

(1.) Course Title: INFPHD630 Neural computing (complex exam preparatory)	Credits: 6
Course Classification: Mandatory chosen	
Theoretical or Practical Nature of the Course, ' <i>training character</i> ' ¹³ : (credit%)	
Type of Class: consultation and number of hours: - in the given semester, (If the course is not (only) taught in Hungarian, then the language: English) Additional (specific) methods and characteristics² used in delivering the knowledge (if any): thematic presentations	
Assessment Method (Exam / Midterm Grade / Other³): practical course mark Additional (specific) methods⁴ applied in knowledge assessment (if any): theme elaborations	
Course Placement in Curriculum (Semester Number): -	
Prerequisites (if any): -	
Course Description: A concise yet informative description of the knowledge to be acquired.	
1. Neural network structures 1.1. Models: self-organized and supervised learning 1.2. Principles of Hebbian learning, roles of graceful degradation, forgetting, normalization 1.3. The basis of the variational principle (parametric approximation) 2. Special networks 2.1. Perceptron and its types (sigmoid, ReLU, etc.) 2.2. Autoencoder, recurrent networks 2.3. Hopfield network 2.4. Generative networks 3. Learning and training 3.1. Stacked autoencoder, denoising autoencoder 3.2. Backpropagation as a modified Hebbian learnings 3.3. Against overtraining: dropout, validation early stopping, and testing 4. Other networks 4.1. Support vector machines 4.2. Sparse representations 4.3. Convolutional neural networks, the role of convolution and pooling, connection to sparsity and to Self-Organizing Maps 5. Optimization methods 5.1. Types of cost functions 5.2. Detection, Classification 5.3. Function approximation 5.4. Clustering and low dimensional embedding	
2-5 Most Important Required and Recommended Literature List of required and recommended literature (notes, textbooks) with bibliographic data (author, title, publication details, (possibly pages), ISBN).	
Haykin, S.: Neural Networks: A Comprehensive Foundation, Prentice Hall, 1999	

Goodfellow, I, Bengio, Y, and Courville, A.: Deep Learning, MIT Press, Cambridge, MA, 2016
Murphy, K. P.: Machine Learning: A Probabilistic Perspective. MIT Press, Cambridge, MA., 2012

List of Prescribed Professional Competencies and Competency Elements

(knowledge, skills, etc., KKK Section 8) that the course significantly contributes to developing (highlight the most important ones).

a) Knowledge

- Has a research-level understanding of the general and specific characteristics, major directions, and precisely developed boundaries of the subject area within the discipline, as well as the agreed and debated interrelations.
- Creatively comprehends the interrelations, theories, and conceptual frameworks and terminologies of the given field of study.¹
- Possesses research methodology knowledge necessary for independent research in the given discipline/field.

b) Skills

- Capable of creative analysis of the field, synthesizing comprehensive and specific interrelations with a new perspective, and conducting appropriate evaluative and critical activities.
- Able to apply and further develop the specialized learning and problem-solving methods of the field.
- Can creatively elaborate on the novel, previously unknown practical implications of theoretical issues.
- Capable of planning and executing new projects, conducting research in the field, and developing new techniques and approaches.
- Able to identify unforeseen professional problems and uncover the detailed theoretical and practical background necessary for their resolution at a research level.
- Can construct and communicate new relations relevant to the field, as well as comprehensive interrelations significant for personal and communal existence.

c) Attitudes

- Represents and further develops the relations that contribute to the process of human self-creation based on the field's characteristics.
- Possesses an interest and learning ability that enable identifying and solving currently unpredictable research problems in the field.

¹**Section 108**, Article 37 of the National Curriculum Act (Nftv.) 37. lesson: a session (lecture, seminar, exercise, consultation) requiring the personal involvement of the instructor to fulfil the academic requirements specified in the curriculum, the duration of which is at least forty-five minutes and not more than sixty minutes.

² e.g. case studies, role play, thematic presentations, etc.

³ e.g. continuous debriefing, mid-year report

⁴ e.g. request for case studies, thematic papers, essays, business, organisational plans, etc.

- Demonstrates a firm professional commitment, a continuous dedication to exploring new approaches, and an acceptance of the necessity for persistent effort.

d) Autonomy and Responsibility

- Builds and initiates new knowledge areas with creative independence and proposes new practical solutions.
- Participates in formulating theoretical and practical questions with a leadership role and high-level cooperation.
- Engages as an equal discussion partner with professionals in the field.
- Takes responsibility for raising and addressing new ethical questions concerning theoretical and practical aspects of the profession.

Course responsible (name, position, academic degree): **János Botzheim, Ph.D., Associate Professor**

Instructor(s) involved in teaching the course (if any) (name, position, academic degree):

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