SYLLABUS

Name: ***Markov Models (MakAu-DS>SM1MM19)***
Name in Polish:
Name in English: ***Markov Models***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau1/course/view.php?id=509

Short description:

The goal of this course is to familiarise students with concepts related to modelling of dynamical systems by means of Markov models and stochastic systems. The course tackles discrete and continuous systems, hidden Markov models and queuing systems. It lays a solid foundation for statistical modelling, bayesian reasoning and other engineering applications of probability theory.

Prerequisites include:
Linear Algebra, Real Calculus (in one and several variables), Modelling of Dynamical Systems, Fundamentals of Computer Programming. Among the above, participants should be able to operate on (complex) matrices, have basic knowledge about ordinary differential equations, be able to identify and describe dynamical elements in physical systems. Basic computer programming skills are necessary to comprehend numerical algorithms presented throughout the course.

Description:

ECTS: 2
Total workload: 60 hours (30 contact hours, 30 students’ own work hours)
Lecture 30h

Students' own work: preparation for classes, elaboration of measurement results, writing reports, preparation for tests
The goal of the course is to familiarise students with concepts related to modelling of dynamical systems by means of Markov models.

Lectures:
1. Introduction to measure-based probability theory and statistics.
2. Introduction to stochastic processes with Markov processes.
3. Discrete Markov chains; transition matrix.
4. Monte Carlo method, Metropolis-Hastings and Gibbs algorithms.
5. Similarities between M-H and Gibbs algorithms, fixed-point theory and control theory perspective
6. Hidden Markov Models; the evaluation, decoding and learning problems
7. Continuous Time Markov Chains (CTMC); time domain nad Laplace domain approaches
8. CTMC Birth and Death Processes
9. Markov Queuing Systems

Laboratories are on 2nd semester

Bibliography:

1. W. Feller, (1957), An Introduction to Probability Theory and its Applications (Volume 1,2), John Wiley & Sons Inc.
2. R. Durrett, Probability: theory and examples, 5th ed.,
3. R. D. Yates and D. J. Goodman (1999), Probability and Stochastic Processes, Wiley
4. O. Haggstrom, (2002), Finite Markov Chains and Algorithmic Applications, Cambridge University Press
5. O. C. Ibe , (2009), Markov processes for stochastic modelling, Elsevier Academic Press

Learning outcomes:

Course specific outcomes:
At the completion of the course , student:
- has knowledge about constructing models of complex systems based on Markov approach - K2A_W04, K2A_W01, K2A_U08
- knows how to model different types of dynamical systems and understands differences between discrete and continuous time Markov models in applications - K2A_U16
- is able to verify, adjust and correct given Markov models - K2A_U07, K2A_U08

Assessment methods and assessment criteria:

Markov Models Course consists of two components: lecture and laboratory. According to SUT regulations, lecture attendance is optional (however highly recommended), whereas laboratory exercises are obligatory.
- Lectures: take home assessment
pass criteria: minimum of 60% of points.
- Laboratories: short tests for each meeting. pass criteria: minimum of 60% of points.

The syllabus is valid from academic year 2024/2025 and its content cannot be changed during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	2	2020/2021-L	