Knowledge Triangle Model in IT Training at Eötvös Loránd University

A tudásháromszög modell megvalósítása az ELTE informatikus képzésében

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Outline

• Innovation oriented IT training within the framework of EIT KIC ICT LABS

• Other forms for good practical, industry driven education
Challenge in Higher Education

Usable Knowledge
Usable Knowledge

• In theory *theory and practice are the same*, in practice *they are not*!
LEARNING + Practice = SUCCESS

x = idea innovation
Hungry lions  Innovation
The EIT and its KICs

**EIT:** Európai Innovációs és Technológiai Intézet (*European Institute of Innovation and Technology* Independent agency within the EU (2008)).

**KIC:** Tudás- és innovációs közösség (*Knowledge and Innovation Community*).

**ICT:** Információs és kommunikációs technológia (*Information and Communication Technologies*)

**Climate KIC:** klímaváltozás

**EIT ICT Labs:** info-kommunikációs társadalom

**InnoEnergy:** fenntartható energiagazdálkodás
Mission of EIT ICT Labs

Networking and collaboration: EIT ICT Labs speeds up ICT innovation.

Education: it equips students, researchers, academics and business people with skills for applying creativity. Empowering ICT Top Talents for the Future.
EIT ICT Labs centres and partners

Co-location centres

The EIT ICT Labs builds upon 7 nodes:

- Berlin (Germany)
- Eindhoven (The Netherlands)
- Helsinki (Finland)
- London (United Kingdom)
- Paris (France)
- Stockholm (Sweden)
- Trento (Italy)

Associate partners representing global companies, leading research centres, and top universities:

- Madrid (Spain)
- Budapest (Hungary), led by ELTE
EIT ICT Labs – Nodes and Companies
Action lines

Each Node has its unique profile within EIT ICT Labs but encompasses all aspects of the knowledge triangle.

Each Action Line (tematikus csoportok) is coordinated through a specific Node.

1. Kiber-fizikai rendszerek (Cyber-Physical Systems)
2. A jövő felhője (Future Cloud)
3. A jövő hálózati megoldásai (Future Networking Solutions)
4. Egészség és jólét (Health & Wellbeing)
5. Adatvédelem, biztonság és bizalom (Privacy, Security & Trust)
6. Okos energetikai rendszerek (Smart Energy Systems)
7. Okos életterek (Smart Spaces)
8. Városi élet és mobilitás (Urban Life and Mobility)
Looking for a European master’s programme in ICT?
Join the EIT ICT Labs Master School!
Apply until 1 April 2014!

Get to know our Master’s Programme!

http://ictlabs.elte.hu/
Implementation of the knowledge triangle in the Budapest Associate Partner Group

Goal:

creating a functional and viable regional educational, research and innovation hub on CEE level driven by a business perspective

Budapest Associate Partner Group

Strategic industrial and research lab. partners

Platform of innovative SMEs (Hungarian micromultis)

Activities: research and carrier potential
Support for I&E (Innovation and Entrepreneurship) education (DTC, MSc)
Financing structure: 3 project euros + 1 EIT euro

Fundings:

- Industry funded R&D projects
- EU FP7 and national R&D projects
- Dedicated National Development Agency grant
  Carrier funding for further R&D activities: 1.000.000.000 HUF
- Support from the Minister of National Development
  Financial background for the preparation period: 20.000.000 HUF
- „Social Renewal Operational Program” (TÁMOP)
  Education - Curricula Development: 120.000.000 HUF
Activities

EDUCATION
Creating a new breed of entrepreneurs

EIT Master Schools

Spearhead Research

Experience Labs & Living Labs

Cross-Sectoral Mobility

RESEARCH
Enabling excellent individuals and multidisciplinary teams to develop breakthrough ideas

Schools & Camps

Testbeds & Simulation Tools

EIT Innovation Radar

BUSINESS
Supporting innovators all the way to the market
EIT ICT Labs Master School

- Budapest’s contribution: 2nd year of the SDE, S&P, DMT.
- High-skilled Hungarian and CEE students with solid mathematic and computer science background.
- Student consulting services.

- **Budapest became coordinator of 3 programmes.**

The technical programmes (szakirányok):

- **Digital Media Technology (DMT) - BMGE**
- Distributed Systems and Services (DSS)
- Embedded Systems (ES)
- Human Computer Interaction and Design (HCID)
- Internet Technology and Architecture (ITA)
- **Security and Privacy (SaP) - ELTE**
- Service Design and Engineering (SDE) - ELTE
Security and Privacy (SaP) Master Programme

Specialisations are provided during the second year.

- **High Assurance Systems** at TU Berlin
- **Applied Security at University** of Trento
- **System Security** at TU Darmstadt
- **Information Security and Privacy at University** of Saarbrücken
- **Advanced Cryptography** at ELTE
- **Network Security** at University of Twente
Courses in Security and Privacy (SaP) Master Programme

The structure of the Security and Privacy major

1st year: Common base
It develops a common background and prepares the students for all the technical specializations offered in the program.

Courses related to five main disciplines:

<table>
<thead>
<tr>
<th>Network Security</th>
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<tbody>
<tr>
<td>Software OS/Security</td>
</tr>
<tr>
<td>Information Security Management</td>
</tr>
<tr>
<td>Cryptography</td>
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<tr>
<td>Privacy</td>
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<tr>
<td>Electives</td>
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</tbody>
</table>

2nd year: Specialization on Advanced Cryptography
It focuses on the general ideas, techniques and methods of Applied Cryptography as well as on the theoretical background and solid knowledge, putting security in a wider context.

Courses:

<table>
<thead>
<tr>
<th>Applied Cryptography Project Seminar</th>
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</thead>
<tbody>
<tr>
<td>Cryptographic Protocols</td>
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<tr>
<td>Cryptography and its Applications</td>
</tr>
<tr>
<td>Economics of Security and Privacy</td>
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<tr>
<td>Electives</td>
</tr>
</tbody>
</table>
EIT ICT Labs Budapest Doctoral Training Centre:

*Education for Creativity, Innovation, and Entrepreneurship*

ICT research topics combined with I&E education

- 16 Hungarian doctoral candidates enrolled in the first year
  (18 more doctoral candidates to be enrolled in 2013 and 2014)

- Focus:
  Excellence in communication software and system performance
## Details

<table>
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<tr>
<th></th>
<th>2011-2012</th>
<th>Prospects 2012-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Master</td>
<td>PhD</td>
</tr>
<tr>
<td>Climate-KIC</td>
<td>46</td>
<td>31</td>
</tr>
<tr>
<td>EIT ICT Labs</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>KIC InnoEnergy</td>
<td>155</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>201</strong></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>

![Image of students raising hands](image1.png)

![Image of three people working together](image2.png)
2013 & 2014: 12 R&D&I projects

IDENTIFYING THE PROBLEMS OF COMPLEX INFOCOMMUNICATION NETWORKS
Cyber-Physical Systems; Future Networking Solutions.

FUTURE DIGITAL FIELDS AND MOBILITY
Urban Life and Mobility; Future Networking Solutions.

HUMAN COMPUTER COLLABORATION
Future Cloud; Smart Spaces.

PRIVACY, SECURITY AND TRUST
Smart Energy Systems.

2 year long projects

CPS For Smart Factories – András Lőrincz, ELTE

Future Programmable Networks – Attila Takács, Ericsson Hungary and Rolland Vida, BME

Europa – EIT’s Cloud-based data – András Benczúr, ELTE

Security monitoring for critical infrastructure – Levente Buttytán and Márk Félegyházi, BME
Student from Budapest won CH.A.N.G.E Award 2013

Annual award of EIT to support entrepreneurial talents

- **Dorottya Maksay**, master student at EIT ICT Labs Budapest, was awarded for developing her Homebuddy initiative
- **Homebuddy** provides social interaction and care for elderly people by matching them with students who need accommodation.
Other Practical Courses and Forms of IT Training at ELTE

Academic Faculty

Graduate Students

Industry Project Owner

Research Faculty
Practical Courses

Database Management Systems I-II (BSc)

We have an introductory (SQL, normal forms, ER model) and an advanced DBMS (indexing, query optimization, transaction management) course in BSc.

```
Select A_1, A_2, ..., A_n
From R_1, R_2, ..., R_m
where condition
```

← what to return
← relations
← combine filter

SQL Performance Optimization

E-BANKING SUMMIT 2014
Practical Courses
Advanced Databases (MSc)

In MSc programme we teach NoSQL (graph, XML, document, semantic) databases, cloud architecture, virtualization, and Hadoop, MapReduce.
Foundations plus up-to-date technologies

Theory of Databases (MSc)

We prove Cood’s theorem (Algebra, Calculus, Datalog), present 3-valued logics, fuzzy databases, optimizations in distributed databases.
Foundations plus up-to-date technologies

Data Warehouses and Data Mining (MSc-PhD)

We show the architectures of data warehousing, data cubes, data mining models (clustering, classifications, predictions, association rules).
Foundations plus up-to-date technologies
Oracle Junior Program I-II

We introduced practical courses.
Student Project Labs
Knowledge Management Systems Project Lab (MSc)

• It takes 4 semesters
• Students works on Research and Industrial Projects
• We have 30-40 students
Teaching Software Systems Used in Many Companies

We use mostly Oracle components.
Large Systems Used in Companies
Software Systems Used in the Courses

We have other large systems with university licence.
Open Source Software Systems Used in the Courses

We show free systems as well which students can use at home.
Updating Teaching Assistant Materials
Supervising practical thesis

Supervisor: Attila Kiss

Second year PhD students (2013):

1. Balázs Pinczel: Optimization of NoSQL and Semantic Query Processing
2. Gábor Rácz: Data Mining of Graph Databases
3. Gergő Gombos: Optimizations of Distributed Systems
4. Tamás Matuszka: Augmented Reality Applying Semantic Web Information
5. Imre Szücs: Analysis of Predictive Data Mining Models Based on Chaos Theory

Former PhD students:

1. Le Anh Vu (2008): Efficient Processing of Regular Queries Over XML Data Sets Using Structural Indexes
2. Ágnes Vathy (2008): Novel Graph Based Clustering and Visualization Algorithms for Data Mining
MSc and BSc thesis

• Supervisor: Attila Kiss
• More than 100
  – 2011-2013: 24
• Offline DBMS on Android (2012): Award for Excellence of Faculty
Supervising Scientific Students' Associations (TDK) Works

• Motivation of 13 TDK works (2012-2013) of students in our KMS Lab

• Supervisor: Attila Kiss
  – 3. Prize on OTDK (2013): AXML queries
Summer Practical Course

• Since 2012 we have been organizing 6 weeks summer laboratory courses.
• DBMS, navigation, sentiment analysis, NoSQL datamining
We examine Structural Recursion as an XML query language.
Industry Driven Researches Optimization of Query Processing

We make researches on XML indexing, Semantic Web query optimizations.
Industry Driven Researches
Cloud Migration

This is a new topic of us, we want to use ontology to describe software systems, that can be used to speed up migration of systems.
Industry Driven Researches
Data Mining of Social Networks

We collect, analyse, visualize social networks to find interesting patterns, behaviors.
Industry Driven Researches

Augmented Reality and Semantic Web Technologies

The information of public semantic databases (such as Dbpedia), can be used for mobile applications with augmented reality facilities.
Projects supported by the European Union and co-financed by the European Social Fund

We gained several research grants.

Grant agreement no.:

- TÁMOP 4.1.2-08/1/A-2009-0008
- TÁMOP 4.1.2.A/1-11/1
- TAMOP 4.2.1/B-09/1/KMR-2010-0003
- TÁMOP 4.2.2.C FuturlICT.hu
- TÁMOP 4.2.2/B-10/1-2010-0030
- TÉT 10-1-2011-0645
Some of Our Publications (2012 - 2013)


10. Akos Ludanyi, Tamás Lukovszki, Péter Ekler: Simulating Network Coding for Accelerating Tit-for-Tat in Peer-to-Peer Content Sharing. EUNICE 2012: 408-411

Industrial Projects with Students
Semantic Virtual Observatory

We developed a SVO on Oracle and PostgreSQL platform with rich GUI functions, SPARQL management, visualization, RDF extraction, text mining.
Industrial Projects with Students
Semantic Query Processing on Hadoop – MapReduce

Parsing SPARQL queries some parts can be transformed into MapReduce Jobs in order to execute it in a parallel way.

```
SELECT ?X WHERE {
  ?X rdf:type ub:Chair .
  ?Y rdf:type ub:Department .
  ?X ub:worksFor ?Y .
  ?Y ub:subOrganizationOf
  <http://www.University0.edu> .
}
```
Industrial Projects with Students

Indoor Navigation based on Augmented Reality

We developed an Indoor Navigation architecture using AR and all information (maps, routes) are represented in semantic form.
Industrial Projects with Students
Simulation and Analysis of Traffic Data
We simulate traffic with VISSIM, try to find the best mathematical models to our real traffic database and try to find interesting traffic patterns in it.
Industrial Projects with Students
Sentiment Analysis of Social Data

Using Natural Language Processing and SVM classifications we can estimate well the opinions of twitter users.

Methodology:

1. Data processing & filtering (NLP) (algorithm)
Industrial Projects with Students
NoSQL (MongoDB and Cassandra) benchmarks

NoSQL databases are tested to know what happens when some computers are shut down.
Industrial Projects with Students
Smart Metering Applications

We made a mobile application using semantic technologies to simulate energy consumption of households.
Industrial Projects with Students POI Locator mobile applications

We made a location based android client to inform truck drivers about Points of Interests nearby.
Industrial Projects with Students
Web Page Change Detection

Comparing actual XML representation of a web page in different times the subscribers get notices if there were essential changes in the web page.
A company asked us to develop an ontology for its organization.
Industrial Projects with Students
OWL2Java Compiler

We wrote a compiler to transform OWL to Java Beans.

```java
import org.itee.OWL2JenaBean; generator.generator;

public class OWL2JenaBean {
    private static String onto_file = "corsehet-organization_comm.owl";

    public static void main(String[] args) {
        generator.generate(onto_file,"src/demo/jenabea,"demo/jenabea");
    }
}
```
Dynamic Visual Programming Editor

We developed a general purposed visual editor for insurance premium calculation modul.
Industrial projects with students
Technologies of Bank Card Payments

We summarized in a study the current internet payment methods, architectures and software components.
Industrial projects with students

Entity Resolution

Using data mining technics we developed an application to integrate client databases in different systems.
Industrial projects with students
HTML5 applications

We implemented several database forms and other database functions in HTML5.
Expanding the group of our industrial partners
Our industrial partners for the above projects
We worked for several smaller or larger companies.
Finally, we need many-many hard-working students.

THANK YOU FOR YOUR ATTENTION!