SYLLABUS

Name: ***Markov Models (AEIAu-DS>SM2MM25)***
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 course aims to familiarise students with concepts related to the modelling of processes using Markov models, with particular emphasis on their various applications. During laboratories, students work on the practical application of Markov models, such as calculating stationary distributions, simulating processes for applications in automation, business, or medicine, and parameter estimation. Classes are conducted in the form of contact laboratories, during which basic knowledge of any programming environment (e.g., Python, R, MATLAB) is required. The labs are a continuation of the lectures given in the summer semester and therefore knowledge of the theoretical background discussed in the lectures is required.

Description:

ECTS: 2
Total hours: 50h (contact 30h / own work 20h)
Laboratories: 30h
Student's own work: 20h (preparation for classes on the basis of materials from the course website, report preparation)

During the labs, students work on the assignments they receive. At the end of the lab, students submit their solutions to the assignments for evaluation. In exceptional cases specified by the teacher (more advanced issues covered in the laboratory, more time-consuming task), a later handing in of solutions is allowed.

Laboratory topics:
1. Basic concepts of Markov chain models.
2. Basic simulations of Markov models.
3. Advanced simulations of Markov models.
4. Hidden Markov models (forward and backward).
5. Metropolis-Hastings algorithm.
6. Time-reversible Markov chains.

Bibliography:

W. Feller, (1957), An Introduction to Probability Theory and its Applications (Volume 1,2), John Wiley & Sons Inc.
O. Haggstrom, (2002), Finite Markov Chains and Algorithmic Applications, Cambridge University Press
O. C. Ive, (2009), Markov processes for stochastic modelling, Elsevier Academic Press

Learning outcomes:

Course-specific learning outcomes:
At the completion of the course, a student:
• understands the concept of stochastic process and Markov process (completion of exercise, laboratory report, activity in class) KA_W01, K2A_W04
• understands a concept of Markov property (completion of exercise, laboratory report, activity in class) KA_W01, K2A_W04
• understands the concepts of transition probability matrix, stationary distributions, transitive and recursive states, aperiodicity, ergodicity, reversibility (completion of exercise, laboratory report, activity in class) KA_W01, K2A_W04
• is able to calculate the evolution of state probability distributions, stationary distributions (completion of exercise, laboratory report, activity in class) K2A_U07, K2A_U08, K2A_U16
• is able to evaluate the parameters of Markov models (completion of exercise, laboratory report, activity in class) K2A_U07, K2A_U08, K2A_U16, K2A_U17
• is able to apply and program all algorithms related to hidden Markov models (completion of exercise, laboratory report, activity in class) K2A_U07, K2A_U08, K2A_U16, K2A_U17
• is able to apply Markov models (completion of exercise, laboratory report, activity in class) K2A_U07, K2A_U08, K2A_U16, K2A_U17

Assessment methods and assessment criteria:

1. Students are obliged to participate in all laboratory classes and be prepared accordingly.
2. One absence is allowed; however, it must be made up during the catch-up term, planned at the end of the course.
3. During the laboratory classes, students work in pairs.
4. During each laboratory, students are obliged to prepare a brief report that should be submitted for grading before the end of each class.
5. Laboratory reports are graded from 0% to 100%.
6. To pass the course, the student has to get a grade of 40% or higher in all laboratory classes.
7. Final grade will be established based on an average of all laboratory grades by the following rules:

Average grade	Final grade
≤ 39.99	2
40.00 – 49.99	3
50.00 – 59.99	3.5
60.00 – 69.99	4
70.00 – 79.99	4.5
≥ 80.00	5

This syllabus is valid from the academic year 2025/2026 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	2025/2026-L	