Course Unit Descriptor

**Study Programme:** Applied Mathematics – Data Science

**Course Unit Title:** Pattern recognition and machine learning

**Course Unit Code: MDS06**

**Name of Lecturer(s):** Dušan Jakovetić, Miloš Radovanović

**Type and Level of Studies:** Master studies

**Course Status (compulsory/elective):** Compulsory

**Semester (winter/summer):** Summer

**Language of instruction:** English

**Mode of course unit delivery (face-to-face/distance learning):** Face-to-face

**Number of ECTS Allocated: 6**

**Prerequisites:** Basics of linear algebra and probability

**Course Aims:**

- Understanding of a wide range of pattern recognition/machine learning methods
- Understanding of advantages/disadvantages of the taught methods
- Ability to select appropriate methods for the problem at hand
- Ability to implement the taught methods in MATLAB

**Learning Outcomes:**

- Ability and experience in applying the taught methods on real-world problems
- Ability to apply the taught methods on research problems from a wide variety of application areas

**Syllabus:**

*Theory*

Statistical Pattern Recognition: Bayesian Decision Theory, Quadratic Classifiers, Parameter and Density Estimation, Nearest Neighbors; Neural network approaches: Linear Discriminants, Multilayer Perceptrons, Radial Basis Functions, Validation; Clustering: Mixture models and EM algorithm, Statistical Clustering, Self-Organizing Maps; Dimensionality Reduction: Principal Components Analysis, Fisher's Discriminants Analysis, Feature Subset Selection; Advanced topics: Support Vector Machines, Hidden Markov Models, Ensemble Learning, Evolutionary algorithms.

*Practice*

Application examples in electric grid (smart grid), computer vision, medical imaging, speech recognition, agriculture, etc.; Implementation of the taught methods in MATLAB; Application of selected methods on real-world examples through the course project.

**Required Reading:**

C. Bishop: Pattern recognition and machine learning, Springer, 2006

T. Hastie, R. Tibshirani and J. Friedman: Elements of Statistical Learning. Springer, 2009

R.O. Duda, P.E. Hart and D.G. Stork: Pattern Classification, Wiley, 2000.

S. Theodoridis, K. Koutroumbas: Pattern Recognition, Academic Press, 2008.

| **Weekly Contact Hours:** | **Lectures: 2** | **Practical work: 3** |
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**Teaching Methods:** Lectures; revisions of the material; active students' participation in problem solving; knowledge tests – colloquia; application of the taught material on real-world examples.

**Knowledge Assessment (maximum of 100 points): 100**

| **Pre-exam obligations** | points | **Final exam** | points |
|---|---|---|---|
| Active class participation | | written exam | 40 |
| Practical work | 30 | oral exam | |
| Preliminary exam(s) | 30 | Course project | |
| Seminar(s) | | | |

The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.