Fuzzy Logic

Tim Asprak Metkuan

Analogi

Tinggi Badan bisa dikategorikan:

-Tinggi
- Sedang
- Pendek

} **Himpunan fuzzy**

Berapa tinggi sebenarnya ???

Anak 1: 140 cm
Anak 2: 112 cm
Anak 3: 125 cm

} **Nilai Crisp**

Fuzzy Logic

- Logical system yang mengikuti penalaran manusia yang cenderung menggunakan ‘pendekatan’ dan bukan ‘eksak’
- Sebuah pendekatan terhadap ketidakpastian yang mengkombinasikan nilai real [0..1] dan operasi logika

Keuntungan Fuzzy:

- Mudah dimengerti
- Pemodelan matematika sederhana
- Toleransi data yang tidak tepat
- Dapat memodelkan fungsi-fungsi non linear yang kompleks
- Mengaplikasikan pengalaman tanpa proses pelatihan
- Didasarkan pada bahasa alami

Variable fuzzy

- Variabel dalam suatu sistem fuzzy
- Contoh: tinggi badan, berat badan, kecepatan, suhu, cuaca, dll

Fuzzy Set

- Himpunan fuzzy yang mewakili suatu kondisi pada variabel fuzzy
- Tinggi badan = {pendek, sedang, tinggi}
- Suhu = {panas, hangat, dingin}

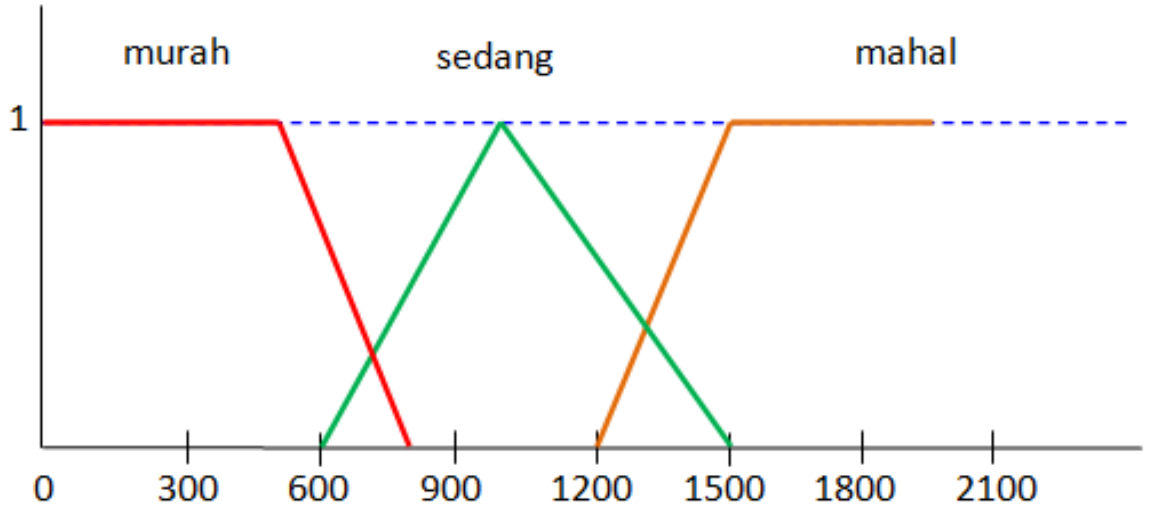
Membership Function

- Cara untuk merepresentasikan himpunan fuzzy
- Contoh membership function: fungsi linier, segitiga, trapesium, sigmoid, phi

Membership Function (lanj..)

- Diketahui fuzzy set dari variabel ‘harga’

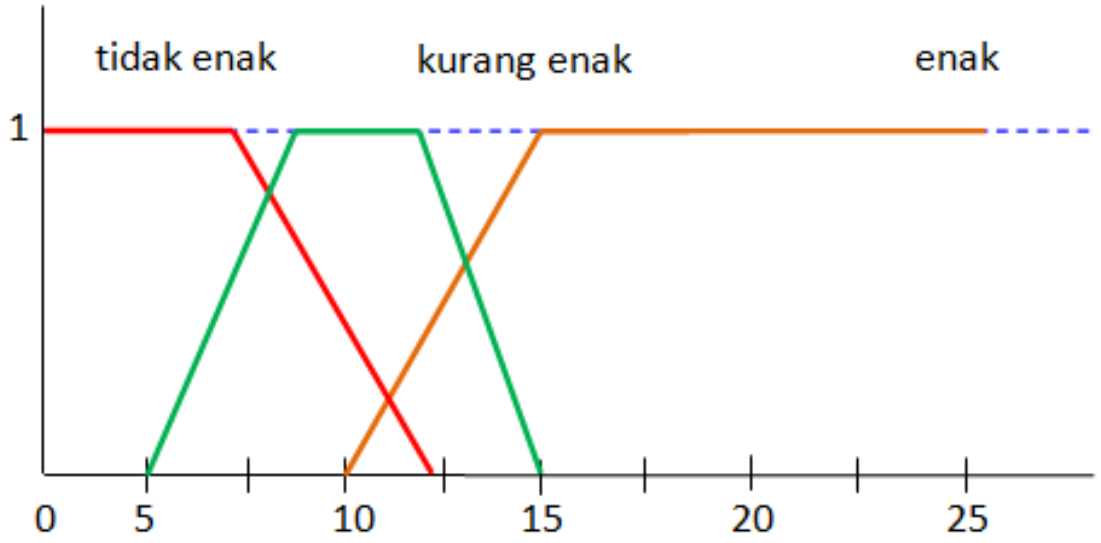
Fuzzy Set	Range	Domain
Mahal	[1200 – 2000]	[1200 1500 2000 2000]
Sedang	[600 – 1500]	[600 1000 1500]
Murah	[0 -800]	[0 0 500 800]



Membership Function (lanj..)

- Diketahui fuzzy set dari variabel ‘rasa’

Fuzzy Set	Range	Domain
Enak	[10 - 25]	[10 15 25 25]
Kurang Enak	[5 - 15]	[5 8 12 15]
Tidak Enak	[0 - 12]	[0 0 7 12]



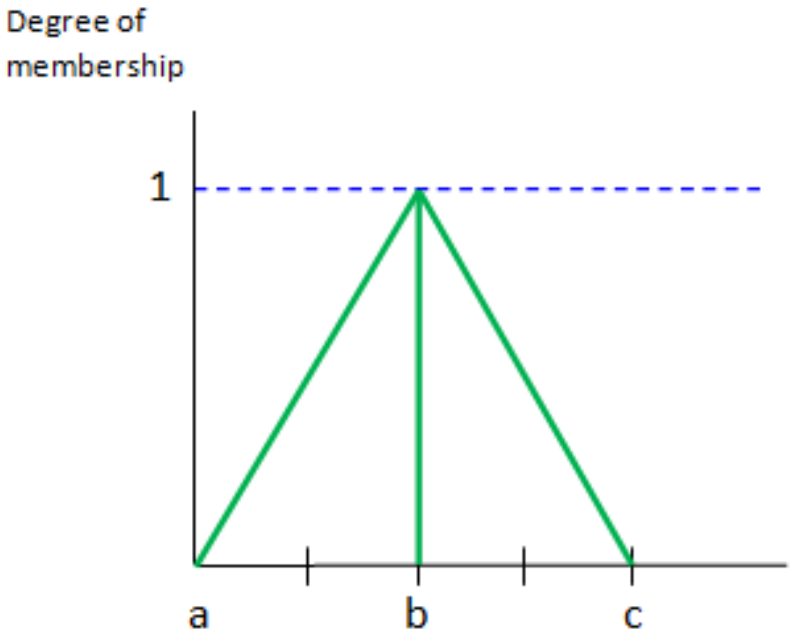
Membership Function (lanj..)

- Diketahui fuzzy set dari variabel ‘porsi’

Fuzzy Set	Range	Domain
Besar	[60 - 100]	[60 75 100 100]
Sedang	[20 - 75]	[20 25 50 75]
Kecil	[0 - 25]	[0 10 15 25]

Bagaimana Membership Functionnya ???

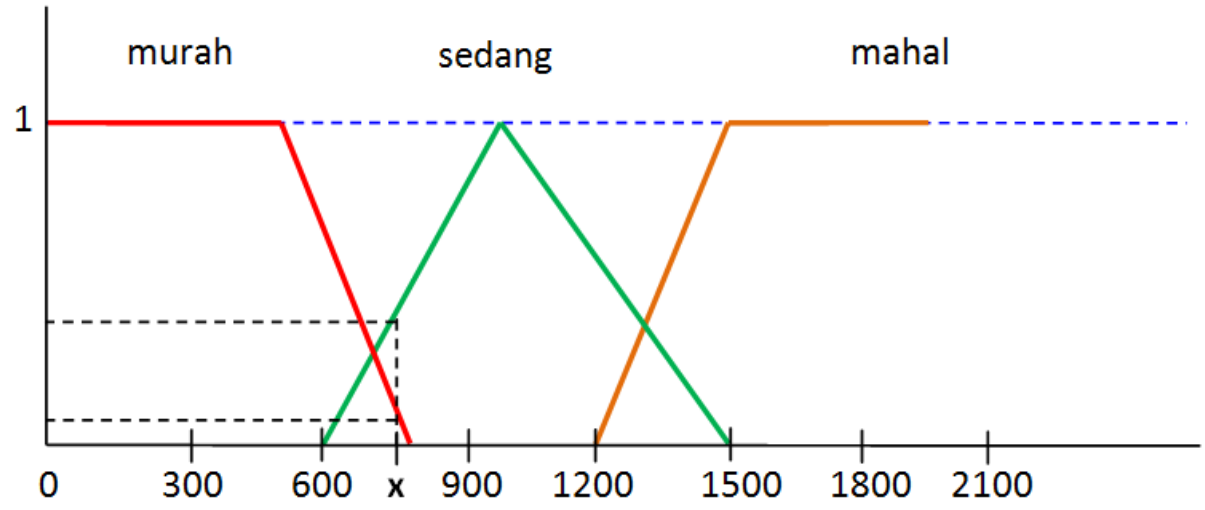
Degree of Membership



$$\mu(x) = \begin{cases} 1 & ; x = b \\ 0 & ; x < a \text{ atau } x > c \\ \dfrac{x-a}{b-a} & ; a < x < b \\ \dfrac{c-x}{c-b} & ; b < x < c \end{cases}$$

Degree of Membership (lanj..)

- Jika x = 750, berapa degree of membershipnya??

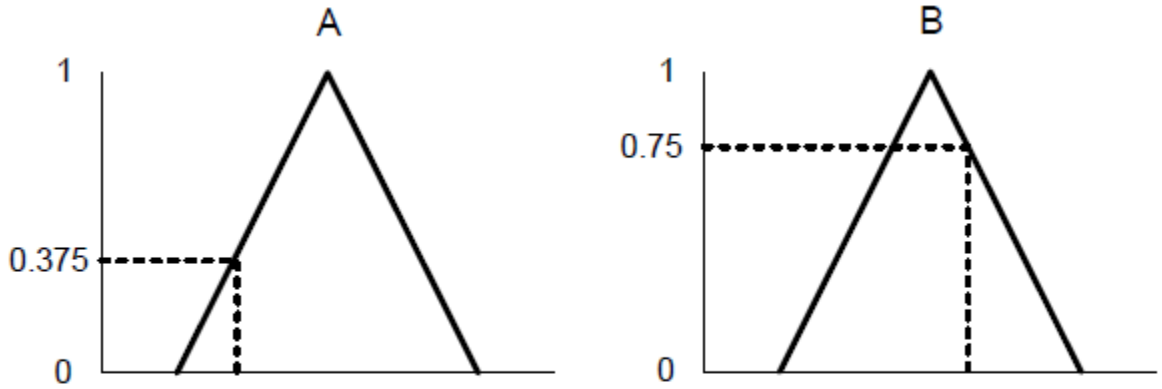


$$\mu(750) = \frac{750-600}{1000-600} = 0{,}375 \quad \rightarrow \text{sedang}$$

$$\mu(750) = \frac{800-750}{800-500} = 0{,}166 \quad \rightarrow \text{murah}$$

Fuzzy Connectives

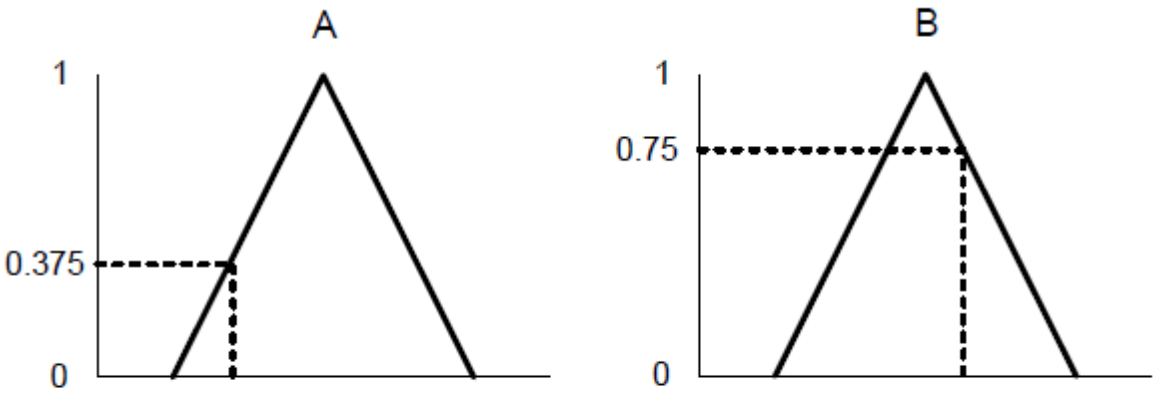
- Disjunction => or
- A V B => max(A,B)



- $(A \vee B = C) \Rightarrow (C = 0.75)$

Fuzzy Connectives (lanj..)

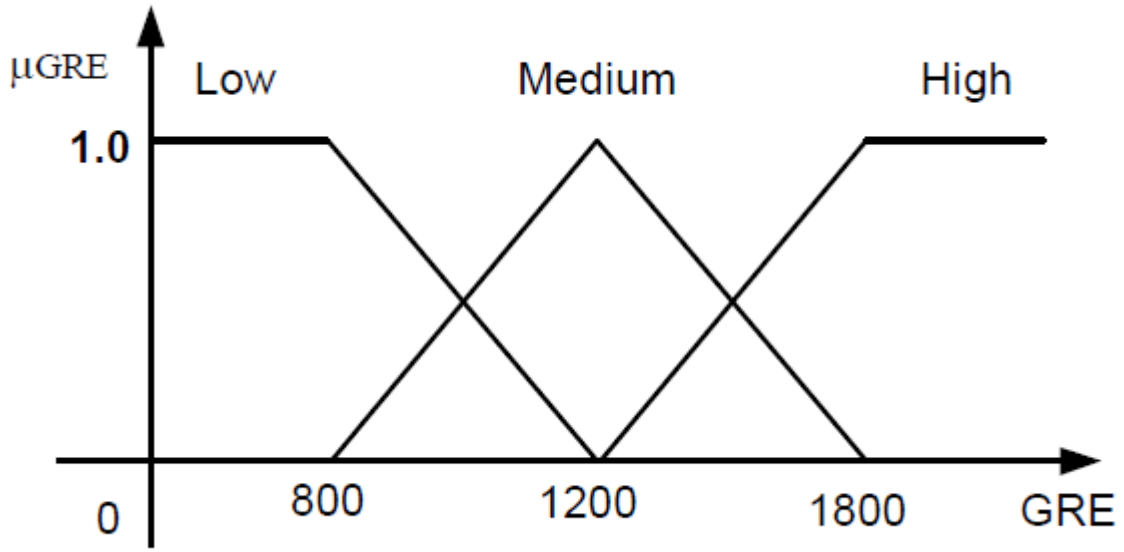
- Conjunction => and
- A ∧ B => min (A,B)



- $(A \wedge B = C) \Rightarrow (C = 0.375)$

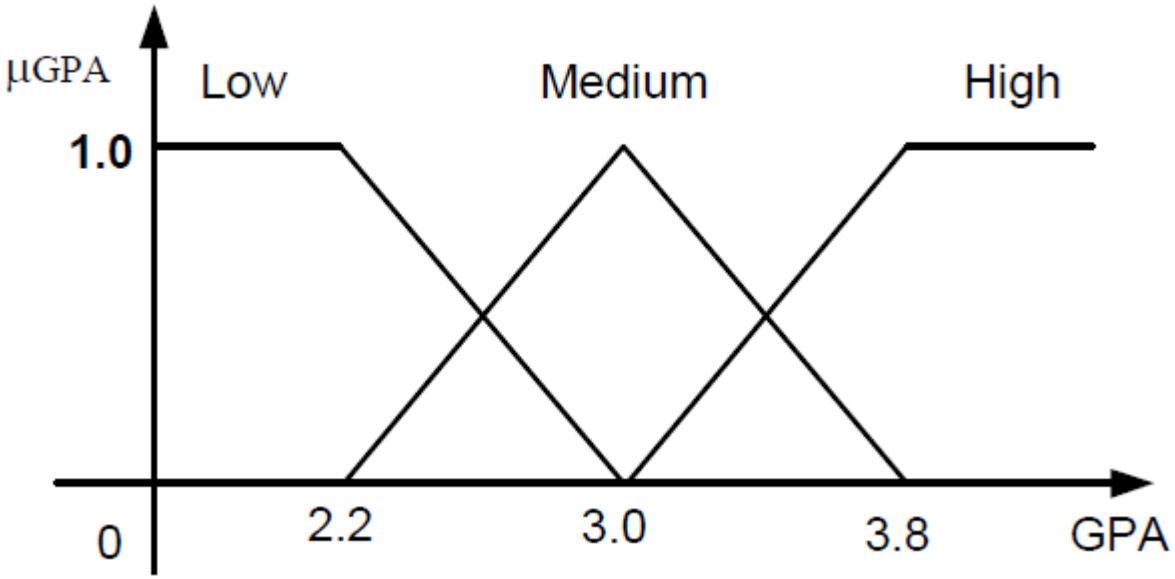
Example

- Mengevaluasi mahasiswa berdasarkan GPA dan GRE
- Membership function untuk ‘GRE’



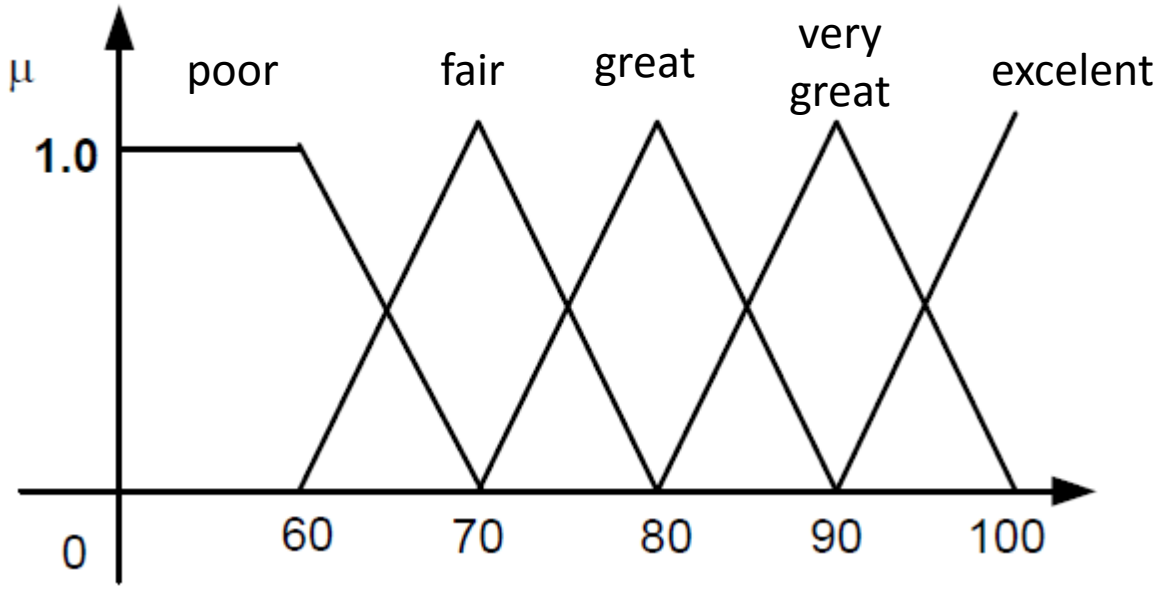
Example (cont..)

- Membership function untuk ‘GPA’



Example (cont..)

- Membership function untuk ‘decision’



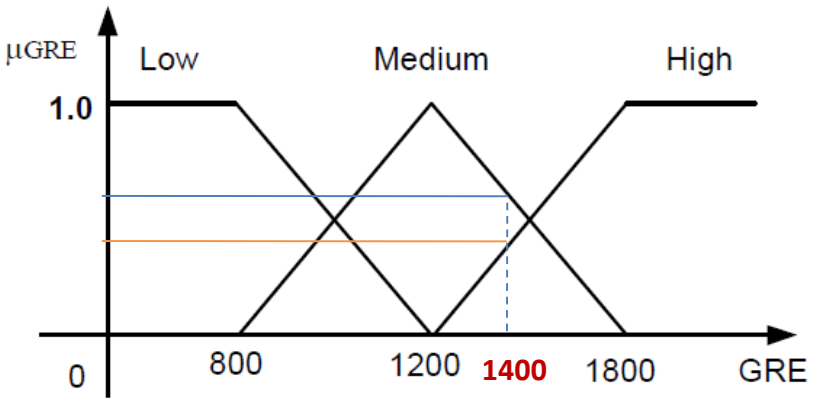
Example (cont..)

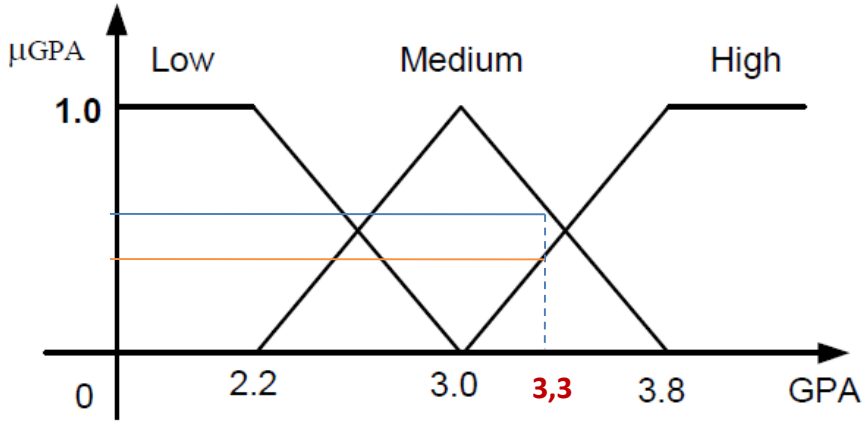
Rules:

1. If GRE is high and GPA is high then decision is excelent
2. If GRE is medium and GPA is high then decision is very great
3. If GRE is low and GPA is high then decision is fair
4. If GRE is high and GPA is medium then decision is great
5. If GRE is medium and GPA is medium then decision is great
6. If GRE is low and GPA is medium then decision is poor
7. If GRE is high and GPA is low then decision is fair
8. If GRE is medium and GPA is low then decision is poor
9. If GRE is low and GPA is low then decision is poor

Example (cont..)

- Diketahui:
  - GRE = 1400
  - GPA = 3.3





$$\mu(1400) = \frac{1800-1400}{1800-1200} = 0{,}67 \rightarrow \text{medium}$$

$$\mu(1400) = \frac{1400-1200}{1800-1200} = 0{,}33 \rightarrow \text{high}$$

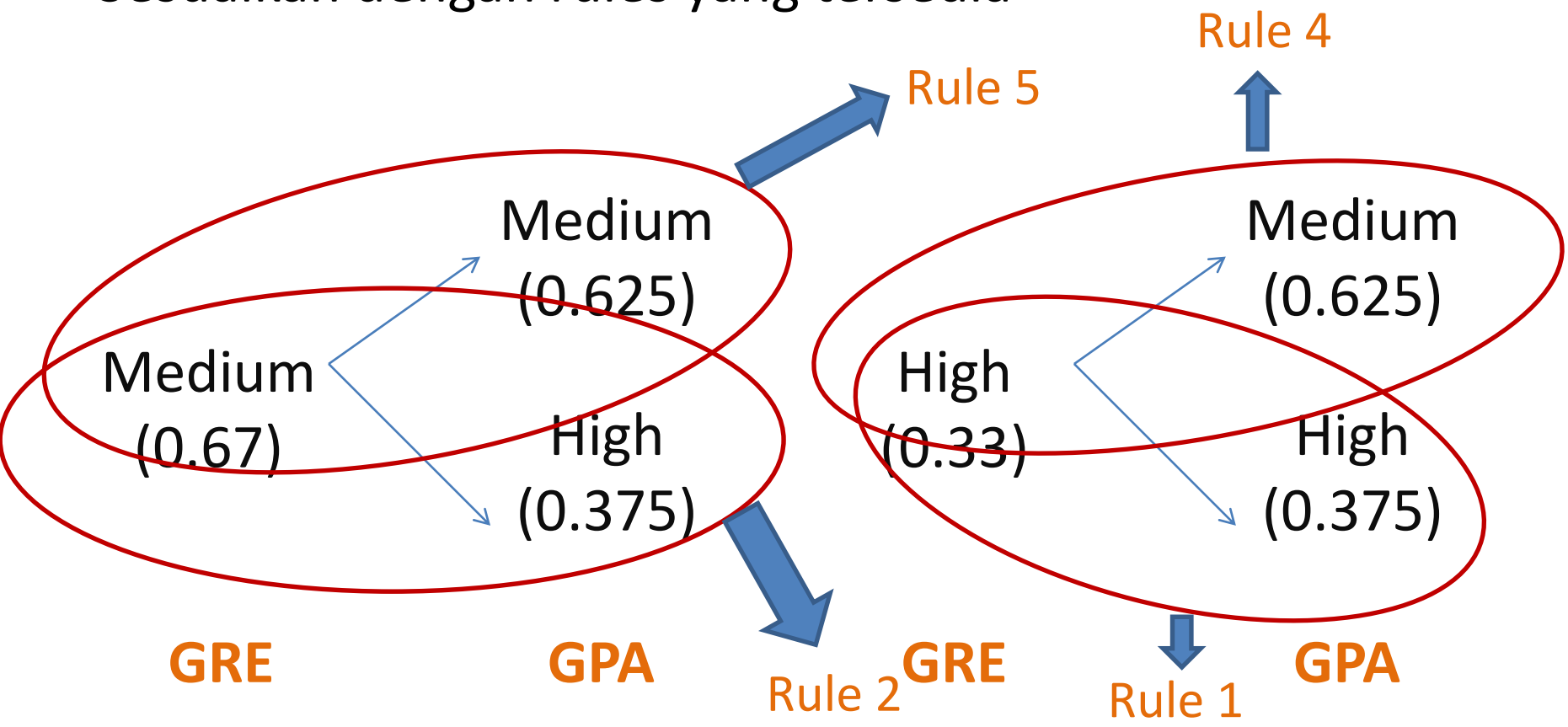
$$\mu(3.3) = \frac{3.8-3.3}{3.8-3.0} = 0{,}625 \rightarrow \text{medium}$$

$$\mu(3.3) = \frac{3.3-3.0}{3.8-3.0} = 0{,}375 \rightarrow \text{high}$$

Example (cont..)

Diperoleh degree of membership dari 2 varibel fuzzy.

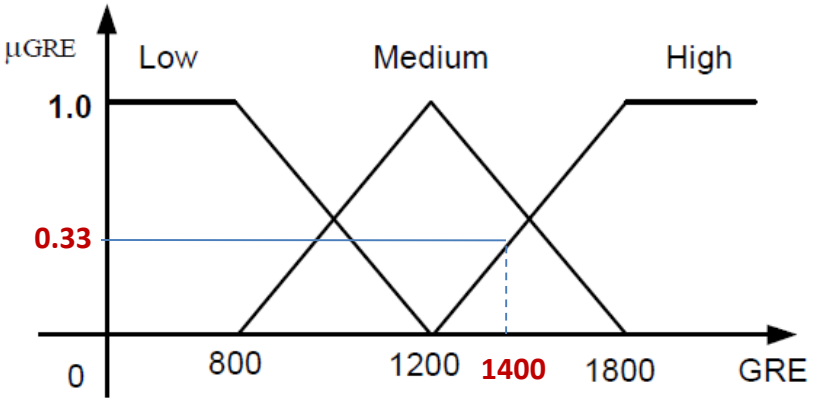
Sesuaikan dengan rules yang tersedia

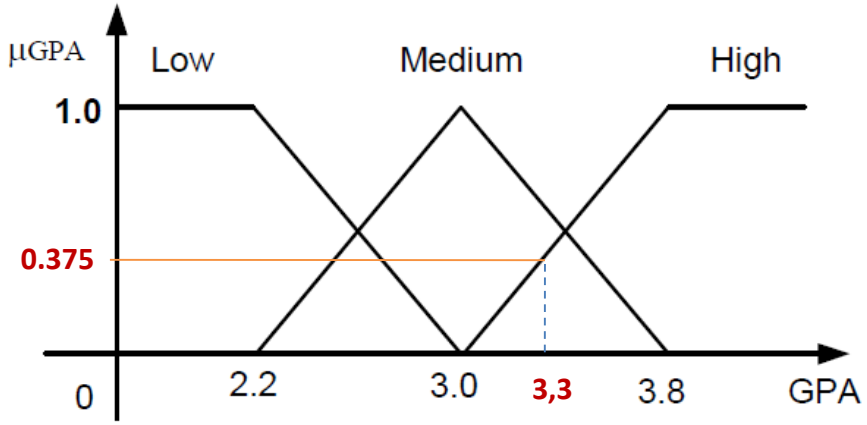


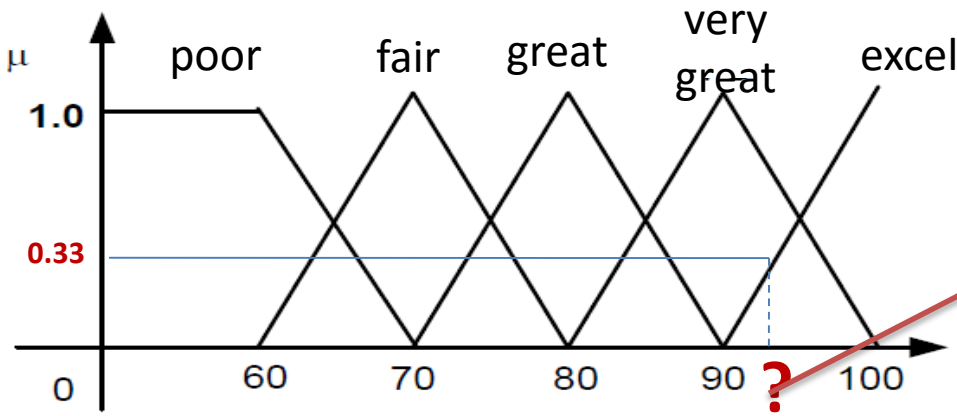
Example (cont..)

Rule 1:

If GRE is high and GPA is high then decision is excelent







$$\mu(x) = \frac{x - a}{b - a}$$

$$0.33 = \frac{x - 90}{100 - 90}$$

$$0.33\,(100 - 90) = x - 90$$

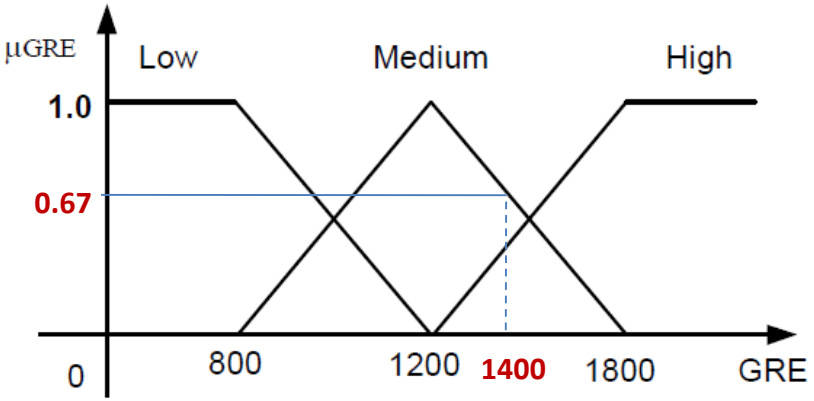
$$3.3 = x - 90$$

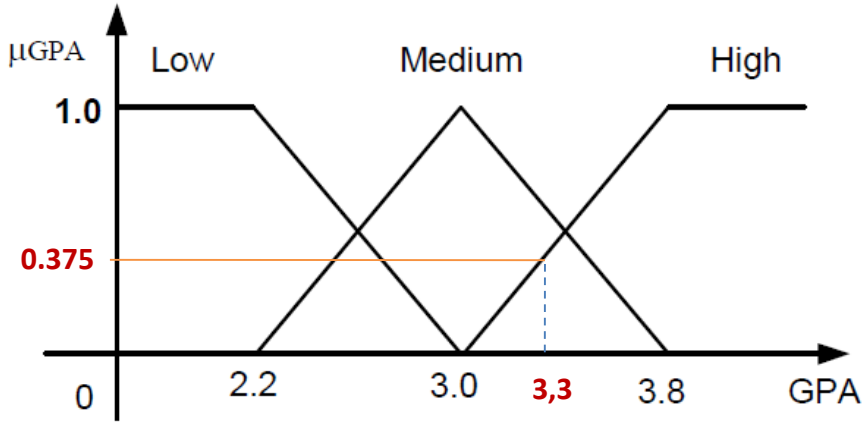
$$X = 93.3 \rightarrow Z1$$

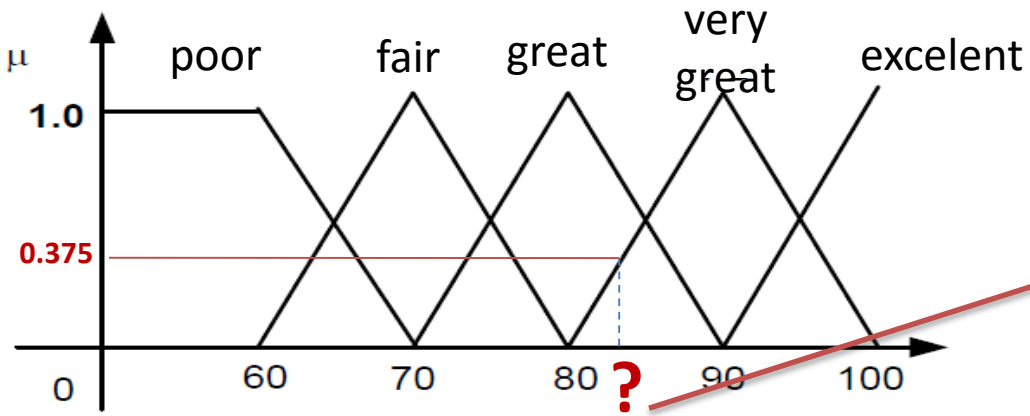
Example (cont..)

Rule 2:

If GRE is medium and GPA is high then decision is very great







$$\mu(x) = \frac{x - a}{b - a}$$

$$0.375 = \frac{x - 80}{90 - 80}$$

$$0.375\,(90 - 80) = x - 80$$

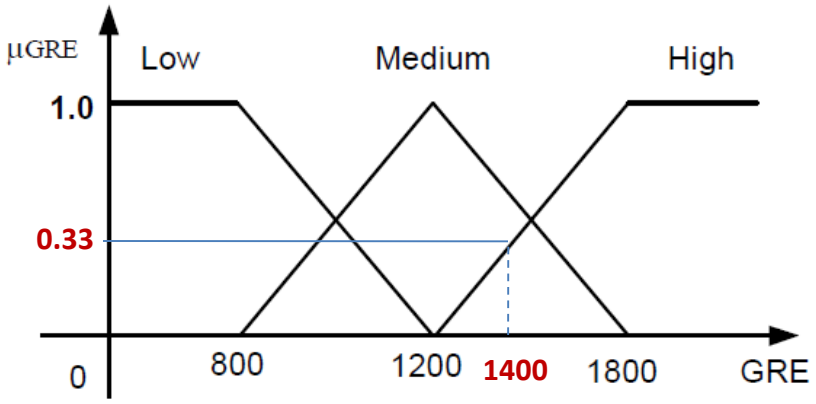
$$3.75 = x - 80$$

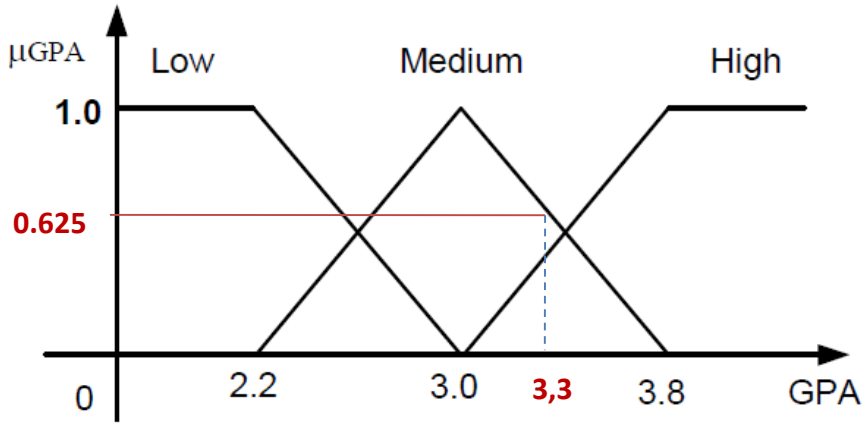
$$X = 83.75$$ → Z2

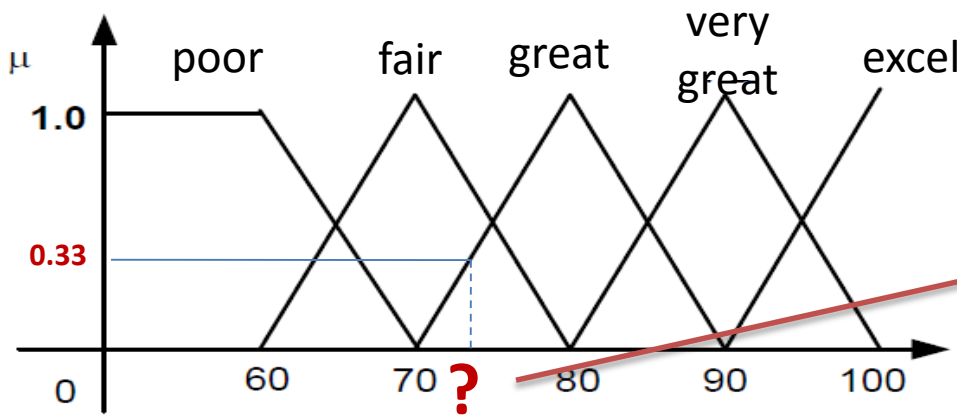
Example (cont..)

Rule 4:

If GRE is high and GPA is medium then decision is great







$$\mu(x) = \frac{x - a}{b - a}$$

$$0.33 = \frac{x - 70}{80 - 70}$$

$$0.33\,(80 - 70) = x - 70$$

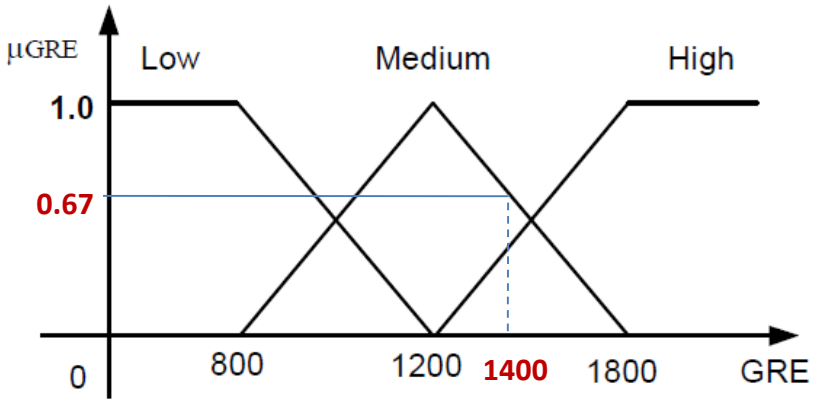
$$3.3 = x - 70$$

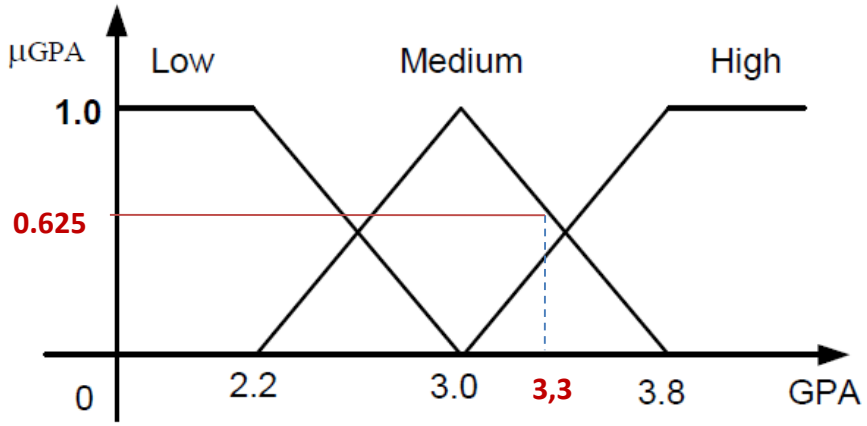
$$X = 73.3 \rightarrow Z3$$

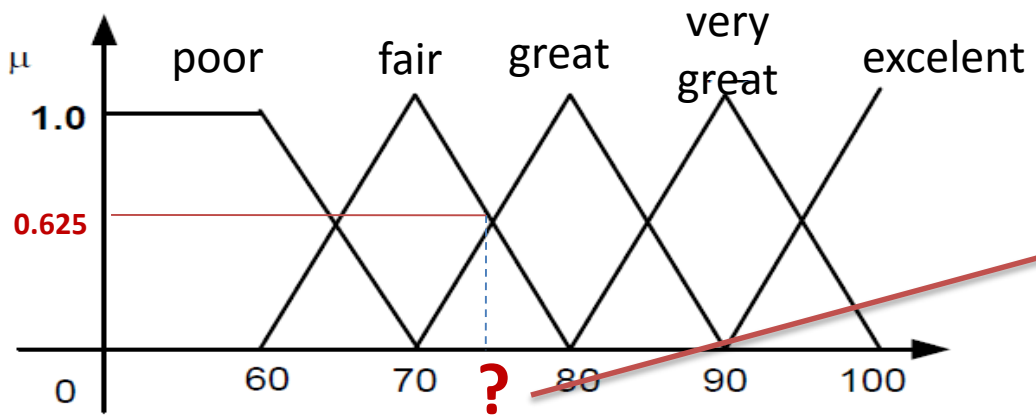
Example (cont..)

Rule 5:

If GRE is medium and GPA is medium then decision is great







$$\mu(x) = \frac{x - a}{b - a}$$

$$0.625 = \frac{x - 70}{80 - 70}$$

$$0.625\ (80 - 70) = x - 70$$

$$6.25 = x - 70$$

$$X = 76.25 \rightarrow Z4$$

Defuzzification

- Menghitung nilai crisp output:
  - rata-rata terboboti

$$Z_{total} = \frac{\mu_1 \cdot z_1 + \mu_2 \cdot z_2 + \ldots + \mu_n \cdot z_n}{\mu_1 + \ldots + \mu_n}$$

  - center of gravity (COG) → FIS Mamdani

$$COG = \frac{\int_a^b \mu_A(x)\, x\, dx}{\int_a^b \mu_A(x)\, dx}$$

Defuzzification

- Hitung nilai crisp dari output (decision) dengan rata-rata terboboti
- Dari contoh sebelumnya
  - Rule 1 -> μ1 = 0.33, Z1= 93.3
  - Rule 2 -> μ2 = 0.375, Z2 = 83.75
  - Rule 4 -> μ3 = 0.33, Z3 = 73.3
  - Rule 5 -> μ4 = 0.625, Z4 = 76.25

$$Z_{total} = \frac{(0.33 \times 93.3) + (0.375 \times 83.75) + (0.33 \times 73.3) + (0.625 \times 76.25)}{0.33 + 0.375 + 0.33 + 0.625}$$

$$= \frac{134.0405}{1.66}$$

$$= 80.74$$

Exercise

1. Suatu Perusahaan akan melakukan perkiraan terhadap produksi suatu barang tiap bulan. Untuk menentukan jumlah barang yang diproduksi tersebut digunakan pendekatan *fuzzy*. Dalam kasus ini terdapat parameter masukan yaitu permintaan dan persediaan barang. Adapun parameter keluaran adalah jumlah barang yang akan diproduksi. Tabel di bawah ini memperlihatkan variabel *fuzzy* yang akan dibuat berikut range nilai *fuzzy set*nya

Variable	Fuzzy Set	Range	Domain
Permintaan	Sedikit	[8 - 24]	[8 11 14]
	Sedang		[13 16 19]
	Banyak		[18 21 24]
Persediaan	Sedikit	[30 – 60]	[30 36 42]
	Sedang		[38 45 50]
	Banyak		[47 55 60]

Output	Fuzzy Set	Range	Domain
Jumlah Produksi	Sedikit	[10 - 25]	[10 10 14 20]
	Banyak		[17 21 25 25]

Exercise(cont..)

Rules:

- IF permintaan sedikit AND persediaan sedikit THEN produksi sedikit
- IF permintaan sedikit AND persediaan banyak THEN produksi banyak
- IF permintaan sedikit AND persediaan sedang THEN produksi sedikit
- IF permintaan sedang AND persediaan sedang THEN produksi sedikit
- IF permintaan sedang AND persediaan sedikit THEN produksi sedikit
- IF permintaan sedang AND persediaan banyak THEN produksi banyak
- IF permintaan banyak AND persediaan sedikit THEN produksi sedikit
- IF permintaan banyak AND persediaan sedang THEN produksi banyak
- IF permintaan banyak AND persediaan banyak THEN produksi banyak

Exercise (cont..)

- Jika diketahui:
  - Permintaan = 17, persediaan = 44
  - Permintaan = 20, persediaan = 31
  - Permintaan = 10, persediaan = 48
- Hitung nilai crisp dari variabel output jumlah produksi

Pengumpulan

Subjek: Metkuan_NIM_P[1/2]_LKP5

Deadline: Kamis, 12 November 2015, 11:55 PM

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Terima Kasih