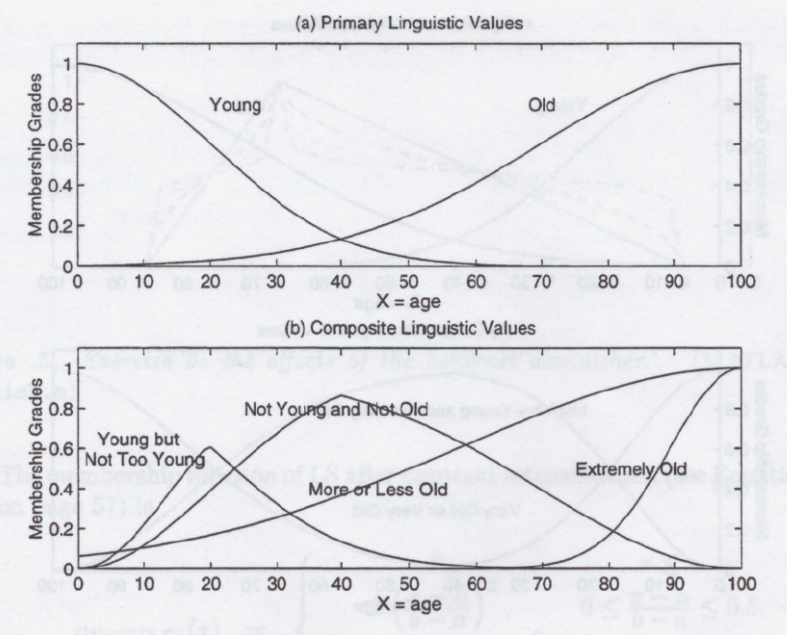
MEMC-5173
Intelligent Tools for Engineering Applications

Assignment #3 reference solution

Q 3-5



Q 3-13

The fuzzy relation R of the rule "*if x is A or y is B then z is C*" is

$$\begin{aligned} R &= A \cup B \rightarrow C \\ &= (A \cup B) \cap C \\ &= (A \cap C) \cup (B \cap C) \\ &= (A \rightarrow C) \cup (B \rightarrow C) \end{aligned}$$

It is equivalent to the union of the fuzzy relations of two fuzzy rules "*if x is A then z is C*" and "*if y is B then z is C*".

Q 4-1

For a single rule with multiple antecedents, the resulting qualified output MF $\mu_{C'}(z)$ is available directly from Equation (3.25) (page 67) by replacing "$\wedge$" with "$\cdot$" (multiplication):

$$\begin{aligned}
\mu_{C'}(z) &= \vee_{x,y}[\mu_{A'}(x) \cdot \mu_{B'}(y)] \cdot [\mu_A(x) \cdot \mu_B(y) \cdot \mu_C(z)] \\
&= \vee_{x,y}\{[\mu_{A'}(x) \cdot \mu_{B'}(y) \cdot \mu_A(x) \cdot \mu_B(y)]\} \cdot \mu_C(z) \\
&= \underbrace{\{\vee_x[\mu_{A'}(x) \cdot \mu_A(x)]\}}_{w_1} \cdot \underbrace{\{\vee_y[\mu_{B'}(y) \cdot \mu_B(y)]\}}_{w_2} \cdot \mu_C(z) \\
&= \underbrace{(w_1 \cdot w_2)}_{\substack{\text{firing} \\ \text{strength}}} \cdot \mu_C(z),
\end{aligned} \tag{.2}$$

which implies that the qualified output MF is scaled down by the firing strength $w_1 w_2$. For multiple rules with multiple antecedents (which is the situation in Figure 4.3), the overall qualified output MF is the maximum of each qualified output MFs, as indicated in Equation (3.28) (page 68).

Q 4-4

x_{COA} = 46,

x_{BOA} = any value between 44 and 45

x_{MOM} = 40

Note that you can verify the answers by using the MATLAB file defuzzy.m