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| 1. Course title: Computer Networking | | | | | |
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| 2. Code: | | 3. Type (lecture, practice etc.): lecture | | | |
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| 4. Contact hours: 4 hoursper week | | 5. Number of credits (ECTS): 5 | | | |
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| 6. Preliminary conditions (max. 3): | | | | | |
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| 7. Announced:fall semester, spring semester, both | | | | | |
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| 8. Limit for participants: | | | | | |
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| 10. Responsible teacher (faculty, institute and department):  Viktor Rébay (Faculty of Science, Institute of Mathematics and Informatics, Department of Informatics) | | | | | |
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| 11. Teacher(s) and percentage: | | Viktor RÉBAY | | 100% | |
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| 12. Language:English | | | | | |
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| 13. Course objectives and/or learning outcomes:  The lecture intends to introduce students to the basics of computer networks. Students completing the course will have knowledge on the layer concept, the roles and devices of the OSI and TCP/IP layers, and the main standards. They will be able to understand the basic operation of computer networks and Internet, and comprehend the most important Internet services. | | | | | |
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| 14. Course outline   1. Basic information, concepts. Historical overview of evolution of the computer networks, history of the Internet. Classification of computer networks by size and topology. SAN, NAS, VPN. Bandwidth, maximal and typical data speed. Network connections and contact types. Choosing the network interface. The direction of information traversal. Modulation and multiplexing. 2. Layer conception, OSI, TCP/IP and hybrid models. The goal of the network architectures. Layer conception, requirements towards the layers. Services, service primitives. The OSI model and its layers. The TCP/IP model, the hybrid reference model and their layers. Evaluation of the OSI and the TCP/IP model. Comparison of the models. 3. Wired and wireless networks. Types of cables, characteristics, and ways of mounting. Shielded and unshielded twisted pair cable. Construction of the CAT cables, types, usage, features. Construction and work of optical cables. IrDA. The Bluetooth standard. Bluetooth packets, transfer modes, frequencies, power. WLAN standards. The features of the 802.11a/b/g/n standards, frequency assignment. WLAN hardware, topologies, and working modes. The physical layer and devices. The role of the physical layer and possible transmission media. The repeater, HUB and media converters. The features and parameters of synchronous and asynchronous transmission. Data and controlling information transmission. 4. The role and task of the data link layer. Framing. Frame delimiting: creation and recognition of frame boundaries. Frame error checking. One bit and bit group errors. Error correction with Hamming code. The CRC error correction, calculation of the CRC checksum. Multiple channel access protocol. ALOHA and slotted ALOHA. Persistent and non-persistent CSMA. CSMA with collision detection. Ethernet frame formats. DIX and 802.3 frames. Ethernet collision handling, speed and performance. Extending network segments, increased impact treatment ranges. Switching Ethernet networks. Group messaging, message broadcasting, broadcast domains. The Fast Ethernet and its media. Gigabit Ethernet and operating modes. The IEEE 802.3z transmission medium. 5. Routing. The main tasks of the network layer. Connectionless and connection-oriented services at the network layer. Adaptive and non-adaptive routing algorithms. The shortest path algorithm. Traffic control by flooding. Distance vector routing. The routing loops and counting to infinity problem, some possible solution. The link-state routing. Routers structure, functions of the components. Configuration, system startup. 6. Congestion protection at the network layer. The role and basics of protection against congestion. Congestion in datagram based and virtual circuit networks. Methods of removing load. Jitter handling. Means of providing QoS in the network layer. Quality characteristic of services, requirements and needs. Comparison of key applications in terms of QoS needs. Some method of ensuring service quality. Over-provisioning, buffering, traffic shaping. The leaky- and token bucket algorithms. Resource reservation and access control. Proportional routing, packet scheduling. 7. The Internet network layer. Structure of the IP packets, analysis of IP header components. Possible options and functions of the IP header. IP addresses and IP address classes. The reserved address ranges and their role in the network. Special IP addresses. The role of the subnets and creating subnets in practice. CIDR and its operation by an example. Function of Network Address Translation (NAT), arguments for and against. Control protocols of the Internet: ICMP, ARP, RARP, DHCP. IPv6. The structure of the IPv6 header, functions of its components. Structure of the IPv6 addresses. IPv6 header options. 8. The transport layer and the TCP. The main tasks of the transport layer. The structure of the UDP segment. UDP characteristics and main fields of application. Features and functions of TCP. TCP ports. TCP protocol functions. Alternatives and problems of sequencing and acknowledgment. Analysis of the TCP header fields. Connection and disconnection in TCP. Buffering possibilities, problems and solutions. Delaying of acknowledgments and the silly window syndrome. Congestion in TCP, protection of congestion on the Internet. Wireless networks and TCP. 9. Identification of Internet resources. History of DNS, other forms of identification. Operation of DNS. Structure and components of DNS namespace. Domain names and name servers. Delegation. Function of address resolution, resolution strategies. Registration of resources, DNS records, record types. The root level. Top level domains. Registering domain names. 10. Structure, functions, services of e-mail systems. User agents. Email message formats. RFC 822, RFC 821. MIME message format and MIME header fields. Encoding of MIME messages. Transmission and delivery of e-mail messages. SMTP, POP3 and IMAP. Origin of SPAMs, history and types. SPAM efficiency, appearance today. Protection of e-mail addresses. E-mail address "purchase" and the usage for SPAM messages. The legal regulation of unsolicited messages. SPAM filtering on servers and on the user's machine. The means of protection of the network. The new ways of Internet communication, Instant Messaging and other services. 11. Development of the World Wide Web, the server and the client side operations, communication. Increase of the service effectiveness. Server farm and their problems. The concept and structure of the URL. Role of cookies, structure and use. Possibilities of use and misuse (attack). Alternative solutions. HTTP operation. HTTP requests and responses, header fields. The purpose and possibilities of HTTP proxy servers. Proxy strategies. 12. Encoding of human voice and other analog signals, transmission in digital form. A/D and D/A conversion. Sampling, Fourier transform. Audio compression, audio streaming on the Internet. Streaming audio. Playing live and stored streams from the Internet. Responsibility of a media player. QoS. VoIP communication. Tools, protocols and operation of H.323. SIP and RTP. Comparison of SIP and H.323, areas of use. Quality Service for VoIP transmission. 13. Content sharing, social networks, the newest information and communication technologies in society. Internet shopping. Online stores and auction sites. The purchase process, payment and delivery options, feedback. Buying within the borders of the European Union and outside of these borders. Typical opportunities for abuse, means of protection. | | | | | |
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| 15. Mid-semester works | | | | | |
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| 16. Course requirements and grading Final exam. | | | | | |
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| 17. List of readings   1. Andrew S. Tanenbaum, David J. Wetherall: Computer Networks (5th Edition). Pearson, 2010. ISBN: 9780132126953 | | | | | |
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| 18. Recommended texts, further readings   1. James F. Kurose, Keith W. Ross: Computer Networking: A Top-Down Approach (7th Edition). Pearson, 2016. ISBN: 9780133594140 | | | | | |
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| **Date** | 10 May, 2017 | **Prepared by** |  | | |
| Viktor RÉBAY  responsible teacher | | |
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| **Endorsed by** | | |  | | |
| program supervisor | | |