Design a Fuzzy Logic Model for Grading the Project 4 in Fuzzy Logic
due Friday, November 23rd, 2018, 2pm

In a real life, while developing FL models, you are the one who transfers your knowledge into the algorithm and, consequently, you are choosing everything, meaning the domains i.e., input variables, number and type of fuzzy subsets a.k.a. membership functions (MFs) for each domain (input), as well as number and type of output fuzzy subset. Finally, you are the one who will transform your structured knowledge about the problem into the IF-THEN rules. In this project, I will try to make your job easier by suggesting to you some parts of the mentioned tasks. The three relevant input domains (meaning the inputs used to make an output which is the grade) are the **Writing Skill** (i.e. written **Quality**) of the Report (**Q**), number of **Errors** in the report (**E**) and expressive power of **Figures** (**F**). Under the excellent Skill (Quality), we understand a well written project, grammatically correct, stylistically nice, edited and formatted sophistically and following a prescribed format. As for the numerical values for Q, use 0 for the lowest quality and 100 for the highest one. For the number of errors let's say that they go from 0 to 10. As for the expressive power of Figures, use three membership functions only (ugly and/or non-informative (placed it at 50), medium (placed it at 75) and very fine (placed it at 100)). The output domain is the **grade** (**G**) on the scale of percentages from 40% and less to 100%, where 40% is fail (F) and 100% is excellent i.e. an A.

Hence, you have **3** input domains (a.k.a. antecedents) and 1 output variable (consequence). For the inputs' fuzzy subsets use triangles (i.e., you should develop your code for designing triangular MFs). Place triangles symmetrically with all of them having same width. For the **output G**, use the singleton MFs. Use the **product** for **AND**, and make a **Fuzzy Additive Model**.

a) 15 points
First design fuzzy model without using the third domain i.e. neglect the Power of Figures input here. Your model should work for any number of MFs per the first two input variables. Run and show the results for any **two** different, but not same, numbers of MFs per variables (say, between 2 and 6 MFs per input). Show **two** models (meaning for the two choices of the numbers of MFs, say 3 & 4 and 4 & 3, or 6 & 2) only.

For each model show two figures:

1) Show all the MFs in a single graph having three subplots - inputs **Q (subplot 131)** & **E (subplot 132),** and the output **G (subplot 133).**
2) In addition, show the 'surface of knowledge' describing the dependency of grade **G** upon the two input variables **Q** and **E.**

However, show these two figures for three cases:

a) one for narrow MFs (overlapping 0.1 in the middle between the triangles),
b) one for medium size MFs (overlapping 0.5) and
c) one for broad MFs (overlapping 0.9)).

In short, I expect 6 figures per a model in your report.

If you are encoding your model correctly by using MATLAB'S **kron** function, YOUR MODEL MUST WORK FOR ANY NUMBER of MFs. In this case, **kron** will take care of **getting H** values in eq. (6.16).

That's all
for Project four!

Your report doesn't have to be in IEEE journal (conference) paper this time. Just title and your name + 12 figures. No Comments.!

If you want some additional points which will be counted toward your final grade in the course, expand your model by using the third antecedent, namely, the Power of Figures input.

3) Now, show all the MFs in a single graph having four subplots - inputs **Q (subplot 221)**, **E (subplot 222)** & **F (subplot223),** and the output **G (subplot 224).**
4) In addition, show the 'surfaces of knowledge' describing the dependency of grade **G** upon the two input variables**.**

Those will be two additional figures in your report.

SOFTWARE MUST BE USER FRIENDLY, so that I can run it easily too. Submit both your written report as the PDF document and MATLAB routines to me by Email. ZIP your report and programs into single zip file (which will contain the report and the routines for FLM, name it with your family name (say, lee.zip) and send it to me.

A Subject field in your Email should be CMSC 678, Your family name, Project 5.

Don't hesitate to contact me in the case of need. My Email is: vkecman@vcu.edu.

Note: Late submission will shrink your points as follows: up to 1 hour late -2 points, 1 to 3 hours late -4 points, more than 3 hours late -10 points, but if you are late more than 6 hours don't bother with submitting, for there won't be any points. **This remark is here because the semester is ending soon and both you and I must have time for both closing it and the exam.**