

**Courses in English language at the Department of Informatics, University of Rijeka  
(2018/2019)**

**UNDERGRADUATE STUDY PROGRAMME IN INFORMATICS**

**Programming 1 (6 ECTS; 2+2) - winter term**

Historical survey of programming languages. Procedural and object-oriented languages. General or multipurpose languages. Special-purpose languages. The software development process. Developing programs interactively. Concepts of imperative, structured programming. The notion of the algorithm. Syntax and semantics of C++. Types, values and declarations: Names. Declarations. Type definitions. Numeric data types. Logical types. Character types. Enumeration types. Expressions and statements: Expressions. Statements. Sequencing and control. Iterative statements. Program structure: Procedural architecture. Alternative program architectures. Simple algorithms for search and sort. Parameters. Functions. Structured data: Arrays. Records. Strings. Files.

**Programming 2 (5 ECTS; 2+2) - summer term**

Advanced programming techniques: separate compilation, interface/implementation design and coding, dynamic memory allocation, pointer manipulation, and recursion. Standard library. Preprocessor. Relationship between the operating system and the executing program. Run-time support provided by the operating system to the program. Components of typical program development environments: shells, editors, preprocessors, compilers, linkers and program/project managers. Development of a coherent style of programming.

**Computer Networks 1 (5 ECTS; 2+2) - winter term**

Computer networks: basic structures, principles of functioning, and forms of use. The extents of networks and the technologies of data transmission. Layers and protocols of the network systems. Referential models: the OSI and the Internet model. Network standards. The physical layer of the network. Elements of the physical layer and data transmission media. Terrestrial transmission systems, systems of wireless transmission, and mobile communications. Throughput, latency, resource sharing. Elements of the data link layer. Reliability of transmission: detecting and correcting errors. Control of the intensity of flow. Local area networks (LANs): Ethernet and Token ring; extended LANs; FDDI network. Elements of the network layer. Virtual circuits switching and packets switching. Methods of routing, forwarding, and congestion control. Interconnecting different networks. The network layer of the Internet. IP protocol and packet. The address space of the Internet. The transport layer. End-to-end protocols. Controlling the intensity of data flow; methods of preventing congestion. Sharing resources and securing a quality of connections. Transport layer of the Internet (UDP, TCP protocols). Real-time communications.

## **Computer Networks 2 (5 ECTS; 2+2) - summer term**

Digital recording of the information contents: principles and methods. Basic formats and protocols: GIF, JPEG, MPEG, MP3. Compressing the digital records, with and without the loss of the information contents: principles and the ways of use. Compression and transmission: on-line transmission (video-conferencing). ITU-T network standards (H-series). Security and protection. Protecting the secrecy of contents, protecting the integrity of messages, establishing the identity of communicators: principles, protocols (algorithms) and methods of work. Protocols DES, RSA, MR5. Systems PEM, PGP, TLS. "Reliable third side"; firewall, proxy, filters. The application layer. The Internet applications (services) and their protocols. Domain name system (DNS), electronic mail system (SMTP), web page system (HTTP), multimedial and interactive applications (VIP, VIC). Controlling the functioning of a compound computer network. Administration and optimization; a system for managing of the functioning of computer network (SNMP).

## **Algorithms and Data Structures (5 ECTS; 2+2) - summer term**

Principles of algorithm analysis. Introduction to trees. Ordered binary trees. Heaps. AVL trees. Red-black trees. Graphs. Greedy algorithms. Minimum spanning tree. Paths in graphs. Shortest path algorithms.

## **GRADUATE STUDY PROGRAMME IN INFORMATICS**

### **Natural Language Processing (5 ECTS; 2+2) – summer term**

Introduction. What is NLP? Computational linguistics and language technologies. Language resources, corpora, lexicons and dictionaries. Probabilistic models of pronunciation and spelling. N-grams. Perplexity. Syntax models. Morphological analyser. Part of speech tagging. Parsing with Context-free grammars. Semantic analysis. Representing meaning. Lexical semantics. Pragmatics. Discourse. Dialogue and conversational agents. Natural language generation. Language identification. Computer aided translation. Machine translation. Information Retrieval.

### **Decision Support Systems (5 ECTS; 2+2) – summer term**

Decision making process. Individual and group decision making. Elements of decision support systems architecture. Developing decision support systems. Methods and tools for DSS development. Analytical information system. Difference between analytical and transactional information systems. A reason for development of analytical IS. Data warehouse. The spiral methodology of data warehouse development. Dimensional modelling. Multidimensional analytical processing. Data visualisation Knowledge discovery. Output knowledge representation. Connection with knowledge management systems.

### **Knowledge Management (6 ECTS; 2+2) – winter term**

Introduction. The knowledge representation and the knowledge management. Types of Knowledge: Factual Knowledge, Subjective Knowledge and Heuristic Knowledge. Deep and Shallow Knowledge. The knowledge base. Knowledge Processing: Knowledge Acquisition, Representation and Manipulation. Knowledge Representation Formalism: Rules, Frames, Semantic Networks, Blackboard Representations, Object-based Representations, Case-Based Reasoning. Knowledge Representation Tools. Knowledge organization: anthologies and taxonomies. Knowledge exchange: Capture, Transfer, and Distribution. Semantic web. Knowledge discovery, knowledge navigation and exchange of knowledge formalism: blogs, forum, intranets. Knowledge visualization techniques. The effective use of knowledge in business systems. User Interaction. Constrained Access: Technological Limits and User Limitations. Ethical and Social Dimensions of Knowledge. Impact of Knowledge Access. Knowledge assessment methods and intellectual property rights.

### **Intelligent Systems 2 (6 ECTS; 2+2) – summer term**

Production system model: components, functions. Models of reasoning: rule-based, model-based, case-based. Expert systems: development process, roles of participants, process of knowledge acquisition, components, problems amenable to expert system solution, use of expert system shells. Uncertainty: necessity for mechanisms to deal with uncertainty, confidence measures, statistical methods, belief measures, fuzzy logic, nonmonotonic logic. Planning. Automated reasoning and theorem proving. Learning: Symbolic algorithms: decision-tree, version space, clustering; Connectionist algorithms: characteristics of neural networks, overview of learning algorithms; Genetic algorithms.

### **Knowledge Discovery and Data Mining (6 ECTS; 2+2) – winter term**

Introduction. Data preprocessing. Classification and prediction. Classification by decision tree induction. Bayesian classification. Classification by backpropagation. Rule-based classification. kNN classifier. Evaluating the accuracy of a classifier or predictor. Methods fusion—increasing the accuracy. Midterm exam. Clustering methods. Partitioning methods. Hierarchical clustering. Conceptual clustering. Density-based methods. Cluster evaluation. Mining frequent patterns, associations, and correlations. The Apriori algorithm. Constraint-based association mining. Project presentation and demonstration. Final exam.

### **Network Systems Management (6 ECTS; 2+2) – winter term**

Network documentation and planning. Network layer protocols in practice (IP, TCP, DHCP, ARP). Directory services (LDAP, AD, DNS, WINS). Network firewalls and intermediary servers: firewalls and TCP/IP, packets filtering, proxy servers, network passages at the circuit level, SPI network barriers. Data storing on the network. NAS devices, networks of NAS devices. Backup data copies on the network: data restoring from the network, techniques of producing copies; logs, applications for the creation of security copies on the network. Basics of the web server administration: installing web sites, virtual hosts, access authorizations, web server security.

## **POSTGRADUATE STUDY PROGRAMME IN INFORMATICS**

### **Business Intelligence (6 ECTS; 1+0)**

Introduction and overview of business intelligence. Principles of competitive intelligence. Operational, tactical, and strategic needs of the organization. Decision-making needs of the organization. Success and failure of warehousing and BI. Problems and issues to be addressed on data warehouse and BI projects. BI architecture. Data Warehousing, Data marts. Front end tools. OLAP, ROLAP, HOLAP, DM. Extraction. Transformation. Load. Integration platforms or warehouse appliances. Back-end tools. The importance of metadata. The quality of data. Implications of legislation on warehousing and business intelligence practices Managing unstructured data in BI. Active data warehousing: Closed-loop processes active warehousing techniques. The importance of data visualization. Using warehousing/BI to measure business performance. BI styles customer relationship management, business performance management and real-time/tactical decision making. Emerging trends in the data warehousing/BI industry: mobile BI, the power of social network for BI.

### **Information Retrieval and Text Mining (6 ECTS; 1+0)**

Text information retrieval systems; efficient text indexing; Indexing, terms and doc processing. Robust term processing. Web search overview, web structure, the user, paid placement, search engine optimization/spam. Web size measurement. Crawling and web indexes. Near-duplicate detection. Index construction Boolean, vector space model. Hierarchical clustering. Probabilistic retrieval models; ranking and rank aggregation; evaluating IR systems. Text clustering and classification methods: Text classification. Naive Bayes models. Spam filtering. Nearest Neighbours, Decision boundaries, Vector space classification using centroids. Comparative results. Text clustering. Partitioning methods: k-means clustering; Latent semantic indexing (LSI). Applications to clustering and Support vector machine classifiers. Kernel Function. Evaluation of classification. Micro- and macro-averaging. Learning rankings. Taxonomy induction, cluster labelling; classification algorithms and their evaluation, text filtering and routing. Information Extraction. Text Understanding. Question Answering. Link analysis. Sentiment Analysis.