

Comparative Analysis of Fuzzy Inference System and Bayesian Network for Rain Prediction

Sergii Babichev

Univerzita Jana Evangelisty Purkyně v Ústí nad Labem

sergii.babichev@ujep.cz

Problem Formulation

- Goal: Predict the likelihood of rain the next day (**RainTomorrow**).
- Features used: **WindGustSpeed**, **Humidity9am**, **Humidity3pm**, **Pressure9am**.
- Two models compared:
 - Fuzzy Inference System (FIS)
 - Bayesian Network (BN)
- Dataset: Australian weather data (`weatherAUS.csv`).

Fuzzy Inference System (FIS)

- A rule-based system with fuzzy logic.
- Steps:
 - 1 **Fuzzification** of input variables.
 - 2 **Rule base** with IF-THEN rules.
 - 3 **Inference mechanism** applies rules.
 - 4 **Defuzzification** to obtain crisp output.

- **Input Universes:**

- WindGustSpeed: 0 to 100 km/h
- Humidity9am, Humidity3pm: 0% to 100%
- Pressure9am: 980 to 1040 hPa

- **Membership Functions:**

- *Low, Medium, High* for each input using triangular functions
- Output variable (RainTomorrow): *No, Yes* with trapezoidal functions

FIS: Optimized Rule Base (11 rules)

- IF WindGustSpeed is High AND Humidity9am is High THEN RainTomorrow is Yes
- IF WindGustSpeed is Low AND Humidity3pm is Low THEN RainTomorrow is No
- IF Humidity9am is Medium AND Humidity3pm is High THEN RainTomorrow is Yes
- IF WindGustSpeed is Medium AND Humidity9am is Low THEN RainTomorrow is No
- IF Pressure9am is Low AND Humidity9am is High THEN RainTomorrow is Yes
- IF Pressure9am is High AND Humidity9am is Low THEN RainTomorrow is No
- IF WindGustSpeed is Medium AND Pressure9am is Low THEN RainTomorrow is Yes
- IF Humidity9am is High AND Pressure9am is Low THEN RainTomorrow is Yes
- IF Humidity3pm is High AND WindGustSpeed is High THEN RainTomorrow is Yes
- IF Humidity9am is High AND Humidity3pm is High THEN RainTomorrow is Yes
- IF WindGustSpeed is High AND Humidity3pm is High THEN RainTomorrow is Yes

Bayesian Network (BN)

- Probabilistic graphical model.
- Nodes: variables, Edges: dependencies.
- Steps:
 - 1 **Discretization** of input variables.
 - 2 **Define structure** of the DAG.
 - 3 **Estimate conditional probabilities (CPTs)**.
 - 4 **Query** for RainTomorrow given inputs.

- Evaluation metrics used:
 - Accuracy
 - Confusion Matrix
- Comparison of FIS and BN results
- Observations:
 - Interpretability vs Probabilistic reasoning
 - Flexibility to new data

Results Summary

- FIS achieved X% accuracy.
- BN achieved Y% accuracy.
- Depending on interpretability needs, FIS may be preferable.
- For uncertainty management, BN is advantageous.