Introduction to Fuzzy Set Theory

Uncertainty

- Information
  - Meaningful data
  - Knowledge get from experience
  - Bilgi. Bir çok olasıl olay arasında belirli bir olayın meydana gelme belirsizliğini, bilinemezliğini azaltan herhangi bir bilgi
- Uncertainty
  - The condition in which the possibility of error exist
  - Belirsizlik. Bir kuralın ya da olgunun geçerliliğine duyulan kuşku
- Complexity
  - Karmaşıklık. Bir sistem ya da bileşenin tasarım, gerçekleştirme, anlama ve doğrulanmasına ilişkin güçlüklerin derecesi

Possibility and Probability

- Possibility
  - The degree that thing happens
- Probability
  - The probability that things be happen or not

Symbol ?

Measurement and Uncertainty

- Precision
  - No matter how accurate our measurements are, some uncertainty always remains
  - Fractional parts
  - Kesinlik. Aynı yöntemle aynı koşullarda ölçülen fiziksel bir özelliğin yinelenen ölçümlerinin yakınlığı.

Measure ?

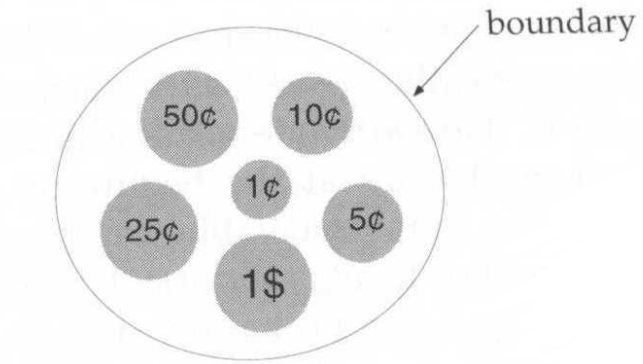
Language and vagueness

- Understanding of word meaning
  - Full texture of cultural and personal association
  - Vagueness
- Heap paradox
  - Generally speaking it involves abandoning a principal when the terms are not clearly defined.

- Quantitative method for taking into account of vagueness

The emergence of fuzzy set theory

- To deal with uncertainty
  - Avoid
  - Statistical mechanics
  - Fuzzy set (Zadeh in 1965)
- Crisp set
  - A collection of things
  - Boundary is require to be precise

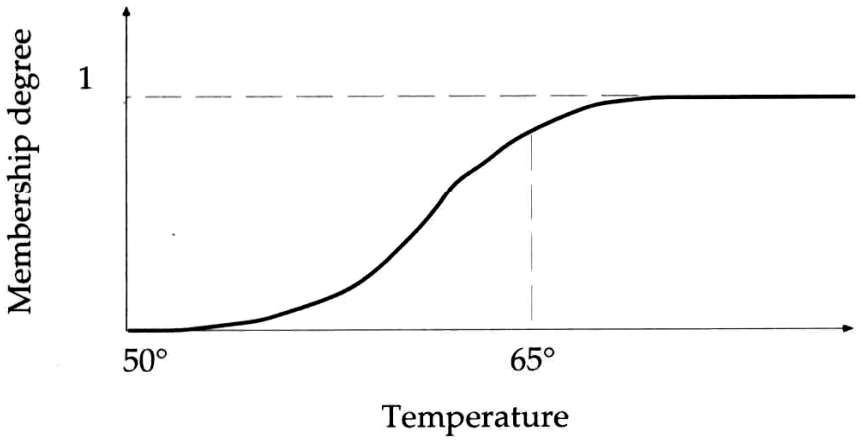


LEGAL U. S. COINS

French franc English pound

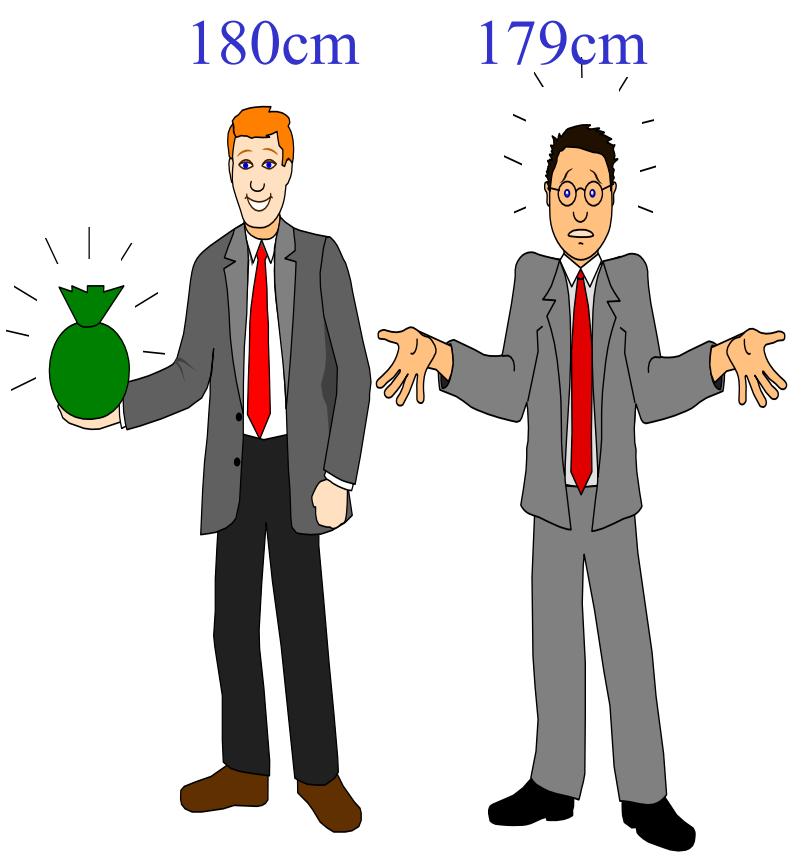
Fuzzy sets

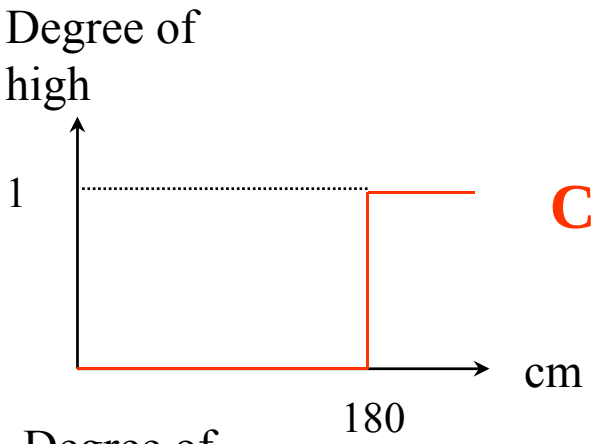
- Definition
  - The pair of member and the degree of membership of the member
- Membership function



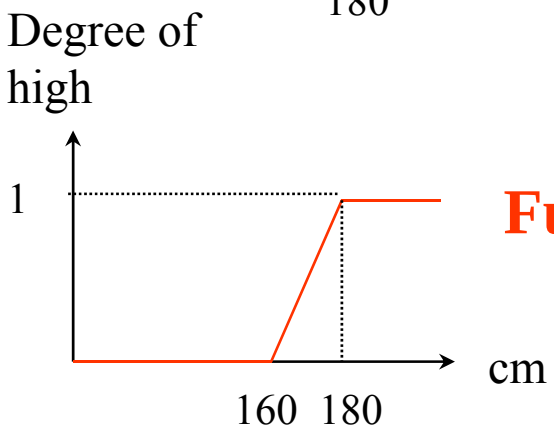
Possible membership function of fuzzy set WARM.

Fuzzy and crisp





Crisp (Kesin)



Fuzzy (Bulanık)

Fuzzy and crisp

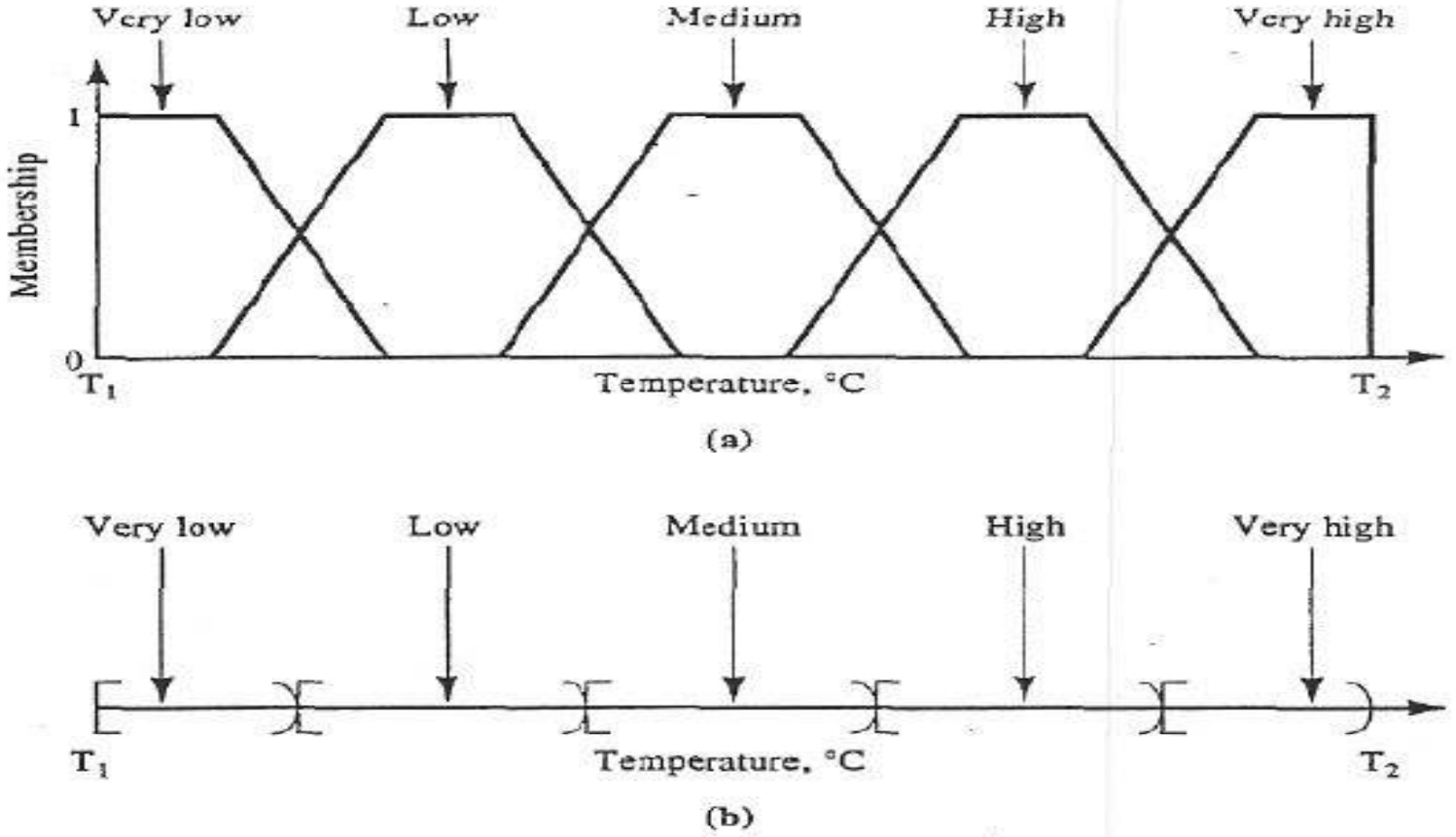
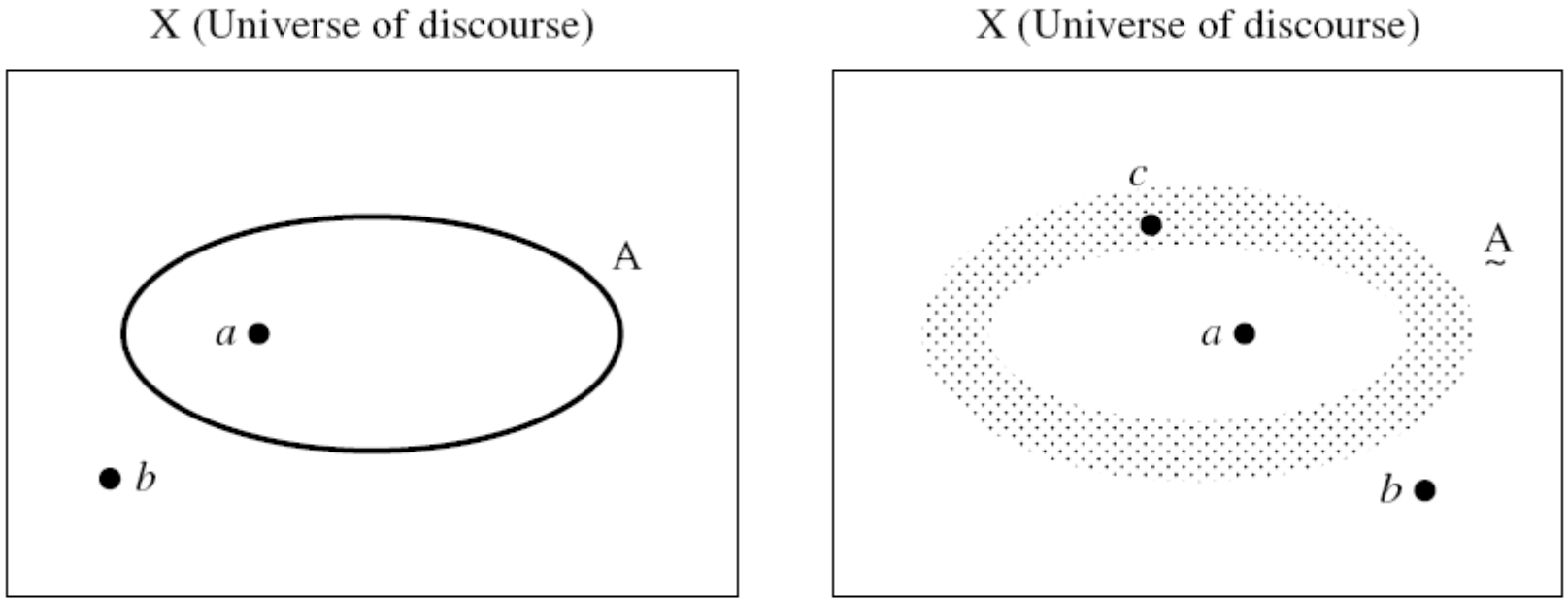


Figure 1.4 Temperature in the range $[T_1, T_2]$ conceived as: (a) a fuzzy variable; (b) a traditional (crisp) variable.

Crisp and fuzzy



Diagrams for (*a*) crisp set boundary and (*b*) fuzzy set boundary.

Crisp and fuzzy

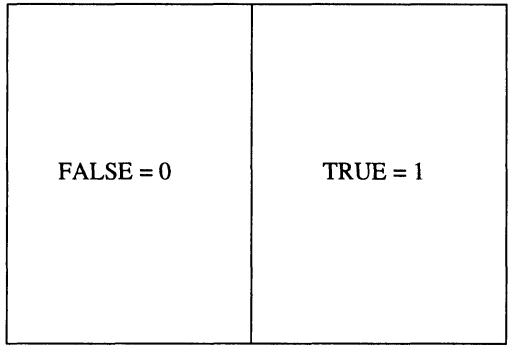


Figure 1.1 Crisp sets of TRUE and FALSE.

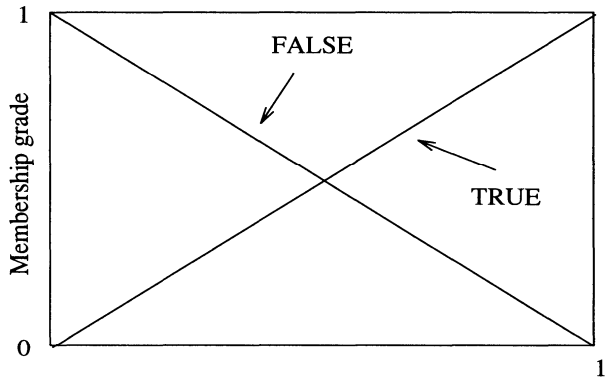


Figure 1.2 Fuzzy sets of TRUE and FALSE.

Applications

- Pattern recognition and clustering
- Fuzzy control
  - Automobiles, air-condition, robotics
- Fuzzy decision
  - Stock market, finance, investment
- Expert system
  - Database, information retrieval, image processing
- Combined with other field
  - Neural network, genetic algorithms