World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(REVIEW ARTICLE)

Check for updates

Translation of imprecise query into SQL Query via MATLAB

Subita Kumari and Sonia *

Department of Computer Science, Govt. PG College for Women, Rohtak.

World Journal of Advanced Engineering Technology and Sciences, 2025, 15(03), 2312-2319

Publication history: Received on 12 May 2025; revised on 21 June 2025; accepted on 24 June 2025

Article DOI: https://doi.org/10.30574/wjaets.2025.15.3.1149

Abstract

A Relational Data Base Management System (RDBMS) is software which offers convenient and effective method of storing and retrieving information from database. In real life user's queries are in natural language, so queries need to be expressed using vague or imprecise or fuzzy terms. This paper provides the flexibility to query the database in natural language using FRDB (Fuzzy Relational Data Base). FRDB allow users to have a range of answers, which in turn will enhance the eloquence of human expression, without extra search time and cost. Fuzzy query interpreter layer of FRDB assists to translate vague query into SQL query without learning a new query language. Automatic mapping of existing RDBMS can be done with FRDB, which increases the efficiency of query response. In this paper fuzzy queries are being translated into SQL query. Query Builder tool of MATLAB is being used to show the result of query.

Keywords: Query builder tool; SQL; FRDB; Membership Function

1. Introduction

Databases hold data that represent properties of real-world objects. Fuzzy relational database is extension of relational database which comprise of fuzzy predicates or fuzzy conditions to express linguistic expressions. So, Fuzzy Relational Data Base Management System (FRDBMS) uses the concept of flexible queries that permits the user to get range of responses each one with its membership degree. It offers all intermediate variations between the dissatisfactory and completely satisfactory values [2]. FRDBMS is considered first of all a database. It must be made up of core of database which permits to execute the classical operations of the DBMS and to store, manipulate the fuzzy attributes [1]. We can add flexibility in database in many forms. The simplest one is to add a fuzzy membership degree to each record (a value in the range [0, 1]). Fuzzy database, being a querying tool, improves the meaning of the query as well as extracts additional valuable information. Linguistic expressions and degrees of truth are being used to select the wanted scenario for the user. These linguistic expressions have logical meaning for user and define a data selection process in the natural language [7].

2. Basic concepts

- Database: A database is a collection of information stored in a computer.
- Fuzzy Database: A fuzzy database is the one which is capable to deal with incomplete, uncertain or vague information using fuzzy logic.
- Traditional logic: It deals with information which is completely false or completely true. This logic does not deal with information that is imprecise or incomplete. A characteristic function assigns values of false or true to each element of the set in traditional logic.

* Corresponding author: Subita Kumari and Sonia

- Fuzzy Logic: Fuzzy logic has been derived from fuzzy set theory. It deals with interpretation which is rough rather than accurately deduced from traditional predicate logic. It can be considered as the application side of fuzzy set theory.
- Membership Function: A membership function is the one which assigns degree of membership to every member of the set in fuzzy logic. Fuzzy membership functions are being used to express vagueness in the query. Zadeh classified membership into two groups namely “linear” and “curved” [5].
- FRDB: It is an extension of the RDBMS. This extension introduces fuzzy predicates in the form of linguistic expressions which permits to have a range of answers having membership degree in order to offer all intermediate variations between the completely dissatisfactory answers and those completely satisfactory.
- Fuzzy Degrees: Fuzzy attributes have values in the interval [0, 1]. A fuzzy degree is a degree of membership that can have values from 0 to 1. A value of 1 shows complete belongingness and the value 0 means element doesn't belong to the fuzzy set. Values between 0 and 1 show the degree of uncertainty. The important terms of degrees used are : uncertainty degree, fulfillment degree, importance degree and possibility degree.

3. FRDBMS architecture

FRDBMS is a database which provides the same functionality as provided by RDBMS such as DDL, DML, confidentiality, security and integrity of database but with enhanced capabilities of working on vague or fuzzy information [1]. In this paper, a software layer has been added for translating fuzzy query into SQL query using VB.net. RDBMS used in this implementation is SQL server. For better reporting and analysis of results, Query Builder tool of MATLAB has been integrated with the implemented software layer.

3.1. Proposed Architecture

The proposed architecture of FRDBMS is based on GEFRED model [6]. FSQL_to_SQL layer has been introduced over conventional RDBMS server (SQL server). FRDBMS can model RDB as well as FRDB. The software layer converts the command given by user in FSQL language to equivalent SQL queries [3]. The new architecture of FRDBMS is shown in figure 1.

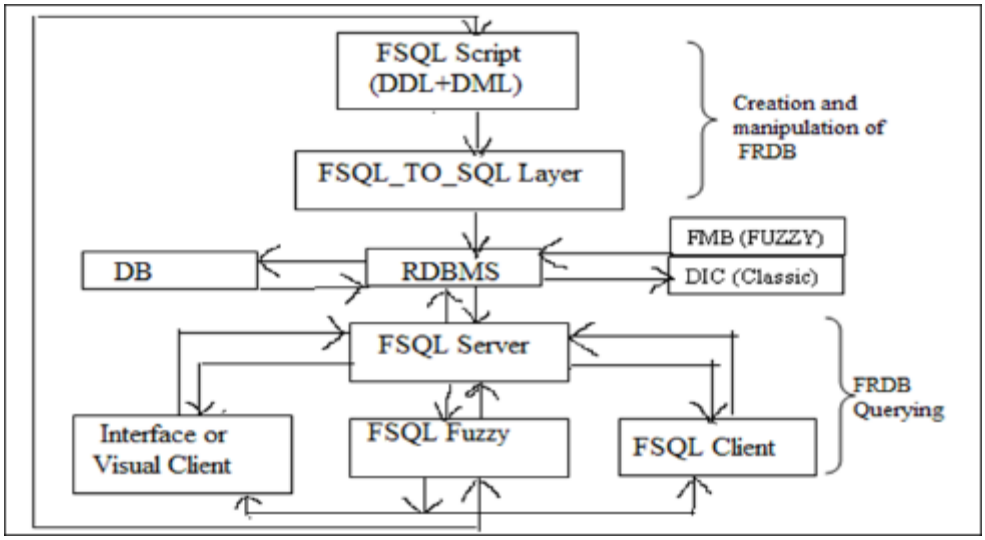

Figure 1 Proposed FRDBMS Architecture

3.2. Algorithm of Implementation

The algorithm of functioning of FSQL_to_SQL layer is as follows:

- Begin
- Read each instruction in the SQL query:
- If it is a traditional attribute,
- Send it SQL_Query.sql file.
- Else

Partition the vague attribute in two parts:

- Traditional attributes: Send traditional attribute part to SQL_Query.sql file.
- Fuzzy Attribute part: Each fuzzy attribute is being translated by script and the corresponding output having SQL equivalent of the vague query is being sent in the FMB_Output.sql file.
- End if
- End

4. Implementation

A sample database of a school has been used to implement the concept of flexible querying. Three tables Class, Student and Teacher have been taken in the database. Both Teacher table and Student table have fuzzy as well non fuzzy attributes. The field TeacherID is the primary key of the Teacher table and it is foreign key corresponding to the Incharge field of Class table. The field ClassID is the primary key of the Class table and it is foreign key corresponding to the Class field of Student table. The primary key of Student table is Roll_no. The database dependency graph is shown in figure 2.

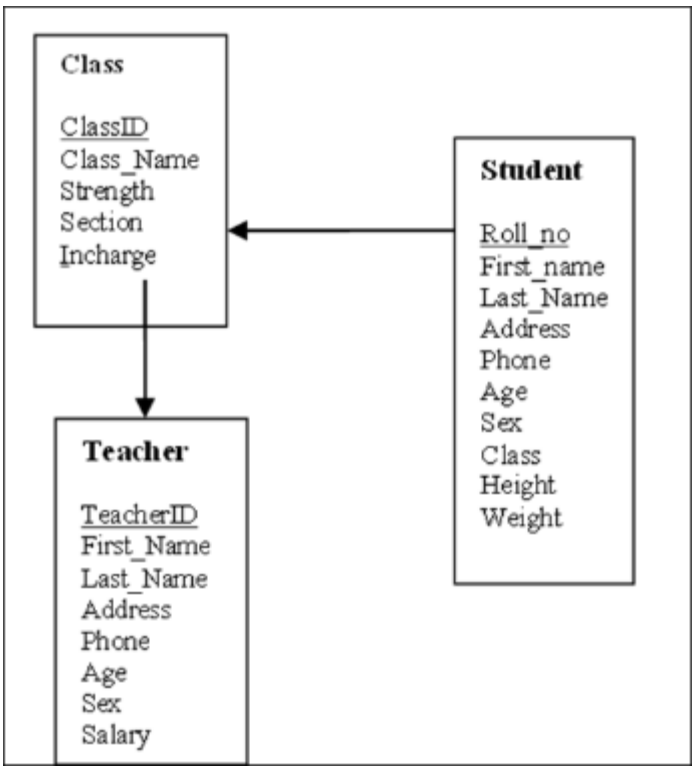

Figure 2 The database dependency graph

Now, Student table is taken with fuzzy field "Age" and all its fuzzy attributes. All the fuzzy attributes of "Age" field named "toddler", "young", "teenagers" and "seniors" with corresponding membership function are shown in Figure 3.

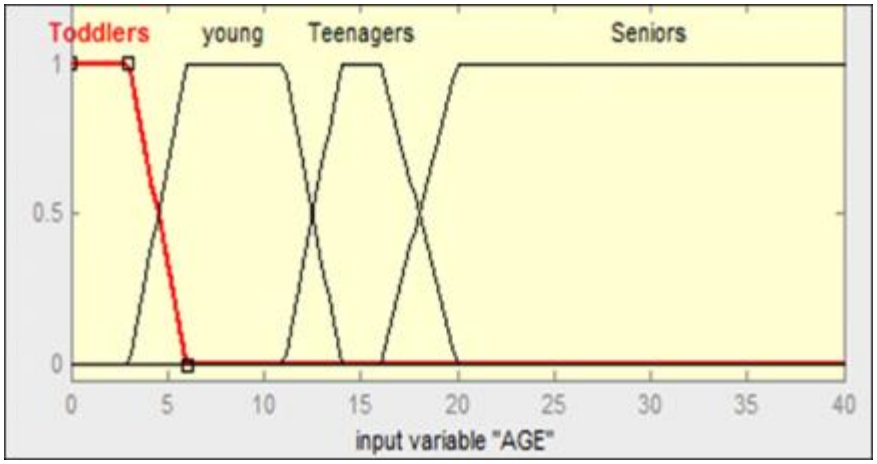

Figure 3 Fuzzy attributes of condition field AGE of table Student

Figure 4 shows the result of an executed query. User selects table, field and fuzzy attribute value through this interface. Then “Generate SQL from Fuzzy query" button is clicked. This gives results in tabular form with one additional attribute "Satisfying Degree" which in turn shows the fulfilling degree of corresponding row as per fuzzy value selected. The fuzzy database is updated each time any such query is executed.

Figure 4 Result of selecting Table-Student, Condition Field =Age, Fuzzy Value =Young

If "Show SQL Details" button is clicked by user, a query in the form of SQL which translates the vague data into precise form gets generated. The fuzzy logic used in this implementation is shown in figure 5.

```
Update Student set Satisfying_Degree=cast(case when (0 = 1) then case when
(Age<=11) then 1.0 when ((Age>11) and (Age<=14)) then
((14-Age)*1.0)/((14-11)*1.0) when (Age>14) then 0.0 end when ((0!=1) and (0!=1))
THEN case when (Age<=3) then 0.0 when ((Age>3) and (Age<=6)) then
((Age-3)*1.0)/((6-3)*1.0) when ((Age>6) and (Age<=11)) then 1.0 when ((Age>11)
and (Age<=14)) then ((14-Age)*1.0)/((14-11)*1.0) when (Age>14) then 0.0 end
when (0=1) then case when (Age<=3) then 0.0 when ((Age>3) and (Age<=6))
then ((Age-3)*1.0)/((6-3)*1.0) when (Age>6) then 1.0 end end as decimal(3,2))
```

Figure 5 SQL corresponding to Fuzzy Query

The generated SQL query is being transported in MATLAB using MATLAB database Query Builder tool. After executing this query in "Query Builder tool", a detailed report gets generated showing memory and size of the variable created as shown in figure 6.

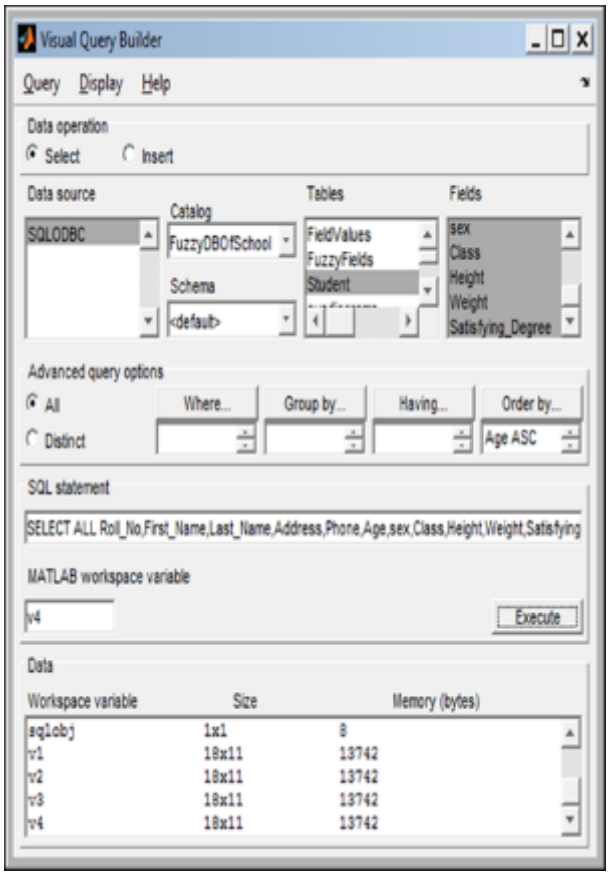

Figure 6 Execution of SQL query in MATLAB Query Builder tool

Query Builder Tool

- It imports data from SQL server into the MATLAB workspace.
- It can also export data from the MATLAB workspace into new records in a database.
- It displays retrieved data in the form of relational tables, reports, and charts.
- It automatically creates a MATLAB file which consists of functions to perform queries built using Visual Query Builder.

Figure 7 shows the charting view of Query Builder tool displaying the students whose age is between 3-14 years (Young) with their satisfying degree

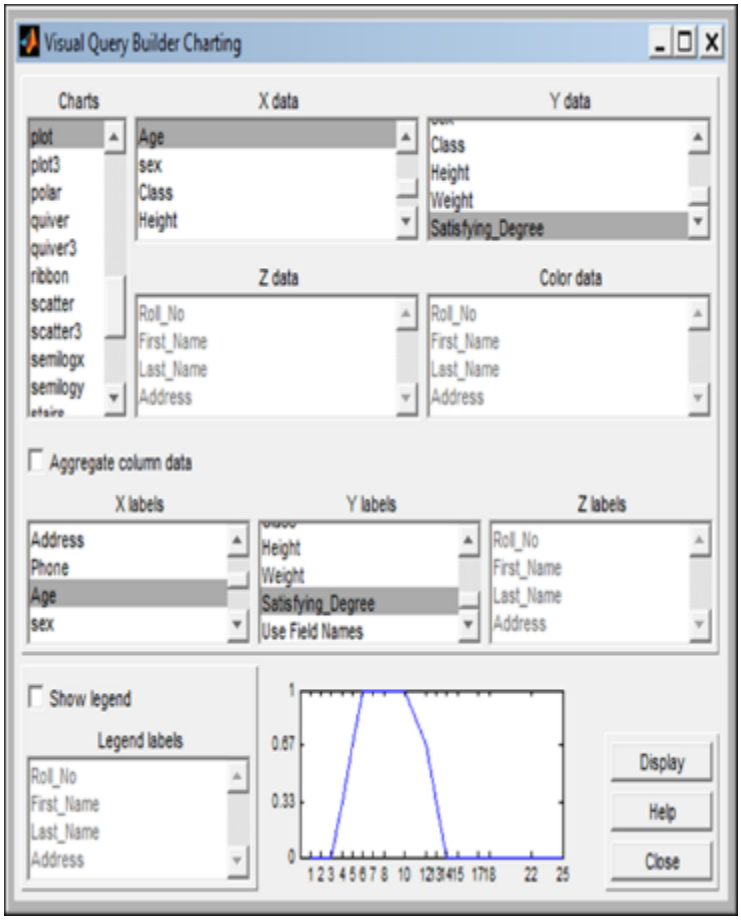

Figure 7 Query Builder showing result of Table – Student, Condition Field = Age

Every time Query Builder gives the updated report which is present in SQL database. Whenever a query is executed, SQL database stores result of that query and query builder report shows that output. The chart above displays all "Young" students with satisfying degree between 0-1.

So, this implementation provides users a tool to convert imprecise queries into SQL queries.

5. Conclusion

For users a query is best expressed in the real life terms of a natural language with ambiguities and uncertainties. But, when working with software one has to change the many valued thinking or any kind of ambiguities into two-valued computer logic. In SQL, one needs to specify query very crisply. So, there arises strong need to translate fuzzy query into SQL query. In this paper, a powerful and simple to use data mining tool has been built which allows user to query information from databases by making use of linguistic expressions in order to improve the quality of selection process and better reporting is being done using Visual Query Builder tool of MATLAB. FSQL_to_SQL interpreter is being developed to translate fuzzy queries to the SQL ones and Query Builder tool helps to show the final output with the

satisfying degree. User does not need to learn a new query language for working with his implementation. The future work can be done in the development of web based applications with a fuzzy module for improving fuzzy query approach.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] AmelGrissa T. and Mohamed Hassine, "New Architecture of Fuzzy Database Management Systems",The International Arab Journal of Information Technology, Vol. 6, No. 3, July 2009 213

[2] Ben Hassine A., GrissaA.,Galindo J. and Ounelli H., " IGI Global: How to achieve Fuzzy Relational Databases Managing Fuzzy Data and Metadata" 2008

[3] "FRDBMS for Fuzzy Querying based on GEFRED Model",IJCA Proceedings on National Workshop-Cum-Conference on (RTMC2011), 2012.

[4] Grissa A., Ben Hassine A., and Ounelli H., "Extended_FSQL_Server: A Server for the Description and the Manipulation of FRDB," in Proceedings of the 4th International Multi Conference on Computer Science and Information Technology (CSIT), Jordan, pp. 454- 464, 2006.

[5] Jose Galindo, "Handbook of research on fuzzy information processing in databases" IGI Global, 2008.

[6] Medina M., Pons O., and Vila A., "GEFRED: A Generalized Model of Fuzzy Relational Data Bases", Computer Journal of Information Sciences, vol. 76, no. 1, pp. 87-109, 1994.

[7] Miros lav Hudec, "An Approach to Fuzzy Database Querying, Analysis and Realisation", UDC 004.4'2, DOI: 10.2298/csis0902127H, 2009.

[8] P Gupta, "FUZZY QUERYING IN TRADITIONAL DATABASE," International Journal of Artificial Intelligence and Knowledge Discovery, Vol. 1, No.4, 2011.

[9] S.K.Mondal, J.sen, Md.R.Islam and Md.S.Hossian, "Performance comparison of fuzzy queries on fuzzy database and classical database",International journal of Computer Application Issue 3, Volume1 (February 2013).

[10] Touzi, A. G., and Hassine, M. A. B. (2009). New architecture of fuzzy database management systems. Int. Arab J. Inf. Technol., 6(3), 213-220.

[11] Bosc, P., and Pivert, O. (1995). SQLf: A Relational Database Language for Fuzzy Querying. Computer Journal of IEEE Transactions on Fuzzy Systems, 3(1), 80-89.

[12] Bosc, P., and Pivert, O. (2000). SQLf query functionality on top of a regular relational database management system. Knowledge Management in Fuzzy Databases, 171-190.

[13] Galindo, J., Medina, J. M., Pons, O., and Cubero, J. C. (1998). A server for fuzzy SQL queries. In Flexible Query Answering Systems: Third International Conference, FQAS'98 Roskilde, Denmark, May 13–15, 1998 Proceedings 3 (pp. 164-174). Springer Berlin Heidelberg.

[14] Galindo, J., Aranda, M. C., Caro, J. L., Guevara, A., and Aguayo, A. (2002). Applying fuzzy databases and FSQL to the management of rural accommodation. Tourism Management, 23(6), 623-629.

[15] Galindo, J. (2005). New characteristics in FSQL, a fuzzy SQL for fuzzy databases. WSEAS Transactions on Information Science and Applications, 2(2), 161-169.

[16] Galindo, J., Urrutia, A., and Piattini, M. (Eds.). (2006). Fuzzy databases: Modeling, design, and implementation. IGI Global.

[17] Grissa, A., Ben Hassine, A., and Ounelli, H. (2006). Extended_FSQL_Server: A Server for the Description and the Manipulation of FRDB. In Proceedings of the 4th International Multi Conference on Computer Science and Information Technology (CSIT) (pp. 454-464).

[18] Mama, R., and Machkour, M. (2021). Fuzzy querying with SQL: Fuzzy view-based approach. Journal of Intelligent and Fuzzy Systems, 40(5), 9937-9948.

[19] Rachid, M., and Mustapha, M. (2022). A Comparative Study of Existing Fuzzy Query Systems of Database. In Distributed Sensing and Intelligent Systems: Proceedings of ICDSIS 2020 (pp. 465-476). Cham: Springer International Publishing.

[20] Mama, R., and Machkour, M. (2019, July). A study on fuzzy interrogation systems of database. In 2019 International Conference of Computer Science and Renewable Energies (ICCSRE) (pp. 1-6). IEEE.

[21] Mama, R., and Machkour, M. (2019, October). A study of fuzzy query systems for relational databases. In Proceedings of the 4th International Conference on Smart City Applications (pp. 1-5).

[22] Mama, R., and Machkour, M. (2020). Fuzzy questions for relational systems. In Innovations in Smart Cities Applications Edition 3: The Proceedings of the 4th International Conference on Smart City Applications 4 (pp. 104-114). Springer International Publishing.