

Workshop

Cooperation at Academic Informatics
Education across Balkan Countries and
Beyond: The Impact of Informatics to Society

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ABSTRACTS

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Student Experiences and Opinions on the Practical Application of Software Engineering Methods and Technologies in Industry: Case Studies in South West Romania – Oltenia and Albania

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The aim of this study is to collect and analyze data about the real experiences and opinions of students on the practical applicability of current software methodologies and technologies in IT industries in our regions. IT industry emerged as a promising and sustainable business, requiring affordable infrastructure investments, and that is able to attract and involve young and clever graduates in related areas of Computer Science and Engineering, Mathematics and Informatics, as well as Business Informatics. The focus of IT industry is on the development of practical applications useful in all areas of the social and economic life, by employing the most recent advances in IT technologies.

The development of this study was inspired by one of the presentations given at the previous edition of the workshop, authored by our colleagues from Albania. Here we aim to expand their results by collecting similar as well as augmented data, from our region of Romania – South-West Oltenia. This would enable a comparison of the results, being able to cross-fertilize experiences and findings from both regions, with the potential of better cross-understanding and alignment of knowledge and best practices in IT sector of both business and academic worlds.

The study is focused mainly on Software Engineering methodologies and technologies, as they are practically applied, as well as perceived by students, from business and academic / school perspective. We have in mind both undergraduate students at Bachelor level, as well as graduate students at Master level. The study targets students in all IT-related areas, including Computer Science and Engineering, Mathematics and Informatics, as well as Business Informatics.

The starting point of the work is the initial questionnaire, already used by our Albanian colleagues to develop their last year study, presented in the workshop. We plan to update and refine it, based also on our local regional experiences and contacts from Romania. We will do our best to collect relevant data and present interesting results for the workshop audience.

The Experiences of Students and Academic Staff during the Erasmus Mobility: How does it impact the capacity to operate internationally

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In the recent years, Computer Engineering Department is involved in some collaborations in framework of Erasmus Mobility projects, the trend of these collaborations is being incremented. Expanding the mobility projects for a department with certain number of students and academic staff , it is a challenge and needs efforts on how to implement it successfully and on the other hand is very important to analyze the results and the impact they do have in academic staff and students. Renewal of existing Erasmus mobility projects shows a clear indicator of successful implementation and the positive effect in institutional level.

The focus of our study is to show through students and academic staff experience on how the mobility of Erasmus projects has impacted their competence expanding, not only from professional point of view but also in operating internationally. The collection of the academic staff opinion through interviews and a survey including analysis - oriented questions, indicates a very positive impact in expanding the professional knowledges and academic competences in international level as well as compatibility in operating internationally.

Introducing “Veleri-OI IoT School” Project

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Abstract

„Development of the International Education Program Veleri-OI IoT School“ is a project which started in October 2018. Project coordinator is Polytechnic of Rijeka and project partner University of Rijeka, Department of informatics. The project will receive 1.769.698,00 HRK (235.000 EUR) during the next three years. It is fully financed by the European Union from the European Social Fund.

The project encompasses development of a new international education program in the field of Internet of Things (IoT), aligned with the needs of international labor market. It also includes implementation of a pilot project that will educate the first generation of 30 students. An important element of the project is development of a business plan, which will assure sustainability of the education program after the project is completed. The education program will be held in English, and it will include a modern approach to teaching and individual projects. Key competencies students will acquire through this program are from the field of Internet of Things, but not to forget competencies from the field of commercialization that will positively influence students' employment and self-employment.

Project team consists of 13 members – teachers from both participating partners. They will implement 94 project activities which belong to 5 project modules. This paper will present project structure, project activities and outcomes.

Big Data myths and facts: Explaining Digital Transformation to non-IT Professionals

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The rapid progress in the areas of artificial intelligence, machine learning techniques, data processing, and robotics resulted in unprecedented technological achievements. These technological advances are often referred to as "industry 4.0" or "digital economy".

The digital transformation produces new challenges to society and especially to education. As anything staying on a hype for significant period of time, digital technologies produce, in addition to advantages, several myths, misunderstandings, and mis-uses. Several information sources, including mass media and Web, produce and re-produce unintentionally or intentionally a number of misleading statements, myths, etc.

To address the issues mentioned above, the administration of Saint Petersburg State University decided to develop and enforce a course called "Digital Culture", mandatory for all students of the university. The task looked reasonable, as the university programs cover nearly all areas from mathematics, and sciences to linguistics, fine arts, philosophy, and social sciences. This diversity was also present on the development team consisting of representatives from several schools.

However, finally the team was able to deliver a set of materials to be studied remotely.

The introductory part of the course covers basics on everyday use of computers by non-IT professionals, including use of Web resources.

The main part includes basics of applied statistics and then concentrates on data processing and analytics. The objective is to provide for understanding of related techniques, including machine learning, concepts related to big data, etc. The students are expected to gain the knowledge of principles, but not tools, so that they can perform simple data analysis on small volumes, formulate the problem for data professionals, and understand what kind of results can be and what cannot be expected from data analytics.

The talk includes several examples of cases illustrating mis-interpretations, myths, and mis-uses of data analytics discussed in the course.

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Student survey on the relevance of topics in the Human Computer Interaction course

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During the years of teaching the Human Computer Interaction course we have conducted student evaluation surveys to use data for continuous improvement. The survey is addressing the importance of topics covered in the course and students reflection on their achieved results. We have noticed students' preferences for learning technology oriented methods, and topics belonging to solution domain. The results suggest that students find topics belonging to problem domain more theoretical and less attractive what is linked to their perception of the usefulness of these topics.

We wanted to find appropriate learning activity to bridge the gap between “theoretical” and “practical” part of the course. Developing successful product demands understanding the users and their needs, their tasks and context in which users are operating. These skills are familiar to product managers, business analysts and marketing experts. Interesting example of documenting and managing product requirements based on user needs is Product Fit Matrix (PMF) involving direct translation from problem domain concepts to solution domain. In this academic year we have introduced this tool, with adjustments for developing software product/service.

After the course completion we have carried the survey again, with two questions for each topic, assessing how useful and how fun it is for students (on the scale 1-5). The topics are: Cognitive concepts and interaction design principles, User and user needs analysis methods, Task analysis methods (HTA), UX –Product Market Fit Matrix, Prototyping – paper and mockup tools, Interaction design patterns, Visualization, Usability and user experience evaluations. In the end of the survey we asked students to pick up the three concepts they have found the most important for Interaction Design and also to evaluate the level of their competences.

When analyzing the survey results we have noticed that students mainly assessed problem domain topics as interesting, but less useful; and results for solution domain topics are opposite. The least fun topics were: UX –Product Market Fit Matrix (3.45), HTA (3.81), Prototyping (3.91) and Interaction design patterns (3.91), but Design patterns were graded as the most important (4.55), with Mockup tools following (4.45). Importance of Cognitive concepts and interaction design principles is graded (4.09) and UX –Product Market Fit Matrix (4.09)

When selecting the most important topics 80% of students selected Interaction Design Patterns, followed by Error prevention (60%) and Iterative development (50%), User involvement (40%), Responsive design (40%) and Minimalism (20%). Interesting result is that no one selected Visual design and User help. In assessing the level of their competences, we have offered a scale corresponding to simplified version of the Bloom taxonomy. Students evaluated their competences and the level of application (50%) and level of evaluation (50%).

Guided development of scientific research tasks - experiences of students' completion of studies in Institute of informatics, Maribor (2019)

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Master thesis is the final result, students have to accomplish before finishing their studies, to receive the title: Masters of Informatics and Technologies of Communication. To help them with their final task, the last semester of the 2nd level Bologna Studies includes the subject Empirical research methods. The students have a theory course of research methods overview and gain practical experience at conducting at least three selected research methods; typical among them are systematic literature review, survey, interview, experiment, case study or reverse engineering.

The objective of this research was to statistically examine, if the success of the students increased after guided step-by-step development of research thesis (supported by an assistant and the professor). In addition, a brief evaluation of final documents was also examined on a non-randomly chosen sample, evaluating the quality of the student's final product.

Experiences from New Accreditation Cycle of the Information Engineering Study Program at Faculty of Technical Sciences

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In the year 2015, the three new study programs in the area of Data Science were accredited at the University of Novi Sad, Faculty of Technical Sciences in Novi Sad. One is a 4-year B.Sc. program in Information Engineering, with 240 ECTS, and the two are master-level study programs: a) 1-year M.Sc. in Information Engineering, with 60 ECTS, and b) 1,5-year M.Sc. in Information and Analytics Engineering, with 90 ECTS. All the programs are officially accredited in the category of interdisciplinary and multidisciplinary programs, in the two main areas: Electrical Engineering and Computing, and Engineering Management. In practice, the programs cover in deep the disciplines in Data Science, as a completely new combination of courses predominantly coming from Computer Science, Software Engineering, Mathematics, Telecommunications and Signals, Finances, and Engineering Management.

Execution of the two of these study programs has been initiated in the year 2017. Those are B.Sc. in Information Engineering, and M.Sc. in Information Engineering. By this, now we have two active generations of students in the B.Sc. program, as well as two generations of M.Sc. students, where the first students have already completed their M.Sc. studies in Information Engineering. Our first experiences with these generations of students are quite positive.

In this school year, the new 7-year accreditation cycle is initiated at Faculty of Technical Sciences. The process of preparation of all the three study programs for the new accreditation cycle is almost done, in the time of writing the abstract (March 2019). We have faced with the two main goals: a) to embed the best practices of already running students' generations in these study programs, and b) to face with some new or improved regulations set by the National Accreditation Body of Republic of Serbia, in January of 2019.

In this presentation, we are going to communicate our experiences with the execution of the study programs B.Sc. in Information Engineering, and M.Sc. in Information Engineering in the school years 2017/2018 and 2018/2019, as well as our experiences related to the reengineering of the three study programs in the new accreditation cycle.

Use of games in Software Engineering Courses

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CollabNet VersionOne publishes annual report of their analysis of the benefits of adoption and the percentage of adoption rates of agile and engineering practices. These reports, in addition to scientific papers on agile method tailoring, show that the most adopted practices are classified into project management categories. Meanwhile, the usage of various gaming practices has increased among professionals that work according to one of the (tailored) agile methodologies. Some games are used with the sole purpose of increasing team cohesion as part of team building exercises. However, most games are used to enhance a skill important for an agile methodology. Lego Scrum is a typical example; used for improvement of estimation techniques by iteratively building various structures with Lego bricks. Various workshops were organized for such games, and in addition special playing sets were designed and sold. However, this brings up the question: Are those “agile games” just hyped up and their sole use is for team building or are they worth investing in?

This inevitable rise of agile practices has already triggered, or is going to trigger, educational changes in Software engineering courses. The aim is to teach students something beyond technical excellence. Additionally, the rise of “agile games” cannot be ignored, and those games have already become a part of the educational process. Some scientific papers suggest using games like planning poker, and Lego bricks as an alternative to practical work in case there is not enough time or skills for development. Other papers suggest dividing the course in two parts – games and labs, in which games are used to describe methodology concepts in an informal way, followed by labs with concrete work on real problems.

The aims of this paper are to enumerate typical games used in combination with agile methodologies and categorize them by methodology and aim. Furthermore, a review of the usage of games in educational process in order to find out whether gaming approach could be universally applied, or is it affected by cultural differences, or perception of the seriousness of the teaching process.

Gamification as a tool for enhancing students' motivation, engagement and participation in Programming course

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Nowadays, with technology advances, available communication networks and new skills developed by the new generations, there is a need to adapt teaching methodologies, making them much more interactive and attractive to attain students' attention. This new generation can be called "digital natives", since today's students are native speakers of the digital language of computers, video games, and the Internet. They are the first generation to grow up with these technologies combined. In this way, computer games, smartphones and instant messaging are integral parts of their lives.

This overwhelmingly interesting surrounding, with lots of gigabytes of information changes when students enter a classroom. There they normally need to sit and pay attention to an older person that is giving a lecture. Generally, teachers and professors are not as keen in technology as they are, and many classes could be quite boring for this type of students, and they end up losing interest very rapidly. This is a problem that many professors are facing nowadays, in which students prefer to navigate on the internet rather than pay attention or participate in the class. Therefore, this work is focused in an active learning methodology, called Gamification, which combines content, game and technology aiming to motivate the learning experience in a classroom. This methodology aims to enhance the student learning experience, introducing an alternative to class management and traditional evaluation methods, getting students' attention through gamified activities with goals and rankings in a collaborative environment. Furthermore, through this research attempts are to contribute with the investigation of the effect of active learning methodologies in higher education based on the student's perception. This work intends be replicable for all areas and to contribute in measuring the impact of gamification in students' behavior. Regarding the importance of this work, an evaluation about teaching methodologies is important to encourage new actions of implementation and diffusion of active learning. Understanding how some actions of active methodologies impact students will contribute for the dissemination of good practices among professors and universities.

Due to technological evolution, it has become increasingly challenging to engage students in the classroom, gain their attention and involve them in some activities. In this context, the objective of this work is to stimulate students' engagement in Programming class through the use of gamification, creating metrics to evaluate their participation and informing their progress during the semester. In order to carry out such evaluation, a spreadsheet will be developed in which students will be awarded with points for attendance and participation in each class throughout the semester. A survey will be conducted with students to evaluate such method. As results it is possible to perceive a greater interest of the students to participate in the classes, a significant increase in the presence, and a fun and healthy competition among the students.

Experiences with Projects about Digital Games for Learning Computational Thinking and Programming

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Abstract:

Game-Based Learning (GBL) is an approach that involves the use of educational digital games whose purpose is to achieve certain learning outcomes. In modern education it is more and more applied to motivate students, increase their engagement, and improve their learning results. Three ongoing projects at the University of Rijeka, Department of Informatics that deal with GBL are Erasmus+ project “Games for Learning Algorithmic Thinking” – *GLAT* (2017-1-HR01-KA201-035362), Erasmus+ project “*Coding4Girls*” (2018-1-SI01-KA201-047013), and UNIRI project “Digital Games in the Context of Learning, Teaching, and Promoting Inclusive Education” – *Digital Games* (uniri-drustv-18-130). These projects address open and innovative education from both pedagogical and technological aspects and generally support developing computational thinking and programming skills by using educational digital games.

GLAT and *Coding4Girls* projects are funded by the Erasmus+ Programme of the European Union under the Key Action 2: Cooperation for innovation and the exchange of good practices (Action Type: Strategic Partnerships for School Education). *Digital Games* project started in 2019 at it is supported by University of Rijeka (UNIRI) funding for research.

The main objective of the *GLAT* project is encouraging the integration of computational and algorithmic thinking into the daily teaching through different subjects in students' younger ages by using e-learning strategies that include GBL and other modern pedagogical strategies. This has been achieved by professional training of teachers regarding the computational thinking and the use of innovative teaching methodologies. The direct participants are Croatian primary school junior grade teachers which participated in the *GLAT* workshops and applied the developed contemporary learning scenarios in classrooms with their students.

The project *Coding4Girls* promotes the development of programming skills among girls through digital games. It aims to address the gap between male and female participation in computer science education and careers by introducing early methodological learning interventions that make computer science attractive to all, girls and boys. In the context of the project a methodological learning framework for building programming skills based on design thinking approaches and serious games will be developed as well as instructional support content for teachers to facilitate the integration of the proposed framework into existing school practices.

The purpose of the project *Digital Games* is to explore the possibilities of using digital games to improve the quality of learning, teaching and promoting inclusive education, and the development and promotion of modern pedagogical-technological frameworks for the use of GBL in schools. The specific research objectives are: the selection and development of games and digital tools, as well as modern teaching models for building the GBL frameworks, and the designing of learning scenarios based on developed frameworks applicable in practice for learning and teaching subjects in primary schools.

Experiences from an Arduino Programming Course for Teachers

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Arduino is regarded as something trendy and fun, and an attractive topic for extracurricular activities. However, once the beginner examples are done and the novelty of blinking LEDs wears off, one begins to wonder what to do next, and more importantly, how to do it. Teachers and students alike quickly come to the realization that C++ programming is demanding and electronics is not exactly simple. Ambitions of smart houses and intelligent robots quickly fade as usual tasks, such as reading a keyboard or formatting a decimal number prove to be quite tedious and intricate. Furthermore, hardware limitations force the programmer to reinvent some features that are standard in high-level languages on more powerful machines. The programming paradigm for microcontrollers is substantially different than what is taught at middle school level.

We have developed a curriculum on Arduino C++ programming for teachers. Three courses were held in 2018. Our aim was to train the teachers to overcome the initial steep learning curve and learn some fundamental specifics of microcontroller programming. To this end, we have developed an ambitious eight-hour curriculum, which covers a wide range of topics, from basic electronics to Arduino hardware to advanced C++ programming. Naturally, it is impossible to cover every topic of every field in such a short time. Therefore, it was crucial to find the right balance of materials and concepts to present. This paper summarizes our experiences from the courses and presents several characteristic examples.

Evolution of Teaching Strategies in a Software Quality and Testing Course

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The university course on software quality and testing at the Faculty of Computer Science and Engineering and previously at the Faculty of Natural Science and Informatics, Ss. Cyril and Methodius University, has been run as an elective course in third and last studying year for different 4-year and 3-year bachelor programs since 2008.

The goal of this course is to understand the need for software testing, different techniques of software modeling, and using those models for testing. Also, practical projects for real software testing, verification, and validation are mandatory part of the course. The course was first based on the lectures of the first edition of “Introduction to Software Testing” by Paul Ammann and Jeff Offutt and the in the last two years, the lectures are based on the second edition of the book.

Learning methods include lectures using presentations, interactive lectures, exercises (using equipment and software packages), teamwork, case studies, invited guest lecturers, independent preparation and defense of a project assignment and seminar work. The homework exercises were first more “theoretical” (paper-based), and now, they include computer-based testing tasks of real software programs using the latest software testing packages and frameworks. Also, the project assignments were same for all students (mathematical tasks or testing the same simple software system) at the beginning and now each team have to choose different real software system for testing.

In more than ten years, about 600 people have been taught and successfully finished the course. Many of the students used the knowledge acquired to apply for the software tester positions in the software industry. In order to show the importance and applicability of the course in the software testing industry, we will present the evolution of the course in numbers (official reports about the pass rate and enrollment obtained from the Moodle course pages and Faculty student management system), the evolution of lectures, project assignments, homework and software testing technologies: packages and frameworks.

Analysis of Computer Science Based Dissertation Theses in Turkey

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According to National Thesis Center of Turkish Council of Higher Education (<https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp>) first graduate study was completed in 1900 as Specialization in Medicine. Starting from 1900 till February 2019, 525.562 graduate studies were completed. Majority of the dissertation theses as the results of these graduate studies were master (366.163) and doctorate (96.143).

When the computer science related dissertation theses is considered, it has been seen that 11.828 theses of master and doctorate belong to this field. The main division of computer science field is Computer Engineering Sciences-Computer and Control whereas this main division has 26 sub-divisions such as Information Security Engineering, Information Technology, Computer Science and Engineering and etc. Additionally, the number of dissertation theses for 11 inter-disciplinary divisions such as Electricity and Computer, Electricity and Computer Engineering and etc. is 1240 and this amount plays significant role in the main division called Electrical-Electronics Engineering. Finally

Having done in this study, the master and doctorate theses submitted under the 26 sub-divisions of Computer Engineering Science and also inter-disciplinary divisions of Electrical and Electronics Engineering Science such as Electronics Engineering and Computer Science, Electronics and Computer Systems Education, Electricity and Computer and etc. have been analyzed in details according to the type, year, university and subject. It has been seen that the first several graduation studies in Computer Science started in 1980s in only several division and reached to almost 13.000 studies in around 40 different divisions.

Usability investigation of University Library Website from the Students' Perspective

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A university library website plays an important role in making available and disseminating the library resources and services for students during their studies. Therefore, a university library website should be designed carefully to ensure a certain degree of usability for all students. Usability represents an important criterion for evaluating websites from a user's perspective. In general, website usability can be defined as a quality characteristic that describes how easily a user can navigate across a website. Overall, usability evaluation methods are classified into two general categories – empirical methods and inspection methods. Empirical methods involve real users, while inspection methods are based on reviewing the usability by expert evaluators or designers. In the library domain, the existing literature reports that the majority of website library evaluation studies are related to usability testing and most of them include end-user-based usability testing. In this way, the research is based on usability testing with end users. Therefore, the main goal of this research is to investigate how students respond to a university library website in term of usability. The answers will be obtained by performing formal usability testing, including think-aloud protocol, log analysis and questionnaires.

The impact of multiple quiz application on student's learning progress – a case study in system convergence and integration domain

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The study investigates factors, influencing student's motivation and success during one of 1st bologna level subjects focused on web and xml technologies. The subject is called System convergence and integration and is an obligatory subject. The study presents three years of observation in various stages of the study process. Each year included several tests, quizzes and lab overviews, documenting student's progress on a week-to-week basis.

Results demonstrate a positive influence of multiple knowledge testing, performed in various forms. Each next generation of students achieved improved average grades compared to the previous one. Based on the results, we can conclude that more frequent and stricter testing approaches (including several shorter quizzes) provides more success and positively impacts the students' average grades and motivation in general.

Involvement of Software Engineering Students in Research Projects

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Involvement of students in research projects is one of the objectives in many Software Engineering curricula. It is mandatory for the PhD students. It is also desirable for graduate as well as undergraduate students, but usually accompanied by additional challenges and difficulties. This paper presents some recommendations and experiences, with focus on involvement of software engineering students at University of Banja Luka, particularly in development of the AMADEOS system.

AMADEOS is an online system for automated model-driven database design. It constitutes the main objective of an ongoing long-term research project devoted to business process model-driven database design, which has been implemented within the M-lab Research Group at the Faculty of Electrical Engineering, University of Banja Luka. As many other long-term research projects in academia, AMADEOS is characterized by an incremental and iterative development process, where the increments are based on the research activities and outcomes of PhD, MSc and BSc thesis. This paper presents the past, current and planned activities in AMADEOS development, as well as challenges, difficulties and lessons learned, with focus on involvement of software engineering students.

Last release of the Joint course in Software Engineering in Skopje

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The beginning of the “Software engineering education and reverse engineering” project in 2001 coincided with the new computer science curricula at the former Institute of Informatics. Parts of the Joint course in software engineering (JCSE) were included in the Theory of Programming course in 2004/05. The complete JCSE was first delivered in the academic 2006/07 to 75 students from 4-year and 46 students from 3-year studies.

In 2011, the course was introduced at the new Faculty, and since 2014, it has been released in English too. For 7 years, both courses, the one inherited from the Faculty of Electrical Engineering, and the JCSE were delivered in parallel. With the new FCSE curricula, which started in October 2018, a complete new software engineering will replace the former two courses. Current sophomores will be the last students to attend the old good JCSE in Macedonian and in English.

Since 2006, thousands of students have enrolled and successfully finished the course. We became more experienced and confident in both, the lectures and particularly in the practical assignments. All the lectures dealing with the structured programming were excluded from the course. The lectures connected with object-oriented analysis were extended, to enable the students to smoothly use and create UML in all its details. The lecture about agile programming designed to accompany Roger Pressman’s book *Software Engineering: A Practitioner’s Approach* was added to the pool. Practical assignments were associated with real life middle sized software products. In the last four years, students worked on different team projects for creating Software Requirement Specifications (SRS) for various software systems: Web Based Integrated Development Environment; Personal Investment Management System; Electronic System for Issuing Licenses and Elaborates; and Electronic System for Recording and Exchange of Documents.

Within its long history, the course became recognized and appreciated by the local software developing industry. In order to show the importance and the influence of the course to local and European industry, we will present basic information about the evolution of the: course syllabus, student team projects, and student exam papers. The review will be associated with the Faculty reports about the enrolment and student results at both competing courses.

We thank all the colleagues from the DAAD consortium who have contributed to the development of the Joint course in software engineering, its slides and lecture notes. Their names are available from the title slide of each lecture. We also thank our colleagues who have unselfishly contributed to the local delivery of the course. And finally, we thank you all for your attention.

Master Course in Parallel Computing - from Pen-and-Paper to Heterogenous NUMA Cluster

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Serious course in parallel computer systems can hardly fit in 3 lecture hours per week, 14 weeks semester budget. Covering typical problems (what?) suitable for parallelization, solved with adequate algorithms (how?), coded with contemporary programming languages (tools?) and executed on accessible parallel machines (architectures?), requires more lecture hours and lab resources. Leading technical universities around the world do this in increased number of teaching hours and with extended access to variety of parallel hardware platforms. They also avoid "the textbook"-based teaching by offerin extended list of conference papers in various parallel computers and programming technologies. Our approach is to maximize learning outcomes using (very) limited resources.

The Use of Python in Practical Students' Work at Programming-Related Courses

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In this note we introduce our experiences with using Python programming language at practical students' work in two programming related courses at the Faculty of Automatics, Computers and Electronics, University of Craiova, Romania, gathered during 2018-2019 academic year. These courses target Computer Engineering students, as follows: i) first year, second semester students in Algorithms Design, and ii) second year, second semester students in Artificial Intelligence.

Currently, our curriculum does not include a separate course for teaching Python programming to our Computer Engineering students. On the other hand, during recent years Python has gained a very high popularity in both academic and business worlds, as can be easily noticed by consulting many references, including the Interactive Top of Programming Languages – an online application promoted by IEEE Spectrum that provides an adjustable data-driven ranking of programming languages according to their usage figures.

Therefore we decided that the introduction of our students to Python is a must. Currently, this is done gradually: i) during Algorithm Design course (first year, second semester) students are briefly exposed to Python as a convenient language for expressing algorithms, and ii) during Object-Oriented Programming course (first year, second semester) students are taught the object-oriented features of Python. In this way students have the possibility to expand their knowledge of Python by using it in other courses of our curricula, like for example Artificial Intelligence (second year, second semester).

In this study we report our initial experiences by focusing on students' practical programming work using Python. We consider two different courses and we discuss the practical programming coursework, as well as the results obtained by our students in these activities. Our general conclusion is that the role of Python should be expanded in the future, by also exposing students to other problems that can be conveniently addressed with Python, like for example numerical calculus and / or data analysis, as early as possible in the academic curriculum.

Utilization of ASQ in web design course

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Final goal of each educational process is to maximize learning outcome of the enrolled students. It is well-known that the learning environment highly influences performance of the students. Evolution of personal devices (PD) introduced various ways to modify learning environment in order to obtain improvement over the learning outcomes of students. One such modification was introduced with ASQ. ASQ is a web application which uses students' PDs to improve educational process.

Main purpose of ASQ is to promote active learning during interactive lectures. Having that most professors use slides during their lectures, ASQ introduced interactive slides, where students answer questions and solve simple tasks by using their PDs. In that way students become active component of the process, rather than being just passive listeners. Besides that, ASQ gives a professor immediate feedback about the lecture quality in form of answer correctness statistics.

In our research we wanted to determine how ASQ influences the learning outcome in Web Design course. For that purpose, we conducted an experiment that lasted for two school years: 2016/2017. and 2017/2018. In our experiment we divided students into two groups: control group and treatment group. In the control group we used traditional slides, while in the treatment group we utilized ASQ. For the assessment of students' performance we used unified unbiased test that covered all course's topics.

Statistical analysis of the students' performance gave us a confirmation that ASQ really improved learning outcomes of the students of Web Design course. Moreover, we detected an interesting phenomenon – for some course's topics ASQ turned out to be more beneficial than for the others. Nevertheless, in all topics we detected certain improvements, implying that ASQ could be a good way to make learning process better.

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Application a ViPS for Lifelong Learning

The modern Internet development and the synergy between the physical and the virtual spaces determine the need for development of the Cyber-Physical Spaces (CPS). Our research is aimed at building a system, at the center of which the social and the human factors occupy a key position, and the concept of Cyber-Physical-Social spaces (CPSS) is fully justified. We named this system ViPS (Virtual Physical Space). As we wish to provide security and trust between the users of the system under development by providing them with timely, personalized and customizable services and learning resources, we will use the capabilities of Personal Assistants and blockchain technologies.

This report presents a ViPS -based application known as BLISS. The system supports a kind of lifelong learning where people who need to be educated have dropped out of school for various reasons but wish to complete their education through individual training. The active components of BLISS called personal assistants are implemented as intelligent agents. The agents' environment consists of two different parts – an event-driven BLISS server and a School Diary implemented as a blockchain.

The problem we want to solve is related to teaching people, who have dropped out of school for various reasons but wish to complete their education through individual training. Since these people have jobs, the education process is conducted on individual curriculum plans. For the instructors, managing this way of teaching is a serious challenge because it goes beyond the standard course of study.

In recent years, more attention has been paid to the security that the various IoT systems have to provide. To a large extent, this applies to sensitive information processed in educational establishments such as personal data, achievement in different school subjects, diplomas, etc. In order to provide a higher level of security for the system, we chose to use blockchain technologies to ensure trust and reliability. Following the analysis, we considered that ViPS could serve as a basis for developing a school learning support system for both regular and adult learners of self-training and lifelong learning.

At the moment the first prototype of BLISS is being tested in a high school. Currently, more than 35 students are provided with personal assistants that help them to study on individual plans in a personalized manner.

From eLearning Environment to Cyber Physical Social Space

In the DeLC laboratory of the Faculty of Mathematics and Informatics at the Plovdiv University "Paisii Hilendarski", a project aiming the development of a distributed e-learning environment had been started. The software system developed as a result of the project was improved and is currently being used in the real education process.

Although DeLC was a successful project for applying information and communication technologies in education, one of its major drawbacks is the lack of close and natural integration of its virtual environment with the physical world where the real learning process takes place. CPSS and IoT paradigms reveal entirely new opportunities for taking into account the needs of disabled people, in our case disabled learners. For these reasons the DeLC environment has been transformed into a Virtual Education Space (VES) that operates as an Internet of Things ecosystem.

Based on the collected practical experience and the developed prototype software components, and taking into account the new capabilities of IoT, CPS, and CPSS, we decided to go one step further, namely to create a CPSS-like reference architecture, which is known as the Virtual Physical Space (ViPS). The Internet of Things (IoT), Cyber-Physical-Space (CPS) and Cyber-Physical-Social Systems (CPSS) are closely related concepts. While CPS focuses on integrating the physical and cyber worlds, IoT is concerned with the unique identification of heterogeneous devices and smart objects and their connectivity to the Internet. In such systems, however, users are often overlooked or only partially addressed. The Cyber-Physical-Social System (CPSS) addresses this problem by placing the user at the focus of CPS. In this way, CPSS integrates various data originating from the physical, cybernetics and social spaces through synthesis techniques to provide human-readable abstractions and insights.

Currently, the ViPS is adapting to the following three domains:

- Project "Smart Agriculture" – to support the optimization of production by increasing harvest yield and save operational costs with 24-hour monitoring of vital performance.
- Project "Personal Touristic Guide" – the personal touristic guide takes into account various factors, such as the tourist's preferences, location, time available, and the presence and location of cultural and historical objects in the area, in order to propose virtual or real cultural and historical routes.
- Project "BLISS" - the system supports a kind of lifelong learning where people who need to be educated have dropped out of school for various reasons but wish to complete their education through individual training.

User evaluation of an adaptive learning system DITUS

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The system for distance learning based on dialogue (DITUS – Department of Informatics Tutoring System) was under development at the Department of Informatics between 2012 and 2017. During that period, in 2013, a study aimed at evaluating user experience with the system was conducted with the aim of obtaining useful insights on how to improve it by adding new functionalities. In 2017, a similar study was done on a different sample of learners. The results obtained by using a specially devised questionnaire are given below.

The architecture of the DITUS system consists of a knowledge database, content delivery subsystem (interface), students as key stakeholders, evaluation module for processing students' answers to questions, records log and control module. The latter is the most complex element in the model and is crucial for the success of the learning process. This part of the architecture is responsible for:

- generating the distance learning process by selecting appropriate learning content and delivering it to the student;
- analysing the effects of the generated distance learning process by evaluating student behaviour during learning;
- modifying the current learning session with the aim of improving it, while, at the same time, adding new knowledge about the learning process into the records log;
- defining important parameters that improve the learning process on the basis of current and past learning sessions;
- influencing the criteria for selecting data from the knowledge base using the knowledge obtained from previous learning sessions (by forming queries to the knowledge base for the given content).

The learning domain is organised as a set of interconnected items. The process of learning an item begins with the selection and delivery of learning content and continues with the analysis of the effects it has on the learner by testing his knowledge on the current item and the items that are below it in the hierarchy.

The future development of the DITUS system is aimed at integrating the system and tools for data mining and implementing the process of data mining on educational data (learning paths through the hierarchy of the items in the learning domain), which includes the techniques for automatic interpretation of the results obtained.

Based on the DITUS learning system, a new system called LLS was developed for the domain of language learning. In addition to the functionalities of the DITUS system, LLS implements a novel algorithm for guiding the process of English language learning and an adaptive testing procedure rarely found in tutoring systems of any domain. The system relies on the Common European Framework of Reference (CEFR) for languages, which means that the learning success may be expressed using a widely recognised international scale.

A recent study of user satisfaction with the LLS system, conducted using an adapted version of a previously verified questionnaire, reports on the strengths and weaknesses of the system in question with a special emphasis on its content (tests, language tasks, learning materials and feedback opportunities), adaptive capabilities, and the overall graphical design, and, where appropriate, suggests ways for improvement. The results reveal positive attitudes of system users (learners) towards the system and their satisfaction with all its aspects, but also point out a couple of minor issues that can be easily and quickly dealt with.

The development of a footballing web application using Laravel

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The increase of use of web applications has made it mandatory for developers to find solutions and please the users on what they demand regarding the application. This project done as bachelor theses, selected a target group; a group of users, regular football fans whose requirements were relatively based on the search of daily information regarding their favorite team, involving the posting of daily articles, match previews and reviews. On the other hand, it required the search of statistics, and a special section where they could discuss over the latest news, in the context of a social media. While these were the specifications from the users, as part of the work done on building the application, there were some specific requirements on the platform to be used, as of the PHP framework, Laravel, which follows the MVC architecture. Laravel eased the developing process and offered a set of modules that helped on the further increase of security of the application. Furthermore, based on the specifications made by the user there were several tasks to be taken into consideration, which were solved by creating the logical flow scheme of the application.

The trend of using software development phases in the students' academic projects

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Software development processes intend to help project teams in organizing and structuring software projects and not only. Nowadays, giving the increased importance of Software Engineering in several aspects of the development of new applications, as of applying the waterfall model phases in the project, there's a need of understanding how these phases/stages are applied during university days in both course projects and diploma thesis from students.

The study tends to observe the natural flow of the way students work, whether in project teams or not, while working and finding a solution to a practical problem given as an assignment from the professors and on the other hand, how these stages are applied while they are working on their diploma thesis. Students think less of how things are done rather than the fact that their program indeed works and is functional as well. The suggestion is that Computer Engineering students tend to oversee a part of the stages due to the size of their projects and not giving a full attention to a part of the phases, considering some are more important. This, of course based on the work they have done and previous experiences from other students.

The analysis of this study will be made through a questionnaire, where its intentions are on the aspects of concluding regarding the hypothesis and how a well thought work from the beginning, eliminates several issues in the path and makes the work even more pleasant. A highlighted detail from the start is the different approaches being compared, the course projects and diploma thesis and how the complexity of a project changes the student's perspective.

On Ethics for AI and Robotics

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After some years of the so called “AI-winter”, AI and Robotics are back on the stage of discussions with fears concerning loss of working places, inhuman usage, control of our daily life, killer robots or even with machines taking over the rulership in the world. Machines have become smarter by learning, they are now able to play games like chess and go better than the best humans, they can identify faces and personalities, they decide about labor contracts, bank credits, or therapies. They support our social relations, guide our search for information and for shopping, and they will eventually drive our cars autonomously.

Humans have laws and ethical rules to prevent (hopefully) from undesirable actions, they are controlled by attitudes of responsibility and empathy. But what about machines? They follow their programs and trained behaviors and are expected to work efficiently, which does not automatically lead to humanistic behavior. Humans can adapt their decisions to situations not seen before and still care about ethical rules. Machines are programmed and trained in advance, their behavior is determined long before such situations may appear. Ethical behavior is in the hands of the designers and programmers.

This leads to several questions:

- 1) Ethics and laws depend on the culture, the country, the society. What rules should be implemented?
- 2) Who decides about the ethical behavior and the rules that should be built into the machines?
- 3) Given such constraints and rules, how can they be implemented into programs and trained by useful and sufficient data?
- 4) Who is able to test the behavior of the machines and to guarantee the fulfillment of ethical conditions?

Besides regulations for the behavior of machines, we will also need regulations for the changes of our world and our society when machines can be used for replacing jobs, care of people, surveillance, military, cyberwar, hacking, manipulation, violation of privacy. AI will change the world in many ways. It is necessary to discuss the chances and the risks in advance. European Commission has presented a “Draft Ethics guidelines for trustworthy AI”¹. The final document is expected in April 2019. It will also be discussed in the talk.

¹ <https://ec.europa.eu/digital-single-market/en/news/draft-ethics-guidelines-trustworthy-ai>

Bosnian Women in STEM

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In Bosnia and Herzegovina, there are more women than men with university degrees. Regardless to this fact, among the employed university graduates prevail males. Areas in which more women are employed than men are: Education (excluding higher education), Health and Social Sciences. On the other hand, among the illiterate population there is a lot more females than males. There are also more females regarded as illiterate in the terms of Information Technologies.

STEM is a well known acronym but its full definition varies. The list made by the U.S. Immigration and Customs Enforcement may be illustrative and of practical importance. Like in most of the world, in Bosnia and Herzegovina, STEM faculties are more attractive to boys than to girls. After reaching the age of about 15 years, girls appear to lose interest in Science, Mathematics and Engineering. One of the reasons might be that girls are perceiving rather few women in positions of scientists and engineers. In the Bosnian society, there is not much public discussion evolving about women scientists and their respective contributions. In the current public media space, examples are obviously lacking, which would motivate girls and young women to choose a career in science and technology.

STEM, or close to STEM areas at the universities in the Federation of Bosnia and Herzegovina with over 50% of female students in the academic year 2017/18 were: Natural Sciences and Mathematics, Health Studies, Medicine, Dentistry, Pharmacy, Architecture, Biotechnics. STEM faculties at the universities in the Federation of Bosnia and Herzegovina with predominantly male students in 2017/18 were: Faculty of Electrical Engineering, Faculty of Civil Engineering, Faculty of Mechanical Engineering, Faculty of Information Technologies. For Bosnian women it is not a problem to be a teacher or a doctor, but being a female construction worker, electrical engineer, or a mining engineer - that is much less expected.

The *Save the Children* organization started in 2016 with the realization of a project through which it intends to ensure that students in Bosnia and Herzegovina master the key competencies necessary to become the bearers of economic development in the future. It has been commonly accepted that the key to a knowledge-based economy lies in STEM competencies. Through this project, they want to improve learning outcomes in the fields of Mathematics, Natural Sciences, Engineering and Information Technologies. Since 2017/2018, there is a trend in growth of the female enrollment in secondary schools in Bosnia and Herzegovina, hoping that a larger proportion of the female population than before will turn to STEM and in the future contribute to dismiss current unpopular image that perpetuates the insufficient representation of women in these areas.

Computer Engineering as one of the favorite studies for female gender in Albania.
Betim Cico, Klaus Bothe

One of the major challenges today in the world is the involvement of women in all areas of life. This is a challenge for both big and small nations, for the developed and undeveloped countries. But we will not even consider tackling this challenge in general, but only in the field of Computer Engineering. This field for many years has been considered as a male domain.

Women's involvement in this field does not only bring advantages to women in general, but it also creates more opportunities for this field to have even more innovative ideas coming from females. In this paper we will not address these problems in developed countries such as Germany, England, France or others, where this problem is more forceful, but we will provide women's involvement in this field in 3 time period, before 1970, after 70th until 90th, 90th to date, which corresponds to the period of democracy in Albania.

The results obtained from this study show that the period after the 2000 has a ratio of 50 to 50 in both master and bachelor studies, or in some cases in favor of female gender. This is a quantitative approach, but also in the qualitative one, often this is in favor of the female gender.

In our study as key study we have used the period 2005-2012 at the Polytechnic University of Tirana, in computer engineering master studies and as an exam to evaluate the obtained result is considered the software engineering exam; the subject developed, held and evaluated from two foreign professors (from Berlin Humboldt University and the University of Novi Sad). This subject has been taken for granted to avoid any possible impact on the Albanian professors from the environment where they live in.

As a second case study, have been considered three academic years of 2016-2019 in bachelor studies, computer engineering at the EPOKA University (the best private university in Albania). To evaluate the level of students, their results were obtained in 3 different subjects: software engineering, computer architecture and digital system design. In the second case study, a set of hardware and software subjects has been taken to analyze the results.

We would like to point out that in all cases in Albania there is no gender difference.

Female students' attitude towards studying ICT - Balkan case

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This presentation brings the results of research on female students at three different faculties of informatics: Novi Sad in Serbia, Plovdiv in Bulgaria and Tirana in Albania. The idea of our work is to analyze and compare female students' attitudes towards studying informatics and their expectations for future career. Therefore, we have collected female students' opinions, experiences, attitudes, and perspectives, on current studies, employment opportunities and expectations of future professional careers. Reliable statistical tests were used for a detailed analysis of student responses. The obtained results indicate that the opinions of female students vary, depending on the place where they study.

How to Decrease the Drop-out Rate of Computer Science Students

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The drop-out rate of Computer Science students is typically very high. To prevent our students from dropping out, we have investigated the reasons behind this phenomenon and implemented several changes in our education. Retention depends on student grades and knowledge. Student engagement is associated with patterns and quality of using self-regulation strategies, self-motivation methods, and creative competency. 2006: first year students were organized in fixed composition groups of 20 students in order to promote community building. We launched a buddy program where students shared their problems with their teachers and fellow students, who then helped them to cope with issues in university life. A tutoring program implemented by fellow students was started. 2014: the first of five student counselling psychologists was employed and started to offer individual life management consultancy and training to groups of students to overcome study difficulties. A circle of peer counselors was formed and a training program was introduced for mentors and for peer counselors. 2015: an elective 3 day pilot training course was offered to 70 first year students having the worst results in the first 8 weeks of their university studies. 2016: an advisory service was started on how to schedule exams and how to register for courses in the optimal way. Student attendance in all classes was made compulsory for all CS students (except for students having good results, i.e. with a performance higher than 80% average grade for 30 ECTS/semester). A special course entitled “Preparation course for university studies and developing learning skills” became obligatory for all first-year students. The course consists of two main parts: an intensive training program and a special mentoring program. The training program is held by psychologists and peer counsellors for a group of 16 students. In addition to teaching them general studying and time-management techniques so that they will avoid procrastination, psychologists also develop students' soft skills and strengthen their Computer Science identity. Besides psychologists, peer counsellors hold a special workshop about learning techniques on how to study mathematics and programming subjects efficiently. These last 30 hours. 2018: the curricula were changed based on data science analysis (more informatics and less math in the first semester, mathematics was shifted to the second semester). As a result of all these changes the number of students who successfully completed 5 of the 7 obligatory courses of the first semester increased significantly from 66% in 2014 to 90% in 2018. The number of students having good results increased from 120 to 320 between the autumn semesters of 2017 and 2018, while the number of active students (with the same annual intake) has increased by 25% in the past few years.

The Need for Digital Literacy at Faculties of Social and Human Sciences – A Case Study of Faculty of Philosophy in Novi Sad

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The Internet has evolved into a global platform that constitutes an integral part of our everyday life, both private and business. Familiarity with the Internet services, understanding the way in which they function and mastering their usage are the essential elements of computer literacy.

In order to assess the previous knowledge of the first-year students of the Faculty of Philosophy acquired in elementary and secondary schools and with the aim of adjusting the lectures to their specific needs, anonymous testing was carried out. The test questions were selected from a set of questions used for the exam in the subject of Digital Literacy at the Faculty of Philosophy and deal with the two basic ECDL modules: Computer Essentials and Internet Essentials.

More than 500 first-year students from 13 departments of the Faculty of Philosophy took part in this research, and this work presents the results related to their knowledge of the basic concepts of the Internet.

The existence of evident shortcomings in their knowledge of basic concepts of Internet technologies observed in this pilot study indicates the necessity of providing Digital Literacy courses at the faculty level.

Software engineering profession

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Several aspects of software engineering as a profession are considered as follows.

Guide to the Software Engineering Book of Knowledge has been examined, specifically the section on the Software Engineering Professional Practice knowledge area which is concerned with the knowledge, skills, and attitudes that software engineers must possess to practice software engineering in a professional, responsible, and ethical manner. Breakdown of topics for Software engineering professional practice includes, among others, topics *Accreditation, Certification, and Licensing* and *Codes of Ethics and Professional Conduct*.

Steps to becoming a software engineer are briefly presented. An overview of software engineering degrees and concentrations is given together with the career goals and educational needs. Software engineering as a career choice is discussed. The aspects of professional development and practical issues of licensing and certification are considered.

Software engineering employment and demographics are investigated. Current demand for software engineers and career trends in software engineering are reviewed. Which new careers in software engineering and demand for skilled and qualified software engineers can be expected for the foreseeable future?

Finally, social and human aspects of software engineering considered. What are the characteristics and personality types of software engineers? What the software engineers really do and what are the particularities of the profession. How perception of the software engineers depends on the skills they practice.

Applied Text-Mining algorithms for stock price prediction based on financial news articles

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This presentation will cover parts of research conducted at South East European University, partially within the work of Master thesis.

Lots of investors are involved in stock market and they are all interested to know more about the future of market to be able to have more successful investments. Effective market prediction can help investors with trade advices or can be used as a component inside automatic trader agents, ability to predict in a market economy is equal to being generate wealth by avoiding financial losses and making financial gains. As usually full prediction in science is not applicable, specifically when we deal with stock market where many variables are in play, the expert opinions through news articles are more qualitative variables that can be of high value if analyzed properly.

The idea relies on proposing a model and needed steps that one should undertake in order to try and predict potential stock price fluctuation solely based on financial news from relevant sources.

The presentation and the paper starts by providing background information on the problem and text mining in general, furthermore supporting the idea with relevant research papers needed to focus on the problem we are researching. The model proposed relies on existing text-mining techniques used for sentiment analysis, combined with historical data from relevant news sources as well as stock data.

The second part of the presentation will focus mainly on the application of the model that we have undertaken in order to predict potential stock price fluctuation solely based on financial news from relevant sources that have been identified as crucial ones. Further elaboration of identifying the news source articles as well as companies that are a matter of the study are to be presented. The results of the applied model in our own generated dataset are further explained and presented in the presentation and paper.

IT Graduates and Entrepreneurship - Love or Hate?

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According to startups' statistics, Romania is one of the fastest-growing IT markets in Central and Eastern Europe area. EUROSTAT indicates Romania as number one in Europe and sixth in the world as concerns IT specialists – approximately 100,000 people in the IT field. Microsoft acquired Romanian Antivirus Technology in 2003. Microsoft representatives consider there is a huge potential for development in IT in Romania, as we have a very good high tech education and a western-oriented culture. Romania is ranked on the third place in the world as for outsourcing services, quite close to India and China.

Encouraged by the cost-effective human resources on one side and the high qualification of IT specialists on the other side, many IT corporations like Microsoft, Google, Continental, Intel, Motorola, Sun Microsystems, Boeing, Amazon have opened subsidiaries in Romania, leading to a spectacular increase of the software development activities.

Apart from this spectacular development, Romania suffers from a lack of real entrepreneurship in IT. Most of the software created here is exported. High tech specialists prefer to get hired at multinational companies and create software at request to be outsourced, instead of opening their own firms and along with outsourcing services, maybe valorizing own creativity in designing new software products.

There is an hesitation and mistrust in taking initiative for creating a start-up in IT area. There are multiple causes leading to this state-of-the art. Lack of a serious entrepreneurial education and culture, taxes, administrative barriers, restricted access to financing, and lack of mentorship represent strong obstacles for young IT specialists towards creating their own companies.

One of the few entrepreneurs that had the courage to set up their own companies considers that IT entrepreneurship has a great potential in Romania, but IT specialists “live in a big bubble”. They benefit of quite comfortable salaries and don't have any incentive to start their own businesses. These young high tech specialists (between 25 and 40 years) should be stimulated to leave away the fear of investing in something new and to take initiative in founding their own firms, with own ideas, own new soft products.

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Challenges in designing educational information system

Keywords: Information system; Education; Information system design.

Abstract: This paper describes the experiences gained in the work on educational information systems. The paper presents an overview of potential challenges in the development of these information systems, as well as a set of potential solutions that can be applied in these situations. These challenges are divided into three categories, the first one covers the process of designing the information systems, the second covers the usage of the information systems, and the third covers the usage of data from the systems.

In the first part of the paper, the topic of designing information systems that starts with the collection of requests is addressed. The educational process involves a large number of different participants who on the basis of previous experience perform certain business processes. This experience ensures the functioning of the system, but the absence of unique written documentation and unique looking at a system as a whole requires substantial amount of time for understanding all processes. Assistance in understanding the processes can be provided by exploring existing software solutions that describe business processes in a partial way, but these solutions can lead to new challenges if they are not implemented in a uniform manner. This can be added the need for frequent changes to the legislation that can make some processes inconsistent, but also can lead to different interpretations and views of the given processes.

The second part of the paper deals with the challenges when using these educational information systems. These challenges include work with a large number of diverse users, the level of their training and the initial release of the system. Only putting into operation is a challenge as it should be done in such a manner that all the users relatively early see the benefits from the data they enters into the system. The system should also consider later updating of the given system, data, and users. The third part of the paper deals with the challenges of using the data themselves. The usage of the data contained in these systems could include exchanged with other systems for statistical processing, as well as for decisions making purposes. These exchanges include concepts such as correctness, transparency and privacy when working with the data itself.

Academic promotion and financing in the field of software engineering in a medium developed country

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Software engineering is a multidisciplinary field of investigation and study, sharing features of the technical or engineering field. One of its characteristics is the aim to create new values for the benefit of the society. Another trait might be the fact that software engineers are in high demand on the market, relatively well paid and often attracted by highly developed countries. For less developed countries, this may cause competitive disadvantage due to brain drain and chronic lack of expertise in a vibrant field, preventing from narrowing the gap.

One of the problems can become the threat of negative selection among higher education teaching staff in that field. It should not come as surprise in Croatia, where the promotion policy in higher education is based mostly on so called scientific excellence, while the salaries of the faculty are regulated by legal acts in a highly bureaucratic manner, like for civil servants' hierarchy. They principally depend on the academic position and the number of years in service and not on the field of activity, nor quantity or quality of the delivered teaching. A young academic novice is equally paid in highly demanded software engineering as in some fields modestly present in the market demand. Resistance to solve that problem has loud supporters. A remedy could be to finance the faculties and/or studies in proportion to the income taxes collected from their alumni, at home and abroad. How to realise it in practice requires some deliberations. That could enforce the attempts to adapt the enrolment quotas to the market demand and stimulate staff for excellence in teaching as their main task.

Regarding the academic promotion, world-wide have been accepted scientometric criteria as the simplest and apparently objective measure of scientists' quality. However, even the inventor of one of the most used criteria, the journal impact factor, explicitly denounced it as a measure for academic promotion. In the literature, opinions are rather abundant against the mechanical application of scientometric criteria. For a semi-developed country, it remains the question who will use the published results of its best and brightest? Hardly their country of origin, but more probably a better developed country would find resources to do it. Paradoxically, the achievements abroad are much more appreciated than those in Croatia. The most-read Croatian daily newspaper listed 10 of the "Croatian most famous" scientists. They are excellent scientists but only one of them lives and works in Croatia and earns money and pays taxes there. For academic promotion, any achievement abroad is more valued than at home. On one hand that is devised to prevent from corruptive promotions, but on the other hand it is a remnant of tragic colonial mentality in Croatia, developed through centuries of foreign rule.

The proposal would be to keep the old promotion scheme in order to avoid chaos due to a radical change, but to introduce in parallel a possibility that promotion decisively can depend upon the relevance of the candidate's activity for the benefit of the home country. In addition to publications, that would encompass decent salaries for alumni, income from projects, notable improvements in industry, health, social services, facilities and administration, and contribution to the overall quality of life. With that tasks in mind, corruption and nepotism in academic promotion might be eliminated even without excessive bureaucratic control.

Extension of Tourist Guide with recognition of Bulgarian embroideries

The cultural and historical heritage is a topical theme for every country in Europe. Various tools of digitization and conservation are being developed for the cultural and historical sites, as well as for those that assist and guide the tourists during their visits.

Tourist Guide is an intelligent tool that is developed in Faculty of Mathematics and Informatics of Plovdiv University, as part of the VIPS project at the Department of Computer Systems. Tourist guide is implemented as an intelligent assistant that help the users to create a tourist route depend on their location, cultural objects that they interested in and the different physical characteristics of the places where these objects are located. The tourist can choose one of the two options to implement the route:

- Virtual Route - in this scenario, the environment provides the user tourist route with the attractions that interest him, information about each of the objects in the route, their interrelations, if there are any, and the multimedia presentation of the objects. In this case, the location of the user, the physical space where the objects are and the visiting constraints such as working time or weather forecast are irrelevant.
- Real route - in this case, it is generated and offered to the user a real route according to his wishes. It will take into account the location of the user and the time he is in a given place, the constraints imposed by the real space. For example, if the user wants to see the Antique Theater in Plovdiv, the system will generate the route according to the working time of the object and how long time it will take to reach there. If the weather forecast is rainy, the system may alert the user that this object is outdoors and is not suitable for a visit at that time.

A part of the Bulgarian cultural and historical heritage are the national costumes and dresses decorated with a lot of embroidery and needlework. In every region in Bulgaria embroidery has specific characteristics, which are determined by the combination of colors, stitches, symbols, ornaments, sewn beads, coins, tassels, and sequins. These features can determine the place where the embroidery was made. By using machine learning methods, in particular neural network algorithms, the tourist guide can be taught to recognize embroidery, conclude whether it is Bulgarian or not, and classify it in relation to its area of production. This classification could help it to extract information from related ontologies and to enrich and expand the user's knowledge.

The user can take a photo of an embroidery and the TG can try to identify the embroidery in real time and convey information to the tourist. The task of the tourist guide can be divided into three separate parts: recognition of an image as an embroidery, identification of the embroidery as Bulgarian, and its classification in relation to the area of production. All of these three tasks can be completed by using methods based on neural networks. Recognition of the image as an embroidery, is decided with Hopfield's associative memory, whose neural network was used for this purpose.

Software testing tools: from real-world software projects to educational contents

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Software testing is a key discipline in software engineering. There are a lot of sources that can be used to develop educational contents in that discipline: numerous textbooks, recommendations from authorities like IEEE and ISTQB, and others.

Software testing without tool support is not a useful way in practical projects. Thus, students should become familiar with some of them – but which ones?

Our approach to educational contents in software testing and tool support originates in real-world software projects and their requirements to quality. In those projects, we were faced with the following questions:

- How to support the development test cases?
- How to check the completeness of developed test cases?
- How to automate regression testing, i.e. to prove that there is no regression after modifications of software?

While these questions are one focus to our software testing course, we included testing tools to support each of these points, either by using free software or by developing testing tools by own efforts. Students had to work with them in practical assignments.

Assessment of the Evolution of Computing Curricula at the Ss. Cyril and Methodius University in Skopje – Focus on the Areas of Software Engineering and Information Systems

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Abstract

The urge to be in flux with recent technological advances and the latest developments of computing as a field, has driven the respective department(s) at the Ss. Cyril and Methodius University in Skopje, Macedonia, to continuously change the curricula every few years. Even when only considering undergraduate studies, there were 7 major reconstructions: in 2000, 2005, 2009, 2011, 2013, 2016 and 2018. Until recently, most of the undergraduate students were undertaking 4-year studies, a fact that implies that in most situations a new program was introduced even before the first generation of students from the previous one have been able to graduate, so there was never a chance for a true closure of each development process. The situation gets even more complex knowing that each student has the right to study according to the original program for at least 8 years and in many situations there is the possibility to halt or postpone the studies and continue later from the same spot. As a conclusion, one can easily claim that until except for the first two, all the other curriculum development efforts has not yet truly reached their end – a process of constant change. This opens many questions, some of which touch the issues of quality assurance and the feasibility of realistic assessment of the effects of change.

The main interest of the author of this work lies in the evolution of the curriculum itself – how the structure evolved and how their coverage of the

respective body of knowledge (BoK) has moved across the areas of interest. Therefore, the main goals of this study are: to give an overview of the evolution of the teaching within the areas of software engineering and information systems over the past two decades at the author's institution, to assess the breadth and degree of coverage of the BoK of these two areas over the multitude of accreditation processes, and finally to measure the extent of exposure of students to knowledge from these areas. This work uses an implementation of a software framework for tracking of curriculum evolution developed within the SISng project [1,2].

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Development of a new undergraduate study program of Informatics

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This work presents a new undergraduate study program of informatics at a Department of Informatics, University of Rijeka.

As the most important issue of the ICT industry in Croatia, there is a shortage of educational resources already, and in the near future a demand for ICT professionals will continue to grow and ICT will be the main generator of the economy and society development. It is therefore important to have contemporary study programs that educate future IT professionals. This was also the motivation for creating our new study program.

The biggest change compared to the existing undergraduate study program is the introduction of modules at the 3rd year of study (the student chooses one of the 4 offered modules). The motivation for the introduction of modules was to increase the possibility of choice for students, as well as to answer to labor market's needs and trends (diversity of jobs in ICT).

Due to the specificity and width of the areas of information and communication science it was possible to allow students flexibility in choosing the module (as a predefined set of related courses), according to their interests. The module design took into account the needs of the labor market and examples of related study programs in ICT. Four modules were proposed: a) Development of program support, b) Communication systems, c) Multimedia systems, and d) Information systems. At the 3rd year of study each student chooses one module and thus specializes in the selected IT field.

In addition, it is particularly important that we introduced the course Professional Practice at the last semester of the new study program, so the students will now have the possibility to go to companies or other institutions for a semester and acquire this kind of practical competence.

By modernizing the study program, introducing modules, a course of Professional Practice, and more elective courses, we hope to influence the quality of the study program and the greater satisfaction of enrolled students, as well as increase the enrollment quota.

Real-Time Change Data Capture: A case from Oracle DB to Google Cloud Spanner

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Companies that are dealing with huge amount of data (big data) have many challenges, storing the data, processing the data, applying machine learning, syncing the data with cloud platforms, working on different data formats etc. One of the biggest open questions nowadays is where to keep the data, on prem or cloud. Since most of big enterprises are using legacy systems and for most of them the data currently is in private clusters, they are after solutions for moving and syncing the data with different cloud vendors. Having a copy of your data in the cloud can be very beneficial for enterprises.

There are various solutions proposed for change data capture for relational DBs, from open source to commercial ones. However not many of these solutions target all the data formats and allow us to apply CDC on cloud. Oracle Golden Gate plays a crucial role in industry recently on capturing the change data logs. It is widely used for replication and database synchronization, however there is still potential to utilize it better for Big Data applications and Cloud.

Through this presentation we are going to present and demonstrate a solution for Change Data Capture from Oracle DB to Google Spanner. Our solution is made of two parts, 1) the initial seeding of the data and 2) the CDC and support of main DML operations for this process. The solution will be built and developed on top of CDAP (Cask Data Application Platform) which will allow us to use Spark for real-time CDC in Google Cloud.

The Proposal of the New Course on Faculty of Electrical Engineering Sarajevo for the Hardware/Software Codesign

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The software developers and programmers can easily find job nowadays. It's not required to have any prior knowledge about the hardware design. However the need for the computer scientist also rises. This was the reason to propose the course that will deal with the basic ideas of hardware-software codesign. If the course get accepted on the University the students will have the opportunity to learn some fundamentals and practical aspects of hardware-software codesign. The main idea is to try to understand the relation between software complexity and hardware cost. The book that is proposed is A Practical Introduction to Hardware/Software Codesign by Patrick R. Schaumont.

Lessons Learned from an Experiment with Database Professionals

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This paper presents the results from an experiment we conducted with database professionals in order to more objectively evaluate an approach to automated design of the initial conceptual database model based on the bussines process model. The source bussines process model is represented by collaborative BPMN. The target conceptual database model is represented by the UML class diagram.

The results obtained from the experiment with database professionals confirm the results of initial case study based evaluation of the approach, as well as the results of the previous experiment we conducted with undergraduate students at our Faculty. The evaluation results of the approach imply that the approach and the implemented automatic generator enable generation of very high percentage of the target conceptual database model with very high precision. In addition, the experiment implies that automatically generated conceptual database model can be used as a good starting point for manual design of the target model, since it significantly shortens the time required for the design.

This paper also presents challenges and lessons learned from the preparation and realisation of the experiments. The challenges are related to the identification of the potential participants in the experiment, communication with the participants, and time slots and deadlines to conduct the experiment. The experiences gained through this experiment are very valuable, and will be of great help in the next experiment(s) we plan to conduct.

AMADEOS – An Online System for Automated Model-driven Database Design

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During the last several years, our research was devoted to the automatic business process model-driven database design, particularly automatic conceptual database model (CDM) synthesis. We identified the semantic capacity of the business process models (BPMs), specified the formal transformation rules and implemented several tools for the automatic CDM synthesis. This set of tools includes: ATL-based CDM generator based on the single source UML activity diagram (UML AD), ATL-based CDM generator based on the single source collaborative BPMN model, and Java-based CDM generator taking a collection of the source UML AD models.

In order to obtain a platform independent and publicly available tool for the BPM-driven CDM synthesis, we performed the migration of these tools into a SOA application. The result of the migration is the AMADEOS – an online tool for the automatic BPM-driven CDM synthesis. AMADEOS currently enables automatic generation of the target database model represented by UML class diagram, based on BPMs represented by two concrete notations: BPMN and UML AD. In addition, AMADEOS enables web-based visualization of automatically generated database models.

AMADEOS is implemented as a web-based, platform-independent tool, in contrast to the existing tools that are dependent on some specific technological platform used for their implementation. Unlike the existing approaches, which are characterised by the direct synthesis of the target model based on business process models represented by a sole concrete notation such as BPMN, AMADEOS uses an indirect two-phase approach, which is based on introduction of a simple domain specific language (DSL) as an intermediate layer between source and target notations. The DSL specification is based on the identified semantic capacity of BPMs for automatic CDM synthesis. With the intermediate layer, the synthesis is split into two phases: (i) automatic extraction of specific concepts from the source model and their DSL-based representation, and (ii) automated generation of the target model based on the DSL-based representation of the extracted concepts.