Problem 1. Assume that fuzzy relations R, S ($R \subseteq X$, $S \subseteq Y$) are defined below:

R=[0.9, 0.2, 0.8, 0.2, 0.4], S=[0.1, 0.7, 0.2, 0.3, 0.1, 0.7].

- Find the join $R \times S$ of R and S.
- Find the composition R°S of R and S.

Problem 2. Assume that fuzzy relations R, S ($R \subseteq X$, $S \subseteq Y$) are defined below:

R=[0.9, 0.2, 0.8, 0.2, 0.4],

S=

0.1	0.2	0.2	0.3	0.9	0.4
0.2	0.1	0.8	0.2	0.1	0.3
0.1	0.3	0.2	0.8	0.1	0.1
0.2	0.7	0.1	0.5	0.4	0.3
0.1	0.9	0.2	0.3	0.1	0.7

- Find the join $R \times S$ of R and S.
- Find the composition R°S of R and S.

Problem 3. Assume that S is an information system given below:

X	E	F	G	C
x1	e1	f1	{(g1,1/2),(g2,1/2)}	c2
x2	e2	f1	g2	c1
x3	{(e1,1/2), (e2,1/2)}	f1	g1	c2
x4	e2	{(f1,1/2),(f2,1/2)}	g2	c1
x5	e1	f2	g1	c2
x6	e2	f2	{(g1,1/2),(g2,1/2)}	c2

Expert-based semantics of attribute C (values c1, c2) is based on the following set of rules:

e1 $\rightarrow$ c2 sup=2, conf=1

f2 $\rightarrow$ c2 sup=5/2, conf= 5/6

g1 $\rightarrow$ c2 sup=2, conf=2/3

g2 $\rightarrow$ c1 sup=2, conf = 2/3

e2.f1 $\rightarrow$ c1 sup=3/2, conf=1

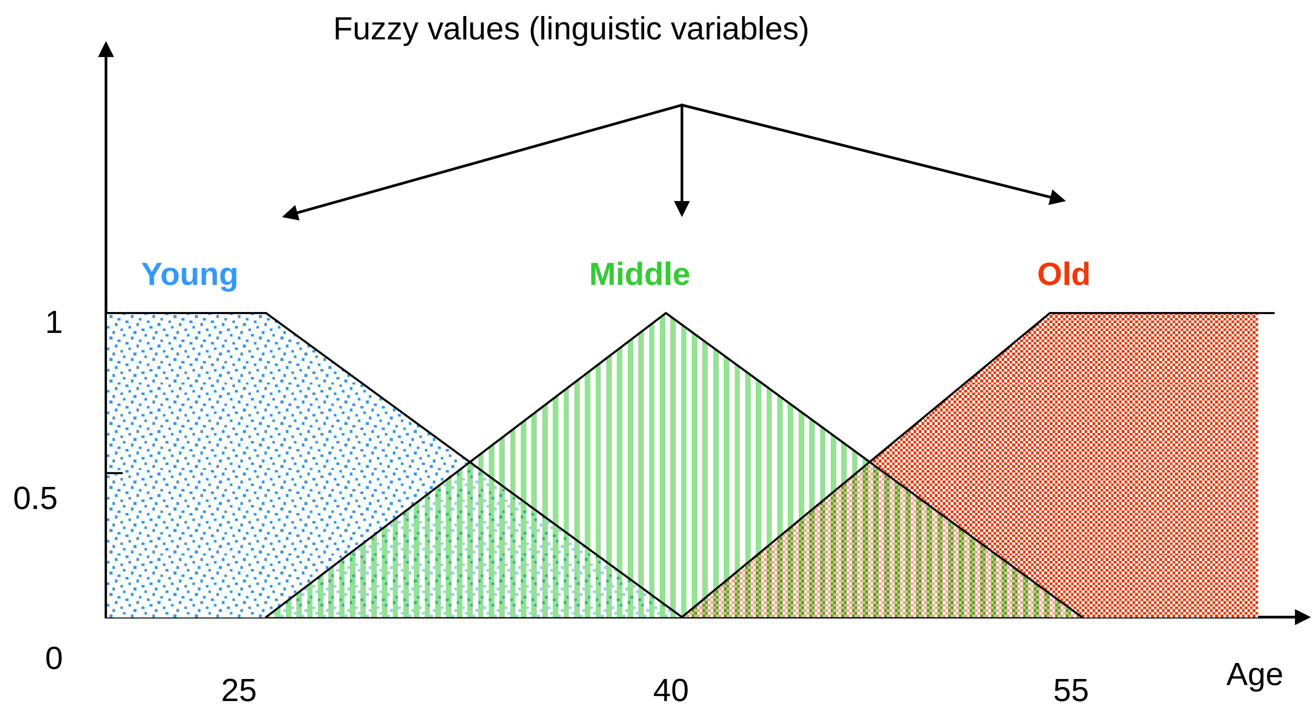
e2.g2 $\rightarrow$ c1 sup=2, conf=4/5

$f1.g2 \to c1$ sup=3/2, conf=3/4

$f2.g1 \to c2$ sup=3/2, conf=1

Find precission and recall of user semantics with respect to attribute C.

Problem 4. Assume that Yong, Middle, Old are defined by membership functions given below:



- Find the membership function representing (Middle and not Old).
- Find membership function $\mu_R(x,y)$ where R = [Middle $\to$ not Old] or equivalently R = [if x is Middle then y is not Old]. Take propositional calculus interpretation of R defined as $A \to B = \neg A \cup (A \cap B)$. Other interpretations of R:

  1) Material implication: $A \to B = \neg A \cup B$
  2) Extended propositional calculus: $(\neg A \cap \neg B) \cup B$
  3) Generalization of modus ponens:

     $\mu_R(x,y) = \mu_{[A \to B]}(x,y) = [1 \text{ if } \mu_A(x) \le \mu_B(y), \text{ else } \mu_B(y)]$.