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>
</tr>
<tr>
<td>Engineer in Turkey</td>
<td>151</td>
<td>68.0%</td>
</tr>
<tr>
<td>Co-founder in Turkey</td>
<td>14</td>
<td>6.3%</td>
</tr>
<tr>
<td>PhD abroad</td>
<td>35</td>
<td>15.8%</td>
</tr>
<tr>
<td>PostDoc abroad</td>
<td>10</td>
<td>4.5%</td>
</tr>
<tr>
<td>Faculty abroad</td>
<td>20</td>
<td>9.0%</td>
</tr>
<tr>
<td>Engineer abroad</td>
<td>147</td>
<td>30.6%</td>
</tr>
<tr>
<td>Co-founder in abroad</td>
<td>9</td>
<td>4.1%</td>
</tr>
<tr>
<td>Unknown</td>
<td>37</td>
<td>7.7%</td>
</tr>
</tbody>
</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>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty in Turkey</td>
<td>25</td>
<td>69.4%</td>
</tr>
<tr>
<td>Engineer in Turkey</td>
<td>10</td>
<td>27.8%</td>
</tr>
<tr>
<td>Co-founder in Turkey</td>
<td>1</td>
<td>2.8%</td>
</tr>
<tr>
<td>PostDoc abroad</td>
<td>8</td>
<td>25.0%</td>
</tr>
<tr>
<td>Faculty abroad</td>
<td>6</td>
<td>18.8%</td>
</tr>
<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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Turkey</td>
<td>36</td>
<td>52.9%</td>
</tr>
<tr>
<td>Abroad</td>
<td>32</td>
<td>47.1%</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>68</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

- Faculty in Turkey: 25 graduates, 69.4%
- Engineer in Turkey: 10 graduates, 27.8%
- Co-founder in Turkey: 1 graduate, 2.8%
- PostDoc abroad: 8 graduates, 25.0%
- Faculty abroad: 6 graduates, 18.8%
- Engineer abroad: 17 graduates, 53.1%
- Co-founder in abroad: 1 graduate, 3.1%

- In Turkey: 36 graduates, 52.9%
- Abroad: 32 graduates, 47.1%
- **Total**: 68 graduates, 100.0%
## Graduates of PhD Program

### in Turkey
- **METU** 4
- **Bilkent University** 3
- **Hacettepe Univ.** 3
- **Akdeniz University** 2
- **Sabancı Univ.** 3
- **TED University** 2
- **Ankara University** 1
- **Aselsan** 1
- **Atılım University** 1
- **Beykent University** 1
- **Çukurova Üniversitesi** 1
- **SAP** 1
- **TAI** 1
- **TCMB** 1
- **Turkcell** 1

### Abroad
- **Amazon** 3
- **Oregon Health and Sci. U.** 3
- **Case Western R. U.** 2
- **Lawrence Berkeley Lab** 1
- **LIP ENS-LYON CNRS** 1
- **ETH** 1
- **Facebook** 1
- **Fraunhofer** 1
- **Georgia Tech** 1
- **Google** 1
- **Microsoft** 1
- **Oracle** 1
- **Salesforce** 1
- **Sandia National Labs.** 1
- **Stony Brook University** 1
- **U. of Central Florida** 1
- **Uber** 1

### Faculty Members
- **Georgia Institute of Technology**
- **Oregon Health and Science University**
- **Stony Brook University**
- **University of Calgary**
- **Bilkent University**
- **Akdeniz University**
- **Ankara University**
- **Ankara Yıldırım Beyazıt University**
- **Atatürk University**
- **Atılım University**
- **Beykent University**
- **Celal Bayar University**
- **Çukurova University**
- **Hacettepe University**
- **Konya Food & Agriculture University**
- **METU**
- **Sabancı University**
- **Selçuk University**
- **TED**
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 422 (4th floor)

Research interests:
➢ Computer vision
➢ Pattern recognition
➢ Machine learning

Current topics:
➢ Medical image analysis
➢ Remote sensing image analysis
➢ Image classification
➢ Object recognition
➢ Content-based image retrieval
Sponsored Research Projects

- Medical image analysis
  - TÜBİTAK 1001, 2018-2021
  - TÜBİTAK 1001, 2014-2017
  - TÜBİTAK CAREER Grant, 2005-2010

- Remote sensing image analysis
  - TÜBİTAK 1001, 2010-2012
  - European Commission, Joint Research Centre, 2008-2009
  - TÜBİTAK CAREER Grant, 2005-2010
  - FP6 Marie Curie Grant, 2005-2007

- Image and video mining
  - DPT, 2004-2005
Medical Image Analysis

Segmentation and classification of cervical cells

Classification of prostate biopsies

Content-based search of medical archives
Medical Image Analysis

Whole slide imaging
(100,000 x 100,000 pixels, 30 GB/image)

Deep networks for region of interest detection

Different weakly supervised learning scenarios

Dr. Selim Aksoy
Medical Image Analysis

Deep feature representations

Conditional random fields for weakly supervised learning

Convolutional neural networks for region of interest classification

Computer aided diagnosis of breast biopsies
Remote Sensing Image Analysis

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Landsat 5 (30 m) (1984)</td>
<td>Increasing spatial resolution (300m → 1-2cm)</td>
</tr>
<tr>
<td>(b) Spot 5 (5 m) (2002)</td>
<td></td>
</tr>
<tr>
<td>(c) WorldView-3 (0.31 m) (2014)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) False color</td>
<td>Hyperspectral image analysis</td>
</tr>
<tr>
<td>(b) Buildings</td>
<td></td>
</tr>
<tr>
<td>(c) Roads</td>
<td></td>
</tr>
<tr>
<td>(d) Vegetation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Aerial</td>
<td>Orchard segmentation and agricultural mapping</td>
</tr>
<tr>
<td>(b) Landsat</td>
<td></td>
</tr>
<tr>
<td>(c) DEM</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d) Ikonos</td>
<td></td>
</tr>
<tr>
<td>(e) Ikonos</td>
<td></td>
</tr>
</tbody>
</table>

Multi-source fusion and missing data analysis

Dr. Selim Aksoy
Remote Sensing Image Analysis

Geospatial data mining

Zero-shot learning for object recognition

Attention model for multi-source fine-grained object recognition

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

Read mapping and variation analysis
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 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
**sample:** 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
Illumina MiSeq
Ion Torrent PGM
Ion Torrent Proton
Oxford Nanopore MinION
Oxford Nanopore GridION

Complete Genomics

... 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.
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

Sample data from the MSU dataset. (a) Genuine faces; (b)-(d) Spoof faces.
Anomaly Detection

Developing novel methodologies along with applications to:

- Surveillance
- Novelty detection
- Healthcare
- etc.
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 petascaling **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

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

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: Petascale 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
Current Positions of Some Former PhD. Students

- Dr. Seher Acer, 2017. **Sandia National Lab.**, Postdoc
- Dr. Oguz Selvitopi, 2017. **Lawrence Berkeley National Lab.**, Postdoc
- Dr. Şükrü Torun, 2017. **Yıldırım Beyazıt University**, Assistant Professor
- Dr. Kadir Akbudak, 2015. **KAUST**, Postdoc
- Dr. Enver Kayaaslan, 2013. **Google Switzerland**, Researcher
- Dr. Ertuğrul Tabak, 2013. **Aurea Software**, Software engineering manager
- Dr. Eray Özkural, 2013. **Celestial Intellect Cybernetics**, Software engineer
- Dr. Tayfun Küçükyılmaz, 2012. **TED University**, Assistant Professor
- Dr. Ata Türk, 2010. **Boston University**, Postdoc
- Dr. Engin Demir, 2009. **Hacettepe University**, Assistant Professor
- Dr. Barla Cambazoğlu, 2006. **RMIT University**, Senior research fellow
- Dr. Ümit Çatalyürek, 1999. **Georgia Institute of Technology**, Professor
- Dr. Tahsin Kurc, 1997. **Stony Brook University**, Associate Professor

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

Faculty
Fazlı Can
Seyit Koçberber

Graduate Students
Sepehr Bakhshi
Alicant Büyükçakır
Sevil Çalışkan
Sanem Elbaşi
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.
A. Ercument Cicek

cicek@cs.bilkent.edu.tr
cs.bilkent.edu.tr/~cicek

My research focuses on building algorithms for analyzing biological data using algorithms for biochemical networks. Even though various algorithms for discovering disease biomarkers in particular for genetic diseases have been developed, the search for algorithms that can efficiently analyze power and power algorithms is based on computational bottlenecks. Consequently, vast amounts of "big data" have resulted in a day of accumulation. Today, it took 13 years and $1b to sequence the first human genome, and more. It took right now, it takes a day to sequence the first genome. This has informed the accumulation of vast amounts of data and algorithms that can be used for computing in the bio-research. Central data and algorithms that can be used for computing and algorithms that can be used for computing. Central data and algorithms that can be used for computing and algorithms that can be used for computing.
Gene Discovery for Autism Spectrum Disorder
-Broken interplay between 1000 genes lead to autism.
-So far we have only discovered ~50 of them, Biological networks along with intelligent search algorithms needed to discover new genes to understand the genetic architecture.
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.
A. Ercument Cicek
cicek@cs.bilkent.edu.tr
cs.bilkent.edu.tr/∼cicek

Selected Publications:

De Novo Chip-Seq Analysis. Genomic Insights into 16:205.


NEURON 2015, 515(7526):209-15

Biometarics for Metabolite Network.

DAWN: A framework to identify autism genomics.

MIR4: Mutational, transcriptional, and chromatin network.

Synaptic analyses reveal new autism risk loci.

ARCHITECTURE AND BIOLOGY.

MiRNA, transcriptomic, and chromatin network:

Gene expression and biology.

Molecular Autism.

Expected Metabolite Level Changes Using 

BA: Supplementary Information.

PlasComputation Biology 2013, 9(1):

Mutual Metabolite Level Changes Using

e1002859.
• 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
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

dibeklioglu@cs.bilkent.edu.tr | http://www.cs.bilkent.edu.tr/~dibeklioglu/
Kinship Verification

Kin 2
Maximize Similarity
Minimize Similarity
Output
Decoding
Full Connection
Encoding
Expression Matching
Input: Kin 1 (Father)

Kin 1
Maximize Similarity
Minimize Similarity
Output
Decoding
Full Connection
Encoding
Expression Matching
Input: Kin 2 (Daughter)

Others (No Kinship)

Maximize Similarity
Minimize Similarity
Decoding
Full Connection
Encoding
Expression Matching

Shared Weights

Others (No Kinship)
Facial Expression Recognition

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


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
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

End-to-end segmentation in biopsy images

Gland/cell segmentation in colon tissues

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
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

http://www.cs.bilkent.edu.tr/~gunduz
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
Networks and Systems Research Group

Bilkent University – Department of Computer Engineering

Faculty Member

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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

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  Sponsor: TUBITAK

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Sample Current Work

- **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
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
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 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
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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?
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 Consortium, 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)
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

- "http://www.cs.bilkent.edu.tr/~bilweb"
Search Engines are the key to access Web Data

1995
- S. Brin meets L. Page

2000
- First billion-URL index
- The world’s largest!
- ≈5000 PCs in clusters!

2008
- Google counts 1 trillion unique URLs

2009
- TBs or PBs of data/index
- Tens of thousands of PCs

1998
- Birth of Google

2004
- Index grows to 4.2 billion pages

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

**System Architecture**

- **Fact-Extractor**
- **Extracted Facts**
- **Knowledge-Base**
- **Query Processor**
- **Video-Annotation**
- **Feature Database**
- **Object-Relational DBMS**
- **Raw Video Database (File System)**

**Query**

**Videos**

**Results**
BilVideo-7: An MPEG-7 Compatible Video Retrieval System

- 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
- Salient video object extraction
- puta
- bush
- dog

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