Tool environment for creating training prototypes of intelligent decision support systems

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Agenda:

1. Decision support system (DSS) in power engineering field

2. Bayesian belief networks (BNN)

3. HUGIN tooling system

4. Example of using

5. Conclusion

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		SPRINKLER	
RAIN		T	F
F		0.4	0.6
T		0.01	0.99
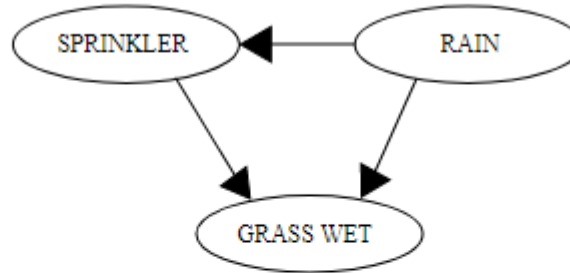
	RAIN	
	T	F
	0.2	0.8

		GRASS WET	
SPRINKLER	RAIN	T	F
F	F	0.0	1.0
F	T	0.8	0.2
T	F	0.9	0.1
T	T	0.99	0.01

CONDITIONAL PROBABILITY TABLES - CPT

Production type rules present in HUGIN in the form

if A then B

where *A* is the premise-statement, and *B* is the result-action or another statement. For example, the following three rules are a fragment of the Rule Base for diagnosing and troubleshooting problems with water pumps:

1) *if* the pump failed *then* the pressure is low;

2) *if* the pump refused *then* check the oil level;

3) *if* a power failure *then* the pump fail.

Expert rules for diagnosing rotor cracks:

Rule 1.

If during operation under load, an alarming increase in vibration detected on the generation rotoros (RG) or (low pressure) RND. If there is a suspicion of a crack in the (rotors of high) RVD or (and medium pressure) RSD.

And if in the coasting mode the levels of the 1 component vibration at the main critical rotation frequencies are beyond the limits of permissible values (the vertical direction of measuring the vibration of the shaft and (or) bearings).

And if the levels of the two components of vibration at critical frequencies of rotation of the second kind are outside the permissible values. The vertical direction of measuring the vibration of the shaft and (or) bearings.

And if in working mode ratio of the shaft's span displacements in the vertical direction to the span in the transverse direction is outside the acceptable range.

Then conclusion with a confidence of 90% is the presence of a crack in the rotor, where there were suspicions of the operating mode under load.

Rule 2.

If during operation under load, an alarming increase in vibration detected on the RG or RND.

Or if there is a suspicion of a crack in the RVD or RSD.

And in the coast mode, the levels of the one components of vibration at the main critical rotation speeds are in the limits of permissible values. The vertical direction of measuring the vibration of the shaft and (or) bearings.

And the levels of the two components of vibration at critical frequencies of rotation of the second kind go beyond the permissible values (the vertical direction of measuring the vibration of the shaft and (or) bearings).

And in the mode with since ratio of the shaft displacements spans in the vertical direction to the span. In the transverse direction goes beyond permissible values.

Then the conclusion is drawn with a confidence of 60% about the presence of a crack in the rotor. Where there were suspicions of the operating mode under load.

First level

Operating modes

Status:

working – normal operation;

coast – operation mode upon the termination of the operating mode.

Trend presence

Status:

False – there is a trend;

True – there is no trend.

On adjacent supports, the vectors of changes of 1 component of the vibration of one direction when the active power changes are antiphase or close to it

Status:

False – lack of antiphase nature of the one components of vibration;

True – the presence of the absence of an antiphase nature of the one components of vibration.

Existence of 1 component of vibration beyond acceptable values

Status:

False – there is no way out of 1 vibration component outside the normal range

True – there is an exit of 1 component of vibration outside the normal range.

Existence of 2 components of vibration beyond acceptable values

Status:

False – there is no output of 2 components of vibration outside the normal range;

True – there is an exit of 2 components of vibration outside the normal range.
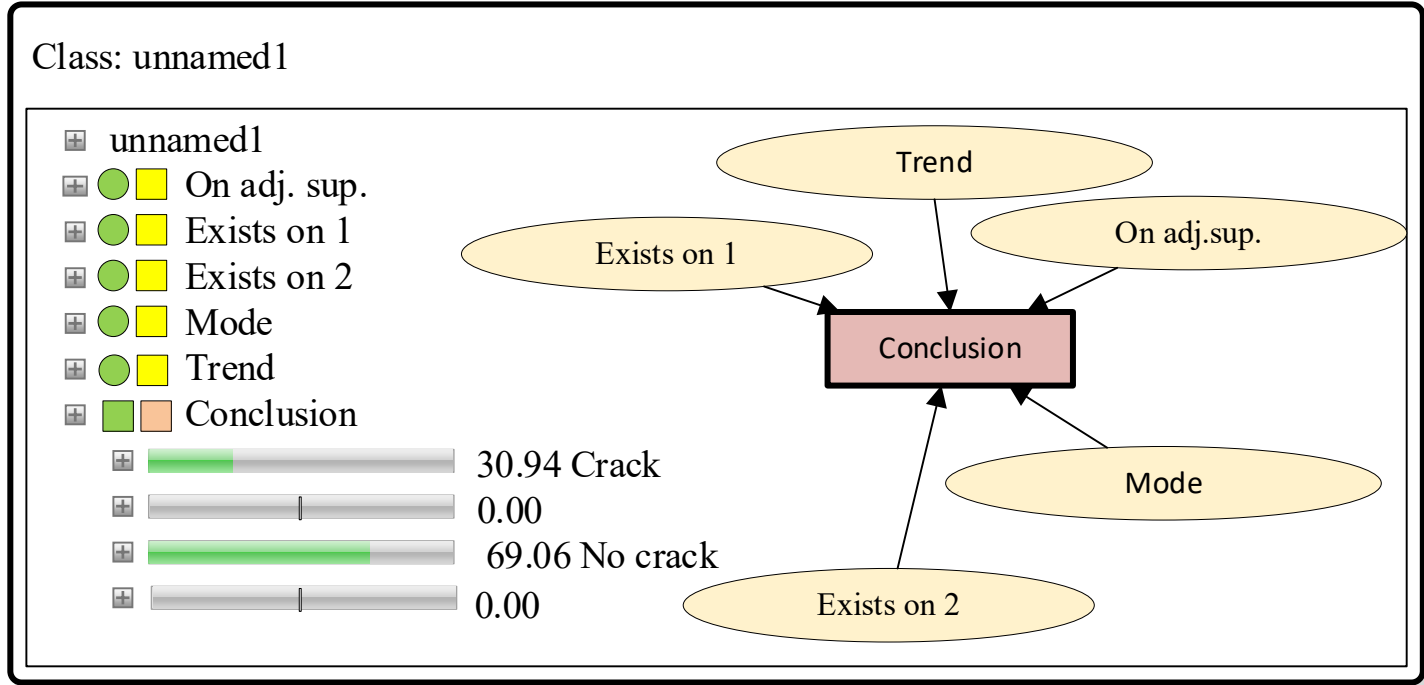
Second level
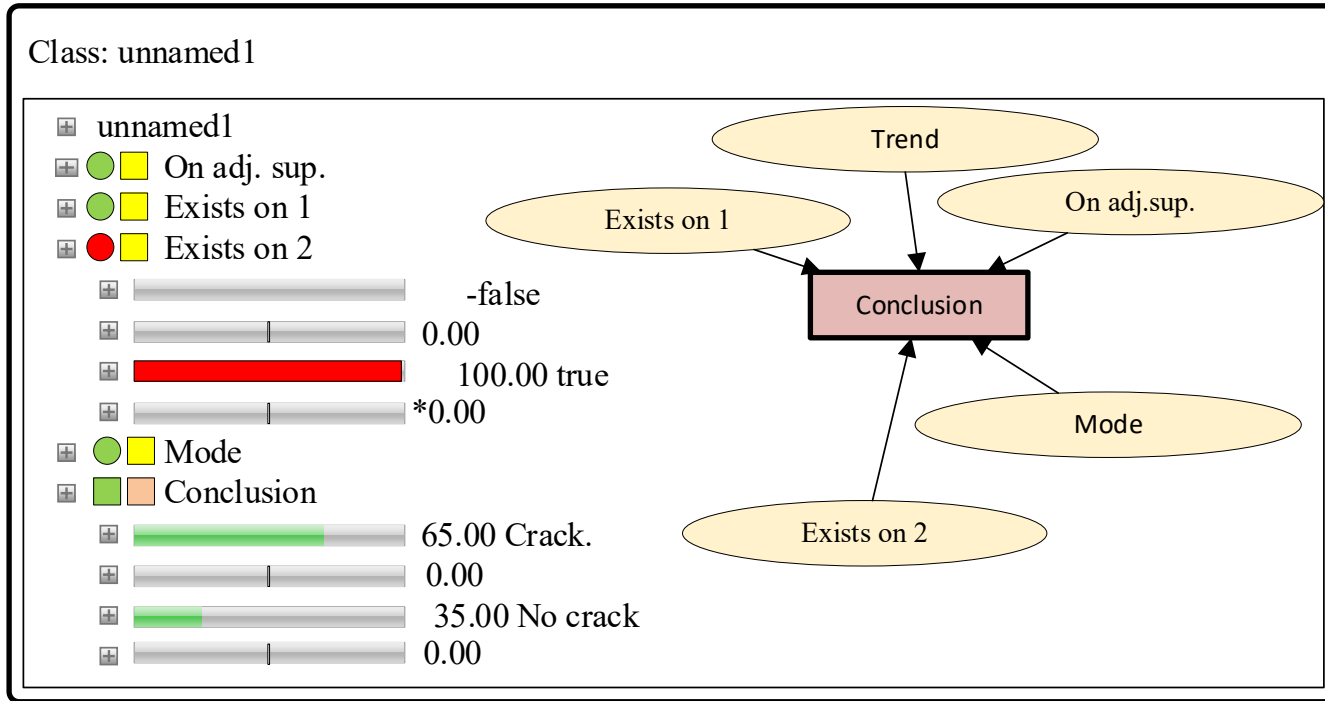
Diagnosis

Conditions:

• crack presence.

• no cracks.

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CPT FOR THE PROBLEM OF DIAGNOSTICS OF CRACKS IN THE ROTOR

On adj. sup.	false				true			
Exists on 1	false		true		false		true	
Exists on 2	false	true	false	true	false	true	false	true
Mode	Coast	Coast	Coast	Coast	Coast	Coast	Coast	Coast
Crack	0	0.2	0.3	0.8	0.4	0.5	0.6	0.9
Good	1	0.8	0.7	0.2	0.6	0.5	0.4	0.1

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Class: unnamed1

- unnamed1
- On adj. sup.
- Exists on 1
- Exists on 2
  - -false
  - 0.00
  - 100.00 true
  - *0.00
- Mode
- Conclusion
  - 65.00 Crack.
  - 0.00
  - 35.00 No crack
  - 0.00

Trend

On adj.sup.

Exists on 1

Conclusion

Mode

Exists on 2

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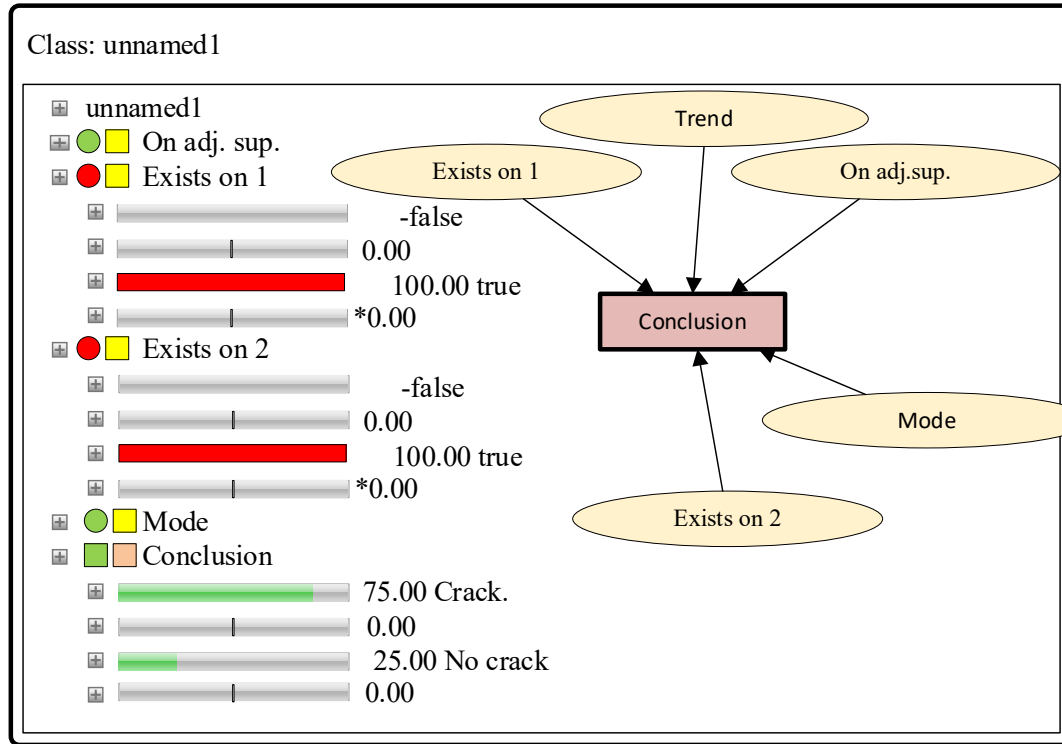
CONCLUSION

The use of tools such as HUGEN in the educational process allows students to more deeply study and master the basic methods, models and tools of constructing modern intellectual (expert systems) based on the knowledge of expert experts and modelling the reasoning of these specialists in finding a solution.

Possession of relevant skills will allow them to develop promising EDSS in the future, including the most complex EDSS RTs to help DMP solve applied problems in various problem/subject areas:

- monitoring and managing complex technical and organizational systems in the energy sector

- in transport

- business applications

- computer training of specialists.

The teachers using this tool in the direction of "Applied mathematics and computer science" when performing laboratory and course work on the discipline "Expert systems," as well as when preparing a master's thesis on this topic

Thank you for attention!

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