Decision Making Algorithms and Tools

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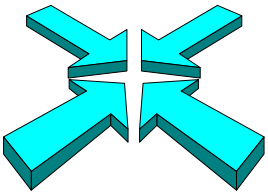
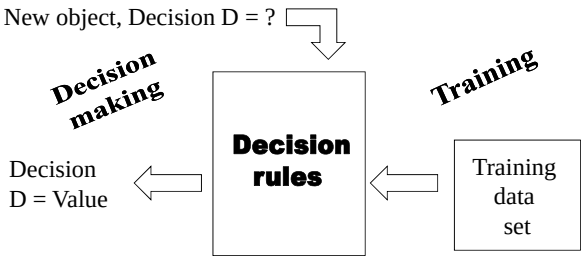
Decision Making Algorithms



- Matching algorithm
- Confirmation algorithm

Bagging
Boosting

Matching Algorithm (1)



Matching Algorithm (2)

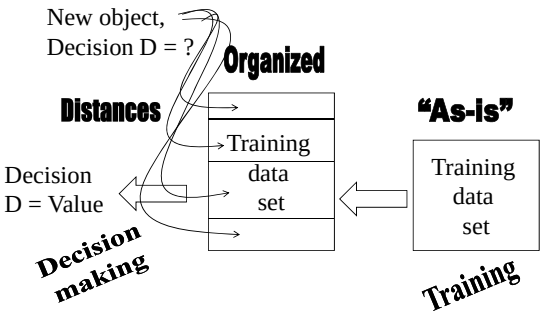
Step 1. Match the new object's feature values with the features of the decision rules generated by the learning algorithm.
If the match is satisfactory, go to Step 2; otherwise go to Step 3.

Step 2. Assign the decision to the new object equal to the decision associated with the matching decision rules and go to Step 4.

Step 3. Output "No decision is made - More feature values are needed" and go to Step 4.

Step 4. If all new objects have been considered, Stop; otherwise go to Step 1.

Confirmation Algorithm (1)



Confirmation Algorithm (2)

Definition

Absolute distance measure d_{ij} between objects i and j

$$d_{ij} = \sum_{k=1}^{n} |f_{ik} - f_{jk}|$$

where: f_{ik} = the value of feature F_k for object i
n = the number of features in a feature set

Other distance measures

Confirmation Algorithm (3)

Step 0. Define a proper feature set.
For each proper feature set:
Step 1. Cluster objects with equal outcome in groups.
Step 2. Compute distance d_{ij} between a new object and every object in each group of Step 1.
Step 3. For each group, compute the average distance of the distances d_{ij} obtained in Step 2.
Step 4. Assign the new object a decision corresponding to the cluster with the minimum average distance.
Step 5. Continue until all new objects have been considered.

Decision Fusion

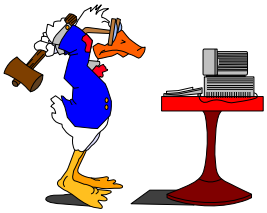
Decision making algorithm

	Algorithm 1	Algorithm 2	Algorithm 3	**Final Decision**	Decision Metric
New Object 1	D1	D1	D2	**D1**	2/3
New Object 2	D2	D4	D3	**?**	N/A
New Object 3	D2	D2	D7	**D2**	2/3

Predicted decision

- Relative frequency
- Weight
- Confidence

Decision Making Tools

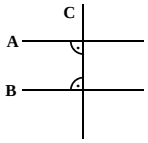


Examples

- Expert system shells
- Fuzzy systems
- Neural networks

Traditional Knowledge-Based System

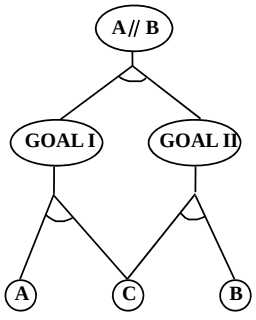
Example



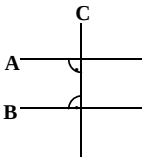
R1: IF A ⊥ C
THEN GOAL I
R2: IF B ⊥ C
THEN GOAL II
R3: IF GOAL I AND GOAL II
THEN A // B

Inference Tree for the Rules R1, R2, and R3

R1: IF A ⊥ C
THEN GOAL I
R2: IF B ⊥ C
THEN GOAL II
R3: IF GOAL I AND GOAL II
THEN A // B



KB System with Tolerances

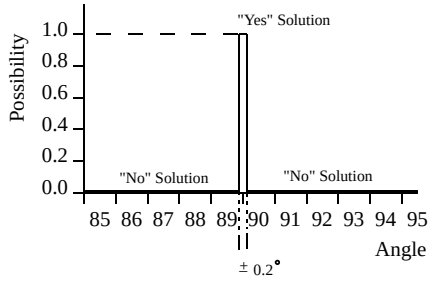


R1': IF $|\angle AC - 90^\circ| \le 0.2^\circ$
THEN GOAL I

R2': IF $|\angle BC - 90^\circ| \le 0.2^\circ$
THEN GOAL II

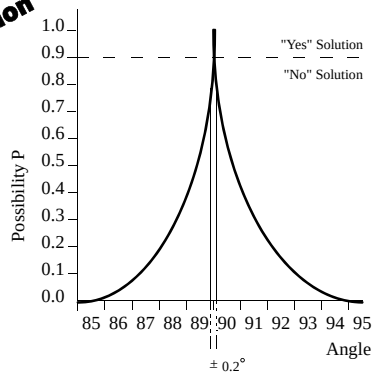
R3': IF GOAL I AND GOAL II
THEN A // B

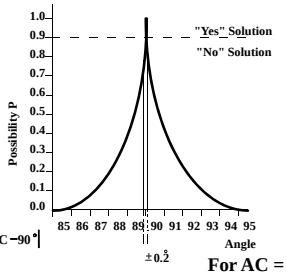
Binary Interpretation of Production Rules
R1', R2', and R3'



Membership function

Possibility Function





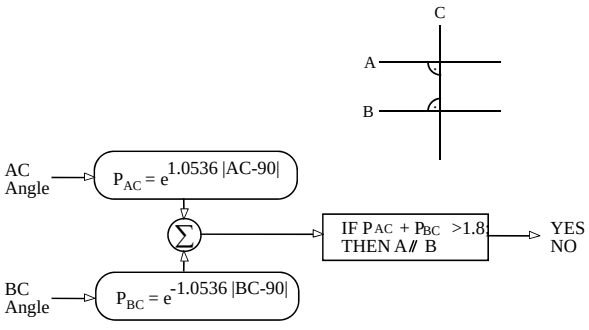
R1": $P_{AC} = e^{1.0536|AC-90°|}$

R2": $P_{BC} = e^{-1.0536|BC-90°|}$

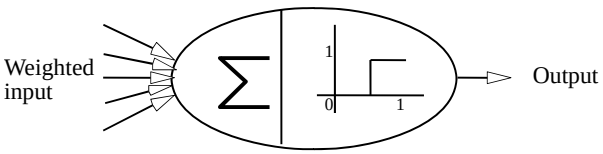
R3": IF (P_{AC} + P_{BC}) > 1.8
THEN A// B

For AC = 90°
P_{AC} = 1
For BC = 90°
P_{BC} = 1
1 + 1 = 2 > 1.8

Fuzzy Logic-Based System



Neural Networks



NN Operation Modes

- Learning
  (Weight acquisition)
- Decision making
  (Prediction)