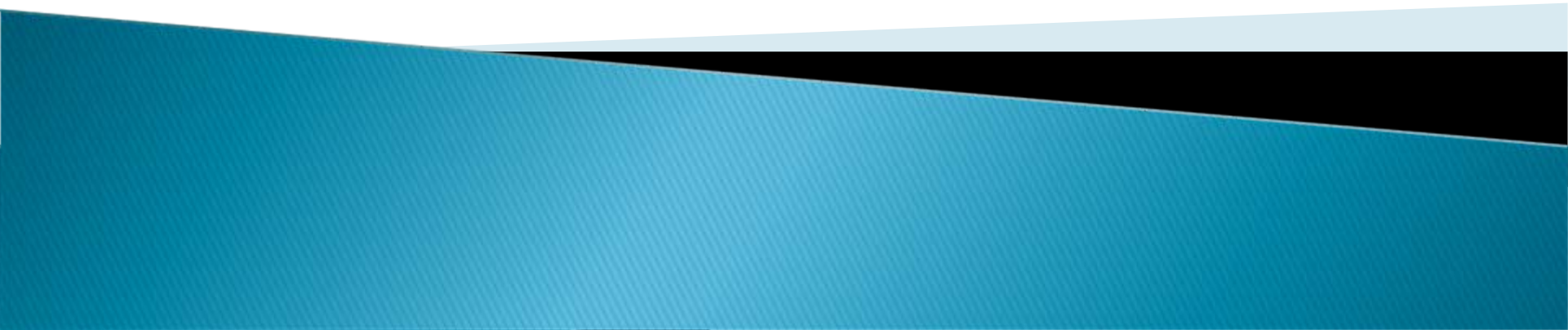



Fuzzy Logic and its Applications

Cse 352, Fall 2008


Bradford Wagner and Brandon Haviland



Topics:

1. What is Fuzzy Logic
 2. The origin of Fuzzy Logic and its inventor
 3. Why use Fuzzy Logic
 4. How Fuzzy Logic works
 5. The applications of Fuzzy Logic in the real world
 6. Where Fuzzy Logic is going in the future
- 

What is Fuzzy Logic?

- Fuzzy Logic is a super set of Boolean logic.
 - It adds degrees between absolute true and absolute false.
 - Some propositions may be more true than others.
- 

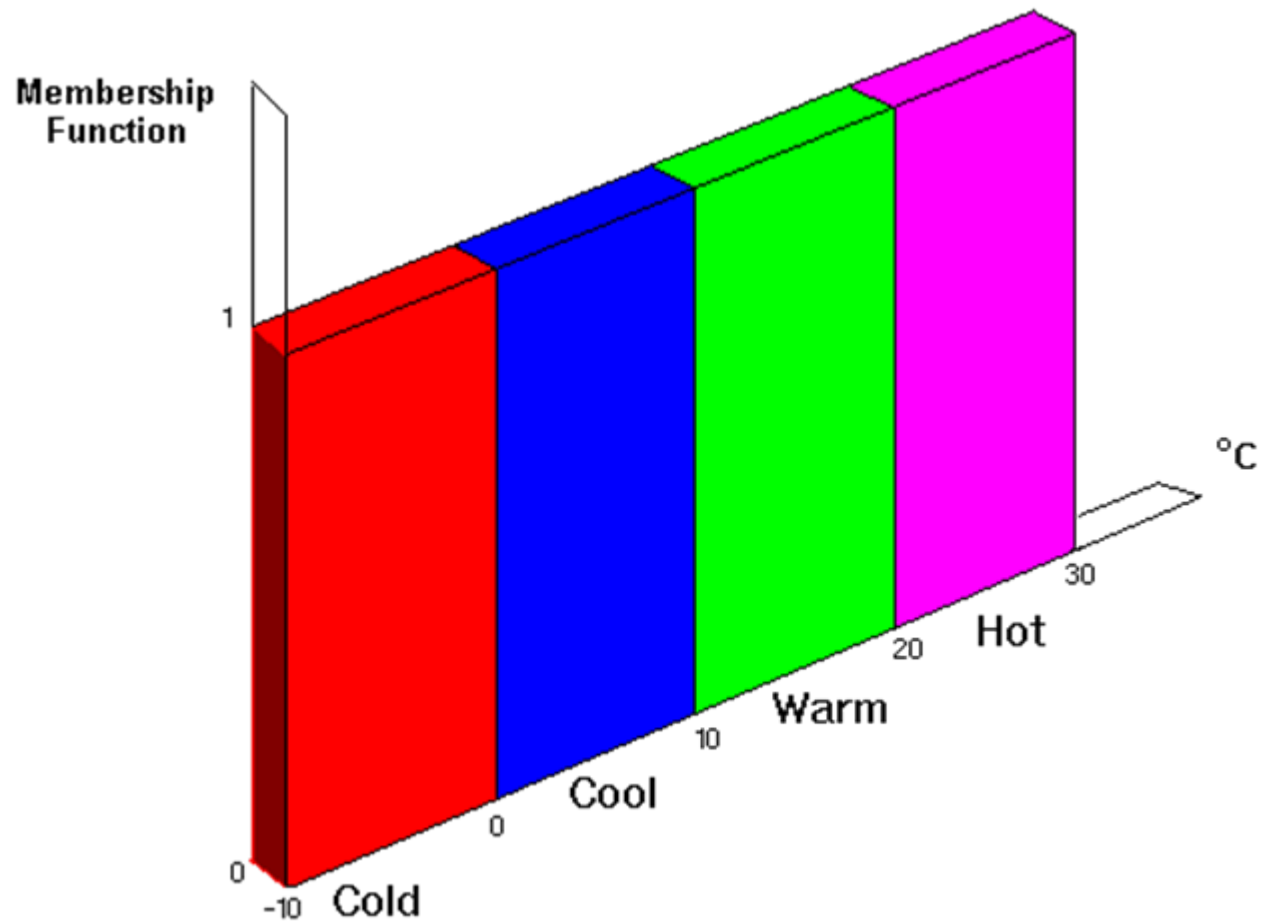


Fig. 1 : Bivalent Sets to Characterize the Temp. of a room.

Image provided by: http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/sbaa/report.fuzzysets.html

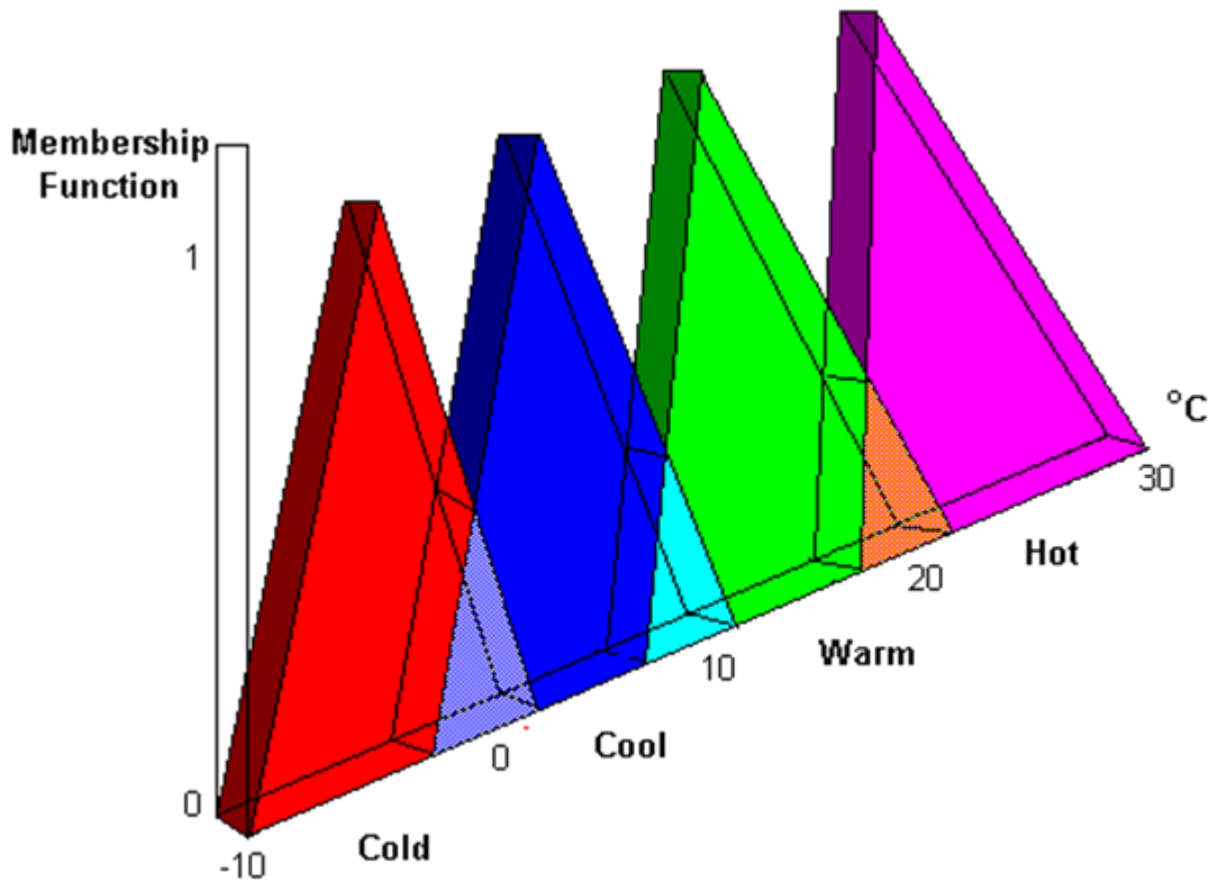


Fig. 2 - Fuzzy Sets to characterize the Temp. of a room.

Image provided by: http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/sbaa/report.fuzzysets.html

Inventor of Fuzzy Logic



Lotfi Askar Zadeh

Image from Wikipedia

History of Lotfi Zadeh

Born: February 4th 1921

Location: Soviet Azerbaijan

Education: University of Teheran B.S. Electrical Engineering
 MIT S.M. Electrical Engineering
 Columbia University Ph.D. Electrical Engineering


Faculty: Columbia University: Professor

University of California at Berkeley: Chairman of Electrical
Engineering

Moved to America in 1944

Published a paper on Fuzzy Sets in 1965, changing the course of
computer systems as we know it.

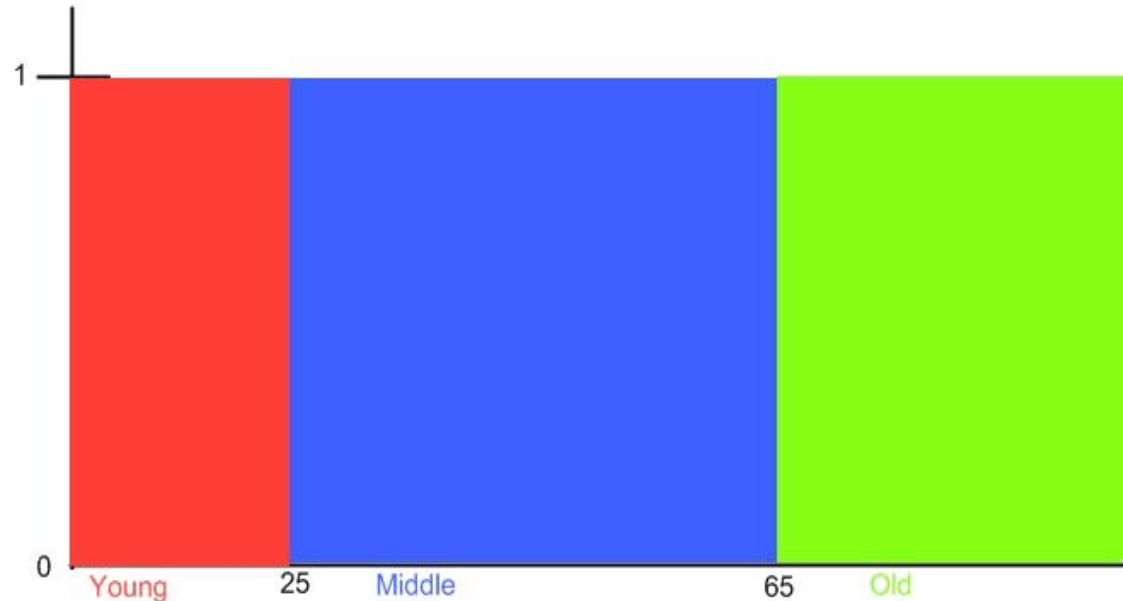
A few Awards...

- ▶ IEEE Education Medal
 - ▶ IEEE Richard W. Hamming Medal
 - ▶ IEEE Centennial Medal
 - ▶ Ronda Prize
 - ▶ American Society of Mechanical Engineers
Rudolf Oldenburger Medal
 - ▶ Grigore Moisil Prize
 - ▶ IEEE Medal of Honor 1995
- 

Origins of Fuzzy Logic

- ▶ “My 1965 paper on Fuzzy sets reflected my conclusion that what was needed was a theory of imprecision and uncertainty that was not based on probability theory.”
- ▶ – Lotfi Zadeh

Boolean Representation of Age

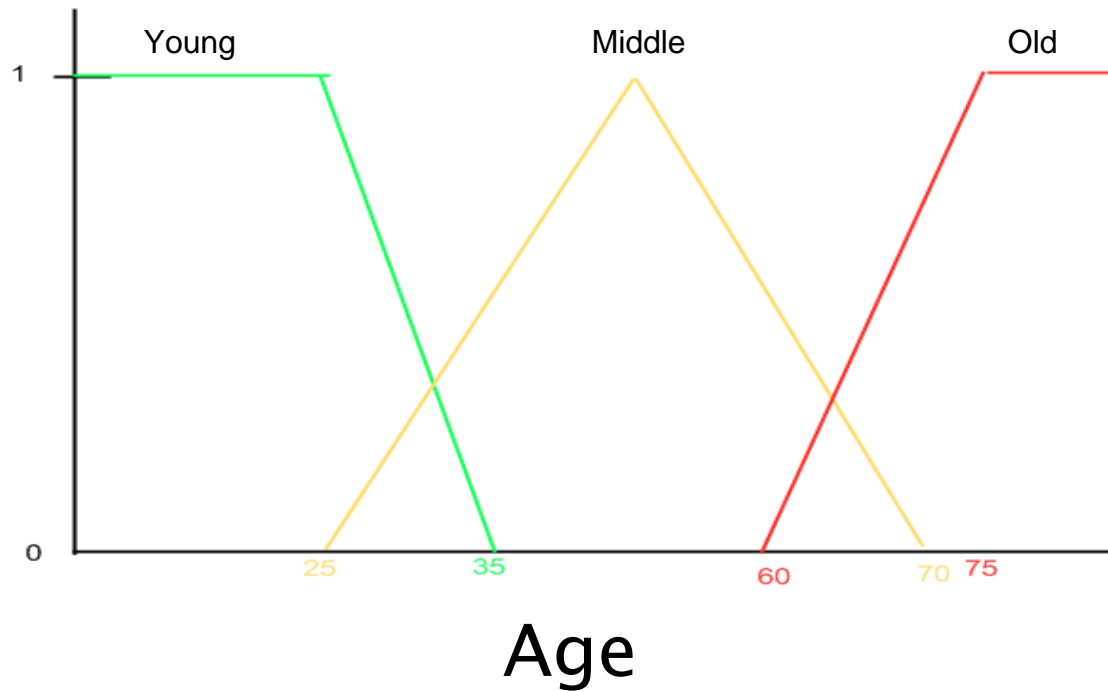


$$\text{Young}(x) = \begin{cases} 1, & \text{if } 0 \leq \text{age}(x) < 30 \\ 0 & \text{otherwise} \end{cases}$$

$$\text{MA}(x) = \begin{cases} 1, & \text{if } 30 \leq \text{age}(x) \leq 65 \\ 0 & \text{otherwise} \end{cases}$$

$$\text{Old}(x) = \begin{cases} 1, & \text{if } \text{age}(x) > 65 \\ 0 & \text{otherwise} \end{cases}$$

Fuzzy Representation of Age



Rules for Fuzzy Age

$$\text{Young}(x) = \left\{ \begin{array}{l} 1, \text{ if } \text{age}(x) \leq 25, \\ (35 - \text{age}(x)) / 10, \text{ if } 25 < \text{age}(x) < 35, \\ 0, \text{ if } \text{age}(x) > 35 \end{array} \right\}$$


$$\text{MA}(x) = \left\{ \begin{array}{l} 0, \text{ if } \text{age}(x) \leq 25, \\ 1 - (47.5 - \text{age}(x)) / 22.5, \text{ if } 25 < \text{age}(x) < 47.5, \\ 70 - \text{age}(x) / 22.5 \text{ if } 47.5 < \text{age}(x) \leq 70 \end{array} \right\}$$

$$\text{Old}(x) = \left\{ \begin{array}{l} 0, \text{ if } \text{age}(x) \leq 60, \\ 1 - (75 - \text{age}(x)) / 10, \text{ if } 65 < \text{age}(x) \leq 75, \\ 1, \text{ if } \text{age}(x) > 75 \end{array} \right\}$$

Applicable Laws

- ▶ DeMorgan's
 - ▶ Associatively
 - ▶ Commutative
 - ▶ Distributive
- 

Uses of Fuzzy Logic

- ▶ Robotic Control
 - ▶ Traffic Light Control
 - ▶ Expert Systems
 - ▶ Temperature Control
 - ▶ Antilock Braking Systems
 - ▶ Language Processing
 - ▶ The United Kingdom Transplant Support Service Authority has implemented the use of fuzzy logic in prioritizing the kidney waiting list
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