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IDENTIFYING OPTIMIZATION PROBLEMS BY MEANS OF CLUSTERING AND KNOWLEDGE BASED SYSTEMS IN INTERNET*

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Abstract: Model design and implementation by means of computer technology and methods has been a focus of multiple researches in Artificial Intelligence, Operations Research, Decision Support and Management Systems at the last years. Case based reasoning techniques and methods are used frequently in problem solving. They help model builders to identify and design optimization models improving their cognitive skills and knowledge in modeling process. At the present paper, it is proposed a new approach based on application of case based reasoning in model building. The problems associated to construction of optimization models by means of computer are discussed from theoretical and practical point of views. Finally, a new intelligent system is proposed and described. It has as objectives to help professional (specialists, professors, students and others) in model building and implementation on Internet. The fast rise of information and telecommunication networks, and particularly Internet and its rapid diffusion, implementation and introduction into universities, professional training and postgraduate institutions, have highlighted the need to define the most effective ways of realizing the teaching and learning potential. Electronic learning (e-Learning) as it has come to be known, makes use of the Internet and digital technologies to deliver instruction synchronously or asynchronously to anyone who has access to a computer and an Internet connection. Taking into account this reality and necessity it was proposed a new e-learning platform for Operations Research's teaching and learning. The system has been implemented in .**net** technology using **C#** computer language and **web services**. At the present time, it has been testing and improving at Havana Institute of Technology.

Intelligent System in Computer Science

The concept of Intelligent System in the Computer Science field is closely related to the concepts of adaptation, learning and explanation.

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Definition 6

Adaptation. A change in structure, function, or behavior by which, a system improves its chance of functioning efficiently in a specific environment. Adaptation concept is referred to the ability to adjust to new information and experiences. Through adaptation, we are able to adopt new behaviors that allow us to cope with change.

The concept of adaptation has been adopted in several scientific fields including system theory, cybernetic, management, biology and others. A framework for systematically defining adaptations is based on three questions:

– adaptation to what?

– who or what adapts? and

– how does adaptation occur?

The ability of adaptation for an intelligent system is given by the ability that has a system to adapt by itself to technological changes occurred in certain application domain. The contradiction between stability and change constitutes an important element in order to determine the necessary and convenient adaptation level.

Learning

Herbert A. Simon was interested in learning how the brain actively constructs internal perceptual and memory representations, how eye movement, visual processing and reasoning can be integrated together. With Allen Newell, Simon developed a theory for the simulation of human problem solving behavior using production rules. Simon was interested in the role of knowledge in expertise.

Definition 7

Herbert Simon defined Learning as: «… any change in a system that allows it to perform better the second time on repetition of the same task or on another task drawn from the same population».

In agreement with Simon's definition, learning covers an ample set of phenomena, since the knowledge acquisition, to the improvement of the learner's abilities in problem solving. Another implicit challenge in this definition is the restricted nature of the empirical learning. In other words: «the learning involves the generalization from the experience». The efficiency must be improved not only by means of the «repetition of the same task»; but also in «solving a set of analogous tasks defined in the dominion». Since the dominions that are interesting, in general, present also high complexity, the learner is able of examining only a part or a fraction of all the possible cases belonged to such dominion. Thus, it is necessary that the learned acquires knowledge by induction based on his experience. In most of the learning problems the data available are not sufficient to guarantee «an adequate» generalization. Finally, Simon formulates in its definition that learning allows to learner: «to make better the same task in the second time». The investigation of the learning must go to make possible and to facilitate the «changes» that improves the leaner's efficiency (Upgrade); and to detect the changes that make worse or degrade his efficiency (Downgrade);

Errors Catalog

The learning strategies must make possible to reveal the learner's errors. It is assumed that all learners' problem solving steps executed in a problem solving process can be controlled or supervised by the computer system or the web site. The errors detected by the system are sending to a diagnose module, in which must be revealed the possible error or fault causes. These errors or faults can be:

1) conceptual errors;

2) mathematical errors;

3) syntactic and semantic errors;

4) and others.

The conceptual errors are treated by a module built for student answers' processing. This processing consists of proposing and executing if it is considered opportune, a set of strategies that allow the operator to reveler or discover the committed failure or error and its causes. The error processing has three stages. In the first stage it is analyzed the symptoms of the errors and is evaluated and decided how to explain them to student or learner. In the second one, it is established a error correction strategy more convenient under actual conditions. In this moment, is defined a remedial strategy.

Explanation

With the objective to clarify the meaning and better understood the concept of Explanation it is formulated a general definition of it.

Definition 8

By Explanation it is understood:

1) a stage of investigation that consists of making intelligible the essence of the operation of a system;

2) process that leads to the elucidation of the content of certain object and to that its parts be independents and can be differentiated ones from others;

3) cognitive process of making something seem consistent with or based on reason.

The present world is without place to doubt a world of communication and explanation. The capacity to communicate and the capacity of explanation are two fundamental elements of the modern intelligent systems. In dependence of the systems have:

1) capacity to explain the logic of their operation and to explain where and why arise errors and;

2) rational and efficient tools to solve these problems;

the systems will be more or less intelligent. By all it, the explanation capacity is one of the fundamental elements in intelligence.

Hypermedia Problem Classifier and Generator

Since ancient times, the mankind history has been full of situations in which the man had necessity of classifying objects with similar or analogous characteristics (natural phenomenon, concepts, things and others). Classification is an essential tool in science. The concept Classification appears frequently in all branches of science. By Classification, Clustering, Cluster Analysis or Taxonomy we understand a process of grouping, organizing or ordering different objects into certain classes. Etymologically, Class (Classe in French and Classis, from Latin) means a group, set or kind sharing common attributes, a division or rating based on grade or quality. Classify – to arrange in classes, to assign some thing to a category. Classification – the act or process of classifying, systematic arrangement in-groups or categories according to established criteria.

In the last years, some researches to classify adequately automation objects have been developed. Several researchers have formulated the idea of making interviews and tests to experts to determine the intervals of variation for each one of the fundamental parameters in each analyzed object. They proposed a classification method for stratification in complexity levels according to the value assigned to each parameter. Then, the establishment of relation rules based on characteristics of different parameters and the elaboration of certain set of criteria for a description and identification of classes can be considered a solution of classification problem. The classification of objects and word problems consists in the determination of several levels of complexity. These levels are defined in accord to the characteristics of every specific problem

results an interesting computer problem. It is possible to define a problem in function of a set of parameters. In this relation, it's necessary to define that set in one domain or knowledge area of analyzed object or word problem. This requires consulting groups of experts in this knowledge area with the objective of establishing the more representative or significant parameters. Here, a method to divide in n levels of complexity the different objects and word problems starting from values of parameters used for characterizing them is proposed. Specifically, a software tool on Delphi 4,0 of Borland Corporation was developed. The proposed method consists in the following: Suppose we have m objects or word problems that must be classified in different classes in accord to the values reached for the more relevant parameters of each object or word problem. These parameters can be of subjective and objective character on their activity. In this relation, it's possible to design or construct a matrix that relates the problems and its parameters. Let $A = //Aij//$, where $i = 1, 2, \ldots, n$; in this matrix, Aij is a value correspondent to object or word problem «i». How was observed before, on the matrix there exists objective and subjective evaluations. The subjective evaluations require a special treatment. In this work, it is proposed to use different methods for making a scientific evaluation of values for each parameter. The methods analyzed are: 1) delphi Method; 2) kendall Tau Method; and others [9, 10, 12–16].

Procedure:

1) select for each column «*j*» of matrix $A = //Aij//$ the value: max $\{Aij\}$ and min $\{Aij\}$;

2) determine the difference between max $\{Aij\}$ and min $\{Aij\}$;

3) calculate the middle value $Aij = [\max \{Aij\} - \min \{Aij\}] / 2$;

4) classify the set of objects or word problems in function of its location. In this relation, «*n*» intervals of variation or complexity levels for a set of problem are defined;

5) when all parameters have been analyzed it is necessary to define in what class must be located each problem. This step can be made in different ways:

a) locate a problem in the complexity level or class that have been repeated more times during the evaluation process;

b) use the decision theory methods for deciding in what complexity level locate each problem (Tabl. 1).

The development system was designed in a way such that it permits to use different decision-making methods for different problem situations. Thus, for example, the system permits to use decision-making methods and criteria such a, Optimist Criterion, Pessimist or Wald Criterion, Laplace Criterion, Savage Criterion, Hurwicz Criterion and others. Analyze of these criteria conduce to select the alternative more convenient in from of different decision situations. This software tool can be used if it is possible to define objects or word problems as a function of certain set of parameters and weights. These can change according to a relative importance of each parameter. A feature or attribute is used in order to measure the efficiency in relation with a determined objective. The features initially can be vague and later can be defined with mayor precision depending of knowledge level acquired by experts.

Table 1

Intervals of variation of parameters

Classes	Inferior limit	Superior limit
1	min $\{Aij\}$	1/3 [max $\{Aij\}$ + 2min $\{Aij\}$]
2	1/3 [max $\{Aij\}$ + 2min $\{Aij\}$]	1/3 [2max $\{Aij\}$ + 2min $\{Aij\}$]
3	1/3 [2max $\{Aij\}$ + min $\{Aij\}$]	max $\{Aij\}$

The selection of specific word problems based on student's performance will improve the learning quality. In this relation, the bank (stock) of word problems is divided into classes or complexity levels depending of difficulty or complexity of its solution. The usual way of dealing with problems for a voluminous and complex problem is to divide the system situation into sub-problems or cases. Problem situations or cases that are included in a class should be selected in accord to its «similarity». Expert and teaching criteria determine the complexity of OR problems. In each case the student's task consists in identifying, diagnosing or revealing, what kind of problem is and to determine which the optimization model is more efficient or adequate in the particular decisional situation. He must decide taking into account the main characteristics (attributes, distinguishing qualities) of problem statement.

Another scientific problem that appears in the model identification process is associated to feature selection. In modeling process it is necessary to discover and select the most distinguishing qualities, features or attributes. They are closely associated to the model structure. Features selection permits to discover the similarities and differences between different models. The selection of the «best» subset of features from a given set is considered an important and complex scientific problem.

Complex system is a system composed of interconnected parts that as a whole exhibit one or more properties not obvious from the properties of the individual parts. The complexity of a system can be expressed in function of the number of elements, properties and relations between elements and parts of the system. In this relation, we can define the complexity of an optimization model as a function of its properties, attributes, distinguishing qualities or features (objectives and restrictions). The complexity of a model increases in dependence of its attributes or features quantity. Between the features, attributes or distinguishing qualities of the models we can indicate or mention the following ones: productivity, time available, profit, cost, availability, technical specifications, selling price, land available, source, destination, supply, demand and others. We understand as feature an objective or subjective evidence that signs or warns on the existence of something or the membership to certain predefined class or category.

On this base, he concludes and select between the optimization methods set: transportation; assignment; blending; and/or other. According to OR teaching experience and practice new software based on Systems Approach was designed. In other words, for each class or complexity levels was proposed word problems set, in which the student is encouraged to compose and decompose different real systems. The learning goal consists in training the student to solve different problems using the systems approach. Related with this conception several word problems associated with each representation stage (or layer) can be proposed to the student. Only by learning the isolation, decomposition – composition concepts and the hierarchical representation of systems, students would obtain a clear idea of the optimization problems and finally get its entire domain.

Actually we are developing a new version of the Classifier system on Internet. The designed Hypermedia Problem Classifier and Generator contribute to reach the teaching goal. The student can analyze several problem representations by means of video, photos, graphics, animations and sound. This facility improves student's relations with the reality and its modeling. The student actively participates in a Cognitive Experiment. He can change several structural components of the problem and study its characteristics under different conditions. This process to make deeper or more profound their knowledge on modeled «real phenomena or systems» in magnitude and complexity. The students can move from one node (problem statement) to another in accordance with their learning objectives or goals. A problem statements' graph was designed. The root node is the «biggest problem statement». The interior nodes are

coupled problem statements and their children represent their sub problems or cases. The set of problem statements represents the most general problem situation and the interior nodes are the based on Systems Approach. In this relation, the student knowledge could be increased step by step from one node to another. This design element is very important in order to increase the quality of System (Tabl. 2).

Expert Module

Expert Module (**EM**) is formed by a knowledge base and an inferencing engine. It is a software package that attempts to simulate the function of an expert in OR model selection. The program acts as an intelligent consultant or advisor in the OR domain, capturing the knowledge of one or more professors and experts. Expert Module answer questions, solve problems, and make decisions. This is a creative way to capture and

Table 2

Classifier definitions

Classes of dominion	Description
Universe	Define the knowledge area, in this case Operations Research
Problem	Describe the word problems formulated by the professor to student, they can be transport problems, mixture problems, assignment problems and others
Parameters	Attributes or features that characterize each problem in a knowledge area
Classification	Classification in complex levels in accordance with the maximum number of defined by the professor
Professor	Person who use the application. He is the Expert in the knowledge area
Student	Person who use the application in accordance with the access defined by the system`s administrator
Expert	Expert is the software package in which are defined the production rules, questions and answers associated to the identification of optimization model in accordance with the problem formulation. ORWEB has a forward chaining inference engine
Expert Mode	Information Process where Expert (Professor) edit the Knowledge Base, enter questions, and its answers, formulate the productions rules and execute the inference engine
Professor Mode	Information Process where Expert (Professor) defines the overlay model. In it, he enters the correct answers to formulated questions
Student Mode	Information Process in which the Expert verifies the consistence and veracity of the student knowledge in trying to identify of OR model in accordance with the formulated problem

package knowledge. EM software is knowledge based as it contains useful facts, data, and relationships that are applied to solve creatively the OR identification problem. It contains a special type of heuristic knowledge derived from real teaching and learning experience in Operations Research. It is knowledge derived from learning by doing. EM diagnoses students' mistakes, faults and misconceptions in OR model selection and gives the appropriate recommendations in order to improve their work. It represents the expertise knowledge as data or rules within the computer. These rules and data can be called upon when needed to solve problems. EM architecture includes three major components: 1) a working memory that holds the facts, the goal and intermediate results; 2) rule memory which holds all the system rules; 3) rule interpreter which decides about rule applicability and firing sequence [1–8].

In correspondence with the OR application domain was developed and implemented a specialized OR shell. In accordance with the characteristics of the OR identification problem was developed a forward chaining inference engine. EM contains too explanations facilities. It interacts with the user asking their question on how and why. When it used in the learning environment, it will gave many benefit to student as it prepare the answer without referring to the teacher. Beside that, expert module is able to a give reasons towards the given answer.

EM contains the knowledge about the subject area (Optimization Models) we want to teach. Drawing on this knowledge the system should be able to answer the student's questions and give him guidance. Here, one should strive for deep structure knowledge instead of surface knowledge. In the case of OR this module includes the knowledge that an expert uses when he selects the best solving method. The acquisition of this kind of knowledge is extremely difficult, but this «implicit knowledge» should be made «explicit» in order to be taught. The proposed method provides questions about OR models and it recommends the more rational solution for the given conditions. The knowledge base has been built through interactions with OR professors. This body of knowledge is represented as a collection of conditional sentences called «production rules».

A production system offers a number of formalisms for representing expert knowledge. The most important of these of course, is the production rule formalism, in which the actual problem solving knowledge is expressed. The entire set of production rules in a production system is called its rule base. In addition to the production rule formalism a production system provides a means for defining the objects referred to *n* the production rules, called the domain declaration. The base rule and the domain declaration together constitute the knowledge base of the production system.

In EM the underlying knowledge for an identification problem can be formulated as two discrete finite sets which define the scope of identification problem, they are:

– MODEL = $\{m_1, m_2, \ldots, m_n\}$ – representing all possible Optimization Models that can be formulated;

– FEATURE = $\{f_1, f_2, \ldots, f_n\}$ – representing all possible Features that can be exhibit in the problem statement;

Definition

An identification problem IP is a $F' \subseteq$ FEATURE. F' – represents the features (attributes or distinguishing qualities) occurring in a specific case.

An IP is a triple <MODEL, FEATURE, F'> where these components are:

– MODEL = $\{m_1, m_2, \ldots, m_n\}$ – representing all possible Optimization Models that can be formulated;

– FEATURE = $\{f_1, f_2, \ldots, f_n\}$ – representing all possible Features that can be exhibit in the problem statement.

For example, a Mixture Problem can be described by a feature set like as:

Mixture Problem
[Description]
Features:
– rough materials;
– finished products;
– capacities;
– necessities;
– technological requirements.

At the present paper will be introduce too a security factor *K*. It is a subjective non-numerical estimate of how certainty the student (user) recognizes the existence of determined feature (attribute or distinguishing quality) in the problem statement. For example, the feature exists with:
– completely sure;
– more o less sure;
– non-sure.

Certain features present in the problem statement can be viewed as relevant to recognize certain type of model. For example, the existence of origin and destination points addresses the search to the set (class) of transportation models. In contrast, other features of a problem statement are not causally associated with it. In problem statement you can find redundant information or information not relevant to recognize specific OR model.

The major part of knowledge takes the form of heuristic rules or rules of thumb, which, as we shall see, are the informal, real-life analogies of production rules. In a heuristic rule, several conditions and conclusions are interrelated, as follows:

RULE: IF
The problem exhibits feature F_1
And
…
The problem exhibits feature F_i
…
And
The problem exhibits feature F_m
THEN
We may conclude that the likely model is of type MODEL_j with a security factor *K*.

It was supposed that we have a set of optimization models. This means we can solve each selected model using the Solver module. This Solver has the required algorithm to solve them. In this relation, certain number of model classes was established. They are the following.

Production systems:
– production assembly lines problems;
– production distribution planning problems;
– resource assignment problems;
– blending problems;
– diet problems;
– location – investment problems;
– and others;
– transportation problems;
– generalized transportation problems;
– transshipment problems;
– assignment problems;

– route problems;
– critical paths problems;
– and others.

Several syntactic forms have been developed for the representation of production rules. At the present work we employ the syntax described in the following definition.

Definition:

A production rule for an OR identification problem is a statement having the following form:

< production rule > :: = if < antecedent > then < consequent >

< antecedent > :: = < distinguishing quality > {and < distinguishing quality >}

< consequen t> :: = < string > < variable >

Follows an example of Expert Module Knowledge Base designed for OR model identification is showed.

```
/*
This is a description for a linear programming example
Research Center for Systems Engineering
2008
*/
DTree LinearProg,
HelpFile 'Base.Hlp'.
QUESTIONS
«Are there origin and destination points in the problem statement?»;
«Have intermediate points that transship products from the sources to destinations?»;
«Are there capacity restrictions from sources to destination points?»;
«Have transportation costs from the origins to destinations?»;
«Are there rough materials and products?»;
«Have mixtures?»;
«Is there a diet?»;
«Is there an assignment?»;
«Is there assembly lines?».
ANSWERS
«Non-linear model»;
«Integer programming»;
«General Simplex model»;
«Maximum Flow model»;
«Transshipment model»;
«Generalized transportation model»;
«Standard transportation model»;
«Assignment model».
RULES
Rule:   PL54
        IF:      Linear = «Y» and
                 Origins = «Y» and
                 Transship = «N» and
                 Capacity_restrictions = «Y»
                 Transportation_cost = «N»
        THEN:   method = «Maximum_Flow»
RULE:   PL55
        IF:      Linear = «Y» and
                 Origins = «Y» and
                 Transship = «N» and
                 Capacity_restrictions = «Y»
                    Transportation_cost = «Y»
    THEN: method = «Maximum_Flow_Minimal_Cost»
```

Experts go from the initial formulation of general questions to the formulation of more detailed questions lastly. In the last time, we thank on the possibility to develop an intelligent editor. Its objective consists in helping students in mathematical model formulation. In this relation, a new module for determining the mathematical model of proposed problem was designed. The intelligent editor encourages the student to find the mathematical model helping him in this complex task by means of warnings and commentaries. Finally, when the student has edited his mathematical model version the editor compares it with the expert formulation and explain the student its characteristics.

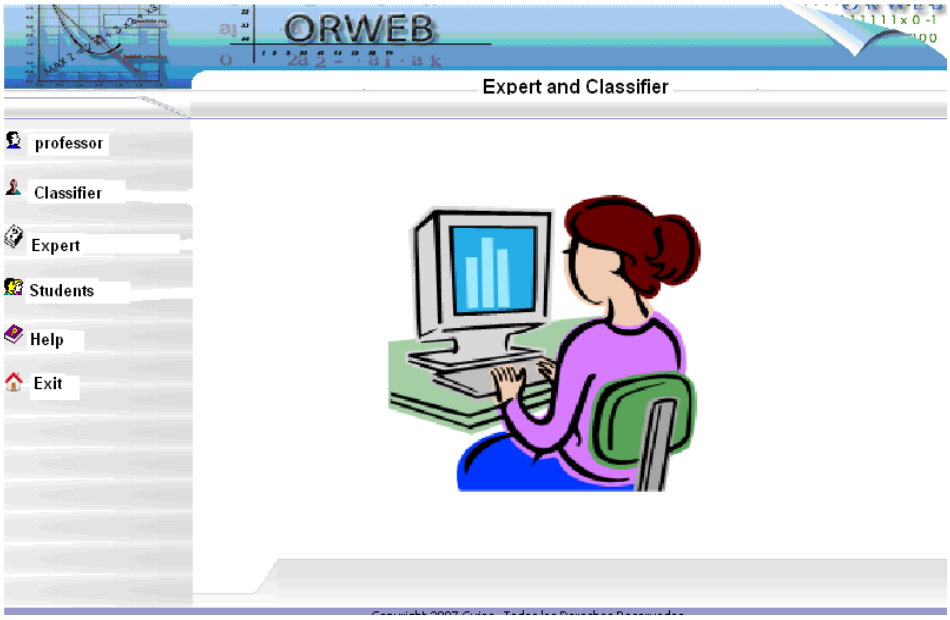

Fig. 1. Expert and Classifier

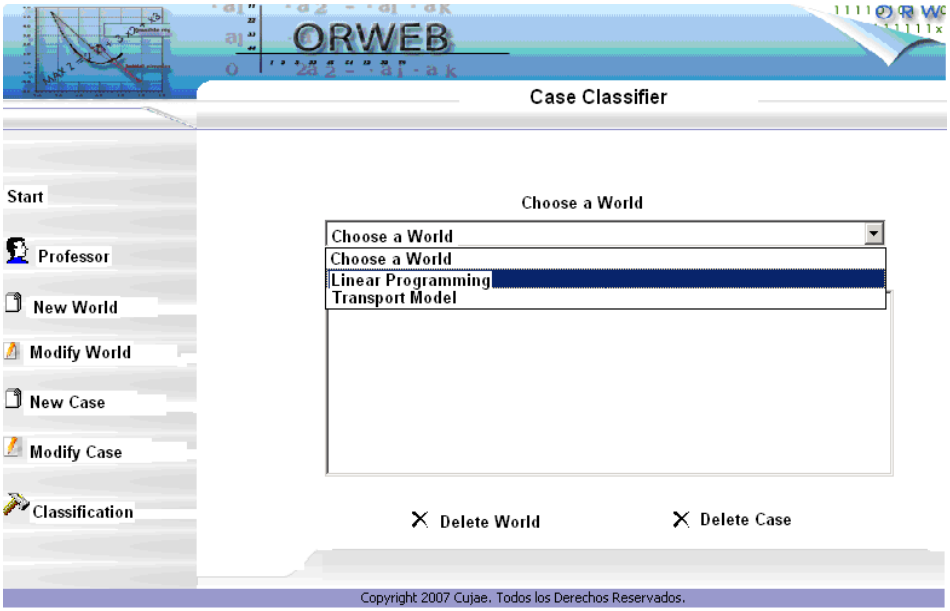

Fig. 2. Case Classifier

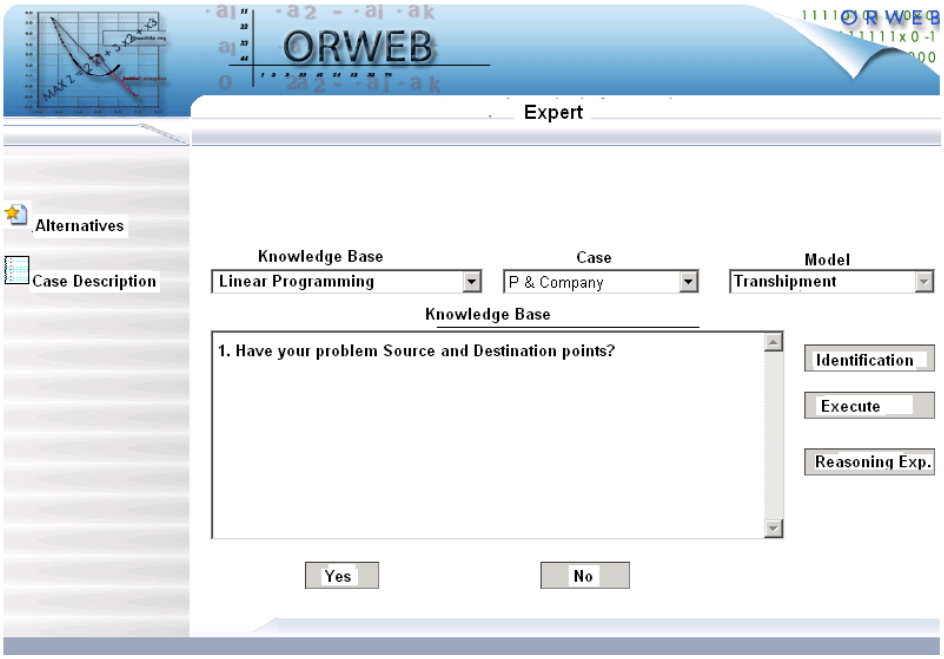

Fig. 3. Expect module operation

At the present section, the ORWEB software modules and the Data Base design is described in detail. Therefore, the user interface design principles, the report's format and the error processing are discussed. Client and server technologies developed at the present application minimize the feedback time and the user errors. Client application is responsible for reordering data, meaning that error processing and retransmission are also handled by the client. In ORWEB site are making immediately verifications of the information given by the user. Its objective is the elimination or reduction to a minimum the incorrect data sent to the server. This validation takes into account the fallowing errors: empty data fields; syntax's errors in rules statements, in questions and answers designed by the expert; and others (Fig. 1–3).

Conclusions

At the present paper, it is proposed a new approach based on Systems Theory, Knowledge based Systems, Case based Reasoning and e-learning in OR model building and optimization problem solving. A new hypermedia intelligent system on Internet is proposed and described. It have been developed a set of software modules that make easy, efficient and comfortable the work of learners, professors and students. Between these modules can be mentioned the following:

1) classifier;

2) expert; and others.

Here was explained the classification problem. This software tool permitted to find a computer solution to process of subjective evaluations by means of different expert methods, such as Delphi Method, Kendall Tau Method and others. Classifier has been used for classifying different objects and word problems and it can be used also to classify the academic state of each student during a training session. It is an interesting question because the academic state of students can change dynamically during the training sessions using a Hypermedia Intelligent Trainer System. It helps professors to

organize the problems banks improving the student efficiency in OR identification problem solving. Here was presented too the Expert Module.

Expert Module is formed by a knowledge base and an inferencing engine. It is a software package that attempts to simulate the function of an expert in OR model selection. The program acts as an intelligent consultant or advisor in the OR domain, capturing the knowledge of one or more professors and experts. Expert Module diagnoses students' errors and misconceptions in OR model selection and gives the appropriate recommendations in order to improve their work. The system has been implemented in .net technology using C# computer language and web services. At the present time, it has been testing and improving at Havana Institute of Technology. Using ORWeb student can analyze different problem situations and solve complex OR problems by means of computer system on Internet. This facility improves the student's relations with the reality and allows him to develop modeling skills. Implemented system stimulates the student active participation in teaching and learning process. It has been developed at Havana Institute of Technology. It has been used by professors and students of several Cuban universities in their projects and thesis works for several years.

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Определение оптимизационных задач средствами кластеров и основанных на знаниях систем в Сети (Интернете)

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Ключевые слова и фразы: искусственный интеллект; кластеры; системы интеллекта; электронное обучение.

Аннотация: В последнее время проектирование и реализация моделей с использованием компьютерных технологий и методов находится в центре внимания многих научных работ в области искусственного интеллекта, исследования операций, систем поддержки принятия решений и систем менеджмента. Приемы и методы доказательной аргументации часто используются в решении задач. Они помогают создателям моделей определить и спроектировать оптимизационные модели, при этом в процессе моделирования они совершенствуют свои когнитивные навыки и знания. В настоящей статье предлагается новый подход, основанный на применении доказательной аргументации в ходе создания модели. Проблемы, связанные с созданием оптимизационных моделей с помощью компьютера, широко обсуждаются с точки зрения теории и практики. Кроме того, предложена и описана новая интеллектуальная система. В ее задачи входит оказание помощи профессионалам (специалистам, преподавателям, студентам и др.) в создании моделей и их реализации в Сети. Быстрый рост информационных и телекоммуникационных сетей, и в частности, Интернета, а также его быстрое распространение, использование и внедрение в университетах, профессиональном обучении, аспирантуре обусловило необходимость определения наиболее эффективных способов его применения в процессе преподавания и обучения. В электронном обучении Интернет и цифровые технологии используются для подачи материала синхронно и асинхронно всем, кто имеет доступ к компьютеру и Интернет-соединению. Принимая во внимание сложившиеся обстоятельства и потребности, была предложена новая электронная обучающая платформа для преподавания и изучения исследования операций. Система была реализована с помощью .net технологии с использованием языка программирования C и сетевых услуг. В настоящее время она проходит апробацию и усовершенствование в Институте технологий Гаваны.

Bestimmung und Lösung der Optimisationsaufgaben im Computernetz

Zusammenfassung: In der letzten Zeit sind die Projektierung und die Realisierung der Modelle mit der Benutzung der Computertechnologien unter der Berücksichtigung vieler Wissenschaftsarbeiten auf dem Gebiet der Kunstintelligenz, der Operationsuntersuchungen, des Systems der Unterstützung der Beschlußfassung und des Magemenentsystems. In diesem Artikel wird die neue Methode der Modellenentwicklung vorgeschlagen, die sich auf die Anwendung des Systemherangehens, der Systeme, die auf die Kentnisse, überzeugender Argumination und der Computerausbildung, stützt. Aus der Sicht der Theorie und der Praxis warden die Probleme, die mit der Schaffung der Optimisationsmodelle mit Computerhilfe, besprochen. Außerdem wird das neue intermediale Intelligenzinternetsystem vorgeschlagen. Sein Ziel besteht in der Hilfe den Ausbildendern (den Professionals und den Studenten) in der Konstruierung und in der Realisierung der Modelle. Mit Rücksicht auf diese Konzeption wurde die neue Ausbildungsplattform für den Unterricht und das Erlernen der Operationsuntersuchung erarbeitet. Das System wurde mit Hilfe der .net-Technologie mit der Benutzung der Programmierungssprache C und der Netzleistungen realisiert. Gegenwärtig verläuft dieses System die Approbation und die Verbesserung im Institut der Technologie Havanna.

Définition des problèmes d'optimisation par les moyens des clastères et fondés sur les connaissances du Réseau (Internet)

Résumé: Ce dernier temps la conception et la réalisation des modèles avec l'emploi des technologies et des méthodes informatiques se trouve au centre de l'attention de beaucoup de travaux scientifiques dans le demaine de l'intelligence artificielle, des études des opérations, des systèmes du maintient de la prise des décisions et des systèmes de management. Les moyens et les méthodes de l'argumentation de la preuve sont souvent utilisés dans la solution des problèmes. Ils aident les créateurs des modèles de définir et de concevoir les modèles d'optimisation; de plus dans le processus de la modélation ils perfectionnent leurs savoirs et leurs connaissances. Dans le présent article on propose une nouvelle approche fondée sur l'application de l'argumentation de la preuve lors de la création du modèle. Les problèlmes liés à la création des modèles d'optimisation à l'aide de l'ordinateur sont largement discutés de point de vue de la pratique et de la théorie. Outre cela on a proposé et décrit un nouveau système intellectuel. Ses tâches comprennent la prestation de l'aide aux professionnels (spécialistes, professeurs, étudiants, etc) dans la création des modèles et leur réalisation dans le Réseau. L'augmentation rapide des réseaux informatiques et télécommunicatifs, en particulier, l'Internet, ainsi que sa vite propagation et l'introduction dans les Universités, dans l'enseignement professionnel et au stage de recherches boursiers ont abouti à la définition des moyens les plus efficaces de son application lors de l'enseignement et l'éducation. Dans l'enseignement one-line l'Internet et les technologies digitales sont employés pour donner une présentation synchrone et asynchrone du matériel à tous ceux qui ont accès à l'Internet. Compte tenu de tous les circonstances et necessités on a proposé une nouvelle plate-forme électronique pour l'enseignement et l'étude des opérations. Le système a été réalisé à l'aide de la technologie Net, la langue de la programmation C et les services du réseau. A présent ce système est en train d'être tester et perfectioner à l'Université des Technologies à Havane.