University POLITEHNICA of Bucharest

two centuries of innovational wisdom

October 5th, 2019
Who we are

- The most prestigious technical university in Romania, with over 30,000 students and 200 years of history
- The most important research centre in the region, with outputs towards the private sector
- An international partner to some of the most prestigious and innovative universities in the world
Quality teaching and learning

<table>
<thead>
<tr>
<th>Study Level</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor</td>
<td>18 major fields, over than 95 study programs, 4 years duration</td>
</tr>
<tr>
<td>Master</td>
<td>More than 184 study programs, 2 years duration</td>
</tr>
<tr>
<td>PhD</td>
<td>16 fields of Engineering Sciences</td>
</tr>
</tbody>
</table>

**30,000** students enrolled in BSc, MSc, and PhD studies

**2,785 total staff; 1,334** academic staff – **366** full professors, **370** PhD coordinators

**15** faculties, **35** study programs in **English**, **German** and **French**

2,785 total staff; 1,334 academic staff – 366 full professors, 370 PhD coordinators
Budgeting for the future

Over half a billion invested in research, education and human resource in the past decade

Budget for 2018: 180 milion Euros

- 51 research centres
- 70 new state-of-the-art laboratories
- 115 pending patents
- over 1,000 WOS publications yearly
- over 200 R&D job opportunities per year
- 50,000 m² new buildings in 6 years
- 17,000 m² dedicated to research

Budget sources

State budget
EU projects (Structural funds, horizon 2020 and others)
Private
Two new research facilities (CAMPUS & PRECIS)

- TOTAL PROJECT VALUE – 16.300.000 EUR
- 41 state-of-the-art research labs
- oriented towards private sector services and international cooperation

- TOTAL PROJECT VALUE – 10.937.586 EUR
- 28 research labs
- oriented towards private sector services and international cooperation
NEW RESEARCH CENTER

QUICK FACTS:
- FINALIZED DECEMBER 2015;

- 28 new R&Ds created by the project;
- 8370 m² built-up surface for the new building;
- 35 jobs created in R&Ds;
- 9 international projects in which the infrastructure will be involved.

Purchase of the latest technological equipment and related equipment:
- 291 research equipment development, of which 3 equipment with an individual value of over 100,000 Euro:
  - a state-of-the-art computational cluster with over 10 TFlops over-the-counter and over 50 TFlops
  - a complete line of PCB prototyping for wiring, printing, component mounting and soldering
  - an integrated multi-level monitoring system on wide indoor / outdoor air quality;
The Research Center includes 28 laboratories:

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Product Driven Manufacturing Management;</td>
</tr>
<tr>
<td>L2</td>
<td>Innovative Processes in Intelligent Product Exploitation;</td>
</tr>
<tr>
<td>L3</td>
<td>Energy Efficient Processes and Critical Infrastructures;</td>
</tr>
<tr>
<td>L4</td>
<td>Robots for Production Processes and Innovative Services;</td>
</tr>
<tr>
<td>L5</td>
<td>Innovative products for Sustainable Processes Development;</td>
</tr>
<tr>
<td>L6</td>
<td>Complex Cyber Physical Systems;</td>
</tr>
<tr>
<td>L7</td>
<td>Organizational Interoperability and Knowledge Management;</td>
</tr>
<tr>
<td>L8</td>
<td>The Enterprise of the Future;</td>
</tr>
<tr>
<td>L9</td>
<td>Innovative Products and Processes to Increase Life Quality;</td>
</tr>
<tr>
<td>L10</td>
<td>Advanced Control Systems for Real-Time Applications;</td>
</tr>
<tr>
<td>L11</td>
<td>Interoperable Products and Services to Support Decisions Based on Geospatial Data;</td>
</tr>
<tr>
<td>L12</td>
<td>Computer Based Innovation and Collaborative Knowledge Development;</td>
</tr>
<tr>
<td>L13</td>
<td>Innovative Products and Processes for Knowledge Extracting;</td>
</tr>
<tr>
<td>L14</td>
<td>Technologies for Ambient Intelligence, Fluid Interface and Semantic Lighting;</td>
</tr>
<tr>
<td>L15</td>
<td>Humanoid Robots and Drones;</td>
</tr>
<tr>
<td>L16</td>
<td>Digital Business Ecosystems for Innovative Product and Process Development;</td>
</tr>
<tr>
<td>L17</td>
<td>Pervasive Products and Services;</td>
</tr>
<tr>
<td>L18</td>
<td>Innovative Services Laboratory for Smart, Digital and Collaborative Future Society;</td>
</tr>
<tr>
<td>L19</td>
<td>Innovative Products for Mobile Systems and Services;</td>
</tr>
<tr>
<td>L20</td>
<td>Innovative research and use of advanced computational methods in the areas of aerospace, astrophysics, seismology, meteorology and hydrology;</td>
</tr>
<tr>
<td>L21</td>
<td>Cloud-based Innovative Services;</td>
</tr>
<tr>
<td>L22</td>
<td>Cluster and Grid Computing based Innovative Systems;</td>
</tr>
<tr>
<td>L23</td>
<td>Innovative Products and Processes in the Software Industry;</td>
</tr>
<tr>
<td>L24</td>
<td>Data Security and Services in Complex Networks;</td>
</tr>
<tr>
<td>L25</td>
<td>E-Health Platform Services;</td>
</tr>
<tr>
<td>L26</td>
<td>Cognitive Robotics Applied in Assistive Medicine;</td>
</tr>
<tr>
<td>L27</td>
<td>Virtual Reality;</td>
</tr>
<tr>
<td>L28</td>
<td>Laboratory for Reconfigurable High-Precision Medical Devices.</td>
</tr>
</tbody>
</table>
Industry oriented

- Inter-, multi-disciplinary
- Infrastructure-as-a-lab
- Human-centered research
- Green building Bucharest's landmark
- Cutting edge research (41 labs)

Quick facts:
- finalized December 2015;
- investment 16M Eur (building) + 17M Eur (equipment);
- 8,500 mp, 200 people.
Integrated BMS

Solar panels on the facades

Solar panels on the terrace

Small curtain waterfall for additional air humidification

Geothermal heat pumps

Rain water recovery and filtration
Cutting edge research e.g., biomaterials and nanotechnology
Cutting edge research e.g., food safety and microscopy
Cutting edge research
e.g., artificial intelligence
Data Centers

NCIT Cluster - EF108

- CPU Nodes (Xeon, Opteron, Power)
  - 2500 Cores
  - 3 TB RAM
- GPU Nodes (Nvidia Tesla)
  - 3584 Threads
  - 40 GB RAM
- Storage (IBM, Dell, HP)
  - 40 TB
- Local Network Interconnect
  - Infiniband – 56 Gbps
  - Giga/10Giga Ethernet

Cisco 4500

2x10Gbps

RoEduNet

2x10Gbps

2x10Gbps

PRECIS

- CPU Nodes (Xeon): 270 Cores and 2 TB RAM
- GPU Nodes (Nvidia Tesla): 25000 Threads and 108 GB RAM
- Storage (HP MSA): 120 TB
- Local Network Interconnect: Infiniband – 56 Gbps and Giga/10Giga Ethernet

Cisco 6880

CAMPUS

- CPU Nodes (Xeon): 900 Cores and 7 TB RAM
- Storage (EMC2): 66 TB
- Local Network Interconnect: Infiniband – 56 Gbps and 10Giga Ethernet

Lenovo G8264
Rankings:
Academic Ranking of World Universities – ARWU (Shanghai Ranking)
QS (Quacquarelli Symonds) World University Rankings by Subjects
Grown locally, spread internationally

collaborating with universities from over **100 countries**
With regards to the international dimensions, our university is part of over 20 larger academic associations:

- European University Association (EUA),
- The Conference of European Schools for Advanced Engineering Education and Research (CESAER),
- L’ Agence Universitaire de la Francophonie (AUF),
- T.I.M.E. Association,
- Magna Charta Observatory (MCO),
- European Distance and E-Learning Network Ltd. (EDEN) etc.
UPB. 11 Double Degree Agreements

- National Institute of Applied Sciences (INSA Group)
- National School of Arts and Crafts (ENSAM)
- Catholic School of Arts and Crafts of Lyon (ECAM)
- University of Corsica Pascal Paoli
- University of Montpellier
- Technical University of Moldova
- University of Burgundy
- Telecom SudParis
- Central Supélec
- University of Porto
- University of Lorraine

In the last five years, 65 UPB students are graduates of partner universities.
UPB is one of the main partners of the project ELI-NP is going to be the most advanced research facility in the world focusing on the study of photonuclear physics and its applications, comprising a very high intensity laser of two 10PW ultra-short pulse lasers and the most brilliant tunable gamma-ray beam.

The Măgurele Science Park is aiming at attaining the regional development role of the facility, while economically valorizing the scientific research results on the entire Măgurele platform.
COMPUTER SCIENCE AND ENGINEERING


Education in Computer Science and Engineering

- **Bachelor (4 years)**
  - C1. Computer Systems Architecture
  - C2. Embedded systems
  - C3. System Software
  - C4. Application Software Systems and Artificial Intelligence
  - C5. Information Technology

- **Master (2 years - research program)**

<table>
<thead>
<tr>
<th>Nr</th>
<th>Master Program</th>
<th>Coordinator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Advanced Computer Architecture</td>
<td>Prof. Dr. Ing. Nicolae Tapus</td>
</tr>
<tr>
<td>2.</td>
<td>Parallel and Distributed Systems – English track</td>
<td>Prof. Dr. Ing. Valentin Cristea</td>
</tr>
<tr>
<td>3.</td>
<td>Artificial Intelligence – English track</td>
<td>Prof. Dr. Ing. Adina Florea</td>
</tr>
<tr>
<td>4.</td>
<td>Advanced Software Services</td>
<td>Prof. Dr. Ing. Valentin Cristea</td>
</tr>
<tr>
<td>5.</td>
<td>Internet Systems Engineering</td>
<td>Prof. Dr. Ing. Stefan Trausan-Matu</td>
</tr>
<tr>
<td>6.</td>
<td>System graphics, Multimedia and Virtual Reality</td>
<td>Prof. Dr. Ing. Florica Moldoveanu</td>
</tr>
<tr>
<td>7.</td>
<td>Security of Complex Information Networks</td>
<td>Prof. Dr. Ing. Nicolae Tapus</td>
</tr>
<tr>
<td>8.</td>
<td>Management in Information Technology</td>
<td>Prof. Dr. Ing. Florica Moldoveanu</td>
</tr>
<tr>
<td>9.</td>
<td>Data base Administration</td>
<td>Prof. Dr. Ing. Florin Radulescu</td>
</tr>
<tr>
<td>10.</td>
<td>E-Government</td>
<td>Prof. Dr. Ing. Mariana Mocanu</td>
</tr>
<tr>
<td>11.</td>
<td>Advance Cyber Security</td>
<td>Prof. Dr. Ing. Nicolae Tapus</td>
</tr>
</tbody>
</table>

- **Ph.D. studies (3-4 years) Computer Science and Engineering**
## Curricula, Computer Science and Engineering Bachelor

<table>
<thead>
<tr>
<th>Background in Engineering</th>
<th>Core courses (3 semesters)</th>
<th>Core courses (3 semesters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>Programming Paradigms</td>
<td>Operating Systems Design</td>
</tr>
<tr>
<td>Physics</td>
<td>Digital Computers</td>
<td>Databases Design</td>
</tr>
<tr>
<td>Mechanics</td>
<td>Communications Protocols</td>
<td>Compiler Design</td>
</tr>
<tr>
<td>Electrical engineering</td>
<td>Formal Languages and Automata</td>
<td>Software Systems for Computer Networks</td>
</tr>
<tr>
<td>Electronic Devices</td>
<td>Parallel and Distributed Algorithms</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>Digital Circuits</td>
<td>Algorithm Design</td>
<td>Tools for programs development</td>
</tr>
<tr>
<td></td>
<td>Local Area Networks</td>
<td>Graphic Processing Systems</td>
</tr>
<tr>
<td></td>
<td>Computer Engineering</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td></td>
<td>Software Engineering</td>
<td>System Software</td>
</tr>
<tr>
<td></td>
<td>Computer Graphics</td>
<td>Application Software</td>
</tr>
<tr>
<td></td>
<td>Microprocessor Based System Design</td>
<td>Systems and Artificial Intelligence</td>
</tr>
<tr>
<td></td>
<td>Computer Systems Architecture</td>
<td>Information Technology</td>
</tr>
<tr>
<td></td>
<td>Databases Systems</td>
<td>Data Base Operation</td>
</tr>
<tr>
<td></td>
<td>Operating Systems</td>
<td>WEB Programming</td>
</tr>
<tr>
<td></td>
<td>Software Project Management</td>
<td>E-Commerce</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance Evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Software Project Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Informatic Systems Integration</td>
</tr>
</tbody>
</table>

### Background in Engineering (3 semesters)
- General courses
- Mathematics
- Physics
- Mechanics
- Electrical engineering
- Electronic Devices
- Digital Circuits

### Core courses (3 semesters)
- Introduction to CS
- Computer Programming
- Data Structures
- Algorithms Analysis
- Data Processing
- Assembly Languages
- OO Programming
- Numerical Methods
- System Theory
- Operating System Usage

### Core courses (3 semesters)
- Programming Paradigms
- Digital Computers
- Communications Protocols
- Formal Languages and Automata
- Parallel and Distributed Algorithms
- Algorithm Design
- Local Area Networks
- Computer Engineering
- Software Engineering
- Computer Graphics
- Microprocessor Based System Design
- Computer Systems Architecture
- Databases Systems
- Operating Systems

### Specialization (2 semesters)
- Parallel Computer Architectures
- Multiprocessor Based Systems
- Computer Network Design
- VLSI Design
- Distributed Services Design

### Diploma project
- Embedded Systems
- Microprocessors Systems
- Signal Processing
- Embedded Systems
- Digital Systems Testing
- Fault Tolerant Systems

### Computer Systems Architecture
- Operating Systems Design
- Databases Design
- Compiler Design
- Software Systems for Computer Networks
- Artificial Intelligence
- Tools for programs development

### System Software
- Graphic Processing Systems
- Artificial Intelligence
- Human Computer Interface
- Automated Learning
- CAD/CASE Systems
- Integrated Application

### Application Software
- Systems and Artificial Intelligence

### Information Technology
- Data Base Operation
- WEB Programming
- E-Commerce
- Performance Evaluation
- Software Project Management
- Informatic Systems Integration
University Partners / Company Partners

FREE UNIVERSITY OF AMSTERDAM
UNIVERSITE PIERRE ET MARIE CURIE
DELT UNIVERSITY, THE NETHERLANDS
UNIVERSITY OF OULU, FINLAND
TECHNICAL UNIVERSITY OF KONSTANZ, GERMANY
TECHNICAL UNIVERSITY OF DARMSTADT, GERMANY
TECHNICAL UNIVERSITY OF TAMPERE, FINLAND
CITY UNIVERSITY LONDON, UK
UNIVERSITA DI CATANIA, ITALY
INSTITUTO POLITECNICO DI TORINO, ITALY
TECHNICAL UNIVERSITY OF WIEN, AUSTRIA
GRANADA UNIVERSITY, SPAIN
UNIVERSITE DE MONTPELLIER, FRANCE
ECOLE POLYTECHNIQUE DE NANTES, FRANCE
UNIVERSITE DE SCIENCE ET TECHNOLOGIE DE LILLE, FRANCE
UNIVERSITE DE SAVOIE, FRANCE
UNIVERSITE JOSEPH FOURIER, GRENOBLE, FRANCE
L' INSTITUT POLYTECHNIQUE DE GRENOBLE, FRANCE
KATHOLIEKE HOGESCHOOL SINT LIEVEN, GENT, BELGIUM
TAMPERE UNIVERSITY OF TECHNOLOGY, FINLAND

Laboratories for research and training in partnership with companies:
INTEL,
Microsoft,
IBM,
CISCO,
FreeScale
Oracle,
HP,
UTI,
IXIA
Major research areas:

- Large Scale Distributed Systems; (Cluster, GRID and Cloud Computing)
- Artificial Intelligence; Multi-Agent Systems;
- Semantic Web technologies; Service Science;
- Embedded Systems & Wireless Sensor Networks
- Computer Networks and Mobile Systems
- Distributed Databases;
- E-Learning.
Distributed Systems and Grid Laboratory

Cluster

• Projects in collaboration with California Institute of Technology and the European Organization for Nuclear Research (CERN) (MonAlisa – UPB, CERN, Caltech)

• Modelling, simulation, monitoring and evaluation large scale distributed systems Development of scalable, fault tolerant, high performance platforms for information gathering and visualisation of processing tasks

• Resource management, activity scheduling and optimization techniques

• Prototyping, monitoring and evaluating heterogeneous wireless sensor and actuator networks

• Partner in FP6 projects: EGEE and SeeGRID,

• FP7 projects: P2P-next, SENSEI, Cooper, LTfLL, HP-SEE, Erric, TwisNET, EuWB, LEXNET, etc

• Internationally recognized results: CENIC awards in 2006 and 2008 for the MonAlisa project
The RoEduNet network provides connectivity to:
- universities
- high-level education institutes
- research institutes
- high schools
- elementary schools
- not-for-profit governmental institutions

Its backbone operates at 10/100 Gbps and connects 7 NOC situated in the cities with large universities.

The link to GÉANT is 10 Gbps.
(Partial 100Gbps)
Real-time monitoring is an essential part of managing distributed systems. The MonALISA system is designed as an ensemble of autonomous multi-threaded, self-describing agent-based subsystems which are registered as dynamic services, and are able to collaborate and cooperate in performing a wide range of monitoring tasks and to analyze and process this information in a distributed way to provide optimization decisions in large scale distributed applications.

Monitoring all aspects of complex systems:

- System information for computer nodes and clusters
- Network information: WAN and LAN
- Monitoring the performance of Applications or services
- The End User Systems

Iosif Legrand California Institute of Technology & UPB research team
Cluster Services

• High Performance Computing Services
• European Grid Infrastructure (EGI) - RO-03-UPB
• Cloud Services
• E-learning platforms
• Cisco Certified Internetwork Expert (CCIE) laboratory
• Performant and High Available Directory Services
• E-mail services
• High Available and Performant hosting environment
HPC Services

- High Performance Computing for users
- More than 3500 CPU cores and 12 TB RAM dedicated
- More than 30000 GPU cores
- Hybrid architectures (Intel Xeon, AMD Opteron, Power7, CellBE, GPU)
- 220 TB distributed storage (GluInfiniband interconnect)
- Modern batch system (Open Grid Scheduler) for scheduling management
- Access through fep.grid.pub.ro
EGI – RO-03-UPB

• Part of the European Grid Infrastructure (EGI)
• Certified site RO-03-UPB
• RA administrator for UPB: http://www.romaniangrid.ro/ra.htm
• Runs jobs for CERN Alice experiment
Cloud Services

- Private cloud for UPB students based on OpenStack deployment (http://cloud.curs.pub.ro)
- More than 800GB RAM available for virtual machines
- More than 15 OS templates (Linux and Windows)
- One can create virtual topologies to simulate different environments
Identity Management

• Performant and High Available Directory Services
• Automatic account creation through integration with http://studenti.pub.ro and Emsys platforms.
• More than 70,000 users with a unique account for any service provided
• Synchronized 389DS (LDAP) and Active Directory
• Cloud synchronized accounts for access to Microsoft Office and e-mail subscriptions
E-learning platforms

- E-learning platforms based on Moodle Framework (www.curs.pub.ro)
- Each faculty has its own dedicated platforms (*.curs.pub.ro)
- We ensure versioning of the platforms each year
- Automatic account creation for students and teachers
- Scalable course structure creation and enrolment

### Monthly history

<table>
<thead>
<tr>
<th>Month</th>
<th>Unique visitors</th>
<th>Number of visits</th>
<th>Pages</th>
<th>Hits</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2018</td>
<td>37,119</td>
<td>131,741</td>
<td>7,447,701</td>
<td>8,593,848</td>
<td>509.13 GB</td>
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<tr>
<td>Feb 2018</td>
<td>28,113</td>
<td>80,111</td>
<td>3,786,554</td>
<td>4,599,753</td>
<td>263.63 GB</td>
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<tr>
<td>Mar 2018</td>
<td>29,402</td>
<td>99,167</td>
<td>5,357,089</td>
<td>6,715,664</td>
<td>352.45 GB</td>
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<tr>
<td>Apr 2018</td>
<td>32,782</td>
<td>114,346</td>
<td>6,343,210</td>
<td>7,898,895</td>
<td>428.95 GB</td>
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<tr>
<td>May 2018</td>
<td>39,630</td>
<td>147,582</td>
<td>8,339,202</td>
<td>10,442,227</td>
<td>643.03 GB</td>
</tr>
</tbody>
</table>
The UPB Hub

Aula Magna Conference Center
1300 places
The UPB Hub

Central library
event halls
The UPB Hub

Central library halls
The UPB Hub

Central library halls
The UPB Hub

Amphitheater

Events halls
The UPB Hub

The central Rectorate Building
The UPB hub

Hotel
Thank you!