Tackling Approach for Transferring Database to Knowledge Base via Practical Algorithm

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Abstract: Nowadays, data and information gathering became the core of almost all technologies. The collection of this data, its arrangement and orientation in a way that provides easy access, manipulation, updating and management is what's called "Database". While knowledgebase is like a reservoir, it commonly stores the obtained answers to proposed questions, or saves the solutions to previously faced problems, thus providing speedy search, recovery and reuse. The approach of transferring database to knowledgebase will greatly help in benefiting from the advanced features of Knowledgebase, and this can be achieved by creating a practical algorithm which is presented in this paper to improve data representation and to be able to predicate extra facts depending on rules. The proposed approach achieves moving traditional database into logic syntax. A case study is presented to reflect implementation of the algorithm. This paper is towards the database community to improve the overlap with the expert systems and integrate between them, and the proposed transferring algorithm will be of great support to all researchers in the field of Database and Knowledgebase.
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1- Introduction

Having data and dealing with it is a powerful aspect in any research area. Both database and knowledge base fields are related to processing data and gathering information and then generating knowledge. There are some similarities between database and knowledgebase which makes them somehow indirectly related to each others, however, there is a great difference between them which needs further investigations to understand these grey areas in between.

Understanding the overlap and integrations between expert system and database raise the possibilities of transferring data from one state to another. This transfer aims to overcome the limitations faced by the first state and converts it to the second one to benefit from its extra features in overcoming those limitations. In this research paper, an algorithm is proposed to transfer traditional database into knowledgebase to be smarter, generates new facts and predicates according to existing data and rules.

This paper is organised as following: related works for the integrations between databases and expert systems are mentioned in section 2. A general comparison between database and knowledgebase is discussed in section 3 to understand similarities and differences. The view on overlaps between database system and expert system are explained in section 4. After standing on the critical areas, the proposed algorithm is listed in section 5 to transfer the database into knowledgebase and take advantage of both sides. The case study is given in section 6 to show the scenario of dealing with data from database to reach knowledge base. Then the conclusion which points out to the main points, followed by the future works in section 7.

2- Related works

Researches in relational databases started more than thirty years ago. Nowadays, relational database is considered as a well-known and developed type of databases. Relational databases store structured data in relations (tables) by containing records in rows and attributes in columns. It connects between data values using relations concepts and referential integrity. Applying structured query language (SQL) to retrieve and manipulate data in relational databases is considered as one of the main reasons of their popularity [1-2].

Thousands of researches were published related to relational databases but still there are some points that need further investigations and advance developing in dealing with relational database. One of these points is developing database to be smart and handling data in intelligent ways. These lead to encouraging some researches to study the overlaps between database and expert system [3-6]. Eaglestone and Ridley [3] explained the overlap from database perspective focusing on issues related in verification, validation and integrity. They found disjoint with expert system due to these limited issues but they expect in future research that expert system will support databases in wider and advanced manner. On the other hand, Coenen [4] discussed the same point from expert system view and explained the overlap areas that include: Deductive Database, Active database, and Error Detection. Authors in [5-6] emerging the overlap between expert

system and database from both perspectives and limited to verification, validation and integrity issues.

Capon [7] discusses the importance of working together for both Database and expert systems investigators' to achieve adding extra values and complementing each other. The paper also explained the relation between Databases systems and expert systems. While databases mainly focus on storing huge amounts of data to do variety of tasks, the expert systems focus on small amounts of data to perform specific tasks depending on intentional definitions.

Other researches directed developing smart expert system to solve issues in databases. Moussa [8] proposed a recommender expert system to help in design process for distributed databases by studying all cases of fragmentations and select the appropriate one. Some researches mentioned that knowledge based for different aspects can be depended on by using databases [9-11]. Researches in both articles [9-10] developed knowledge base of safety expert system utilising the concepts of relational database by storing facts and rules in tables. Howard and Rehak [11] proposed a prototype of flexible interface for connection with both knowledgebase and database.

Many concepts of integration and transferring are used commonly in deferent approaches to gather features from many areas and provide additional values. The study in [12] developed procedures to integrate expert system with database to identify mechanisms of failure. Authors in [13] integrated between relational databases and graph databases by suggested hybrid approach to face growth in data and handle different structure for data. Karnitis and Arnicans [14]offered a quick approach to migrate relational databases to document-oriented database for providing technical solutions for transferring data and assists many companies towards using NoSQL databases in cloud computing. This approach used two logic levels based on physical level. In addition, several proposed approaches to map among relational databases, object databases and XML databases are observed in survey paper done by Gamal et al. [15]. Hasan and Huq [16] developed techniques to transform from multi value database system to a relational database system. They aimed to solve retrieval issues in using query and suggested generating schema to third normal form (3NF). Another case of transformation in data representation that Deka [17] proposed is an approach to transform multidimensional data model into graph model to support queries operation.

3- Database vs. Knowledge base

Database is a core component and works as a backbone in any system. Database mainly used to manage data which includes storing, retrieving and accessing processes. It can be defined simply that a collection of related data can represent real world information. Database systems were developed over timeline and investigated from different perspectives until they reached what they are nowadays. Starting from hierarchical and network databases reaching to relational databases that are considered as world well known model and to object database. Also, NoSQL database is still under development to handle data in more flexible ways with structured or unstructured data. This research focuses on a relational database since it is classified as standards.

On the other hand, knowledgebase concentrates on dealing with knowledge rather than data. It can be classified as kind of advanced database that has intelligent features. It is developed to be smarter and handling different sources of information. Using knowledge base to predicate and support decision in expert systems. It is a tool that can take benefit from previous experience data to detect problems and suggest solutions in intelligent ways.

Both database and knowledgebase concepts can support each other in direct and indirect manners. This led to studying the overlap between database system and expert system in the next section.

4- Overlap between Database system and Expert System.

The overlap areas between database system and expert system were studied in [3-6] from different perspectives. This section discusses the main viewpoints.

4.1. The Architecture of Expert System and Database System

Comparing the architecture of expert system and database system shows that some parallels points. The expert system architecture consists of main components: user interface, inference engine and knowledge base that are shown in Figure 1. The database system includes application programme, Database Management System and Database that explained in figure 2. The concept of operating management applied in expert system as inference engine and in database as database management system. Both systems are developed using usual software engineering tools since they are considered as traditional software. They have repository for storing information in expert system which contains knowledge base including rules and in database system contain database. The concepts of verification, validation and integrity can be concerned in both repositories [3-4].

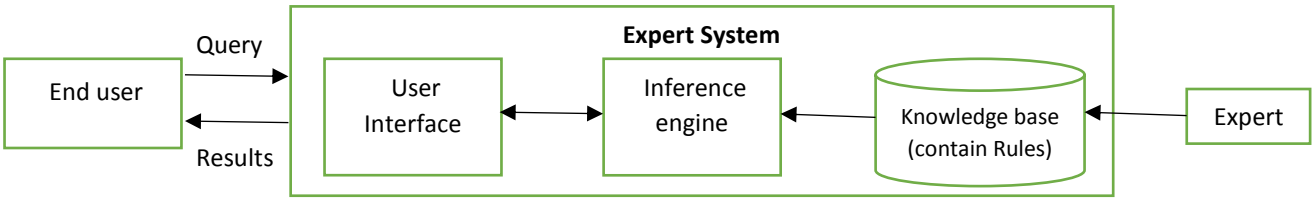

Figure1: The Architecture of an Expert System

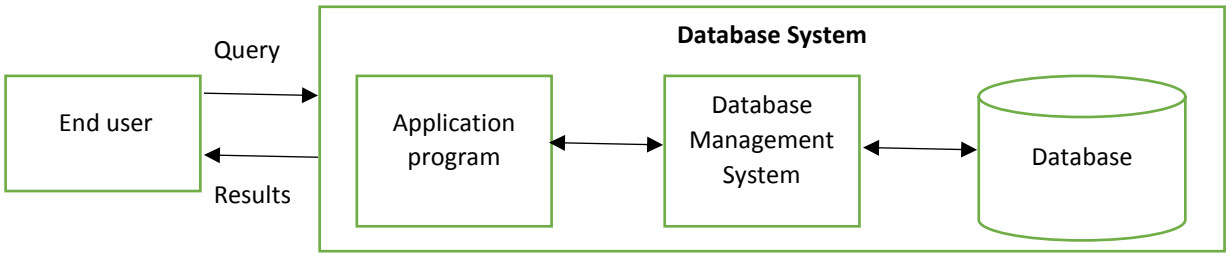

Figure2: The Architecture of Database System

4.2. Deductive Databases (DDB)

Deductive database system can deal with data, information and knowledge. It combines between relational database and logic programming to make deductions [4]. Datalog used as language to represent data, rules and facts in Deductive database. It can predict new information using existing data by generalising concepts and store rules in expert system formats. Applying deductive concepts into relation to database led to making it smarter and can handle extra tasks. This paper will apply some deductive rules to transfer relation database into knowledge base and the intelligent features on it[5,6,18].

5. The Proposed Algorithm for mapping Database to Knowledgebase:

Data in database can be expressed and mapping to knowledgebase using following algorithms:

1- Make conceptual design for relational database using entity relationship diagram (ERD).
2- Mapping ERD into relations (tables) and fill the with datasets.
3- Convert each tuple in specific relation into fact. Write fact base using logic programming that reflect data in relations. Each line in fact base equivalent to record in relational database.
4- Express quires in SQL to interact with data in relational database.
5- Convert SQL query into logic syntax using rule based programming
6- Store rules that can used in different ways.
7- Retrieve data in applicable queries forms using rule based programming and predict knowledge.

6. Case Study

This case study represents data for student in the university databases. Applying the proposed practical algorithms to it will be as following:

Step 1:

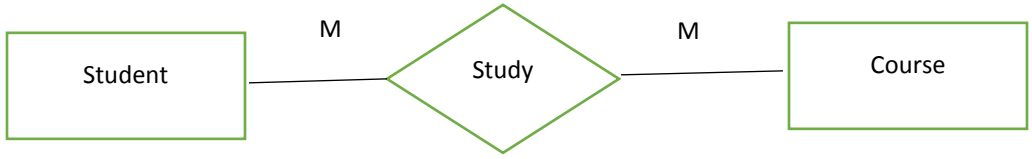

Figure3: ERD for case study

Step2:

Table1: Relations for case study

Student

Student_ID	**Student_Name**	**Address**	**GPA**
7001	Saleh	Makkah	3.99
7002	Mohammad	Jeddah	3.3
7003	Ibrahim	Taif	2.7

Course

Course_Num	**Course_Name**	**Hours**
Com101	Databases	4
Com102	Security	3
Com103	Networks	3

Study

Student_ID	**Course_Num**	**Marks**
7001	Com101	97
7002	Com101	70
7003	Com103	88

Step 3

```
Student (7001, Saleh, Makkah, 3.99).
Student (7002, Mohammad, Jeddah, 3.3).
Student (7003, Ibrahim, Taif, 2.7).
…
Course (Com101, Databases, 4).
Course (Com102, Security, 3).
Course (Com103, Networks, 3).
…
Study (7001, Com101, 97)
Study (7002, Com101, 70)
Study (7003, Com103, 88)
```

Figure 4: rule based programming (PROLOG) fact base

Step4:
SQL Query

```
Select Student_Name
From Student,Study
Where Course_Num=Com101and
Student.Student_ID=Study.Student_ID;
```

Step5:
Query into logic syntax using rule based programming

```
Select (Student_Name):- Study (Com101, Student_ID),
Student (Student_Name, Student_ID).
```

Step 6:
Store rule:

```
Select(Student,Study,Course):-
Student(Student_ID,Student_Name,_),Study
(Course_Num,Student_ID,_).
```

Step 7:

1- Return all student and related information.
2- Return all student and their information, studying specific course.
3- Return specific mark for student studying specific course
4- Return a particular course information and registered students.

5- Return all courses offered and their information.
6- Return other related data in intelligent manner.

Several points encountered during the transfer from database to knowledge base. Database system focused on storing original data and managing access and information retrieval. Moving data to knowledge base makes the system can predicate other information and uses rules for more facts. The objective of transferring data from the start is to face obstacles or to add features to another state. Simple seven steps defined as algorithm in this proposal approach can be used to improve using database with different applications. It starts with designing the database then converting it to logic syntax and finding rules for predictions. These steps can get extended further to cover extra situations and can handle different case studies.

7. Conclusion

This work proposed a new approach to extend the functionality of database to be more intelligent by suggesting the algorithm to transfer data in database to knowledgebase. This algorithm developed to avoid limitations in database that manly depends on storing and retrieving data to be more dynamic to generate new facts from existing ones. In addition, this approach aims to satisfy a certain level of transferring stored data and taking benefit from it. This proposed algorithm needs further Investigations and practical experiments. The future work will plan to test the proposed approach with large scale of databases and in different states and case studies. Also, the integration between databases and expert system will be studied by applying and designing expert system to support the database administrators.

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