# Course title: SELECTED CHAPTERS IN BIOMETRICS

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| Lecturers | Full Prof. Miroslav Bača, Ph.D., Asst.Prof. Petra Grd, Ph.D. |
| Language of instruction | English |
| Schedule | 60 teaching hours<br>- 4 hours per week (2 hours lectures + 2 hours laboratory exercises) |
| Level | Bachelor |
| Study programme | Information / Business Systems |
| ECTS | 4 |
| Goal | Main goal of the course is adoption of basic informatic knowledge and skills necessary for work with biometric characteristics, implementation and construction of biometric security systems, especially in everyday network environment. The students learn basic biometric characteristics, gathering methods, processing, storing and comparing biometric characteristics, and their use in comprehensive security systems. The students are also introduced to most recent achievements in the field of biometry development. The course is structured in a way that enables total overview of most important characteristics. Today, it is impossible to imagine any business activity without computer network. Development of computer networks is limited by development and connection within the Internet; this is prerequisite for development of one aspect of this course, i.e. implementation of biometric characteristics in computer network security. The fact is that most of today's companies are inadequately informed about biometric systems and their advantages. Education about these topics will increase the knowledge level, and general consciousness about biometry. The course is oriented toward the final user in network environment, and is divided into lectures, seminars and exercises. |
| Content | 1. Introduction to biometry (2 hours)<br>General description of biometry and its presence in everyday life. Definition of biometry and basic divisions. Methods of identification through development of information technology. Review of most often used biometric characteristics. View into biometric future.<br><br>2. Legal regulations (2 hours)<br>Basic and special legal regulative of production and use of biometric devices. Basic and special legal regulative of use of biometric characteristics. Legal solutions worldwide. Religious, ideological, cultural and philosophical |

limitations. Psychological and physical limitations in use of biometry. Acceptability of biometry in everyday applications.

### 3. Basics of sample recognition (2 hours)

Notion and description of sample. Biometric sample. Architecture of general biometric system. Gathering and pre-processing of biometric samples. Processing of biometric samples. Classification and comparison of biometric sample. Recognition and identification.

### 4. Differences between physical and behavioral biometric characteristics (2 hours)

Basic description of physical characteristics. Specific features and limitations of physical characteristics. Basic description of psychological characteristics. Specific features and limitations of psychological characteristics. Historical development of psychological and physical characteristics. Applicability of physical biometric characteristics. Applicability of behavioral biometric characteristics.

### 5. Methods and tools for sample gathering (2 hours)

Systems for gathering of pictorial samples. Basic mathematical methods and tools for working with pictorial samples. Systems for gathering non-pictorial samples. Basic mathematical methods and tools for working with non-pictorial samples. Applicability of particular systems. Differences in quality and approach. Systems for image conversion. Two-dimensional and multi-dimensional displays.

### 6. Usual contact biometric characteristics (2 hours)

Systems for verification and identification of fingerprint images. Systems for pre-processing, processing and recognizing a fingerprint image. Basic elements of system for palm geometry. Conditions and methods of using palm geometry as biometric sample. Evaluation of signing, biometric characteristics. Basic concept of signature and its biometric characteristics. Algorithm for signature comparison.

### 7. Specific non-contact biometric characteristics (2 hours)

Biological diversity of genotype and fenotype of iris. Iris pattern as biometric characteristic. Iris-based identification. Technology using retina as basic biometric characteristics. Basic elements of system for extracting retina characteristics. Basic limitations of retina as a biometric characteristic. Specific

ear features. Development of biometric model based on ear and its basic characteristics. DNA forensics. Methods of extracting and comparing DNA. Basic limitations.

### 8. Usual non-contact biometric characteristics (2 hours)

Psychological ability for recognition of faces. Methods of extracting characteristics. Various methods for taking face images. Systems of pre-processing and processing of face images. Systems for analysis and comparison. Methods of face description. Systems of detection and identification. Talk and voice processing in context of biometric characteristics. Extraction and selection of characteristics. Systems of classification and comparison of biometric voice characteristics.

### 9. Specific non-contact biometric characteristics (2 hours)

Principles of thermogramic identification. Differences between face and body thermogram. Comparison of thermogramic samples. Systems and classification, and identification of thermogramic samples. Basic elements of biometric systems based upon dynamics of typing. Characteristics and systems of classification and identification of typing dynamics. Model of system of walk recognition. Basics characteristics of biometric system based upon walk. Scent as the specific feature of human body. Basic elements of scent-based biometric system. Ability to differentiate scent and system feasibility.

### 10. New biometric characteristics and their development (2 hours)

Determining uniqueness and recognizability of physical and behavioral characteristics of a person. Realization of new knowledge about biometric characteristics. Development of new biometric characteristics and their implementation and applicability. Tongue print.

### 11. Multimodal biometry (2 hours)

Characteristics of general multimodal biometric system. Definition of resources required for construction of security biometric system. Methods of matching characteristics. Models of comparison of matching characteristics. Applicability of specific multimodal biometric systems.

### 12. Technical characteristics and protocols of examination (2 hours)

Technical characteristics of general biometric system. Technical characteristics of multimodal biometric system. Examination of biometric system by measuring correct identification. Examination of biometric system by

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| | measuring incorrect identification. Examination protocols. Prices and technical characteristics of better known devices and systems.<br><br>**13.    Reliability of biometric systems (2 hours)**<br><br>Reliability of biometric systems through various purposes. Possibilities of cheating the biometric readers. Manipulating biometric security systems. Manipulating in construction of biometric security systems and construction errors.<br><br>**14.    Connecting hardware support with biometric characteristics (2 hours)**<br><br>Construction of biometrical smart card. Basic system elements. Systems of verification and authentication. Implementation of biometric characteristics in professional and specific hardware support. Implementation of biometric characteristics in hardware support of general purpose.<br><br>**15.    Final considerations (2 hours)**<br><br>Biometric characteristics in context of construction of security system. Development and technical and technological improvement of biometric characteristics and devices. Analysis of investition in biometric industry. New methods and aspects of implementation of biometric characteristics. |
| Exercises | **Type of exercise: auditory + practical work**<br><br>Practical work is based on work with biometric tools and analysis and development of biometric systems on PCs in network environment and elaborated into operations with multimodal biometric systems and their implementation in existing security systems. After the exercises, every student needs to implement some biometric characteristics into the system. |
| Preconditions | |
| Realization and exam | Classes: Lectures, seminars and exercises<br>Exam: Written and oral exam |
| Related courses | 1.    University of Glasgow, (Department of Statistics) http://www.stats.gla.ac.uk/undergrad/biometrics<br><br>2.    Florida Atlantic University http://www.cse.fau.edu<br><br>3.    University of Notre Dame (Computer Science and Engineering) http://www.cse.nd.edu<br><br>4.    University of Nevada (Computer Science Department) http://www.cs.unr.edu |

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| | 5.    West Virginia University (Lane Department of Computer Science and Electrical Engineering) http://www.lcsee.cemr.wvu.edu/biometrics |
| Literature | **Basic:**<br><br>1.    Lecture materials available on: http://www.foi.hr/studiji/dodiplomski/IS/kolegiji/otb<br><br>2.    Jain, A., Bolle, R., Pankanti, S. ed, Biometrics, Kluwer Academic Publishers, 1999.<br><br>**Additional:**<br><br>1.    Ashbourn, J., Biometrics: Advanced Identify Verification: The Complete Guide, Springer- Verlag, 2000.<br><br>2.    Bolle, R., Connell, J., Pankanti, S., Ratha, N., Senior, A., Guide to Biometrics (Springer Professional Computing), Springer-Verlag, 2003.<br><br>3.    Castleman, K. R., Digital Image Processing, Prentice Hall<br><br>4.    Reid, P. Biometrics and Network Security, Prentice Hall PRT, Upper Saddle River, New Jersey, 2004<br><br>5.    Woodward, J., Orlans, N.M., Higgins, P.T., Biometircs, McGraw-Hill Osborne, 2000.<br><br>**Unit 1.**<br><br>1.    Gonzales, R.C., Woods, R.E., (1992.): Digital Image Processing, Adison-Wesley Publishing Company<br><br>2.    Nanavati, S., Thieme, M., Nanavati, R., Biometrics: Identity Verification in a Networked World, Wiley, 2002.<br><br>**Unit 2.**<br><br>1.    Bača M., Uvod u računalnu sigurnost, Narodne novine, 2004.<br><br>2.    Dragičević, D., Kompjuterski kriminal i informacijski sustavi, Informator, 1999.<br><br>**Unit 3.**<br><br>1.    Nanavati, S., Thieme, M., Nanavati, R., Biometrics: Identity Verification in a Networked World, Wiley, 2002.<br><br>**Unit 4.**<br><br>1.    Nanavati, S., Thieme, M., Nanavati, R., Biometrics: Identity Verification in a Networked World, Wiley, 2002.<br><br>2.    Chirillo, J., Blaul, S., Implementing Biometric Security, Wiley, 2003.<br><br>**Unit 5.** |

1. Andrews, H.C., Computer Techniques in Image Processing, Academic Press, 1970.

Unit 6.

1. Maltoni, D., Jain, A.K., Prabhakar, S., Handbook of Fingerprint Recognition, Springer-Verlag, 2003.

Unit 7.

1. Chirillo, J., Blaul, S., Implementing Biometric Security, Wiley, 2003.

Unit 8.

1. Jain, L.C., Halici, U., Hayashi, I., Lee, S.B., Tsutsui, S., Intelligent Biometric Techniques in Fingerprint and Face Recognition, CRC Press, 1999.

Unit 9.

1. Jain, L.C., Halici, U., Hayashi, I., Lee, S.B., Tsutsui, S., Intelligent Biometric Techniques in Fingerprint and Face Recognition, CRC Press, 1999.

2. Zhang, D., Automated Biometrics: Technologies and Systems (Kluwer International Series on Asian Studies in Computer and), Kluwer Academic Publishers, 2000.

Unit 10.

1. Jain, L.C., Halici, U., Hayashi, I., Lee, S.B., Tsutsui, S., Intelligent Biometric Techniques in Fingerprint and Face Recognition, CRC Press, 1999

Unit 11.

1. Pejas, J., Poegat, A., Enhanced Methods In Computer Security, Biometric And Artificial Intelligence Systems, Springer-Verlag, 2004.

2. Zhang, D., Automated Biometrics: Technologies and Systems (Kluwer International Series on Asian Studies in Computer and), Kluwer Academic Publishers, 2000.

Unit 12.

1. Zhang, D., Automated Biometrics: Technologies and Systems (Kluwer International Series on Asian Studies in Computer and), Kluwer Academic Publishers, 2000.

Unit 13.

1. Chirillo, J., Blaul, S., Implementing Biometric Security, Wiley, 2003.

Unit 14.

1. Chirillo, J., Blaul, S., Implementing Biometric Security, Wiley, 2003.

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| | 2.      Smith, R.E., Autentication: From Password to Public Keys, Addison-Wesley Professional, 2001. |
| | **Unit 15.** |
| | 1.      Nanavati, S., Thieme, M., Nanavati, R., Biometrics: Identity Verification in a Networked World, Wiley, 2002. |