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COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice					
Faculty: Faculty of Science					
Course ID: ÚINF/ ADA/24		Course name: Applications of data analysis			
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present					
Number of ECTS credits: 5					
Recommended semester/trimester of the course: 2.					
Course level: II.					
Prerequisites:					
Conditions for course completion:					
Learning outcomes:					
Brief outline of the course:					
Recommended literature:					
Course language:					
Notes:					
Course assessment Total number of assessed students: 6					
A	B	C	D	E	FX
66.67	33.33	0.0	0.0	0.0	0.0
Provides: doc. Mgr. Michal Gallay, PhD., doc. Ing. Norbert Kopčo, PhD., univerzitný profesor, doc. RNDr. Peter Pristaš, CSc., univerzitný profesor, RNDr. Jana Kisková, PhD., doc. RNDr. Ján Kaňuk, PhD.					
Date of last modification: 28.03.2024					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ ATG/13	Course name: Applied graph theory
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 1 Per study period: 28 / 14 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisites:	
Conditions for course completion: To complete the course, it is necessary to demonstrate the ability to formulate definitions and theorems from the lectured material, to demonstrate the proofs of theorems and solve selected problems based on the presented areas of graph theory. The exam takes written form by elaborating a test containing several questions of a theoretical and practical nature; the maximum number of points that can be obtained is 100. To pass the exam, it is necessary to obtain more than half of the maximum number of 100 points (otherwise the exam is evaluated by FX), while the rating E is given in the case of points 51-59, D in the case of 60- 69, C for 70-79, B for 80-89 and A for over 90 points.	
Learning outcomes: After completing the course, the student is acquainted with selected applications of graph theory in the natural and technical sciences and mathematical properties of related graph concepts.	
Brief outline of the course: Week 1: Working with graphs in computer algebra systems Maple and Wolfram Mathematica. Weeks 2 - 4: Practical problems leading to the use of graph coloring (scheduling and resource allocation); common types of graph colorings for practice and their properties; algorithms and heuristics for graph coloring. Weeks 5 - 7: Polynomial cases of NP-complete graph problems (the most important graph classes, their properties and efficient algorithms for calculating selected invariants) Weeks 8 - 10: Basics of complex network analysis (centrality, community structure) Weeks 11 - 13: Chemical graph theory (Wiener index and its properties, related topological indices)	
Recommended literature: U. Brandes, T. Erlebach: Network analysis. Methodological Foundations, Springer, 2005.	
Course language: Slovak or English	
Notes: Intermediate knowledge of graph theory and general programming is assumed, as well as the basics of working with computer algebra systems.	

Course assessment					
Total number of assessed students: 41					
A	B	C	D	E	FX
7.32	24.39	24.39	21.95	19.51	2.44
Provides: prof. RNDr. Tomáš Madaras, PhD.					
Date of last modification: 14.04.2022					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ AST/26	Course name: Applied statistics
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 3 / 2 Per study period: 42 / 28 Course method: present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 4.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Given at the basis of statistical processing of real data. Final evaluation is given at the basis of partial examination, computing part, and oral part of the exam.	
Learning outcomes: Learning most frequently applied statistical methods.	
Brief outline of the course: o Matrices and linear spaces, g-inversions, projections o Normal distribution and related distributions o Hotelling's test o Probability foundations of regression and correlation o General linear model with full rank o Model with incomplete rank o Submodels testing o Regression analysis, basic models o Assessing the quality of a model o Analysis of variance o One-way ANOVA, multiple comparison procedures, problem of heteroskedasticity o Balanced factorial models, hierarchical models o Analysis of covariance o Statistical software for linear modeling	
Recommended literature: <ul style="list-style-type: none"> • Rao: Linear statistical inference and its applications, Wiley, 1973 • Seber: Linear regression analysis, Wiley, 1977 • Searle: Linear models, Wiley, 1997 • Sen, Srivastava: Regression analysis (Theory, Methods, and Applications), Springer, 1990 • Christensen: Plane answers to complex questions (The Theory of Linear Models), Springer, 1987 	
Course language: Slovak	

Notes:					
Course assessment					
Total number of assessed students: 0					
A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0
Provides: prof. RNDr. Ivan Žežula, CSc.					
Date of last modification: 24.03.2026					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ APA1/21	Course name: Approximation algorithms
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: 3 Per study period: 42 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Continuous assessment is awarded on the basis of the quality of homework given in lectures and continuous written test. Oral final exam.	
Learning outcomes: To learn basic conceptions of randomized algorithms and to classify the algorithms due to their error probability.	
Brief outline of the course: <ol style="list-style-type: none"> 1. Basic notions of Probability Theory. 2. Basic randomized computing models and its characterisations. 3. Las Vegas algorithms. 4. One sided error Monte Carlo algorithms. 5. Two sided bounded error Monte Carlo algorithms. 6. Two sided unbounded error Monte Carlo algorithms. 7. Classes of randomized algorithms with polynomial time complexity and relationships between them. 8. Optimisation problem, approximation algorithm, relative error, approximation ratio. 9. Special optimisation problems and approximation solutions. 10. Classification of optimisation problems based upon their approximations. 11. FPTAS. 12. PTAS. 13. TSP problem and its relaxations. 14. Unapproximability. 	
Recommended literature: Hromkovič, J.: Algorithmics for Hard Problems, Introduction to Combinatorial Optimization, Randomization, Approximation, and Heuristics, Springer=Verlag 2004. Hromkovič, J.: Communication Protocols - An Exemplary Study of the Power of Randomness. In: Handbook on Randomized Computing, P.Pardalos, S.Rajasekaran, J.Reif, J.Rolim, Eds., Kluwer Publ., 2001. Hromkovič, J.: Design and analysis of ranodmized algorithms. Springer-Verlag, 2005.	

Hromkovič, J.: Einführung in die algorithmischen Konzepte der Informatik, Teubner, 2001.
Motwani R. and Raghavan P.: Randomized Algorithms. Cambridge University Press 1995.
Mitzenmacher M. and Upfal P.: Probability and Computing: Randomized Algorithms and Probabilistic Analysis. Cambridge University Press 2005.

Course language:

Slovak or English

Notes:

content prerequisites: basics of probability, basics of algorithms and data structures

Course assessment

Total number of assessed students: 140

A	B	C	D	E	FX
28.57	12.14	25.71	11.43	20.0	2.14

Provides: doc. RNDr. Ondrej Krídlo, PhD.

Date of last modification: 23.11.2021

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ VMO/22	Course name: Calculus of variations in optimization
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion: EN Ongoing evaluation takes the form of a written test during the semester and attendance in lectures or exercises. The overall evaluation is based on a result of mid-term evaluation (60%) and the result of final written and oral examination (40%).	
Learning outcomes: Students will learn to find local extremes of functionals, especially to derive variational integrals. They will be able to verify the necessary and sufficient conditions for the existence of global and local extrema for specific functionals, find extremals in the case of one-dimensional integrals, and determine whether they are weak or strong extremes. Use theoretical results for examples from geometry, physics, chemistry or financial mathematics.	
Brief outline of the course: Abstract variational calculus in Banach space - critical points, extremals, sufficient conditions for the existence of a (global) minimizer and its uniqueness. Differentiability in Banach spaces (Gateaux and Fréchet derivative, variation of functionals). Euler's necessary condition (Beltrami's identity) and Lagrange's sufficient condition of local extremes. Lagrange's multipliers method. Courant-Weinstein principle and Rayleigh's quotient. Ekeland's principle of variation. Rayleigh-Ritz method. The mountain pass theorem. Least squares method in spaces with infinite dimension. Bayesian variational methods. Discrete variational calculus. Du Bois-Reymond, Legendre and Weierstrass necessary conditions. Lavrentiev phenomenon. Conjugate points method. Sufficient conditions for weak and strong extremes. Hamilton-Jacobi equation. Geometric and physical aspects of calculus of variations (minimum areas, harmonic representations, central tendency measures, curvature equations, isoperimetric problem, geodesic calculation, Lagrange and Hamiltonian formulation of mechanics, Legendre transform, Fermat's principle).	
Recommended literature: 1. K. Rektorys: Variační metody, Academia - nakladatelství, ISBN: 80-200-0714-8, 602 s., 1999. 2. J. Bouchala: Variační metody, https://mi21.vsb.cz/sites/mi21.vsb.cz/files/unit/variacni_metody.pdf , 2012. 3. Cassel, Kevin W.: Variational Methods with Applications in Science and Engineering, Cambridge University Press, 2013.	

4. Elsgolc, L.E.: Calculus of Variations, Courier Corporation, ISBN 9780486457994, 2007.

Course language:

Slovak

Notes:

Course assessment

Total number of assessed students: 10

A	B	C	D	E	FX
40.0	40.0	10.0	10.0	0.0	0.0

Provides: doc. Mgr. Jozef Kiseľák, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ KKV1/21	Course name: Classical and quantum computations
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 3 / 2 Per study period: 42 / 28 Course method: present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 3.	
Course level: II., N	
Prerequisites:	
Conditions for course completion: Successful completion of the subject is conditioned by proper acquisition of basic concepts, algorithms and models and demonstrating the ability to apply them creatively. The acquisition of knowledge takes place: <ul style="list-style-type: none"> - continuously during the semester in the form of partial assignments, - a written test during the semester, - a written test at the exam, - oral exam. In order to receive an evaluation, it is necessary to obtain at least 50% of points from each of the three parts (assignments during the semester, written part of the exam, oral part of the exam). The detailed evaluation method is published in the AIS.	
Learning outcomes: By completing the subject, the student will get: <ul style="list-style-type: none"> - knowledge of the classification and design of probabilistic algorithms, - basic knowledge of the principles of quantum computers and their differences compared to classical computing models, - knowledge and skills about the design and functioning of quantum computing and become familiar with the most well-known algorithms, = basic quantum computer programming skills.	
Brief outline of the course: <ol style="list-style-type: none"> 1. Introduction to quantum quantum computers. Basics of classical complexity theory. 2. Boolean circuits and their basic properties. 3. Probability algorithms. 4. BPP class and probability testing. 5. Basic properties of circuits and Fermat's test. 6. Miller - Rabin's test and the position of the BPP class in the hierarchy of complexity models. 7. Introduction to quantum computing and mathematical foundations of quantum theory. 8. Spectral representation of self-adjoint operators. 9. Quantum states and Hilbert vector spaces. 10. Basic quantum operators and basic quantum algorithms. 	

11. Quantum teleportation, superdense coding and Grover's algorithm.
12. Fourier transformation.
13. Shor's algorithm.

Recommended literature:

1. BERMAN, G.P., DOOLEN, G.D., MAINIERI, R., TSIFRINOVIC, V.I. Introduction to Quantum Computers. World Scientific, 2003.
2. GRUSKA, J. Quantum Computing. McGraw-Hill, 1999.
3. JOHNSON, G. A Shortcut Through Time: The Path to the Quantum Computer, Knopf 2003.
4. KITAEV, A.Y., SHEN, A.H., VYALYI, M.N. Classical and Quantum Computation. American Mathematical Society, 2002.
5. NIELSEN, M.A., CHUANG, I.L. Quantum Computation and Quantum Information. Cambridge University Press, 2000.
6. HIRVENSALO, M., Quantum Computing, Springer 2004

Course language:

Slovak or english

Notes:

Content prerequisites:

Linear algebra, Group theory, Probability theory, Theory of algorithms, Introduction to quantum computers.

Course assessment

Total number of assessed students: 116

A	B	C	D	E	FX
27.59	37.93	15.52	6.03	3.45	9.48

Provides: prof. RNDr. Gabriel Semanišin, PhD., Mgr. Viktor Olejár

Date of last modification: 25.07.2022

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ KMU/25	Course name: Coding and multimedial data transition
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 1., 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Homeworks, active participation in laboratory exercises, midterm test. Final written exam, oral examination.	
Learning outcomes: Understand the principles of lossy compression algorithms. Be able to apply different methods of quantization, prediction and difference procedures in lossy image and sound compression algorithms. Understand the JPEG and MPEG compression standards.	
Brief outline of the course: <ol style="list-style-type: none"> 1. Formal model of coding and information transfer, compression ratio, criteria of uniquely decodable codes, block and prefix lossless codes. 2. Coding with known distribution of probabilities of occurrences of input characters, relation to entropy, Huffman construction, adaptive variants. 3. Arithmetic coding, integer, binary, adaptive versions, advantages and disadvantages of statistical codes. 4. Context coding, prediction methods, JBIG, JPEG-LS standards, PPM. 5. Dictionary compression methods, LZ77, LZW, use of transformations, BWT, ACB, dynamic Markov chains. 6. Principles of lossy compression, RD function, probabilistic and physiological models for efficient compression. Uniform and non-uniform scalar quantization, adaptive versions. 7. Vector quantization, optimization according to distribution function, compressors and expanders. 8. Differential techniques, prediction methods, adaptive quantization with prediction, DPCM method, use in audio and video coding. 9. Transformations in lossy coding, orthonormal representations, component analysis, two-dimensional transformations. 10. Discrete Fourier transform, use in image compression, JPEG encoder. 11. Subband filters, signal decomposition, signal synthesis from subbands, use in sound compression, psychoacoustic models, MP3, AAC coding. 12. Wavelet transforms, EZW encoder, use in audio and video coding. 13. Video compression, MPEG standards, adaptive algorithms for streaming and video conferencing. 	

Recommended literature:					
1. D. Salomon: Data Compression, The Complete Reference, Springer, 2004.					
2. K. Sayood: Introduction to Data Compression, Morgan Kaufmann, 2012.					
Course language:					
Slovak or English					
Notes:					
Course assessment					
Total number of assessed students: 0					
A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0
Provides: doc. RNDr. Jozef Jirásek, PhD., RNDr. Rastislav Krivoš-Belluš, PhD.					
Date of last modification: 05.11.2024					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ KOA/10	Course name: Combinatorial algorithms
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 3 / 1 Per study period: 42 / 14 Course method: present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion: The evaluation consists of projects (30 points) and an exam (70 points). The semester projects consist of the elaboration of computer programs that return the optimal solution or acceptable approximations of the optimal solutions, of selected graph problems given by suitable representations.	
Learning outcomes: Understanding of basic graph algorithm, the close connection between the theoretical and algorithmic aspects of discrete mathematics, ability to understand how selected algorithms can be derived from mathematical statements, ability to prove the correctness of algorithms.	
Brief outline of the course: Basic notions from graph theory. Introduction to algorithms and complexity. Basic types of algorithms - sorting algorithms, search algorithms, greedy algorithms. NP-completeness. Trees, spanning trees and rooted trees. Depth first search, breadth first search. Generating of all spanning trees of a graph, number of spanning trees. Minimum spanning tree problem (Kruskal, Prim, and Boruvka's algorithms). Distance in graphs. Shortest path problem in (non)oriented (weighted) graphs (various types of algorithms) and other variations of this problem. Introduction to network analysis, critical path method. Flows in networks, the max-flow min-cut theorem and related concepts. Matchings, maximum matchings in bipartite and general graphs, finding a matching with maximum weight in bipartite graphs. Location of centers in graphs, finding a center, absolute center, and a median of a graph. Eulerian graphs and Chinese postman's problem. Hamiltonian graphs, Travelling salesman problem and approximation algorithms for TSP.	
Recommended literature: 1. G. Chartrand, O.R. Oellermann: Applied and Algorithmic Graph Theory, McGraw-Hill, Inc. New York 1993. 2. J.L. Gross, J. Yellen: Graph Theory and Its Applications, Chapman & Hall/CRC 2006. 3. D. Jungnickel: Graphs, Networks, and Algorithms, Springer-Verlag Berlin 2005.	

4. J. Plesník: Grafové algoritmy, Veda Bratislava 1983.					
Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 155					
A	B	C	D	E	FX
40.0	23.87	19.35	8.39	5.81	2.58
Provides: RNDr. Alfréd Onderko, PhD., prof. RNDr. Tomáš Madaras, PhD.					
Date of last modification: 06.02.2025					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ VKN/24	Course name: Computational and cognitive neuroscience
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 1., 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Midterm exam Final exam consisting of written and/or oral part	
Learning outcomes: Advanced topics in computational and cognitive neuroscience, and in the tools used in neuroscience.	
Brief outline of the course: 1. Intro: Cognitive psychology, neural modeling. Theme 1: Topics in cognitive and neural science 2. Neural basis of vision 3. Visual object recognition and visual scene analysis 4. Auditory cognition. Echo suppression. Auditory scene analysis 5. Cortical sound processing. 6. Other topics in the study of brain and main: thinking, consciousness, emotions, motivation Topic 2: Modeling in cognitive and neural science 7. Intro 8. Connectionism, STM and LTM modeling 9. Additive and shunting neural networks. 10. Learning rule Outstar. 11. Adaptive resonance theory. 12. Statistical and decision-theory modeling Topic 3: Current research at UPJS 13. Invited lecture	
Recommended literature: 1. KANDEL, E. R., SCHWARTZ, J. H. and JESSELL, T.M.: Principles of Neural Science. McGraw-Hill, 2021 ISBN-13: 978-1259642234 2. Dayan P and LF Abbott: Theoretical Neuroscience - Computational and Mathematical Modeling of Neural Systems. MIT Press, 2005 ISBN-13: 978-0262541855 3. Thagard P: Mind: Introduction to Cognitive Science, 2nd Edition. Bradford Books. ISBN-13 : 978-0262701099	

4. HERTZ, J., KROGH, A. and PALMER R. G.: Introduction to the theory of neural computation. Addison-Wesley 1991 ISBN-13: 978-0201515602					
Course language: Slovak or English					
Notes: Content prerequisites: basics of neurobiology, cognitive psychology, linear algebra and differential equations, programming, or instructor's consent					
Course assessment Total number of assessed students: 16					
A	B	C	D	E	FX
37.5	18.75	12.5	6.25	25.0	0.0
Provides: doc. Ing. Norbert Kopčo, PhD., univerzitný profesor, RNDr. Keerthi Kumar Doreswamy, PhD., Ing. Udbhav Singhal, PhDr. Myroslav Fedorenko					
Date of last modification: 19.03.2024					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ VYZ1/15	Course name: Computational complexity
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 1.	
Course level: II., N	
Prerequisites:	
Conditions for course completion: Oral examination.	
Learning outcomes: To give students theoretical background in computational complexity and theory of NP-completeness.	
Brief outline of the course: 1: Introduction: the notion of computational complexity, computational time, computational model, example - the problem of sorting, computational complexity as an asymptotic function 2: Basic computational models: RAM and RASP computers, the cost of an elementary step on these computers, single-tape Turing machine, multi-tape Turing machine, nondeterministic variants of these computational models, transformations among these models with respect to the time complexity 3: The classes P and NP: basic definitions, presenting (un)undirected graphs on the input, 3COL – the set of all 3-colorable graphs is in NP, 2COL - the set of all 2-colorable graphs is in P, SAT – the set of satisfiable Boolean formulas is in NP, CNF-SAT - Boolean formulas in conjunctive normal form 4: Variants of P and NP: decision problem, the problem of finding a solution, optimization problem, polynomial conversions among different variants 5: NP-completeness: reducibility in polynomial time and its transitivity, definition of the NP-completeness and its basic properties 6: NP-completeness of SAT 7: Variants of SAT: 3CNF-SAT - satisfiability of Boolean formulas in 3-conjunctive normal form, kCNF-SAT, CNF-SAT - satisfiability in k-conjunctive (conjunctive) normal form, 2CNF-SAT is in P 8: 3COL and its variants: 3COL (the problem of coloring vertices of a graph with 3 colors) in NP-complete, consequently: for each $k > 3$, kCOL (the problem of coloring with k colors) is NP-complete as well 9: Colorability of a planar graph with three colors: presenting a planar graph on the input, the proof of NP-completeness, coloring with a larger number of colors 10: Another NP-complete problems: Exact set cover, Clique, Vertex cover	

11: Hamiltonian path: Hamiltonian path in a directed and in undirected graph
 12: Subset-sum-like problems: Subset Sum - the problem of whether any subset of the integers sum to precisely a target sum, Partition - the problem of whether a given multiset of positive integers can be partitioned into two subsets with equal sums, a “more relaxed” version of Partition - achieving an approximate equality of the sums, distribution of tasks among K parallel processors
 13: Beyond P a NP: a review of the basic complexity classes - L, NL, P, NP, PSpace, NPSpace, ExpTime, NExpTime, ..., simulation of (non)deterministic space in (non)deterministic time, conversions in opposite directions
 14: PSpace: QBF - true quantified Boolean formulas, prenex normal form, Pspace completeness of QBF, PSpace = NPSpace

Recommended literature:

1. J.E. Hopcroft, R.Motwani, J.D. Ullman: Introduction to automata theory, languages, and computation, Addison-Wesley, 2007.
2. M. Sipser: Introduction to the Theory of Computation, Thomson, 2nd edition, 2006.
3. L.A.Hemaspaandra, M.Ogihara: Complexity theory companion, EATCS series, texts in computer science, Springer-Verlag, 2002.
4. S. Arora, B. Barak: Computational Complexity: A Modern Approach, Cambridge Univ. Press, 2009.
5. G.Brassard, P.Bradley: Fundamentals of algorithmics, Prentice Hall, 1996.
6. D.P.Bovet, P.Crescenzi: Introduction to the theory of complexity, Prentice Hall, 1994.
7. C. Calude and J. Hromkovič: Complexity: A Language-Theoretic Point of View, in G. Rozenberg and A. Salomaa, Handbook of Formal Languages II, Springer, 1997.

Course language:

Slovak or english

Notes:

Content prerequisites:

Basic notions from the theory of automata and formal languages.

Basic skills in programming and design of algorithms (in any programming language).

Basics knowledge in mathematical logic, set theory, and graph theory.

Course assessment

Total number of assessed students: 423

A	B	C	D	E	FX
57.92	15.37	12.77	6.62	7.09	0.24

Provides: doc. RNDr. Ondrej Krídlo, PhD.

Date of last modification: 03.09.2025

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ VSM/10	Course name: Computational statistics and simulation methods
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Written tests. Final evaluation is given at the basis of partial examination, written and oral part of exam.	
Learning outcomes: Getting to know modern software and computational and simulation methods in statistics.	
Brief outline of the course: <ul style="list-style-type: none"> o Types of statistical computations, popular mathematical software o Computing distribution and quantile functions o Matrix computations o Random numbers generation: <ul style="list-style-type: none"> a) Uniform distribution (linear reccurent generators, bit reccurent generators, nonlinear generators) b) General methods for other distributions c) Special methods for other distributions o Simulations o Approximate evaluation of an integral o Bootstrap method o Random processes and MCMC method o Introduction to Exploratory data analysis o Principles of cluster analysis o Principal component analysis o Factor analysis o GUHA method 	
Recommended literature: <ul style="list-style-type: none"> • Olehla, Věchet, Olehla: Řešení úloh matematické statistiky ve Fortranu, Nadas, 1982 • Olver et al.: NIST Handbook of mathematical functions, NIST and Cambridge University Press, 2010 • Deák: Random number generators and simulation, Akadémiai kiadó, 1990 • Fishman: Monte Carlo. Concepts, Algorithms, and Applications., Springer, 1996 • Backhaus, Erichson, Plinke, Weiber: Multivariate Analysemethoden, 7th ed., Springer, 1994 • Tan, Steinbach, Kumar: Introduction to Data Mining, Pearson Education Ltd., 2014 	

Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 78					
A	B	C	D	E	FX
17.95	21.79	21.79	14.1	17.95	6.41
Provides: prof. RNDr. Ivan Žežula, CSc., doc. RNDr. Daniel Klein, PhD.					
Date of last modification: 14.04.2022					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ SDMa/21	Course name: Data Management Seminar II
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Active presentation of own and already known and published results related to diploma thesis in the middle and end of semester.	
Learning outcomes: To become familiar with selected current knowledge from the area of data analysis, machine learning and artificial intelligence. Developing skills such as understanding and interpreting scientific text.	
Brief outline of the course: 1. - 2. Data mining case studies 3. - 4. Graph algorithms 5. - 6. Group work with students on topics in the field of data management 7. - 8. Individual work with students on topics in the field of data management 9. - 10. Applications of machine learning methods in solving problems in different application domains. 11. - 12. Applications of in-depth learning methods in solving problems in different application domains.	
Recommended literature: 1. CHOLLET, François. Deep learning v jazyku Python: knihovny Keras, Tensorflow. Přeložil Rudolf PECINOVSKÝ. Praha: Grada Publishing, 2019. Knihovna programátora (Grada). ISBN 978-80-247-3100-1. 2. GOODFELLOW Ian, BENGIO Yoshua a Aaron COURVILLE. Deep Learning. MIT Press, 2016. ISBN: 9780262035613. 3. Current articles from scientific journals, contributions at the scientific and professional conferences related to the topic of diploma thesis.	
Course language: English	
Notes:	

Course assessment	
Total number of assessed students: 23	
abs	n
100.0	0.0
Provides:	
Date of last modification: 20.09.2021	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ SDMb/19	Course name: Data Management Seminar II
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Active presentation of known and own results related to final thesis in the middle and end of semester.	
Learning outcomes: To become familiar with selected current knowledge from the area of data analysis, machine learning and artificial intelligence. Developing skills such as understanding and interpreting scientific text.	
Brief outline of the course: 1. - 2. Data mining case studies 3. - 4. Graph algorithms 5. - 6. Group work with students on topics in the field of data management 7. - 8. Individual work with students on topics in the field of data management 9. - 10. Applications of machine learning methods in solving problems in different application domains. 11. - 12. Applications of deep learning methods in solving problems in different application domains.	
Recommended literature: 1. CHOLLET, François. Deep learning v jazyku Python: knihovny Keras, Tensorflow. Přeložil Rudolf PECINOVSKÝ. Praha: Grada Publishing, 2019. Knihovna programátora (Grada). ISBN 978-80-247-3100-1. 2. GOODFELLOW Ian, BENGIO Yoshua a Aaron COURVILLE. Deep Learning. MIT Press, 2016. ISBN: 9780262035613. 3. Current articles from scientific journals, contributions at the scientific and professional conferences related to the topic of diploma thesis.	
Course language: English	
Notes:	

Course assessment	
Total number of assessed students: 19	
abs	n
100.0	0.0
Provides:	
Date of last modification: 25.07.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1a/22	Course name: Diploma project I
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 1	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment	
Total number of assessed students: 25	
abs	n
100.0	0.0
Provides:	
Date of last modification: 24.08.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1b/22	Course name: Diploma project II
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment	
Total number of assessed students: 12	
abs	n
100.0	0.0
Provides:	
Date of last modification: 24.08.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1c/22	Course name: Diploma project III
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment	
Total number of assessed students: 20	
abs	n
100.0	0.0
Provides:	
Date of last modification: 24.08.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1d/22	Course name: Diploma project IV
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 4.	
Course level: II.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment	
Total number of assessed students: 20	
abs	n
100.0	0.0
Provides:	
Date of last modification: 24.08.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice					
Faculty: Faculty of Science					
Course ID: ÚMV/ DPO/22		Course name: Diploma thesis and its defence			
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present					
Number of ECTS credits: 16					
Recommended semester/trimester of the course:					
Course level: II.					
Prerequisites:					
Conditions for course completion: The diploma thesis is the result of the student's own work. It must not show elements of academic fraud and must meet the criteria of good research practice defined in the Rector's Decision no. 21/2021, which lays down the rules for assessing plagiarism at Pavol Jozef Šafárik University in Košice and its components. Fulfillment of the criteria is verified mainly in the process of supervision and in the process of thesis defense. Failure to do so is reason for disciplinary action.					
Learning outcomes: The diploma thesis demonstrates mastery of extended theory and professional terminology of the field of study, acquisition of knowledge, skills and competencies in accordance with the declared profile of the graduate of the study program, as well as the ability to apply them creatively in solving selected field problems. Student demonstrates the ability of independent professional work in terms of content, formal and ethical. Further details on the diploma thesis are determined by Directive no. 1/2011 on the basic requirements of final theses and the Study Regulations of UPJŠ in Košice.					
Brief outline of the course: 1. Elaboration of the diploma thesis in accordance with the instructions of the supervisor. 2. Presentation of the results of the diploma thesis before the examination commission. 3. Answering questions related to the topic of the diploma thesis within the discussion.					
Recommended literature: The recommended literature is determined individually in accordance with the topic of the diploma thesis.					
Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 16					
A	B	C	D	E	FX
75.0	6.25	12.5	0.0	6.25	0.0

Provides:
Date of last modification: 19.04.2022
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ DPO/22	Course name: Doctoral Thesis and its Defence
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 16	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisites: ÚINF/SDI1c/15	
Conditions for course completion: The diploma thesis is the result of the student's own work. It must not show elements of academic fraud and must meet the criteria of good research practice defined in the Rector's Decision no. 21/2021, which lays down the rules for assessing plagiarism at Pavol Jozef Šafárik University in Košice and its components. Fulfillment of the criteria is verified mainly in the process of supervision and in the process of thesis defense. Failure to do so is reason for disciplinary action.	
Learning outcomes: The diploma thesis demonstrates mastery of extended theory and professional terminology of the field of study, acquisition of knowledge, skills and competencies in accordance with the declared profile of the graduate of the study program, as well as the ability to apply them creatively in solving selected field problems. Student demonstrates the ability of independent professional work in terms of content, formal and ethical. Further details on the diploma thesis are determined by Directive no. 1/2011 on the basic requirements of final theses and the Study Regulations of UPJŠ in Košice for the 1st, 2nd and combined 1st and 2nd degree.	
Brief outline of the course: 1. Elaboration of the diploma thesis in accordance with the instructions of the supervisor. 2. Presentation of the results of the diploma thesis before the examination commission. 3. Answering questions related to the topic of the diploma thesis within the discussion.	
Recommended literature: The recommended literature is determined individually in accordance with the topic of the diploma thesis.	
Course language: Slovak and optionally English.	
Notes:	

Course assessment					
Total number of assessed students: 27					
A	B	C	D	E	FX
51.85	22.22	22.22	3.7	0.0	0.0
Provides:					
Date of last modification: 19.11.2021					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ ZNA1/21	Course name: Foundations of knowledge systems
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: 3 Per study period: 42 Course method: present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Test of theoretical knowledge in the middle of the semester. Written and oral exam.	
Learning outcomes: The goal is to teach students some advanced applications of logic, fuzzy logic and basic clustering methods, especially in database and knowledge systems.	
Brief outline of the course: 1. basic notions of Ordered sets and Formal concept analysis, motivation example 2. closure operator, closure system, Galois connection and concept lattice, example 3. basic notions of fuzzy logic, one-sided and fuzzy formal concept analysis 4. basic algorithms of Formal concept analysis 5. optimal decomposition of formal context, optimal factors, algorithms, example 6. intercontextual structures, bonds, direct products and selection of best bonds, relationship with factorisation 7. applications on real data	
Recommended literature: 1. Bělohlávek, R. (2002). Fuzzy Relational Systems: Foundations and Principles. New York: Kluwer Academic/Plenum Publishers. 2. Carpineto, C., & Romano, G. (2004). Concept Data Analysis: Theory and Applications. Hoboken, NJ: John Wiley & Sons, Inc. 3. Ganter, B., & Wille, R. (1999). Formal Concept Analysis: Mathematical Foundations. Berlin: Springer. 4. Guniš, J., Šnajder, L., Antoni, L., Eliaš, P., Krídlo, O., & Krajčí, S. (2024). Formal Concept Analysis of Students' Solutions on Computational Thinking Game. IEEE Transactions on Education. doi:10.1109/TE.2024.3442612. 5. Krídlo, O., Antoni, L., & Krajčí, S. (2022). Selection of appropriate bonds between L-fuzzy formal contexts for recommendation tasks. Information Sciences, 606, 21-37. ISSN 0020-0255. https://doi.org/10.1016/j.ins.2022.05.047 .	

<p>6. Křídlo, O., López-Rodríguez, D., Antoni, E., Eliaš, P., Krajčí, S., & Ojeda-Aciego, M. (2023). Connecting concept lattices with bonds induced by external information. <i>Information Sciences</i>, 648, 119498. ISSN 0020-0255. https://doi.org/10.1016/j.ins.2023.119498.</p> <p>7. Pitka, T., Bucko, E., Šnajder, L., et al. (2024). Time analysis of online consumer behavior by decision trees, GUHA association rules, and formal concept analysis. <i>Journal of Marketing Analytics</i>. https://doi.org/10.1057/s41270-023-00274-y.</p>					
<p>Course language: Slovak or English</p>					
<p>Notes: content prerequisites: basics of logic, introduction to computer science</p>					
<p>Course assessment Total number of assessed students: 120</p>					
A	B	C	D	E	FX
51.67	10.83	17.5	6.67	10.83	2.5
<p>Provides: doc. RNDr. Ondrej Křídlo, PhD., doc. RNDr. Ľubomír Šnajder, PhD.</p>					
<p>Date of last modification: 03.11.2024</p>					
<p>Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.</p>					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice					
Faculty: Faculty of Science					
Course ID: ÚMV/ FAN/22		Course name: Functional analysis			
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present					
Number of ECTS credits: 6					
Recommended semester/trimester of the course: 1.					
Course level: II.					
Prerequisites:					
Conditions for course completion: exam					
Learning outcomes: Understanding of the basic rigorous ideas of Applied Functional Analysis.					
Brief outline of the course: Linear spaces. Algebraic base and dimension. Linear operators and functionals. Algebraic dual spaces. Linear topological space. Locally convex space. Normed space. $L(p)$ spaces. Dual spaces of $L(p)$ spaces. Hilbert space. Applications of Baire category theorem. Open mapping theorem. Closed graph theorem. Hahn-Banach theorem. Spectrum of linear compact operator.					
Recommended literature: A. M. Bruckner, J. B. Bruckner, B. S. Thomson: Real Analysis, Prentice Hall, 1997. B. P. Rynne, M. A. Youngson: Linear Functional Analysis, Springer-Verlag, 2008.					
Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 59					
A	B	C	D	E	FX
22.03	15.25	13.56	15.25	27.12	6.78
Provides: RNDr. Jaroslav Šupina, PhD., prof. RNDr. Ondrej Hutník, PhD.					
Date of last modification: 12.08.2025					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice					
Faculty: Faculty of Science					
Course ID: ÚMV/ THR/22		Course name: Game theory			
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present					
Number of ECTS credits: 6					
Recommended semester/trimester of the course: 1., 3.					
Course level: II.					
Prerequisites:					
Conditions for course completion: Two written exams during the semester (solving problems), presentation of an interesting model. The final assessment is based on the written tests and oral examination.					
Learning outcomes: Knowledge of basic models of noncooperative and cooperative game theory, solution methods and applications of game-theoretic models in economics and everyday life.					
Brief outline of the course: Examples of games. Extensive form of a game, value of the game. Von Neumann Morgenstern utility theory. Matrix games and their solution methods: geometric, linear programming . Bimatrix games. Nash equilibrium and its computation. Negotiations theory. Cooperative n-person games: core, Shapley value. Economic applications of game theory.					
Recommended literature: 1. K. Binmore, Fun and games, D.C. Heath, 1992 2. G. Owen, Game Theory, Academic Press (existuje ruský preklad). 3. A.R. Karlin, Y.Peres, Game theory alive, American Mathematical Society, 2017 4. L.C. Thomas, Games, Theory and Applications, Wiley, New York. 5. H.S. Bierman, L. Fernandez, Game Theory with Economic Applications, Addison-Wesley, 1998.					
Course language: Slovak					
Notes: The students should have basic knowledge in probability theory and linear programming (including duality theory and simplex method).					
Course assessment Total number of assessed students: 116					
A	B	C	D	E	FX
22.41	22.41	22.41	15.52	15.52	1.72

Provides: prof. RNDr. Katarína Cechlárová, DrSc.
Date of last modification: 24.11.2024
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ IMUI/19	Course name: Information management and artificial intelligence methods
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisites: ÚINF/ZNA1/21 and ÚINF/NEU/24 and ÚINF/STU1/16 and ÚMV/VSM/10 and (ÚMV/KOA/10 or ÚMV/NPR/19)	
Conditions for course completion: Appropriate knowledge and competencies from the profile subjects of the study program, demonstrating the ability to synthesize the acquired knowledge and procedures and apply them to the problems of data analysis and artificial intelligence.	
Learning outcomes: Verification of acquired student competencies in accordance with the graduate profile.	
Brief outline of the course: ZNA01 Basic concepts of Formal Concept Analysis. ZNA02 Basic algorithms of Formal Concept Analysis. NEU03 Feedforward neural networks and the backpropagation method. NEU04 Convolution and Convolutional Neural Networks. NEU05 Deep Neural Networks (DNN) and their use. NEU06 Graph Neural Networks (GNN) and their applications. STU07 Phases of machine learning, overfitting of machine learning models. STU08 Decision trees, random forests, and other types of ensemble models of machine learning. STU09 Support Vector Machines (SVM) and other classification methods. ZNA10 Basic concepts of fuzzy logic and their use in formal concept analysis. VSM11 Solving systems of linear equations, calculating eigenvalues and eigenvectors of matrices. VSM12 General methods of generating random numbers. VSM13 Stochastic processes and the MCMC method. VSM14 Principles and methods of cluster analysis. VSM15 Principal Component Analysis (PCA), Factor Analysis. KOA16 Polynomial and NP-complete problems of combinatorial optimization. KOA17 Optimal acyclic subgraphs (paths, trees, matchings). KOA18 Network flows (algorithms, complexity, modifications, and applications). NPR16 Stochastic processes and their properties: Concepts of stationarity, causality, invertibility, and the time-domain approach. NPR17 Time series analysis in the frequency domain: Spectral density and the periodogram. NPR18 Time series prediction: Properties of predictors and forecasting models.	

Recommended literature: Information sources recommended within individual profile subjects.					
Course language: Slovak language or English language					
Notes:					
Course assessment Total number of assessed students: 9					
A	B	C	D	E	FX
66.67	11.11	0.0	11.11	11.11	0.0
Provides:					
Date of last modification: 06.03.2026					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice					
Faculty: Faculty of Science					
Course ID: ÚINF/ TIK1/22		Course name: Information theory, encoding			
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 1 Per study period: 28 / 14 Course method: present					
Number of ECTS credits: 3					
Recommended semester/trimester of the course: 1.					
Course level: II.					
Prerequisites:					
Conditions for course completion: Satisfiable knowledge of basic notions					
Learning outcomes: To understand principles of lossless coding and entropy and their mutual relationship.					
Brief outline of the course: 1. Word and language 2. Decodable codes 3. Prefix-free codes 4. Kraft-McMillan inequality 5.-7. Entropy 8.-9. Price of code sequence 10. Shannon's theorem 11. Fano's code sequence 12. Huffman's optimal code sequence					
Recommended literature: 1. D. Hankersson, G. Harris, P. Johnson: Introduction to Information Theory and Data Compression, CRC Pr., 1998. 2. J. Adámek: Kódování a teorie informace, Vydavatelství ČVUT, Praha 1994 3. J. Černý: Entropia a informácia v kybernetike, Alfa 1981					
Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 149					
A	B	C	D	E	FX
59.06	20.81	11.41	4.03	0.0	4.7
Provides: prof. RNDr. Stanislav Krajčí, PhD.					

Date of last modification: 08.02.2022

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ STU1/16	Course name: Machine learning
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion: The realization of a project focused on the application of machine solution methods in solving practical tasks. Successful completion of two written tests based on machine learning, probabilistic learning, classification tasks. Successful completion of the written and oral part of the exam based on machine learning, probabilistic learning, classification tasks.	
Learning outcomes: The result of education is an understanding of the basic principles of machine learning. The student will gain the ability to analyze data using selected methods of machine learning and artificial intelligence. Can work with a selected tool for modeling neural networks.	
Brief outline of the course: 1. Learning algorithms, concepts, hypotheses. Training and learning, learning by construction and numbering. 2. Boolean formulas and their representation. Learning algorithms for monocells. Hypothesis space representation. 3. Probabilistic learning. An estimate of the number of examples needed to achieve some accuracy and credibility. 4. Probabilistic learning and consistent algorithms. 5. Relationships between attribute sets and predicted variables. Regression. Linear modeling using the least squares method of deviations. 6. Linear modeling, generalization, nonlinear responses from a linear model, data validation. Classification. 7. Linear modeling using probability theory and maximum confidence. 8. VC (Vapnik - Cervonenkis) dimension of its relation to perceptrons. 9. Bayesian approach to learning. SVM. 10. Clustering. 11. Hidden Markov models.	
Recommended literature: 1. ANTHONY, Martin a Norman BIGGS. Computational Learning Theory, Cambridge University Press, 1997. ISBN 978-0521599221. 2. BROWNLEE, Jason. Machine Learning Mastery With Python. 2019.	

3. WATT, Jeremy, Reza BORHANI a Aggelos K. KATSAGGELOS. Machine learning refined: foundations, algorithms, and applications. Cambridge: Cambridge University Press, 2016. ISBN 978-1-107-12352-6.

Course language:

Slovak language or English language

Notes:

Course assessment

Total number of assessed students: 97

A	B	C	D	E	FX
38.14	19.59	23.71	11.34	6.19	1.03

Provides: doc. RNDr. Ľubomír Antoni, PhD., RNDr. Zoltán Szoplák, RNDr. Šimon Horvát, PhD.

Date of last modification: 31.03.2022

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ MPA/19	Course name: Markov's processes and their applications
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 3 / 2 Per study period: 42 / 28 Course method: present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Total evaluation based on 2 written tests (2x40p) + assignment (5p) and oral exam (40p). At least 50% must be obtained from each part. Final evaluation: $\geq 90\%$ A; $\geq 80\%$ B; $\geq 70\%$ C; $\geq 60\%$ D; $\geq 50\%$ E; $< 50\%$ FX.	
Learning outcomes: Student should: <ol style="list-style-type: none"> 1. Obtain the knowledge about modelling of real stochastic processes. 2. Apply theoretical knowledge in practical problems solving in queuing and renewal theory. 3. Obtain basic skills with CAS software SageMath based on Python. 	
Brief outline of the course: <ol style="list-style-type: none"> 1. Stochastic (random) processes (definition, characteristics, classification of processes). 2. Markov chains (Markov property, transition matrix, discrete-time Markov chains). 3. Classification of states of the process. 4. Evaluation of transitions, optimal strategies, Howard's algorithm. 5. Special chains with continuous time (continuous-time Markov chains, intensity of transition, Kolmogorov's differential equations, Poisson process). 6. Birth-and-death processes. 7. Applications in queuing theory (Kendall's classification of queuing systems, efficiency indicators, opened systems without waiting). 8.-9. Opened systems with waiting, closed systems. 10. Applications in renewal theory and reliability. Markov chains in discrete renewal models. 11. Renewal process with continuous time. 12. Reliability of the system of elements. 13. Limit theorems of renewal theory. 	
Recommended literature: <ol style="list-style-type: none"> 1. Skřivánková V., Hančová M.: Náhodné procesy a ich aplikácie, UPJŠ, Košice, 2018 (in Slovak) 2. Beichelt F.: Applied Probability and Stochastic Processes, 2nd Ed., Chapman and Hall, 2016 3. Ross S. M.: Introduction to Probability Models, 13th ed., Elsevier, 2023 4. Janková, K. a kol. Markovove reťazce a ich aplikácie, epos, 2014 (in Slovak) 	

5. Prášková Z., Lachout P.: Základy náhodných procesů, MFF UK, Praha, 2020 (in Czech)

Course language:

Slovak

Notes:

The students are required to have basic knowledge about axiomatic theory of probability, distributions and characteristics of random variables.

Course assessment

Total number of assessed students: 122

A	B	C	D	E	FX
26.23	21.31	18.85	17.21	13.11	3.28

Provides: doc. RNDr. Martina Hančová, PhD.

Date of last modification: 21.11.2024

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice					
Faculty: Faculty of Science					
Course ID: ÚMV/ VRS/14		Course name: Multidimensional statistical methods			
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 3 Per study period: 42 Course method: present					
Number of ECTS credits: 4					
Recommended semester/trimester of the course: 2.					
Course level: II.					
Prerequisites:					
Conditions for course completion: Given at the basis of partial examination and working out an individual project.					
Learning outcomes: To learn to use the most widely used multivariate methods of data processing practically.					
Brief outline of the course: Multivariate data, graphical visualization. Multivariate normal distribution. Inference for multivariate normal distribution. Dimension reduction - principal component analysis, factor analysis. Multidimensional scaling. Cluster analysis. Odds and risk ratios. Logistic regression.					
Recommended literature: 1. W. Härdle, L. Simar. Applied multivariate statistical analysis. Heidelberg: Springer, 2019 2. W. Härdle, Z. Hlávka: Multivariate statistics: Exercises and solutions. New York: Springer, 2007 3. R.A. Johnson, D.W. Wichern. Applied multivariate statistical analysis. Upper Saddle River, N.J: Pearson Prentice Hall, 2014 (6. vydanie) 4. B. Everitt and T. Hothorn. An introduction to applied multivariate analysis with R. New York: Springer, 2011 5. D.J. Bartholomew et al. Analysis of multivariate social science data. Chapman & Hall, 2008 (2. vydanie)					
Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 26					
A	B	C	D	E	FX
42.31	30.77	7.69	15.38	3.85	0.0
Provides: doc. RNDr. Daniel Klein, PhD.					
Date of last modification: 27.01.2022					

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ NLP/26	Course name: Natural language processing
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 3	
Recommended semester/trimester of the course: 1., 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Student assessment is based on a combination of continuous assignments and a practical project (50%).	
Learning outcomes: After successful completion of the course, the student: <ul style="list-style-type: none"> - understands the theoretical foundations of natural language processing and transformers, - is able to prepare text data for NLP tasks (tokenization, normalization), - is capable of creating and annotating datasets for NLP applications, - can design a training pipeline and fine-tune transformer models for a specific problem, - applies models to practical tasks such as text classification, question answering (QA), and machine translation. 	
Brief outline of the course: <ol style="list-style-type: none"> 1. Introduction to NLP, history and overview of NLP, traditional approaches vs. neural networks 2. Tokenization and preprocessing, basic techniques 3. Advanced tokenizers (BPE, WordPiece, SentencePiece) 4. Embeddings and contextual representations 5. Language models 6. Transformers: transformer architecture, self-attention mechanism, positional encoding 7. Training and fine-tuning of transformers 8. Training and fine-tuning of transformers II 9. Fine-tuning for specific tasks (transfer learning) 10. Datasets in NLP, creation of custom datasets 11. Big Data in NLP, processing of large datasets, use of IterableDataset and batching 12. Applications of transformers: text classification, question answering (Q&A), machine translation 	
Recommended literature: <ul style="list-style-type: none"> - Jurafsky, D., Martin, J.H.: Speech and Language Processing. - Goldberg, Y.: Neural Network Methods for Natural Language Processing. - Vaswani, A. et al.: Attention Is All You Need (transformer paper). - Wolf, T. et al.: Transformers for NLP: The Illustrated Guide. 	

- Mikolov, T.: Word2Vec Tutorial / rôzne články o embeddingoch.					
Course language: slovak or english					
Notes:					
Course assessment Total number of assessed students: 51					
A	B	C	D	E	FX
96.08	3.92	0.0	0.0	0.0	0.0
Provides: RNDr. Zoltán Szoplák, RNDr. Peter Gurský, PhD., univerzitný docent					
Date of last modification: 17.12.2025					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ NEU/24	Course name: Neural networks
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 1., 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Successful realization of a project focused on the applications of neural networks. Successful completion of two written tests at 60% which are focused on various architectures of neural networks and the connections with other areas of computer science - automata, fuzzy logic. Demonstration of knowledge focused on neural network methods and their application in the exam.	
Learning outcomes: Knowledge of basic paradigms of neural networks. Knowledge about applications of neural networks in various fields. Ability to assess the applicability of neural networks in solving algorithmic problems.	
Brief outline of the course: 1. Motivational examples. Mathematical model of neuron and neural network. Perceptrons. Linear separable objects, adaptation process (learning), perceptron convergence, multiple perceptrons. 2. Computational power of single input neural networks, neuromata. Simulation of automata using neural networks. 3. Classical layer neural networks, hidden neurons, adaptation process (learning), feedback method backpropagation and its variants. 4. Recurrent neural networks, algorithm for training recurrent networks. Examples of use. 5. Self-organization of neural networks and Kohonen neural networks, learning algorithm, use. 6. Networks with local neurons, RBF networks, networks with semi - local units. RBF approximations networks. 7. Written test I. Neuromat for regular language. neural network to deterministic finite state automaton, recurrent backpropagation algorithm and its applications, Kohonen and RBF neural networks. 8. Convolutional neural networks. Basic knowledge of convolution. Convolutional neural networks for image processing. 9. Deep neural networks and their use. 10. Graph neural networks, structure, learning and applications. 11. Deductive systems of fuzzy logic. Fuzzy neural networks and their use. Fuzzy controller.	

12. Universal approximation using neural networks, Kolmogorov theorem. Approximation properties layered neural networks.
13. Solving practical problems using neural networks.
14. Written test II. Convolution and convolutional neural networks, deep neural networks, graph neural networks, construction of fuzzy regulator, Kolmogorov theorem and idea of its proof.

Recommended literature:

1. Y. Bengio: Learning Deep Architectures for AI, Foundations and Trends in ML, Vol. 2, No. 1 , 2009, pp. 1-127 ##
2. I. Goodfellow, Y. Bengio and A. Courville: Deep Learning, MIT Press book, 2016, ISBN-13: 978-0262035613
<https://www.deeplearningbook.org/> ##
3. M. H. Hassoun: Fundamentals of artificial neural networks. MIT Press, Cambridge, 1995. ##
4. J. Hertz, A. Krogh, R.G. Palmer: Introduction to the theory of neural computation, Addison-Wesley, 1991. ##
5. V. Kvasnička a kol.: Úvod do teórie neurónových sietí, IRIS, Bratislava, 1997. ##
6. P. Sinčák, G. Andrejková: Neurónové siete. I. diel: Dopredné siete, II. diel: Rekurentné a modulárne siete, Košice, 1997. ##
7. J. Šíma, R. Neruda: Teoretické otázky neuronových sítí, Matfyzpress, MFF UK, Praha, 1996. ##
8. F. Scarselli, M. Gori, Ah Ch. Tsoi, M. Hagenbuchner, and G. Monfardini: The Graph Neural Network Model. IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 20, NO. 1, JANUARY 2009 ##

Course language:

Slovak or English

Notes:

For ERASMUS students:

It is necessary to know a model of artificial neurons, its computation and its setting, layered neural networks and backpropagation training algorithm.

Course assessment

Total number of assessed students: 134

A	B	C	D	E	FX
30.6	20.9	20.15	14.93	11.94	1.49

Provides: doc. RNDr. Ľubomír Antoni, PhD.

Date of last modification: 19.03.2024

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ PDB1/15	Course name: Organization and data processing
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 1 Per study period: 28 / 14 Course method: present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Conditions for the final evaluation: final test	
Learning outcomes: To understand the principles of database management systems. To be able to use the knowledge when solving optimization problems over big data and managing parallel and distributed databases.	
Brief outline of the course: 1. Data representation, disk and file organization, 2. Tree-based indexing methods B+tree, R-tree, 3. Working with low-level classes to working with files 4. Creation of clustered and unclustered indexes 5. Hash-based indexing methods, external sorting, 6. Enumeration of relational operators, query optimization, 7. Case study: practical DB optimalization 8. Transaction management, 9. Crash recovery 10. Parallel databases, evaluation of relational operators in parallel databases 11. Distributed databases, evaluation of relational operators in distributed databases, database security and data consistency, recovery management in distributed database, distributed trasactions, distribution of table replicas	
Recommended literature: 1. R. RAMAKRISHNAN, J. GEHRKE: Database Management Systems, McGraw Hill Higher Education, 2003 2. A. SILBERSCHATZ, H. F. KORTH, S. SUDARSHAN: Database system concepts, McGraw Hill Higher Education, 2006	
Course language: Slovak or English	
Notes: Content prerequisites: SQL language (DBS1a), basics of programming (PAZ1a)	

Course assessment					
Total number of assessed students: 162					
A	B	C	D	E	FX
25.93	17.28	14.81	14.2	24.69	3.09
Provides: RNDr. Peter Gurský, PhD., univerzitný docent					
Date of last modification: 04.01.2022					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ PDS1/21	Course name: Parallel and distributed systems
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 2.	
Course level: II., N	
Prerequisites:	
Conditions for course completion: Home assignments, class project from tutorials, midterm written exam. Final written and oral exam.	
Learning outcomes: Understand the principles, basic problems and algorithms of parallel programming. Be able to implement synchronization procedures and manage and use interprocess communication. Master the basics of GPU programming. Understand the differences between parallel and distributed computational models. Master basic distributed algorithms and know how to implement them. Understand the problems of creating a distributed system environment and know how to solve them. Be able to use distributed environments in practical applications.	
Brief outline of the course: Parallel architectures, parallel computational model, access to shared memory. Basic algorithms, scaling, optimality. Effective methods of parallel search and sorting. Working in a GPU environment. Distributed computational model, communication protocols, characteristics of distributed systems. Intercomputer communication, distributed synchronization algorithms, transactions, termination and deadlock detection. Consistency issues with distributed memory sharing. Distributed application environment. Reliable calculations in an environment with errors.	
Recommended literature: 1. J. JáJá: An Introduction to Parallel Algorithms, Addison-Wesley, 1992, ISBN 0-201-54856-9 2. P. Sanders, K. Mehlhorn, M. Dietzfelbinger, R. Dementiev: Sequential and Parallel Algorithms and Data Structures, Springer, 2019 3. Sukumar Ghosh: Distributed Systems and Algorithms (Second Edition), CRC Press 2014 4. M. Raynal: Distributed Algorithms for Message-Passing Systems, Springer, 2013 5. Gerard Tel: Introduction to Distributed Algorithms, Cambridge University Press, 2001	
Course language: Slovak or English	
Notes: Content prerequisites: basic of concurrent programming, basic of operating system principles	

Course assessment					
Total number of assessed students: 78					
A	B	C	D	E	FX
19.23	7.69	19.23	20.51	24.36	8.97
Provides: doc. RNDr. Jozef Jirásek, PhD., RNDr. Rastislav Krivoš-Belluš, PhD., RNDr. Ladislav Mikeš, PhD., doc. RNDr. Ľubomír Antoni, PhD.					
Date of last modification: 23.11.2021					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ PDSII/15	Course name: Pro-seminar to diploma thesis in informatics
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Evaluation of the student's paper with a focus on the issue of the diploma thesis. Evaluation of the achieved results of the student during the semester on the diploma thesis on the basis of his / her report and the created diploma website.	
Learning outcomes: To inform students about areas of informatics they are suitable to work in diploma theses. In the end of semester students have to prepared themes of diploma theses, goals and recommended study literature.	
Brief outline of the course: The seminar is oriented to problems prospective to preparations of Diploma theses.	
Recommended literature: 1. MEŠKO, D., KATUŠČÁK, D. Akademická príručka. 1. vyd. Vydavateľstvo Osveta : Martin, 2004. 316 s. ISBN 80-8063-150-6 2. ISO 690: 1987 Documentation - Bibliographic references. Content, form and structure. 3. ISO 2145: 1978 Documentation - Numbering of divisions and subdivisions in written documents. 4. Eco, U.: Jak napsat diplomovou práci, z taliančiny Come si fa una tesi di laurea, Milano, 1977, Olomouc, Votobias. 5. Professional and scientific literature related to the diploma thesis according to the recommendation of the thesis supervisor.	
Course language: Slovak or English	
Notes:	
Course assessment Total number of assessed students: 152	
abs	n
98.68	1.32

Provides:
Date of last modification: 08.01.2022
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ CM/13	Course name: Seaside Aerobic Exercise
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II., P	
Prerequisites:	
Conditions for course completion: Completion: passed Condition for successful course completion: - active participation in line with the study rule of procedure and course guidelines - effective performance of all tasks- aerobics, water exercise, yoga, Pilates and others	
Learning outcomes: Content standard: The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature. Performance standard: Upon completion of the course students are able to meet the performance standard and: - perform basic aerobics steps and basics of health exercises, - conduct verbal and non-verbal communication with clients during exercise, - organise and manage the process of physical recreation in leisure time	
Brief outline of the course: Brief outline of the course: 1. Basic aerobics – low impact aerobics, high impact aerobics, basic steps and cuing 2. Basics of aqua fitness 3. Basics of Pilates 4. Health exercises 5. Bodyweight exercises 6. Swimming 7. Relaxing yoga exercises 8. Power yoga 9. Yoga relaxation 10. Final assessment Students can engage in different sport activities offered by the sea resort – swimming, rafting, volleyball, football, table tennis, tennis and other water sports in particular.	
Recommended literature: 1. BUZKOVÁ, K. 2006. Fitness jóga. Praha: Grada. 167 s.	

2. ČECHOVSKÁ, I., MILEROVÁ, H., NOVOTNÁ, V. Aqua-fitness. Praha: Grada. 136 s.
3. EVANS, M., HUDSON, J., TUCKER, P. 2001. Umění harmonie: meditace, jóga, tai-či, strečink. 192 s.
4. JARKOVSKÁ, H., JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. 209 s.
5. KOVAŘÍKOVÁ, K. 2017. Aerobik a fitness. Karolium, 130 s.

Course language:

Slovak language

Notes:

Course assessment

Total number of assessed students: 82

abs	n
7.32	92.68

Provides: Mgr. Agata Dorota Horbacz, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ BPD/25	Course name: Security of computer systems and data
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 2 / 2 Per study period: 28 / 28 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: To complete the course, students must: <ol style="list-style-type: none"> 1. Participate in seminars (20% of the total score). 2. Complete assignments (30% of the total score). 3. Pass a written exam (50% of the total score). 	
Learning outcomes: Students will familiarize themselves with the concepts, methods, and tools to ensure the confidentiality, integrity, and availability of data and computer systems. The course provides detailed insights into securing data in Windows and Linux operating systems as well as in cloud environments. Upon completing the course, students will acquire the knowledge necessary for designing and implementing data and system security, including analyzing security events.	
Brief outline of the course: <ol style="list-style-type: none"> 1. Introduction to security of computer systems and data, Security concepts and principles. Threats, attacks, and assets. Security functional requirements. 2. Windows operating system security. Security configuration settings. Encryption. Technologies to prevent malware execution. 3. Introduction to active directory. Kerberos protocol. Best practices for secure Active Directory management. Group policies. 4. Standard attacks on Active Directory. Credential theft attacks (Pass-the-Hash, Kerberoasting). Attacks exploiting Kerberos vulnerabilities (Golden Ticket, Silver Ticket). Lateral movement using Active Directory (Pass-the-Hash, Pass-the-Ticket). 5. Linux operating system security. Encryption (GPG, LUKS). User account security. Kernel security. Process isolation. 6. Access control in Linux operating systems. Discretionary Access Control (DAC), access control lists. Mandatory Access Control (MAC), implementing SELinux and AppArmor. 7. Public Key Infrastructure (PKI). Certificate Authorities. Certificates (X.509 standard) and their lifecycle. Pretty Good Privacy (PGP). 8. Database system security. Concepts and security of relational databases. Data integrity in database systems. Access control. 	

9. Cloud data security. Analysis of the Microsoft Azure cloud environment. Security incident response in Azure.
10. Monitoring and logging events in Windows OS. Log structure and sources. Types of events.
11. Monitoring and Logging Events in Linux OS. Syslog. Journald.
12. Data Analysis in SIEM (Security Information and Event Management). Data collection and storage. Normalization, aggregation, and correlation of data.

Recommended literature:

1. Forshaw, James. Windows Security Internals: A Deep Dive into Windows Authentication, Authorization, and Auditing. No Starch Press, 2024.
2. Yosifovich, Pavel, et al. Windows Internals, Part 1: System Architecture, Processes, Threads, Memory Management, and More. 7th ed., Microsoft Press, 2017. ISBN 978-0735684188.
3. Allievi, Andrea, et al. Windows Internals, Part 2. 7th ed., Microsoft Press, 2021. ISBN 978-0135462409.
4. Stallings, William. Computer Security: Principles and Practice. 4th ed., Pearson, 2017. ISBN 978-0134794105.
5. Tevault, Donald A. Mastering Linux Security and Hardening: A Practical Guide to Protecting Your Linux System from Cyber Attacks. 3rd ed., Packt Publishing, 2023. ISBN 978-1837630516.

Course language:

Slovak or English

Notes:

Content Prerequisites:

Students are expected to have a basic understanding of operating systems, Windows and Linux operating systems, and database fundamentals.

The course is not offered every year.

Course assessment

Total number of assessed students: 53

A	B	C	D	E	FX
32.08	22.64	16.98	13.21	15.09	0.0

Provides: doc. RNDr. JUDr. Pavol Sokol, PhD. et PhD., RNDr. Rastislav Krivoš-Belluš, PhD., Bc. Michal Šafranko

Date of last modification: 18.11.2024

Approved: prof. RNDr. Gabriel Semanišín, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ VKP/10	Course name: Selected topics in probability
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: 3 Per study period: 42 Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Evaluation is based on written and oral part of the exam.	
Learning outcomes: Perspective of probability from the standpoint of measure theory. Understanding of most important results of probability theory.	
Brief outline of the course: <ul style="list-style-type: none"> • Probability and measure <ul style="list-style-type: none"> o Set systems, random variables and measure o Distribution functions and their properties o Independence o Radon-Nikodym derivative of measure • Characteristics of random variables <ul style="list-style-type: none"> o Moment characteristics o Characteristic and generating functions o Quantile characteristics o Conditional densities and conditional mean values o Transformations of random variables, convolutions • Important probability distributions <ul style="list-style-type: none"> o Discrete distributions o Absolute continuous distributions • Convergence of sequences of random variables <ul style="list-style-type: none"> o Types of convergence (a.s., L_p, P, D) o Laws of large numbers o Central limit theorems 	
Recommended literature: <ul style="list-style-type: none"> • Štěpán: Teorie pravděpodobnosti, Academia, 1987 • Loeve: Probability theory, Van Nostrand, 1960 • Rényi: Foundations of Probability, Holden-Day, 1970 • Athreya, Lahiri: Measure Theory and Probability Theory, Springer, 2006 	

Course language: Slovak					
Notes:					
Course assessment Total number of assessed students: 69					
A	B	C	D	E	FX
13.04	14.49	14.49	14.49	33.33	10.14
Provides: RNDr. Andrej Gajdoš, PhD.					
Date of last modification: 19.04.2022					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ SD11a/15	Course name: Seminar to diploma theses in informatics
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites: ÚINF/PDSI1/15	
Conditions for course completion: Presentation of the analysis of the assignment and the proposal of the solution of the diploma thesis tasks, editing of the web page, written elaboration of the analysis and design of the solution.	
Learning outcomes: Monitoring and public presentation of work done so far on thesis preparation	
Brief outline of the course: The seminar serves for control, public presentation and defense of partial results at DP. In order to be awarded the credits, it is necessary to successfully complete the presentation of the analysis of the assignment and the achieved results, including the proposal of specific steps of the further solution procedure, update the presentation of the diploma thesis on the network and prepare a written analysis and proposal for solving the assigned problem in the range of 15-20 pages.	
Recommended literature: According to the topic of diploma thesis.	
Course language: Slovak or English	
Notes:	
Course assessment Total number of assessed students: 231	
abs	n
96.1	3.9
Provides:	
Date of last modification: 08.01.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ SDI1b/15	Course name: Seminar to diploma theses in informatics
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisites: ÚINF/SDI1a/15	
Conditions for course completion: Presentation of achieved results on the diploma thesis, web page modification, written processing of results.	
Learning outcomes: Monitoring and public presentation of work done so far on thesis preparation	
Brief outline of the course: Every thesis has a compulsory theoretical part and may also contain a software part. To gain recognition, the following is necessary: a detailed compilation of studied literature (a minimum of thirty pages) and at least twenty pages of text containing the candidate's own views of the problem area, possible research goals, own results are welcome (if the thesis is purely theoretical, this will be judged more strictly). For the SW part: a tested implementation (must conform to user requirements, help and user friendly user interface not necessary at this stage) and access to source texts. For both parts there will be an oral presentation and discussion.	
Recommended literature: According to the topic of diploma thesis	
Course language: Slovak or English	
Notes:	
Course assessment Total number of assessed students: 216	
abs	n
99.54	0.46
Provides:	
Date of last modification: 08.01.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ SDI1c/15	Course name: Seminar to diploma theses in informatics
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 4.	
Course level: II.	
Prerequisites: ÚINF/SDI1b/15	
Conditions for course completion: Presentation of the achieved results of the diploma thesis with a discussion. Final editing of the web page.	
Learning outcomes: Monitoring and public presentation of work done so far on thesis preparation	
Brief outline of the course: The seminar serves for control, public presentation and defense of DP results. In order to be awarded the credits, it is necessary to complete a public presentation of the work associated with the discussion, together with the final presentation of the presentation on the Internet.	
Recommended literature: According to the topic of diploma thesis.	
Course language: Slovak or English	
Notes:	
Course assessment Total number of assessed students: 199	
abs	n
100.0	0.0
Provides:	
Date of last modification: 08.01.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVa/11	Course name: Sports Activities I.
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: combined, present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 1.	
Course level: I., II., P	
Prerequisites:	
Conditions for course completion: Min. 80% of active participation in classes.	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Brief outline of the course: The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling. Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.	
Recommended literature: BENČE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345. LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902. ŠNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.	

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment

Total number of assessed students: 16384

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
85.48	0.06	0.0	0.0	0.0	0.04	9.25	5.17

Provides: Mgr. Patrik Berta, Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Melicharová, PhD., Mgr. Marcel Čurgali, PhD., Mgr. Alena Buková, PhD., univerzitná docentka, doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD., Mgr. Ferdinand Salonna, PhD., Mgr. Július Evelley, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVb/11	Course name: Sports Activities II.
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: combined, present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 2.	
Course level: I., II., P	
Prerequisites:	
Conditions for course completion: active participation in classes - min. 80%.	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Brief outline of the course: The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling. Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.	
Recommended literature: BENČE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345. LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902. ŠNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.	

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment

Total number of assessed students: 14337

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
83.67	0.47	0.01	0.0	0.0	0.04	11.47	4.32

Provides: Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Marcel Čurgali, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Melicharová, PhD., Mgr. Alena Buková, PhD., univerzitná docentka, doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD., Mgr. Ferdinand Salonna, PhD., Mgr. Július Evelley, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVc/11	Course name: Sports Activities III.
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 3.	
Course level: I., II.	
Prerequisites:	
Conditions for course completion: min. 80% of active participation in classes	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Brief outline of the course: The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling. Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.	
Recommended literature: BENČE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345. LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902. ŠNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.	

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
 VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
 Slovak language

Notes:

Course assessment

Total number of assessed students: 9620

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
87.8	0.06	0.01	0.0	0.0	0.02	5.16	6.95

Provides: Mgr. Marcel Čurgali, PhD., Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Melicharová, PhD., Mgr. Alena Buková, PhD., univerzitná docentka, doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD., Mgr. Ferdinand Salonna, PhD., Mgr. Július Evelley, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVd/11	Course name: Sports Activities IV.
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 4.	
Course level: I., II.	
Prerequisites:	
Conditions for course completion: min. 80% of active participation in classes	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Brief outline of the course: The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling. Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.	
Recommended literature: BENČE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345. LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902. ŠNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.	

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment

Total number of assessed students: 6052

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
82.19	0.26	0.03	0.0	0.0	0.0	8.67	8.84

Provides: Mgr. Marcel Čurgali, PhD., Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Melicharová, PhD., Mgr. Alena Buková, PhD., univerzitná docentka, doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD., Mgr. Ferdinand Salonna, PhD., Mgr. Július Evelley, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ NPR/19	Course name: Stochastic processes
Course type, scope and the method: Course type: Lecture / Practice Recommended course-load (hours): Per week: 3 / 2 Per study period: 42 / 28 Course method: present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisites:	
Conditions for course completion: Total evaluation based on a written test (35p) + individual project work (25p) and oral exam (40p). At least 50% must be obtained from each part. Final evaluation: $\geq 90\%$ A; $\geq 80\%$ B; $\geq 70\%$ C; $\geq 60\%$ D; $\geq 50\%$ E; $< 50\%$ FX.	
Learning outcomes: To obtain knowledge of the stationary stochastic processes analysis in time domain and spectral domain. To study properties of random processes with discrete time (time series) and continuous time and their application in finance. To obtain skills in time series analysis with software R.	
Brief outline of the course: 1.-2. Stationary process, linear process. 3. Causal and invertible process. 4. Time domain analysis (autocovariance, autocorrelation and partial autocorrelation function). 5. Sample characteristic of time series and their properties. 6.-7. Frequency domain analysis (spectral density and distribution function, periodogram). 8. Prediction of time series. 9. Random processes with continuous time (fundamental concepts). 10. Brownian motion, Itô's process, Itô's lemma and its application. 11.-12. The Black-Scholes formula.	
Recommended literature: 1. Brockwell P., Davis R.: Introduction to Time Series and Forecasting, 3rd ed., Springer, New York, 2016 2. Prášková Z.: Základy náhodných procesů II, Karolinum, Praha, 2016 (in Czech) 3. Tsay R.: Analysis of Financial Time Series, 3rd ed., Wiley Interscience, New Jersey, 2010 4. Shumway R., Stoffer D.: Time Series Analysis and Its Applications with R Examples, 5th ed., Springer, New York, 2025 5. Melicherčík I., Olšarová L., Úradníček V.: Kapitoly z finančnej matematiky, Epos, Bratislava, 2005 (in Slovak) 6. Oksendal B.K.: Stochastic Differential Equations, 6th ed., Springer, 2014	

Course language: Slovak					
Notes: The students are required to have basic knowledge about random vectors and their characteristics, conditional distribution, estimation theory and hypothesis testing.					
Course assessment Total number of assessed students: 104					
A	B	C	D	E	FX
39.42	21.15	21.15	9.62	5.77	2.88
Provides: doc. RNDr. Martina Hančová, PhD.					
Date of last modification: 10.02.2026					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ SVK2/24	Course name: Student scientific conference
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2., 4.	
Course level: II.	
Prerequisites:	
Conditions for course completion: It is required to be registered for the participation on the Student Scientific Conference (ŠVK) in accordance to the Statute of the Student Scientific Conference at PF UPJŠ and the specific conditions for participation in a given year, which are announced by the dean of the faculty. Within one year of the ŠVK, a student or a research team can register in one track only. It is also possible to apply with a written work that is an integral part of a bachelor's or master's thesis or a result of a student support program. The written work at ŠVK is the result of the student's own work or the work of the research team. It must not show elements of academic fraud and must meet the criteria of good research practice defined in the Rector's Decision no. 21/2021, which lays down the rules for assessing plagiarism at Pavol Jozef Šafárik University in Košice and its components. Fulfillment of the criteria is verified mainly in the process of supervision and in the process of work presentation. Failure to do so is reason for disciplinary action. The condition for the evaluation is a successful presentation and defense of the work in the relevant track headed by a commission appointed by the dean of the faculty. The commission decides on the eligibility of credits and states its decision in the memorandum of the ŠVK.	
Learning outcomes: The student demonstrates mastery of extended theory and professional terminology of the field of study, acquisition of knowledge, skills and competences, the ability to apply them creatively in solving selected field problems, ability to present the results using appropriate presentation methods and tools and ability to actively participate in a professional discussion.	
Brief outline of the course: 1. Analysis of the state of the art in the field. 2. Design and implementation of a solution to the researched problem. 3. Evaluation of achieved results. 4. Preparation of work annotation. 5. Processing the written work. 6. Preparation of results presentation. 7. Presentation and defense of the obtained results.	
Recommended literature:	

The recommended literature is specified individually by the student or research team in agreement with the consultant or the supervisor.					
Course language: Slovak or english					
Notes:					
Course assessment Total number of assessed students: 101					
A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0
Provides:					
Date of last modification: 24.03.2024					
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ LKSp/13	Course name: Summer Course-Rafting of TISA River
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II., P	
Prerequisites:	
Conditions for course completion: Completion: passed Condition for successful course completion: - active participation in line with the study rule of procedure and course guidelines - effective performance of all tasks: carrying a canoe, entering and exiting a canoe, righting a canoe, paddling	
Learning outcomes: Content standard: The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature. Performance standard: Upon completion of the course students are able to meet the performance standard and: - implement the acquired knowledge in different situations and practice, - implement basic skills to manipulate a canoe on a waterway, - determine the right spot for camping, - prepare a suitable material and equipment for camping.	
Brief outline of the course: Brief outline of the course: 1. Assessment of difficulty of waterways 2. Safety rules for rafting 3. Setting up a crew 4. Practical skills training using an empty canoe 5. Canoe lifting and carrying 6. Putting the canoe in the water without a shore contact 7. Getting in the canoe 8. Exiting the canoe 9. Taking the canoe out of the water 10. Steering a) The pry stroke (on fast waterways) b) The draw stroke	

11. Capsizing 12. Commands	
Recommended literature: 1. JUNGER, J. et al. Turistika a športy v prírode. Prešov: FHPV PU v Prešove. 2002. ISBN 8080680973. Internetové zdroje: 1. STEJSKAL, T. Vodná turistika. Prešov: PU v Prešove. 1999. Dostupné na: https://ulozto.sk/tamhle/UkyxQ2IYF8qh/name/Nahrane-7-5-2021-v-14-46-39#!ZGDjBGR2AQtkAzVkAzLkLJWuLwWxZ2ukBRLjnGqSomICMmOyZN==	
Course language: Slovak language	
Notes:	
Course assessment Total number of assessed students: 252	
abs	n
36.11	63.89
Provides: Mgr. Dávid Kaško, PhD.	
Date of last modification: 29.03.2022	
Approved: prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ KP/12	Course name: Survival Course
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II., P	
Prerequisites:	
Conditions for course completion: Completion: passed Condition for successful course completion: - active participation in line with the study rule of procedure and course guidelines, - effective performance of all the tasks defined in the course syllabus	
Learning outcomes: Content standard: The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature. Performance standard: Upon completion of the course students are able to meet the performance standard and should: - acquire knowledge about safe stay and movement in natural environment, - obtain theoretical knowledge and practical skills to solve extraordinary and demanding situations connected with survival and minimization of damage to health, - be able to resist and face situations related to overcoming barriers and obstacles in natural environment, - be able implement the acquired knowledge as an instructor during summer sport camps for children and youth within recreational sport.	
Brief outline of the course: Brief outline of the course: 1. Principles of conduct and safety in the movement in unfamiliar natural environment 2. Preparation and guidance of a hike tour 3. Objective and subjective danger in the mountains 4. Principles of hygiene and prevention of damage to health in extreme conditions 5. Fire building 6. Movement in the unfamiliar terrain, orientation and navigation 7. Shelters 8. Food preparation and water filtering 9. Rappelling, Tyrolian traverse 10. Transport of an injured person, first aid	

Recommended literature:

1. JUNGER, J. et al. Turistika a športy v prírode. Prešov: Fakulta humanitných a prírodných vied PU v Prešove. 2002. 267s. ISBN 80-8068-097-3.
2. PAVLÍČEK, J. Člověk v drsné přírodě. 3. vyd. Praha: Práh. 2002. ISBN 8072520598.
3. WISEMAN, J. SAS: příručka jak přežít. Praha: Svojtka & Co. 2004. 566s. ISBN 8072372807.

Course language:

Slovak language

Notes:**Course assessment**

Total number of assessed students: 489

abs	n
46.42	53.58

Provides: Mgr. Ladislav Kručanica, PhD.**Date of last modification:** 16.05.2023**Approved:** prof. RNDr. Gabriel Semanišin, PhD., prof. RNDr. Ivan Žežula, CSc.