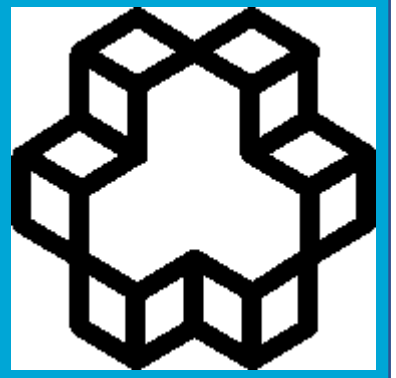

Artificial Intelligence and Expert Systems

Fuzzy - TA Session 1

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Motivating examples

System Modeling

- Weather
  - If weather is cold and there are clouds in the sky then it will rain
  - If weather is not cold and there are clouds in the sky then it might rain
  - If weather is not cold and there aren't clouds in the sky then it wont rain

Control

- Room temperature control
  - If room is very cold then heater on max
  - If room is cold then heater on medium
  - If room is warm then heater off

Motivating examples

- Electricity consumption
  - If crowded household and many electric devices then very high consumption
  - If crowded household and few electric devices then medium consumption
  - If medium household population and few electric devices then low consumption
  - If uncrowded household and few electric devices then very low consumption
  - …

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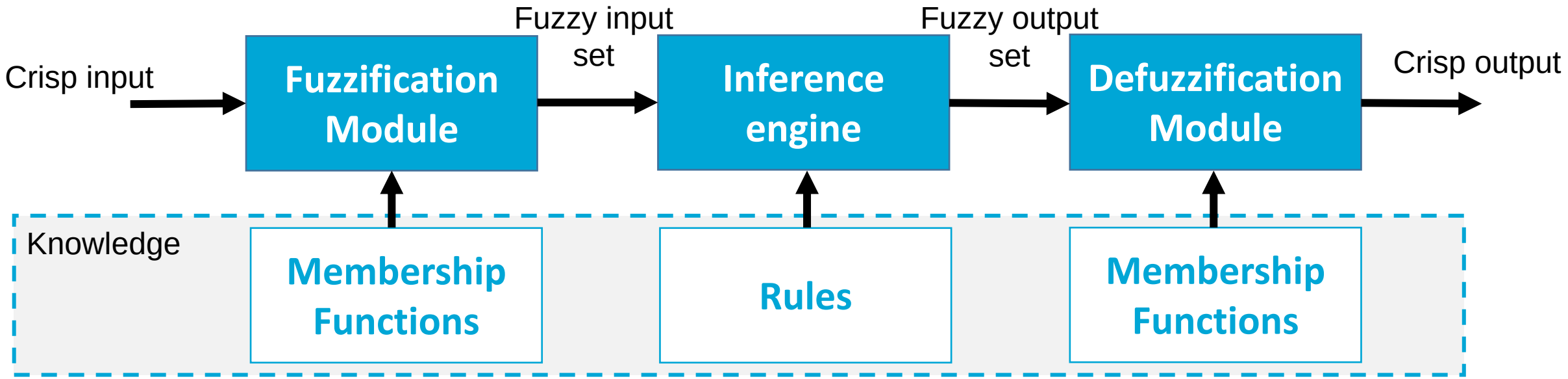

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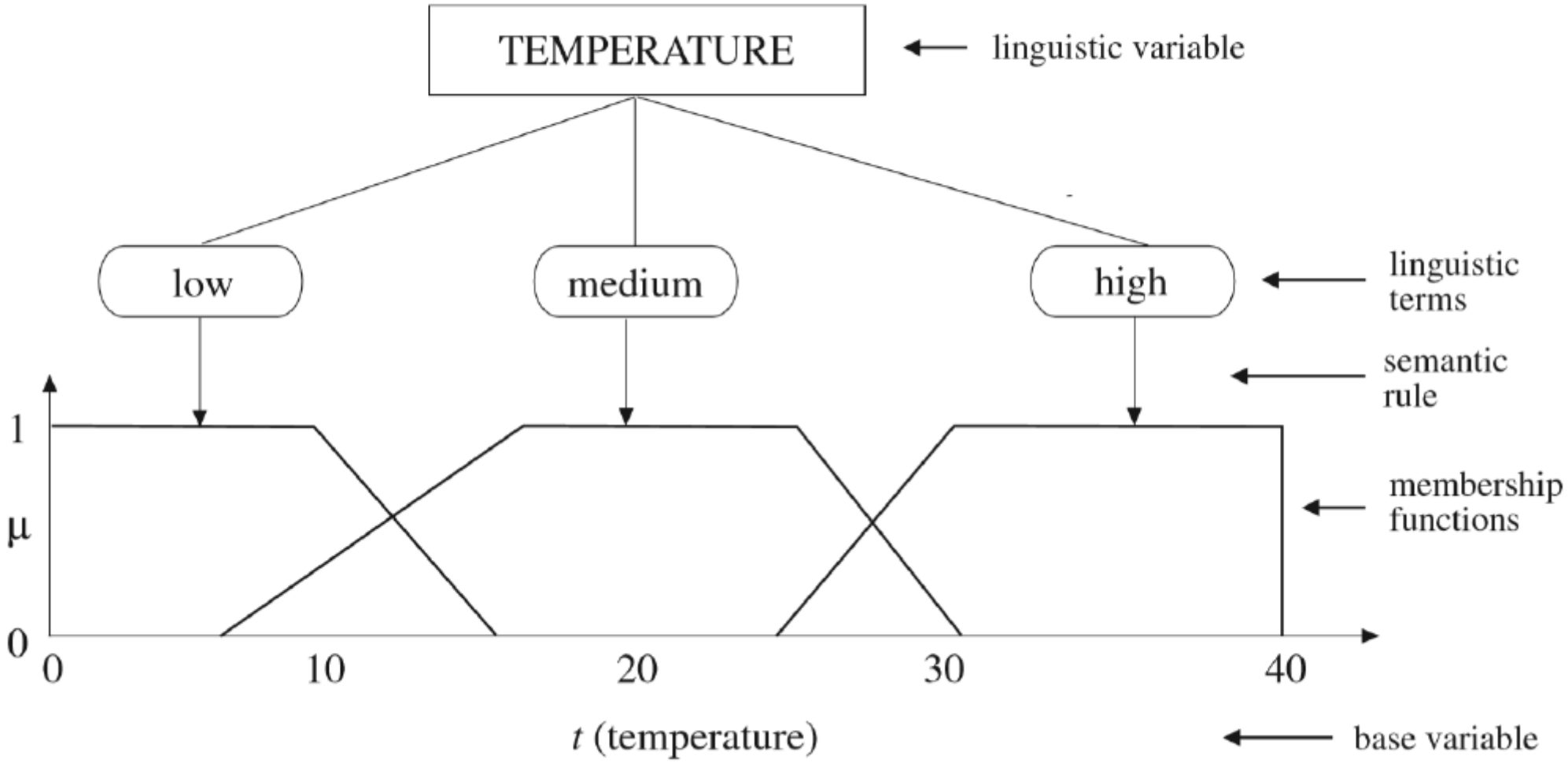
Motivating examples



CODE

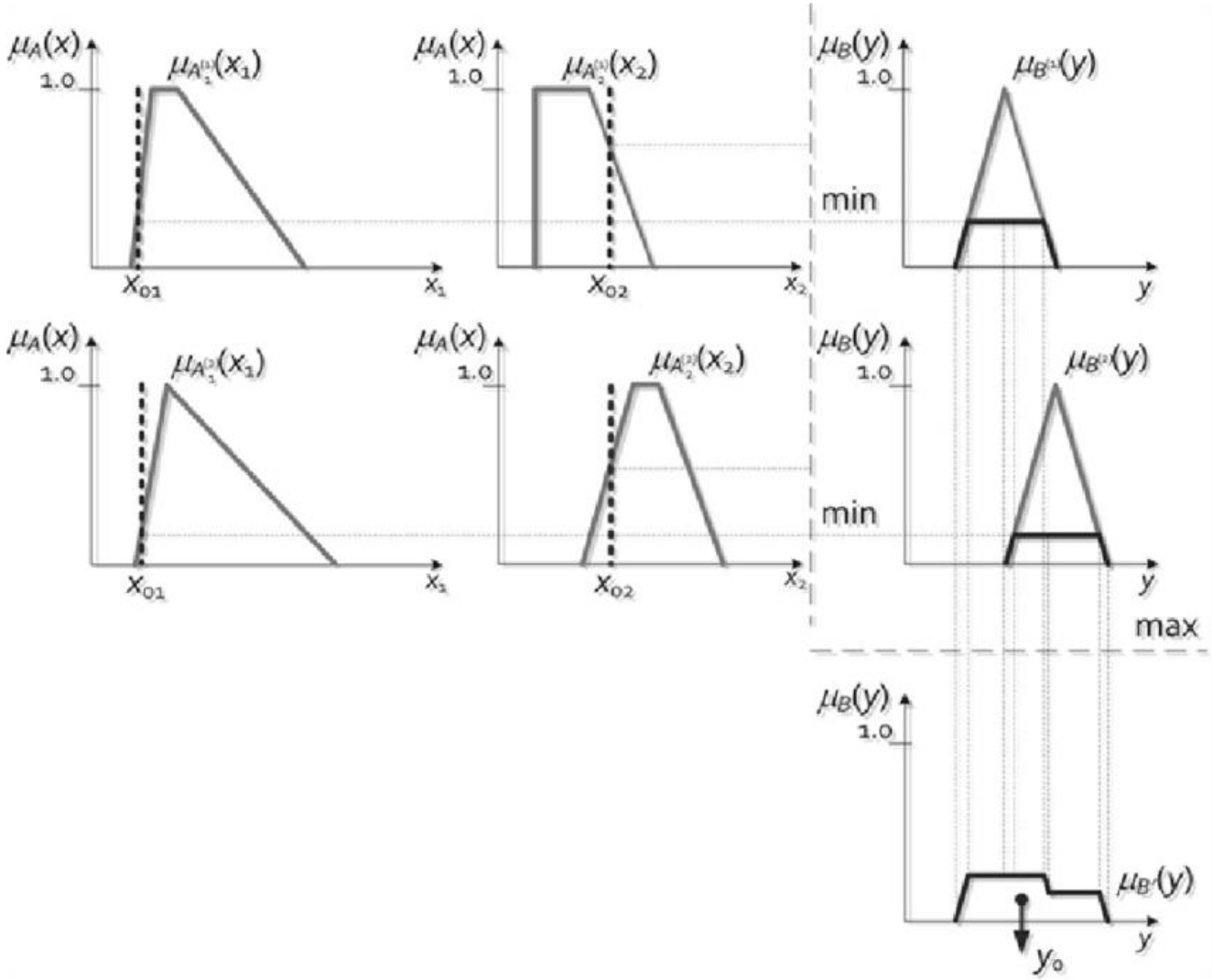
Fuzzy Mamdani method (Max-Min)

1. **Fuzzification on inputs**

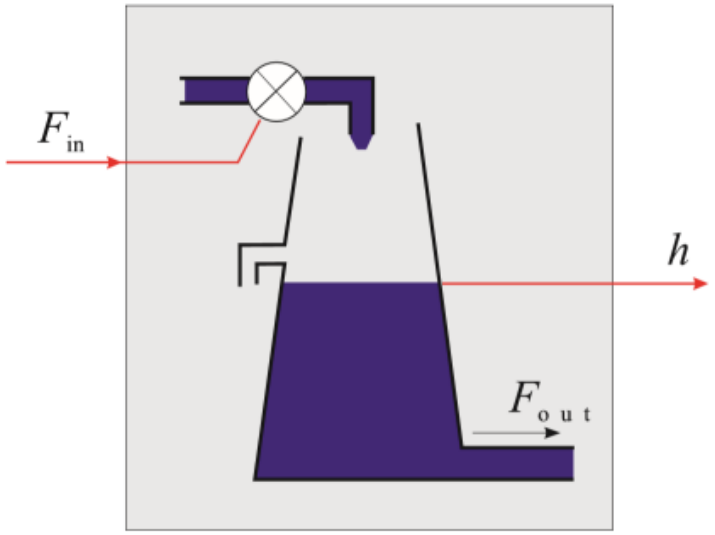
2. **Implication**
   Implication function -> Min

3. **Aggregation**
   Aggregation function -> Max

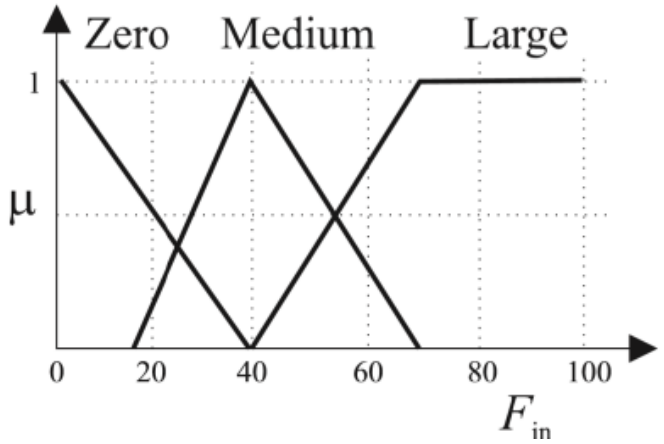
4. **Defuzzification**

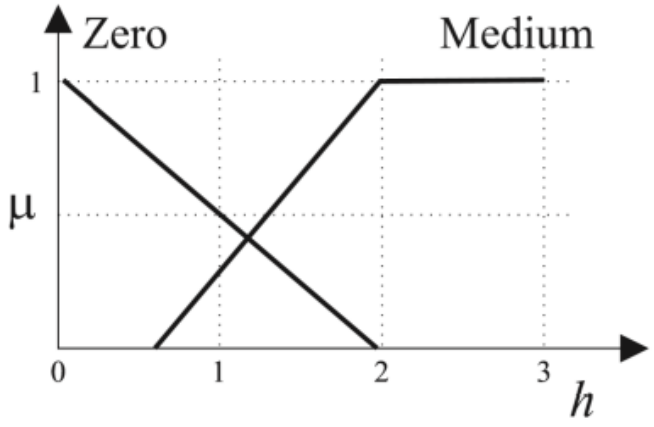


Example 1: Modeling of Liquid Level

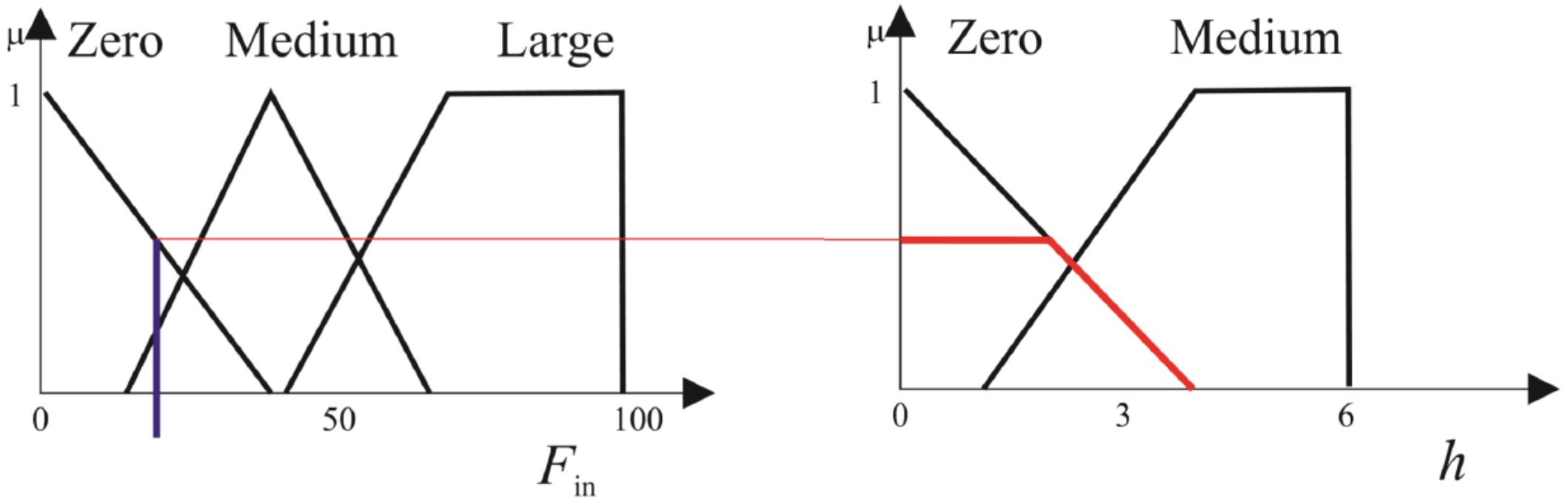


- **If** F_{in} **is** Zero **then** h **is** Zero
- **If** F_{in} **is** Med **then** h **is** Med
- **If** F_{in} **is** Large **then** h **is** Med



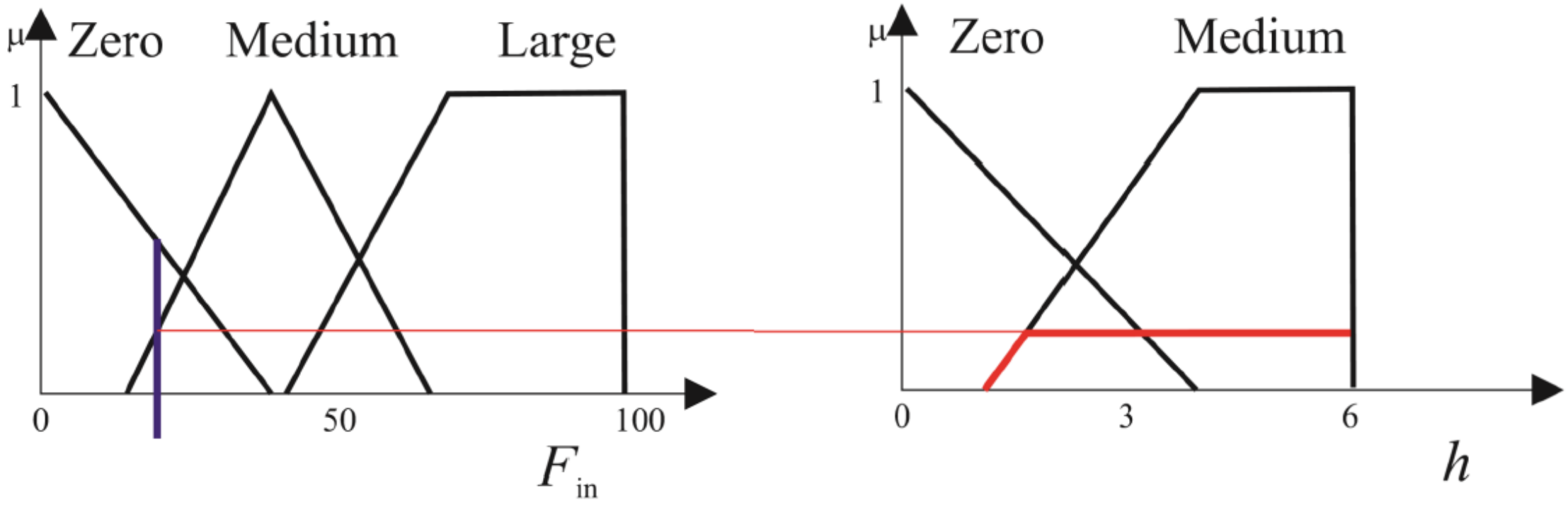


Rule 1 implication



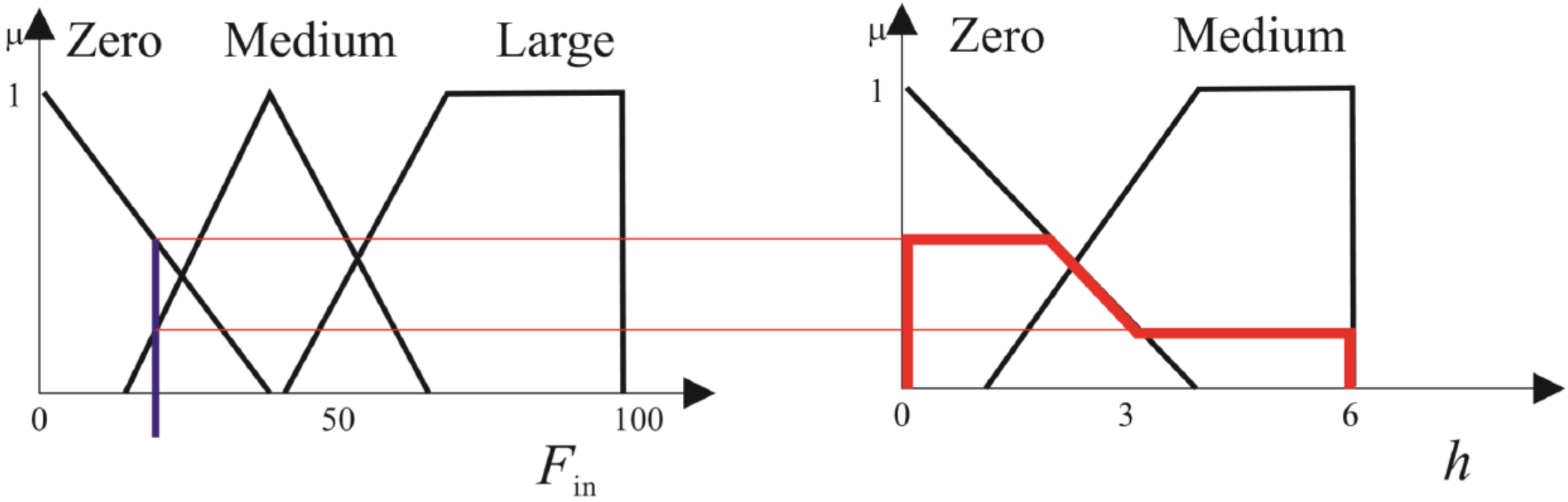
Clip consequent membership function of the first rule.

Rule 2 implication



[Clip consequent membership function of the second rule. rule.

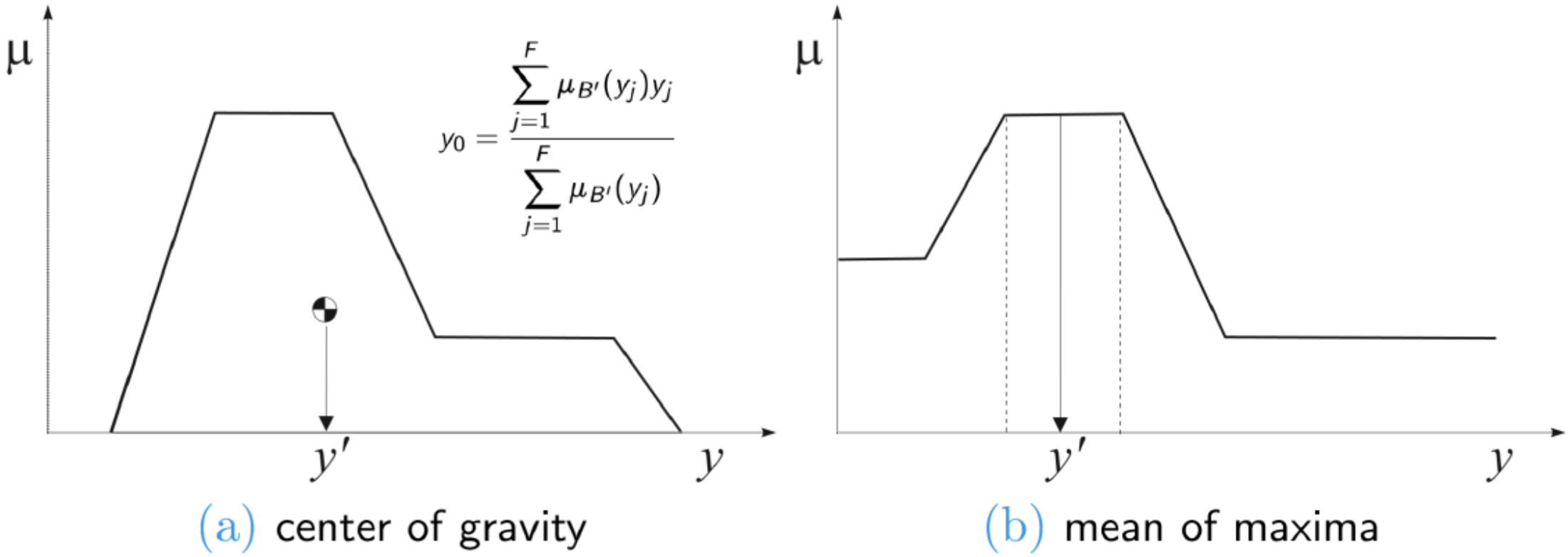
Aggregate outputs



Combine the result of the two rules (union).

Defuzzification

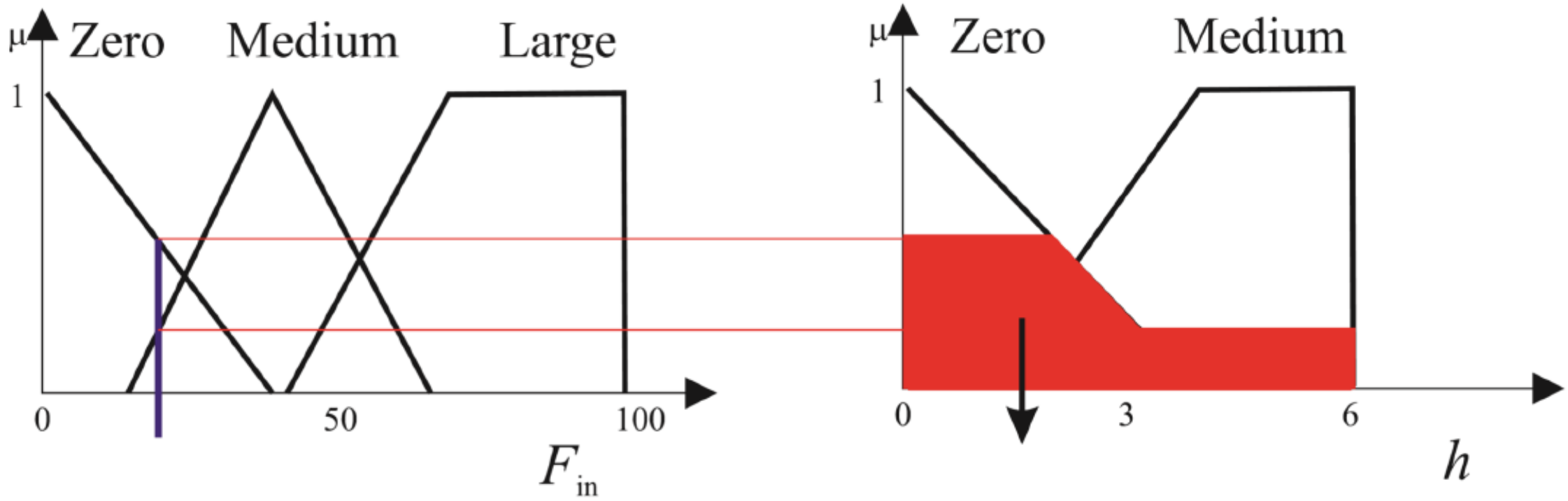
conversion of a fuzzy set to a crisp value



(a) center of gravity

(b) mean of maxima

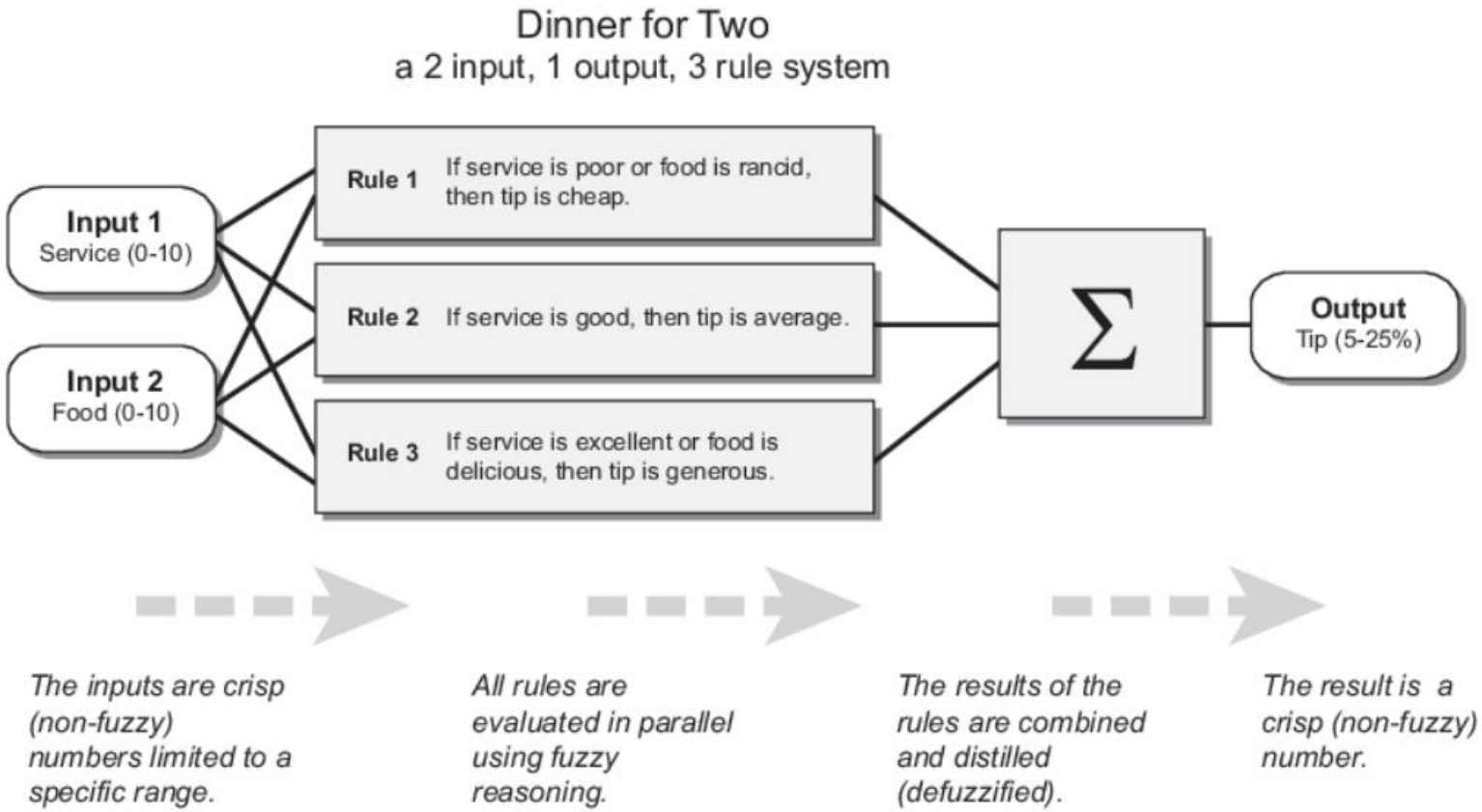
Defuzzification



Compute a crisp (numerical) output of the model (center-of-gravity method).

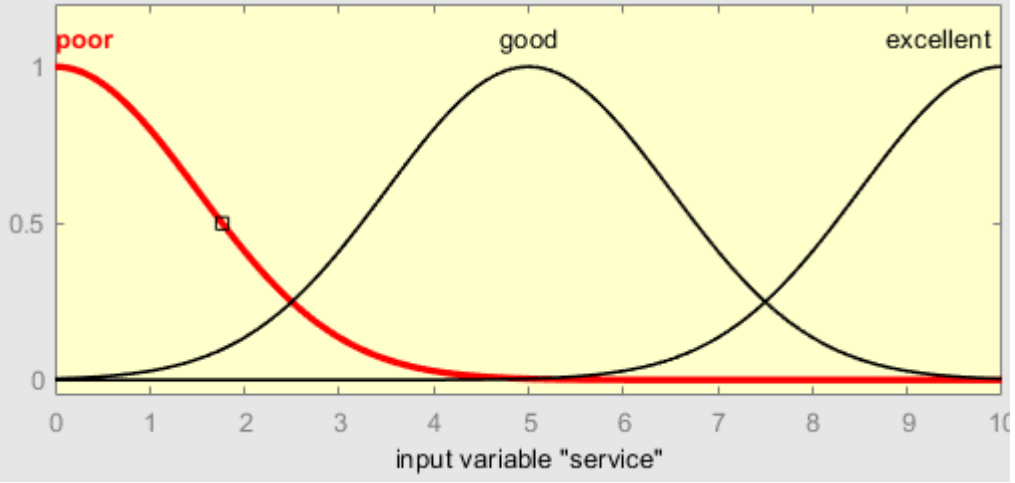
Example 2: Basic Tipping problem

1. If the service is poor or the food is rancid, then tip is cheap.
2. If the service is good, then tip is average.
3. If the service is excellent and the food is delicious, then tip is generous.

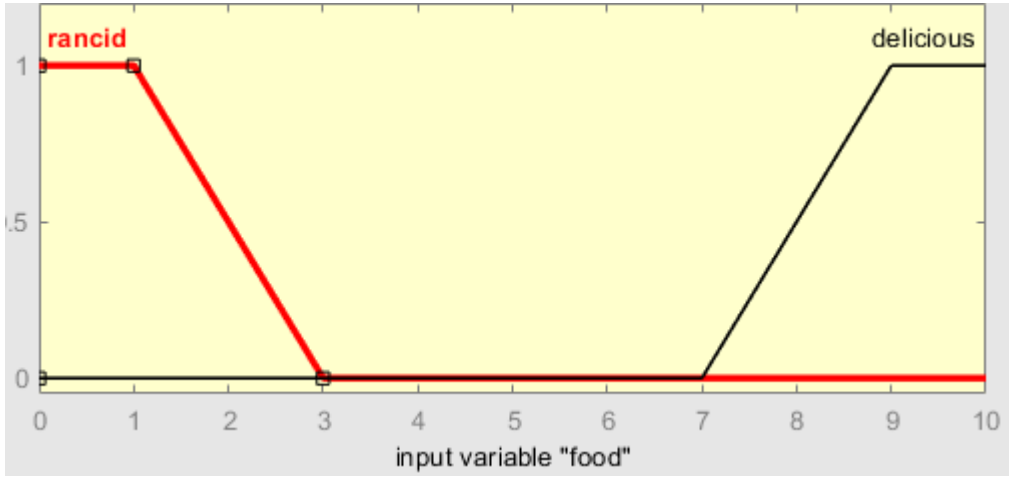


Input membership functions

Input 1: service
3 gaussian membership functions
(Standard deviations = 1.5)

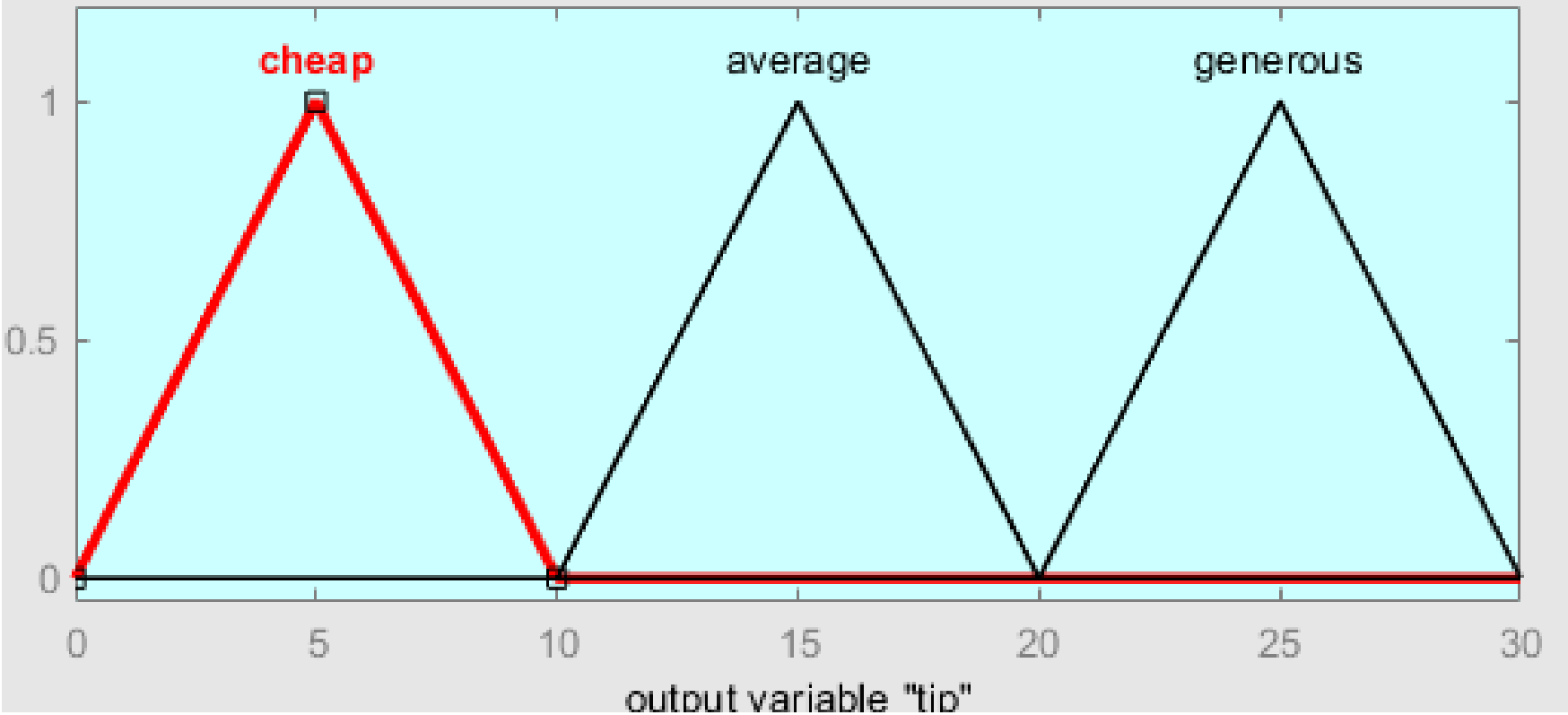


Input 2: food



Output membership functions

Output: Tip (0-30)



Rules

1. If the service is poor or the food is rancid, then tip is cheap.
2. If the service is good, then tip is average.
3. If the service is excellent and the food is delicious, then tip is generous.

Aggregate and defuzzification