Bilkent University
Computer Engineering Department

MSc and PhD Programs

Prof. Dr. H. Altay Güvenir
Research Areas

- Algorithms, artificial intelligence, big data, bioinformatics, cloud computing, computational biology, computational geometry, computer architecture, computer graphics, computer networks, computer vision, cryptography, data mining, data science, data security, database systems, graph visualization, high performance computing, image analysis, information retrieval, machine learning, mobile systems, parallel and distributed systems, pattern recognition, performance evaluation, scientific computing, virtual reality.
Applications

• Application Deadlines:
  Early: March 26, 2019; Regular: June 10, 2019

• Online Application:
  https://stars.bilkent.edu.tr/gradapp/

• Requirements for application:
  – CGPA ≥ 2.80 / 4.00
  – ALES (Turkish citizens) or GRE (Foreign applicants)
    • ALES: Quantitative ≥ 55 (for MS), 80 (for PhD w/o BS)
    • GRE: Quantitative ≥ 153 (MS), 157 (PhD)
  – English Proficiency: TOEFL (IBT) ≥ 87 or IELTS avg ≥ 6.5 (and min 5.5 in each section)
  – And YDS ≥ 55 (for Turkish citizen applying PhD).
Interview

• **Date:** April 15, 2019; June 27-28, 2019

• If not uploaded during online application, hard copy documents to be submitted during interview:
  – Transcript
  – ALES or GRE score report
  – Proof of English Proficiency
    (TOFLE, IELTS or YDS report)
Acceptance requirements

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

• Department scholarship
  – Tuition waiver
  – Stipend
  – Accommodation support
  – Health Insurance
  – Additional Scholarship for Teaching Assistantship
  – Office (shared)

• TÜBİTAK Scholarship or TÜBİTAK projects
  – Tuition waiver
  – Accommodation
  – Health Insurance
  – Office (shared)
Scholarship Options

• **Project grants (other than 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
Degree Requirements

• MSc
  ▪ 7 technical elective courses + Seminar + MS Thesis + Research Methods and Academic Publication Ethics course

• PhD
  ▪ 7 technical elective courses + Seminar + Qual Exam + PhD Thesis + Journal Publication Research Methods and Academic Publication Ethics course
# Graduates of MS Program

<table>
<thead>
<tr>
<th>Position</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD in Turkey</td>
<td>20</td>
<td>9.0%</td>
</tr>
<tr>
<td>Faculty in Turkey</td>
<td>37</td>
<td>16.7%</td>
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<tr>
<td>Engineer in Turkey</td>
<td>151</td>
<td>68.0%</td>
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<tr>
<td>Co-founder in Turkey</td>
<td>14</td>
<td>6.3%</td>
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<tr>
<td>PhD abroad</td>
<td>35</td>
<td>15.8%</td>
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<tr>
<td>PostDoc abroad</td>
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<td>4.5%</td>
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<tr>
<td>Faculty abroad</td>
<td>20</td>
<td>9.0%</td>
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<tr>
<td>Engineer abroad</td>
<td>147</td>
<td>30.6%</td>
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<tr>
<td>Co-founder in abroad</td>
<td>9</td>
<td>4.1%</td>
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<tr>
<td>Unknown</td>
<td>37</td>
<td>7.7%</td>
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</table>

**In Turkey**

- 222 (46.3%)

**Abroad**

- 221 (46.0%)

**Unknown**

- 37 (7.7%)

**Total:**

- 480 (100.0%)
## Graduates of MS Program

### in Turkey

- **Bilkent Univ.** 25
- **ASELSAN** 20
- **HAVELSAN** 16
- **TÜBİTAK** 13
- **Hacettepe Univ.** 6
- **METU** 6
- **TSK** 5
- **STM** 4
- **TCMB** 4
- **Vestel** 4
- **Cybersoft** 3
- **Garanti Teknoloji** 3
- **MilSOFT** 3
- **OpsGenie** 3
- **Sabancı Univ.** 3
- **Akdeniz Univ.** 2
- **Oracle** 2

### Abroad

- **Microsoft** 23
- **Google** 16
- **Amazon** 6
- **Booking.com** 4
- **Case Western Reserve Univ.** 4
- **Facebook** 4
- **Univ. California** 4
- **SAP** 3
- **U. of Massachusetts Amherst** 3
- **UBER** 3
- **EPFL** 2
- **ETH** 2
- **Imperial College** 2
- **Sandia National Labs.** 2
- **U. of Texas at San Antonio** 2
- **University of Florida** 2
- **University of Waterloo** 2
- **U. of Illinois at Urbana-Champaign** 1
- **Washington U. in St. Louis** 1
Graduates of PhD Program

<table>
<thead>
<tr>
<th>Position</th>
<th>Count</th>
<th>%</th>
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<tbody>
<tr>
<td>Faculty in Turkey</td>
<td>25</td>
<td>69.4%</td>
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<td>Engineer in Turkey</td>
<td>10</td>
<td>27.8%</td>
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<td>Co-founder in Turkey</td>
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<td>2.8%</td>
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<tr>
<td>PostDoc abroad</td>
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<tr>
<td>Faculty abroad</td>
<td>6</td>
<td>18.8%</td>
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<tr>
<td>Engineer abroad</td>
<td>17</td>
<td>53.1%</td>
</tr>
<tr>
<td>Co-founder in abroad</td>
<td>1</td>
<td>3.1%</td>
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<table>
<thead>
<tr>
<th>In Turkey</th>
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</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>52.9%</td>
<td></td>
</tr>
<tr>
<td>Abroad</td>
<td>32</td>
<td>47.1%</td>
</tr>
<tr>
<td>Total:</td>
<td>68</td>
<td>100.0%</td>
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Graduates of PhD Program

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<tr>
<th>in Turkey</th>
<th>Abroad</th>
<th>Faculty Members</th>
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</thead>
<tbody>
<tr>
<td>METU</td>
<td>Amazon</td>
<td>Georgia Institute of Technology</td>
</tr>
<tr>
<td>Bilkent University</td>
<td>Oregon Health and Sci. U.</td>
<td>Oregon Health and Science University</td>
</tr>
<tr>
<td>Hacettepe Univ.</td>
<td>Case Western R. U.</td>
<td>Stony Brook University</td>
</tr>
<tr>
<td>Akdeniz University</td>
<td>Berkeley Lab</td>
<td>University of Calgary</td>
</tr>
<tr>
<td>Sabancı Univ.</td>
<td>CNRS</td>
<td>Bilkent University</td>
</tr>
<tr>
<td>TED University</td>
<td>ETH</td>
<td>Akdeniz University</td>
</tr>
<tr>
<td>Ankara University</td>
<td>Facebook</td>
<td>Ankara University</td>
</tr>
<tr>
<td>Aselsan</td>
<td>Fraunhofer</td>
<td>Ankara Yıldırım Beyazıt University</td>
</tr>
<tr>
<td>Atılım University</td>
<td>Georgia Tech</td>
<td>Atatürk University</td>
</tr>
<tr>
<td>Beykent University</td>
<td>Google</td>
<td>Atılım University</td>
</tr>
<tr>
<td>Çukurova Üniversitesi</td>
<td>Microsoft</td>
<td>Beykent University</td>
</tr>
<tr>
<td>SAP</td>
<td>Oracle</td>
<td>Celal Bayar University</td>
</tr>
<tr>
<td>TAI</td>
<td>Salesforce</td>
<td>Çukurova University</td>
</tr>
<tr>
<td>TCMB</td>
<td>Sandia National Labs.</td>
<td>Hacettepe University</td>
</tr>
<tr>
<td>Turkcell</td>
<td>Stony Brook University</td>
<td>Konya Food &amp; Agriculture University</td>
</tr>
<tr>
<td></td>
<td>U. of Central Florida</td>
<td>METU</td>
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<tr>
<td></td>
<td>Uber</td>
<td>Sabancı University</td>
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<td>Selçuk University</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TED</td>
</tr>
</tbody>
</table>

Number of graduates:
- Turkey: 8 institutions
- Abroad: 12 institutions
- Faculty Members: 14 institutions
Faculty Members

• In alphabetic order

(Please contact with them in person for details.)
My current research is two pronged:

i. contextual reasoning in AI
ii. public implications of the Internet
Contextual reasoning in AI

Problems originating from natural language processing and understanding, especially those caused by the lack of explicit context:

When we say a particular thing, we do so in a context. Thus, there are embedded background assumptions available only through the context. We are also good at shifting between contexts. Can context be formalized in a formal framework? This would lead to improved software not only in Natural Language Understanding but also in knowledge-based systems, robotics, search engines, and personal assistants like Siri, Cortana, OK Google.

My grad courses CS 563 and CS 661 examine contexts, as well as other AI topics.
Public implications of the Internet

Problems caused by tensions between local versus global, individual versus corporate, and democratic versus authoritarian in the framework of the Internet. More specifically:

Basic concepts and history of the Internet as a socio-political medium. Free access to information in the networked world. The Internet as a trusted communications medium in light of security and privacy issues. Censorship and politics of the Internet vis-à-vis interventions by oppressive governments. Social movements in the 21st century marked by rapid broadcast of ideas and images.

My grad course CS 513 treats such societal aspects of the Internet.
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
Medical Image Analysis

- Microscopic image classification
- Cancer detection / grading
- Content-based searching of past cases
- Automatic report generation

Dr. Selim Aksoy
Combinatorial algorithms to analyze high throughput sequence data to discover, genotype, and phase genomic variants, assemble genomes and transcriptomes.

Test genome

Random shearing and Size-selection

Paired-end sequencing

Reference Genome

Read mapping and variation analysis

Resequencing

De novo sequencing

Contigs/Scaffolds

Assembly
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 - T
sample: C A C C G T G - G C A T

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
sample: 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
Illumina MiSeq
Pacific Biosciences RS
Ion Torrent PGM
Ion Torrent Proton
Illumina MiSeq
Complete Genomics
Oxford Nanopore MinION
Oxford Nanopore GridION

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


Recipient of the **2010 AAAS Newcomb Cleveland Prize**.


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.
Shervin Rahimzadeh Arashloo

s.rahimzadeh@cs.bilkent.edu.tr
www.cs.bilkent.edu.tr/~s.rahimzadeh
Office: EA 429

Research Interests
• Computer Vision
• Pattern Recognition
• Machine Learning

Current Research Topics
• Face Recognition
• Face Presentation Attack Detection
• Anomaly Detection
Unconstrained Face Recognition
Face Presentation Attack Detection

Securing face recognition systems against security threats made by fake biometric traits
Anomaly Detection

Developing novel methodologies along with applications to:

Surveillance
Novelty detection
Healthcare
etc.
Bilkent University
High Performance Computing

Recent research interest and expertise

- **Combinatorial scientific computing**

  - **Iterative solvers**: novel partitioning models, algorithms and software utilities for development of parallel iterative methods for linear-system solutions

- Optimizing latency-centric communication metrics for petascale sparse iterative solvers

- **Partitioning irregular domains** for large-scale parallel processing

- Locality aware scheduling of irregular applications on Xeon Phi architecture

- Partitioning models for scaling 1D-, 2D- and 3D-parallel sparse matrix-matrix multiplication on distributed/shared memory architectures

- Partitioning large scale social networks and graph databases

- High performance parallel graph analytics kernels for big data applications

- High performance **tensor decomposition** methods for distributed/shared memory parallel systems

- Partitioning models and methods for scaling parallel stochastic gradient descent algorithms for recommendation systems

- Task leader in FP7 / Horizon2020 PRACE projects: 1IP, 2IP, 3IP, 4IP, 5IP

Contact Address:
Prof. Cevdet Aykanat
aykanat@cs.bilkent.edu.tr

![Speedup curves](image)

- Speedup curves of Conjugate Gradient solver for different methods on a Cray and BlueGene/Q machine
(kkt-power matrix: 2 million rows, 12 million nonzeros)
Recent Publications


Recent Funded Projects

TUBITAK/COST Projects

119E035: Parallel Stochastic Gradient Descent Algorithms for Large-Scale Recommendation Systems, 1/7/2019 - 31/12/2021
116E043: High Performance Tensor Decomposition Methods for Distributed and Shared Memory Parallel Systems, 01/05/2017 – 1/11/2019
115E212/COST-CA15109: Improving Sparse Matrix Based Graph Analytics Kernels for Big Data Applications, 01/09/2015 - 01/03/2018
114E545/COST-IC1406: Petascaling Sparse Iterative Solvers via Optimizing Multiple Communication Metrics, 01/04/2015 - 01/10/2017
112E120: Partitioning, Replication and Query Processing in Social Networks, 01/09/2012 - 01/09/2014

FP7/HORIZON-2020 Projects

PRACE 5IP 01/01/2017 – 01/05/2019
  Task 7.2: Preparing for PRACE Exascale Systems
PRACE 4IP 01/02/2015 - 01/05/2017
  Task 7.2: Preparing for Future PRACE Exascale Systems
PRACE 3IP 01/08/2012 - 01/08/2014
  D7.2.1 HPC Tools and Techniques
PRACE 2IP 01/07/2011 - 01/07/2014
  D12.5 Summary of Novel Programming Techniques Results (Task leader)
PRACE 1IP-Extension 01/07/2013 - 01/07/2014
  D7.1.3 Application Enabling for Capability Science in the MIC Architecture
PRACE 1IP 01/07/2010 - 01/07/2013
  D7.5 HPC Programming Techniques (Task leader)

Contact Address:
Prof. Cevdet Aykanat
aykanat@cs.bilkent.edu.tr
Bilkent Information Retrieval Group

Faculty
Fazlı Can
Seyit Koçberber

Graduate Students
Sepehr Bakhshi
Alican Büyükçakır
Sevil Çalışkan
Sanem Elbaşı
Pouya Ghahramanian
Ömer Gözüaçık
Aykut Güven

UG Student(s)
Taha Aksu

Some Prev. Members
Cem Aksoy
Ahmet Buğdaycı
Hayrettin Erdem
Cem Karbeyaz
Süleyman Kardaş
Cihan Kaynak
H. Çağdaş Öcalan
Anıl Türel
İbrahim Uysal

Other Contributors
Hamed R. Bonab, UMass
Dilek Küçük, TÜBİTAK
 Çağrı Toraman, UCF
Research Interests

Information Retrieval (IR)

- Information Filtering
- News Aggregation and Categorization
- Turkish Text Mining

- Data Stream Mining
  - Ensemble Models for Stream Classification
  - Multi-label Classification
  - Concept Drift Detection
  - Multi-stream Processing
  - Stance Detection
You are the right person for our group

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

- **If you**
  - can dream,
  - can do, and
  - can write.
My research focuses on building algorithms for analyzing biological data using various biochemical networks. Even though it took 13 years and ~$1b to sequence the first genome, right now, it takes a day and ~$1k. This has resulted in accumulation of vast amounts of information. Consequently, biosciences have faced the problem of “big data”. Today, the bottleneck in the bio-research is the lack of computational power and algorithms that can efficiently analyze the data and make discoveries. Central dogma in molecular biology dictates the information flow from DNA -> RNA --> Protein --> Metabolite. Each layer introduces 20k, 100k, 1m, and 3k variables respectively. The search space for even a basic pattern discovery is clearly intractable. I design machine learning algorithms that use biological networks to prune the search space and discover biomarkers in particular for genetic Diseases.
A. Ercument Cicek

cicek@cs.bilkent.edu.tr
cs.bilkent.edu.tr/~cicek
Using Dynamic Network Algorithms to Model Neurodevelopment.

- Autism is a neurodevelopmental disorder and affects evolving the gene interaction networks of the fetal period to early childhood.
- We design algorithms that analyze the dynamic networks to understand the functionality autism affects.
Metabolic Networks to Understand Cancer

Metabolites are the small compounds in the body and have been found to be key biomarkers to define certain tumors.

We use network algorithms and build online systems that analyze metabolic signatures in tumors and understand the differences within the subtypes of the same cancer.
Selected Publications:

- De Novo Chip-Seq Analysis. Genome Biology 2015, 16:205.
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](http://www.cs.bilkent.edu.tr/~tugrul/tugrul.html) for further information
I work in the fields of Affective Computing, Computer Vision, and Pattern Recognition.

My current research mainly focuses on multimodal analysis of non-verbal human behavior (e.g. face analysis, gesture recognition, etc.) and deep learning of temporal representations.
Assessment of Depression Severity
Kinship Verification

Input: Kin 1 (Father) → Full Connection → Decoding → Output

Kin 2
Maximize Similarity
Minimize Similarity

Others (No Kinship)
Expression Matching

Expression Matching
Shared Weights
Maximize Similarity
Minimize Similarity

Output

Input: Kin 2 (Daughter) → Full Connection → Decoding → Output

Kin 1

Others (No Kinship)
Expression Matching

Expression Matching

Kinship Verification

dibeklioglu@cs.bilkent.edu.tr  |  http://www.cs.bilkent.edu.tr/~dibeklioglu/
Age Estimation through Facial Dynamics
Facial Expression Recognition

Angst: 65%
Fear: 30%
Verrassing: 5%
Surprise: 5%
Walging: 5%
Disgust: 5%
Selected Publications

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
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
**Digital pathology: classification and segmentation in biopsy images**

- Gland/cell segmentation in colon tissues
- End-to-end segmentation in biopsy images
- High-level representation of histopathological images and colon cancer classification

**CT and MR image analysis for in vivo images**

- Subcutaneous tumor segmentation
- Cartilage endplate segmentation

**High content screening: cell segmentation in microscopic images**

- Cell segmentation in phase contrast microscopy
- Cell segmentation in fluorescence microscopy
- Cell segmentation in peripheral blood and bone marrow images
Deep Learning for Medical Image Analysis
Digital Pathology

Unsupervised feature extraction via deep neural networks for histopathological image representation and classification

End-to-end gland and tissue segmentation using fully convolutional networks

http://www.cs.bilkent.edu.tr/~gunduz
Deep Learning for Medical Image Analysis

Cell Segmentation

Multi-task models for cell detection in live cell microscopy

Two-stage convolutional neural networks for cell nucleus segmentation in tissue images
Computer Graphics
Uğur Güdükbay
http://www.cs.bilkent.edu.tr/~gudukbay
gudukbay@cs.bilkent.edu.tr

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
Human Modeling and Animation
Current research topics include

Learning to

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

Application areas: Medical, Social Networks
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
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
Wireless Mesh Networks
- Routing
- Channel assignment
- Interference modeling
- Interference mitigation

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

Testbeds

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

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

Delay tolerant networks
- Routing and Scheduling

Delay tolerant networks
- Routing and Scheduling
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.


High-Performance and Energy Efficient Computing

*Algorithms, Systems, and Applications*

- FPGAs
- GPUs
- Xeon Phi
- Parallel Systems
- Novel Architectures
Active projects:

- Energy efficient FPGA accelerators for big data applications (*supported by European Commission, in collaboration with Intel, Oregon*)
- Parallelizing Collaborative Filtering algorithms for recommender systems
- Parallel and vectorized scientific computing algorithms
- Optimizing memory architecture for graph analytics applications for large datasets.

I am interested in graduate student candidates who have one or more of the following:

- Strong algorithmic background and analytical skills
- Interest in solving programming puzzles
- C++ programming skills
- Experience with multi-core, GPU, and/or FPGA programming

For more information, see [www.bilkent.edu.tr/~mustafa.ozdal](http://www.bilkent.edu.tr/~mustafa.ozdal). You can send an email to [mustafa.ozdal@cs.bilkent.edu.tr](mailto:mustafa.ozdal@cs.bilkent.edu.tr) to set up an appointment.
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- **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*
Eray Tüzün
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Research Areas
- Software Analytics
- Software Product Line Engineering
- Gamification / Serious Games
- Software Engineering Education
- Software Development Processes
- Empirical Software Engineering

Interested in being part of our research group? Please contact us at eraytuzun@cs.bilkent.edu.tr

Bilkent University Software Engineering and Data Analytics Research Group (BILSEN)
https://bilsengroup.github.io
"practice offering software practitioners (not just developer) up-to-date and pertinent information to support their daily decision-making processes and Software Intelligence should support decision-making processes throughout the lifetime of a software system."

Ahmed E. Hassan and Tao Xie

Programmers who changed this function also changed
Don’t program on Fridays
Which files are more likely to be buggy?
Serious Games & Gamification in Software Engineering

Gamification is the use of game mechanics to drive engagement in non-game business scenarios and to change behaviors in a target audience to achieve business outcomes.
Selected Publications

- **Catching up with Method and Process Practice: A new Baseline for Researchers**, HELENA Consurtium, International Conference on Software Engineering in Practice, 2019


- **An Auction-Based Serious Game for Bug Tracking**, Cagdas Usfekes, Eray Tuzun, Murat Yılmaz, Yagup Macit, Paul Clarke, IET Software, 2019

- **Closing the gap between software engineering education and industrial needs**, Vahid Garousi, Görkem Giray, Eray Tüzün, Cagatay Catal, Michael Felderer, IEEE Software, 2019

- **Adopting Augmented Reality for the Purpose of Software Development Process Training and Improvement: An Exploration**, İpek Ohri, İrem Öge, Bora Orkun, Murat Yılmaz, Eray Tüzün, Paul Clarke, RV O’Connor, European Conference on Software Process Improvement, 195-206

- **Adopting the Essence Framework to Derive a Practice Library for the Development of IoT Systems**, Görkem Giray, Bedir Tekinerdogan, Eray Tüzün, Connected Environments for the Internet of Things, Challenges and Solutions, Springer International Publishing, 2018 (Book Chapter)


- **Are Computer Science and Engineering Graduates Ready for the Software Industry? Experiences from an Industrial Student Training Program**
Eray Tuzun, Hakan Erdogmus and Izzet Gokhan Ozbilgin, International Conference in Software Engineering SEET 2018
Database Research
Özgür Ulusoy
http://www.cs.bilkent.edu.tr/~oulusoy/

- Web Databases and Search Engines
- Multimedia Databases
- Big Data and Social Network Analysis
Web Databases and Search Engines

- Social Web search and personalization
- Domain-specific search engines
- 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

Efficient and scalable strategies are of vital importance!
Multimedia Databases
(joint work with Prof. Uğur Güdükbay)

- Video Retrieval Systems
- Mobile Visual Search
- Ottoman Archive Content-Based Retrieval System

http://www.cs.bilkent.edu.tr/~bilmdg
**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-7: An MPEG-7 Compatible Video Retrieval System

- **Raw Video Database (File System)**
- **Visual Query Interface**
- **Query Processor**
- **Video Processing**
  - SBD, Segmentation
  - Object Extraction
  - Annotation
  - etc.
- **XML-Native Feature Database (Tamino)**
- **Feature Extraction**
  - MPEG-7 Features

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

**Example query formulation**
- segmentation
- Salient video object extraction
Mobile Image Search Using Multi-Image Queries

Workflow of the Search System

Early and Late fusion methods

Multi-View Dataset and Queries

Single (a) and multi-view queries and corresponding result lists using early (b) and late (c) fusion methods.
Big Data and Social Network Analysis

- Social Network Data Analysis on Big Data Processing Platforms
  - Development, implementation and evaluation of algorithms/methods to process/analyze social network data for various social network problems.
    (joint work with Prof. İbrahim Körpeoğlu)

- Decentralized Social Networks
  - Development, implementation and evaluation of algorithms/methods for peer-to-peer social networks.
    (joint work with Prof. Hakan Ferhatosmanoğlu)