Bilkent University
Computer Engineering Department

MSc and PhD Programs

Prof. Dr. H. Altay Güvenir
Graduate Programs

- **MSc**
  - 8 courses + Seminar + Thesis

- **PhD**
  - With MSc degree (approx. 4 years)
    - 8 courses + Seminar + Thesis
  - With BSc degree (approx. 5 years)
    - 16 courses + 2 Seminars + Thesis
Applications

- **Application Deadline:** 2 June 2014
- **Online Application:**
  https://stars.bilkent.edu.tr/gradapp/
- **Requirements for application:**
  - CGPA $\geq 2.80 / 4.00$
  - ALES (Türk adaylar) or GRE (Foreign applicants)
    - ALES: Quantitative $\geq 55$ (for MSc), 80 (for PhD w/o BSc)
    - GRE: Quantitative $\geq 153$ (MSc), 157 (PhD)
  - English Proficiency: TOEFL (IBT) $\geq 82$ or IELTS $\geq 6.5$ or KPDS $\geq 87$ or ÜDS $\geq 87$. 
Interview

- **Date:** 9-10 June 2014
- **Hard copy documents to be submitted during interview:**
  - Transcript
  - ALES or GRE score report
  - Reference letters (2)
  - Proof of English Proficiency (TOFLE, IELTS, KPDS or ÜDS report)
Acceptance requirements

- At least one faculty member willing to work with the applicant
- Department approval
- Graduate School of Engineering and Science approval
Scholarship Options

- **Department scholarship**
  - Tuition waiver
  - Stipend
  - Accommodation
  - Health Insurance
  - Additional Scholarship for Teaching Assistantship
  - Office (shared)

- **TÜBİTAK Scholarship or TÜBİTAK projects**
  - Tuition waiver
  - Accommodation
  - Health Insurance
  - Office (shared)
Ways of acceptance

- Project grants (except TÜBİTAK projects)
  - Tuition waiver
  - Stipend (paid from the project budget)
  - Accommodation
  - Health Insurance (paid from the project budget)
  - Additional Scholarship for Teaching Assistantship
  - Office (shared)

- Graduate School scholarship
  - Tuition waiver
  - Additional Scholarship for Teaching Assistantship
Faculty Members

- In alphabetic order

(Please contact with them in person for details)
Varol Akman (akman@bilkent.edu.tr)

• Doğal dilde anlam ve kullanımla ilgili sorunların — özellikle bağlamın katkılarının — bilgisayar programları yazarak irdelenmesi
• Yapay zekanın — özellikle sağduyunun — mantıksal temelleri ve bunların bilgisayarda gösterimi
• İnternetin toplumu ilgilendiren yönleri
Selim Aksoy
saksoy@cs.bilkent.edu.tr
http://www.cs.bilkent.edu.tr/~saksoy
Office: EA 423 (4th floor)

Research interests:
- Computer vision
- Pattern recognition
- Machine learning
- Data mining

Current topics:
- Remote sensing image analysis
- Image and video mining
- Medical image analysis

RETINA Vision and Learning Group
http://retina.cs.bilkent.edu.tr
Sponsored Research Projects

- Remote sensing image analysis
  - TÜBİTAK CAREER Grant, 158,000 YTL, 2005-2010
  - EC Joint Research Centre, 35,000 Euro, 2008
  - FP6 Marie Curie Grant, 80,000 Euro, 2005-2007
  - U.S. Army, $850,000, 2003-2005
  - NASA Goddard Space Flight Center, $430,000, 2001-2004

- Image and video mining
  - TÜBİTAK and COST 292 Action, 102,060 YTL, 2004-2008
  - DPT, 2004-2005

- Medical image analysis
  - TÜBİTAK CAREER Grant, 158,000 YTL, 2005-2010
  - U.S. National Library of Medicine, $750,000, 2001-2004
Remote Sensing Image Analysis

- Increasing resolution in space and time (NASA receives 3 TB/day)
- Object recognition, classification and retrieval (Have you tried Google Earth?)

- Urban planning / monitoring
- Effects of natural disasters
- Environmental monitoring

Dr. Selim Aksoy
Image and Video Mining

- Huge amounts of multimedia data (personal, commercial, free, ...)
- Semantic classification and retrieval (Have you tried Google Video?)
- Object recognition
- Scene classification
- Combining image/audio/motion/text

Dr. Selim Aksoy
Medical Image Analysis

- Microscopic image classification
- Cancer detection / grading
- Content-based searching of past cases
- Automatic report generation
Combinatorial algorithms to analyze high throughput sequence data to discover, genotype, and phase genomic variants, assemble genomes and transcriptomes.
Types of genomic variants

**SNP:** Single nucleotide polymorphism (substitutions)
**Indel:** Insertions and deletions of sequence of length 1 to 50 basepairs

**reference:**

```
C A C A G T G C G C - T
```

**sample:**

```
C A C C G T G - G C A T
```

SNP \ deletion \ insertion

**Short tandem repeats:** microsatellites, minisatellites, alpha & beta satellites, etc.

**reference:**

```
C A G C A G C A G C A G C A G C A G C A G C A G
```

**sample:**

```
C A G C A G C A G C A G C A G C A G C A G C A G
```

**Structural variation:**
Genomic alterations > 50 bp
Deletions, insertions, mobile elements, duplications, inversions and translocations
Genome sequencers

- Roche/454
- AB SOLiD
- Illumina HiSeq2000
- Pacific Biosciences RS
- Ion Torrent PGM
- Ion Torrent Proton
- Illumina MiSeq
- Oxford Nanopore MinION
- Oxford Nanopore GridION

... and more! All produce data with different properties.
Selected publications


**Combinatorial algorithms for structural variation detection in high throughput sequenced genomes.** Genome Research, Jul, 19(7):1270-8, 2009.


**A draft sequence of the Neandertal genome** Science, 7 May, 328 (5979):710-722, 2010.
*Recipient of the 2010 AAAS Newcomb Cleveland Prize.*


**Limitations of next-generation genome sequence assembly.** Nature Methods, 8(1):61-65, 2011.


Projects

- Discovery and characterization of genomic variation
  - Funded by EU Marie Curie Actions Career Integration Grant
- Algorithms and hardware designs for ultra-fast mapping of HTS reads to reference genome assemblies
  - Funded by US National Institutes of Health
- De novo and hybrid (multi-platform) sequence assembly.
- Genomic repeat discovery, classification and annotation.
- Distributed algorithms for genome assembly.

Positions available. Contact if you have B.Sc. or M.Sc. degree in computer science, computer engineering, electrical engineering, or mathematics, and if you are interested in combinatorial optimization, approximation algorithms, and graph theory. Strong programming skills in C/C++ are highly desired.

Successful applicants will also have a chance to contribute to many international consortiums such as the 1000 Genomes Project and the Genome 10K, and will involve in other international collaborations with researchers in Vancouver, Seattle, Barcelona, Bari, Pittsburgh, and more.

Basic understanding of biology/genetics/genomics is a plus, but not required.
Volume rendering of a combustion chamber: pressure and velocity fields.

Screen assignments for 24 processors: jagged and hypergraph partitionings.
Projects funded by TÜBİTAK, Intel and European Union

- EU-funded FP6 SEE-GRID2 project (2006-2009)
- Parallel Text Retrieval & Query Processing (TÜBİTAK, 2006-2008)
- EU-funded FP6 EUMedGrid project (2006-2008)
- EU-funded FP6 SEE-GRID project (SE4SEE application) (2004-2006)
- Task scheduling for PC clusters (TÜBİTAK, 1999-2002)
- Unstructured domain mapping (EU ITDC, 1995-1998)
- Parallel direct volume rendering (TÜBİTAK EEAG, 1995-1997)
Paralel and Grid Computing Group

- Paralel computing architectures
  - Intel iPSC/2 hypercube (32 nodes)
  - Parsytec CC24 (24 nodes)
  - PC cluster (Borg) (32 nodes)
  - PC cluster (Skynet) (48 nodes)
  - Grid cluster (16 nodes)
Paralel and Grid Computing Group
Current research topics

- Algorithm design for parallel and distributed computing applications
- Parallel text retrieval, query processing
- Parallel and distributed Web crawling
- High-performance geographical information systems
- Parallel scientific computing
- Inverted index compression
- Parallel and distributed data mining
- Task allocation and scheduling for Grid systems
- Grid-enabled Web search
- Parallel direct volume rendering


Paralel and Grid Computing Group

- Contact information
  - Cevdet Aykanat
  - Phone: 312 290 1625
  - Email: aykanat@.cs.bilkent.edu.tr
  - Homepage: http://www.cs.bilkent.edu/~aykanat
Bilkent Information Retrieval Group

**Faculty**
- Fazli Can
- Seyit Koçberber

**Graduate Students**
- Cem Aksoy
- Ceyhun Karbeyaz
- Çağrı Toraman
- Anil Türel
- Ahmet Yeniçağ

**Volunteers**
- Aykut Bal
- Akif Buğday
- Bilge Köroğlu
- Hasan Can Tuncay

**Some Prev. Members**
- Erman Balçık
- Ahmet Buğdaycı
- Tunay Gür
- Cihan Kaynak
- Levent Koç
- İbrahim Uysal

**Other Contributors**
- Cevdet Aykanat
- Pınar Duygulu
- Özgür Ulusoy
- İsmail Şengör Altingövde
- Özgür Bağlıoğlu
- Ethem F. Can
- Gönenç Ercan
- Süleyman Kardaş
- H. Çağdas Öcalan
- Erkan Uyar

**Undergraduate Students**
- Turgut İşik
- Oğuz Kaya
- Harun Özden
- Abdullah Şahin
Research Interests

- New Event Detection and Tracking
- Novelty Detection
- Information Retrieval
- Information Filtering
- News Categorization
- Text Mining & Processing
Son Haberler

- Küçük Tamil askerler siniflarına dönüyor...
  Sri Lanka'da 30 yıllık çatışmaların ardından hükümet tarafından eski topraklarına döndürülen ülkenin doğu ve kuzeyinde.
  Devam...

- Kütahya'da göçük meydana gelen maden...
  Kütahya'nın Tavşanlı ilçesinde, göçük meydana gelen maden ocağı hakkında Valilikçe yaklaşık 2.5 ay önce eksikleri.
  Devam...

- Kuru ve potansiyel:
  Tüketicimiz daha içli bir şekilde kuru ve potansiyel olarak tüketebilmek için.
  Devam...

- Vali Güler: Devletin verdiği görevi...

Güncel & Geçmiş Olaylar

- Keita Milli Takımda....... İzleyenler (54)
- Yeni bir sergi katılar.. İzleyenler (7)
- Ağlayan öğrenci valiye zor... İzleyenler (6)
- Güneyde plajlar doldu taştı... İzleyenler (7)
- Çorum'da kendi ölümden... İzleyenler (9)
- Şok iddia: Michael Jackson... İzleyenler (9)
- Papakostandımu: Yeni önlemler alınması... İzleyenler (7)
- İzleyenler (7)
- 10 projenin şampiyonu varyap... İzleyenler (5)
- Arnavutluk'ta siyasi kriz... İzleyenler (6)
- Türkiye ve Yunanistan, ortak... İzleyenler (5)
- Karaparada "İnceleme havuzu"nda yüz... İzleyenler (7)
- Chínti dünyanın kardeslerin... İzleyenler (15)

En Çok Okunanlar
You are the right person for our group

- If you are good at four core practices of CS
  - programming,
  - systems thinking,
  - modeling, and
  - innovation.

- If you
  - "can dream,"
  - "can do," and
  - "can write."
Interactive Computer Graphics
Computer Animation

• **Research Goal:** How can we represent virtual humans in interactive apps?
  - How can we animate avatars in games / VR?
  - How can we make use of motion capture?


Perceptually Driven Graphics

**Research Goal:** How we can make use of human perception in graphics & displays?

- How can a computer model human attention?
- How can we measure the 3D graphics quality?


3D Rendering

- **Research Goals:**
  - How can we add artistic / perceptual styles for 3D display of graphical models?
  - How to use 3DTV / stereo displays efficiently?
  - How to make efficient use of 3D depth cues?


Mobile Graphics

• **Research Goal:** How can we interact with 3D graphics on mobile displays?
  - How can we build a mobile phone with everything in 3D? (with stereo display, 3D camera, 3D apps)
  - How can we build 3D interaction techniques? (e.g. 3DUIs, 3D gestures)

Sponsored Projects

- **3DPHONE** – *An All-3D Imaging Phone* – European Commission’s FP7 STREP Project (Grant no: FP7-213349), Coordinator / Principal Investigator.

- **ALGI** – TÜBİTAK 1001 Project (Grant no: 110E029), Principal Investigator.

- **3DTV** – European Commission’s FP6 NoE Project, Researcher.

- Various Nokia-internal projects related to mobile graphics and user interfaces, 2000-2006.

- Played a key role in setting up European Projects: SoNG, VIDAS, and FIVE. Role: Workpackage Leader, Researcher, 1995-1999.
Selected Publications

More Information

Asst. Prof. Tolga Çapın
http://www.cs.bilkent.edu.tr/~tcapin
David Davenport
david@cs.bilkent.edu.tr

Self-motivated, creative, committed
Graduate Students
• Unraveling mysteries of cognition (Center for Mind language & Culture)
• Information Quality – (ColSys group)
• Computer use in Education
• Ethical concerns raised by Internet

Contact: David david@cs.bilkent.edu.tr

WANTED ALIVE

Self-motivated, creative, committed

Graduate Students
Interested in…
• Unraveling mysteries of cognition (Center for Mind language & Culture)
• Information Quality – (ColSys group)
• Computer use in Education
• Ethical concerns raised by Internet

Contact: David david@cs.bilkent.edu.tr
Tuğrul Dayar
(tugrul@cs.bilkent.edu.tr)

- Performance modeling and analysis
- Scientific computing (especially numerical linear algebra for stochastic matrices)
- Bioinformatics
- Computer networks

requires solid background:
1) in computer engineering
2) specifically in probability theory, linear algebra, numerical analysis, and high-level programming,

which one must either have or be willing to develop

Visit: www.cs.bilkent.edu.tr/~tugrul/tugrul.html

for further information
Uğur Doğrusöz

On Research of i-Vis

Information Visualization Research Group

For us, research is practical solutions to real problems using strong theory!

Topics: Graph visualization, bioinformatics & graph algorithms

Projects:

• PATIKA & Visibio [Pathway Modeling, Analysis & Visualization Tools]
• Chisio [Graph Visualization Tool]

Our projects have been supported by TÜBİTAK and Tom Sawyer Software (CA, USA)
Social Network of Drug Traffickers
Chisio Drawing Tool

Bilkent Univ. CS Dept.
Curriculum & Prerequisites, 2007

Freshmen

Sophomore

Junior

Senior

Restricted Electives

prepared by Chao 1.0
i-Vis Research Group
The PATIKA Project
www.patika.org

Sample PATIKA Tool: PATIKAweb

Lost in the jungle of cellular processes...?

PATIKAweb can show you the PATHway
Interested in being part of this kind of research & development? Then join us! Please contact me at ugur@cs.bilkent.edu.tr
Data Management and Mining
Hakan Ferhatosmanoglu

• We investigate data management and data mining methods for emerging applications:
  – Data streams (telecom data warehouses, financial markets)
  – Social Media (Twitter text and social network)
  – Bioinformatics (proteins, genes)

• We aim to build scalable systems for online exploration of text, image, time-series

• Funded by USA Dept of Energy, NSF, NASA, Pfizer, IBM
Data Management and Mining
Hakan Ferhatosmanoglu

• Looking for students with theoretical interest and systems building skills (basically math and programming..)

Please contact me for more information:

hakan@cs.bilkent.edu.tr
We are conducting research in data-intensive distributed systems, looking at issues such as parallelization, load balancing, load shedding, placement optimization, fault-tolerance, etc.

Particular topics of interest include:

- Distributed data stream processing systems
- Big Data technologies, such as distributed key-value stores, map/reduce systems, bulk-synchronous parallel processing frameworks, etc.
- Large-scale distributed graph management and mining
- Peer-to-peer, mobile, and sensor data management
Data Stream Processing Systems

Stock market
- Impact of weather on securities prices
- Analyze market data at ultra-low latencies

Law Enforcement, Defense & Cyber Security
- Real-time multimodal surveillance
- Situational awareness
- Cyber security detection

Fraud prevention
- Detecting multi-party fraud
- Real time fraud prevention

Transportation
- Intelligent traffic management

e-Science
- Space weather prediction
- Detection of transient events
- Synchrotron atomic research

Health & Life Sciences
- Neonatal ICU monitoring
- Epidemic early warning system
- Remote healthcare monitoring

Natural Systems
- Wildfire management
- Water management

Telephony
- CDR processing
- Social analysis
- Churn prediction
- Geomapping

Other
- Smart Grid
- Text Analysis
- Who’s Talking to Whom?
- ERP for Commodities
- FPGA Acceleration

Manufacturing
- Process control for microchip fabrication

Other
- Smart Grid
- Text Analysis
- Who’s Talking to Whom?
- ERP for Commodities
- FPGA Acceleration

Manufacturing
- Process control for microchip fabrication

Natural Systems
- Wildfire management
- Water management

Data intensive Distributed Systems
@ Bilkent University
Automatic Parallelization

- Transparent parallelization: Locate parallel regions in streaming applications without user intervention
- Safe parallelization: Generate parallel alternatives that produce the exact same results as the sequential version
- Elastic parallelization: Dynamically adjust profitability decisions w.r.t. parallelization based on run-time dynamics
Looking for students

We are seeking highly motivated and skilled students for graduate level research in data intensive distributed systems. Both Ph.D. and Masters level students are welcome. Students with strong interest in systems and implementation as well as a good understanding of fundamental theory are encouraged to apply.

Contact: www.bugragedik.com
Selected Publications


Main research interests:

- Medical image analysis for **automatic cancer diagnosis, grading, and prognosis**
- Machine learning for **intelligent medical systems**
Current projects:

- **Diagnosis and grading of colon cancer**
  - Construction of new biocomputational methods
  - Colon cancer diagnosis
  - Colon cancer grading
  - Tissue image segmentation
  - Colon gland segmentation

- **Designing medical diagnostic systems**
  - Cost-sensitive classification
  - Qualitative decision theory
  - Dynamic model selection and combination
Research Topics:
1. Augmented and Virtual Reality
2. Terrain and Urban Modeling and Visualization
3. Human Modeling and Animation
Augmented and Virtual Reality

- Crowd Simulation
- Realistic Lighting
- Camera Registration and Tracking
- Augmented Reality on Mobile Devices
Terrain and Urban Modeling and Visualization

- Level-of-detail management
- View-dependent refinement
- Stereoscopic visualization
- GPU-based tessellation
- Crowd simulation in urban environments
Current research topics include

Learning to

- rank instances
- model risk factors
- estimate risks
- suggest to increase chances

Application areas: Medical, Mobile
Faculty Member
Ibrahim Korpeoglu
Assoc. Professor
Dept of Computer Engineering
Bilkent University

Email: korpe@cs.bilkent.edu.tr
Web: http://www.cs.bilkent.edu.tr
Office: Engineering EA 409
Phone: 290 25 99

Working on Problems and Projects related with Computer Networks and Computer Systems

Research Areas:
- Computer Networks
- Computer Systems
- Network and Distributed Algorithms
- Wireless Networks
- Distributed Systems
- Cloud Computing
- P2P Networks
- Sensor Networks
- Internet of Things
- WiFi and Bluetooth
- Big Data Systems
Networks and Systems Research Group
Sample Funded Projects

- Efficient Resource Allocation in Heterogeneous Cloud Infrastructures
  Sponsor: TUBITAK

- Supporting Real-time Traffic in Wireless Ad Hoc and Sensor Networks
  Sponsor: TUBITAK

- Bluetooth Scatternet Construction and Bluetooth Applications
  Sponsor: TUBITAK

- Network Middleware for Environmental Monitoring and Control with Wireless Ad hoc, Mesh and Sensor Networks
  Sponsor: IBM Corporation

- Intel WCNC, Wireless Networking Curriculum Enhancement Project
  Sponsor: Intel Corporation

- FIRESENSE Fire Detection and Management through a Multi-Sensor Network for the Protection of Cultural Heritage Areas from the Risk of Fire and Extreme Weather Conditions
  Sponsor: European Commission FP7 Programme, ENV

- Network of Excellence in Wireless Communications (NEWCOM and NEWCOM++)
  Sponsor: European Commission FP7 Programme, ICT

- Efficient Resource Allocation in Heterogeneous Cloud Infrastructures
  Sponsor: TUBITAK
Wireless Mesh Networks
- Routing
- Channel assignment
- Interference modeling
- Interference mitigation

Testbeds

Cloud Computing
- Resource allocation
- VM placement
- Network virtualization
- Network embedding

Sensor Networks
- Energy efficient routing
- Activity scheduling
- Channel access scheduling
- ZigBee wireless technology
- ZigBee routing

P2P Networks
- Query forwarding
- Free riding
- File sharing and lookup

Delay tolerant networks
- Routing and Scheduling
Networks and Systems Research Group

Sample Publications

- Hidayet Aksu, Mustafa Canim, Yuan-chi Chang, Ibrahim Korpeoglu, Ozgur Ulusoy, *Distributed k-Core View Materialization and Maintenance for Large Dynamic Graphs*, IEEE Transactions on Knowledge and Data Engineering, 2014.


Özcan Öztürk
Office: EA 421 Phone: 290-3444
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URL: http://www.cs.bilkent.edu.tr/~ozturk

- **Computer architecture** - memory scheduling, memory hierarchy design, metrics to consider energy, performance, reliability....
- **Multicore/Manycore architecture** - design of multicore systems, application mapping, data mapping, communication
- **Heterogeneous computing** - heterogeneous multicore design, core and cache selection, application execution
- **Parallel programming/systems/applications** - OpenMP, MPI, GPGPU, application characterization, automatic parallelization, scheduling
- **Cloud computing** - at the system level and architectural optimizations, heterogeneity aware scheduling
- **Embedded computing** - energy, performance, ...
- **Compiler optimizations** - code modifications and optimizations to generate better applications
Current Projects

- **Heterogeneous Multicore Design**
  - **Funding**: EC FP7
- **Parallelization for Heterogeneous Multicore Architectures**
  - **Funding**: IBM
- **Utilizing Accelerator Technologies in the Cloud**
  - **Funding**: Türk Telekom
- **Parallelizing Data Mining applications using GPUs**
  - **Funding**: Nvidia
- **Accelerator Design for Graph Parallel Applications**
  - **Funding**: Intel
Our research interest is in developing computational methods and tools, which aim at providing novel insights into biological mechanisms of the diseases and phenotypes. The techniques we employ base themselves on statistical machine learning and advanced algorithms that are guided by insights from a systems biology perspective.
Significant progress has been made in our ability to measure DNA, RNA and protein sequences, structures and expression quantities. In addition to the part list of molecules, substantial amount of knowledge has been accumulated on the interactions of these molecules and their role in the cellular machinery.
It is critical to translate this vast amount of data into biological findings, clinical research and eventually into clinical practice. As the data is vast, heterogenous, multi-dimensional and noisy, unleashing the full power of the accrued data will be only possible through development of rigorous computational techniques. We employ statistical machine learning approaches to gain insight into biological mechanisms.
Mission Statement

- We are dedicated to continued growth in the field of software engineering and aim to provide excellence in research, teaching and service relative to the university in particular and the community in general.
- We are committed to responsible and innovative way of working and collaboration with academic and industrial partners, both in Turkey and abroad.
- We aim to achieve our goals through publishing high quality papers, actively participating in the software engineering community, writing industrially relevant project proposals, and constant collaboration with our colleagues and students who understand the importance and value of software engineering.

Vision

- We believe that software engineering is one of the most important disciplines in computer science with the largest impact on the community.
- We envision that this influence on the society will remain for the future and will even get stronger for the coming decades.
- In particular, for Turkey with a highly developing potential, we think that software engineering should be put on the agenda for a broader interest and participation.
- Based on our in-depth experiences in different domains of software engineering we think that we can substantially contribute to the developments in state-of-the-art and state-of-the-practice of software engineering.

http://www.cs.bilkent.edu.tr/Bilsen
Software Everywhere...

The Discipline that is Shaping our World....
Software Engineering

- an Engineering discipline
- that builds on Computer Science...
- and in particular Software Engineering Science

**Engineering** - Creating cost-effective solutions to practical problems by applying scientific knowledge building things in the service of mankind....

Research Topics

Software is *Hard*...
How to cope with inherent complexity...?

- **Research Topics**
- Software Architecture Design
- Software Product Line Engineering
- Aspect-Oriented Software Development
- Model-Driven Software Development
- Software Testing
- Software Requirements Engineering
- Quality-Driven Software Development
- Experimental Software Engineering
- ...
Our Strategy - Industry as Laborator

- Problem is acquired from the real practitioners in industry, (e.g. industrial partners in a research project).
  - Stronger connection at start
  - Solve problems that really do matter to practitioners
- Constant interaction by practitioners and researchers
- Early evaluation and usage by industry
- Optimal reduction of Technology Transfer Gap
- Increasing quality publications
Database Research
Özgür Ulusoy
http://www.cs.bilkent.edu.tr/~oulusoy/

- Web Databases and Search Engines
- Multimedia Databases
- Mobile and Peer-to-Peer Systems
Web Databases and Search Engines

- Social Web search and personalization
- Temporal analysis of web search results
- Efficiency and scalability issues for Web Search Engines (caching, index pruning)
- Web information extraction
- Modeling and querying of Web resources
- XML querying & searching

Search Engines are the key to access Web Data

- **1995**: S. Brin meets L. Page
- **1998**: Birth of Google
- **2000**: First **billion-URL** index
  - The world’s largest!
  - ≈5000 PCs in clusters!
- **2004**: Index grows to **4.2 billion** pages
- **2008**: Google counts **1 trillion** unique URLs
- **2009**: TBs or PBs of data/index
  - Tens of thousands of PCs
- **2012**: The world’s largest!
  - ≈5000 PCs in clusters!

Efficient and scalable strategies are of vital importance!
Multimedia Databases

- **BilVideo**: A Video Database Management System
- **Ottoman Archive Content-Based Retrieval System**

**BilVideo**: Integrated video DBMS supporting low-level, spatio-temporal, motion and semantic querying of videos

**SPATIO-TEMPORAL QUERY GUI**

**SEMANTIC QUERY GUI**

**TRAJECTORY QUERY GUI**

**SYSTEM ARCHITECTURE**
BilVideo v2.0: MPEG-7 Compliant Video DBMS

Users -> Visual Query Interface

Raw Video Database (File System) -> Video Processing
- SBD, Segmentation
- Object Extraction
- Annotation
- etc.

Feature Extraction
- MPEG-7 Features

XML-Native Feature Database (Tamino) -> Query Processor

Automatic processing: segmentation, tracking, feature extraction, annotation, indexing

Powerful querying capability for video data
- keyword and content-based queries
- spatio-temporal object queries

Example query formulation
Example query formulation
Example query formulation

keywords: trees, greenery, sky – bush, putin, dog

segmentation

Saliency video object extraction
Ottoman Archive Content-Based Retrieval System

Symbol library

Ottoman Documents → Extraction & Recognition → Codebooks

Query

Web-based GUI

OTTMAN DOCUMENT

CODEBOOK

WEB GUI

814 16 83 7 8
556 2 28 7 9
2322 0 62 7 8
1838 7 69 7 8
1802 5 18 7 13
2258 5 8 15 29
819 6 43 11 12
982 21 15 8 39
1802 6 23 8 16
1378 7 5 8 46
2263 14 20 7 44
1008 16 13 13 26
1537 1 19 7 9
1838 15 44 7 8
2068 7 30 8 8
2107 8 18 8 0
14 1 13 9 11
410 8 15 10 12
1838 10 16 7 8
1226 1 22 9 18
984 6 31 7 9
1092 2 24 7 8
756 15 43 7 37
433 8 14 11 11
1607 2 64 8 9
1654 2 14 9 21
1812 11 26 8 16
556 7 16 7 9
1 7 45 10 19

...
Mobile and P2P Systems

- Moving Object Processing
  (location indexing, location-dependent query processing)

- Mobile Data Management
  (data broadcasting, transaction processing, hoarding)

- Peer-to-peer systems
  (routing, free riding)

- http://www.cs.bilkent.edu.tr/~p2p