

SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Computer Science
1.4 Field of study	Computer Science
1.5 Study cycle	Master
1.6 Study programme / Qualification	Cloud and network infrastructure with high-performance computing

2. Information regarding the discipline

2.1 Name of the discipline (en)			Multimedia communications in IP networks				
(ro)			Comunicatii multimedia in retele IP				
2.2 Course coordinator			Assoc.prof. phd. Sterca Adrian				
2.3 Seminar coordinator			Assoc.prof. phd. Sterca Adrian				
2.4. Year of study	2	2.5 Semester	3	2.6. Type of evaluation	E	2.7 Type of discipline	Mandatory
2.8 Code of the discipline		MME8251					

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	1sem +1pr
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					40
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					50
Tutorship					20
Evaluations					4
Other activities:					0
3.7 Total individual study hours	144				
3.8 Total hours per semester	200				
3.9 Number of ECTS credits	8				

4. Prerequisites (if necessary)

4.1. curriculum	Computer Networks, Distributed Operating Systems, Databases, Data Structures and Algorithms, Object Oriented, Programming
4.2. competencies	Strong knowledge in computer networks, very good knowledge on data structures and algorithms, programming languages, object-oriented programming.

5. Conditions (if necessary)

5.1. for the course	• Class room with a video projector device
5.2. for the seminar /lab activities	•

6. Specific competencies acquired

Professional competencies	Basic understanding of how today's video streaming over the internet works Principles of state-of-the-art and modern video codecs, adaptive videostreaming
Transversal competencies	Applying rules for an organized and efficient work, responsible attitude towards the didactic-scientific field for creative capitalization of one's own potential, complying to the principles and professional ethics norms. Utilizing efficient methods and techniques for learning, knowing, research and development of knowledge capitalization capacities, adapting to the requirements of a dynamic society and the communication in Romanian or an international language.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Getting the student acquainted with concepts and technologies used in multimedia processing and audio-video communication in digital networks and most importantly in digital "best-effort" networks based on IP (e.g. the Internet). The course is meant to be on an intermediate-to-advanced level in the field of multimedia
7.2 Specific objective of the discipline	• Understanding audio-video codecs and digital audio-video formats, audio-video streaming fundamentals in the Internet (signaling and streaming protocols, rate/congestion control) • Understanding how adaptive video streaming works over IP networks, including HTTP streaming and RTP streaming

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction to multimedia. Analog representation of audio and video signals. Digital representation of audio and video signals. The JPEG compression standard.	Exposure:description, explanation, examples, discussion of case studies	
2. Audio-video formats (containers) and codecs. Basics of video encoding. The structure of a general video encoder/decoder. AV encoding standards. AV containers: .avi, .ogg, .mp4, .vob, .3gp, .mkv etc.	Exposure:description, explanation, examples, discussion of case studies	
3. Video standards. The MPEG family: MPEG-1, MPEG-2, MPEG-4.	Exposure:description, explanation, examples, discussion of case studies	
4. Video standards ITU.T/MPEG. The H.264/MPEG-	Exposure:description,	

4 AVC standard.	explanation, examples,discussion of case studies	
5. Video standards. The H.265/MPEG-H part 2 (HEVC) standard.	Exposure:description, explanation, examples,discussion of case studies	
6. Video standards. The H.266 / MPEG-I Part 3 (VVC) standard	Exposure:description, explanation, examples,discussion of case studies	
7. Video standards. The AOMedia Video 1 (AV1) standard.	Exposure:description, explanation, examples,discussion of case studies	
8. Real-time streaming protocols. RTP and RTCP. Multimedia signaling protocols. RTSP, SDP, SIP. Media streaming over RTP.	Exposure:description, explanation, examples,discussion of case studies	
9. Adaptive media streaming over HTTP/2	Exposure:description, explanation, examples,discussion of case studies	
10. Adaptive media streaming over HTTP/3 (QUIC).	Exposure:description, explanation, examples,discussion of case studies	
11. MPEG DASH	Exposure:description, explanation, examples,discussion of case studies	
12. The FFMPEG library	Exposure:description, explanation, examples,discussion of case studies	
13. Congestion control algorithms for audio-video applications in best-effort networks. TCP AIMD, DCCP, TFRC, MulTFRC and UTFRC	Exposure:description, explanation, examples,discussion of case studies	
14. Congestion control algorithms for audio-video applications in best-effort networks: Scream, GCC, Nada.	Exposure:description, explanation, examples,discussion of case studies	

Bibliography

- 1.Al Bovik, The Essential Guide to Video Processing, Academic Press, Elsevier, 2009.
- 2.L. Hanzo, P. Cherriman, J. Streit, Video Compression and Communications. From Basics to H.261, H.263, H.264, MPEG4 for DVB and HSDPA-Style Adaptive Turbo-Transceivers, Wiley & IEEE Press, 2007.
- 3.A. Sterca, Congestion Control for Streaming Protocols, PhD Thesis, 2008.
- 4.Iain Richardson, Video Codec Design, Wiley, 2002.
- 5.Iain Richardson, H.264 and MPEG-4 Video Compression, Wiley, 2003.
- 6.Colin Perkins, RTP - Audio and Video for the Internet, Addison-Wesley, 2003.
- 7.Tokunbo Ogunfunmi, Madihally Narasimha, Principles of Speech Coding, CRC Press, 2010
- 8.Frank Y. Shih, Image Processing and Pattern Recognition: Fundamentals and Techniques, Wiley-IEEE Press, 2010.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Project presentations.	Dialogue, debate, case studies, examples	The seminar is scheduled once in two weeks
2. Project presentations.	Dialogue, debate, case studies, examples	
3. Project presentations.	Dialogue, debate, case studies, examples	
4. Project presentations.	Dialogue, debate, case studies, examples	
5. Project presentations.	Dialogue, debate, case studies, examples	
6. Project presentations.	Dialogue, debate, case studies, examples	
7. Project presentations.	Dialogue, case studies	
Bibliography Recent articles from ACM Digital Library and IEEE Xplore		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

• The course respects the IEEE and ACM Curricula Recommendations for Computer Science studies; • The course exists in the studying programs of all major universities in Romania and abroad; • The content of the course is considered by software companies as important for average programming skills
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10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowing the theoretical issues discussed during the course. Being able to design and understand a multimedia streaming system.	Written Examination	50%
10.5 Seminar/lab activities	Applying the knowledge received from the course, the ability to implement a multimedia system	Project	50%
10.6 Minimum performance standards			

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| <ul style="list-style-type: none">➤ In order to successfully pass this class, students must get at least 5 to both the project presentation and to the written exam.➤ The course requirements are described at: http://www.cs.ubbcluj.ro/~forest/mcoip |
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Date

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Signature of course coordinator

Assoc.prof.PhD. Adrian Sterca

Signature of seminar coordinator

Assoc.prof.PhD. Adrian Sterca

Date of approval

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Signature of the head of department

Assoc.prof.PhD. Adrian Sterca