

## AN INTELLIGENT DECISION SUPPORT USING GENETIC FUZZY INTEGRATION FOR CAPABILITY ANALYSIS

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**Abstract:** Soft Computing is a consortium of computing methodologies that provides a foundation for the conception, design, and deployment of intelligent systems to provide economical and feasible solutions with reduced complexity. Fuzzy Logic deals with uncertainty and imprecision for real world's problems while Genetic Algorithm mimics natural evolution with robust search. The hybridization of Genetic-Fuzzy Systems is gaining popularity in handling real world problems in different domains. The paper focuses on education domain in order to identify human capabilities. Here, integrated genetic-fuzzy approach is utilized for evolving rules automatically. It discusses need of intelligent decision support, role of genetic-fuzzy hybridization with literature survey in various application domains, Theory of Multiple Intelligence and its types. The paper presents a novel architecture using genetic fuzzy techniques for intelligent decision support to classify human intelligence. Theory of Multiple Intelligence has been utilized for prototype implementation of the system. Result is presented in form of charts showing capabilities for different user categories.

**Keywords:** Genetic Fuzzy Systems (GFS), Soft Computing (SC) and Theory of Multiple Intelligence (MI).

### INTRODUCTION

Decision support system is a specific type of computerized information system that supports decision-making activities. It is intended to assist decision makers in compiling useful information from raw data, user knowledge, and domain model in order to identify and solve problems and make decisions. As such, studies of decision support and decision support systems naturally belong to an environment with multidisciplinary foundations, including (but not exclusively) database and operations research, artificial and computational intelligence, human-computer interaction, modeling and simulation, and software engineering. In particular, the research and development of techniques that enable the construction and performance of selected cognitive decision-making functions form a key to the successful application of decision support systems [1]. In today's technological era, intelligent decision support has become a need for system's framework. The paper proposes a novel framework based on evolutionary methods to deal with fuzzy knowledge classification.

Education field has introduced numerous trends in different areas of human life. This resulted in generation of more employment and increased demand for multiple skills. It has been observed that many times an individual himself can not identify his own interest and capabilities in specific areas due to improper educational methods. As a result, the need for intelligent decision support to classify human intelligence is generated. According to cognitive science theory, intelligence is the key component of individual's success. Here, Theory of Multiple Intelligence (MI) is focused to classify human intelligence.

The paper is arranged as follows: The second section presents advantages of genetic fuzzy hybridization and enlists literature survey. The third section discusses role of Theory of Multiple Intelligence (MI) and literature survey

for the same. The fourth section presents architecture of proposed system using fuzzy genetic approach. The fifth section discusses results. The final section discusses conclusion and future scope of research work.

### GENETIC FUZZY HYBRID APPROACH

Genetic Algorithms (GA) are robust general purpose search algorithms that use principles inspired by natural population genetics to evolve solutions to the problem. GA provides flexibility to interface with existing models and easy to hybridize [2]. On other hand Fuzzy Logic (FL) based systems are designed to handle uncertainty and imprecision in real situation easily. But the major limitation of such systems is that they are not able to learn [3] as well as requires documentation of knowledge which needs further continuous maintenance. Hence, hybridization of FL with GA becomes essential to achieve advantages both the aforementioned approaches. In such systems, knowledge in the form of linguistic variables, fuzzy membership function parameters, fuzzy rules, number of rules, etc. can be converted into suitable candidate solutions through generic code structure of GA.

### RELATED WORK IN AREA OF GENETIC FUZZY SYSTEMS

Enlisted examples are very useful real world applications those dealing with intelligent information systems where genetic fuzzy methodology has been successfully implemented [2-16].

- Diagnostic system for disease such as myocardial infarction, breast cancer, diabetes, dental development age prediction, abdominal pain, etc.
- A trading system with GA for optimized fuzzy model;
- For optimizing social regulation policies;

- D. Self integrating knowledge-based brain tumor diagnostics system ;
- E. Classification of rules in dermatology data sets for medicine ;
- F. Integrating design stages for engineering using GA ;
- G. Multilingual question classification through GFS ;
- H. University admission process through evolutionary computing;
- I. Genetic mining for topic based on concept distribution;
- J. Intelligent web miner with Neural-Genetic-Fuzzy approach ;
- K. Extraction of fuzzy classification rules with genetic expression programming ;
- L. Integrated approach for intrusion detection system using GA ;and many more.

**MULTIPLE INTELLIGENCE- A BASE FOR SUCCESS**

Intelligence can be loosely defined as “The capacity to learn and understand”. Intelligence is a combination of five abilities such as perception, information processing, memory, learning and behavior. The way in which intelligence is utilized in reality is known as modes of intelligence. Table1 shows different modes of intelligence observed by several research projects [17].

Table 1: Modes of Intelligence

Mode	Working Area
Business Intelligence (Military Intelligence)	Actively collecting, interpreting, and using vast quantities of complex data.
Organizational Intelligence	Collaborative problem-solving between people and technical artifacts within and beyond complex enterprises.
Developmental Intelligence	The capacity to acquire and use knowledge effectively for personal and organizational learning.
Existential Intelligence	Authentic and flexible engagement with the demands of the environment known as Requisite Variety.

Focus of this work is on developmental mode of intelligence. This mode provides the direction to work with design of management support systems to deal with education, human resources, production and maintenance, research and development projects for individuals as well as organization to increase the socio-economic values.

According to the recent theories, human intelligence is not limited to one or two directions but there are several other equally important and valuable aspects of intelligences. It is observed that no one is talented in every domain and no one is completely incompetent in every domain. So level of different types of intelligence is different in every different human being. The originator of the Theory of Multiple Intelligences (MI), Howard Gardner, defines intelligence as potential ability to process a certain sort of information [18]. Dr. Gardner has identified nine intelligences however there is also a possibility of many other types of intelligence in individuals [19]. Following are various types of intelligence along with their meanings [20]:

- A. Linguistic/Verbal Intelligence is the capacity to learn, understand and express using languages e.g. formal speech, verbal debate, creative writing etc.

- B. Logical-Mathematical Intelligence is the capacity to learn and solve problems using mathematics e.g. numerical aptitude, problem solving, deciphering codes etc.
- C. Spatial/Visual Intelligence is the ability to represent the spatial world of mind using some images e.g. patterns and designs, painting, imagination, sculpturing etc.
- D. Bodily-Kinesthetic Intelligence is the capacity of using whole body or some to solve a problem e.g. body language, physical exercise, creative dance, physical exercise, drama etc.
- E. Musical Intelligence is the capacity to understand music, to be able to hear patterns, recognizes them and perhaps manipulates them e.g. music performance, singing, musical composition etc.
- F. Interpersonal Intelligence is the ability to understand other people. e.g. person-to-person communication, group projects, collaboration skills etc.
- G. Intrapersonal Intelligence is the ability to understand oneself regarding of every aspects of the personality. e.g. emotional processing, knowing yourself etc.
- H. Naturalist Intelligence is the ability to discriminate among living things and sensitivity towards natural world e.g. knowledge and classification of plants and animals with naturalistic attitude etc.
- I. Existential and Moral Intelligence is the capability of changing attitude. It is found to be required with every individual.

**LITERATURE REVIEW ON MULTIPLE INTELLIGENCE**

The field of education and technology has contributed numerous research projects by implementing Theory of MI for the last few decades, some of them are enlisted as follows [21-26]

- A. Classification of types of intelligence among young boys and girls (age (12-14)years);
- B. International educational online learning programs for students as well as teachers;
- C. Adult developmental programs;
- D. Curriculum planning, parents’ interaction, etc. ;
- E. The research project “EDUCE”, implemented as a predictive system using MI ;
- F. Employees’ developmental programs;
- G. New AI approach for students’ academic performance using fuzzy rule generation;
- H. Application of the Theory of Multiple Intelligence (MI) to Digital Systems Teaching;
- I. Rule based classifiers for identifying Technical and Managerial abilities and many more.

As a result of such review, it has been observed that Theory of MI has not been utilized to classify different intelligence for professional success using evolutionary approaches. Hence, we are proposing a model for classifying multiple intelligences using evolving knowledgebase approach.

**PROPOSED MODEL**

The proposed system is designed to measure and compare levels of intelligence in successful professionals and students of higher technical studies by providing web based forms.

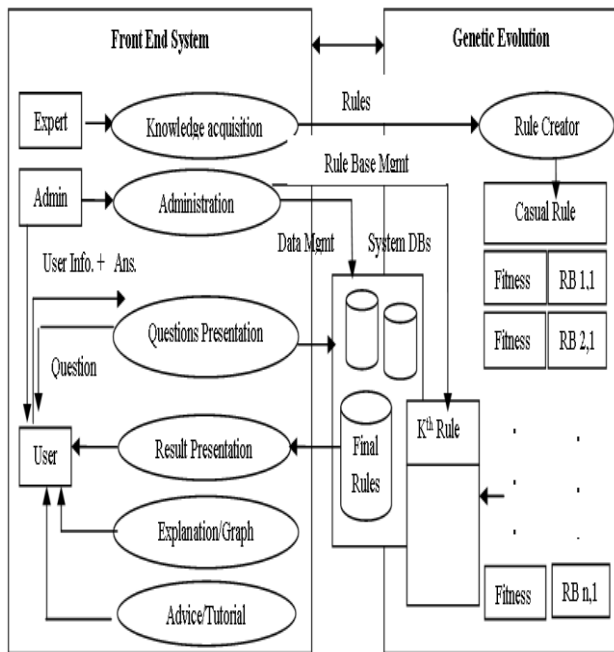


Figure. 1: Framework of proposed System (kunjai M, SajjaP.S.,2011)

**FRONT END SYSTEM WITH USER INTERFACES**

The left component of Fig. 1 shows front end interface for proposed system. Through this interface the domain knowledge is captured and stored in form of questionnaires which have been designed with deep and clear understanding of theory of MI. The proposed system utilizes rule base for identification of human intelligence. Knowledge is represented as a set of rules and data is represented as a set of facts. These set of rules can be collected, analyzed, and finalized during interviews with experts or from multiple references as well as from example sets using theory of multiple intelligence. Further, this domain knowledge is inserted and modified by domain/human expert. Different sets of interactive questionnaires for different user categories are created/collected by human/domain experts. These set of questionnaires are stored in the database. Different users will be created and their access rights will be assigned according to their categories; for example, higher secondary education students, college students, and professionals. According to user’s category, questionnaires will be presented to the user. User is supposed to select answer from given list of multiple choices. These answers will be stored in the database and later on calculation of total score of set of questionnaires will be presented to the users. Once score is presented, system provides decision using evolved rules to select appropriate class such as technical or management. The procedure of rule evolution is transparent to the users and executes in background. The users are advised to improve their intelligence by the system. In order to reinforce the intelligence, different tutorials will be suggested and presented to the users [27].

**BACK END SYSTEM WITH GENETIC EVOLUTION**

The back end component of the system deals with genetic evolution process. Initially, rules are suggested by human expert using different types of intelligence for efficient

categorization of skills of users. Knowledge engineer facilitates rules within the rule bases in encoded fashion. Fitness of each rule is measured with fitness function. It is obvious that higher the fitness, the rule is considered as stronger. An individual is evaluated through fitness function. Application specific fitness function has been designed which calculates strength of population selected as a parent for next generation. Evolving procedure utilized can be enlisted as follows [27]:

1. Generate an initial population of encoded rules.
2. Evaluate fitness of these rules and store into the rule profile.
3. Determine the minimum fitness accepted for the application.
4. Identify and discard the weak rules. One may generate new population from the remaining rules for clarity of operation.
5. Apply mutation and cross over operators on rules.
6. Go to step (ii) and repeat the procedure till required fit rules are achieved.

**RESULTS**

For implementing proposed model, we have tested one point and two point crossover operation on chromosome. The rules from rule sets are encoded using binary encoding scheme and crossover and mutation operation have been carried out. User Interface design forms and questionnaires are designed with ASP.NET 2.0 and MS ACCESS 2000 respectively. For proposed prototype application, we have utilized Logical and Verbal intelligence of Theory of Multiple Intelligence. Result of questionnaires is calculated with the help of total score for every individual. Four different criteria are determined to analyze the results. They show the total number of individuals acquiring the specific type intelligence. Charts presented in Fig. 2(a) shows level of verbal intelligence in both the user’s categories while Fig. 2(b) shows measure of logical intelligence in user’s categories.

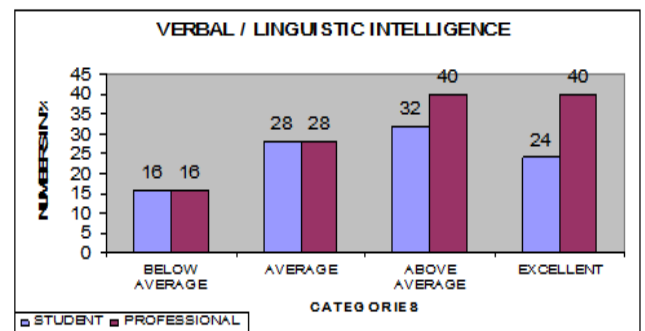


Fig. 2(a): Measure of Verbal Intelligence

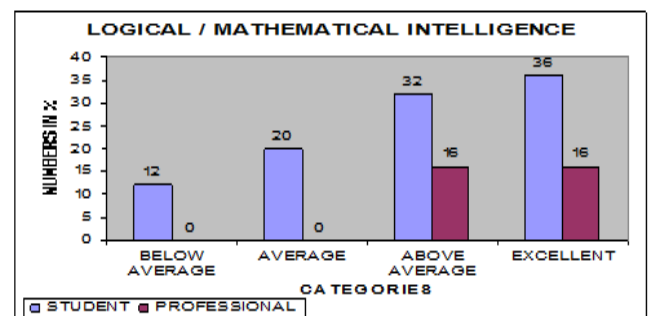


Fig. 2(b): Measure of Logical Intelligence

Outcome generated by charts shows that more professionals are fall under excellent categories of verbal and logical intelligence while very few students have achieved this category. Very few students fall into excellent measure of logical intelligence. It is observed that students need to achieve good logical or mathematical capabilities to satisfy the requirements of professional growth. Hence, it is concluded that students must acquire verbal as well as logical types of intelligence in very high measure in order to achieve success in professional fields. These results also support the theory of MI.

## CONCLUSION AND FUTURE WORK

The presented evolutionary model offers decision support including many advantages such as handling imprecision and minimizing efforts for creation and documentation of knowledge in form of rules. The presented application is to categorize user's different skills in education domain. The same approach can be used to provide training for teachers, planning for resources and many more. The proposed architecture of evolving rule based model using genetic-fuzzy approach can also be applied to various domains like advisory systems, decision support systems, data mining systems, and control and monitoring systems, etc. In order to have exact classification of skills in different areas, this framework can be useful for automatic decision support. The system can also be extended to different areas where analysis of human intelligence is required. New inventions in Multiple Intelligence can also be integrated with designed rule sets. The proposed system presents a platform for a generic commercial product with an interactive editor in the domain of multiple intelligence identification. This increases the scope of the system and meets the requirements of increased number of non-computer professionals in various fields.

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