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Application Of Geogebra And Fuzzy Logic

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***Abstract*—Concepts of dynamic geometry can be applied to topics in algebra, calculus, statistic, physics and optical problems with suggested GeoGebra software tools and fuzzy logic . GeoGebra is an open source mathematics software program that help students visualize different theoretical mathematics concepts. A fuzzy set is a class of objects with a continuum of grades of membership. Such a set is characterized by a membership function which assigns to each object a grade of membership ranging between zero and one. The notions of inclusion, union, intersection, complement, relation, convexity, etc., are extended to such sets, and various properties of these notions in the context of fuzzy sets are established.**

Keywords—GeoGebra, Fuzzy, graphics, statistic.

INTRODUCTION

People all over the world are profoundly improving the human condition in the areas of education, environment, health and economic development through the use of technology.

Mathematical problem solving is a complex process. GeoGebra is open-source software available for free through the Web that enables users to dynamically experiment with mathematical concepts. Technology can play an important role in learning mathematics.

The dynamic mathematics software GeoGebra addresses all levels of education by joining geometry, algebra, calculus and statistic.

GeoGebra has translated into over 45 languages, in this way offer information access across the globe.

GeoGebra provides multiple representations of mathematical objects; it can help students to discover connections between mathematical objects and their graphical representation. Students take more responsibility for their own learning, and the dynamics of classroom activity shift to more discussion, interest, motivation to study and cooperative learning.

A. GeoGebra: Dynamic Mathematics Software

- The most powerful feature of GeoGebra is the connection it makes between Geometry, Algebra, Calculus and Statistics. GeoGebra is a dynamic geometry system in which you work with points, vectors, segments, lines, and conic sections. GeoGebra is also an dynamic algebraic system, where equations and coordinates can be entered directly.
- Functions can be defined algebraically and then changed dynamically afterwards.
- GeoGebra make a link between algebra and geometry in entirely new, visual way- students can finally see touch and experience math.
- Viruses, Proteins, Chromosomes, and many other molecular structures consist of large groups of geometrical shapes. Research Scientists study these to better understand how humans can be made healthier.
- GeoGebra became the dynamic software that learners preferred to the other software. The learner have highly evaluated GeoGebra because it integrates dynamic geometry, algebra, calculus, and statistics into a single easy-to-use package, so it is helpful and comfortable for students and mathematics teachers

Probability and Statistics
– modeling of random events and analysis of the received results, estimation of the probability using the relative frequency, graphical representations of random events by geometric probability.
– statistical data processing and their graphical representation, investigation of the relationships between data (e.g. fig.1) developing understanding of the least squares method in Statistics.

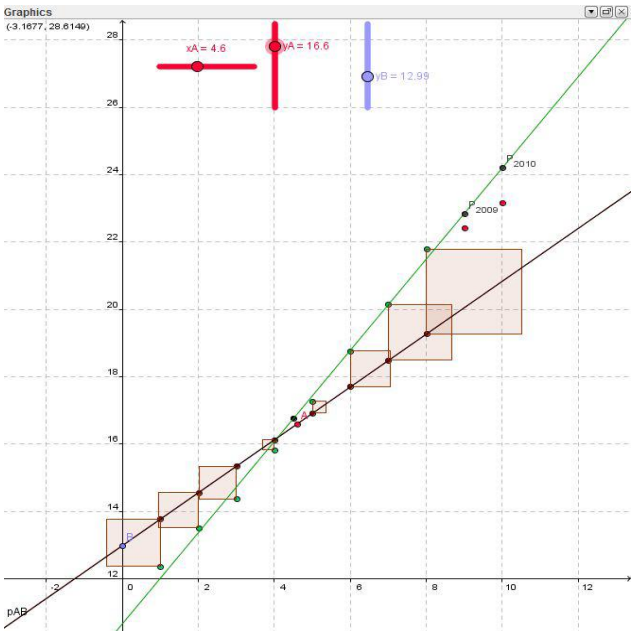

Fig.1

The tool for analysis of multiple samples can either, give a side by side set of descriptive statistics for the samples, or it can do an ANOVA test on the samples, or do a pair wise comparison of Z or T tests. The fourth tool in this menu is a probability calculator, which gives a nice visualization of a variety of continuous and discreet probability distributions.

In the fig. 2 is shown histogram, statistical coefficient of some data of cancer deaths in Albania

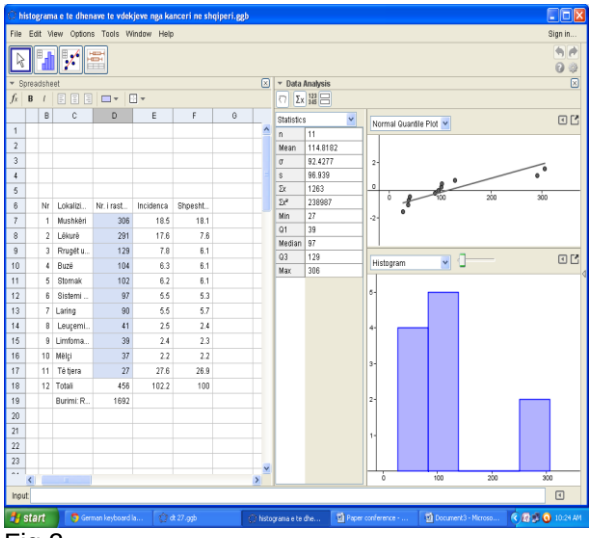

Fig.2

- In the theory of probability can be interpreted graphically the Bayes's theorem show in the fig. 3

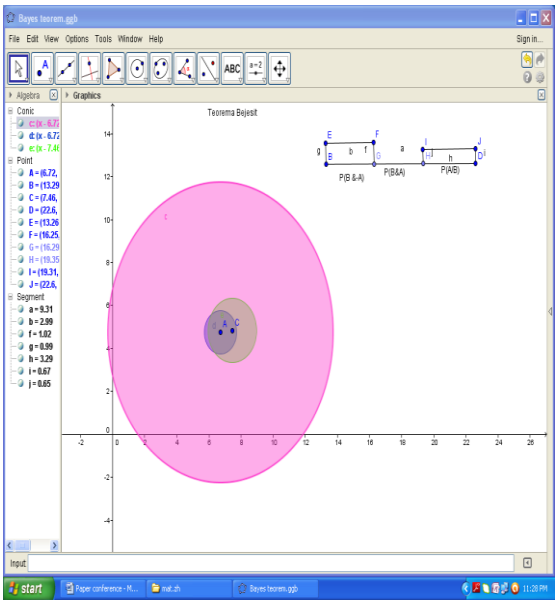

Fig.3

- Teaching geometric optics of mirrors and lenses Geometric optics: GeoGebra is very useful for illustrating the principles of geometric optics. The GeoGebra construction sequence of the ray diagram differ very little from textbook description. The GeoGebra page allows the investigator to explore the effect on the image when the position of the object or focal length is varied. There is no need to reconstruction another ray diagram for every variation.

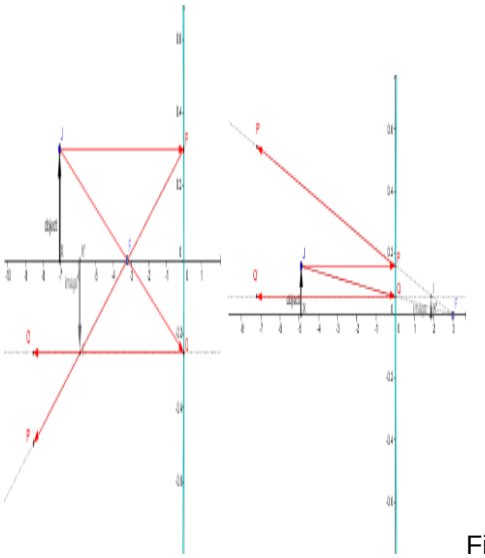

Fig.4

- We might want to use the tool Rotate 3D Graphics View to get different views on our construction. Finding the volume of intersecting of two or more surfaces, also can see the projection from every plan fig. 5

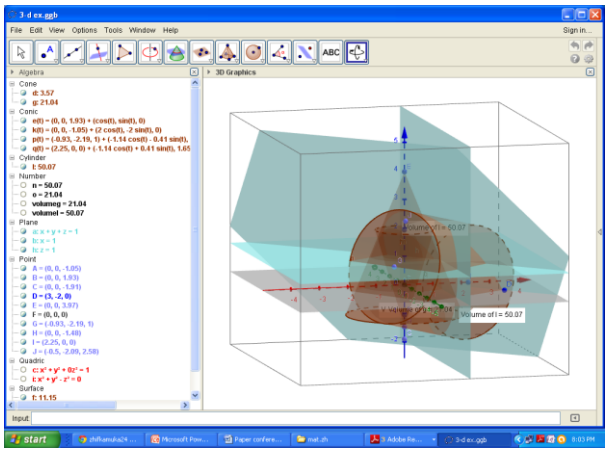

Fig.5

- Linear algebra's unique blend of geometry and algebra has many applications in physics, biology, engineering, and chemistry . Various linear algebra concepts can illustrated using GeoGebra:

- exploring basic operations of vectors in two and three dimensional space
- exploring basic geometric operations of vectors in two and three dimensional space
- geometric illustration of linear combinations and coordinates
- linear systems of equations
- spanning spaces in R2 and R3
- spanning subspaces in R2 and R3
- row, column, and null subspaces
- linear transformations in R2 and R3
- geometric illustration of eigenvalues, eigenvectors, and eigenspaces
- geometric application of determinants
- orthogonal and orthonormal basis etc

- Volume of a parallelepiped using determinants

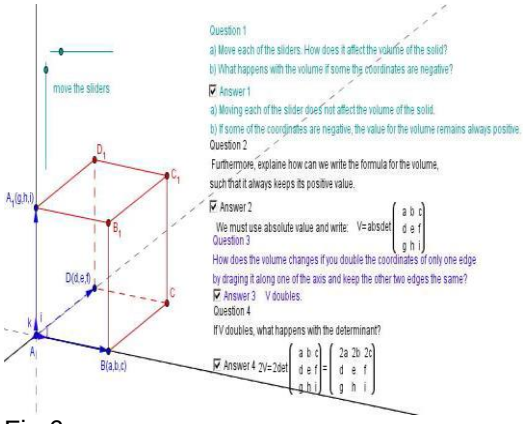

Fig.6

-Illustrating basic operations of vectors in two and three dimensional space fig.7

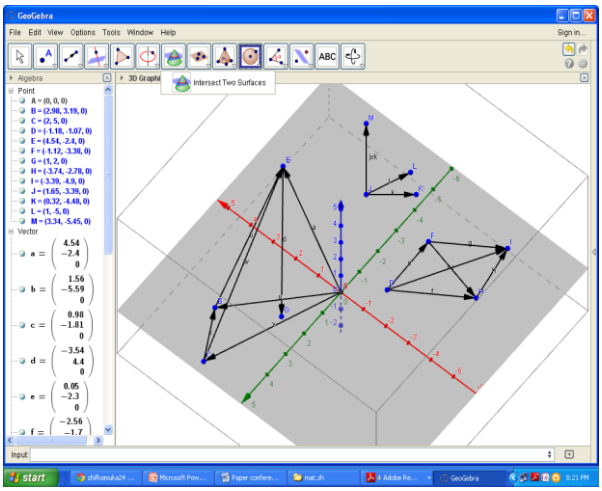

Fig.7

Conclusions

- GeoGebra provides multiple representations of mathematical objects, it can help us to discover connections between mathematical objects and their graphical representation
- To summarise, the use of GeoGebra enables the possibility to formulate questions that need a high level of thought. This is something that students desire and can find within themselves in order to continue enriching their experience outside school (Edwards, 2006).
- The integration of computer software GeoGebra, in the teaching process we demonstrated on the examples from the field of geometry, algebra, calculus, statistics, optics.

B. Description of Fuzzy Logic

In recent years, the number and variety of applications of fuzzy logic have increased significantly. The applications range from consumer products such as cameras, camcorders, washing machines, and microwave ovens to industrial process control, medical instrumentation, decision-support systems, and portfolio selection.
To understand why use of fuzzy logic has grown, you must first understand what is meant by fuzzy logic.
Fuzzy logic has two different meanings. In a narrow sense, fuzzy logic is a logical system, which is an extension of multivalued logic. However, in a wider sense fuzzy logic (FL) is almost synonymous with the theory of fuzzy sets, a theory which relates to classes of objects in which membership is a matter of degree. Even in its more narrow definition, fuzzy logic differs both in concept and substance from traditional multivalued logical systems.

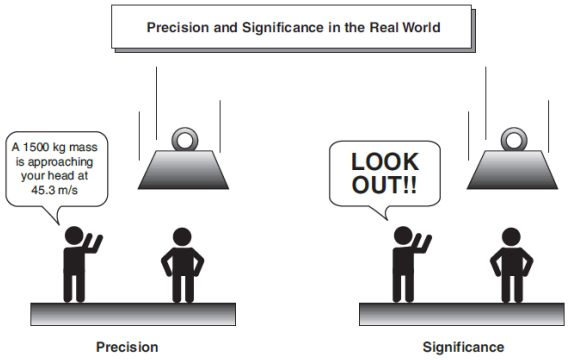

Fig. 8

In this sense, fuzzy logic is both old and new because, although the modern and methodical science of fuzzy logic is still young, the concepts of fuzzy logic relies on age-old skills of human reasoning.

- Why Use Fuzzy Logic?

Here is a list of general observations about fuzzy logic:

• Fuzzy logic is conceptually easy to understand.

The mathematical concepts behind fuzzy reasoning are very simple. Fuzzy logic is a more intuitive approach without the far-reaching complexity.

• Fuzzy logic is flexible.

With any given system, it is easy to layer on more functionality without starting again from scratch.

• Fuzzy logic is tolerant of imprecise data

Definition 1.1. (Zadeh, 1965) Let X be a nonempty set. A fuzzy set A in X is characterized by its membership function

$$\mu_A : X \to [0,1]$$

and μ(x) is interpreted as the degree of membership of elementx in fuzzy set A for each x ϵ X.

Let μ be a fuzzy subset of X; the support of A, denoted supp(A), is the crisp subset of X whose elements all have nonzero membership grades in A.

Interpretations of basic operations(fig.9):

- Union A ∪ B −→ *μA∪B(x) = μA(x) ∨ μB(x) = max(μA(x), μB(x))*
- *Intersection A ∩ B −→ μA∩B(x) = μA(x) ∧ μB(x) = min(μA(x), μB(x))*

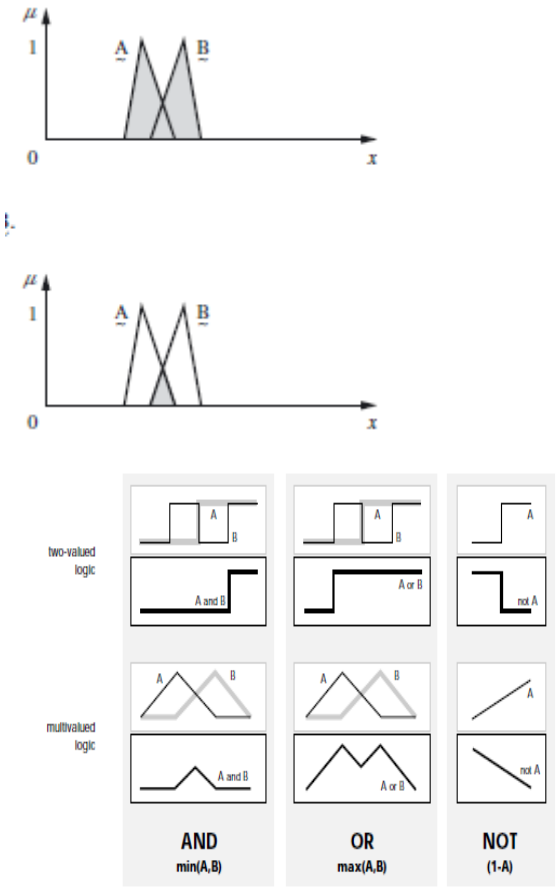

Fig. 9

- Excluded middle axioms for crisp sets. (*a) Crisp set A and its complement;*
(b) crisp A∪ C_A= X(axiom of excluded middle); (*c) crisp A∩ C_A = ∅ (axiom of contradiction).*

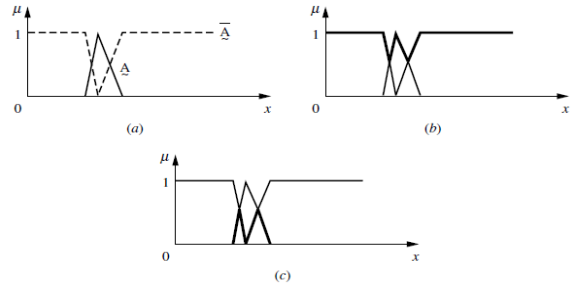

Fig.10

These basic operations, provide guidelines to construct more complex ones which in turn can be used to create fuzzy machines.

- MATLAB fuzzy logic toolbox facilitates the development of fuzzy-logic systems using:graphical user interface (GUI) tools command line functionality

The tool can be used for building Fuzzy Expert Systems Adaptive Neuro-Fuzzy Inference Systems (ANFIS)

There are five primary GUI tools for building, editing, and observing fuzzy inference systems in the Fuzzy Logic Toolbox:Fuzzy Inference System (FIS) Editor (fig. 11)

Membership Function Editor
Rule Editor
Rule Viewer
Surface Viewer

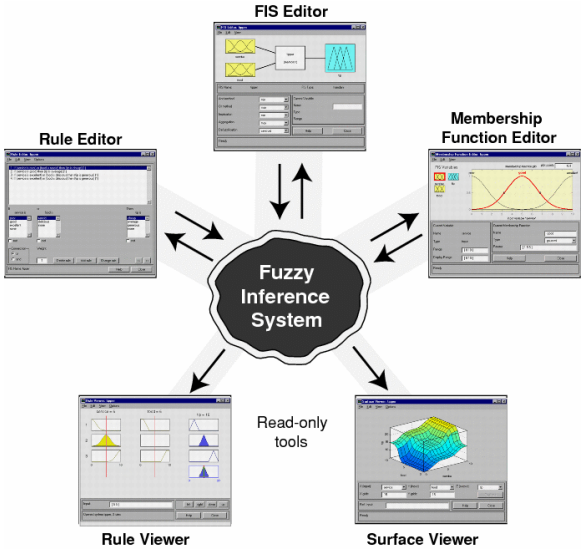

Fig.11

Two type of inference system
Mamdani inference method
Sugeno inference method

- Mamdani's fuzzy inference method is the most commonly seen fuzzy methodology. Mamdani's method was among the first control systems built using fuzzy set theory.

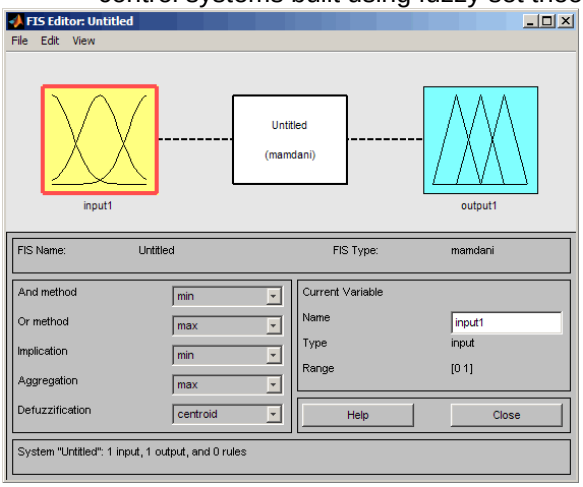

Fig. 12

Fuzzy logic is based on natural language.
The basis for fuzzy logic is the basis for human communication.

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