SYLLABUS

${\bf 1.}\ Information\ regarding\ the\ programme$

1.1 Higher education	Babeş-Bolyai University
institution	
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	Bachelor
1.6 Study programme /	Computer Science
Qualification	

2. Information regarding the discipline

2.1 Name of the di	sciplin	e (en)	Audio-video Data Processing					
(ro)								
2.2 Course coordinator			Lec	Lect. PhD. Sterca Adrian				
2.3 Seminar coordinator			Lect. PhD. Sterca Adrian					
2.4. Year of study	3	2.5 Semester	5	2.6. Type of	C	2.7 Type of	Optional	
			evaluation discipline					
2.8 Code of the MLE8117								
discipline								

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

3.1 Hours per week	4	Of which: 3.2 course	2	3.3	11ab
				seminar/laboratory	+1pr
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6	28
				seminar/laboratory	
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					6
Additional documentation (in libraries, on electronic platforms, field documentation)					6
Preparation for seminars/labs, homework, papers, portfolios and essays					14
Tutorship					10
Evaluations					8
Other activities:					0
2.7 Total individual study hours 44					

3.7 Total individual study hours	44
3.8 Total hours per semester	100
3.9 Number of ECTS credits	4

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	Identification of concepts and models from the field of multimedia, networking (multimedia streaming) and computer vison (image/video/sound feature extraction)
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
Tra	com	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, satellite or terrestrial, 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) and the basics of audio-video satellite broadcasting. Being able to perform digital sound processing (like applying sound filters or voice/speech recognition) and video processing (like edge detection and blurring in video frames, object recognition and tracking in videos). The course has also a strong applicative part meaning that students must implement specific applications/projects on the processing, transmission and playback of digital audio-video signal.

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction to multimedia. Analog representation	Exposure:description,	JPEG and JPEG2000
of audio and video signals. Digital representation of	explanation,	compression standards
audio and video signals. The JPEG compression	examples, discussion	are the most used
standard.	of case studies	image compression
		standards in Internet
		and on digital cameras
		and capture devices
2. Audio-video formats (containers) and codecs.	Exposure:description,	

Basics of video encoding. The structure of a	explanation,	
general video encoder/decoder. AV encoding	examples, discussion	
standards. AV containers: .avi, .ogg, .mp4, .vob,	of case studies	
.3gp, .mkv etc.		
3. Audio-video formats (containers) and codecs. The	Exposure:description,	
MPEG-1 and MPEG-2 standards.	explanation,	
	examples, discussion	
	of case studies	
4. Audio-video formats (containers) and codecs. The	Exposure:description,	H.264/MPEG-4 AVC
H.264/MPEG-4 AVC standard. H.264/MPEG-4	explanation,	is one of the most
SVC	examples, discussion	commonly used
	of case studies	formats for high
		definition video in
		Internet and
		satellite/terrestrial
		television networks
5. Audio-video formats (containers) and codecs. The	Exposure:description,	
H.265/HEVC standard. VP9 codec.	explanation,	
	examples, discussion	
	of case studies	
6. Multimedia streaming protocols. RTP and RTCP.	Exposure:description,	Explains how skype or
Multimedia signaling protocols. RTSP, SDP, SIP.	explanation,	google hangouts
	examples, discussion	function
	of case studies	
7. Audio-video streaming over HTTP. DASH	Exposure:description,	Explains how
	explanation,	youtube,
	examples, discussion	Vimeo work
	of case studies	
8. Congestion control algorithms for audio-video	Exposure:description,	
applications in best-effort networks. TCP AIMD,	explanation,	
DCCP, TFRC and UTFRC	examples, discussion	
	of case studies	
9. Voice over IP. Speech coding. Voice and Speech	Exposure:description,	Explains the basic
recognition.	explanation,	technologies behind
	examples, discussion	sound recognition
	of case studies	software like Google
		Voice Search on
		Windows/Android and
		Siri and Shazzam on
	<u> </u>	iOS
10. Audio-video communication in satellite networks.	Exposure:description,	
Basics of satellite communication and DBS (Direct	explanation,	
Broadcast Satellite)	examples, discussion	
11 4 1' '1	of case studies	D ()
11. Audio-video communication in satellite networks.	Exposure:description,	Presents the protocols
Video broadcasting and DVB standards: DVB-S,	explanation,	used by current TV
DVB-T and DVB-C	examples, discussion	content providers.
10 4 1' '1 1'1 ' 1 1' ' 177 077	of case studies	EEMDEC 1
12. Audio-video libraries and applications. FFMPEG,	Exposure: description,	FFMPEG and
VideoLan, OpenCV	explanation,	VideoLan are the most
	examples, discussion	used free, open-source
	of case studies	libraries for audio-
		video
		encoding/decoding
		and

		processing and OpenCV is a powerful library used in computer vision (object recognition in video)
13. Multimedia QoS in Internet. P2P video streaming	Exposure:description,	
and Internet Television.	explanation,	
	examples, discussion	
	of case studies	
14. Object recognition in video.	Exposure:description,	The basic techniques
	explanation,	for object recognition
	examples, discussion	and tracking in videos
	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. Presentation of project themes. Students must	Dialogue, debate,	The laboratory is
choose a project theme and must develop that	case studies,	structured as 2 hours
project by the end of the semester. Examples of	examples	classes, one lab every
project themes for the current year are at		two weeks
http://www.cs.ubbcluj.ro/~forest/pdav/projects.html		
2. Image processing. JPEG encoder in java.	Dialogue, debate,	
Simple examples (in C/C++) using the SDL library	case studies,	
(displaying a BMP/YUV image on a SDL surface)	examples	
3. Getting acquainted with the FFMPEG library. A	Dialogue, debate,	
simple audio-video player based on FFMPEG and	case studies,	
SDL (written in C); synchronizing audio with	examples	
video, saving frames as images. Youtube		
downloader using FFMPEG.		
4. Sound processing in Java and C. Creating digital	Dialogue, debate,	
effects for an electric-acoustic guitar (delay,	case studies,	
distortion, chorus, echo etc.) – demonstration using	examples	
a Yamaha FX370C electro-acoustic guitar.		
5. Getting input from a digital camera, internal or	Dialogue, debate,	
using a video capture device (TV tuner), in java	case studies,	
and C/++; demonstration using a Sony HDR-TD10	examples	
Full HD 3D video camera and an internal Acer		
notebook camera. 3D movie rendering on a regular		
LCD display using anaglyph glasses – demo.		
6. Object Recognition in videos - simple applications	Dialogue, debate,	
in C/C++ using the OpenCV library.	case studies,	
	examples	
7. Presentation of student projects	Dialogue, case	

	studies	
Bibliography		
1. The FFMPEG code		
2. The VideoLan VLC code		
3. Al Bovik, The Essential Guide to Video Processing, Academic Press, Elsevier, 2009.		

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

5. David Salomon, Data Compression: The Complete Reference, Springer, 3rd edition, 2004

4. Iain Richardson, Video Codec Design, Wiley, 2002.

- The course respects the IEEE and ACM Curriculla 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

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share
			in the
10.4 Course	Vnovvina the the austical	1) Duciente Ctudente cheuld develop e project	grade (%)
10.4 Course	Knowing the theoretical issues discussed during	1) Project : Students should develop a project related to audio-video data processing either	
	the course. Being able to	individually or in small teams of 2 persons.	
	design and understand a	Students must choose the project theme in the	
	multimedia streaming	beginning of the semester and they must present	
	system.	the project at the end of the semester. During	
10.5 Seminar/lab	Applying the knowledge	the semester, they must also show work	
activities	received from the	progress and intermediate versions of the	
uctivities	course, the ability	project at the labs. The possible grades a	
	to implement from	student can receive on the project are: 10, 9	
	scratch a multimedia	and 4. No other grades are possible.	
	system (without any	Examples of project ideas are here: List of	
	help from a multimedia	possible projects (in romanian).	
	framework, using only	, ,	
	operating system's	2) Labs + Quiz test: Students must complete 4	
	drivers and tools).	laboratory tasks (i.e. 4 labs) during the semester	
		and at the end of the semester they must take a	
		quiz test. The lab tasks require the students to	
		build a part of a video codec and are detailed	
		here: <u>Laboratorytasks</u> .	
		The final grade is formed like this:	
		averageLabGrade*0.8 + quizGrade*0.2	
		3) Quiz test: If the student does not get an	
		average lab grade of at least 6 and he/she does	
		not do a project, he/she must take the quiz test	
		and the grade he/she receives for this quiz test	
		is the final grade. This grade can not be greater	
		than 7.	

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- In order to successfully pass this class, students must get at least 5 at either the project presentation (preferable) or at the written exam.
 The course requirements are described at: http://www.cs.ubbcluj.ro/~forest/pdav

Date	Signature of course coordinator	Signature of seminar coordinator	
	Lect.PhD. Adrian Sterca	Lect.PhD. Adrian Sterca	
Date of approval	Signature of the head of department		
	Prof. PhD. Anca Andreica		