Solutions to Problem Set 2

1. Let us represent her knowledge about fruits by the following fuzzy relation:

	tangerine	apple	pineapple	watermelon	strawberry
long	0	0	0.3	0	0.8
round	0.9	1	0.3	1	0.2
large	0.2	0.4	0.7	1	0.1

Guess the fruit that Sally sees if she recognises a fruit that is:

Case a: "round and big" represented by 0/long + 0.7/round + 1/large

Ans:

$$\begin{bmatrix} 0 & 0.7 & 1 \end{bmatrix} \circ \begin{bmatrix} 0 & 0 & 0.3 & 0 & 0.8 \\ 0.9 & 1 & 0.3 & 1 & 0.2 \\ 0.2 & 0.4 & 0.7 & 1 & 0.1 \end{bmatrix}$$

$$= \begin{matrix} \text{tangerine} & \text{apple} & \text{pineapple} & \text{watermelon} & \text{strawberry} \end{matrix}$$

$$\begin{bmatrix} 0.7 & 0.7 & 0.7 & 1 & 0.2 \end{bmatrix}$$

We can interpret the membership as the possibility. The possibility of watermelon is the highest and tangerine, apple, and pineapple come next at an equal possibility.

Case b:"relatively long, somewhat round, and not very large" represented by 0.5/long + 0.5/round + 0.3/large

Ans:

$$\begin{bmatrix}0.5 & 0.5 & 0.3\end{bmatrix} \circ \begin{bmatrix}0 & 0 & 0.3 & 0 & 0.8\\ 0.9 & 1 & 0.3 & 1 & 0.2\\ 0.2 & 0.4 & 0.7 & 1 & 0.1\end{bmatrix}$$

$$= \begin{matrix}\text{tangerine} & \text{apple} & \text{pineapple} & \text{watermelon} & \text{strawberry}\end{matrix}$$
$$\begin{bmatrix}0.5 & 0.5 & 0.3 & 0.5 & 0.5\end{bmatrix}$$

In this case, Sally's remark has turned out to be too ambiguous to identify the particular fruit she had in mind.

2. A fuzzy set A is defined by

$$A = 0.3/a + 0.7/b + 1/c + 0.8/d + 0.5/e$$

Use the extension principle to find the fuzzy set $B = f(A)$, where the function $f(\cdot)$ is defined by

$$f(x) = \begin{cases} i, & x = e \\ j, & x = d \\ i, & x = c \\ k, & x = b \\ j, & x = a \end{cases}$$

Ans:

$$B = f(A) = f(0.3/a + 0.7/b + 1/c + 0.8/d + 0.5/e)$$

$$= 0.3/f(a) + 0.7/f(b) + 1/f(c) + 0.8/f(d) + 0.5/f(e)$$

$$= 0.3/j + 0.7/k + 1/i + 0.8/j + 0.5/i$$

$$= 1/i + 0.8/j + 0.7/k$$

3. An object is governed by the equation $z=x^2+xy$. Its fuzzy x coordinate and fuzzy y coordinate is defined by the fuzzy set

$$x = 0.4/5 + 0.6/10$$
$$y = 0.5/1 + 0.6/2 + 0.7/3$$

respectively. Using the extension principle, find the fuzzy z coordinate.

$$x^2 = 0.4/25 + 0.6/100$$
$$x \cdot y = 0.4/5 + 0.4/10 + 0.4/15 + 0.5/10 + 0.6/20 + 0.6/30$$
$$= 0.4/5 + 0.5/10 + 0.4/15 + 0.6/20 + 0.6/30$$
$$z = x^2 + x \cdot y = 0.4/30 + 0.4/35 + 0.4/40 + 0.4/45 + 0.4/55$$
$$+ 0.4/105 + 0.5/110 + 0.4/115 + 0.6/120 + 0.6/130$$