Foundation of the software engineering educational profile at the Faculty of Mathematics and Natural Sciences, Univ. of Banja Luka: opportunities and challenges

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Faculty of Mathematics and Natural Sciences, University of Banja luka

▸ Founded in 1996.

▸ 8 study programs (Biology, Chemistry, Physics, Geography, Ecology, Spatial planning, **Mathematics and Informatics**, Technical education)

▸ Over 80 employees (academic staff)

▸ About 2000 graduated students

▸ This year we celebrate 20 years from the foundation!

16th Workshop on Software Engineering

16th Workshop on Software Engineering

Dept. of Mathematics and Informatics

▸ 19 full time employed professors and teaching assistants

▸ 7 guest professors

▸ More than 400 active students

▸ About 250 graduated students

Graduates who prefer **mathematics** are mainly oriented to work in **educational sector** (elementary, high and grammar schools)

Graduates who prefer **informatics** go to **ICT sector** (large companies and SMEs)

About 10% stay at the University (usually best students)

Current educational profiles at the Dept.

‣ **Bachelor degrees**

  ‣ Professor of mathematics and informatics – 180 ECTS

  ‣ Professor of mathematics and informatics – 240 ECTS

  ‣ Graduated mathematician and informatician – 240 ECTS

‣ **Master degrees**

  ‣ Master of mathematical sciences - 300 ECTS

    ‣ algebra and geometry,

    ‣ analysis and applied mathematics

‣ **PhD studies (math) are in the accreditation process**

Scientific activities at the Dept.

- Pure Mathematics:
  - Mathematical mechanics, partial differential equations, analysis (in general), discrete geometry, number theory, universal algebra

- Computational fields:
  - numeric mathematics, convex and linear/integer programming, discrete optimization, heuristic algorithms

- Data mining

- Bioinformatics –
  - Recently we have become participants in a COST action

Why new ICT educational profile

- Academic needs
  - Strengthening own academic capacities in the field of CS
  - Prerequisite for master and PhD studies in the field of ICT at the Faculty
- Answer to the market demands
- Strengthening the influence of the Faculty in strategic decisions in the field of ICT
  - ICT education (formal and informal)
  - ICT strategies
  - Law regulatives

Opportunities on the labor market

▸ ICT specialists are in high demand in Bosnia and Herzegovina (similar in other developing countries)

▸ Many open positions for ICT profile

▸ Good starting position for young graduates

▸ There are no unemployed graduated students coming from our Department

▸ Our students have a relatively "good reputation" in the labor market

Source:
Assessment of Competencies, Technical Skills and Needs in Bosnia Herzegovina's ICT Services Sector, Partnership for Innovation, USAID, **2014**.

The name of the institution	Administrative region	Total number of graduates hired by ICT SMEs	Average rating (1 - extremely poor, 5 - excellent)
Faculty of Electrical Engineering, University of Sarajevo	Sarajevo	208	3.77
Faculty of Information Technologies, Džemal Bijedić University of Mostar	Mostar	109	4.04
Faculty of Mechanical Engineering and Computing, University of Mostar	Mostar	90	3.38
Faculty of Electrical Engineering, University of Banja Luka	Banja Luka	71	3.71
Faculty of Electrical Engineering, University of Tuzla	Tuzla	54	3.75
Sarajevo School of Science and Technology	Sarajevo	15	3.27
Faculty of Science, University of Banja Luka	Banja Luka	14	3.63
Faculty of Science and Education, University of Mostar	Mostar	9	3.14
Banja Luka College	Banja Luka	8	3.43
Faculty of Electrical Engineering, University of East Sarajevo	Lukavica	6	3.88
University of Business Studies	Banja Luka	4	2.83
Paneuropean University Aperion	Banja Luka	4	2.60
University for Business Engineering and Management	Banja Luka	2	2.75
Faculty of Science	Tuzla	1	3.50
Technical Faculty	Bihać	1	3.00
American University in Bosnia and Herzegovina	Sarajevo	1	2.75
American University in Bosnia and Herzegovina	Tuzla	1	2.67
Economics and Information Technology College	Prijedor	1	2.60
Faculty of Mechanical Engineering, University of Banja Luka	Banja Luka	1	3.33
Faculty of Information Technology	Bijeljina	1	3.00
Other educational institutions		496	

Some other facts

▸ About a half of technical staff at SMEs are graduates from **5 public B&H faculties**

▸ SMEs reported a **significant need for new staff** with senior technical skills and practical experience

▸ Two thirds of SMEs (64%) reported that:

  ▸ more than 50% of technical staff **are not skilled enough** to be competitive in EU and global markets

  ▸ Java, iOS and Android programming are **the most deficient** technical skill areas for newly hired youth.

  ▸ newly hired youth possesses **above average skills** in Microsoft Windows, HTML, XML, .NET, C++, C# and SQL programming languages and technologies.

Source: Assessment of Competencies, Technical Skills and Needs in Bosnia Herzegovina's ICT Services Sector, Partnership for Innovation, USAID, **2014**.

Foundation steps

- Internal Agreement
    - The initiative is highly supported by the faculty management
- Creation of the detailed overview of the profile
    - We have a fresh experience - founding PhD studies in math
    - Human resources identification
    - Curriculum identification
    - Define the methods of monitoring quality of the studies
- Acreditation period: depends on the Ministry of Education (usually about a year)
- Make a promotion (high schools, public sector, companies)

Curriculum

▸ Duration:

   ▸ Decide: three or four years study (180 ECTS or 240 ECTS)?

▸ **Conform to the ACM and IEEE recommendations**

▸ Must fit to the Faculty orientation: include fields of bioinformatics, GIS, applied mathematics, statistics…

▸ Highly consider market needs, but do not restrict the curriculum to those needs

▸ We have findings from the project "Strategic Development of Higher Education and Qualification Standards in B&H", Council of Europe, 2014-2015

   ▸ The development of standards of qualifications in five different subject fields

   ▸ The development of Guidelines for further development and use of qualifications standards in Bosnia and Herzegovina

   ▸ …

▸ Public document:

   ▸ "Manual for development and use of qualifications and occupational standards in BiH"

Groups of special learning outcomes

- We have identified 11 groups of learning outcomes
  - Mathematics; min. 16 ECTS
  - Theoretical basics of computer sciences; min. 10 ECTS
  - Programming paradigm and programming languages, min. 18 ECTS
  - Operative systems and system programming, min. 6 ECTS
  - Computer architecture and organization of computers, min. 10 ECTS
  - Computer networks and communication, min. 6 ECTS
  - Databases and data management, min. 8 ECTS
  - Software engineering and software development, min. 20 ECTS
  - Computer and information security, min. 5 ECTS
  - Foreign languages, min. 5 ECTS
  - Final paper/project, min. 10 ECTS
- At least **114** ECTS must come from the mandatory Units of learning outcomes listed in the table

Main competences of the profile

▸ Application of basic principles and methods of computer sciences in the wide application area

▸ Application of mathematical and scientific deduction to various IT problems

▸ Designing, adequate implementing and documenting of solutions to complex problems in the field of IT

▸ Analyzing and comparing of alternative solutions of the problems in the field of IT

▸ Applying of generally accepted principles to the synthesis and computer system analyses

▸ Application of advanced algorithmic and mathematical concepts in software designing and analyses

▸ Designing and implementing of software in accordance with the system requirements

Positioning on the labor market

- Software engineer fields
  - system analyst,
  - software designer,
  - programmer/developer,
  - software quality controller,
  - maintenance
- Information system administrator
- Computer system administrator
- Technical support engineer for computer systems
- Teacher in the field of computer sciences and IT in primary school (with prior successful passing of the group of courses in the field of pedagogy and didactics)

Challenges

▸ Provide the support from the government institutions (Ministry of education, Ministry of science, local government bodies) and ICT companies

▸ Engage high quality academic staff in the education process

▸ Provide the equipment for laboratories

▸ Define the curricula in details

▸ Establish the stronger cooperation with public and private ICT sector

▸ Think in advance: as soon as possible start to work on founding master and PhD studies in CS

▸ How to attract quality candidates?
  ▸ Keep the quality
  ▸ Work on providing the scholarships for (most) regular students
  ▸ Provide the student practicing (make agreement with local ICT companies)

Thank you for your attention.

Questions and suggestions are welcome.

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