_i$, $1 \le i \le q$;
BPA_b – the b-th basic project attribute value, $1 \le b \le m$;
m – number of BPA values;
BCA_k – the k-th basic competitive attribute value, $1 \le k \le n$;
n – number of BCA values;
$BPA_b(\vec{D})$ – the b-th basic project attribute value calculated analytically or by means of simulation at the routine search point $\vec{D}$;
Z_b – the worst permissible value for the b-th basic project attribute (pre-given);
Y_b – the best possible value for the b-th basic project attribute, $1 \le b \le m$ (pre-given);
BCA_k^* – the worst competitive estimate of the k-th competitive attribute (pre-given by experts);
BCA_k^{**} – the best competitive estimate of the k-th competitive attribute (pre-given by experts);
η_{gk} – priority level (level of importance) of the k-th competitive attribute given by the g-th expert, $1 \le g \le f$;
f – the number of experts entering the team;
BCA_{gk} – the personal subjective judgment of the g-th expert on the expected value of the k-th competitive attribute;
$BPA_{\xi_1, \xi_2, \ldots, \xi_{m_1}}$ – basic independent project attributes (pre-given);
$m_1 \le m$ – number of independent basic project attributes (pregiven);

$BPA_{\Theta_1,\Theta_2,\ldots,\Theta_{m-m_1}}$ – basic dependent project attributes (pregiven);

$m-m_1$ – number of dependent project attributes;

$BPA_{\Theta_v} = PHM\left\{D \middle/ \overrightarrow{BPA}_{\xi_h}, 1 \le h \le m_1\right\}$ – the estimate of basic project dependent parameters, $1 \le v \le m-m_1$, obtained by means of implementing partial harmonization models or simulation models on the basis of vector $\vec{D}$;

U_C – the product's multi-attribute competitive utility (to be maximized);

U_P – the project's utility obtained by means of BPA values;

ρ_b – partial utility value for the b-th BPA (pre-given);

ε – the relative accuracy of the harmonization problem's objective (value U_C).

5. The Problem's Formulation

Referring to *Sections 2–3*, the strategic harmonization problem is as follows: to determine optimal versions assigned to all sub-products $d_1^{(opt)}, d_2^{(opt)}, \ldots, d_q^{(opt)}$, to maximize the multi-attribute competitive utility value

$$\underset{\{\vec{D}\}}{Max}\ U_C\ , \tag{4}$$

s.t.

$$\min\left(Y_b, Z_b\right) \le BPA_b\left(\vec{D}\right) \le \max\left(Y_b, Z_b\right),\ \ 1 \le b \le m\,, \tag{5}$$

where U_C satisfies (3).

Restriction (5) means that only feasible solutions $\vec{D}$, i.e., sets of versions which honour pre-given worst permissible constraints Z_b, can participate in the optimisation procedure.

We suggest solving the strategic harmonization problem (3–5) by means of a two-stage algorithm. At the first stage feasible solutions $\vec{D}$, i.e., combinations of versions assigned to the sub-products, are determined. Those vectors present input information for the second stage, to maximize the multi-attribute competitive utility parameter U_C obtained by means of experts subjective judgments.

Note that in some cases it might be not easy to develop the initial feasible search point $\vec{D}$ at the first stage. We suggest implementing in the algorithm the corresponding subsidiary *Problem AI* which can be formulated as follows:

Determine at least one combination $\vec{D} = \left\{d_1,\ d_2,\ \ldots\ ,\ d_q\right\}$ satisfying restriction (5).

6. Subsidiary Problem AI

The suggested step-wise algorithm to solve *Problem AI* is as follows:

Step 1. By means of the Monte-Carlo method simulate for each sub-product the index of its version, i.e., simulate integer values

$$d_i = \left[\alpha_i \cdot r_i\right] + 1,\ \ 1 \le i \le q, \tag{6}$$

where $\alpha_i = U\left(0,1\right)$ is a random value uniformly distributed in $\left(0,1\right)$, and $\left[x\right]$ is the whole number of x.

Step 2. By means of Monte-Carlo simulate for each i-th sub-product the values of m_1 independent basic project attributes

$$BPA_{\xi_h} = \min\left(Y_{\xi_h}, Z_{\xi_h}\right) + \alpha_h \cdot \left\{\max\left(Y_{\xi_h}, Z_{\xi_h}\right) - \min\left(Y_{\xi_h}, Z_{\xi_h}\right)\right\},\ \ 1 \le h \le m_1, \tag{7}$$

where $\alpha_h = U\left(0,1\right)$.

Step 3. Using partial harmonization models [10–12], determine values of $m - m_1$ dependent basic project attributes $BPA_{\Theta_v} = PHM\left\{ \vec{D} \middle/ BPA_{\xi_h}, 1 \le h \le m_1 \right\}$. In case $m = 3$ there are usually two independent basic attributes (time to accomplish the project and budget assigned to the project) as well as one dependent attribute – reliability for the project to be accomplished on time. In such a case the problem together with the corresponding algorithm is outlined in [1–2]. If m exceeds 3, the problem becomes more complicated.

Step 4. If all values $BPA_{\Theta_v} = PHM\left\{ \vec{D} \middle/ BPA_{\xi_h} \right\}$, $1 \le v \le m - m_1$ satisfy (5), search point $\vec{D}$ obtained at *Step 1* is a feasible one, thus providing solution to the problem. Otherwise apply the next step.

Step 5. Repeat *Steps 2–3* N_1 times, in order to check possible combinations in different m–dimensional subspaces. If for a significantly large N_1 a feasible solution has still not been obtained, apply the next step.

Step 6. Repeat *Steps 1–5* N_2 times, where N_2 is a significantly large number. If no feasible solution has been obtained, the initial search point cannot be determined. We have either to alter values (Y_b, Z_b), $1 \le b \le m$, or to select other possible versions of the sub-products.

We have deliberately chosen the so-called undirected Monte-Carlo search method [12] because of its simplicity. If m is not large, using the method for solving *Problem AI* does not cause any particular difficulties.

7. Cyclic Coordinate Search Method for the Problem's Solution

To obtain the problem's solution, we suggest implementing the CCSM in the two-level optimisation algorithm. The step-wise algorithm is as follows:

Step 1. Solve subsidiary *Problem AI* to obtain a feasible problem's solution, i.e., determine vector $\vec{D}$ which will be used henceforth as the initial search point.

Step 2. Assign to all sub-products' versions entering $\vec{D}$ (obtained at *Step 1*), the minimal index 1, i.e., $\vec{D} = (1,1,...,1)$. For each sub-product i, $1 \le i \le q$, all other versions can be enumerated in an arbitrary order from 2 to r_i.

Step 3. Transfer the information about the initial search point, i.e., the set of sub-products' versions, to the expert team. After carrying out questioning interviews and receiving the experts' subjective judgments, calculate value U_C by (3). Coordinates of vector $\vec{D}$ together with value U_C are placed in a special array W. In the course of the optimisation process, this array will contain the monotonously increasing utility value U_C together with the corresponding vector of optimised variables $\vec{D}$. Denote henceforth the stored information by U_C^* and $\vec{D}^*$, correspondingly.

Step 4. Start using CCSM with respect to the coordinate variables $d_1, d_2, \ldots, d_q$, beginning from the initial search point $\vec{D} = (1,1,...,1)$. The general idea is to increase the first coordinate d_1 by a constant step equal 1, i.e., $d_{1,j} = d_{1,j-1} + 1$, while all other coordinates $d_2, \ldots, d_q$ are fixed and remain unchanged in the course of the coordinate optimisation. After the first coordinate d_1 is optimised, we fix the index of the latter, and proceed by increasing the second coordinate d_2 by a step equal 1 (coordinates $d_3, \ldots, d_q$ being fixed). Afterwards, when completing optimisation of the second coordinate, the latter is fixed as well, and we proceed with the third coordinate d_3, and so forth, until all coordinates are looked through by the partial coordinate increasing procedure. Go to *Step 5*.

Step 5. Proceed with the optimisation process starting again from the first coordinate d_1 with the index obtained in the course of carrying out *Step 4*. Check two opposite directions: $d_1 - 1 \Rightarrow d_1$ and $d_1 + 1 \Rightarrow d_1$ and choose one of them which results in obtaining a feasible solution as well as in increasing utility value U_C. If such a direction can be chosen, proceed changing d_1 in that direction by a constant step equal 1. The same procedure has to be undertaken with other coordinates. Note that, similar to *Step 4*, only one coordinate undergoes optimisation, while all other coordinates remain fixed and unchanged.

If in the course of carrying out *Steps 4–5* a routine feasible search point $\vec{D}$ coincides with the previously obtained and stored in array W feasible point $\vec{D}^*$, the corresponding utility value U_C^* is taken as the quasi-optimal solution of the harmonization problem. Thus, the search process terminates. Go to *Step 9*.

Implementing the optimisation search process at *Steps 4–5* centres on numerous applications to a group of *Steps 6–7*, which actually examine the routine search point and carry out decision-making as follows:

- either to accept the routine search point as a successful one, i.e., to proceed with the search procedure from that point on, or
- to reject the routine search point and change the optimising coordinate.

As outlined above, the coordinate optimisation centres on examining a routine search point $\vec{D}$ in order to check:

- the search point's feasibility, and
- the increase of the corresponding total utility U_C relatively to the previously obtained maximal value U_C^*.

In order to check the feasibility, apply the next step.

Step 6. To check the routine search point's feasibility, one has to carry out *Steps 2–5* of *Problem AI* outlined in *Section 6*. Note that coordinate values $d_1, d_2, \ldots, d_q$ enter the routine search point $\vec{D}$.

If in the course of carrying out *Step 6* a feasible solution has been obtained, go to the next step. Otherwise reject the routine search point and go to *Step 8*.

Step 7. Undertake questioning interviews of experts and, after obtaining their subjective judgments, calculate value U_C by (3). If U_C exceeds U_C^* (stored in array W), examine the relative increase of the utility value by calculating

$$\Delta U_C = \frac{1}{U_C^*}\left(U_C - U_C^*\right). \tag{8}$$

If relation $\Delta U_C < \varepsilon$ holds, the optimisation process terminates. Go to *Step 9*. Otherwise, when $\Delta U_C \geq \varepsilon$ holds, accept the routine search point as a successful one. Go to *Step 4*, to continue the search procedure.

If U_C does not exceed U_C^*, the routine search point has to be rejected. Go to the next step.

Step 8. Assume that in the course of the optimisation search process, the i-th coordinate, i.e., value d_i, has increased its index by 1, while other values $d_1,\ldots, d_{i-1}, d_{i+1},\ldots, d_q$ were fixed and remained unchanged. If $i \neq q$, decrease value d_i by 1, $d_1 - 1 \Rightarrow d_1$, fix value d_i and start optimising the next coordinate d_{i+1}. So to *Step 4*.

If $i = q$, i.e., all coordinates have been partially optimised, the process is then repeated starting with d_i again. Go to *Step 5*.

Step 9. The optimisation search process terminates, and the information stored in array W, i.e., $\vec{D}^*$ with objective U_C^*, is taken as the optimal solution of the harmonization problem.

8. Case of Compound Utility

It can be well-recognized that in previous sections the competitive utility value U_C has been favoured over the project utility value U_P. However, under certain conditions those different utility parameters may be regarded as practically of equal importance. Thus, the problem of maximizing the competitive utility value U_C has to be substituted for maximizing the compound utility

$$\beta_P \cdot U_P + \beta_C \cdot U_C = U_T , \tag{9}$$

where U_T is the total utility value and β_P and β_C are properly chosen coefficients to present both utility parameters in similar ranking and scaling.

The problem is, thus, to determine the optimal set of versions for each sub-product $\vec{D}$ in order to maximize the total utility U_T

$$\underset{\{\vec{D}\}}{Max}\, U_T = \underset{\{\vec{D}\}}{Max} \left\{ \beta_P \cdot U_P + \beta_C \cdot U_C \right\} \tag{10}$$

subject to (5), where U_C is calculated by (3) and U_P satisfies [1–2]

$$U_P = \sum_{b=1}^{m} \left(\rho_b \cdot BPA_b \right) . \tag{11}$$

We suggest optimising harmonization model (3, 5, 9–11) by using the same search algorithm as being outlined in *Section 7*. Only minor modifications have to be implemented, namely:

1. *Step 1* has to be substituted by the algorithm of solving *Problem AII* to maximize the project's utility value

   $$\underset{\{\vec{D}\}}{Max}\, U_P = \underset{\{\vec{D}\}}{Max} \left[\sum_{b=1}^{m} \left(\rho_b \cdot BPA_b \right) \right] \tag{12}$$

   subject to (5).
   Problem (5, 12) together with the corresponding algorithm, has been outlined in our recent publications [1–2], especially for the three-attribute harmonization model in project management.

2. *Step 6* has to be substituted by solving problem (5, 11) as well.

3. Competitive utility value U_C^* in array W has to be substituted by the total utility value U_T^*.

4. Relation (8) has to be substituted by another one, honouring modification (9).

All other steps of the algorithm do not undergo any changes.

9. Example on Designing a New Passengers Vehicle

An example on designing a new passengers vehicle which is widely presented in the literature on project management (see, e.g., [11]), can illustrate implementation of the outlined above harmonization model. The example is subject to restrictions by competitive attributes which have been used within a long period by questioning experts and obtaining from the latter all kinds of subjective decision-making. However, no harmonization models have been suggested and no optimisation problems have been solved.

Three basic attributes define usually the R&D project's utility:

- BPA_1 – budget assigned to the whole project;
- BPA_2 – time to accomplish the project;
- BPA_3 – reliability for the project to be accomplished on time on condition of pre-given BPA_1 and BPA_2.

Thus, there are two independent attributes (BPA_1 and BPA_2) and a dependent one (BPA_3). For the case of a PERT-COST project the harmonization model together with the optimisation algorithm obtained a detailed solution in [2].

As to competitive attributes, nine of them have been singled out [11] and are usually examined by experts in case of designing a new vehicle:

BCA_1 – relative fuel economy;
BCA_2 – initial cost;
BCA_3 – life cycle cost per mile;
BCA_4 – maintainability (special scaling);
BCA_5 – safety (special scaling);
BCA_6 – refuel time;
BCA_7 – unrefuelled range;
BCA_8 – maximum start-up time;
BCA_9 – minimum speed-up time from 0 to 80 mph.

As to the worst and the best competitive attribute estimates, they are as follows (for the last decade – based on best experts' opinion):

1. BCA_1^* = 20 mpg equivalent;
   BCA_1^{**} = 80 mpg equivalent;
2. BCA_2^* = $\$25{,}000$;
   BCA_2^{**} = $\$\ 5{,}000$;
3. BCA_3^* = $\$1.00/mile$;
   BCA_3^{**} = $\$0.20/mile$;
4. BCA_4^* = 0 (special scaling);
   BCA_4^{**} = 10 (special scaling);
5. BCA_5^* = 0 (special scaling);
   BCA_5^{**} = 10 (special scaling);
6. BCA_6^* = 8 hours;
   BCA_6^{**} = 0.17 hours;
7. BCA_7^* = 50 miles;
   BCA_7^{**} = 250 miles;
8. BCA_8^* = 600 seconds;
   BCA_8^{**} = 5 seconds;
9. BCA_9^* = 60 seconds;
   BCA_9^{**} = 5 seconds;

It can be well-recognized that an experienced decision-maker is capable of undertaking subjective judgment for any BCA_k, $1 \le k \le 9$, together with scaling the attribute's level of importance η_k.

10. Conclusions and Future Research

The following conclusions can be drawn from the study:

1. The problem of maximizing the product's utility by means of considering optimal components for that product, is widely regarded in the literature as an important strategic area in project management. Thus, developing new harmonization models on that subject refers to strategic harmonization models. Those models practically cover the entire life cycle of any newly designed and developed product.

2. The backbone of the models under consideration is the generalized search procedure comprising partially harmonization models on the basis of heuristic approaches with decision-making on the competitive ability of the designed product, to be undertaken by a qualified expert team.
3. The suggested search algorithm is based on the cyclic coordinate search method. The latter may either comprise:
   - an optimisation procedure in the area of basic competitive attributes only, in order to maximize the total competitive utility subject to restrictions for basic parameters of the designing project, or
   - a search procedure to maximize the total product's utility comprising as summands both the competitive utility and the project's utility values.

   The two outlined above procedures are not of any principal difference; one can be obtained from another by implementing only minor modifications.
4. As far as we are concerned similar research has not been undertaken as yet.
5. An emphasis has to be drawn that, in dependence on the novelty of the designed product, the market's demands, etc., other variables to be optimised may be introduced in the harmonization model. However, the basic concepts linked to the necessity of developing a mixed type optimisation procedure comprising a combination of heuristic methods and interview dialogs with experts, have to remain unchanged.
6. Future research to develop new strategic harmonization models has to be undertaken not only in project management, but in additional areas of strategic management as well.

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IS THERE ANY TRUTH IN "PROJECTLIBRE THE OPEN SOURCE REPLACEMENT OF MICROSOFT PROJECT"?

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An intensely intriguing announcement of major producers of open source software stir specialists in project management, namely message "ProjectLibre: the open source replacement of Microsoft Project". In 2012 the founders of OpenProj announced that they forked the project and will be releasing a new version of OpenProj in August 2012. The name of the fork is ProjectLibre. Is it going to try to prove and is it possible to use this software in the learning process for the preparation of students and professionals will try to answer in this article. This issue is especially actual in Higher Education, as the main reason for people to university is a good realization that he would have offered and given trend more and more employers to run a Linux-based systems and to use free software in the near future, their experience with open source products would definitely give them a significant advantage in the labour market.

Keywords: Microsoft Project, OpenProj, ProjectLibre, Project management, open source

1. Introduction

The rise of open source software has been discussed in many places and it is obvious to anyone who likes a bit of development in information technology. Its introduction in education, however, is still the exception rather than the rule. This, of course, is a mistake. For one-sided consideration of IT disciplines only from the perspective of mainstream proprietary software is contrary to the very idea of education, which is rather a person to learn to operate a computer than to learn how to use specific products. Even specialty a student has nothing to do with information technology in nearly every major person will have to use specified type of software. It is difficult to compare in detail any free alternative to correspond and commercial application. But not being ungrounded, you should give at least one specific example in more detail. It would be appropriate to countering Microsoft Project 2007 & 2010 against ProjectLibre, due to their widespread use in automation in the field of Project management.

2. Description

The product OpenProj was developed at Projity by Marc O'Brien, Howard Katz and Laurent Chretienneau in 2007 by Serena Software [3]. It moved out of beta with the release of Version 1.0, on January 10, 2008 [2]. As of early 2009 support for OpenProj and communication about development of OpenProj seem to have been suspended [4]. There has been no improvement in the past four years and it is not longer compatible with new versions of Microsoft Project and in particular there was good compatibility of new versions 2007 and 2010.

Recently, the original founders of OpenProj started to develop a complementary server for OpenProj, comparable to Microsoft Project Server for Microsoft Project. During development they realized, that the fact that OpenProj had not been updated anymore by Serena Software during the last four years will become problematic to their goal, so they needed to develop first a significantly updated version of OpenProj. This version was released as a fork called ProjectLibre in August 2012 [4]. Source forge has issued a note that ProjectLibre http://www.projectlibre.org has superseded ProjectLibre and is the new replacement.

ProjectLibre project management software is an open source alternative to Microsoft Project. It has been downloaded in 146 countries [5] the first month of release and was just voted "Project of the Month". ProjectLibre is compatible with Microsoft Project 2003, 2007 and 2010 files. ProjectLibre runs on the Java Platform, allowing it to run on a variety of different operating systems [1]. You can simply open them on Linux, Mac OS or Windows and if desired save results back.

A ProjectLibre is envisaged that in the future to moan could be used as an alternative to a cloud/ server replacement of Microsoft Project Server.

On the site of OpenProj/ProjectLibre can find various examples of projects. You can take advantage of opportunities to download, for each subproject that you remember, and the overall management of your business.

Working with the program is very intuitive and hardly difficult, even people who are not engaged in project planning. From a technical point of view, we do not comment on the performance of the program.

Example proximity of MS project 2007 (Figure 1) with ProjectLibre (Figure 2) is the design of the task solved with both product the conclusion is "it's the same". When comparing MS Project and ProjectLibre (Figure 1 and Figure 2) clearly visible large external similarities between the two products.

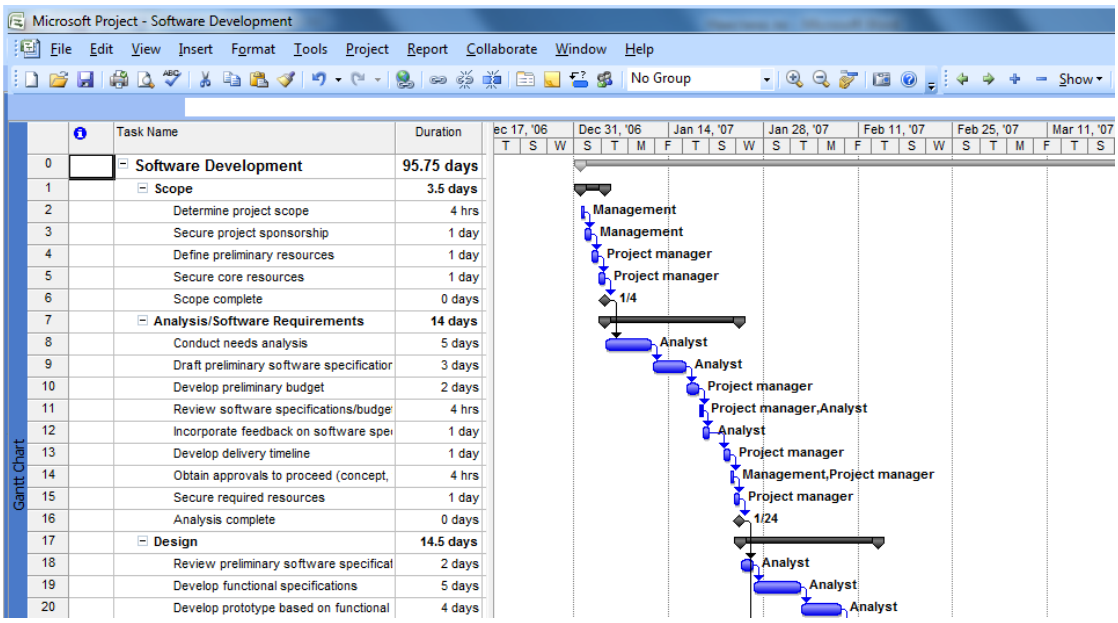

Figure 1. Gantt chart of MS Project 2007

Figure 1 shows the Gantt chart for project implementation, it is used to test for compatibility option.

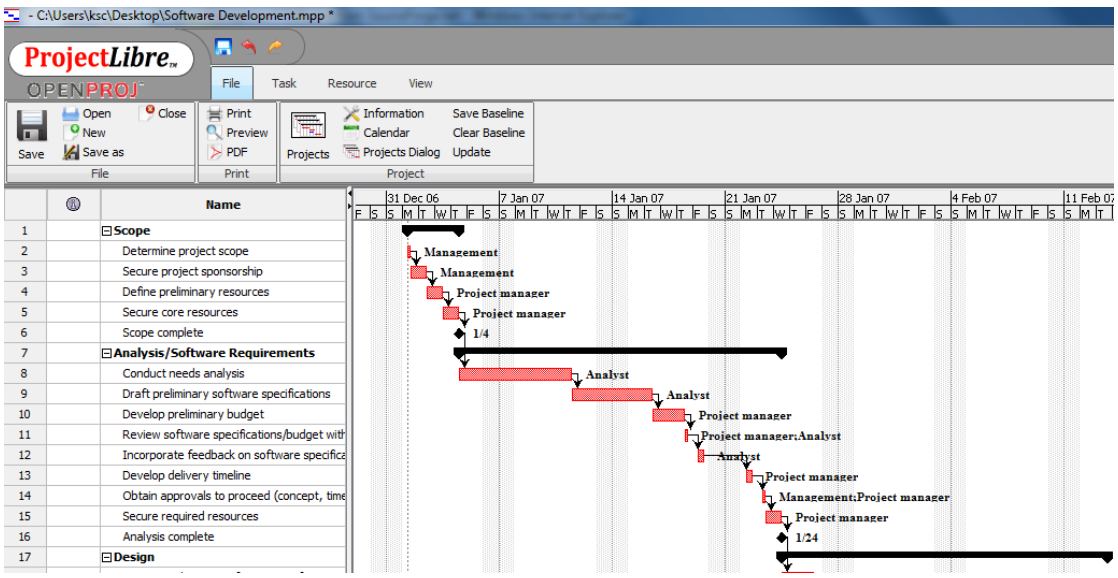

Figure 2. Gantt chart in ProjectLibre

3. Comparison of Packages

The most popular program in the field of project management is undoubtedly the package Microsoft Project. Microsoft Project is suitable for everyone it meets basic needs for project management and has a very large set of highly complex tools for collaboration and management. There is however one of its features, which certainly is not positive and this is the price – $ 999. Naturally for such a price, one has to wonder if there is any other program with similar functionality that is compatible with MS Project and with a lower price. The answer is there and the price is so low that less cannot be – they are free.

What are the main differences in the two platforms of Project management, implemented on the basis of open and proprietary software, which also belong to the advantages/disadvantages comparing two packages?

- Application based on open source is free. Everyone would love to use the free software that is legally free, not pirated. In the case of ProjectLibre it is, and in the words of its creators, will always be free.
- Updates open source application is also free. This is a direct consequence of the philosophy of the license under which it is running these applications. Microsoft updates are also generally free, but they can make them pay when they want without due explanation to someone about it.
- Application code open source is outside the control of a single company. This makes applications independent of the current developers of these products and if the company disappears behind application code will be lost and the product can continue to live.
- The application uses open source open standards. ProjectLibre file formats such as publicly documented, consistent and affordable. Many people do not understand what the advantage of file formats that are open is and their specifications are not known, but it is a great advantage in terms of transparency of what makes your computer data. It is also a great convenience for anyone who wants to create a product that is compatible with that format.

Now let's get to the actual comparison of the two Project packages.

3.1. General Stuff

Microsoft Project and ProjectLibre are two very powerful desktop applications for project management with the following features:

- **Gantt chart**. This is a bar chart that is used for project planning. It divides the design task into several subtasks and shows their relationship, start and end dates – Figure 1 and Figure 2.
- **Project Network.** It shows "pre", "next" and "intermediate" tasks in graphical mode. And called PERT chart. Is shown in Figure 3 and Figure 4. Again seen close to the same product of MS.

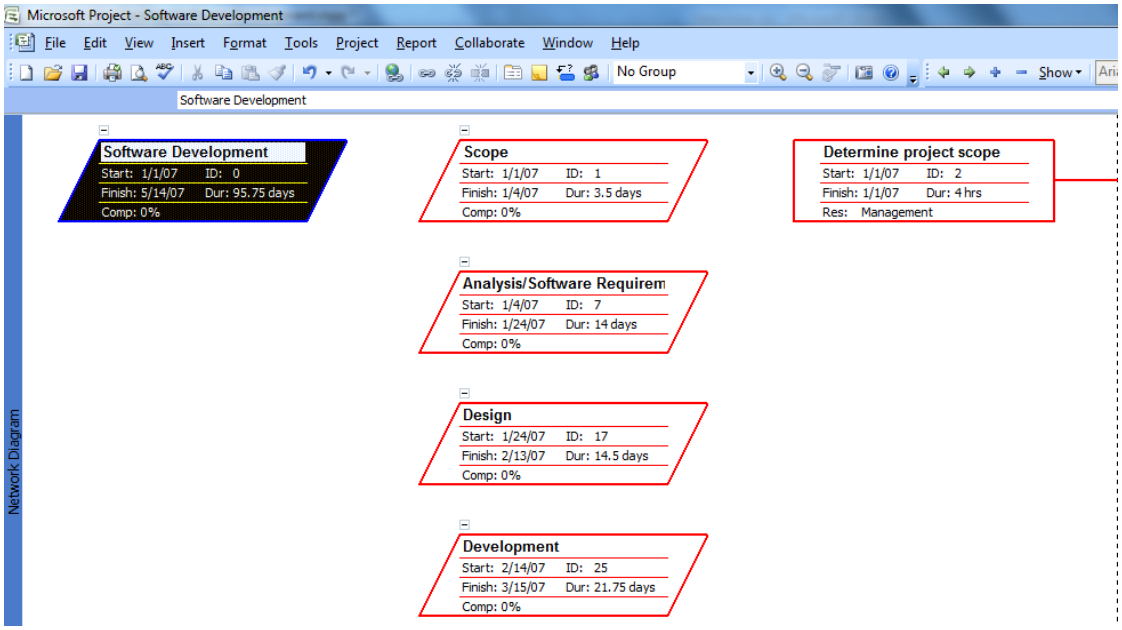

Figure 3. Networking diagram of MS Project 2007

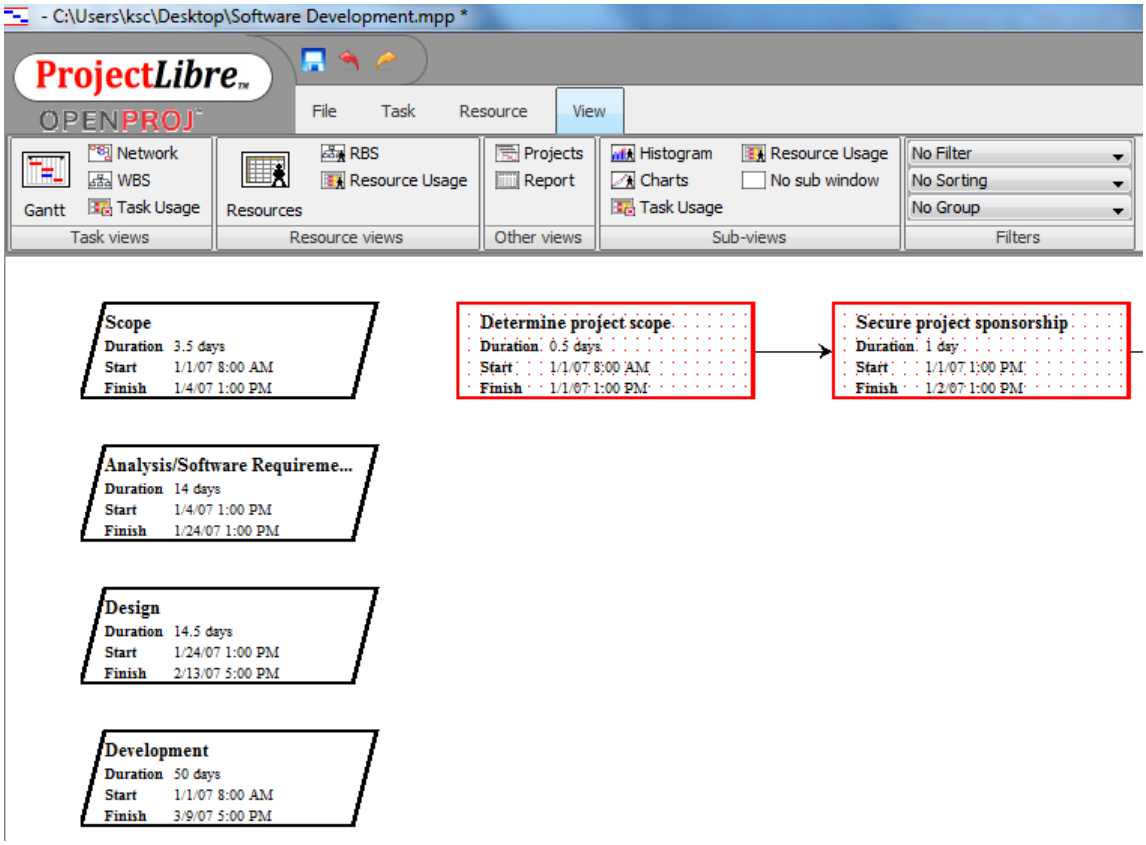

Figure 4. Networking diagram of **ProjectLibre**

- **Resources Chart**. These are the entries for the available resources are listed to the right of the bars.
- **WBS** (Work Breakdown Structure). Component structure of the work. It shows the structure of subordination and systematic breakdown of tasks into subtasks.
- **RBS** (Resource Breakdown Structure). Resource breakdown or RBS is the categorization of resources according to different functions.
- **Output.** Microsoft Project and ProjectLibre offer several methods for tracking consolidated financial statements and for the use of tasks / resources.

Note: In this article we are not given any figures with diagrams near, but above are analogous according to the authors of the article to those of Figure 1–4.

3.2. Some Advantages of Microsoft Project

- **Rich supporting documentation**. Microsoft Project has a really good support documentation that is available both online and offline, so that learning is easy.
- **Java is needed** (debatable advantage). Unlike ProjectLibre, no need to install Java on your machine to run Microsoft Project.

3.3. Some of the Advantages of Projectlibre

- **ProjectLibre is a free software** project management, so you will save $ 700–1000.
- **Easy to system requirements**. In most computers and ProjectLibre and Microsoft Project 2007 & 2010 will go smoothly. In older computers ProjectLibre will have a significant advantage. Its minimum requirements are a Pentium 166 MHz and 128 Mb RAM, while Microsoft Project 2007 & 2010 are Pentium 450 MHz with 266 Mb Ram. Which is more important, ProjectLibre and will run Linux (and Solaris and BSD), and Linux runs much more efficiently than older computers running Windows 2000 or XP. This makes Linux ProjectLibre practical combination even for very old computers.

- **Independence of the operating system. Multiplatform.** This is undoubtedly one of the biggest advantages of ProjectLibre. It is available for each architecture, the three major platforms (Windows, Linux, and Mac). It relies on its Microsoft formats, and many others. Own file formats are extremely effective and generally the same document is smaller than the format as MS format. By comparison, Microsoft Project 2007 & 2010 only supports its own formats and is available only for Windows.
- **Usability, Training, Support.** In general, anyone who has used MS Project 2003 & 2007 & 2010 will be feeling comfortable with ProjectLibre. Interfaces are almost identical, see. Figure 1 and Figure 2, even in ProjectLibre syntax is identical. You can think of migration as ProjectLibre migration to Microsoft Project 2007 & 2010. While this is slightly different, but the concepts are the same.
- **Part of Star Office**. OpenProj by 2008 it was part of Star Office at Sun Microsystems [6]; we assume a large percentage of security as its successor and ProjectLibre becomes part of the package.

Be asked if there are other programs like ProjectLibre, can confidently answer "Yes" and such are Gantter [41], Teambox [7], Rally Community Edition [8], FreedCamp [9], and many others.

4. Conclusions

In conclusion, we emphasize three things.

The differences between the philosophies of open and closed software mentioned in the beginning, is perhaps the most important argument in favour of this application. These are advantages, which cannot be neutralized or removed, no matter how its competitors change.

Second, the flexibility of open source software should be used to implement partial least in the beginning, if possible overall migration. Many open source programs have versions for Windows. Using ProjectLibre under windows, it saves money; even windows have to be paid or otherwise. Sometimes a person just needs the specific commercial applications. But he does not have to use them on Windows. One can use commercial software, without having to pay extra for Windows.

The third thing I want to note is that financial arguments in favour of open source are far from the most important. Since so much of open source programs are free, some people create a false impression that these are decisions for poorer ones, and as such are incomplete. These people carry the logic of the material world, where it has no place. And since we're talking about higher education, I should admit that even Harvard began steps for the introduction of open source software in their curricula (for we are not ungrounded – news can be found at http://news.cnet.com/8301-13505_3-9916323-16.html) and they all would agree, it is certainly not suffering from a shortage of funds, so the example is quite obvious, considering the topic of this report.

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CONSTRUCTING INSPECTION STRATEGIES UNDER UNCERTAINTY

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Certain fatigued structures must be inspected in order to detect fatigue damages that would otherwise not be apparent. A technique for obtaining optimal inspection strategies is proposed for situations where it is difficult to quantify the costs associated with inspections and undetected failure. For fatigued structures for which failures (fatigue damages) are only detected at the time of inspection, it is important to be able to determine the optimal times of inspection. Fewer inspections will lead to lower fatigue reliability of the structure upon demand, and frequent inspection will lead to higher cost. When there is a fatigue reliability requirement, the problem is usually to develop an inspection strategy that meets the reliability requirements. It is assumed that only the functional form of the underlying invariant distribution of time-to-failure is specified, but some or all of its parameters are unspecified. The invariant embedding technique proposed in this paper allows one to construct an optimal inspection strategy under parametric uncertainty. This strategy represents a sequence of inspection times satisfying the specific criterion, which takes into account the predetermined value of the conditional fatigue reliability of the structure. A numerical example is given.

Keywords: fatigued structure, fatigue damage, parametric uncertainty, inspection strategy, optimisation

1. Introduction

Many important fatigued structures (for instance, Transportation Systems and Vehicles: aircraft, space vehicles, trains, ships; Civil Structures: bridges, dams, tunnels; and so on) for which extremely high reliability is required are maintained by in-service inspections to prevent the reliability degradation due to fatigue damage. However, temporal transition of the reliability is significantly affected by the inspection strategy selected. Thus, to keep structures reliable against fatigue damage by inspections, it is clearly important in engineering to examine the optimal inspection strategy. In particular, it should be noticed that periodical inspections with predetermined constant intervals are not always effective, since a fatigue crack growth rate is gradually accelerated as fatigue damage grows, i.e. the intervals between inspections should be gradually smaller in order to restrain the reliability degradation by repeated inspections. Therefore, we need to construct the inspection strategy by paying attention to this case.

Barlow *et al.* [1] tackled this problem by assuming a known, fixed cost of making an inspection and a known fixed cost per unit time due to undetected failure. They then found a sequence of inspection times for which the expected cost is a minimum. Their results have been extended by various authors (Luss and Kander [2]; Sengupta [3]). Unfortunately, it is difficult to compute optimal checking procedures numerically, because the computations are repeated until the procedures are determined to the required degree by changing the first check time. To avoid this, Munford and Shahani [4] suggested a sub-optimal (or nearly optimal) but computationally easier inspection policy. This policy was used for

Weibull and gamma failure distribution cases (Munford and Shahani [5]; Tadikamalla [6]). Numerical comparisons among certain inspection policies are given by Munford [7] for the case of Weibull failure times.

Most models, which are used for solving the problems of planning inspections, are developed under the assumptions that the parameter values of the models are known with certainty. When these models are applied to solve real-world problems, the parameters are estimated and then treated as if they were the true values. The risk associated with using estimates rather than the true parameters is called estimation risk and is often ignored.

In this paper, we consider the case when the functional form of the underlying invariant lifetime distribution is assumed to be known, but some or all of its parameters are unspecified. To make the discussion clear, we make the following restrictions on the inspection: (i) there is only one objective structure component of the inspection; (ii) if a fatigue crack is detected by the inspection, the component is immediately replaced with a new (virgin) one. To construct the optimal reliability-based inspection strategy in this case, the two criteria are proposed and the invariant embedding technique (Nechval *et al.* [8–9]) is used.

2. Constructing Inspection Strategies under Certainty

In this paper we look at inspection strategies for items or structures that can be described as being in one of two states, one of which is preferable to the other. This preferred state might be described as 'working' whilst the other may represent some sort of 'failure'. The structures are originally known to be in a working state but may subsequently fail. In other words, at $t_0 = 0$ the structure is in state S_0 (working) but at a later time, t_1, the structure will move into state S_1 (failed). We suppose that we do not know when the transition from S_0 into S_1 will occur, and that a failure (fatigue crack) can only be detected through inspection. We deal with situations, where it is difficult to quantify the costs associated with inspections and undetected failure, or when these costs vary in time.

The inspection strategy defined is based on the conditional reliability of the structure. It is given as follows. Fix $0 < \gamma < 1$ and let

$$\tau_1 = \arg\,(\Pr\{X > \tau_1\} = \gamma)\,, \tag{1}$$

$$\tau_j = \arg\,(\Pr\{X > \tau_j \mid X > \tau_{j-1}\} = \gamma), \quad j \geq 2, \tag{2}$$

where $\{\tau_j\}_{j=1,\,2,\,\ldots}$ are inspection times, X is a random variable representing the lifetime of the structure. This is named as 'reliability-based inspection'. The above inspection strategy makes use of the information about the remaining life that is inherent in the sequence of previous inspection times. The value of γ can be seen as 'minimum fatigue reliability required' during the next period when the structure was still operational at last inspection time, that is, in other words, the conditional probability that the failure (fatigue crack) occurs in the time interval (τ_{j-1}, τ_j) without failure at time τ_{j-1} is always assumed $1-\gamma$.

It is clear that if F_θ, the structure lifetime distribution with the parameter θ (in general, vector), is continuous and strictly increasing, the definition of the inspection strategy is equivalent to

$$\tau_j = \arg(\overline{F}_\theta(\tau_j) = \gamma^j), \quad j \geq 1, \tag{3}$$

or equivalent to

$$\tau_j^* = \arg\min_{\tau_j}[\overline{F}_\theta(\tau_j) - \gamma^j]^2, \quad j \geq 1, \tag{4}$$

where

$$\overline{F}_\theta(\tau_j) = 1 - F_\theta(\tau_j). \tag{5}$$

If it is known that each inspection costs c_1 and the cost of leaving an undetected failure (fatigue crack) is c_2 per unit time, then the total expected cost per inspection cycle is given by

$$E_\theta\{C\} = \sum_{j=1}^{\infty} \int_{\tau_{j-1}}^{\tau_j} [jc_1 + c_2(\tau_j - x)] f_\theta(x)dx$$

$$= c_1 \sum_{j=1}^{\infty} j\,[F_\theta(\tau_j) - F_\theta(\tau_{j-1})] + c_2 \sum_{j=1}^{\infty} \tau_j [F_\theta(\tau_j) - F_\theta(\tau_{j-1})] - c_2 \int_0^{\infty} x f_\theta(x)dx$$

$$= c_1 \sum_{j=0}^{\infty} \overline{F}_\theta(\tau_j) + c_2 \sum_{j=1}^{\infty} \tau_j [\overline{F}_\theta(\tau_{j-1}) - \overline{F}_\theta(\tau_j)] - c_2 E_\theta\{X\}, \tag{6}$$

where $f_\theta(x)$ is the probability density function of the structure lifetime X,

$$E_\theta\{X\} = \int_0^{\infty} x f_\theta(x)dx. \tag{7}$$

Thus, we can choose γ such that $E_\theta\{C\}$ as defined in (6) is minimized.

3. Constructing Inspection Strategies under Parametric Uncertainty

To construct the optimal reliability-based inspection strategy under parametric uncertainty, the two criteria are proposed.

The first criterion, which takes into account (3) and the past lifetime data of the structures of the same type, allows one to construct the inspection strategy given by

$$\tau_j = \arg(E_\theta\{\overline{F}_\theta(\tau_j)\} = \gamma^j), \quad j \geq 1, \tag{8}$$

where $\tau_j \equiv \tau_j(\hat{\theta})$, $\hat{\theta}$ represents either the maximum likelihood estimator of θ or sufficient statistic S for θ, i.e., $\tau_j \equiv \tau_j(S)$. This criterion is named as 'unbiasedness criterion'.

The second criterion (preferred), which takes into account (4) and the past lifetime data of the structures of the same type, allows one to construct the inspection strategy given by

$$\tau_j^* = \arg\min_{\tau_j} E_\theta\{[\overline{F}_\theta(\tau_j) - \gamma^j]^2\}, \quad j \geq 1. \tag{9}$$

This criterion is named as 'minimum variance criterion'.

It will be noted that in practice, under parametric uncertainty, the criterion,

$$\tau_j = \arg(\overline{F}_{\hat{\theta}}(\tau_j) = \gamma^j), \quad j \geq 1, \tag{10}$$

is usually used. This criterion is named as 'maximum likelihood criterion'.

To find a sequence of inspection times, $\tau_j \equiv \tau_j(\hat{\theta})$ or $\tau_j \equiv \tau_j(S)$, $j \geq 1$, satisfying either (8) or (9), the invariant embedding technique (Nechval *et al.* [8–9]) can be used.

Let us assume that each inspection costs c_1 and the cost of leaving an undetected failure (fatigue crack) is c_2 per unit time, then under parametric uncertainty we can choose γ such that $E_\theta\{E_\theta\{C\}\}$ is minimized.

3.1. Inspection Strategies for the Exponential Lifetime Distribution under Parametric Uncertainty

Theorem 1. Let $X_1, \ldots, X_n$ be the random sample of the past independent lifetime observations from the fatigued structures of the same type, which follow the exponential distribution with the probability density function

$$f_\theta(x) = (1/\theta)\exp(-x/\theta), \quad x \geq 0, \quad \theta > 0, \tag{11}$$

where the parameter θ is unknown. Then the reliability-based inspection strategies for a new fatigued structure of the same type are given as follows.

The unbiased inspection strategy (UIS):

$$\tau_j = [\gamma^{-j/n} - 1]\, S, \quad j \geq 1. \tag{12}$$

The minimum variance inspection strategy (MVIS):

$$\tau_j^* = \frac{1 - \gamma^{\frac{j}{n+1}}}{2\gamma^{\frac{j}{n+1}} - 1} S, \quad j \geq 1, \tag{13}$$

where $S = \sum_{i=1}^{n} X_i$ is the sufficient statistic for θ.

The maximum likelihood inspection strategy (MLIS):

$$\tau_j = j \ln \gamma^{-1} \frac{S}{n}, \quad j \geq 1. \tag{14}$$

Proof. Using the invariant embedding technique (Nechval *et al.* [8-9]), we obtain the unbiased inspection strategy (UIS) from (8):

$$\tau_j = \arg\,[E_\theta\{\overline{F}_\theta(\tau_j)\} = \gamma^j] = \arg\left[E_\theta\left\{\exp\left(-\frac{\tau_j}{\theta}\right)\right\} = \gamma^j\right] = \arg\left[E_\theta\left\{\exp\left(-\frac{\tau_j}{S}\frac{S}{\theta}\right)\right\} = \gamma^j\right]$$

$$= \arg\left[E\left\{\exp\left(-\eta_j V\right)\right\} = \gamma^j\right] = \arg\left[\frac{1}{(1+\eta_j)^n} = \gamma^j\right] = [\gamma^{-j/n} - 1]\, S, \quad j \geq 1, \tag{15}$$

where

$$\eta_j = \tau_j / S, \tag{16}$$

$$V = S/\theta \sim f(v) = \frac{1}{\Gamma(n)} v^{n-1} \exp(-v), \quad v \geq 0. \tag{17}$$

The minimum variance inspection strategy (MVIS) is obtained from (9):

$$\tau_j^* = \arg\min_{\tau_j} E_\theta\{[\overline{F}_\theta(\tau_j) - \gamma^j]^2\} = \arg\min_{\tau_j} E_\theta\left\{[\exp\left(-\tau_j/\theta\right) - \gamma^j]^2\right\}$$

$$= \arg\min_{\tau_j} E\{\exp(-2\eta_j V) - 2\exp(-\eta_j V)\,\gamma^j + \gamma^{2j}\} = \arg\min_{\tau_j}\left(\frac{1}{(1+2\eta_j)^n} - \frac{2\gamma^j}{(1+\eta_j)^n} + \gamma^{2j}\right)$$

$$= [(1 - \gamma^{j/(n+1)}) \big/ (2\gamma^{j/(n+1)} - 1)]S, \quad j \geq 1. \tag{18}$$

The maximum likelihood inspection strategy (MLIS) follows immediately from (10):

$$\tau_j = \arg\,(\overline{F}_{\hat{\theta}}(\tau_j) = \gamma^j) = \arg\left[\exp\left(-\frac{\tau_j}{\hat{\theta}}\right) = \gamma^j\right] = j \ln \gamma^{-1} \frac{S}{n}, \quad j \geq 1, \tag{19}$$

where the maximum likelihood estimator of θ is $\hat{\theta} = S/n$. This ends the proof. ¸

3.2. Determination of the Optimal Value of γ for the Unbiased Inspection Strategy

Theorem 2. Let us assume that under conditions of Theorem 1 each inspection of the UIS costs c_1 and the cost of leaving an undetected failure (fatigue crack) is c_2 per unit time, then γ minimizing $E\{E_\theta\{C\}\}$ is given by

$$\gamma^* = \arg\left(\left[\frac{1-\gamma^{(n+1)/n}}{1-\gamma}\right]^2\left[\frac{1-\gamma^{-1/n}+(\gamma^{-1}-1)/n}{\gamma^{1/n}}\right]=\frac{n+1}{n}\frac{c_1}{c_2}\frac{1}{S}\right). \tag{20}$$

Proof. Taking into account (6) and (12), we have

$$\gamma^* = \arg\min_{\gamma} E_\theta\{E_\theta\{C\}\} = \arg\min_{\gamma} E_\theta\left\{c_1\sum_{j=0}^{\infty}\overline{F}_\theta(\tau_j)+c_2\sum_{j=1}^{\infty}\tau_j[\overline{F}_\theta(\tau_{j-1})-\overline{F}_\theta(\tau_j)]-c_2E_\theta\{X\},\right\}$$

$$= \arg\min_{\gamma}\theta\left(\frac{c_1 n}{S}\frac{1}{1-\gamma^{(n+1)/n}}+c_2 n\frac{\gamma^{-1/n}-1}{1-\gamma}-c_2\right) = \arg\min_{\gamma}\left(\frac{c_1 n}{S}\frac{1}{1-\gamma^{(n+1)/n}}+c_2 n\frac{\gamma^{-1/n}-1}{1-\gamma}-c_2\right)$$

$$= \arg\left(\left[\frac{1-\gamma^{(n+1)/n}}{1-\gamma}\right]^2\left[\frac{1-\gamma^{-1/n}+(\gamma^{-1}-1)/n}{\gamma^{1/n}}\right]=\frac{n+1}{n}\frac{c_1}{c_2}\frac{1}{S}\right). \tag{21}$$

This ends the proof.

4. Numerical Example

Let $X_1, \ldots, X_n$ be the random sample of the past independent lifetime observations from the same fatigued structures follow the exponential distribution (11), where $n = 2$ and the parameter θ is unknown. The sufficient statistic for θ is $S = 335$ hours. In order to construct the reliability-based inspection strategy for a new fatigued structure of the same type, the unbiasedness criterion (8) will be used. Let us assume that each inspection of the UIS costs c_1=1 (in terms of money) and the cost of leaving an undetected failure (fatigue crack) is c_2=2 ((in terms of money)) per unit time. Then it follows from (20) that $\gamma^* = 0.95$. Figure 1 depicts the relationship between $E_\theta\{E_\theta\{C\}\}/\theta$ and γ.

The optimal inspection times (in term of hours) for the unbiased inspection strategy are given in Table 1.

Table 1. Optimal inspection times (in terms of hours) for the unbiased inspection strategy

j	1	2	3	4	5	6	7	8	9	10	11	…
τ_j	8.70	17.63	26.79	36.19	45.83	55.73	65.88	76.29	86.98	97.94	109.19	…

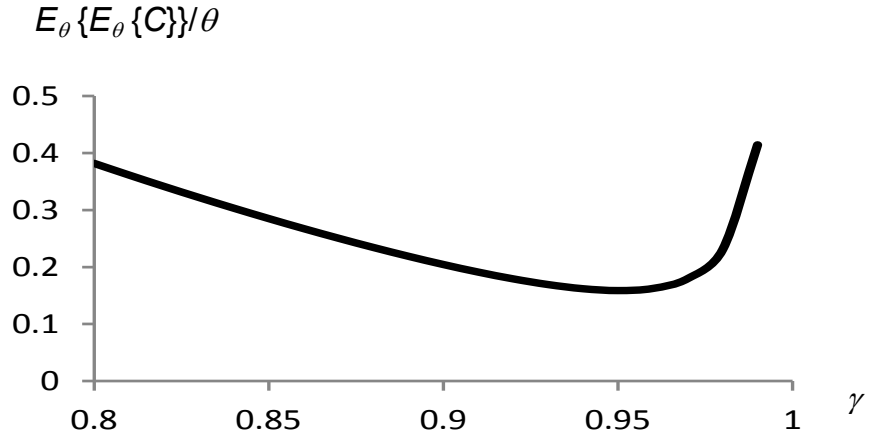

Figure 1. Relationship between $E_\theta\{E_\theta\{C\}\}/\theta$ and γ

5. Conclusion and Future Work

The technique proposed in this paper represents a simple and computationally attractive statistical method based on the constructive use of the invariance principle in mathematical statistics. The main advantage of this technique consists in that it allows one to eliminate unknown parameters from the problem and to use the past lifetime data for planning future inspections as completely as possible.

The unbiasedness and minimum variance criteria, which are proposed in the paper for constructing the unbiased inspection strategy (UIS) and minimum variance inspection strategy (MVIS), respectively, represent the novelty of the work. It is clear that these inspection strategies, which have such properties as unbiasedness and minimum variance, are preferable as compared to the maximum likelihood inspection strategy (MLIS).

We have illustrated the technique of constructing inspection strategies for the exponential lifetime distribution. Application to other log-location-scale distributions could follow directly.

The results obtained in this work can be used to solve the service problems of the following important engineering structures:

(1) Transportation Systems and Vehicles – aircraft, space vehicles, trains, ships;

(2) Civil Structures − bridges, dams, tunnels;

(3) Power Generation – nuclear, fossil fuel and hydroelectric plants;

(4) High-Value Manufactured Products − launch systems, satellites, semiconductor and electronic equipment;

(5) Industrial Equipment − oil and gas exploration, production and processing equipment, chemical process facilities, pulp and paper.

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TO REDUCIBILITY OF DATABASE QUERIES OVER AN ORDERED DOMAIN

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In relational model of databases the state of a database is understood as a finite set of relations between elements. Names of relations and its arties are fixed and refer to *as the circuit of a database*. The separate information stored in the relations of the given circuit, refers to *as a state of a database*. Though relational databases have been thought up for finite data sets, it is frequently convenient to assume that there is an infinite *domain* – for example, the integer or rational numbers – so elements of the data get out of this domain.

Keywords: Database query, circularly ordered domain, o-minimality

1. Introduction

The signature of a relational structure L is non-empty set with the mapping assigning to each relational symbol in L the relation of the same arty over this set. Let M be an infinite structure of signature L. Here we consider circularly ordered structures. This means that L includes a ternary relational symbol K of which the interpretation in M satisfies to axioms of the circular order. We fix the circuit of database SC and enter the following notations:

$L_0 = \{K\}$, $L' = L_0 \cup SC$, $L'' = L \cup SC$.

A query of a database can be formally determined as a mapping which is accepted by the state of a database and it makes a new relation of fixed arty over M. We consider two languages for querying. Queries of the first language are formulas of signature L' – we name them by *limited*. Queries of the second language are formulas of signature L'' – we name them by *expanded*.

Here we study the problem of reducibility of expanded queries to limited ones over a circularly ordered domain.

2. Theory

Let $M = \langle M, =, < \rangle$ be a linear ordering. If we connect two endpoints of the linearly ordered set M (possibly, these are $-\infty$ and $+\infty$) then we obtain a circular ordering.

Definition 1. A *circular ordering* is described by a ternary relation K which satisfies to the following conditions:

(co1) $\forall x\ \forall y\ \forall z\ (K(x, y, z) \rightarrow K(y, z, x))$;
(co2) $\forall x\ \forall y\ \forall z\ (K(x, y, z) \wedge K(y, x, z) \leftrightarrow x = y \vee y = z \vee z = x)$;
(co3) $\forall x\ \forall y\ \forall z\ (K(x, y, z) \rightarrow \forall t\ [K(x, y, t) \vee K(t, y, z)])$;
(co4) $\forall x\ \forall y\ \forall z\ (K(x, y, z) \vee K(y, x, z))$.

In [1] we have proved reducibility of expanded queries to limited ones over an $\aleph_0$-categorical quite o-minimal domain. Here we prove reducibility of expanded queries to limited ones over a circularly ordered domain.

Recall the necessary definitions.

Definition 2. A k-ary query Θ is *locally generic over finite states* if $\overline{a} \in \Theta$ if and only if $\varphi(\overline{a}) \in \Theta(\varphi(s))$ for every partial < -isomorphism $\varphi: X \rightarrow M$, where $X \subseteq M$, for any finite state s over X and for any k-tuple $\overline{a}$ in X.

Definition 3. We will speak that a complete theory T has *the Property of Isolation* if there is a cardinal λ such that for any pseudo-finite set A and for any element $\overline{a}$ of a model of the theory T there exists $A_0 \subseteq A$ such that $|A_0| < \lambda$ and $tp(\overline{a} / A_0)$ isolates $tp(\overline{a} / A)$.

Definition 4. Let $A \subseteq M$ where M is a circularly ordered structure. The set A is *convex* if for any elements $a, b \in A$ the following holds: for any element $c \in M$ such that $K(a, c, b)$ we have that $c \in A$ or for any element $c \in M$ such that $K(b, c, a)$ we have $c \in A$.

Definition 5. Let A, B be convex disjoint subsets of a circularly ordered structure M. We say that A is the *immediate predecessor* of the set B (denote this by $A = IP(B)$) or B is the *immediate successor* of the set A (denote this by $B = IS(A)$) if for any $a \in A$, $b \in B$ and $c \in M$ such that $K(a, c, b)$ we have that $c \in A \cup B$.

Notation 6. (1) Let $M = \langle M, =, <, ... \rangle$ be a linearly ordered structure. We denote by $c(M)$ the structure $M^* = \langle M, =, K^3, ... \rangle$ in which the linear order $<$ is replaced by the ternary relation K^3 as follows:

For every $a, b, c \in M$ $K(a, b, c) \Leftrightarrow a \le b \le c \vee b \le c \le a \vee c \le a \le b$.

(2) Let $M_1, M_2, ..., M_m$ be linear orderings. If we replace $<$ by K^3 as above, we denote by $c(M_1, ..., M_m)$ the circularly ordered sum $M_1, ..., M_m$ such that for every $1 \le i \le m-1$ $M_i = IP(M_{i+1})$ and $M_m = IP(M_1)$.

(3) $K_0(x, y, z) := K(x, y, z) \wedge y \neq x \wedge y \neq z$.

Definition 7. Let $I \subseteq M$ where M is a circularly ordered structure. The set I is called an *open interval* if $I = \{c \in M: M \models K_0(a, c, b)\}$ for some elements $a, b \in M$.

If I is an open interval, we will sometimes write $I = (a, b)$ if we wish to show the endpoints of I. Similarly, we can define *closed, semi-open-semi-closed* and etc. *intervals* in M. By an *interval* in M we will understand any of the above called types of intervals in M. Obviously, both an interval and a singleton are convex sets.

The following notion has been originally introduced by H.D. Macpherson and Ch. Steinhorn in [2]. They have described circularly ordered groups that are circularly minimal.

Definition 8. [2] A circularly ordered structure $M = \langle M, =, K^3, ... \rangle$ is called *circularly minimal* if any definable (with parameters) subset of the structure M is a union of finitely many intervals and points in M.

Example 9. Let $G = \{z \in C \mid |z| = 1\}$, where C is the set of complex numbers. Consider the structure $G = \langle G, =, *, K^3 \rangle$, where $*$ is a binary operation being the multiplication on complex numbers.

Obviously, $\langle G, * \rangle$ is a group. It isn't difficult to prove that G is circularly minimal.

Example 10. Let $M = \langle c(\omega + \omega^*, Q, \omega + \omega^*, Q), =, K^3 \rangle$, where ω is the order of natural numbers, ω^* is the inverse order on natural numbers, and Q is the order of rational numbers.

Obviously that M is a circularly minimal structure. Denote the first elements of these two orderings that are equivalent to $\omega + \omega^*$ by a and c, and the last elements of these orderings by b and d. Consider the following formula:

$$\phi(x) := \forall y \ \forall z \ [K_0(y, x, z) \rightarrow \exists t_1 \ \exists t_2 \ (K_0(y, t_1, x) \wedge K_0(x, t_2, z))]. \quad (1)$$

Obviously that $\phi(x) \equiv (K_0(b, x, c) \vee K_0(d, x, a))$, i.e. $\phi(M)$ is a union of two open intervals, but we see that the endpoints of these intervals are not definable over $\varnothing$: $a, b, c, d \in acl(\varnothing) \setminus dcl(\varnothing)$. This is in contrast with the o-minimal case where $acl(A) = dcl(A)$ for all $A \subseteq M$.

The following notion has been introduced jointly with H.D. Macpherson:

Definition 11. A circularly ordered structure $M = \langle M, =, K^3, ... \rangle$ is called *weakly circularly minimal* if every definable (with parameters) subset of the structure M is a union of finitely many convex sets.

Weakly circularly minimal structures have been originally studied in [3].

Example 12. Let $M = \langle c(Q_1, Q_2, Q_3, Q_4), =, K^3, P^1 \rangle$, where Q_i is a copy of the ordering of rational numbers for each $i \le 4$, and $P(M) = Q_1 \cup Q_3$.

It can be proved that M is a weakly circularly minimal structure. It is easy to see that $P(M)$ is a union of two convex sets that are neither intervals nor points. Therefore, M is not circularly minimal.

We can also observe that $P(M)$ consists of two convex sets each of which is not $\varnothing$-definable. This contrasts with the weakly o-minimal case, where every parametrically definable set is a union of finitely many definable with the same parameters convex sets. Nevertheless we have the following:

Lemma 13. Let M be a weakly circularly minimal structure, $\phi(x)$ be an $\varnothing$-definable formula. Then for every $a \in M$ $\phi(M)$ is a union of finitely many $\{a\}$-definable convex sets.

Proof of Lemma 13. By weak circular minimality $\phi(M)$ is a union of finitely many convex sets $A^{\phi}_1, \ldots, A^{\phi}_s$.

Without loss of generality, take an arbitrary element $a \in A^{\phi}_1$ and consider the following formula:

$$\theta_1(x) : = \phi(x) \wedge [\forall y\,(K(a, y, x) \to \phi(y)) \vee \forall y\,(K(x, y, a) \to \phi(y))]. \quad (2)$$

Obviously that $\theta_1 (M) = A^{\phi}_1$. Further consider the following formula:

$$\theta_2(x) : = \phi(x) \wedge \neg\, \theta_1(x) \wedge \forall y\,[K(a, y, x) \wedge \neg\, \theta_1(y) \wedge \phi(y) \to \forall z\,(K(y, z, x) \to \phi(z))]. \quad (3)$$

Also obviously that $\theta_2 (M) = A^{\phi}_2$. It is easy to see that if we continue the present process then we can define all these convex sets over $\{a\}$.

Corollary 14. Let M be a weakly circularly minimal structure, $A \subseteq M$, $A \neq \varnothing$, $\phi(x)$ – A-definable formula. Then $\phi(M)$ is a union of finitely many A-definable convex sets.

Corollary 15. Let M be a weakly circularly minimal structure, $A \subseteq M$, $A \neq \varnothing$. Then $dcl(A) = acl(A)$.

Definition 16. Maximal consistent set of formulas with parameters of M of the form $K(a, y, b)$, where $a, b \in M$, in a circularly ordered structure M is called a *cut*.

We say that a cut is *algebraic* if there exists $a \in M$, which realizes it, i.e. the cut contains both $K(a, x, b)$ and $K(c, x, a)$ for some $b, c \in M$ that are distinct from a. Otherwise, such a cut is called *non-algebraic*.

Let $C(x)$ be a non-algebraic cut. If there exists some $a \in M$ such that either for every $b \in M$ $K(a,x,b) \in C(x)$ or for every $b \in M$ $K(b, x, a) \in C(x)$, then $C(x)$ is called *rational.* Otherwise, such a cut is called *irrational*.

In [4] a criterion for o-minimality of a linearly ordered structure in terms of cuts and 1-types is given, and in [5] a criterion for weak o-minimality of a linearly ordered structure in terms of realizations of 1-types has been obtained. Returning to Example 12, we see that the formula $\phi(x)$ is complete over $\varnothing$, i.e. it determines some 1-type $p \in S_1(\varnothing)$. Obviously that $p(M)$ is not convex. This is in contrast with the weakly o-minimal case where the set of realizations of every 1-type $p \in S_1(A)$ (where $A \subseteq M$) is convex in every elementary extension of model M. Nevertheless we can prove a weak version of Theorem 3.1 of [5].

Theorem 17. Let M be a circularly ordered structure. Then the following conditions are equivalent:

(1) M is weakly circularly minimal.

(2) For every nonempty $A \subseteq M$ the set of realizations of each complete 1-type over A is convex in any elementary extension of the structure M.

(3) The set of realization of each complete 1-type over M is convex in any elementary extension of the structure M.

Proof of Theorem 17. (1) $\Rightarrow$ (2). Let M be a weakly circularly minimal structure, $A \subseteq M$, $A \neq \varnothing$, $p \in S_1(A)$. Consider an arbitrary A-definable formula $\phi(x) \in p$. By Corollary 14 $\phi(M)$ is a union of finitely many A-definable convex sets $A^{\phi}_1, \ldots, A^{\phi}_s$, i.e. for every $1 \leq i \leq s$ there exists an A-definable formula $\phi_i(x)$ so that $\phi_i(M) = A^{\phi}_i$, i.e. $\phi(M) = \cup^{s}_{i=1} \phi_i(M)$ and $\phi_i(M) \cap \phi_j(M) = \varnothing$ for all $i, j \leq s$ with $i \neq j$.

Clearly that $\phi(x) \in p$ if and only if there exists a unique $i \in \{1, \ldots, s\}$ such that $\phi_i(x) \in p$.

Also clearly that $\phi_i(x)$ is a convex formula if and only if

$$M \models \forall x\ \forall y\ \forall z\,[\phi(x) \wedge \phi(y) \wedge \phi(z) \wedge K(x, y, z) \to \forall t\,(K(x, t, y) \vee K(y, t, z) \to \phi(t))], \quad (4)$$

i.e. the present property is elementary, and therefore it holds in any elementary extension.

(2) $\Rightarrow$ (3). It is obvious.

(3) $\Rightarrow$ (1). Firstly we prove the following lemma:

Lemma 18. Let M be a circularly ordered structure. Suppose that the set of realizations of each 1-type $p \in S_1(M)$ is convex in any elementary extension of the structure M. Then for every cut C in M there exists no more than two complete 1-types over M extending C.

Proof of Lemma 18. We consider an arbitrary cut $C(x)$ in M and show that it has no more than two extensions. If the cut $C(x)$ is algebraic then obviously that such cut is extended by a unique way to a principal type over M, therefore we don't consider such cuts.

Since $C(x)$ is a locally consistent set of formulas, there exists a 1-type $p \in S_1(M)$ which extends it. We have only the following cases:

Case 1. There exist a formula $\phi(x) \in p$ and $a, b \in M$ such that $K(a, x, b) \in C(x)$ and for every $a' \in M$ if $M \models K(a, a', b)$ and $K(a', x, b) \in C(x)$, we have $M \models \neg \phi(a')$.
Case 2. There exist a formula $\phi(x) \in p$ and $a, b \in M$ such that $K(a, x, b) \in C(x)$ and for every $b' \in M$ if $M \models K(a, b', b)$ and $K(a, x, b') \in C(x)$, we have $M \models \neg \phi(b')$.
Case 3. For every formula $\phi(x) \in p$ and for every $a, b \in M$ if $K(a, x, b) \in C(x)$ then there exist $a', b' \in M$ such that $K(a', x, b), K(a, x, b') \in C(x)$ and $M \models K(a, a', b) \wedge K(a, b', b) \wedge \phi(a') \wedge \phi(b')$.
Case 1. Consider the following formula:

$$\psi(x) := K(a, x, b) \wedge \phi(x) \wedge \forall y\,[K(a, y, x) \wedge \phi(y) \rightarrow \forall z\,[K(y, z, x) \rightarrow \phi(z)]]. \tag{5}$$

Clearly that if $\psi(M) \neq \varnothing$, we have

$$M \models \forall y\,[\psi(y) \rightarrow \forall z\,[K(a, z, y) \wedge \phi(z) \rightarrow \psi(z)]]. \tag{6}$$

Suppose that $\psi(M) = \varnothing$. Consequently $\neg \psi(M) = M$ and

$$\neg \psi(x) \equiv (K(a, x, b) \wedge \phi(x)) \rightarrow \exists y\, \exists z\,[K(a, y, x) \wedge K(y, z, x) \wedge \phi(y) \wedge \neg \phi(z)]. \tag{7}$$

We have:

$$M \models \forall x\,[(K(a, x, b) \wedge \phi(x)) \rightarrow \exists y\, \exists z\,[K(a, y, x) \wedge K(y, z, x) \wedge \phi(y) \wedge \neg \phi(z)]]. \tag{8}$$

Then consider the following set of formulas:

$$p(y) \cup p(x) \cup \{K(y, z, x)\} \cup \{\neg \phi(z)\}\ (*). \tag{9}$$

The set (*) is not locally consistent, as otherwise the set of realizations of the type p in some elementary extension of the structure M were not convex, contradicting the hypotheses of the lemma. Consequently, there exist $\phi_0(y) \in p(y)$, $\phi_1(x) \in p(x)$ such that

$$M \models \neg\,[\exists y\, \exists z\, \exists x\,(\phi_0(y) \wedge \phi_1(x) \wedge K(a, x, b) \wedge K(a, y, x) \wedge K(y, z, x) \wedge \phi(y) \wedge \neg \phi(z) \wedge \phi(x))]. \tag{10}$$

Consequently,

$$M \models \forall y\ \forall x\,[K(a, x, b) \wedge K(a, y, x) \wedge \phi(y) \wedge \phi(x) \wedge \phi_0(y) \wedge \phi_1(x) \rightarrow \forall z\,(K(y, z, x) \rightarrow \phi(z))]. \tag{11}$$

Let $\mu(x) := \phi_0(x) \wedge \phi_1(x) \wedge K(a, x, b) \wedge \phi(x)$.
Since $\phi_0(x), \phi_1(x), K(a, x, b), \phi(x) \in p$, we have that $\mu(x) \in p$ and

$$M \models \forall y\ \forall x\,[\mu(x) \wedge \mu(y) \wedge K(a, y, x) \rightarrow \forall z\,(K(y, z, x) \rightarrow \phi(z))]. \tag{12}$$

Consequently, $\psi(M) \neq \varnothing$. Then $\psi(x) \in p$. We assert that $C(x) \cup \{\psi(x)\}$ determines the type p. Assume the contrary: suppose that there exists a formula $\theta(x)$ such that

$C(x) \cup \{\psi(x)\} \cup \{\theta(x)\}$ is consistent and $C(x) \cup \{\psi(x)\} \cup \{\neg \theta(x)\}$ is consistent.

Without loss of generality, suppose that $\theta(x) \in p$. Consequently, $\psi(x) \wedge \theta(x) \in p$ and we have

$$M \models \forall x\,(\psi(x) \wedge \theta(x) \rightarrow \exists y[K(a, y, x) \wedge \psi(y) \wedge \neg \theta(y)]). \tag{13}$$

Then the following set of formulas is locally consistent:

$$p(x) \cup p(z) \cup \{K(x, y, z)\} \cup \{\neg\, \theta(y)\}. \tag{14}$$

Then the set of realizations of the type p in some elementary extension of the structure M is not convex, contradicting the hypotheses of the lemma. Therefore $C(x) \cup \{\psi(x)\}$ determines the type p.

Similarly it can be showed that $C(x) \cup \{\neg\, \psi(x)\}$ has a unique complete 1-type over M which extends it.

Thus, in Case 1 $C(x)$ has at most two complete 1-types over M extending it.

Case 2. This case is considered by analogy with Case 1, and also as in Case 1 $C(x)$ has at most two complete 1-types over M extending it.

Case 3. In this case we assert that for every formula $\phi(x) \in p$ there exist $a, b \in M$ such that $K(a, x, b) \in C(x)$ and $M \models \forall x\, (K(a, x, b) \rightarrow \phi(x))$, and consequently $C(x)$ determines a unique 1-type over M, namely the type p.

Assume the contrary: there exists a formula $\phi(x) \in p$ such that for any $a, b \in M$ such that $K(a, x, b) \in C(x)$ there is $a' \in M$ such that $K(a', x, b) \in C(x)$ and $M \models \neg\, \phi(a')$ or there exists $b' \in M$ such that $K(a, x, b') \in C(x)$ and $M \models \neg\, \phi(b')$.

Then the following set of formulas is locally consistent:

$$p(x) \cup p(z) \cup \{K(x, y, z)\} \cup \{\neg\, \phi(y)\}. \tag{15}$$

This contradicts the hypotheses of the lemma, and therefore the lemma has been proved.

Return to the proof of Theorem 17, (3) $\Rightarrow$ (1).

Let $\phi(x)$ be an arbitrary formula with parameters of M. We need to prove that $\{b \in M: M \models \phi(b)\}$ is a union of finitely many convex sets in M. Assume the contrary: suppose that $\phi(M)$ is a union of infinitely many convex sets in M. Then the formula $\phi(x)$ partitions M into infinitely many convex sets so that for every such convex set U either for all $c \in U$ $\phi(c)$ holds, or for all $c \in U$ $\neg\, \phi\,(c)$ holds. If the set of all such convex sets is discretely ordered then there exists an infinite sequence of such convex sets ordered by the type ω or ω^*. Without loss of generality, suppose the first, and let $\{U_i \mid i < \omega\}$ be such a sequence. Then consider the following cut:

$$C(x) := \{K(a, x, c) \mid \text{there is } i < \omega \text{ such that } (\exists\, b \in U_i)\, K(a, b, c)\} \cup \\ \cup \{K(a, x, c) \mid \text{for all } i < \omega\, (\forall\, b \in U_i)\, K(a, b, c)\}. \tag{16}$$

If the set of all such convex sets is not discretely ordered then there exists a convex set U which has neither the immediate successor nor the immediate predecessor. Without loss of generality, suppose the first. Then consider the following cut:

$$C(x) := \{K(a, x, c) \mid \text{there exists } b \in U \text{ such that } K(a, b, c)\} \cup \{K(a, x, c) \mid \text{for all } b \in U\, K(a, b, c)\}. \tag{17}$$

Clearly that in all theses cases both $C(x) \cup \{\phi(x)\}$ and $C(x) \cup \{\neg\, \phi(x)\}$ are consistent.

By Lemma 18 each of these extensions is extended to a complete type over M by a unique way. Consider the following set of formulas:

$$C(x) \cup C(y) \cup C(z) \cup \{\phi(x)\} \cup \{\neg\, \phi(y)\} \cup \{\phi(z)\} \cup \{K(x, y, z)\}. \tag{18}$$

Obviously that this set of formulas is consistent. Then there exists an elementary extension N of the structure M, in which a 3-type over M extending this set of formulas is realized. Then we obtain that there exists a 1-type over M extending $C(x) \cup \{\phi(x)\}$, and the sets of realizations of this type in N is not convex. This contradicts the hypothesis of the theorem.

The following corollary is a characterization of circular minimality of a circularly ordered structure in terms of cuts and 1-types:

Corollary 19. Let M be a circularly ordered structure. Then M is circularly minimal if and only if for every cut in M there exists a unique complete 1-type over M that extends it.

Theorem 20. Let T be a circularly minimal theory. Then T has the Isolation Property.

Corollary 21. Let T be a circularly minimal theory. Then every expanded query being locally generic over finite states is equivalent to a limited query.

Thus, we conclude that if we consider a circularly minimal domain of databases then locally generic queries in an expanded language can be expressed by queries of databases in limited language.

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DATABASE DESIGN FOR EDUCATIONAL ORGANIZATION

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Database systems are complicated software systems, and, for that reason, they especially need to be carefully designed before they are implemented. This article outlines the process of designing both the application programs and the database that stores the data. On the one hand, application design involves designing transactions and designing user interfaces. Database design, on the other hand, proceeds from constructing a conceptual design, which is then used in a process called logical design to create a conceptual schema that, if good enough, will be implemented and stored in the database system catalogue.

In this article we have considered the *Entity-Relationship* (*ER)* model, which is the consensus choice for use in conceptual database design.

Keywords: database, primary key, weak, entity, strong, attributes, single valued, composite, ID

1. Introduction

The main goal of this research is the implementation of Database Design for University or educational organization. In this project we have selected 6 entity types.

Relationships:

1) Teach: <Teacher, student> 1: N
2) Study: <student, subject> 1:1
3) Learn in: <student, group> 1:N
4) Have: <specialities, subject> 1:N
5) Belongs: <student, specialities> 1:1
6) Member: <student, community> 1:N

We can translate an ER schema to a relational schema by following a nine-step algorithm based on the one given in Elmasri and Navathe 1994. The algorithm attempts to minimize the need for joins and NULL values when defining relations (6 steps). The Database Design for University Project is a Java-based Web application implemented using Java Server Pages, Java Servlets, and JavaBeans. In the project, the view is implemented using Java Server Pages; all elements of the view are implemented in files ending with the extension *.jsp*. The controller is implemented using Java Servlets; all controller servlets are implemented in files with names like **Controller*.java. The model is implemented using JavaBeans. Requests made by users are always sent from the JSPs (view) to the Servlets (controller) which performs operations on the database using the JavaBeans (model). Any changes in the state of the model are returned to the view using the JavaBeans. The University Project is designed to run with PostgreSQL as the DBMS [1].

2. Model

The *Entity-Relationship* or *ER* model (P. Chen 1976) is the consensus choice for use in conceptual database design. Whenever it is necessary to distinguish the basic ER model from its extension, we refer to the latter as the *Enhanced-ER* or *EER* model. The ER model provides a semi-formal notation that allows designers to create a high-level conceptual schema; that is, an abstract implementation that is a complete—and independent—description of the structure of a database. The ER model is based on an Aristotelian classification, distinguishing things into *entities*, their *attributes* (properties), and their *relationships* with other entities. An *entity* is an object in the real world that is uniquely identifiable and has independent existence. The specification of the entities is simplified by grouping them. Entities having the same properties are grouped together to form an *entity type*. A *relationship* is a meaningful association between two or more entities (Figure 1).

Entity type:

1. Teacher weak
2. Student weak
3. Subject weak
4. Specialities weak
5. Community strong
6. Group strong

Attributes:

Teacher:

teacher's_ID – single-valued, simple, Primary Key
name – multi-valued, composite
position – multi-valued, composite
background – multi-valued, composite
e-mail – single
phone number – single
address – multi-valued, composite
teacher's hours – single
social status – single
tutor – single

Student:

Student's ID – single-valued, simple, Primary Key
Name – multi-valued, composite

Subject:

Subject ID – single-valued, simple, Primary Key
Name – multi-valued, composite
Description – multi-valued, composite

Specialities:

ID – single-valued, simple, Primary Key
Name – multi-valued, composite
Description – multi-valued, composite

Group:

Name – single-valued, simple, Primary Key

Community:

Name – single-valued, simple, Primary Key

Relationships:

1) teach: <Teacher, student> 1:N
2) study: <student, subject> 1:1
3) learn in: <student, group> 1:N
4) have: <specialities, subject> 1:N

Mapping

Step 1:

For each strong entity, create a new table. Identify the primary key and the alternate key.

Strong Entities:

Community (Name)

PK: name;

GROUP (NAME)

PK: NAME

STEP 2:

For each weak entity W that is associated with only one 1:1 identifying owner relationship.

STUDENT AND SUBJECT HAVE RELATIONSHIP 1:1,

SUBJECT(SUBJECTID, NAME, DESCRIPTION)

PK: SUBJECTID

Step 3:

For each weak entity W that is associated with a 1:N or M:N identifying relationship, or participates in more than one relationship:

TEACHER AND STUDENT HAVE RELATION 1:N,

TEACHER(TEACHER'SID, NAME, POSITION, BACKGROUND, E-MAIL, PHONENUMBER, ADDRESS, TEACHER'SHOURS, SOCIALSTATUS, TUTOR)

PK: TEACHER'SID;

STUDENT AND GROUP HAVE RELATION: 1:N,

STUDENT(STUDENTID, NAME)

PK: STUDENTID;

SPECIALITIES AND SUBJECT HAVE RELATION: 1:N,

SPECIALITIES(ID, NAME, DESCRIPTION)

PK: ID;

STEP 4:

FOR THE BINARY 1:1 RELATIONSHIP BETWEEN STUDENT AND SUBJECT

Student(StudentID, Name)

PK: StudentID;

FK: SubjectID references Subject;

Step 5:

For the binary 1:N relationship between Teacher and Student:

Teacher(Teacher'sID, Name, Position, Background, e-mail, PhoneNumber, Address, Teacher'sHours, SocialStatus, Tutor)

PK: Teacher'sID;

FK: StudentID references Student;

Student and Group:

Student(StudentID, Name)

PK: StudentID;

FK: Name references Group;

Specialities and Subject:

Specialities(ID, Name, Description)

PK: Name

FK: SubjectID references Subject;

Step 6:

For each N-ary relationship (including binary N:M relationship) R. We haven't that relationship.

Result:

Teacher(Teacher'sID, Name, Position, Background, e-mail, PhoneNumber, Address, Teacher'sHours, SocialStatus, Tutor)

PK: Teacher'sID;

FK: StudentID references Student;

Student(StudentID, Name)

PK: StudentID;

FK: SubjectID references Subject;

FK: Name references Group;

Subject(SubjectID, Name, Description)

PK: SubjectID

Specialities(ID, Name, Description)

PK: ID;

FK: SubjectID references Subject;

Community (Name)

PK: name;

Group (Name)

PK: Name

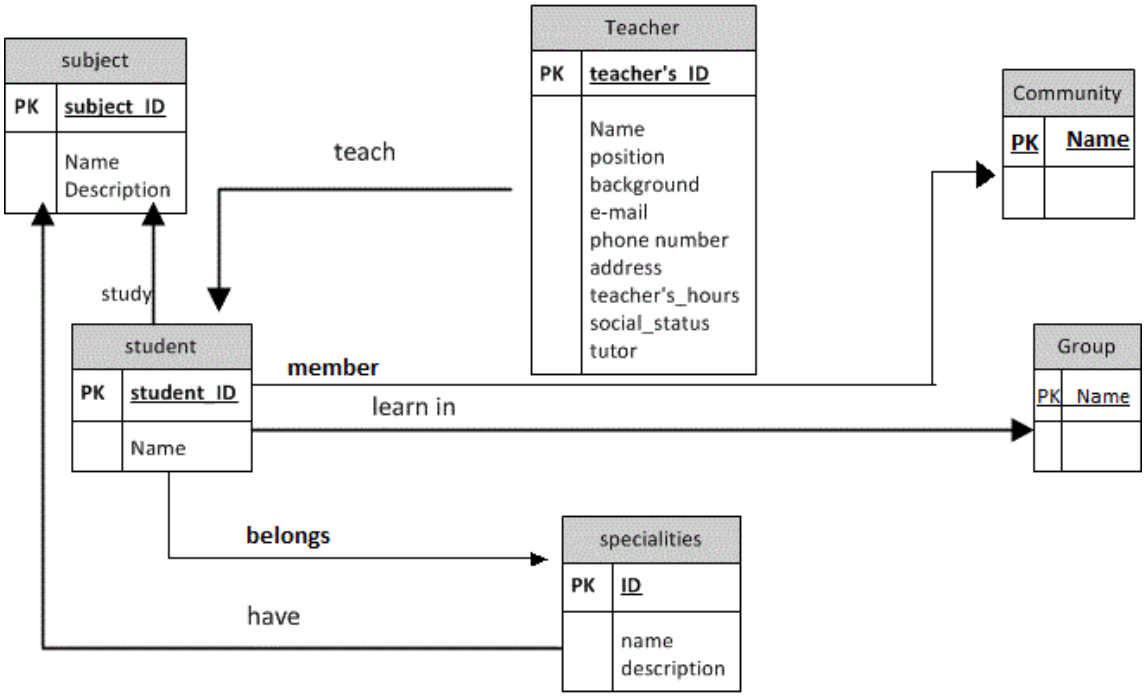

Figure 1. ER diagram for educational organization

Database design is the activity of specifying the schema of a database in a given data model. Recall that a schema defines the data types, relationships, and integrity constraints on the data.

In the past, database design used to involve three main phases: conceptual design, logical design, and physical design. The physical design produces both the internal schema, which describes the physical storage structure of the database, and the access methods, which achieve efficient access to the data.

3. Conclusions

Nowadays, most existing DBMSs use fixed physical designs, automatically select the best possible access paths, and in general attempt to minimize manual tuning. Consequently, our emphasis is on the first two phases — conceptual and logical design [2].

One of the greatest benefits of databases is that data can be shared or secured among users or applications. There is more control and accountability over how the data is managed because the data all resides in one database. Requirements specification -> Analysis -> Conceptual design -> Implementation Design-> Physical Schema Design and Optimisation [3].

In conclusion, the most important need of information of the university – the creation of a unified database, when students can see their estimates, choose subjects and other advantages of credit system of education.

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SOME ASPECTS OF DEVELOPMENT OF WEB TOOLS FOR DISTANCE LEARNING OF FOREIGN LANGUAGES DATABASE DESIGN FOR EDUCATIONAL ORGANIZATION

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People whose native language is based on Cyrillic alphabet constantly meet the same words but written differently in Latin letters. On the other hand person who uses Roman alphabet in writing can't read and learn some new languages just because he doesn't know target ABC.

The first case is clear and comes from IT, because ASCII doesn't support national alphabets and UTF-8 has come too late, when users have had a hard time with mojibake texts. One more reason is the SMS, because 2-byte coding allows sending only 70 national characters, but it could be 160 chars in pure Latin. This texting habit is ineradicable because it is a cheaper and reasonable way of communication; we just need systematization and accustomization to certain transliteration rules – that is one of the duties of the WEB-service.

The second point is to provide the great assistance to people, who learn Kazakh and Russian. Database contains "frequency dictionary" in pictures and you memorize words much faster because you "see" these words and into the bargain you type it. It is a good visualization of items and quite innovative method of new words memorization.

Finally, there should be realized such functionality, which exists in every touch-typing program or WEB-site e.g. measuring typing speed, accuracy, tempo, and so on. The reason is that there exists direct correlation between learning and speed of character input, in our case typing memorizable word and memorization of target keyboard layout, in the long run the user should know how fast he is in typing.

Keywords: typing, touch typing, e-learning, foreign languages, problem of Latin alphabet, Roman ABC, Cyrillic alphabet, memorization of words

1. Introduction

There are a lot of sites with similar subject matter, but all of them are just for increasing typing speed, learning touch-typing and measuring typing speed. Here it is additional functionality, but the main goal is to create and give such method of fast and long-term memorizing of foreign words, which will be open and available to everyone all over the world.

The main goal of this study is the implementation of really helpful WEB-tool for language learning and introduction proper order in appliance of Latin alphabet instead of Cyrillic and vice versa.

As result of painstaking analysis of similar systems there was chosen several the most popular sites. According to target market study and examination of functionality of each website we can name 3 of them. They are http://www.typeracer.com, http://www.klavogonki.ru и http://www.gotowords.com/

TypeRacer is a multiplayer online browser-based typing game.

TypeRacer was launched in March 2008, and claims to be the first multiplayer typing game on the web. Site users compete by racing miniature cars that advance as the user's type short passages of 20 to 100 words. Accuracy is required; any typing errors in words have to be fixed before continuing with the race. The typing passages come from popular songs, movies and books and can be contributed by users.

TypeRacer was created by programmer Alex Epshteyn, working on his own, using the OpenSocial API and the Google Web Toolkit.

Klavogonki.ru – online web-based keyboard trainer, game played around a car theme. Site helps to improve typing skills. There exists 154 480 registered users. Site offers 3 type of racing:

Quick Start – competition with random racer

Choose a track – list of available tracks in current time

Create your own track – The name speaks for itself, but this option is available only for registered users.

Figure 1. Example of word visualization for easier memorization

Gotowords is the web-site for improvement of the English language. Similarity is enclosed in possibility of typing definite words, listening their sounding and memorization of correct spelling of them. List of words is very poor for the time being and it is formed out of the read out news of Voice of America radio channel. Also the content is filled from VOA's website. We can observe a good realization, correct pronunciation, but lack of visualization and graphic representation of these words.

Developing solution should be able to eliminate shortcomings, observable on other sites and make up a deficiency in technologies.

2. Project Actuality

As we mentioned before the project of realization of this thematic site is a partial solution of a burning linguistic problem. The project is feasible because there are at least 5–6 thousand languages on the Earth. Most of the terrestrials speak on 80 languages and we will eternally learn languages of neighbour countries, business partners, TV-show producers, classical literature, we will try to understand languages of up-to-the-date scientific researches. We can easily extrapolate the given learning technique on other languages. Right now WEB-portal provides an opportunity to start foreign language learning without knowledge of target alphabet, but understanding of pronunciation of 26 English letters and their collocations. Under foreign language I assume Kazakh but in foreseeable future we can offer such methodology for other Cyrillic-based languages. Also it is applicable to Latin-based languages but now it seems to be unpopular and excessive because most of learners know Roman ABC.

The field of application is very wide. It is even broader for touch-typing section because every PC user who uses a keyboard, every governmental structure and private business could use this system for evaluation of typing skills of secretaries and people who receives data and inputs them with the keyboard. At first site it seems that 9 specific Kazakh letters don't make any sense, but because of them, the upper-row of the keyboard and comma/dot are rearranged. So there is no any possibility to check typing speed on Kazakh language and it is not a fact that typing speed in Russian just *slightly* beyond typing speed in Kazakh. You must admit that every person in your milieu pressed the button at least once and the question is HOW to press. The developed system will reduce the wasting of time on "hunt&peck", increase productivity of typists and raise the accuracy of typing.

Nevertheless the really unique actuality is hidden in a word memorization part because we have never met such system before. There are approximately 6 million people inside of KZ whose duty to get knowledge of the Kazakh language marginally on elementary level. And, of course, each of us wants to improve his English, better speaking skills, enlarge vocabulary and memorize English keyboard layout.

3. Project Novelty

Project innovation is contained in specific word memorization means, local market orientation and consists in the method of realization. There were a lot of different solutions and the majority of them did not offer other functionality except for touch-typing. All of them played around auto racing theme but our country is fond of horse races that is why I chose exactly this national colouring.

It is proven that we memorize better if more stimulus applied on a greater amount of our receptors. It is the reason why we moved away from simple observation of unknown word to typing it and doing other activities with it. Rote or mechanical memory is trained through the tactile sense / sense of touch. We would be glad to add 5 senses and actually we even tried to create a possibility of use of 6^{th} sense – intuition besides actively used eyesight and hearing. When learner sees only a picture and number of letters in it ****** (7), he tries to guess, applies thinking, involves brain, sets his mind on a picture. Of course forgotten/learned ration approaches to zero. Probably in remote futurity web-site will be able to give an opportunity to user to catch the smell of word but the current project is not aimed on it. The next step will be uttering of every word during its appearance because psychologists proved that some people adopt auditory information even better than visual, in any case pronunciation should be trained on level with reading.

4. Problem Statement

The problem as whole is minutely outlined in previous sections and here we will discuss issues arisen during the implementation of an idea. Also we will take a look on some ambiguous aspects undiscovered on initial stage.

Site should be based on component structure, which will provide maximum flexibility and allow, if necessary, to apply the existing standard solutions.

It is preferable to use some kind of framework like CodeIgniter based on popular Model-View-Controller development pattern.

Baiga.de should be implemented in client-server architecture with the use of Internet-technologies. Web-portal includes 3 components:

- Database Server;
- WEB-server;
- Client.

Client workstations must be implemented as a WEB interface. Client workstation accesses to the WEB server (application server) via WEB browser.

The whole site will play around a horse race, galloping theme and in the wake will have proper design. Index page of the site should look like epodrom. Lots of horses and style like you are situated on “jailau”. Header of the page should be unpretentious, but visible enough to change interface language.

The site will not store a lot of private information nevertheless there will be realized protection from XSS and SQL-injection by means of CodeIgniter framework. Moreover we will implement user password hiding in salted MD5-hash.

As it was said before the screen of ‘words’ page should look like on the Figure 2. It is a pure HTML with the appearance defined by CSS.

Undoubtedly the pages should be interactive otherwise it will be boring for a user if there is no any response to his actions. The system should warn about user’s typos, help in case of absence an idea about drawing and so on. Here JavaScript stretches out a helping hand to a user, but pure JavaScript starts to glitch after 30 wpm. That is why jQuery library was chosen as responsible for interactivity.

Figure 2. Making a mistake in a word definition

Complete reloading of the 'words' page every time will weary user. AJAX relieves us because partial automatic update of the page after completion of the word is in its duty. $.post on the client side and json_encode on the server side will provide such functionality.

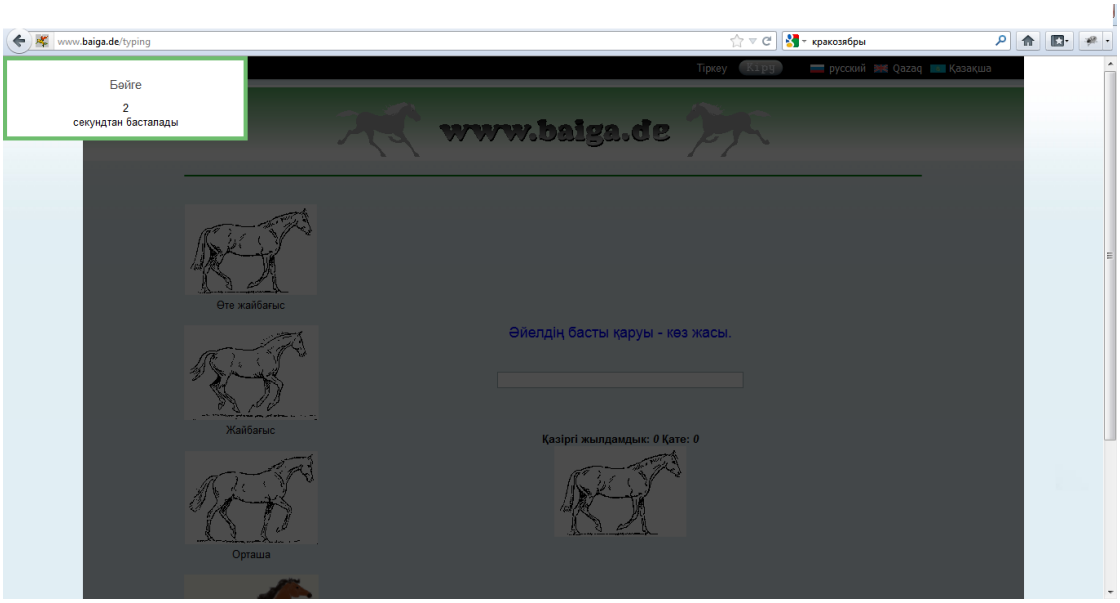

Figure 3. Typing page with a 3-seconds pop-up

Typing page randomly chooses one quote from database and offers it to user.

Also method realized in such way as it is possible to retrieve the page with exact quote. This feature helps to create full sitemap.xml and rapidly crawl the web-site by web-spiders.

Typing page should allow user to concentrate. It is possible through the small 3 second delay before typing. Quote will be typed word by word and copy-pasting will be prevented. Also input line should be inactive during first seconds delay.

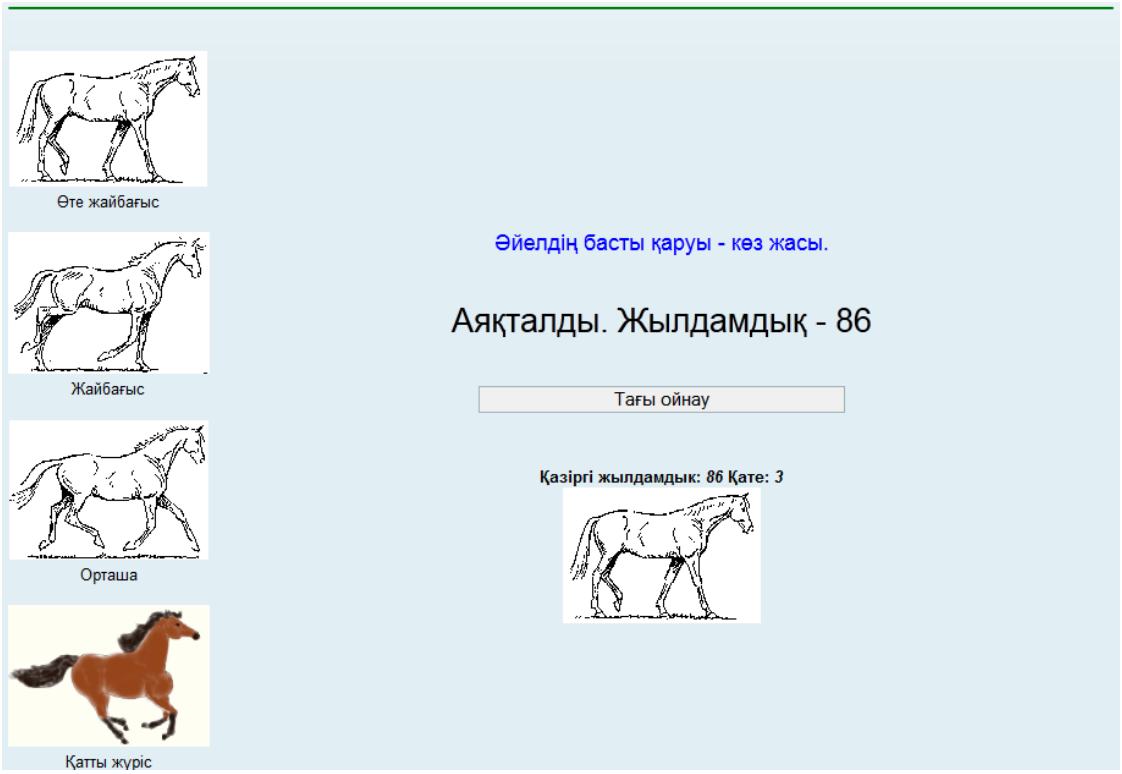

Figure 4. Pioneering invention: Measure typing speed in Kazakh Language

It is clear that we have overcame multitude of different problems connected with database design, virtualhosts, friendly URLs, .htaccess and mod_rewrite but solution of these questions is not unique and doesn't claim to be presented.

5. Produced Results

The main result of accomplished work is the analysis of existing systems, design of unique KazNet-oriented typing WEB-portal and its implementation. Requirements for a project were defined and analysis of similar systems was carried out. Also Business-logic was developed by means of PHP language, jQuery library and MySQL DBMS, as well design were implemented in HTML and CSS. Also the captivating name was chosen for the portal, we set our choice on BAIGA because it means a horse race and spirit of competition lives in everybody. We made comparative analysis of KZ domain name registrars, went over the list of delicious names but most of them was occupied in .KZ TLD. Finally we bought http://www.baiga.de what means "Say Baiga" in Kazakh language. For domain purchase in .de TLD required a registrar with Trustee service or Local presence service, which enables to register domains in domain zones, where domain owners' presence in countries of domain zones is required. At the beginning we deployed the project on the VPS, made a customization of Linux Debian 5.0 Lenny preset, after some time migrated on shared hosting due to the rising of prices of hosting provider and recalculation of estimated load.

Mockups of the following web-pages were developed and their basic functionality was realized:

- http://www.baiga.de/kz/typingwords/2 is the most innovative part, because memorization of word occurs as the result of typing it. User just sees an image of definite word but instead of letters he sees asterisks and their number ******* (7). If mistake takes a place then 1st character opens, after that the second one, and so on. In perspective there will be added uttering of every word.
- http://www.baiga.de/en/typingwords is the section where foreigner learns Kazakh words without knowing Cyrillic alphabet. Sure it will be much easier for sophisticated users because there are means for direct typing of Russian and Kazakh texts in appropriate ABC.

- http://www.baiga.de/en/typing/2 is the page for habituation of Kazakhstan people to proper transliteration rules and measuring typing speed by English letters. This component is mostly oriented on youth, who get accustomed to carry on a correspondence in transliterated way. Such users should know in what extent they are faster in transliterating typing than in typing in appropriate alphabetical system.
- http://www.baiga.de/kz/typing/3 is the standard functional such as typing speed. In this partition we can see social load of the project because person enriches himself through the typing of wise proverbs, truthful proverbs and sayings of Great men.

6. Conclusions

The developed system will reduce the wasting of time on "hunt&peck", partially release the load on wrist and decrease the number of occurrence of "carpal tunnel syndrome", increase productivity of typists and raise the accuracy of typing. By means of this method any user can enlarge his vocabulary, foreigner will learn a lot of Russian and Kazakh words without knowing of alphabet and Cyrillic-aware person will do it even faster. We think that the project has a real chance to life because it is an educational web-portal. The great advantages of this site are three language interface, location on Kazakhstan's servers and national colouring in design. Moreover WEB-portal could satisfy needs of Kazakh and Russian Language learners as inside of the country as foreigners. Educational web-sites have a green light everywhere.

All what we need is to make a better design, fill portal with an appropriate content, attract a lot of people and start to bring a benefit to all and each...

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CREATION OF GRAPHS OF FUNCTIONS WITH USE OF THEOREMS OF ELEMENTARY GEOMETRY

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The solution of tasks with use of compasses and a ruler is one of the most ancient ways of the solution of geometrical tasks. "Great problems of an antiquity" belong to such tasks. Not all tasks can be solved with use of the set tools. Often at mathematics lessons at school pupils ask to the teacher a question: why this or that theorem is necessary and where it can be used? Not always the teacher finds the convincing answer. However many theorems can be applied not only in a school course of mathematics.

If there is given a function $f(x)$ which is defined graphically then it is possible to draw a graph of a function $\frac{1}{f^2(x)}$ and a graph of a function $\frac{1}{\sqrt{f(x)}}$ in a coordinate system where the length of one unit is given. This can be proven using a theorem typically used in school – altitude-catheter projections theorem.

Methods of using right triangles to draw graphs of the functions $\frac{1}{\sqrt{f(x)}}$, $\frac{1}{f^2(x)}$, $\sqrt{f(x)}$, $f^2(x)$ will be explained.

Keywords: rectangular triangle, similarity of figures, average proportional

1. Introduction

Among theorems of school geometry one of the main places is occupied by Pythagoras theorem and the conclusions following from it. Signs of similarity of rectangular triangles and possibility of finding of elements of these triangles are such. So, if from top of a right angle in a rectangular triangle on a hypotenuse the perpendicular is lowered, the length of this perpendicular is an average geometrical between hypotenuse pieces into which it is divided. The theorems connected with circles are proved also. So, if from a point out of a circle to a circle are carried out a tangent and a secant, the square of a tangent is equal to work of a secant on her external part.

2. Creation of Graphics of Inverse Proportional Relationship and Averages Proportional

Let's address to one of school theorems of the geometry relating to a plane. Let the rectangular triangle ACB from which top C on a hypotenuse the height is carried out is h set (Figure 2.1).

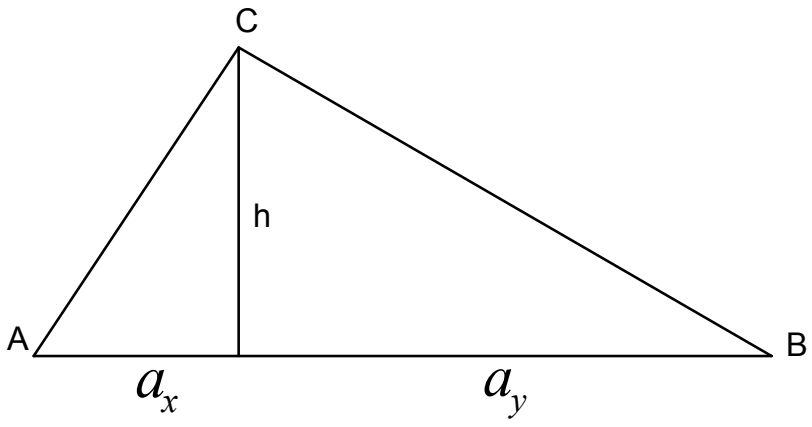

Figure 2.1

The hypotenuse is divided into a_x, a_y pieces. It is $h^2 = a_x a_y$. Let the height h is 1. Then $a_x a_y = 1 \Rightarrow a_y = \frac{1}{a_x}$. So, if in a rectangular triangle the height is 1, Npieces of a hypotenuse are inversely proportional. Let's apply this theorem to creation of the graphic of function $y = \frac{1}{f(x)}$ if the function $y = f(x)$ graphic is set, a unity and compasses and a ruler are used only (Figure 2.2).

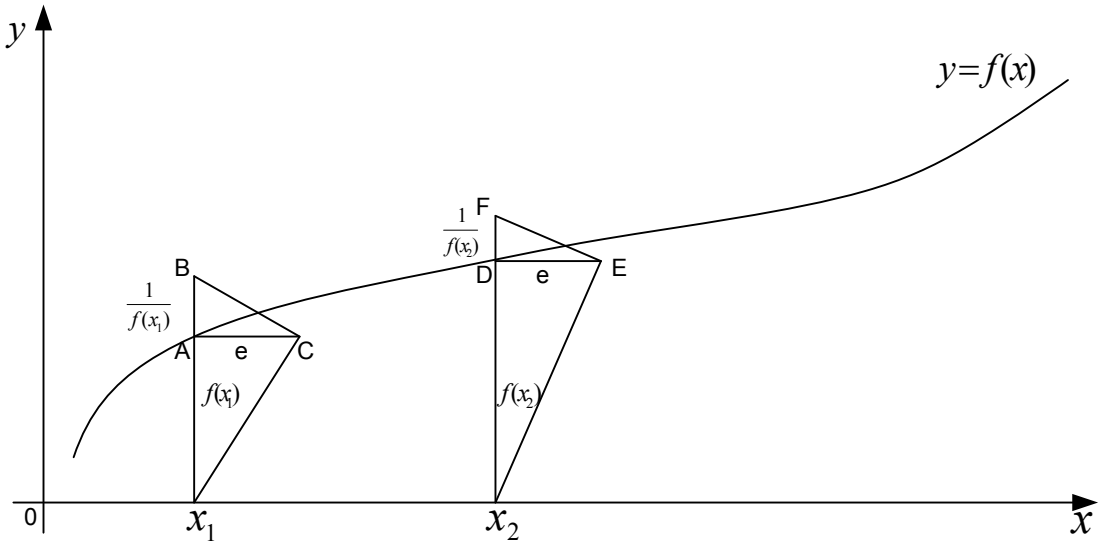

Figure 2.2

In each point of the set graphic of function $y = f(x)$ In each point of the set graphics of function $y = f(x)$ design rectangular triangles $x_1CB, x_2EF, \ldots$, in which heights $AC = 1, DE = 1, \ldots$ Then $AB, DE, \ldots$ pieces are automatically equal to values of required function. Them postpone from points $x_1, x_2, \ldots$, and then connect.

Let's consider one more school theorem (Figure 2.3).

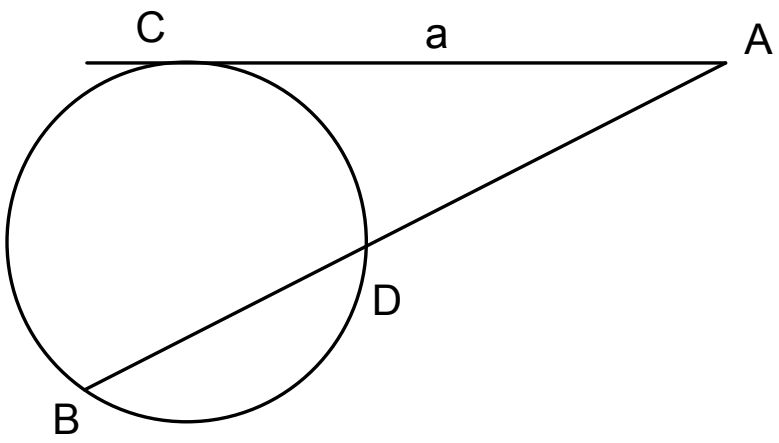

Figure 2.3

Let from A point out of a circle to this circle are carried out a tangent of AC and a secant AB. Then the square of a tangent of AC is equal to work of a secant of AB on its external part of AD. If it will appear that an external part of $AD = 1$, then $AC^2 = AB$ and $AC = \sqrt{AB}$. We use this theorem for creation of the graphics of function $y = \sqrt{f(x)}$ if the function $y = f(x)$ graphic is known is unity piece compasses and a ruler is set (Figure 2.4).

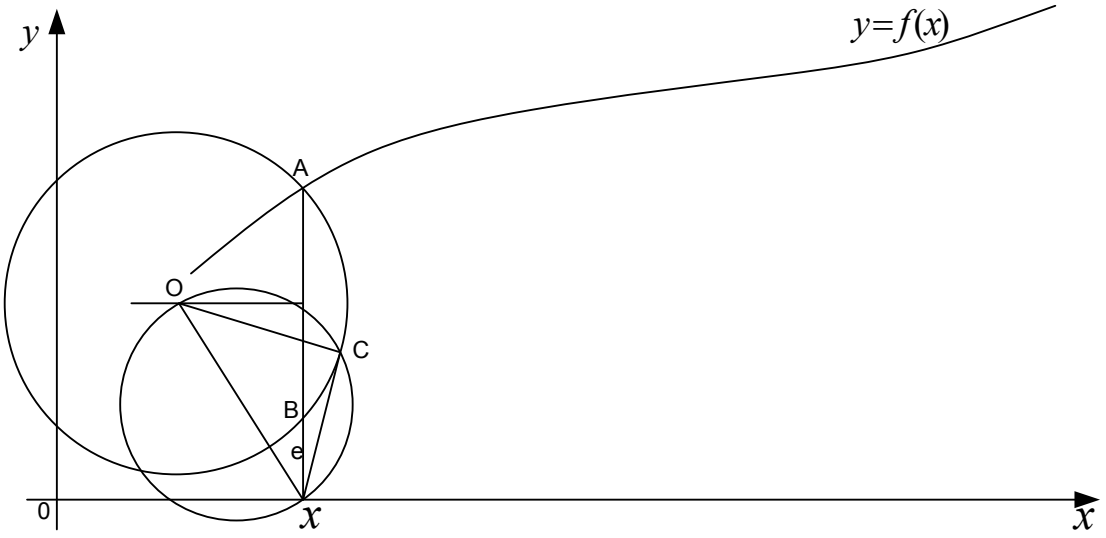

Figure 2.4

In a point x: $Ax = f(x)$. Let's find $\sqrt{f(x)}$ in this point. From a x point we postpone $xB = 1$. AB we halve. Let's out a middle perpendicular. From any point of this perpendicular O through points A and B we carry out a circle. Points A and x it is connected. On a piece of Ox we build a circle. The piece of Ox is diameter, therefore OCx triangle – rectangular. And therefore the piece xC is a tangent to the first circle. The length of this piece and also is equal $\sqrt{f(x)}$ in a x point. Such operation is made in all points of function $y = f(x)$.

3. Creation of Graphics of Various Functions with Use of Theorems of Elementary Geometry

Theorem 1: the altitude-catheter projections theorem – if an altitude is dropped from the vertex with the right angle to the hypotenuse then the product of the catheter projections on the hypotenuse is equal to the length of the altitude squared.

If there is a right triangle where a,b – catheter, c – hypotenuse, a_c,b_c – catheter projections, h – altitude, then:

$a_c \cdot b_c = h^2$. (***Theorem 1***)

If one of the catheter projections is equal to one unit then the other catheters projection is equal to the altitude squared:

$a_c = h^2$ or $b_c = h^2$. (1)

$\sqrt{a_c} = h$ or $\sqrt{b_c} = h$. (2)

If the altitude is equal to one unit then product of catheter projections is equal to one unit or each catheters projection is equal to 1 divided by the other catheters projection:

$$a_c \cdot b_c = 1 \quad \text{or} \quad a_c = \frac{1}{b_c} \quad \text{or} \quad b_c = \frac{1}{a_c}. \tag{3}$$

Let's say that there is given a graph of a function $f(x)$.
If a point of graph is chosen and perpendiculars to axis dropped, then perpendicular dropped to *x*-axis represents value of function $f(x)$.

The right triangle can be drawn using this perpendicular as the altitude or the catheters projection. Using perpendicular as the altitude h and one of the catheter projections a_c equal to one unit, the other catheters b_c would be equal to the altitude squared. As the altitude in this case represents value of function then the catheters projection b_c represents the value of function squared $f^2(x)$ (Figures 3.1 and 3.2).

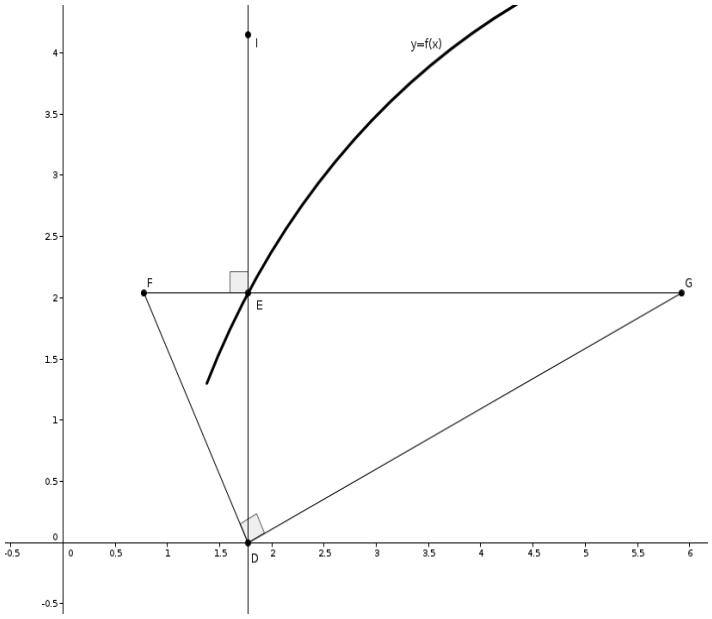

Figure 3.1

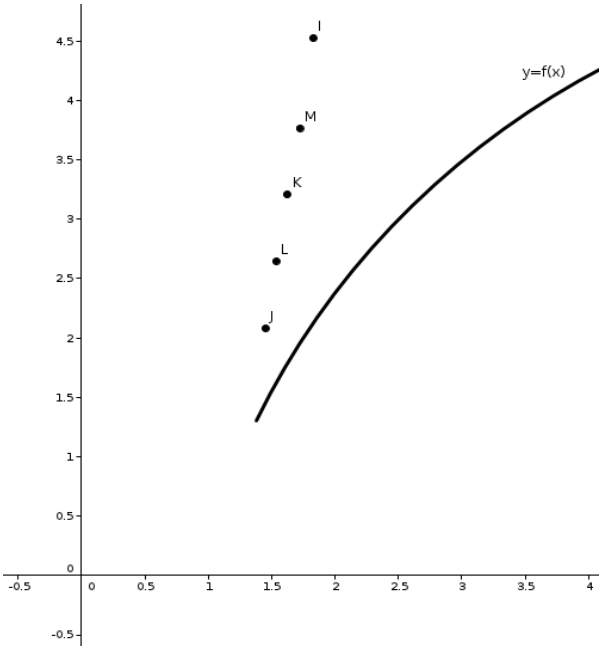

Figure 3.2

As we see in the *Graph 1*, there is the right triangle *DFG* and the altitude *DE* represents the value of the function – $f(x)$. Also, the segment *EF* is equal to one unit. Using *Theorem 1* and *Conclusion* (*1*) we get that the segment *EG* is equal to $f^2(x)$. The segment *EG* can be used to get point *I* so that *DI* = *EG*.

Drawing more right triangles at the other points of the function $f(x)$ we can get other points of the function $f^2(x)$ (Figure 3.2).

The right triangle can also be drawn using the perpendicular to the *x*-axis as a catheters projection. If the perpendicular is the catheters projection a_c and the altitude h is equal to one unit, the other catheters projection b_c is equal to $\frac{1}{a_c}$. As the catheters projection a_c represents the value of function b_c represents the value of 1 divided by value of function $\frac{1}{f(x)}$ (Figures 3.3. and 3.4).

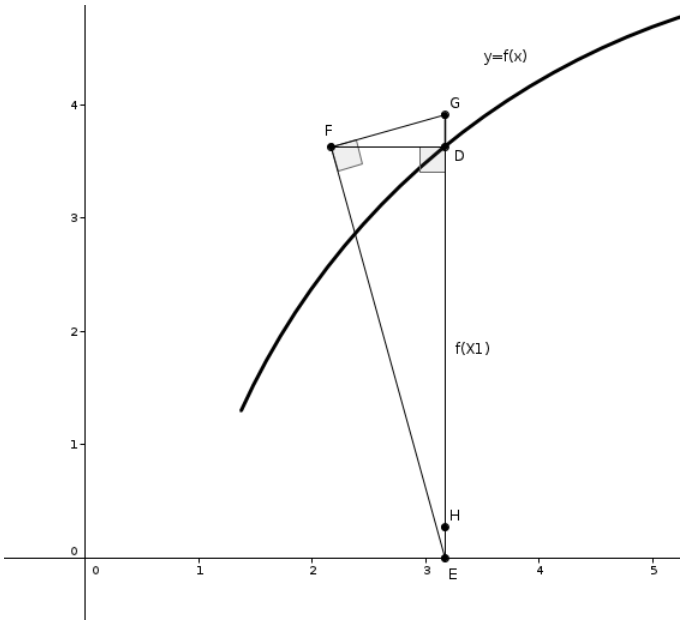

Figure 3.3

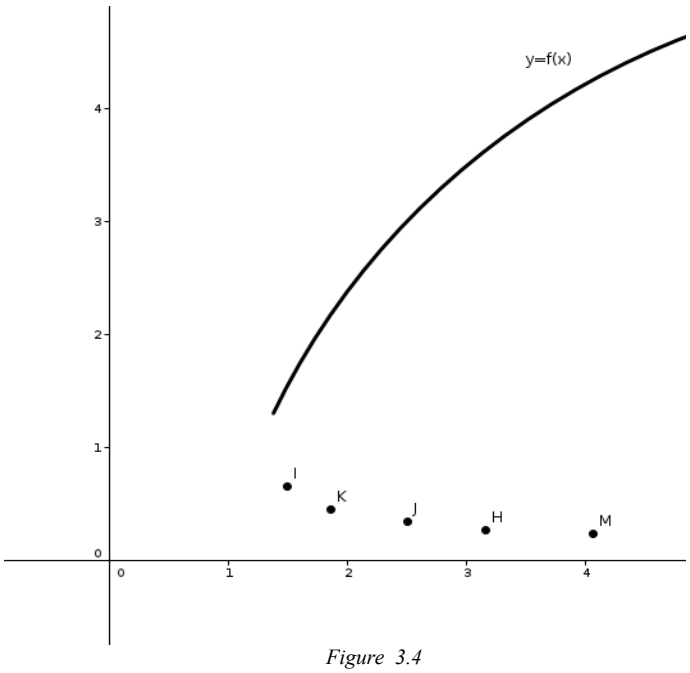

Figure 3.4

As we see on Figure 3.3. , there is right triangle EFG and the altitude DE represents the value of the function $-f(x)$. Also, the segment DF is equal to one unit. Using *Theorem 1* and *Conclusion* (*3*) we get that the segment GD is equal to $\frac{1}{f(x)}$. The segment GD can be used to get point H so that $EH = GD$.

Drawing more right triangles at the other points of the function $f(x)$ we can get other points of the function $\frac{1}{f(x)}$ (Figure 3.4).

If the perpendicular is the catheters projection a_c and the other catheters projection b_c is equal to one unit, the altitude h is equal to the square root of value of catheters projection a_c which represents the value of the function, it means, the altitude is equal to $\sqrt{f(x)}$.

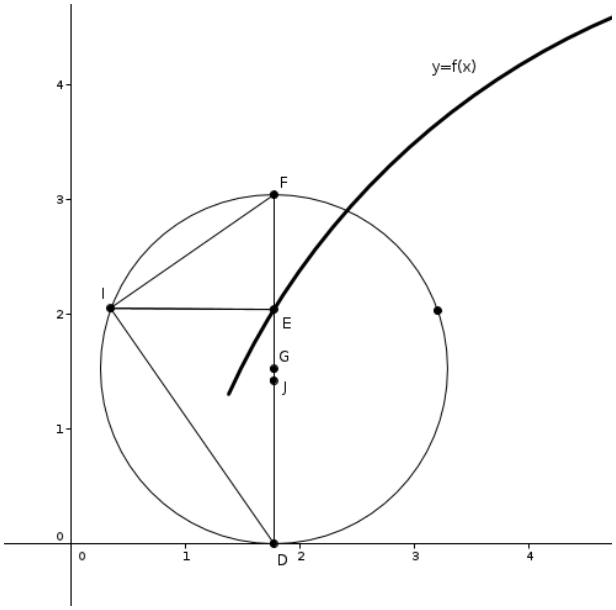

Figure 3.5

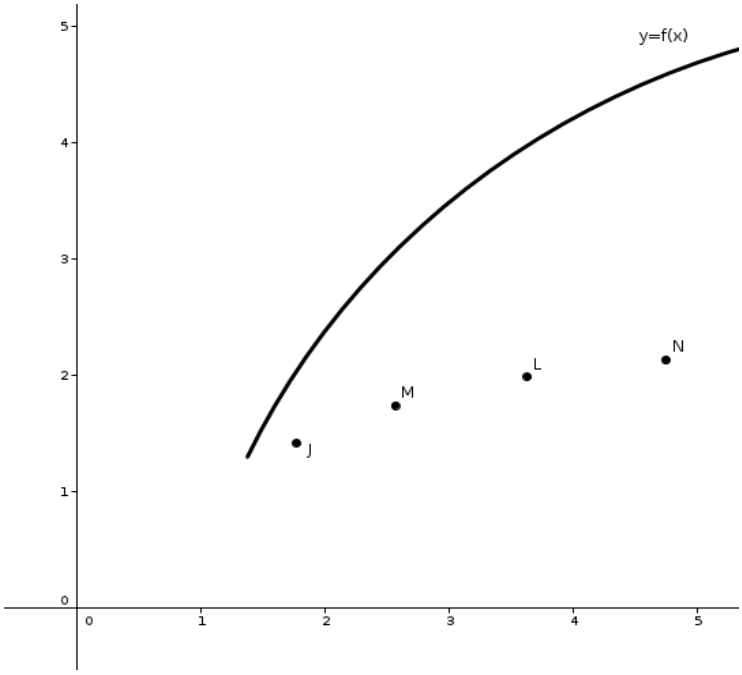

Figure 3.6

As we see in the *Graph 5*, there is the right triangle *DIF* and the catheters projection *DE* represents the value of the function – $f(x)$. Also, the segment *EF* is equal to one unit. Using *Theorem 1* and *Conclusion* (*2*) we get that the segment *EI* is equal to $\sqrt{f(x)}$. The segment *EI* can be used to get point *J* so that *EI* = *DJ*.

Drawing more right triangles at the other points of the function $f(x)$ we can get other points of the function $\sqrt{f(x)}$ (Figure 3.6).

This shows that it is possible to get a segment of line equal to value of function in power of 2 or -1 or $\frac{1}{2}$ by drawing a right triangle.

If the segment of line equal to the value if function in power of $\frac{1}{2}$ is got, then this segment of line can be used to draw another right triangle and get another segment of line which value is equal to the value of previous segment of line in power of -1, in other words, equal to the value of function in power of $-\frac{1}{2}$.

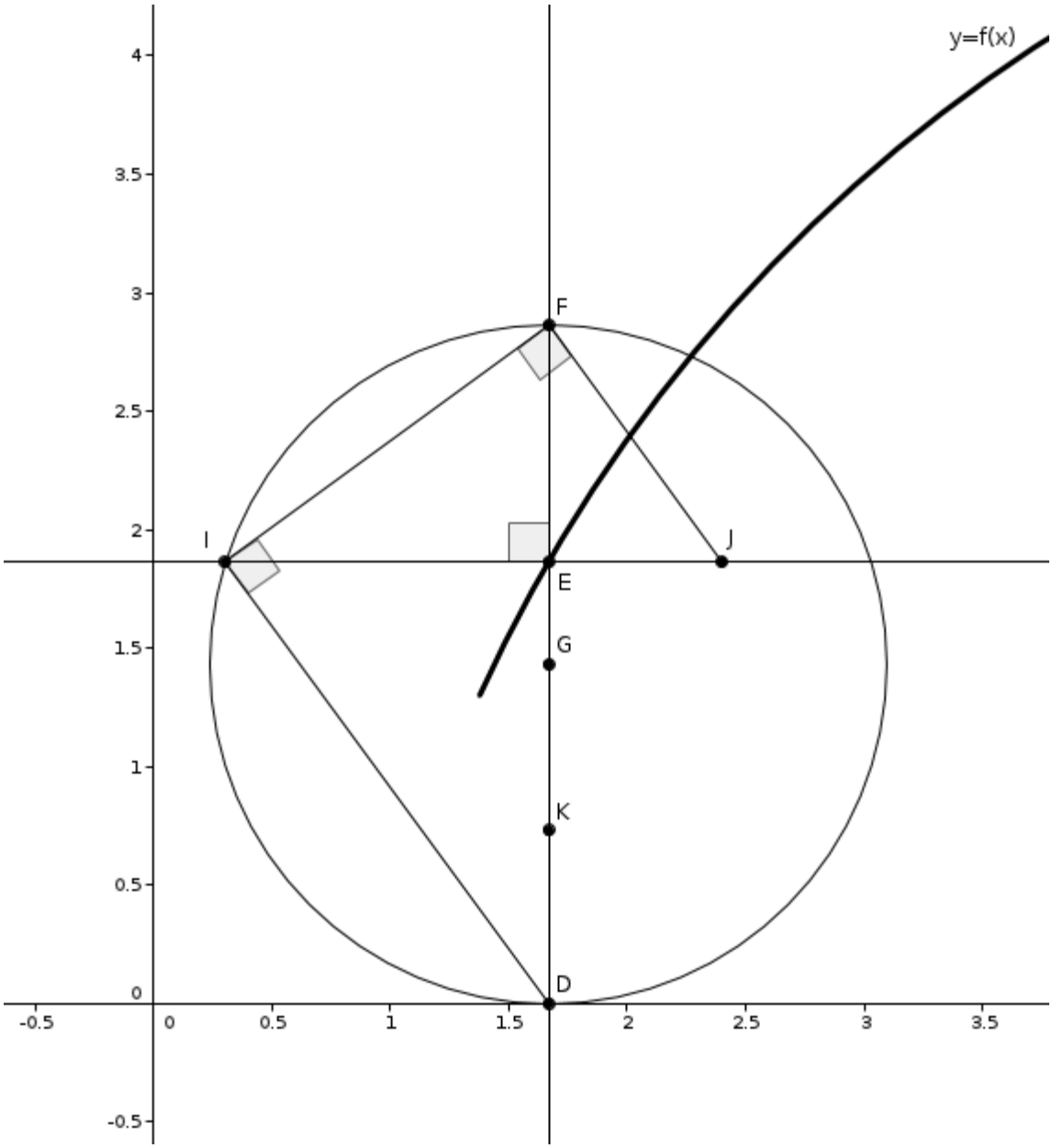

Figure 3.7

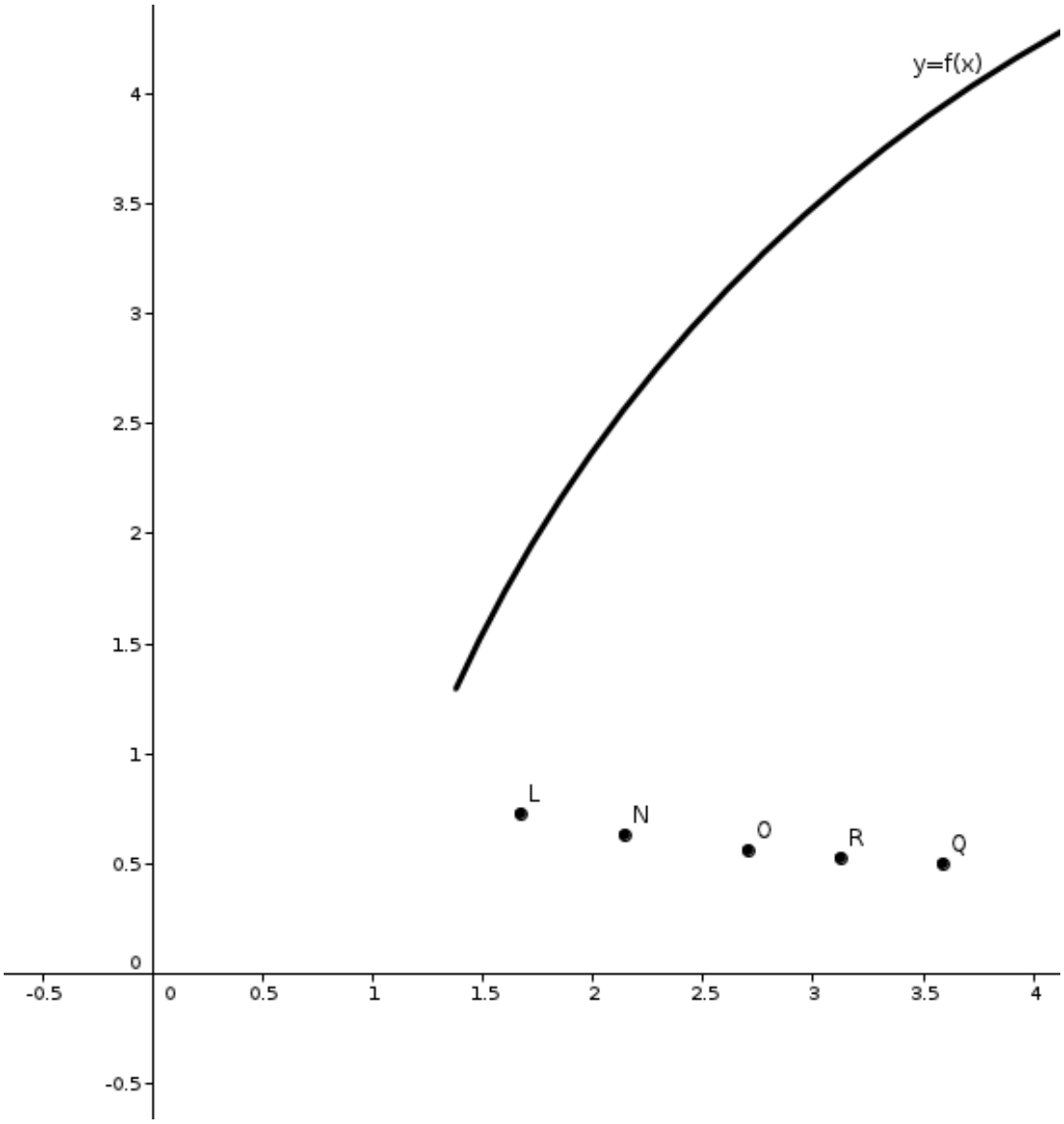

Figure 3.8

As we see on Figure 3.7, there is the right triangle *DIF* and the catheters projection *DE* represents the value of the function – $f(x)$. Also, the segment *EF* is equal to one unit. As proved, *EI* is equal to $\sqrt{f(x)}$. There is also the right triangle *IJF* and the catheters projection *EI* represents the value $\sqrt{f(x)}$. Using *Theorem 1* and *Conclusion* (*3*) we get that the segment *EJ* is equal to $\frac{1}{\sqrt{f(x)}}$. The segment *EJ* can be used to get point *K* so that *DK* = *EJ*.

Repeating this at the other points of the function $f(x)$ we can get other points of the function $\frac{1}{\sqrt{f(x)}}$ (Figure 3.8).

If the segment of line equal to the value of function in power of 2 is got, then this segment of line can be used to draw another right triangle and get another segment of line which value is equal to the value of previous segment of line in power of –1, in other words, equal to the value of function in power of –2.

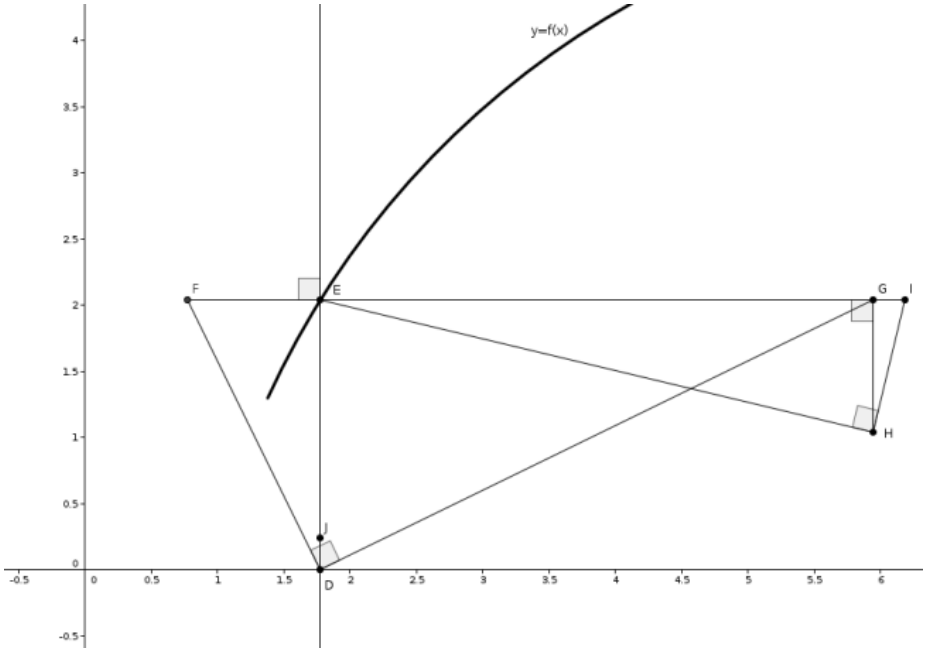

Figure 3.9

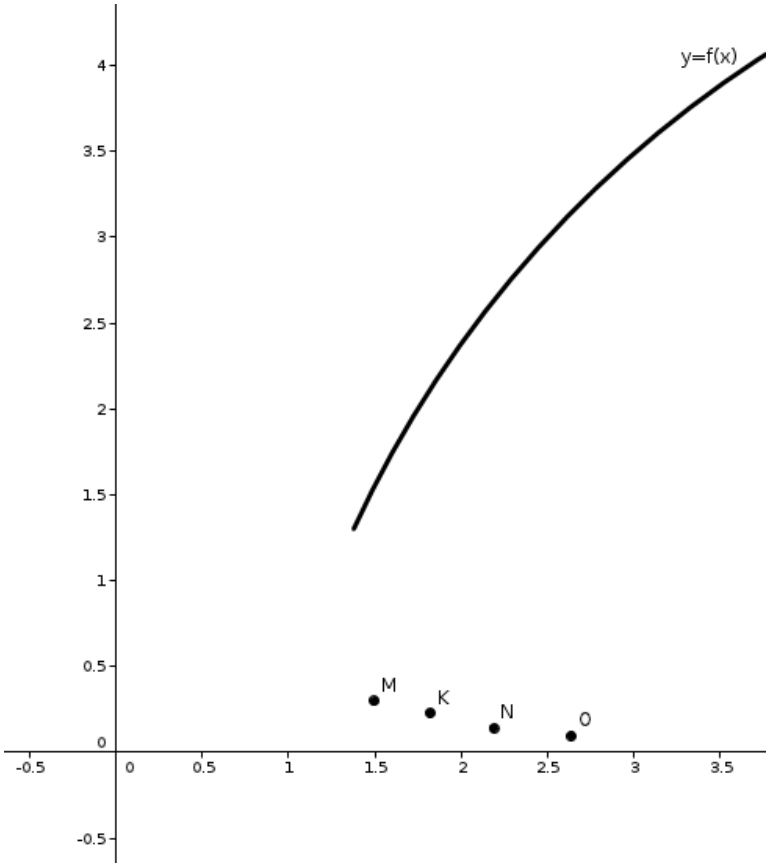

Figure 3.10

As we see on Figure 3.9, there is the right triangle DFG and the altitude DE represents the value of the function – $f(x)$. Also, the segment EF is equal to one unit. As proved, EG is equal to $f^2(x)$. There is

also the right triangle *EHI* and the catheters projection *EG* represents the value $f^2(x)$. Using *Theorem 1* and *Conclusion* (*3*) we get that the segment *GI* is equal to $\frac{1}{f^2(x)}$. The segment *GI* can be used to get point *J* so that *DJ* = *GI*.

Repeating this at the other points of the function $f(x)$ we can get other points of the function $\frac{1}{f^2(x)}$ (Figure 3.10).

4. Conclusions

As shown previously, it is possible to draw function $f(x)$ in the power $-\frac{1}{2}$, –1, –2, $\frac{1}{2}$ or 2 using only a ruler and a compass if the function $f(x)$ is given graphically. Theoretically, it is possible draw functions in powers of:

$-\frac{1}{2}, -\frac{1}{4}, -\frac{1}{8}, -\frac{1}{16} \ldots -\frac{1}{2^n}$, $n = 1,2,3 \ldots$

$-2, -4, -8, -16 \ldots -2^n$, $n = 1,2,3 \ldots$

$2, 4, 8, 16 \ldots 2^n$, $n = 1,2,3 \ldots$

It can be done using the idea that by drawing one right triangle it is possible to power the function in the power -1, $\frac{1}{2}$ or 2. For example function $f^{-\frac{1}{8}}(x)$ can be drawn in 4 steps:

1. Draw the right triangle to get function $f^{\frac{1}{2}}(x)$.
2. Use the function $f^{\frac{1}{2}}(x)$ and draw the right triangle to get function $f^{\frac{1}{4}}(x)$.
3. Use the function $f^{\frac{1}{4}}(x)$ and draw the right triangle to get function $f^{\frac{1}{8}}(x)$.
4. Use the function $f^{\frac{1}{8}}(x)$ and draw the right triangle to get function $f^{-\frac{1}{8}}(x)$.

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GAMES AS A CHALENGE IN EDUCATION

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The educational effect of games can be found in the formation of a certain system of qualities, views and beliefs, in the constructing of the relation between person and reality; the teaching effect is found in the acquisition of a system of knowledge, skills and habits. The article aims to demonstrate the benefits of using a set of educational games made with Scratch programming.

Keywords: games, educational games, education, Montessori, Scratch, visual programming

1. Introduction

We are convinced that the interaction determines the development of thinking. The computer revolution in education does not lie in transferring the contents of the classical book on screen. The creation of teaching software must be relatively independent from the existing educational content and its slow evolution.

The game itself

The game as a type of activity is social in its reasons, origin, content, structure and functions. It imitates the relationship between the player and the surrounding world, above all the social reality. To call an activity a game, it must possess the main structural elements of the game:

- An imaginary situation (game model);
- Role;
- Rules;
- Game actions [2].

The structure of computer games is built of three major functional components:

- **Game environment** is the sum total of all the objects and relations in the game and the laws of their change. In other words, the game environment is the basis, the world in which the action of the game takes place.
- **Interaction with players** – this is the set of means by which players manipulate the game environment.
- **Evaluation of game situation** – these are the relations and the conditions that define the player's goal in a game. It includes a system of awards (e.g. points) and penalties for game actions, as well as the description of the initial and the final game situation [2].

The most important of these components is the game environment. If it is well-chosen, the pace and the difficulty can be modified in different versions of the game by changing the other components.

When people play, they do not think much about the benefit from the outcome of the game. The game is an activity whose purpose is discovered in the process of playing. However, the lack of awareness of the practical importance of the game outcome can be accompanied by a subconscious result, which may be much more significant.

The game activity applies the development function of the computer game by building the intellectual, emotional, volitional and ethical side of the individual in the different age periods.

At pre-school age (3–6 years) children become like adults, but only in their minds, in their imagination. They seek to enter the adult world through imitation. The leading type of activity for this age is the game. It has double functions:

- Learning the rules and norms of life in society.
- Building awareness of their own inner world.

Computer games for this age group can help significantly the transition of these activities from manipulative to mental. This is achieved by modelling real-life situations using the language of visual-active, visual-image and verbal-logical thinking. At this age computer games affect strongly the development of imagination and the emergence of symbolic thinking. They provide children with the opportunity for intellectual development by:

- Helping the teacher illustrate situations like "why" and "what if" in a language that children understand (graphics, animation, sound, and colour).
- Computer messages providing children with meaningful and evaluating information about their game actions.

The thinking of children at preschool age is intuitive. Logical thinking skills, used in the analysis of the relations between objects, are almost absent. The computer game can help children to establish the relations between objects, to combine and classify them. When creating games for children of this age group what must be considered is their great desire to play and to choose game situations, which require solving problems of the same type repeatedly and with increasing difficulty.

2. The Pedagogic Side

Computer games in education are characterized by masking their educational and teaching goals behind game ideas and game actions. As efforts to solve these tasks are always carried out in entertaining circumstances, computer games are always accompanied by positive emotions. The pedagogic value of computer games is determined by their place in education and training, i.e. in the process of the overall impact on the growing person. The educational effect can be found in the formation of a certain system of qualities, views and beliefs, in the constructing of the relation between person and reality; the teaching effect is found in the acquisition of a system of knowledge, skills and habits. The socialization of the growing up is a basic part of their education, their development is the process of creating and forming their personality under the influence of various factors, among which targeted training and education play a major role.

Computer games are important for the adaptation to the conditions of modern life, as well as for their information content.

With the computer game people expand and deepen their knowledge of the surrounding world, they learn about the qualities and structures of objects, they study the world of human relationships by always taking an active part in them.

Depending on expected pedagogic result, there are several main applications of computer games:

- As a reward for the successful resolution of an academic task.
- As an incentive for serious work.
- As a means of modelling a research task.
- As a means of stimulating competition or cooperation.
- As a means of stimulating a certain type of thinking.
- To demonstrate the importance of and the relationship between various factors and situations.
- As a means of giving students an opportunity to practice a certain type of activity, which requires psycho-motor or cognitive skills.

The importance of educational computer games for the development function of the pedagogic process can be found primarily in the development of thinking.

Thinking is a process of acquiring summarised knowledge of reality. The computer game is an important tool for the development of the two main types of thinking – reproductive and creative, with variations in their relative share.

According to the famous French psychologist Piaget, the roots of logic lie in motor actions and in the continuous taking pictures of (photographing) the results of these actions by the sensory systems and in fixing the relations between conditions – action – results [2].

3. Types of Games for Primary School Age

Creative games:

- Role-play games with labour, investigation, research, military, historical story lines.
- Construction and technical games.
- Dramatisation games – borrowing story lines from literary works.

Games with rules:

- Didactic games – as a form of education, didactic games include elements of the educational content on various subjects. As independent game practice of children, didactic games are intellectually cognitive and can be subdivided into: journeys, arcade games, entertainment games, board games, etc.
- Plot didactic games – the didactic goal is linked to a specific story line.

3.1. What is the Montessori System?

The Montessori Method is a unique way of learning. Instead of "teaching" children concepts, the environment is adapted so that it stimulates the interest of the child and its spontaneous desire to learn. It allows the child to act independently and to participate in their own education. When a child is given the opportunity to choose and see results of their own choice, their self-esteem and confidence is enhanced and they are more confident, happier and more independent [1].

Maria Montessori says, "So we found that education is not something that the teacher does, but a natural process which develops spontaneously in the human being. It is not acquired by listening to words, but by the children's experiences in their environment. The teacher's job is not to talk, but to prepare a series of culture-related activities which motivate the child, in a special environment, created for the children."

3.2. What are the Montessori Materials?

Children, as well as adults, learn best through direct experience. The Montessori materials as such do not constitute the Montessori Method. They are simply the tools that encourage logical thinking and discovery in children. Each material is carefully designed to attract the child at a certain stage of its development. Each material teaches more than one concept or skill.

The main sections of materials are distributed between the following areas:

Practical life – these exercises teach children to take care of themselves and of the environment. They promote independence, self-sufficiency and easier integration in the broader social environment – kindergarten, school, and various training groups. They stimulate patience, persistence and concentration and use simple logic algorithms to develop thinking. They also develop gross and fine motor skills, visual motor coordination, enlarge children's vocabulary with concepts connected to everyday life. Anything that helps the development of hand movements is a preparatory stage for writing, reading and mathematical abstraction. According to Montessori 'the hand is the organ of human intelligence'.

Sensory material – it is used to set a goal, an order and a structure to the training. All senses are stimulated and abstract concepts, such as small-big, high-low, light-heavy, warm-cold, etc., are learned in a concrete and tangible way. Geometric shapes and figures are studied, spatial orientation is developed, practical skills and models are built. The materials used are didactic ones and allow children to find their own errors and to correct them (self-monitoring).

Language – in the linguistic zone children have the opportunity to build their vocabulary, get acquainted with letters, learn to compile words using movable alphabet, read.

Mathematics – through appropriate materials children learn to add, subtract, multiply and divide, as well as to count. They receive specific knowledge about the link between quantity and symbol.

Humanities or the so called Cosmic education – children receive an overall picture of the world. They learn about nature and the main concepts of natural science.

The training in writing and reading, as well as in mathematics, starts on the basis of the experience from the previous two areas.

3.3. The Montessori Games

The Montessori Method is a teaching approach and can therefore be applied regardless of social status or intelligence. It is used all over the world and has been successfully applied to children with disabilities, gifted children and children with lagging or normal development. Many parents use Montessori practices to teach their children at home.

The Montessori games, which develop and correct visual-spatial perception, are extremely popular all over the world; and, depending on age and ability, they can be used either for early (advanced) training of gifted children, or for corrective or assisting training of disadvantaged children.

3.4. Why We Chose Scratch for Game Programming Environment?

Some of the main features that make Scratch an extremely suitable environment for creating computer games for children are [3]:

- Scratch is a free software and developed products are with free access.
- Developed games can disseminate like source code and exanimate in BYOB environments or can include sb source in html and execute by browser. In this case we will need JRE installed.
- Easy work in the environment combined with visual style of programming.
- Possibility for animating objects and adding sounds: music, speech, etc.
- Possibility for controlling various characters in 2D environment with mouse or keyboard.
- Options for sequencing selected actions (scripts), managed by events (the actions of the player).
- Possibility to change the theme of the computer game and its multiplication by changing the character or the costumes and preserving the logic.
- Possibility for publishing completed projects online.

The motto of the Scratch is Imagine, Program, Share.

3.5. The Main Visual-Spatial Perceptions That Can Be Trained

Orientation in space, connected with the directions: left-right, up-down, front-back, middle. Such games are "The Pink tower" (Figure 1), "The Ladder", etc.

Figure 1. "The Pink tower" real game

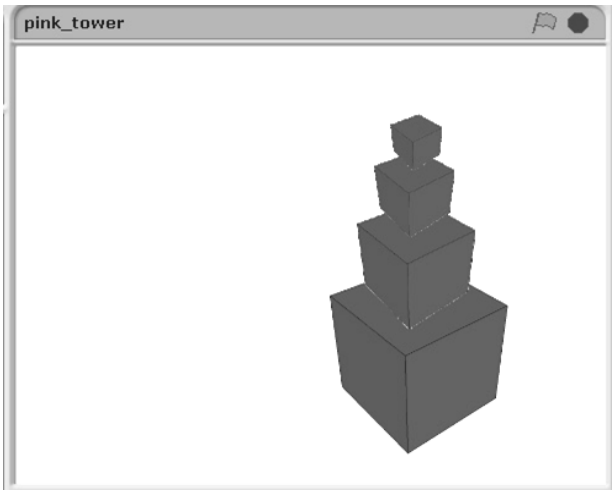

Figure 2. Computer version of the game

The purpose of the game is to make visual and muscular perception of dimension leading to an abstract understanding of size. The "Pink Tower" consists of ten wooden cubes painted in pink.

It develops visual discrimination of size in three dimensions.

Exploration with this material prepares the child for mathematical concepts in the decimal system, geometry and volume.

The important advice in doing these tasks is that you should be sitting side by side with the child so that the two of you will see the lesson from the same perspective.

The lack the possibility to grasp the cubes by hand (with the fingers and thumb on all sides in order to build a muscular impression of dimension) can be substituted with an agent (avatar) measuring or sensing blocks instead of us or to create some kind of virtual reality.

The possibility to record sound as a voice aims to play the game several times and in different places moving the educational environment with the family.

It is possible to order the cubes in tower and to simulate the falling down of cubes when the order is not right. We can simulate the falling of cubes but still it is difficult to simulate the virtual sense of the filling of the cubes with hands.

We expanded the concept of arrangements and we propose a set of games for different subject areas. These games can be graduated in difficulties in order to help children in understanding in a natural way some mathematical abstractions earlier then their coevals.

Game "Arrangement" (Figure 3) – in these game visually impaired children must arrange butterflies of the same type but of different sizes in descending and ascending order. The objective of the game is to create skills for spatial orientation and perseverance.

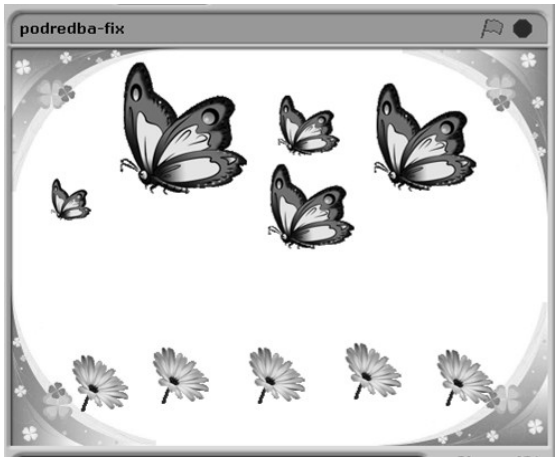

Figure 3. "arrangement"

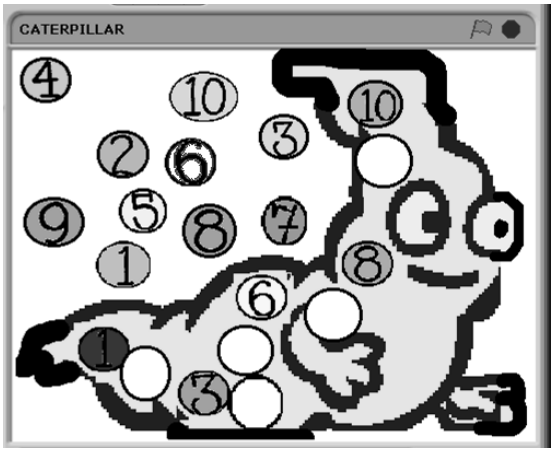

Figure 4. "caterpillar"

3.6. Less, Bigger and Equal Conception

The game asks children to recognize animals (butterflies), to establish their size /bigger, smaller/ or location /left - right, top-bottom, middle/. It aims to create spatial orientation and coordination skills and knowledge in children.

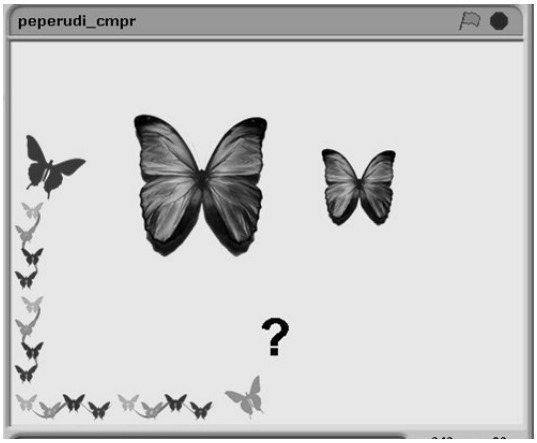

Figure 5

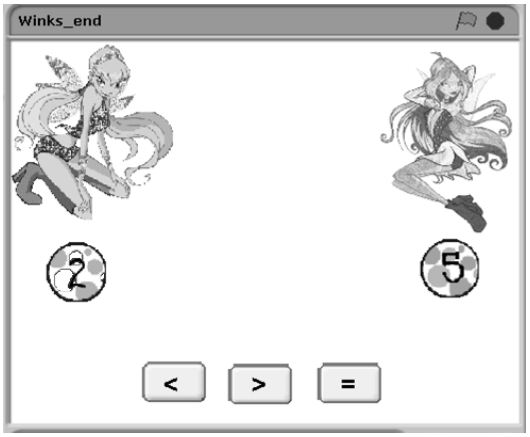

Figure 6

Left – right orientation **–** The original version of the "Snake" game (Figure 7) asks to arrange coloured balls following a template.

The computer version (Figure 8) allows visually impaired children to arrange colours following a given template. It would help children at an elementary level to combine colours by following the sequence in the model. The objective of the game is to create orientation skills in the direction from left to right, as well as following the pre-set model. It is extremely useful for left-handed children, who find specific difficulties with respect to this direction.

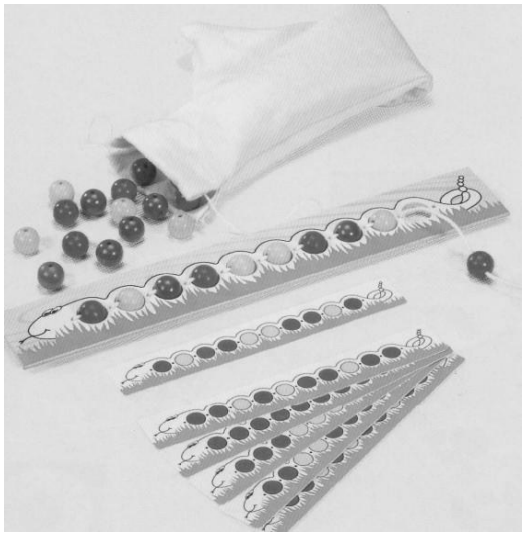

Figure 7. "Snake" game

Figure 8. computer version of the "Snake" game

Very easy this game can be transformed to achieve different goals for other subject area only with changing the costumes in Scratch program.

Figure 9. "Snake" with digits

Figure 10. "snake" with letters

Matching. The original "Butterflies" Montessori game consists of colour cards, each with two pictures of half a butterfly in different colours. The objective of the game is to arrange the cards in such a way that the butterflies are put together (with two identical wings).

The computer game "Butterflies" requires assembling colours and parts. The goal of the game is to put together the two halves and form a whole butterfly in one colour. It teaches children to put individual parts together in separate wholes which are coloured differently, thus creating colour recognition skills and an understanding of the whole in terms of objects.

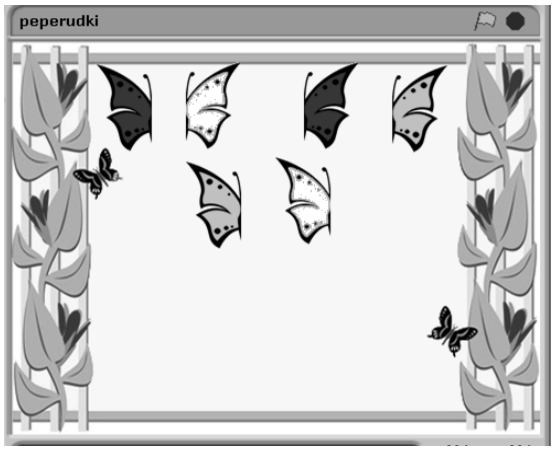

Figure 11. Butterflies matching

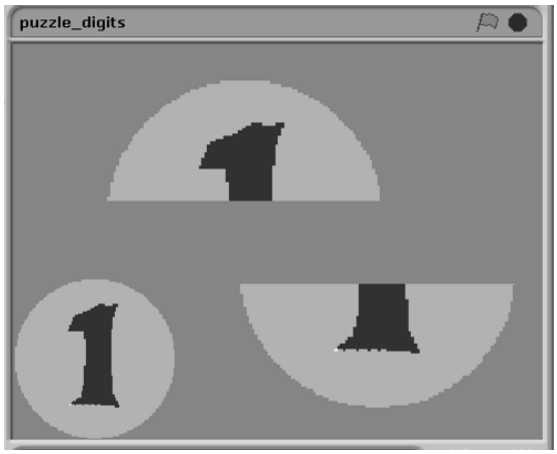

Figure 12. Digits matching

4. Conclusions

The faster the technological approach is distributed in the education system, the closer we come to the school of the future, in which students will use laboratories, workshops and consultation centres, where they will listen a little and will ask a lot, but most of all will act.

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CUMULATIVE INDEX

COMPUTER MODELLING and NEW TECHNOLOGIES, volume 16, no. 2, 2012

(Abstracts)

T. N. Yablonskaya. Development of New Technologies in the Educational Process, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 7–12.

The productivity of higher education is proved to be connected with the search for a complex of measures to improve the future teachers-philologists' professional education, transforming of the didactic system from traditional mainly informative types of training into activate and developing forms, stimulating the creative power and non-standard solution of educational problems, providing students' perspective orientation in the chosen profession. At present, the university practice needs forms, methods and technologies which allow changing the students' position from being just active participants of the learning process. The main mechanism of this process is the proper activity of the individuals, included in the teaching-learning process as a subject and the organizer of the training activity. The article is devoted to the issues on the elaboration of the educational technology, built on the principle of the role perspective. The technology efficiency, which presupposes mastering of the future teachers-philologists' pedagogical training is scientifically grounded.

Keywords: role situation, role perspective, role activity, pedagogical training quality promoting, technology, educational process

D. Golenko-Ginzburg, Z. Laslo, A. Ben-Yair. Multi-Parametrical Optimization Models in Strategic Management, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 13–22.

A two-level consideration – a company engaged in designing and creating a new product and, later on, delivering the new production in large quantities to the market. The product is composed of several sub-products, each of them, in turn, being a subject of several possible versions. The product's utility comprises both the utility of designing and creating the product's pattern example as well as the competitive utility to gain the future commercial success.

The problem is to determine the income versions of designing sub-products in order to maximize the product's competitive utility subject to restrictions related to the design process.

A two-level search algorithm of the problem's solution is suggested. The internal level is faced with optimising the product's competitive utility by means of experts' information, while the external level centres on obtaining a routine feasible solution from the point of designing process.

Keywords: multi-attribute utility; competitive utility; basic project's attributes and competitive attributes; harmonization model on the basis of expert team's decision-making

K. S. Tsvetkov, **M. M. Petrova.** Is There Any Truth in "Projectlibre the Open Source Replacement of Microsoft Project"? *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 23–27.

An intensely intriguing announcement of major producers of open source software stir specialists in project management, namely message "ProjectLibre: the open source replacement of Microsoft Project". In 2012 the founders of OpenProj announced that they forked the project and will be releasing a new version of OpenProj in August 2012. The name of the fork is ProjectLibre. Is it going to try to prove and is it possible to use this software in the learning process for the preparation of students and professionals will try to answer in this article. This issue is especially actual in Higher Education, as the main reason for people to university is a good realization that he would have offered and given trend more and more employers to run a Linux-based systems and to use free software in the near future, their experience with open source products would definitely give them a significant advantage in the labour market.

Keywords: Microsoft Project, OpenProj, ProjectLibre, Project management, open source

K. N. Nechval, N. A. Nechval, M. Purgailis, U. Rozevskis, V. F. Strelchonok, M. Moldovan. Constructing Inspection Strategies under Uncertainty, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 28–33.

Certain fatigued structures must be inspected in order to detect fatigue damages that would otherwise not be apparent. A technique for obtaining optimal inspection strategies is proposed for situations where it is difficult to quantify the costs associated with inspections and undetected failure. For fatigued structures for which failures (fatigue damages) are only detected at the time of inspection, it is important to be able to determine the optimal times of inspection. Fewer inspections will lead to lower fatigue reliability of the structure upon demand, and frequent inspection will lead to higher cost. When there is a fatigue reliability requirement, the problem is usually to develop an inspection strategy that meets the reliability requirements. It is assumed that only the functional form of the underlying invariant distribution of time-to-failure is specified, but some or all of its parameters are unspecified. The invariant embedding technique proposed in this paper allows one to construct an optimal inspection strategy under parametric uncertainty. This strategy represents a sequence of inspection times satisfying the specific criterion, which takes into account the predetermined value of the conditional fatigue reliability of the structure. A numerical example is given.

Keywords: fatigued structure, fatigue damage, parametric uncertainty, inspection strategy, optimisation

B. Sh. Kulpeshov. To Reducibility of Database Queries over an Ordered Domain, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 34–39.

In relational model of databases the state of a database is understood as a finite set of relations between elements. Names of relations and its arties are fixed and refer to *as the circuit of a database*. The separate information stored in the relations of the given circuit, refers to *as a state of a database*. Though relational databases have been thought up for finite data sets, it is frequently convenient to assume that there is an infinite *domain* – for example, the integer or rational numbers – so elements of the data get out of this domain.

Keywords: Database query, circularly ordered domain, o-minimality

A. Syrymbayeva. Database Design for Educational Organization, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 40–43.

Database systems are complicated software systems, and, for that reason, they especially need to be carefully designed before they are implemented. This article outlines the process of designing both the application programs and the database that stores the data. On the one hand, application design involves designing transactions and designing user interfaces. Database design, on the other hand, proceeds from constructing a conceptual design, which is then used in a process called logical design to create a conceptual schema that, if good enough, will be implemented and stored in the database system catalogue.

In this article we have considered the Entity-Relationship (ER) model, which is the consensus choice for use in conceptual database design.

Keywords: database, primary key, weak, entity, strong, attributes, single valued, composite, ID

V. Popov, L. Atymtayeva, Some Aspects of Development of Web Tools for Distance Learning of Foreign Languages Database Design for Educational Organization, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 44–49.

People whose native language is based on Cyrillic alphabet constantly meet the same words but written differently in Latin letters. On the other hand person who uses Roman alphabet in writing can't read and learn some new languages just because he doesn't know target ABC.

The first case is clear and comes from IT, because ASCII doesn't support national alphabets and UTF-8 has come too late, when users have had a hard time with mojibake texts. One more reason is the SMS, because 2-byte coding allows sending only 70 national characters, but it could be 160 chars in pure Latin. This texting habit is ineradicable because it is a cheaper and reasonable way of communication; we just need systematization and accustomization to certain transliteration rules – that is one of the duties of the WEB-service.

The second point is to provide the great assistance to people, who learn Kazakh and Russian. Database contains "frequency dictionary" in pictures and you memorize words much faster because

you "see" these words and into the bargain you type it. It is a good visualization of items and quite innovative method of new words memorization.

Finally, there should be realized such functionality, which exists in every touch-typing program or WEB-site e.g. measuring typing speed, accuracy, tempo, and so on. The reason is that there exists direct correlation between learning and speed of character input, in our case typing memorizable word and memorization of target keyboard layout, in the long run the user should know how fast he is in typing.

Keywords: typing, touch typing, e-learning, foreign languages, problem of Latin alphabet, Roman ABC, Cyrillic alphabet, memorization of words

A. Kovantsov, R. Krumbergs. Creation of Graphs of Functions with Use of Theorems of Elementary Geometry, *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 50–59.

The solution of tasks with use of compasses and a ruler is one of the most ancient ways of the solution of geometrical tasks. "Great problems of an antiquity" belong to such tasks. Not all tasks can be solved with use of the set tools. Often at mathematics lessons at school pupils ask to the teacher a question: why this or that theorem is necessary and where it can be used? Not always the teacher finds the convincing answer. However many theorems can be applied not only in a school course of mathematics.

If there is given a function $f(x)$ which is defined graphically then it is possible to draw a graph of a function $\frac{1}{f^2(x)}$ and a graph of a function $\frac{1}{\sqrt{f(x)}}$ in a coordinate system where the length of one unit is given. This can be proven using a theorem typically used in school — altitude-catheter projections theorem.

Methods of using right triangles to draw graphs of the functions $\frac{1}{\sqrt{f(x)}}$, $\frac{1}{f^2(x)}$, $\sqrt{f(x)}$, $f^2(x)$ will be explained.

Keywords: Rectangular triangle, similarity of figures, average proportional

G. Momcheva, V. Spasova. Games as a Chalenge in Education**,** *Computer Modelling and New Technologies,* vol. 16, no. 2, 2012, pp. 60–66.

The educational effect of games can be found in the formation of a certain system of qualities, views and beliefs, in the constructing of the relation between person and reality; the teaching effect is found in the acquisition of a system of knowledge, skills and habits. The article aims to demonstrate the benefits of using a set of educational games made with Scratch programming.

Keywords: games, educational games, education, Montessori, Scratch, visual programming

COMPUTER MODELLING and NEW TECHNOLOGIES, 16. sējums, Nr. 2, 2012

(Anotācijas)

T. Jabloskaja. Jauno tehnoloģiju izstrāde izglītības procesā, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 7.–12. lpp.

Ir pierādīts, ka produktivitāte augstākajā izglītībā ir saistīta ar pasākumu kompleksa meklējumiem, lai uzlabotu nākamo skolotāju filologu profesionālo izglītību, transformējot didaktisko izglītību no tradicionālās, galvenokārt, mācīšanās informatīvos veidus aktivizētās un attīstītās formās, stimulējot radošos spēkus un izglītības problēmu nestandarta risinājumus, nodrošinot studentu perspektīvo orientēšanos izvēlētajā profesijā. Pašlaik universitātes praksei ir nepieciešamas formas, metodes un tehnoloģijas, kas ļauj mainīt studentu stāvokli no vienkārša aktīva dalībnieka, kas piedalās mācību procesā. Šī procesa galvenais mehānisms ir indivīdu pareiza darbība, kas iekļauta mācību/mācīšanās procesā kā priekšmets un mācību darbības organizētājs. Raksts ir veltīts izglītības tehnoloģiju izstrādes jautājumiem, kas balstīti uz lomu perspektīvas principiem. Tehnoloģiju efektivitāte, kas nozīmē topošo skolotāju filologu pedagoģiskās apmācības apguvi, ir zinātniski pamatota.

Atslēgvārdi: lomu situācija, lomu perspektīva, lomu aktivitāte, pedagoģiskā apmācības kvalitātes paaugstināšana, tehnoloģijas, izglītības process

D. Golenko-Ginzburgs, Z. Laslo, A. Ben-Jears. Daudz-parametru optimizācijas modeļi stratēģiskajā menedžmentā, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 13.–22. lpp.

Divu līmeņu apsvēršana – uzņēmums, kas nodarbojas ar projektēšanu un jaunu produktu izveidošanu, un pēc tam, piegādājot jauno produkciju tirgū lielos daudzumos. Produkts sastāv no vairākiem apakšgrupas produktiem, katrs no tiem, savukārt, ir vairāku versiju subjekts. Produkta lietderība ietver gan lietderību, izstrādājot un izveidojot produkta tipa paraugu, gan konkurences lietderību, lai iegūtu nākotnes komerciālos panākumus.

Problēma ir noteikt apakšgrupas produktu izstrādes ienākumu versijas, lai palielinātu produkta konkurētspējas lietderību, kas pakļauta ierobežojumiem, kas saistīti ar projektēšanas procesu.

Rakstā tiek izskatīts problēmu risinājuma divlīmeņu meklēšanas algoritms. Iekšējais līmenis ir saskāries ar produkta konkurētspējas lietderības optimizēšanu, izmantojot ekspertu informāciju, bet ārējie līmeņa centri ar ikdienas reāla risinājuma iegūšanu, no projektēšanas procesa redzesloka.

Atslēgvārdi: multi-atribūtu lietderība; konkurētspējīga lietderība; pamata projekta atribūti un konkurētspējas atribūti; saskaņošanas modelis, pamatojoties uz ekspertu komandas lēmumu pieņemšanu

K. S. Cvetkovs, M. M. Petrova. Vai ir tur kāda patiesība „*PROJECTLIBRE* Microsoft projekta atklātā pirmkoda nomaiņa”? *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 23.–27. lpp.

Lielāko ražotāju intensīvi intriģējošs paziņojums par atklātā pirmkoda programmatūras speciālistu iesaistīšanu projektu vadībā, proti, ziņojums „ProjectLibre: Microsoft projekta atklātā pirmkoda nomaiņa”. OpenProj dibinātāji 2012. gadā paziņoja par jaunā projekta sazarošanu, un OpenProj jaunās versijas laidiens būs 2012. gada augustā. Atzara nosaukums ir ProjectLibre. Profesionāļi mēģinās rast atbildi šajā rakstā: „Vai mēģināsim pierādīt un vai studenti ir spējīgi lietot šo programmatūru mācību procesā?” Šis jautājums jo īpaši ir aktuāls augstākajā izglītībā, tā kā universitātes cilvēkiem galvenais ir labs rezultāts, tas, ka viņi piedāvās un tiks dota tendence vairāk un vairāk uzņēmēju izmantot uz Linux balstītu sistēmu un lietot brīvu programmatūru tuvākajā nākotnē, viņu pieredze ar atklātā pirmkoda produktiem neapšaubāmi dos viņiem priekšrocību darba tirgū.

Atslēgvārdi: Microsoft projekts, OpenProj, ProjectLibre, projekta vadīšana, atklātais pirmkods

K. N. Nečvals, N. A. Nečvals, M. Purgailis, U. Rozevskis, V. F. Streļčonoks, M. Moldovans. Veidojot pārbaudes stratēģijas nenoteiktības apstākļos, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 28.–33. lpp.

Dažas nogurušas struktūras ir jāpārbauda, lai noteiktu noguruma zaudējumus, kas citādi nebūtu acīmredzami. Rakstā ir ierosināts optimālas pārbaudes stratēģijas iegūšanas paņēmiens situācijām, kad ir grūti aprēķināt izmaksas, kas saistītas ar pārbaudēm un neatklātām neveiksmēm. Nogurušām struktūrām, kurām neveiksmes (noguruma bojājumi) ir konstatētas tikai pārbaudes laikā, tas ir svarīgi,

lai varētu noteikt pārbaudes optimālo laiku. Mazāk pārbaužu novedīs pie struktūras pēc pieprasījuma zemākas noguruma ticamības, un biežas pārbaudes novedīs pie lielākām izmaksām. Ja ir noguruma drošuma prasība, problēma parasti ir attīstīt pārbaudes stratēģijas, kas atbilst drošuma prasībām. Tiek pieņemts, ka tikai invariantu sadalījumu pamatā laiks-neveiksmei funkcionāla forma ir noteikta, bet daži vai visi tā parametri nav konkretizēti. Invariantu iekļaušanas tehnika, kas ierosināta šajā rakstā, ļauj izveidot optimālu pārbaudes stratēģiju pie parametriskas nenoteiktības. Šī stratēģija atspoguļo pārbaudes laiku secību atbilstošu konkrētam kritērijam, kas ņem vērā struktūras nosacīta noguruma drošuma iepriekš noteiktu vērtību. Ir dots skaitliskais piemērs.

Atslēgvārdi: nogurusi struktūra, noguruma bojājumi, parametriska nenoteiktība, pārbaudes stratēģija, optimizācija

B. Š. Kulpešovs. Datu bāzes vaicājumu reducēšana pār pasūtīto domēnu, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 34.–39. lpp.

Datu bāzu relāciju modelī datu bāze ir jāsaprot kā ierobežots attiecību kopums starp elementiem. Attiecību nosaukumi un to *arties* jeb izdomājumi tiek fiksēti un tiek sauktas kā *datubāzes cirkulārs*. Atsevišķa informācija glabāta dotās shēmas attiecībās, norāda uz *kā datu bāzes stāvoklis*. Lai gan relāciju datu bāzes ir izdomātas par ierobežotām datu kopām, to bieži vien ir ērti pieņemt, ka pastāv bezgalīgs *domēns* – piemēram, veseli vai racionāli skaitļi – tādējādi datu elementi izkļūst no šī domēna.

Atslēgvārdi: datu bāzes vaicājums, cirkulāri pasūtīts domēns, o-minimalitāte

A. Sirimbajeva. Datu bāzes izveide izglītības organizācijai, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 40.–43. lpp.

Datu bāzu sistēmas ir sarežģītas programmatūras sistēmas, un šī iemesla dēļ, tās ir īpaši rūpīgi jāizstrādā, pirms tās tiek īstenotas. Šis raksts ieskicē izstrādes procesu kā pieteikumu programmām, tā arī datu bāzei, kas saglabā datus. No vienas puses, pieteikumu dizainparaugs ietver projektēšanas transakcijas un projektēšanas lietotāja interfeisu. Datu bāzes projektēšana, no otras puses, attīstās no konceptuālā dizaina izveides, kas pēc tam tiek izmantots procesā, ko sauc par loģisko izstrādi, līdz konceptuālas shēmas radīšanai, kas, ja pietiekami labs, tiks īstenots un saglabāts datu bāzes sistēmas katalogā.

Šajā rakstā mēs esam izskatījuši *Entītijas-saistības* modeli, kas ir *consensus* izvēle konceptuālā datu bāzes dizaina lietošanai.

Atslēgvārdi: datu bāze, primārā atslēga, vājš, entītija, spēcīgs, atribūti, viens vērtēts, kompozīts, ID.

V. Popovs, L. Atymtayeva. Daži aspekti Web rīku attīstībā datu bāzu projektēšanā svešvalodu tālmācībai izglītojošām organizācijām, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 44.–49. lpp.

Cilvēki, kuru dzimtā valoda ir balstīta uz kirilisko alfabētu, pastāvīgi sastop tos pašus vārdus, bet rakstītus atšķirīgi latīņu burtiem. No otras puses, persona, kas izmanto latīņu alfabētu rakstos, nevar lasīt un apgūt kādu jaunu valodu tikai tāpēc, ka viņš nezina mērķa ABC.

Pirmā lieta ir skaidra, un nāk no IT, jo ASCII neatbalsta valsts alfabētu un UTF-8 ir pienācis pārāk vēlu, kad lietotāji ir bijis grūti ar *mojibake* tekstiem. Vēl viens iemesls ir SMS, jo 2-baitu kodēšana ļauj sūtīt tikai 70 nacionālos simbolus, bet tas varētu būt 160 simboli tīrā latīņu valodā.

Otra lieta ir sniegt lielu palīdzību cilvēkiem, kuri mācās kazahu un krievu valodā. Datu bāzē ir „frekvenču vārdnīca" bildēs un jūs iegaumējat vārdus daudz ātrāk, jo jūs „redzat" šos vārdus un jūs ierakstāt tos. Tā ir laba priekšmetu vizualizācija un diezgan inovatīva metode jaunu vārdu iegaumēšanā.

Visbeidzot, ir jāīsteno tāda funkcionalitāte, kas pastāv katrā pieskāriena-rakstības programmā vai tīmekļa vietnē, piem., drukāšanas ātruma mērīšana, precizitāte, temps, utt.

Atslēgvārdi: druka, pieskāriena-rakstība, e-mācības, svešvalodas, latīņu alfabēta problēmas, romiešu ABC, kiriliskais alfabēts, vārdu iegaumēšana

A. Kovantsovs, R. Krumbergs. Funkciju grafika izveide, izmantojot elementārās ģeometrijas teorēmas, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 50.–59. lpp.

Uzdevumu risinājums, izmantojot kompasu un lineālu, ir viens no senākajiem veidiem ģeometrisko uzdevumu risināšanā. "Senatnes lielās problēmas" pieder pie šādiem uzdevumiem.

Ne visus uzdevumus var atrisināt, izmantojot noteiktos instrumentus. Bieži vien skolās matemātikas stundās skolēni vaicā skolotājam: kāpēc tā vai cita teorēma ir nepieciešama un kur to var pielietot? Pārliecinoša atbilde ne vienmēr tiek atrasta. Tomēr daudzas teorēmas var būt pielietotas ne tikai skolas matemātikas kursā. Ja tiek dota funkcija $f(x)$, kas tiek definēta grafiski, tad ir iespējams uzzīmēt funkcijas grafiku $\frac{1}{f^2(x)}$ un funkcijas grafiks $\frac{1}{\sqrt{f(x)}}$ koordinātu sistēmā, kur ir dots vienas vienības garums. Tas var būt pierādīts, pielietojot teorēmu, kuru tipiski lieto skolā – augstuma-katetru projekcijas teorēma. Pareizo trīsstūru izmantošanas metodes, lai uzzīmētu funkciju grafikus $\frac{1}{\sqrt{f(x)}}$, $\frac{1}{f^2(x)}$, $\sqrt{f(x)}$, $f^2(x)$, tiks izskaidrotas šajā rakstā.

Atslēgvārdi: taisnstūra trijstūris, skaitļu līdzība, vidēji proporcionāls

G. Momčeva, V. Spasova. Spēles kā izaicinājums izglītībā, *Computer Modelling and New Technologies,* 16. sēj., Nr. 2, 2012, 60.–66. lpp.

Spēļu ietekmi uz izglītību var redzēt, veidojot noteiktu kvalitāšu sistēmu, uzskatus un pārliecību, konstruējot saikni starp personu un realitāti; mācību efekts ir atrodams zināšanu sistēmas, prasmju un paradumu apguvē. Raksta mērķis ir parādīt ieguvumus, izmantojot mācību spēļu virkni, kas veidota ar Scratch programmēšanu.

Atslēgvārdi: spēles, mācību spēles, izglītība, Montessori, Scratch, vizuālā programmēšana

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