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 (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
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
Faculty Members

• In alphabetic order

(Please contact with them in person for details)
VAROL AKMAN

- http://www.cs.bilkent.edu.tr/~akman
- email: akman@bilkent.edu.tr

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
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
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 → Resequencing → Read mapping and variation analysis

De novo sequencing → Assembly → Contigs/Scaffolds
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

**Sample**: 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


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.
<table>
<thead>
<tr>
<th>Research Interests</th>
<th>Current Research Topics</th>
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</thead>
<tbody>
<tr>
<td>• Computer Vision</td>
<td>• Face Recognition</td>
</tr>
<tr>
<td>• Pattern Recognition</td>
<td>• Face Presentation Attack Detection</td>
</tr>
<tr>
<td>• Machine Learning</td>
<td>• Anomaly Detection</td>
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</tbody>
</table>
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

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: 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)
# Bilkent Information Retrieval Group

**Faculty**
- Fazli Can
- Seyit Koçberber

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

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

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

- New Event Detection and Tracking
- Novelty Detection
- Information Retrieval
- Information Filtering
- News Categorization
- Text Mining & Processing
<table>
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<tr>
<th>GÜN ÇEYİ &amp; GEÇMİŞ OLYAYLAR</th>
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<tbody>
<tr>
<td><strong>Güncel Olaylar</strong></td>
</tr>
<tr>
<td>1. KEİTA MILLİ TAKİMDA...... İZLEYENLER (54)</td>
</tr>
<tr>
<td>2. YENİ BİR SERİ KATIL...... İZLEYENLER (7)</td>
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<tr>
<td>3. AGLAYAN ÖĞRENCİ VALİYE ZOR.... İZLEYENLER (6)</td>
</tr>
<tr>
<td>4. GÜNEYDĘ PLAJLAR DÖLDU TAŞTI.... İZLEYENLER (7)</td>
</tr>
<tr>
<td>5. ÇОРУМĐÁ KENĐEN 1 Öلوم.... İZLEYENLER (9)</td>
</tr>
<tr>
<td>6. ŞOK İDDİA: MICHAEL JACKSON.... İZLEYENLER (9)</td>
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<tr>
<td>7. PAPAKOSTANDIŅU: YENİ ÖNLEMLER ALINMASI... İZLEYENLER (7)</td>
</tr>
<tr>
<td>8. 10 PROJENİN ŞAMIYONU VARYAP.... İZLEYENLER (5)</td>
</tr>
<tr>
<td>9. ARNAVÜLK'A SYASİ KRİZ.... İZLEYENLER (6)</td>
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<tr>
<td>9. TÜRKİYE VE Yunanistan, Ortak... İZLEYENLER (5)</td>
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<tr>
<td>9. KARAPARADA “İNCELEME HAVUZU”NDAYIZ... İZLEYENLER (7)</td>
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<tr>
<th><strong>Geçmiş Olaylar</strong></th>
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<tbody>
<tr>
<td>1. HİNTİ DÜŞMAN KARDEŞLER MALLARI.... İZLEYENLER (15)</td>
</tr>
<tr>
<td>2. KONUT KREDİSİ FAZİNDE YÜKSELIŞ.... İZLEYENLER (8)</td>
</tr>
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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."
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.
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

<table>
<thead>
<tr>
<th>Selected Publications</th>
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<tbody>
<tr>
<td>De Novo Chip-Seq Analysis: Genome-wide analysis of risk loci architecture spectrum disorder</td>
</tr>
</tbody>
</table>
| Enome: The architecture spectrum disorder and biology network | Risk loci analysis reveals new autism risk genes |}

<table>
<thead>
<tr>
<th>Journal</th>
<th>Title</th>
<th>Year</th>
<th>Volume/Issue/Start Page/End Page</th>
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<tbody>
<tr>
<td>MI conformal transcriptional and chromatin networks</td>
<td>2015</td>
<td>87(6):1215-33</td>
<td></td>
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<tr>
<td>NEURON</td>
<td>Exome</td>
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<tr>
<td>Genome</td>
<td>Insights into</td>
<td></td>
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</table>
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
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/
Age Estimation through Facial Dynamics

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

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

dibeklioglu@cs.bilkent.edu.tr | http://www.cs.bilkent.edu.tr/~dibeklioglu/
Selected Publications


dibeklioglu@cs.bilkent.edu.tr | http://www.cs.bilkent.edu.tr/~dibeklioglu/
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
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
Main research interests:

- Medical image analysis for automatic cancer diagnosis, grading, and prognosis
- Machine learning for intelligent medical systems
Computational Biology Research Group

Çiğdem Gündüz Demir

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
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
 Networks and Systems Research Group

Bilkent University – Department of Computer Engineering

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
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
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. You can send an email to mustafa.ozdal@cs.bilkent.edu.tr to set up an appointment.
Özcan Öztürk
Office: EA 421 Phone: 290-3444
Email: ozturk@cs.bilkent.edu.tr
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*
Eray Tüzün
Bilkent University Software Engineering and Data Analytics Research Group
eraytuzun@cs.bilkent.edu.tr
http://www.cs.bilkent.edu.tr/~eraytuzun
Office: EA-524

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

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

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
- **2015**:

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

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

- **Feature Extraction**
  - MPEG-7 Features

- **XML-Native Feature Database** (Tamino)
  - segmentation, tracking, feature extraction, annotation, indexing

- **Query Processor**

- **Video Processing**
  - SBD, Segmentation
  - Object Extraction
  - Annotation
  - etc.

- **Visual Query Interface**
- **Web Client**

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

**Users**

- **Query Processor**

**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

- **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)