



# Engineering Diagnostics and Decision Making with Bayesian Belief Networks

*Lecturer dr inż. Marian Kemblowski, prof. nadzw. PG (WILiŚ):*

## Contents:

1. Basics of Bayesian statistic
  - a. Probability Functions and Spaces
  - b. Conditional Probability and Independence
  - c. Bayes' Theorem
  - d. Random Variables and Joint Probability Distributions
  - e. Bayesian Inference
2. Utility theory
  - a. Decision making methods
  - b. Maximin
  - c. Minimax
  - d. Decisions under uncertainty – expected value
3. Bayesian Belief Networks (BBNs)
  - a. Networks structure – Directed Acyclic Graphs (DAGs)
    - i. Variable types - nodes
    - ii. Causal/correlation relationships - arcs
    - iii. Conditional independence
  - b. Network parameters
    - i. Conditional probability tables
    - ii. Utility Tables
4. Discussion of selected BBN applications in engineering
  - a. Dam safety - failure analysis
  - b. Environmental pollution - source identification
  - c. Bridge diagnosis - value of information
5. Class project
  - a. General project description
  - b. Individual problem selection by participants
  - c. Expressing the problem in the lingo of BBNs
6. Inference with BBNs
  - a. Prognosis – forward information propagation
  - b. Diagnosis – backward information propagation
  - c. Process change – intervention
  - d. Sensitivity analysis
7. Decision making w/ BBNs
8. Class project revisited
  - a. Network structure
  - b. Net parameters - conditional probabilities



- c. Inference results
- 9. Minimising information entropy
- 10. Value of information
- 11. Monitoring design – information value perspective
- 12. BBN - construction process
  - a. Structure elicitation
  - b. Net parameters
  - c. Estimation
  - d. Simulation
  - e. Verification
- 13. Monitoring design using NETICA
- 14. Additional issues
  - a. Risk and Reliability analysis w/ BBNs
  - b. Data mining and data fusion w/ BBNs
  - c. Fundamentals of Learning Bayesian Nets
- 15. Summary: BBN Decision Support Systems

<b>Terminy wykładów</b>			
<b>Data</b>	<b>Dzień tyg.</b>	<b>Godzina</b>	<b>Sala</b>
2015-05-08	Pt	16.15-19.00	202 Gmach Gł.
2015-05-09	So	9.15-12.00	202 Gmach Gł.
2015-05-14	Cz	16.15-19.00	202 Gmach Gł.
2015-05-21	Cz	16.15-19.00	202 Gmach Gł.
2015-05-22	Pt	16.15-19.00	202 Gmach Gł.