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European University Alliance

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AI in Teaching and Research

at the University of Belgrade, School of Electrical Engineering (UniBG - ETF)

Co-funded by
the European Union

Teaching - AI @ETF - undergraduate studies

- History of computing in our school (ETF):
  - Laboratory for Data Processing, from 1971
  - First division in Computer Engineering, from 1987
  - Computer Engineering curriculum, from 1993
  - Software Engineering curriculum, from 2004
- ETF study programmes for undergraduate studies (240 ECTS):
  - Electrical Engineering and Computing (EEC)
  - Software Engineering (SE)
- ETF enrols 720 students in the 1st year of EEC, and 180 students in the 1st year of SE bachelor studies each year
- AI and data are studied in addition to the Software Engineering Department, in three other departments - Computer Engineering and Information Technology, Signals and Systems (formerly: Automatic control systems), and Electronics and Digital Systems
- About 400 BEng students out of 900 students per year learn the basics of AI.

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Teaching - AI @ETF - master academic studies

Electrical and Computer Engineering (EEC)

- 2 semesters (1 school year):
  5 courses + professional practice + MEng thesis, 60 ECTS
- 12 different modules
  - AI is studied in 3 modules: Computer Engineering, Software Engineering, Signal and Systems
- Advantage: Good choice of subjects
- Disadvantage: Students are employed, so they devote little time and finish this level of study late (poor completion rate)

Advanced information technologies in digital transformation (AIT)

- 3 semesters, joint program [ETF + FON]
  10 courses + team startup project + professional practice + MEng thesis, 90 ECTS
- Pilot project in the Digital Transformation Educational Reform in the Republic of Serbia
- Emphasis is placed on professional practice in industry in the AI field, team project assignment and quality master's thesis, combining development and research
- Advantage: Emphasising teamwork and entrepreneurship as essential values in studying.
- Disadvantage: Poor programming and algorithmic prior knowledge of students who enrol in this program, so they are unable to upgrade their knowledge. Poor financial support from the state, ie. does not exist!

Teaching - AI @ETF - doctoral academic studies

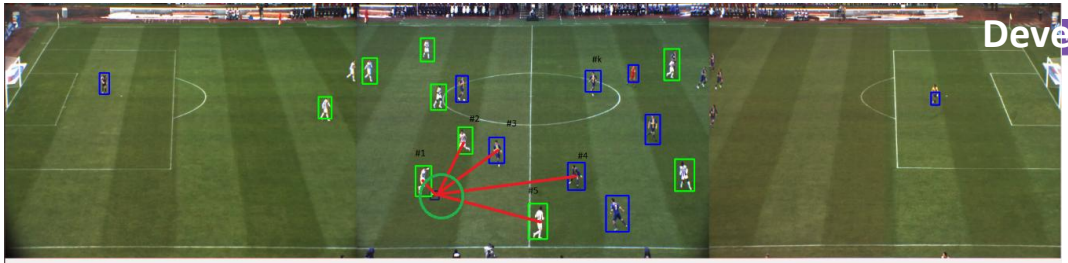
Electrical and Computer Engineering (EEC)

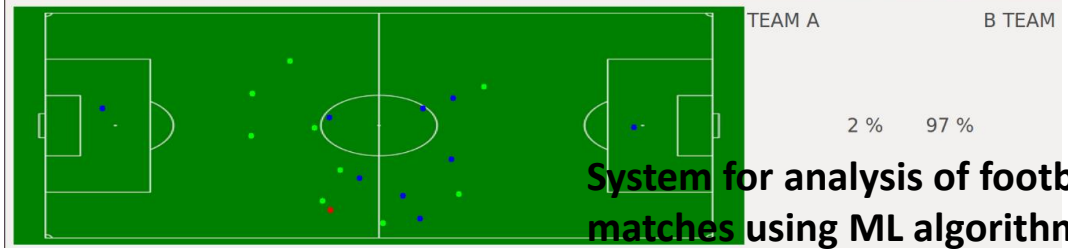
- 3 school years (first and second for courses and research, third for preparation and writing of thesis and oral defence)
  7 courses + PhD thesis
- Requirement for PhD application: at least 1 published scientific paper in a top scientific journal, where the candidate is the 1st author, and at least 2 conference papers
- 11 different modules
  - AI is studied in 3 modules:
    Computer Engineering, Software Engineering, Signal and Systems

Teaching - An overview of AI-oriented subjects

Subject title [ENG]	Study level	Study prog.	Year	% of AI topics in the course
Intelligent Systems	Bachelor	EEC, SE	3, 4	100%
Neural Networks	Bachelor	EEC, SE	3, 4	100%
Artificial Intelligence	Bachelor	EEC	4	100%
Optimization algorithms in engineering	Bachelor	SE	4	100%
Pattern Recognition	Bachelor	EEC	4	100%
Deep Learning Techniques	Bachelor	SE	4	100%
Speech Processing and Recognition	Bachelor	EEC	4	20%
Computer Vision	Master	EEC	1	100%
Data Mining	Master	EEC	1	80%
Machine Learning	Master	EEC	1	100%
Natural Language Processing	Master	EEC	1	100%
Statistical Signal Classification	Master	EEC	1	20%
Soft-computing Methods	Master	EEC	1	25%
Digital Image Processing 2	Master	EEC	1	33%
Machine Vision	Master	EEC	1	8%
Advanced machine learning	Master	AIT	1	100%
Artificial intelligence techniques and tools	Master	AIT	1	100%
Applications of artificial intelligence	Master	AIT	1	100%
Artificial Intelligence and Expert Systems	PhD	EEC	1, 2	100%
Advanced machine learning algorithms	PhD	EEC	1, 2	100%
Deep Learning	PhD	EEC	1, 2	100%

AI projects of our students (MSc thesis): From DEV to Science

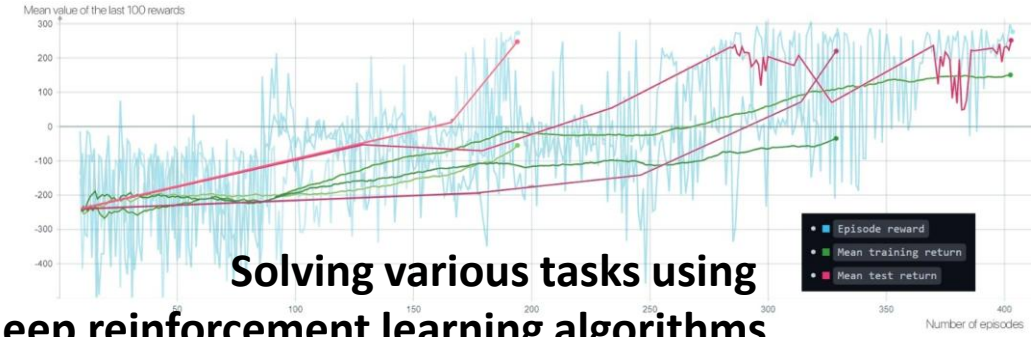




System for analysis of football matches using ML algorithms

Development of an advanced cloud video streaming service with recommendation system

Development of a software system for maintaining vehicle speed on the highway



Solving various tasks using deep reinforcement learning algorithms

Research in the AI/Data science field

- New laboratory space in Belgrade within the Palace of Science
- Active member in BDVA (European Big Data Value Association)
- Infrastructure:
  - 280 computers in 4 computer laboratories
  - More than 75 servers and data storage in the server room
  - 2 specialised AI-machines ThinkSystem SR670
    - CPU 2x Intel Xeon Silver 4216 16C 100W 2.1 Ghz
    - GPU 2x ThinkSystem NVIDIA A40 48GB PCIe Gen4 Passive GP
    - RAM: 8x ThinkSystem 16GB TruDDR4 2933Mhz RDIMM
    - Storage: 3x ThinkSystem 2.5“ MultiVendor 960GB (ThinkSystem SR670 RAID 530-8i + RAID 5)
  - 6 specialised AI-servers with NVIDIA A40/Tesla/Ampere with 11 712 CUDA cores and 8192 AMD cores
  - Atlas 200 AI Accelerator Module and Atlas 500 Pro AI Edge Server

Our new AAI center in the Palace of Science

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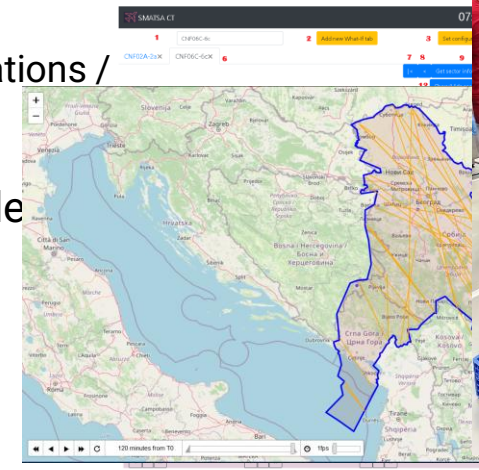
Research in the AI/Data science field - research topics

- Deep Learning and Neural Networks
- Reinforcement Learning
- Explainable AI
- AI Ethics and Bias Mitigation
- Edge AI and IoT
- Auto ML and Model Optimization
- Natural language processing
- Computer vision
- Data Preprocessing and Exploration
- Time Series Analysis and Forecasting
- AI in Healthcare
- AI in Manufacturing

Research in the AI/Data field - Our active R&D projects

- Traffic Forecast: Software tool for planning sectorization - SMATSA
- Combat Vehicles: Software intelligent system for improving the control and visualisation – Ministry of Defence (NDA)
- ERP System: Software integration tool - Henkel AG Germany
- Computer Vision: Software system for automatic detection of product correctness - Henkel Serbia
- ICT consultants' service
  - Ministry of Education / Science / Telecommunications /
  - National Bank of Serbia
  - WHO, UNICEF, UNDP, UNOPS
- Web-based Information Systems with AI module
  - Over 80 universities and faculties
  - Tobacco Administration Agency
  - Belgrade Power Plants
  - Energy Agency



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Research in the AI/Data field - Our scientific projects

- EU & World Bank Funded Projects
  - EuroCC2 - National Competence Centre for HPC (Horizon Europe)
  - European Big Data Innovation Hub (Horizon Europe - EUhubs4data)
  - AVANTES - Advancing Novel Textual Similarity-based Solutions in Software Development
  - HUBTECS - Feasibility study for a Regional Digital Manufacturing Innovation Hub
  - Natural Language Processing to align national plans in Serbia with the global goals
  - STOP - Software for Text Offences Prevention in Serbian: AI-driven Hate Speech Detection
  - Teaching Artificial Intelligence - Build AI courses for mechanical and other (non-AI) engineers (ERASMUS+ HE)

International cooperation in projects

- Temple University (USA)
- The University of Illinois (USA)
- The University of Texas at Austin (USA) - Department of Electrical and Computer Engineering
- San Francisco State University - Department of Computer Science
- Universidad Politécnica de Madrid - Faculty of Computer Science (ESP)
- University of Zurich (SWI)
- ETH Zurich (SWI)
- National University of Singapore - Department of Computer Science - School of Computing (SIN)
- UPC Universitat Politècnica de Catalunya (ESP)
- Instituto Tecnológico de Informática, Valencia (ESP)
- RISE Research Institutes of Sweden AB, Gothenburg, Sweden (SWE)
- TeraLab Data Science - IMT - Institut Mines-Telecom, Paris (FRA)
- King's College London (UK)
- China University of Mining and Technology Beijing (CHN)
- University of Ljubljana, Faculty of Computer and Information Science (SLO)
- University of Ljubljana, Faculty of Electrical Engineering (SLO)
- University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (CRO)
- University of Montenegro, Faculty of Electrical Engineering (CG)
- University of Belgrade, Faculty of Mathematics - Department of Computer Science and Informatics (SRB)
- University of Belgrade, Faculty of Organizational Sciences (SRB)
- University of Belgrade, Faculty of Philology (SRB)
- University of Kragujevac, Faculty of Engineering (SRB)
- University of Novi Sad, Faculty of Technical Sciences (SRB)
- University of Novi Sad, Faculty of Sciences (SRB)
- Verlab Institute - Research Institute for biomedical engineering, medical devices and artificial intelligence, Sarajevo (BiH)
- Blautic Design, Valencia (ESP)
- Nissatech Innovation Center, Niš (SRB)

Conclusion

- Our staff = Combining youth with experience (105 professors + 70 TA; avg. 37 years old).
- In Serbia: the best students enrol in BSc programs in electrical engineering, computing and software engineering, at state universities.
- 41 candidates for enrolment at ETF in 2022 hold prestigious awards in mathematics, physics and informatics, some of them on the Olympic level.
- The average grade of candidates is better than ever (4.73 out of 5) in June 2022.
- About 400 students graduate each year - over 3/4 of graduates continue their careers in the ICT industry.
- And we hope for more ☺

“To stay on top, keep changing!”

Thank you for your attention.

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