

Test 1 for Explainable Fuzzy AI Class

Summer 2021

General comment. It is OK to give brief answers to “why” and “what” questions, but make sure that the main ideas are captured.

1. *Introduction.*

- 1a. What is explainable AI and why do we need it?
- 1b. What are fuzzy techniques and what is their purpose?
- 1c. Who invented fuzzy techniques?
- 1d. Why is it reasonable to use fuzzy techniques in explainable AI?

2. *Degrees of confidence.*

- 2a. If an expert marked 3 on a scale from 0 to 4, what is the resulting degree of confidence?
- 2b. If 4 out of 5 experts believe that the statement S is correct, what is its degree of confidence?
- 2c. Why do we need interpolation in fuzzy techniques?
- 2d. What is a membership function?
- 2e. Assume that $\mu(-2) = 1$ and $\mu(0) = 0$. Use linear interpolation to find $\mu(-1)$.

3. *“And”- and “or”-operations.*

- 3a. What is an “and”-operation? What is an “or”-operation?
- 3b. Assume that our degree of confidence in A is 0.6, and degree of confidence in B is 0.7. Use min, max, algebraic product, and $a + b - a \cdot b$ to estimate degrees of confidence in $A \& B$ and $A \vee B$.

4. *Fuzzy methodology.* Suppose that we have two rules:

- if a student studied hard, the student will get a good grade;

- if a student studied very hard, the student will get a very good grade.

A student studied for 3 hours and got 88/100 on the test. Assume that:

- the degree to which 3 hours means studying hard is 0.6, and the degree to which it means studying very hard is 0.4;
- the degree to which 88 is a good grade is 0.8, and the degree to which 88 is a very good grade is 0.2.

Based on this information, what is the degree to which the student's grade is reasonable? Use min and max.

5. *Defuzzification.*

- 5a. What is the distance $D(a, b)$ between the points $a = (-2, -3)$ and $b = (1, -7)$?
- 5b. What is the squared distance $D^2(a, b)$ between the points $a = (0, 2, 4)$ and $b = (0, -2, -4)$?
- 5c. Use differentiation to find the minimum (= smallest value) of the expression $x^2 - 2x + 1$.
- 5d. What is defuzzification and why do we need it?
- 5e. Suppose that we have the following reasonableness degrees: for $u_1 = -1$, we have $\mu(u_1) = 0.5$, and for $u_2 = 1$, we have $\mu(u_2) = 1$. What will be the result of centroid defuzzification?