Fuzzy Logic Tutorial Sheet

1. Sketch the following fuzzy sets

   None: (0, 0, 0, 0,)
   Small: (2, 4, 2, 3)
   Medium: (7, 10, 2, 1)
   Large: (11, 15, 1, 5)

   On your diagram (or on a new version of the diagram) highlight the following:

   (a) Small AND Medium
   (b) None OR Small
   (c) Medium OR Large
   (d) NOT Medium

2. The following is a verbal description for the fuzzy variable Age:

   "A person is definitely young from the time they are born until they are 20 years old. No-one over the age of forty should be considered young, though some may consider that a person is sort of young up to that age. People may be considered middle-aged between the ages of 35 and 65, and certainly between the ages of 50 60. Old age arrives gradually, starting at age 60 and reaching its fullness by age 70, beyond which anyone is definitely old."

   From this description

   (a) Sketch the fuzzy sets associated with Age.
   (b) Identify the 4-tuples for these sets.
   (c) Calculate the degree of membership in each of these sets for people aged: 20, 37, 55, 63 and 85.

(d) Using these age values identify the degree of the membership from the connectives:

i. young AND middle-aged
ii. middle-aged AND old
iii. young OR middle-aged
iv. middle-aged OR old
v. NOT young.

3. A fuzzy rule base for an oven temperature control system contains the following rules:

Rule1: If temperature is high or current is high then reduce current

Rule2: If temperature is medium then no change to current

Rule3: If temperature is low and current is high then no change to current

Rule4: If temperature is low and current is low then increase current

The fuzzy sets representing the temperature (in degrees C), current (in Amps) and change in current (as a %) are given in 4-tuple form as:

Current: low (0, 0, 0, 10); medium (10, 10, 10, 10); high (20, 20, 10, 0)

Temperature: low (0, 100, 0, 100); medium (200, 200, 150, 150); high (400, 450, 150, 0)

Change in current: reduce (-50, -50, 50, 50); no change (0, 0, 50, 50); increase (50, 50, 50, 50)

Suppose that the temperature is 300 degrees C and the current is 17A.

(a) Sketch the sets for current temperature and change in current.
(b) Calculate the percentage change in current resulting from these measurements utilising a Max-Min aggregation and CoG defuzzification on an a truncated aggregate.
(c) Perform the same calculation by means of a dilatation of the aggregate.