



Bilkent University Computer Engineering Department



MSc and PhD Programs

Prof. Dr. H. Altay Güvenir

Graduate Programs

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

Applications

- Application Deadline: 30 May 2016
- Online Application:
<https://stars.bilkent.edu.tr/gradapp/>
- Requirements for application:
 - CGPA $\geq 2.80 / 4.00$
 - 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 PhD).

Interview

- Date: 6-7 June 2016
- 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

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

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<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>

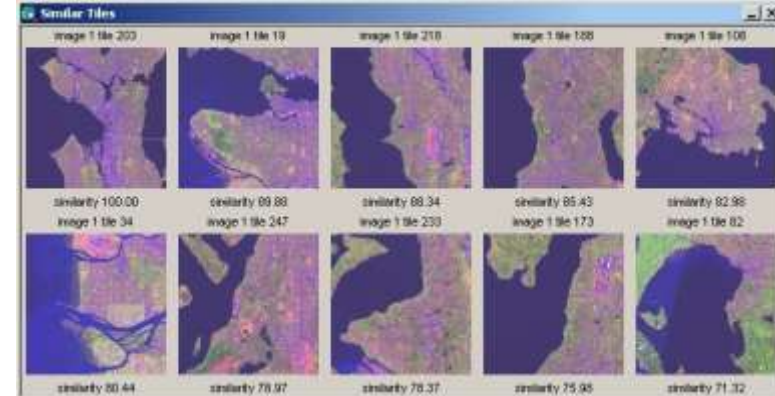
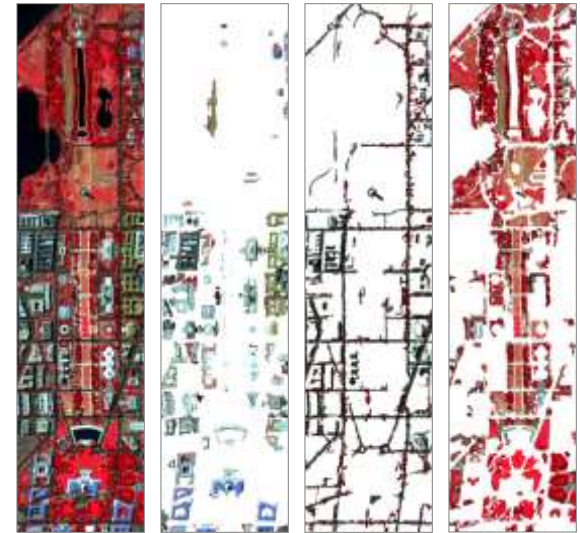


Sponsored Research Projects

- 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

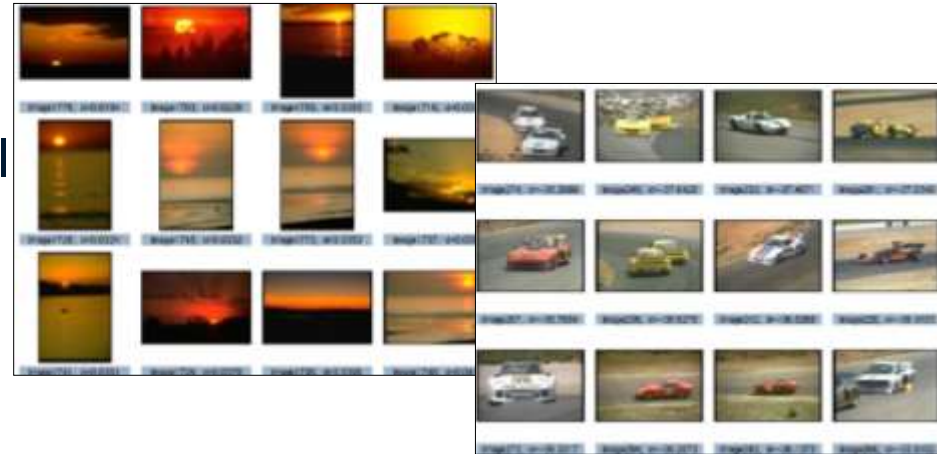
- Increasing resolution in space and time (NASA receives 3 TB/day)
- Object recognition, classification and retrieval (Have you tried Google Earth?)



- 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?)

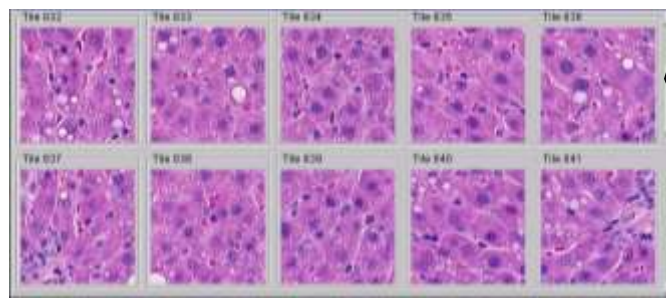
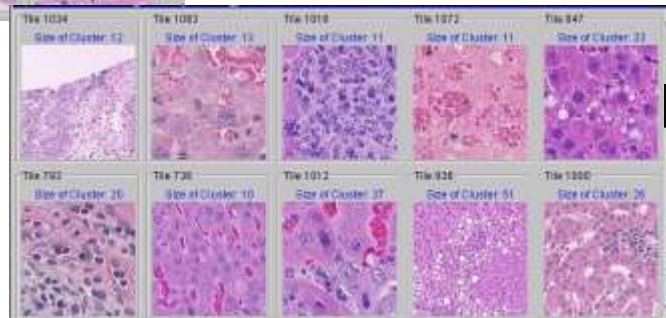
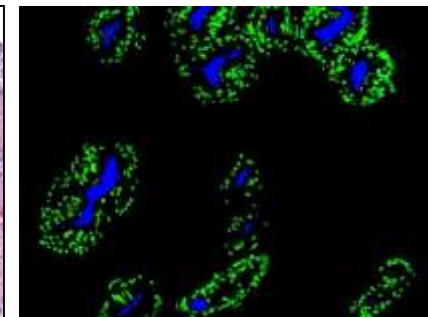
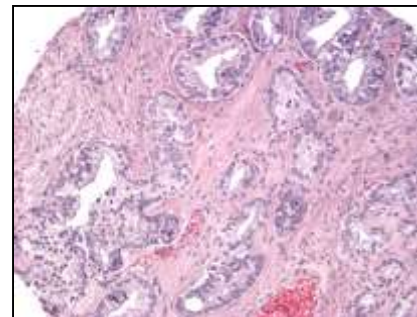
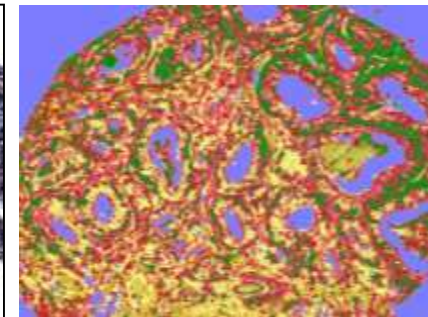
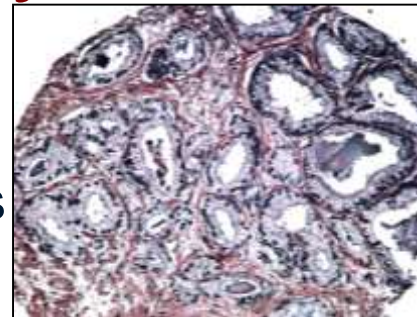
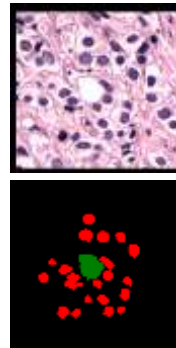
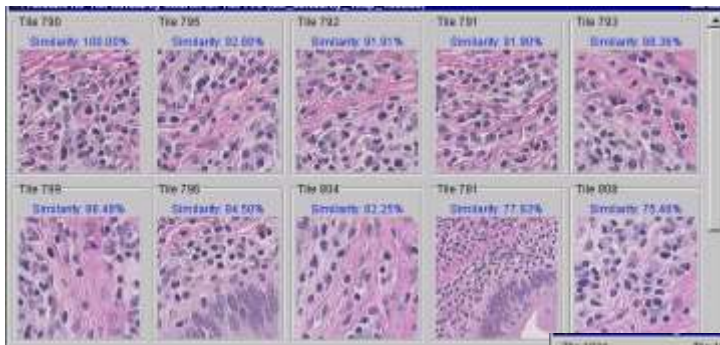


- Object recognition
- Scene classification
- Combining image/audio/motion/text



Medical Image Analysis

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



Can Alkan

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Lab for Bioinformatics and Computational Genomics

<http://www.cs.bilkent.edu.tr/~calkan/compgen>



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

Test genome



Resequencing



Reference
Genome

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:

sample:

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

SNP deletion insertion

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

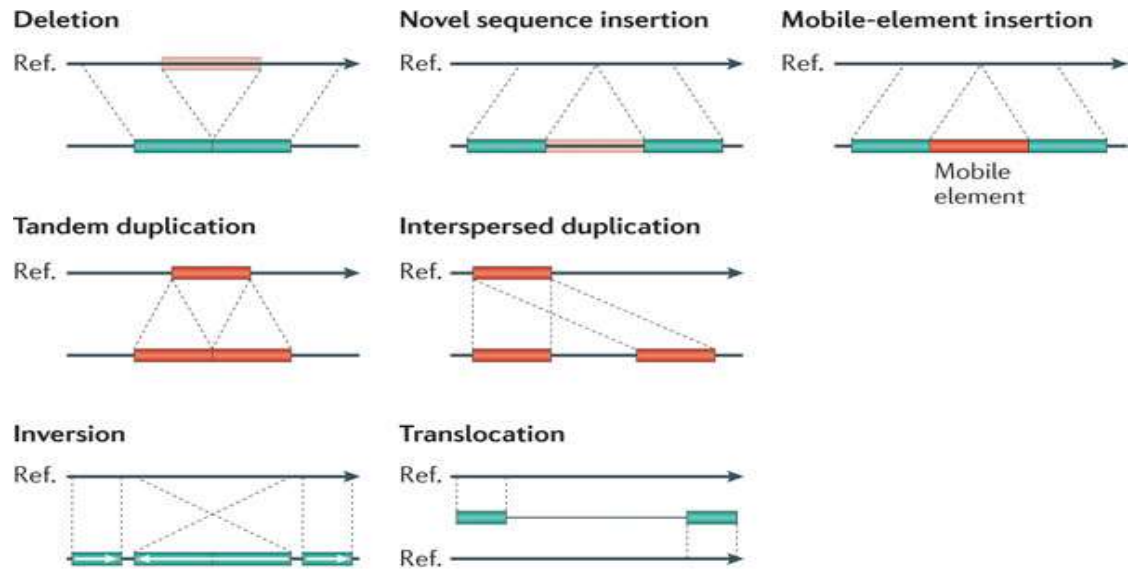
reference:

sample:

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

Structural variation:

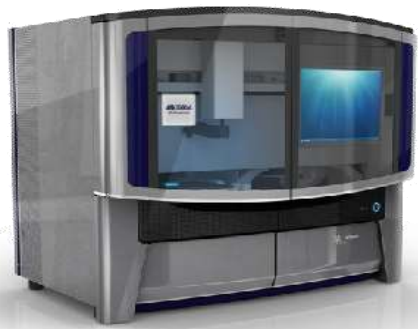
Genomic alterations > 50 bp
Deletions, insertions, mobile
elements, duplications,
inversions and translocations



Genome sequencers



Roche/454



AB SOLiD



Illumina MiSeq



Complete Genomics



Illumina HiSeq2000



Pacific Biosciences RS



Oxford Nanopore MinION



Oxford Nanopore GridION



Ion Torrent PGM



Ion Torrent Proton

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

Selected publications

[Personalized copy number and segmental duplication maps using next-generation sequencing](#). *Nature Genetics*, Oct, 41(10):1061-1067, 2009.

* **Highlighted** in News and Views, "Mapping duplicated sequences", DY Chiang and SA McCarroll, *Nature Biotechnology*, Nov; 27(11):1001-2, 2009.

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

[Detection and characterization of novel sequence insertions using paired-end next-generation sequencing](#). *Bioinformatics*, May 15; 26(10):1277-83, 2010.

[A draft sequence of the Neandertal genome](#) *Science*, 7 May, 328 (5979):710-722, 2010.

Recipient of the [2010 AAAS Newcomb Cleveland Prize](#).

[mrsFAST: a cache-oblivious algorithm for short-read mapping](#). *Nature Methods*, Aug;7(8):576-7, 2010.

[A map of human genome variation from population-scale sequencing](#). 1000 Genomes Project Consortium. *Nature*, Oct 28;467(7319):1061-73, 2010.

[Genetic history of an archaic hominin group from Denisova Cave in Siberia](#). *Nature*, Dec; 468(7327):1053-1060, 2010.

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

* **Highlighted** in Commentary, "Assemblies: the good, the bad, the ugly", E. Birney, *Nature Methods*, 8(1):59-60, 2011.

[Mapping copy number variation by population-scale genome sequencing](#). *Nature*, 470(7332):59-65, 2011.

[Genome structural variation discovery and genotyping](#). *Nature Reviews Genetics*, May;12(5):363-76, 2011.

[Sensitive and fast mapping of di-base encoded reads](#). *Bioinformatics*, Jul 15;27(14):1915-21, 2011.

[Detection of structural variants and indels within exome data](#). *Nature Methods*, 9(2): 176-178, 2012.

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.

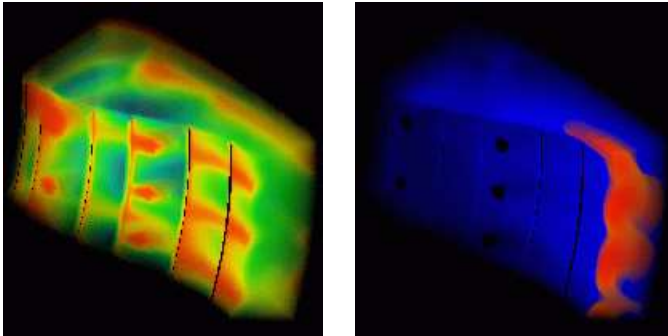
Successful applicants will also have a chance to contribute to many international consortiums such as the 1000 Genomes Project and the Genome 10K, and will involve in other international collaborations with researchers in Vancouver, Seattle, Barcelona, Bari, Pittsburgh, and more.

Basic understanding of biology/genetics/genomics is a *plus*, but **not required**.

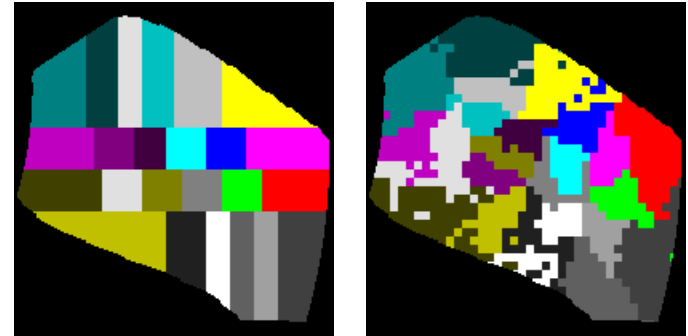
Parallel and Grid Computing Group



Prof. Dr. Cevdet Aykanat



Volume rendering of a combustion chamber:
pressure and velocity fields.



Screen assignments for 24 processors:
jagged and hypergraph partitionings.



Parallel and Grid Computing Group

- Projects funded by TUBITAK, Intel and European Union
 - EU-funded FP6 SEE-GRID2 project (2006-2009)
 - Parallel Text Retrieval & Query Processing (TÜBİTAK, 2006-2008)
 - EU-funded FP6 EUMedGrid project (2006-2008)
 - EU-funded FP6 SEE-GRID project (SE4SEE application) (2004-2006)
 - Efficient Parallel Web Crawling (TÜBİTAK, 2004-2006)
 - Task scheduling for PC clusters (TÜBİTAK, 1999-2002)
 - Unstructured domain mapping (EU ITDC , 1995-1998)
 - Parallel direct volume rendering (TÜBİTAK EEAG, 1995-1997)
 - Real-time realistic image generation (TÜBİTAK & Intel SSD, 1991-1994)



Parallel and Grid Computing Group

- Parallel computing architectures
 - Intel iPSC/2 hypercube (32 nodes)
 - Parsytec CC24 (24 nodes)
 - PC cluster (Borg) (32 nodes)
 - PC cluster (Skynet) (48 nodes)
 - Grid cluster (16 nodes)

Parallel and Grid Computing Group





Parallel and Grid Computing Group

■ Current research topics

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

Journal Publications (2006-2008)

1. C. Aykanat, B.B. Cambazoglu and B. Ucar, “Multi-level Direct K-way Hypergraph Partitioning with Multiple Constraints and Fixed vertices,” **Journal of Parallel and Distributed Computing**, 2008.
2. T. Kucukyilmaz, B.B. Cambazoglu, C. Aykanat, and F. Can, “Chat Mining: Predicting User and Message Attributes in Computer-Mediated Communication”, **Information Processing & Management**, 2008.
3. A. Pinar, E.K. Tabak and C. Aykanat, “One-Dimensional Partitioning for Heterogeneous Systems: Theory and Practice,” **Journal of Parallel and Distributed Computing**, 2008.
4. E. Demir, C. Aykanat and B. B. Cambazoglu, “Clustering Spatial Networks for Aggregate Query Processing, a Hypergraph Approach,” **Information Systems**, 2008.
5. B. Ucar and C. Aykanat, “Revisiting Hypergraph Models for Sparse Matrix Partitioning,” **SIAM Review**, 2007.
6. B. Ucar and C. Aykanat, “Partitioning Sparse Matrices for Parallel Preconditioned Iterative Methods,” **SIAM Journal on Scientific Computing**, 2007.
7. B.B. Cambazoglu and C. Aykanat, “Hypergraph-Partitioning-Based Remapping Models for Image-Space-Parallel Direct Volume Rendering of Unstructured Grids,” **IEEE Transactions on Parallel and Distributed Systems**, 2007.
8. K. Kaya, B. Ucar and C. Aykanat, “Heuristics for Scheduling File-Sharing Tasks on Heterogeneous Systems with Distributed Repositories,” **Journal of Parallel and Distributed Computing**, 2007.
9. B.B. Cambazoglu, E. Karaca, T. Kucukyilmaz, A. Turk and C. Aykanat “Architecture of a Grid-Enabled Search Engine, **Information Processing & Management**, 2007.
10. B. Ucar, C. Aykanat, M. Pinar and T. Malas, “Parallel Image Restoration Using Surrogate Constraint Methods,” **Journal of Parallel and Distributed Computing**, 2007.
11. C. Aykanat, B. B. Cambazoglu, F. Findik, and T.M. Kurc, “Adaptive Decomposition and Remapping Algorithms for Object-Space-Parallel Direct Volume Rendering of Unstructured Grids,” **Journal of Parallel and Distributed Computing**, 2006.
12. B.B. Cambazoglu and C. Aykanat, “Performance of Query Processing Implementations in Ranking-Based Text Retrieval Systems Using Inverted indices,” **Information Processing & Management**, 2006.
13. K. Kaya and C. Aykanat, “Iterative-Improvement-Based Heuristics for Adaptive Scheduling of Tasks Sharing Files on Heterogeneous Systems,” **IEEE Transactions on Parallel and Distributed Systems**, 2006.
14. B. Ucar, C. Aykanat, K. Kaya and M. İkinci, “Task Assignment in Heterogeneous Systems,” **Journal of Parallel and Distributed Computing**, 2006.



Paralel and Grid Computing Group

- Contact information

- Cevdet Aykanat
- Phone: 312 290 1625
- Email: *aykanat@.cs.bilkent.edu.tr*
- Homepage: <http://www.cs.bilkent.edu/~aykanat>





Bilkent Information Retrieval Group

Faculty

Fazlı Can
Seyit Koçberber

Graduate Students

Cem Aksoy
Ceyhun Karbeyaz
Çağrı Toraman
Anıl Türel
Ahmet Yeniçağ

Undergraduate Students

Turgut Işık
Oğuz Kaya
Harun Özden
Abdullah Şahin

Volunteers

Aykut Bal
Akif Buğday
Bilge Koroğlu
Hasan Can Tuncay

Some Prev. Members

Erman Balçık
Ahmet Buğdaycı
Tunay Gür
Cihan Kaynak
Levent Koç
İbrahim Uysal

Other Contributors

Cevdet Aykanat
Pinar Duygulu
Özgür Ulusoy
İsmail Şengör Altingövde
Özgür Bağlıoğlu
Ethem F. Can
Göneng Ercan
Süleyman Kardeş
H. Çağdas Öcalan
Erkan Uyar

Research Interests



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

Bilkent News Portal



Bilkent Haber Portalı

BILKENT BİLGİ ERIŞİM GRUBU 13.05.10

[Ana Sayfa](#) | [Ürünler](#) | [Yardım](#) | [Hakkımızda](#)

KATEGORİLER

[Ekonomi](#)
[Politika](#)
[Türkiye](#)
[Dünya](#)
[Spor](#)
[Kültür - Sanat](#)
[Sağlık](#)
[Bilim Teknoloji](#)
[Yazarlar](#)

SON HABERLER

KÜÇÜK TAMIL ASKERLER SINIFLARINA DÖNÜYOR...

Sri Lanka'da 30 yıllık çatışmaların ardından hükümet tarafından eski topraklarına döndürülen ülkenin doğu ve kuzey [Devamı...](#)

KÜTAHYA'DA GÖÇÜK MEYDANA GELEN MADEN...

Kütahya'nın Tavşanlı ilçesinde, göçük meydana gelen maden ocağı hakkında Valilikçe yaklaşık 2.5 ay önce eksikleri [Devamı...](#)

KURUYEMİŞİN AZI KARAR, ÇOĞU ZARAR...

Tüketiminde dünya ikincisi olduğumuz kuru yemişi, ölçülü miktarda almanın sağlıklı yaşama katkı sağlayacağı bildirildi. [Devamı...](#)



VALİ GÜLER: DEVLETİN VERDİĞİ GÖREVIN...

[TR](#) [EN](#)

[HESAP OLUŞTUR](#)

[GİRİŞ](#)

Türkçe Haber Arama

Haber Ara:



[Arşivde Ara](#)

GÜNCEL & GEÇMİŞ OLAYLAR

Güncel Olaylar	Geçmiş Olaylar
KEİTA MİLLİ TAKIMDA..... İZLEYENLER (54)	YENİ BİR SERİ KATIL... İZLEYENLER (7)
AĞLAYAN ÖĞRENCİ VALİYE ZOR... İZLEYENLER (6)	GÜNEYDE PLAJLAR DOLDU TAŞTI... İZLEYENLER (7)
ÇORUM'DA KENEDEN 1 ÖLÜM... İZLEYENLER (9)	ŞOK İDDİA: MICHAEL JACKSON... İZLEYENLER (9)
PAPAKOSTANDINU: YENİ ÖNLEMLER ALINMASI... İZLEYENLER (7)	10 PROJENİN ŞAMPİYONU VARYAP... İZLEYENLER (5)
ARNAVUTLUK'TA SİYASİ KRİZ... İZLEYENLER (6)	TÜRKİYE VE YUNANISTAN, ORTAK... İZLEYENLER (5)
KARAPARADA "İNCELEME HAVUZU"NDAYIZ... İZLEYENLER (7)	KONUT KREDİSİ FAİZİNDE YÜKSELİŞ... İZLEYENLER (8)
HİNTLİ DÜŞMAN KARDESLER MALLARI... İZLEYENLER (15)	

EN ÇOK OKUNANLAR



You are the right person for our group

- If you are good at four core practices of CS
 - programming,
 - systems thinking,
 - modeling, and
 - innovation.
- If you
 - "can dream,"
 - "can do," and
 - "can write."

A. Ercument Cicek

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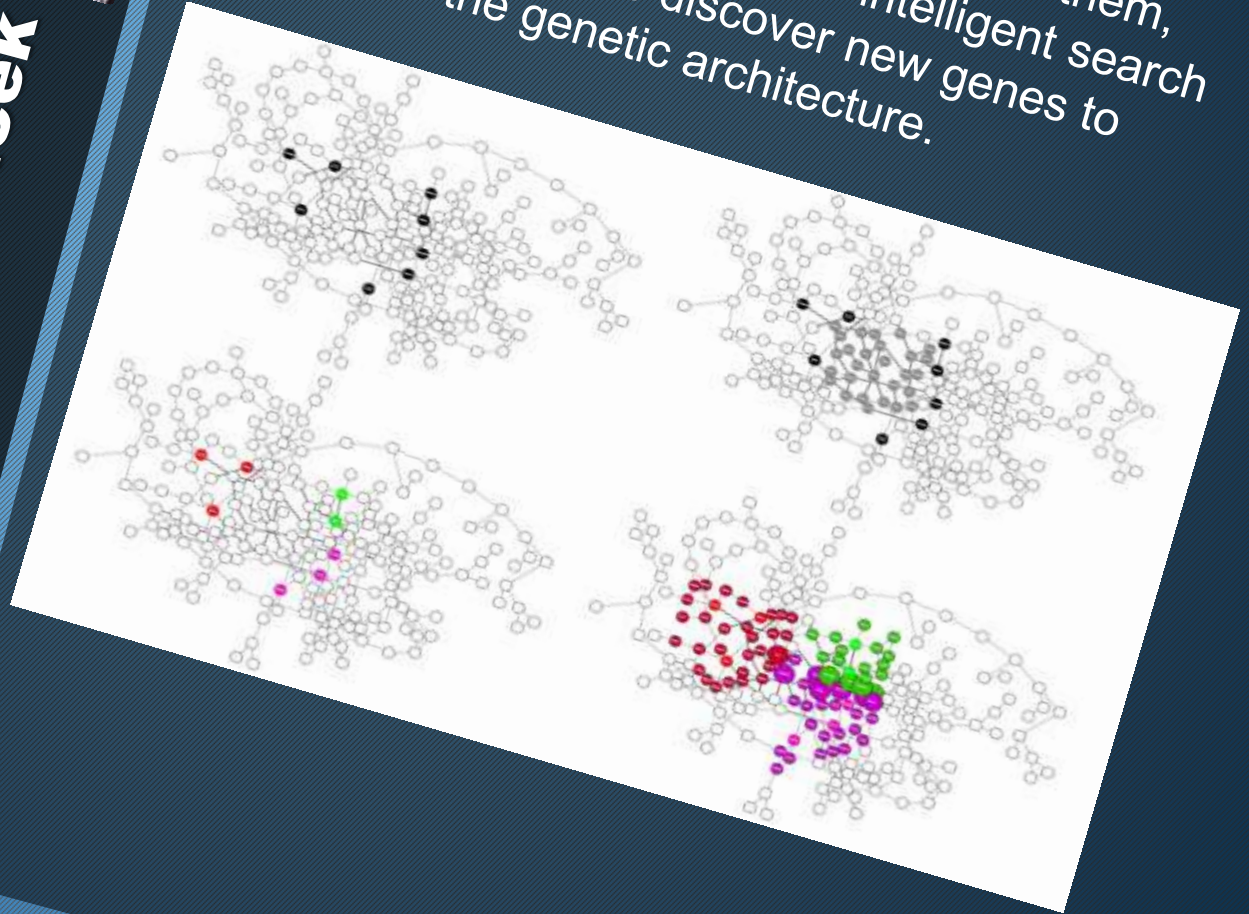
My research focuses on building algorithms for analyzing biological data using various biochemical networks. Even though it took 13 years and ~\$1b to sequence the first genome, right now, it takes a day and ~\$1k. This has resulted in accumulation of vast amounts of information. Consequently, biosciences 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



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.

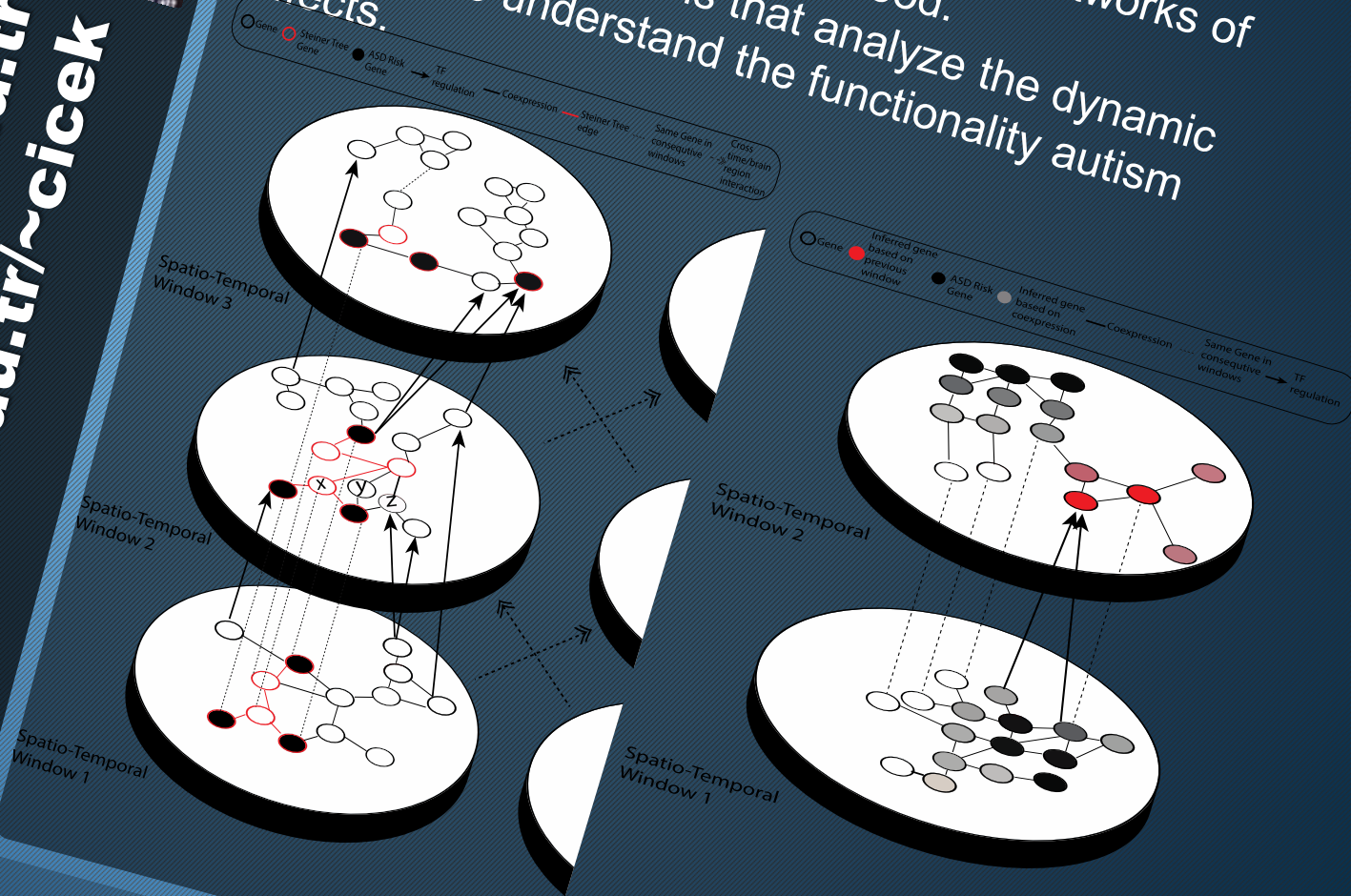


A. Ercument Cicek
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Using Dynamic Network Algorithms to Model Neurodevelopment.

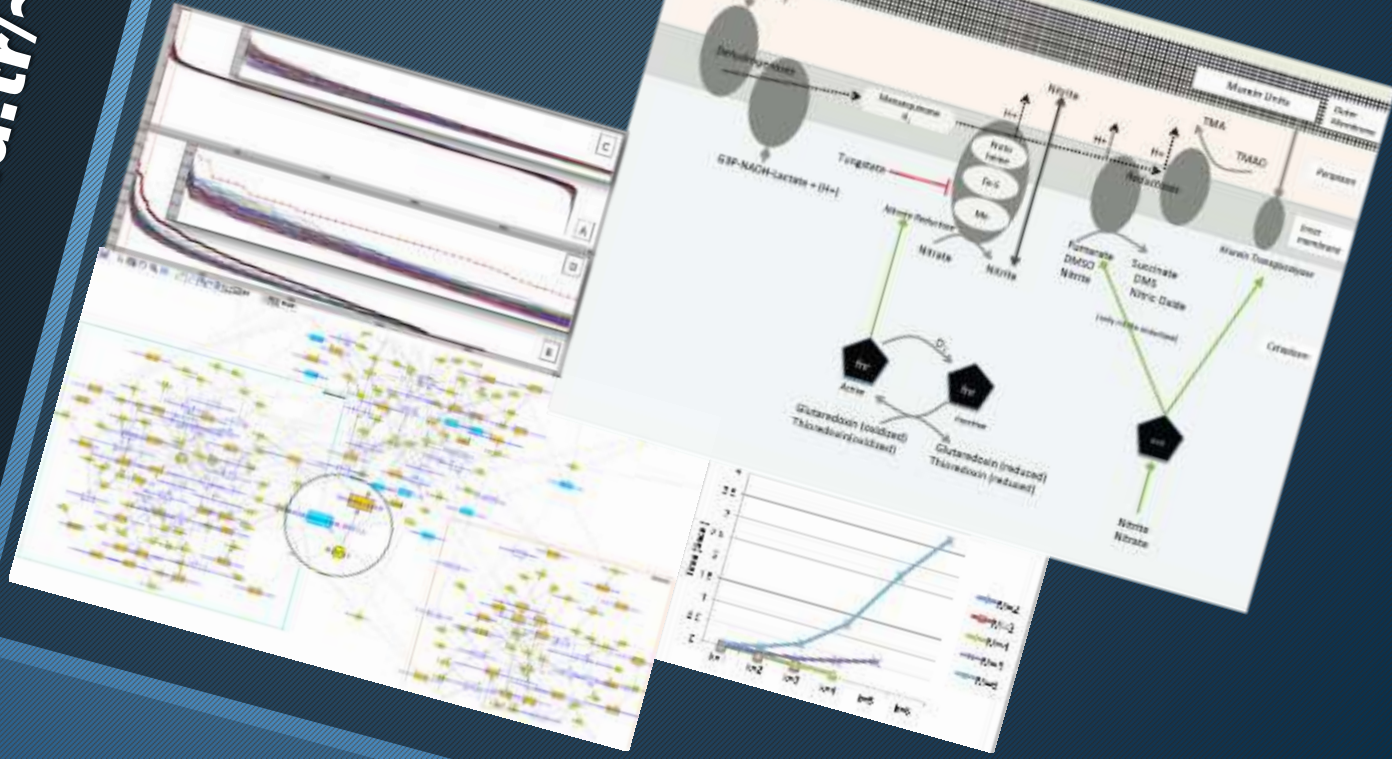
-Autism is a neurodevelopmental disorder and affects evolving the gene interaction networks of the fetal period to early childhood.
-We design algorithms that analyze the dynamic networks to understand the functionality autism affects.



A. Ercument Cicek
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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.

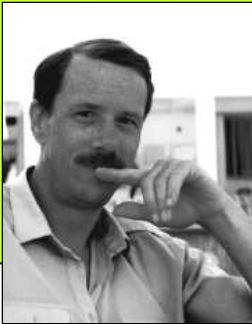


A. Ercument Cicek
cicek@cs.bilkent.edu.tr
cs.bilkent.edu.tr/~cicek



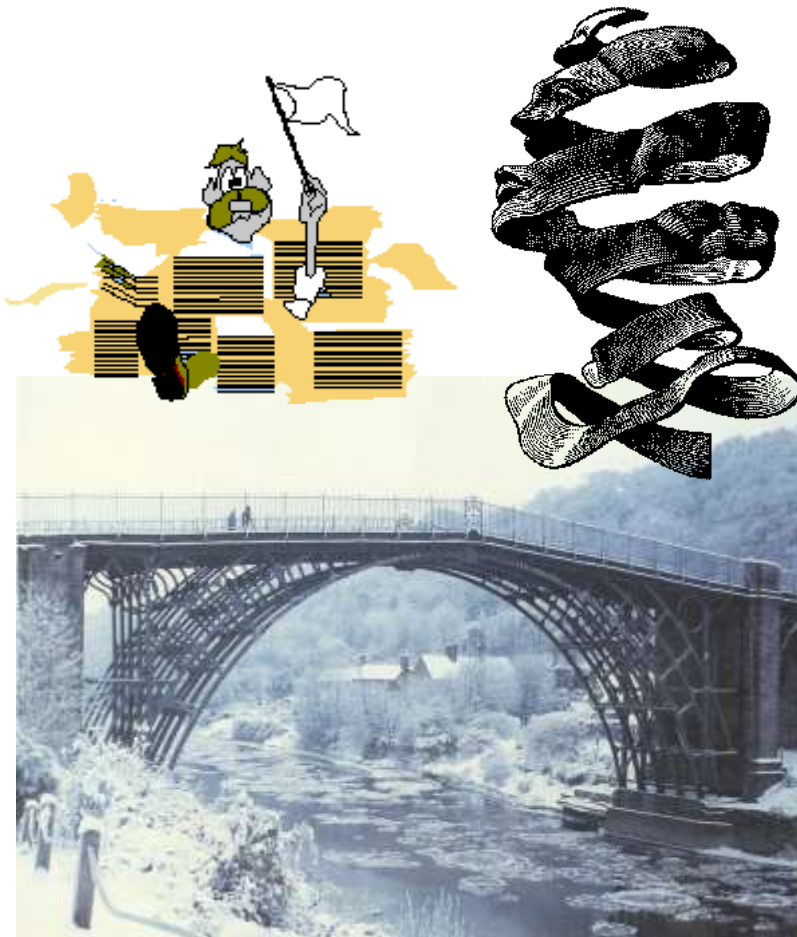
Selected Publications:

- De Novo Chip-Seq Analysis. **Genome Biology** 2015, 16:205.
- Insights into autism spectrum disorder genomic architecture and biology from 71 risk loci **NEURON** 2015, 87(6):1215–33.
- Exome analyses reveal new autism genes in synaptic, transcriptional, and chromatin networks. **NATURE** 2014, 515(7526):209-15
- MIRA: Mutual Information-based Reporter Algorithm for Metabolic Networks **Bioinformatics** 2014, 30(12):i175-i184.
- DAWN: A framework to identify autism genes and subnetworks using gene expression and genetics **Molecular Autism** 2014 5:22.
- ADEMA: An Algorithm to Determine Expected Metabolite Level Changes Using Mutual Information **PLoS Computational Biology** 2013, 9(1) : e1002859.



David Davenport

david@cs.bilkent.edu.tr



WANTED ALIVE

Self-motivated, creative, committed

Graduate Students

Interested in...

- Unraveling mysteries of cognition (Center for Mind language & Culture)
- Information Quality – (CoSys group)
- Computer use in Education
- Ethical concerns raised by Internet

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

Tuğrul Dayar

(tugrul@cs.bilkent.edu.tr)

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

requires solid background:

- 1) in **computer engineering**
- 2) specifically in **probability theory, linear algebra, numerical analysis, and high-level programming,**

which one must either have or be willing to develop



Visit:

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

for further information

Uğur Doğrusöz

On Research of **i-Vis**

Information Visualization Research Group



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

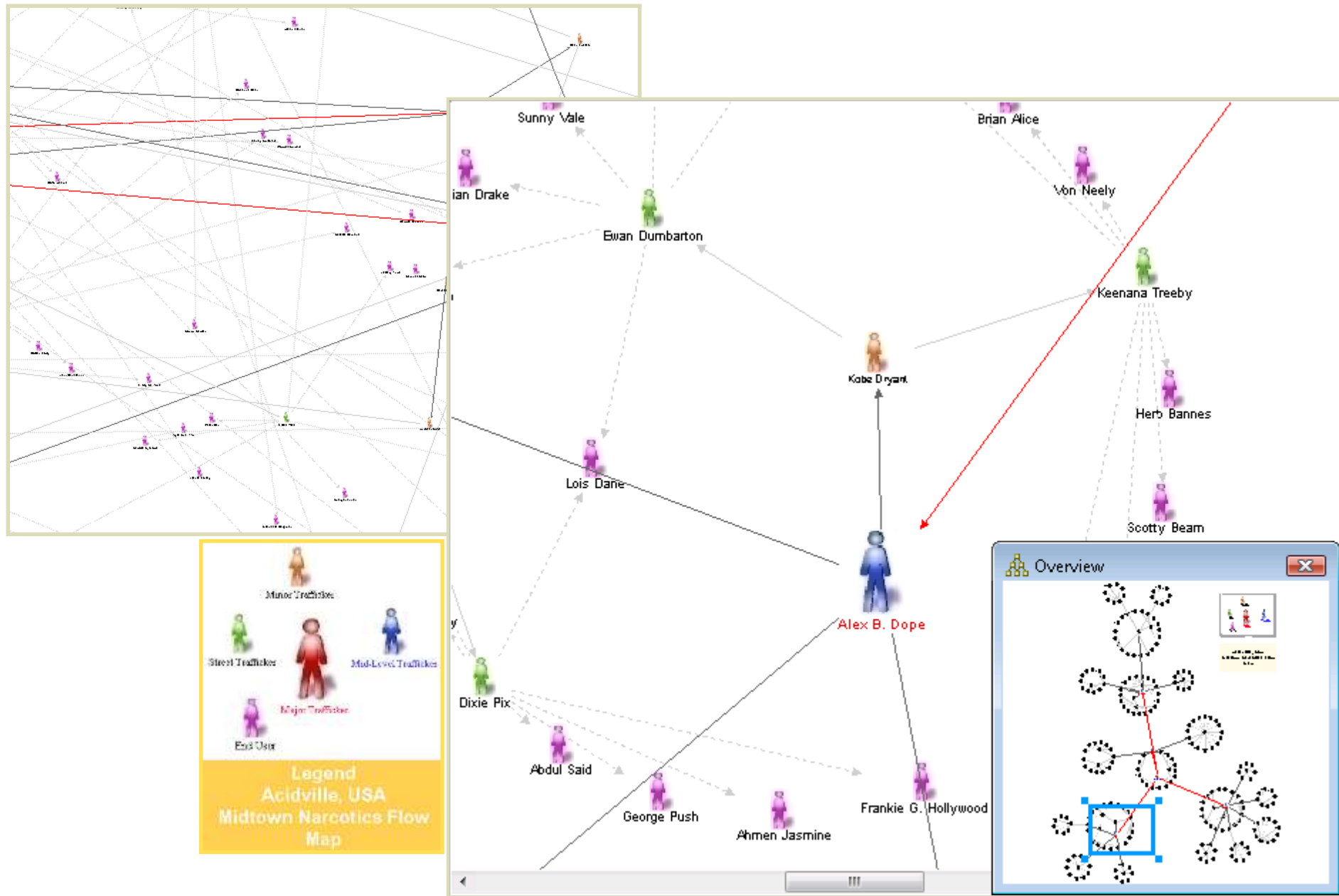
Topics: *Graph visualization, bioinformatics & graph algorithms*

Projects:

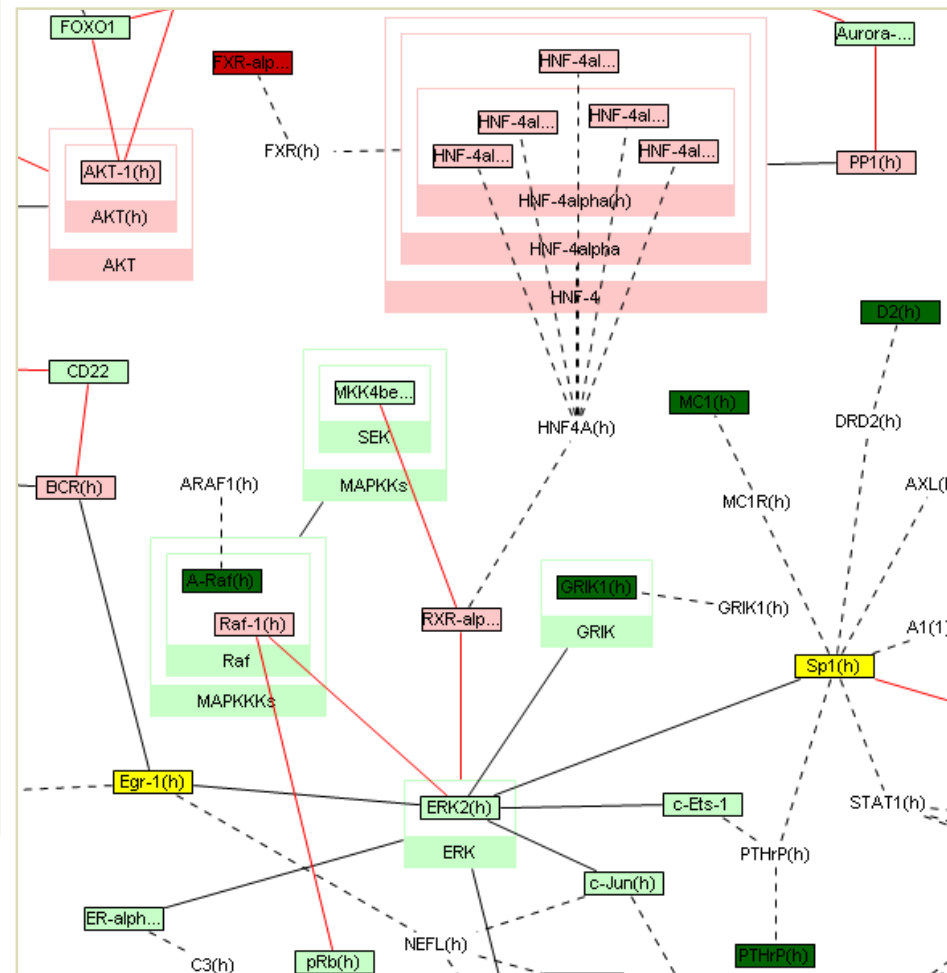
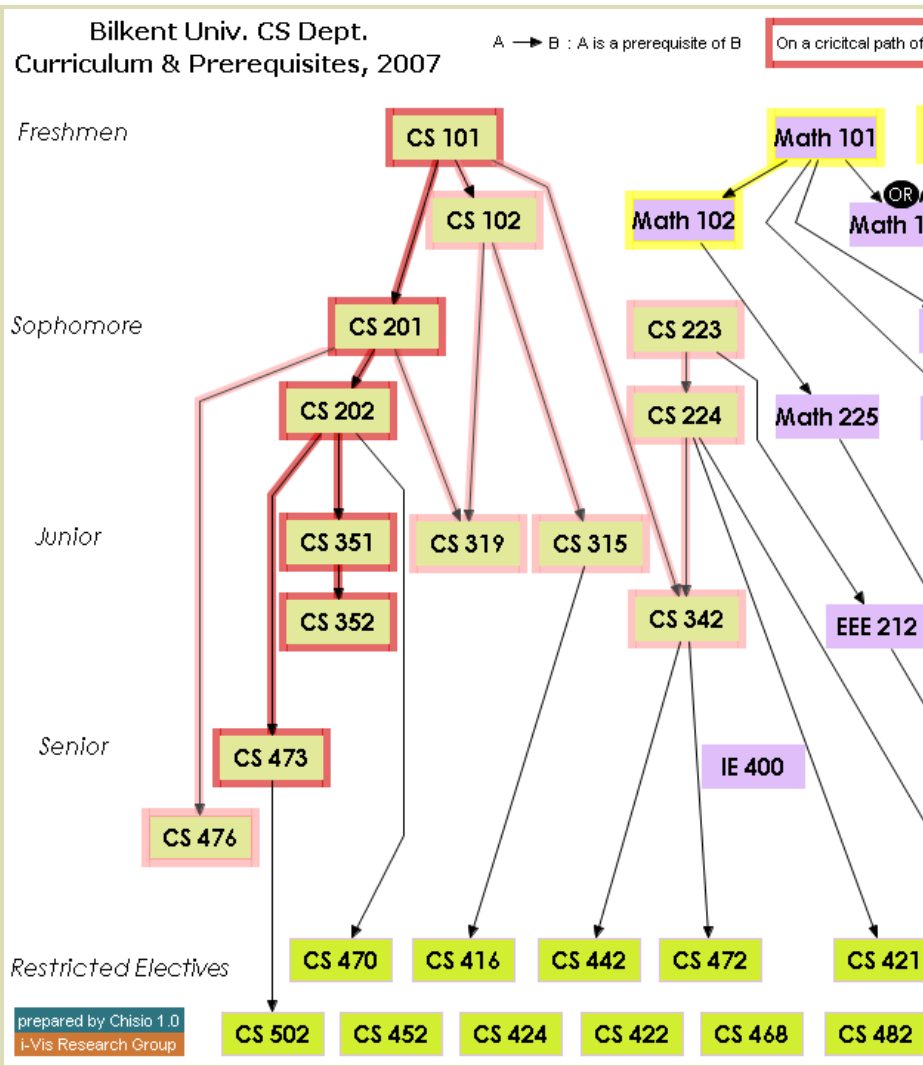
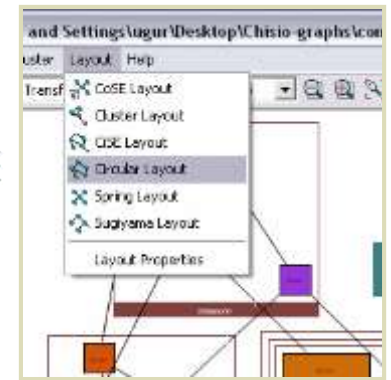
- PATIKA & Visibio [Pathway Modeling, Analysis & Visualization Tools]
- Chisio [Graph Visualization Tool]

Our projects have been supported by TÜBİTAK and Tom Sawyer Software (CA, USA)

Social Network of Drug Traffickers



Chisio Drawing Tool



The PATIKA Project

www.patika.org

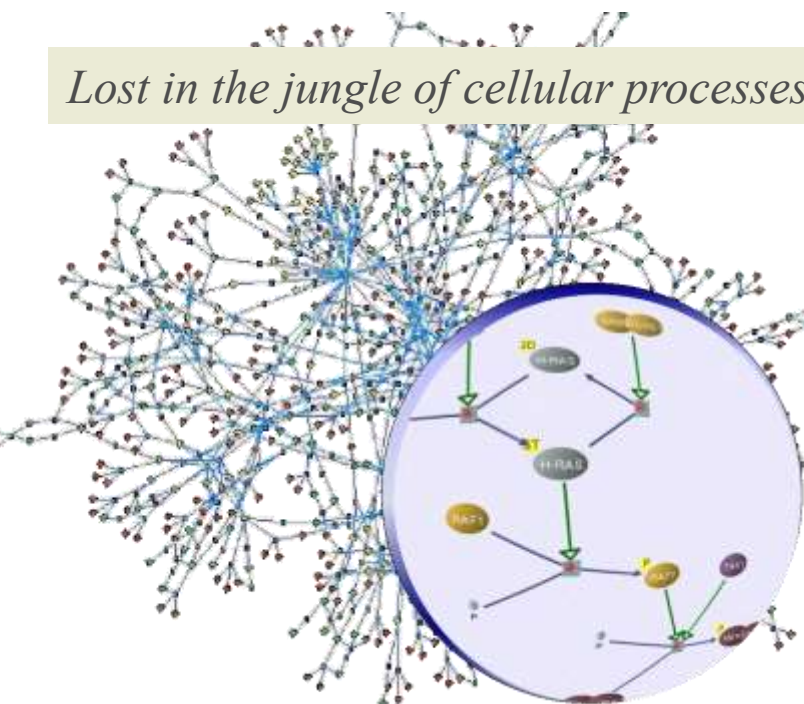


Patikans



Sample PATIKA Tool: PATIKAweb

Lost in the jungle of cellular processes...?



The screenshot shows the PATIKAweb web application in a Microsoft Internet Explorer browser window. The address bar displays <http://web.patika.org/>. The main content area shows a metabolic pathway diagram with various molecules and reactions. A "Complex State" dialog box is open, displaying properties for a specific entity. The "Bioentity Properties -- Web Page Dialog" shows the following details:

Attributes	Values
ID	208
Version	0
Name	[ChEBI:3727]
Description	C6H8O7
Data Source	Reactome , ChEBI , PubChem Compound
Names	Citrate Citric acid 2-Hydroxy-1,2,3-propanetricarboxylic acid 2-Hydroxytricarballic acid

The bottom of the browser window shows the address bar with <http://web.patika.org/> and the status bar with "Internet".

PATIKAweb can show you the PATHway

Uğur Doğrusöz

i-Vis Research Group

www.cs.bilkent.edu.tr/~ugur



Interested in being part of this kind of research & development?

Then join us! Please contact me at ugur@cs.bilkent.edu.tr

Data Management and Mining

Hakan Ferhatosmanoglu

- We investigate data management and data mining methods for emerging applications:
 - Data streams (telecom data warehouses, financial markets)
 - Social Media (Twitter text and social network)
 - Bioinformatics (proteins, genes)
- We aim to build scalable systems for online exploration of text, image, time-series
- Funded by USA Dept of Energy, NSF, NASA, Pfizer, IBM

Data Management and Mining

Hakan Ferhatosmanoglu

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

Please contact me for more information:

hakan@cs.bilkent.edu.tr

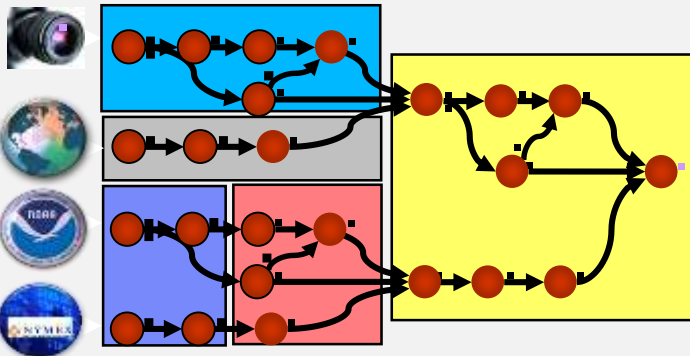
Buğra Gedik

- We are conducting research in data-intensive distributed systems, looking at issues such as parallelization, load balancing, load shedding, placement optimization, fault-tolerance, etc.
- Particular topics of interest include:
 - Distributed data stream processing systems
 - Big Data technologies, such as distributed key-value stores, map/reduce systems, bulk-synchronous parallel processing frameworks, etc.
 - Large-scale distributed graph management and mining
 - Peer-to-peer, mobile, and sensor data management

Data Intensive Distributed Systems

@ Bilkent University

Data Stream Processing Systems



Stock market

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



Law Enforcement, Defense & Cyber Security

- Real-time multimodal surveillance
- Situational awareness
- Cyber security detection



Fraud prevention

- Detecting multi-party fraud
- Real time fraud prevention



e-Science

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

Manufacturing

- Process control for microchip fabrication



Health & Life Sciences

- Neonatal ICU monitoring
- Epidemic early warning system
- Remote healthcare monitoring



Transportation

- Intelligent traffic management



Telephony

- CDR processing
- Social analysis
- Churn prediction
- Geomapping



Natural Systems

- Wildfire management
- Water management

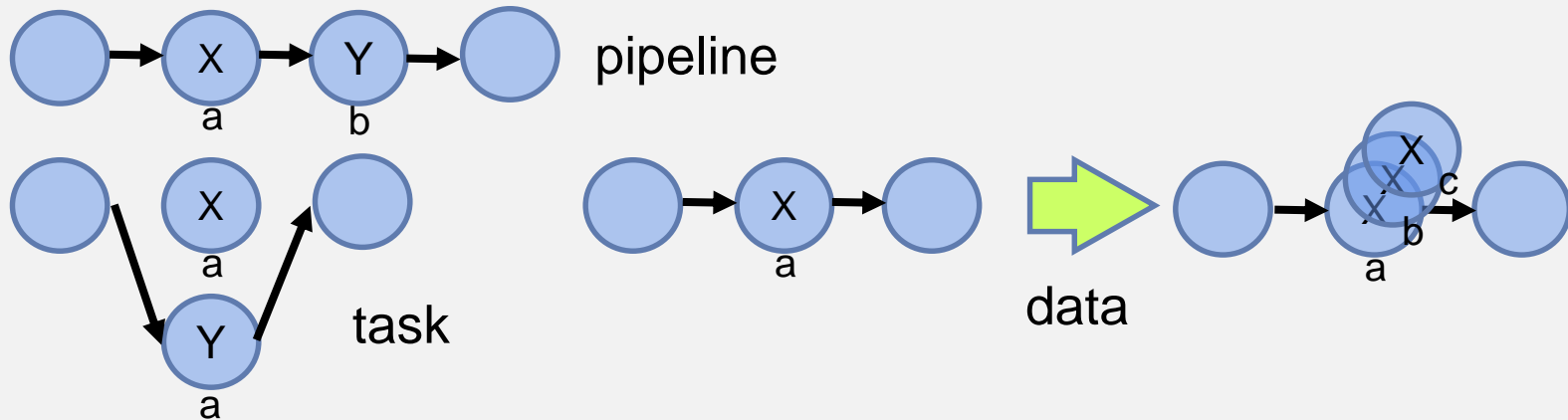


Other

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



Automatic Parallelization



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

Looking for students

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

Contact: www.bugragedik.com

Selected Publications

- Buğra Gedik and Henrique Andrade. "A Model-Based Framework for Building Extensible, High Performance Stream Processing Middleware and Programming Language for IBM InfoSphere Streams", Software - Practice and Experience Journal, Wiley (SP&E), 2012.
- Buğra Gedik, Kun-Lung Wu, Ling Liu, and Philip S. Yu. "Load Shedding in Mobile Systems with MobiQual", Transactions on Knowledge and Data Engineering, IEEE (TKDE), 2010.
- Buğra Gedik, Rajesh R. Bordawekar, and Philip S. Yu. "CellJoin: A Parallel Stream Join Operator for the Cell Processor", Very Large Data Bases Journal - Special Issue on Best Papers from VLDB 2007, (VLDBJ), 2009.
- Buğra Gedik, Ling Liu, and Philip S. Yu. "Asap: An Adaptive Sampling Approach to Data Collection in Sensor Networks", Transactions on Parallel and Distributed Systems, IEEE (TPDS), 2007.
- Buğra Gedik and Ling Liu. "MobiEyes: A Distributed Location Monitoring Service Using Moving Location Queries", Transactions on Mobile Computing, IEEE (TMC), 2006.
- Buğra Gedik and Ling Liu. "A Scalable Peer-to-Peer Architecture for Distributed Information Monitoring Applications", Transactions on Computers, IEEE (TC), 2005.

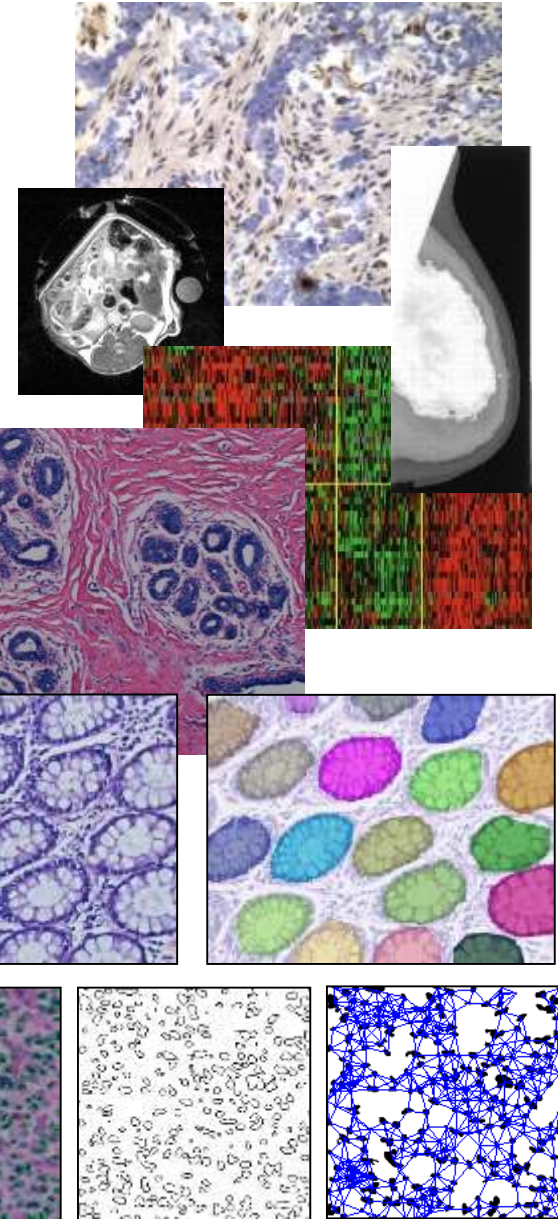


Computational Biology Research Group

Çiğdem Gündüz Demir

Main research interests:

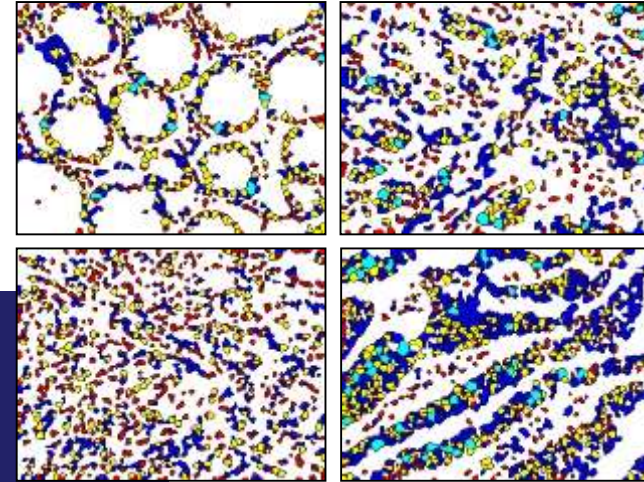
- Medical image analysis for **automatic cancer diagnosis, grading, and prognosis**
- Machine learning for **intelligent medical systems**





Computational Biology Research Group

Çiğdem Gündüz Demir



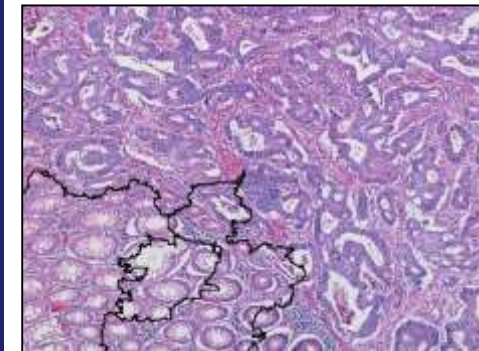
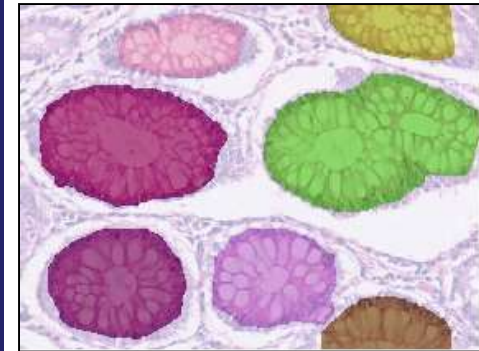
Current projects:

■ 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

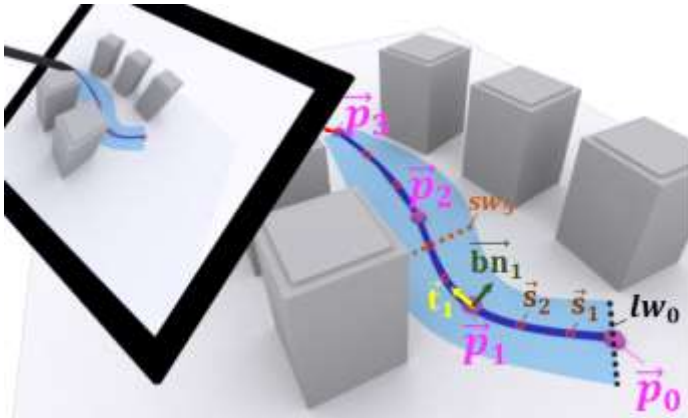
<http://www.cs.bilkent.edu.tr/~gudukbay>
gudukbay@cs.bilkent.edu.tr

Research Topics:

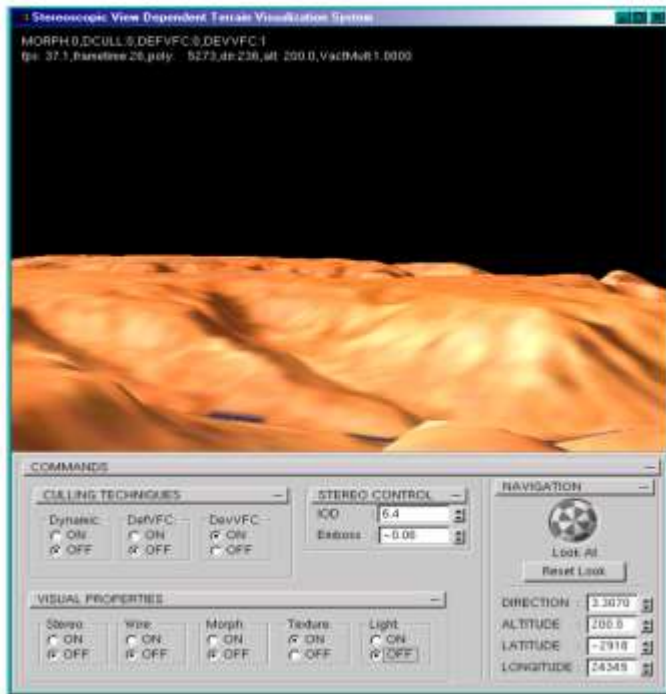
1. Augmented and Virtual Reality
2. Terrain and Urban Modeling and Visualization
3. Human Modeling and Animation

Augmented and Virtual Reality

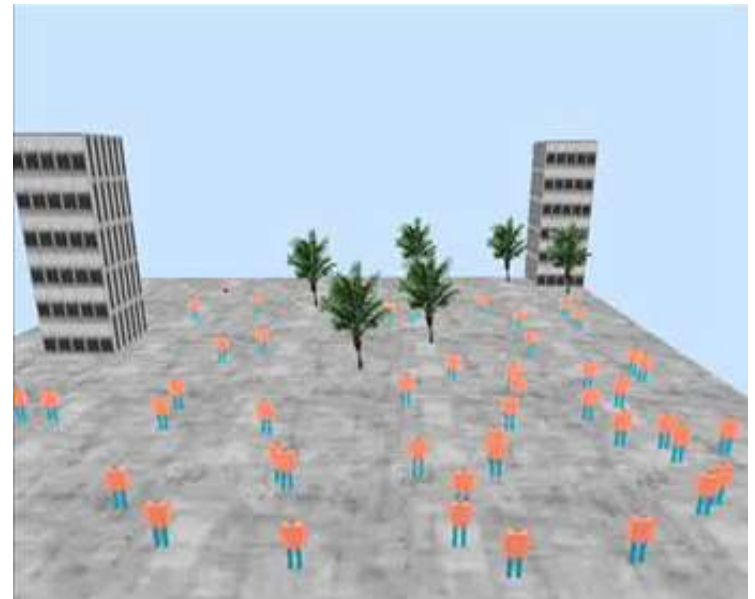
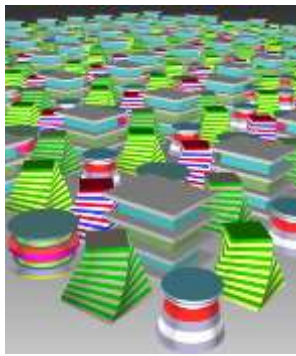
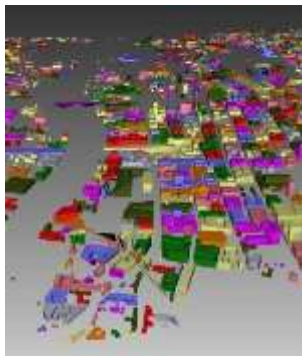
- Crowd Simulation
- Realistic Lighting
- Camera Registration and Tracking
- Augmented Reality on Mobile Devices



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

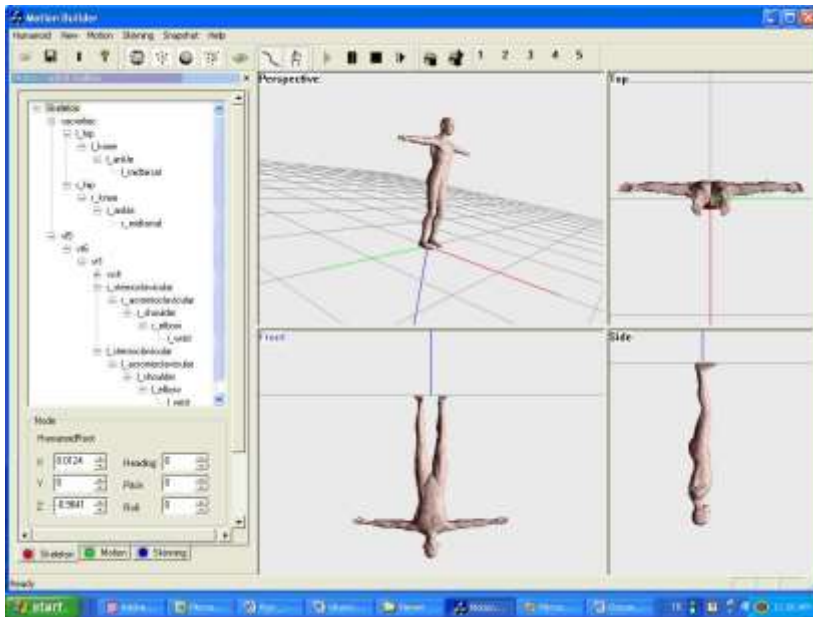
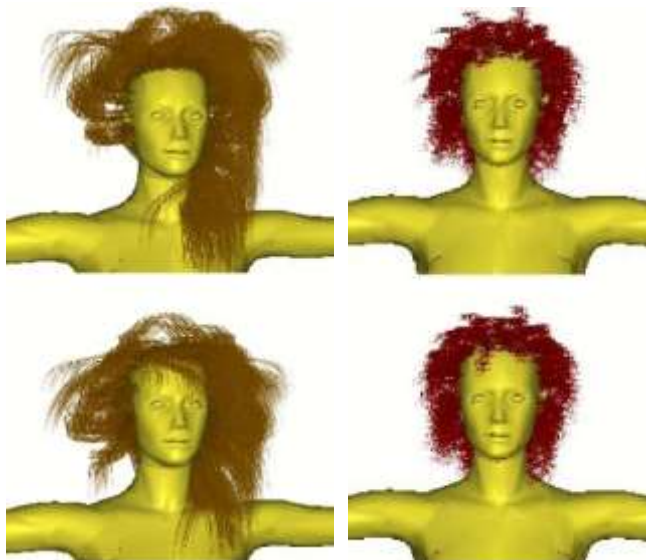


Figure 2: Different facial expressions and expression combinations, from left-to-right and top-to-bottom (rowwise order): neutral, happiness, surprise, fear, anger, sadness, disgust, happy surprise, angry surprise, disgust surprise, happy anger, angry fear, angry sadness surprise, angry sadness surprise disgust, angry sadness surprise disgust.



Real-time Virtual Garment Fitting Using Depth Sensor Data

Realistic Rendering of Joint Regions Using Bone Splitting



A Model Wearing a Sundress with Different Postures



A Model Wearing a Vest and Jeans with Different Postures

Machine Learning and Data Mining



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

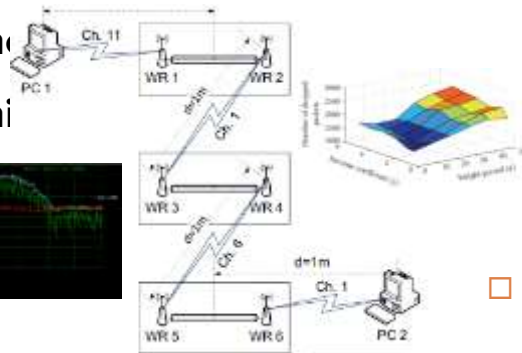
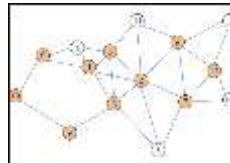


Networks and Systems Research Group

Sample Current Work

Wireless Mesh Networks

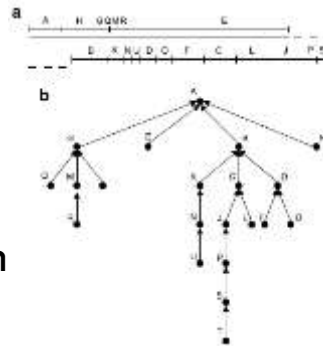
- Routing
- Channel assignment
- Interference management
- Interference management



Testbeds

Cloud Computing

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



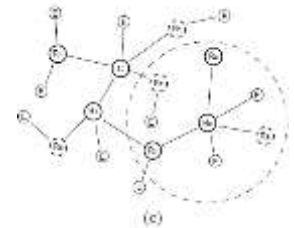
Sensor Networks

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



P2P Networks

- Query forwarding
- Free riding
- File sharing and lookup



Delay tolerant networks

- Routing and Scheduling

Networks and Systems Research Group

Sample Publications

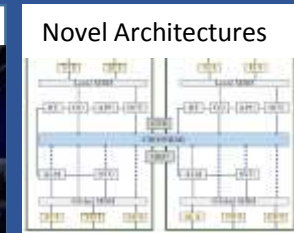
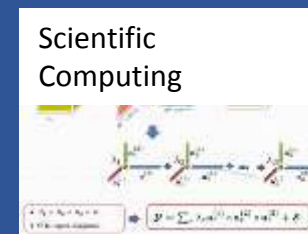
- Hidayet Aksu, Mustafa Canim, Yuan-chi Chang, **Ibrahim Korpeoglu**, Ozgur Ulusoy, **Distributed k -Core View Materialization and Maintenance for Large Dynamic Graphs**, *IEEE Transactions on Knowledge and Data Engineering*, 2014.
- Hakki Bagci, **Ibrahim Korpeoglu**, Adnan Yazici, **A Distributed Fault-Tolerant Topology Control Algorithm for Heterogeneous Wireless Sensor Networks**, *IEEE Transactions on Parallel and Distributed Systems*, 2014.
- Metin Tekkalmaz, **Ibrahim Korpeoglu**, **PSAR: Power-Source-Aware Routing in ZigBee Networks**, *ACM Wireless Networks Journal*, 2012.
- Huseyin Ozgur Tan, **Ibrahim Korpeoglu**, Ivan Stojmenovic, **Computing Localized Power Efficient Data Aggregation Trees for Sensor Networks**, *IEEE Transactions on Parallel and Distributed Systems*, 2011.
- Eyuphan Bulut, **Ibrahim Korpeoglu**, **Sleep Scheduling with Expected Common Coverage in Wireless Sensor Networks**, *ACM Wireless Networks Journal*, 2011.
- Metin Tekkalmaz, Hasan Sozer, **Ibrahim Korpeoglu**, **Distributed Construction and Maintenance of Bandwidth and Energy Efficient Bluetooth Scatternets**, *IEEE Transactions on Parallel and Distributed Systems*, 2006.

Mustafa Ozdal

www.cs.bilkent.edu.tr/~mustafa.ozdal

High-Performance and Energy Efficient Computing

Algorithms, Systems, and Applications



Mustafa Ozdal

www.cs.bilkent.edu.tr/~mustafa.ozdal

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>



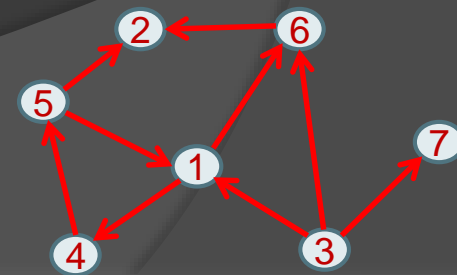
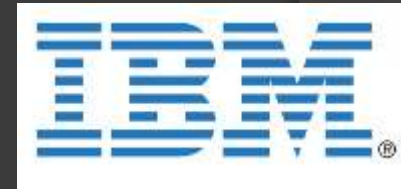
- ◎ **Computer architecture** - memory scheduling, memory hierarchy design, metrics to consider energy, performance, reliability....
- ◎ **Multicore/Manycore architecture** - design of multicore systems, application mapping, data mapping, communication
- ◎ **Heterogeneous computing** - heterogeneous 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



Computational Biology

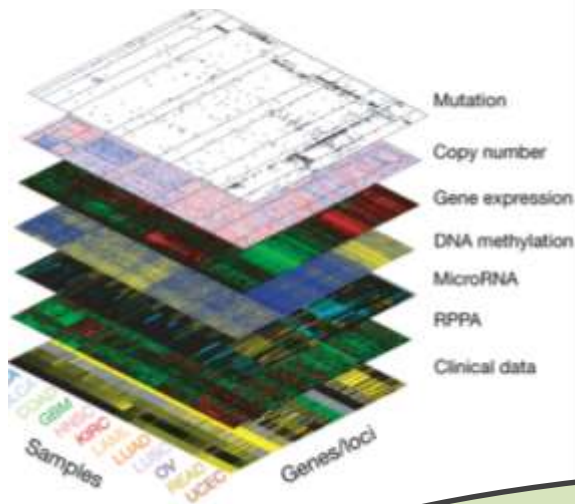
Öznur Taştan

oznur.tastan@cs.bilkent.edu.tr

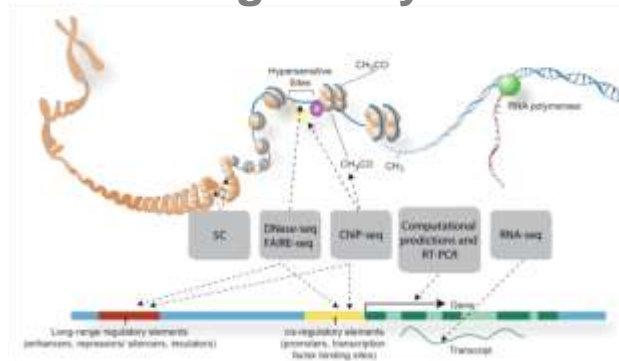
www.cs.bilkent.edu.tr/~oznur.tastan/

Our research interest is in developing computational methods and tools, which aim at providing novel insights into biological mechanisms of the diseases and phenotypes. The techniques we employ base themselves on statistical machine learning and advanced algorithms that are guided by insights from a systems biology perspective.

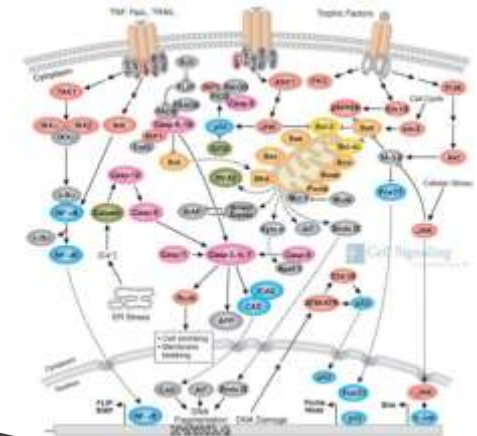
Omics



Regulatory data



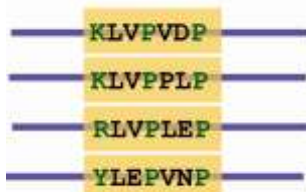
Interaction data



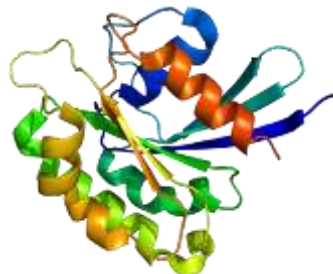
Data Rich Era in Biology

Significant progress has been made in our ability to measure DNA, RNA and protein sequences, structures and expression quantities. In addition to the part list of molecules, substantial amount of knowledge has been accumulated on the interactions of these molecules and their role in the cellular machinery.

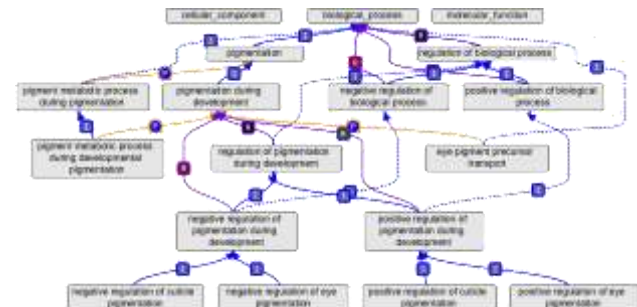
Sequence data



Structural data



Functional Data

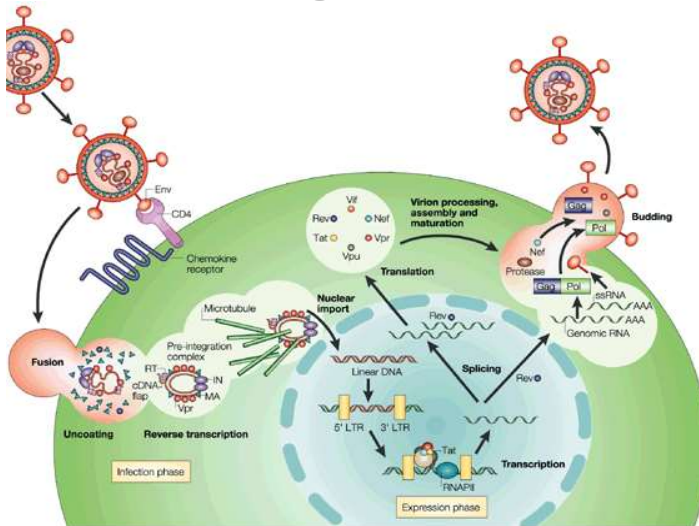


Data to Knowledge

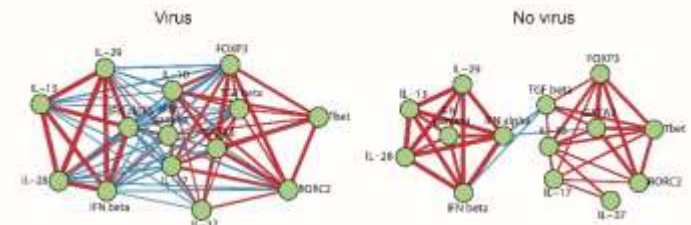
It is critical to translate this vast amount of data into biological findings, clinical research and eventually into clinical practice. As the data is vast, heterogonous, multi-dimensional and noisy, unleashing the full power of the accrued data will be only possible through development of rigorous computational techniques. We employ statistical machine learning approaches to gain insight into biological mechanisms.

Recent Applications

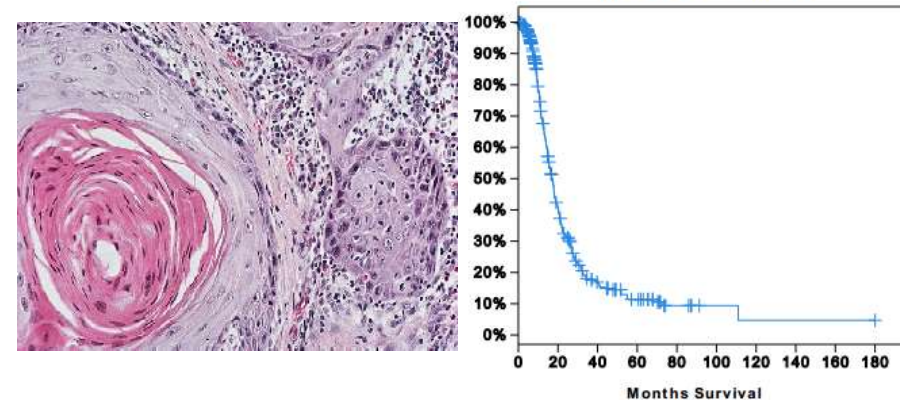
Host-Pathogen Interactions



Infectious Diseases



Cancer Systems Biology





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

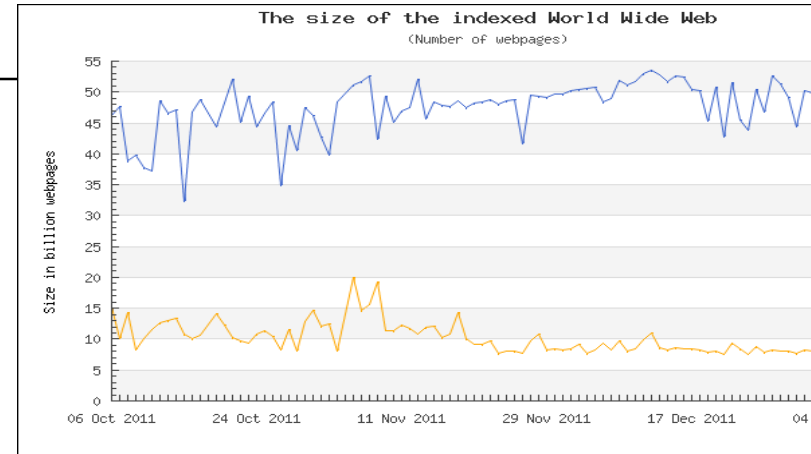
- Social Web search and personalization
- Domain-specific search engines
- Efficiency and scalability issues for Web Search Engines (caching, index pruning)
- Web information extraction
- Modeling and querying of Web resources
- XML querying & searching
- **<http://www.cs.bilkent.edu.tr/~bilweb>**

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



1995

2015

1998 Birth of
Google

2004 Index grows to
4.2 billion pages

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



**Efficient and scalable
strategies
are of vital importance !**

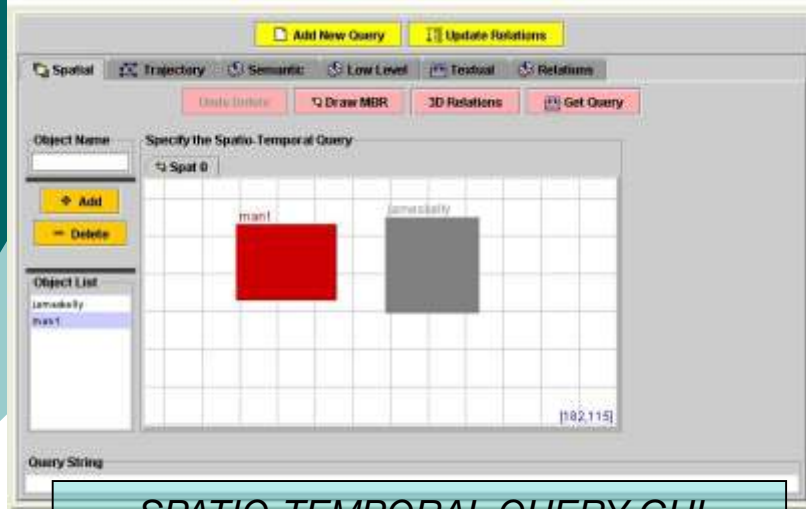


Multimedia Databases

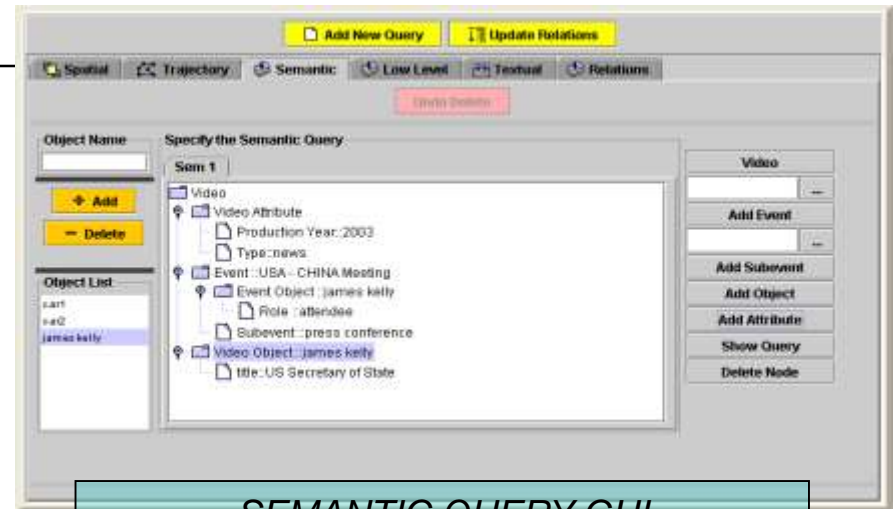
(joint work with Prof. Uğur Gündükbay)

- **Video Retrieval Systems**
- **Mobile Visual Search**
- **Ottoman Archive Content-Based Retrieval System**
- <http://www.cs.bilkent.edu.tr/~bilmdg>

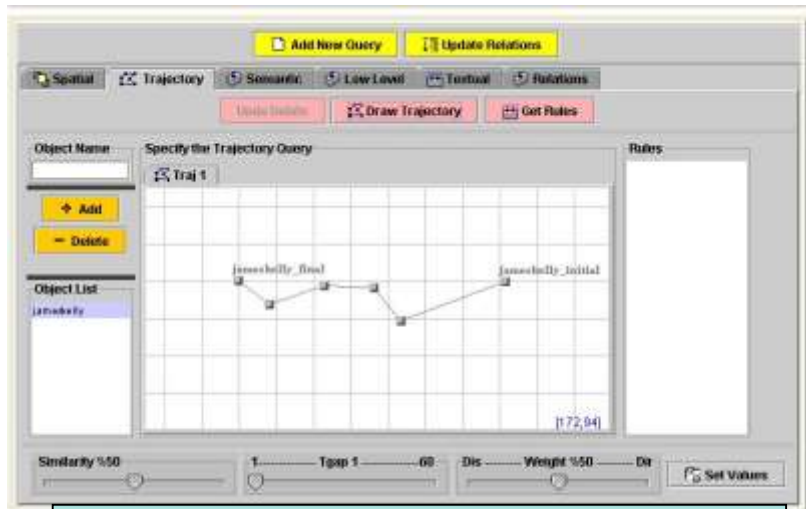
BilVideo: Integrated video DBMS supporting low-level, spatio-temporal, motion and semantic querying of videos



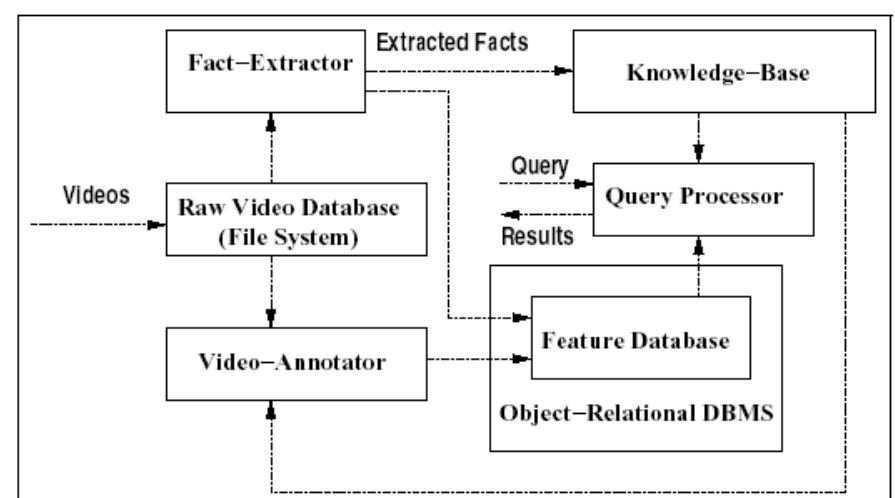
SPATIO-TEMPORAL QUERY GUI



SEMANTIC QUERY GUI

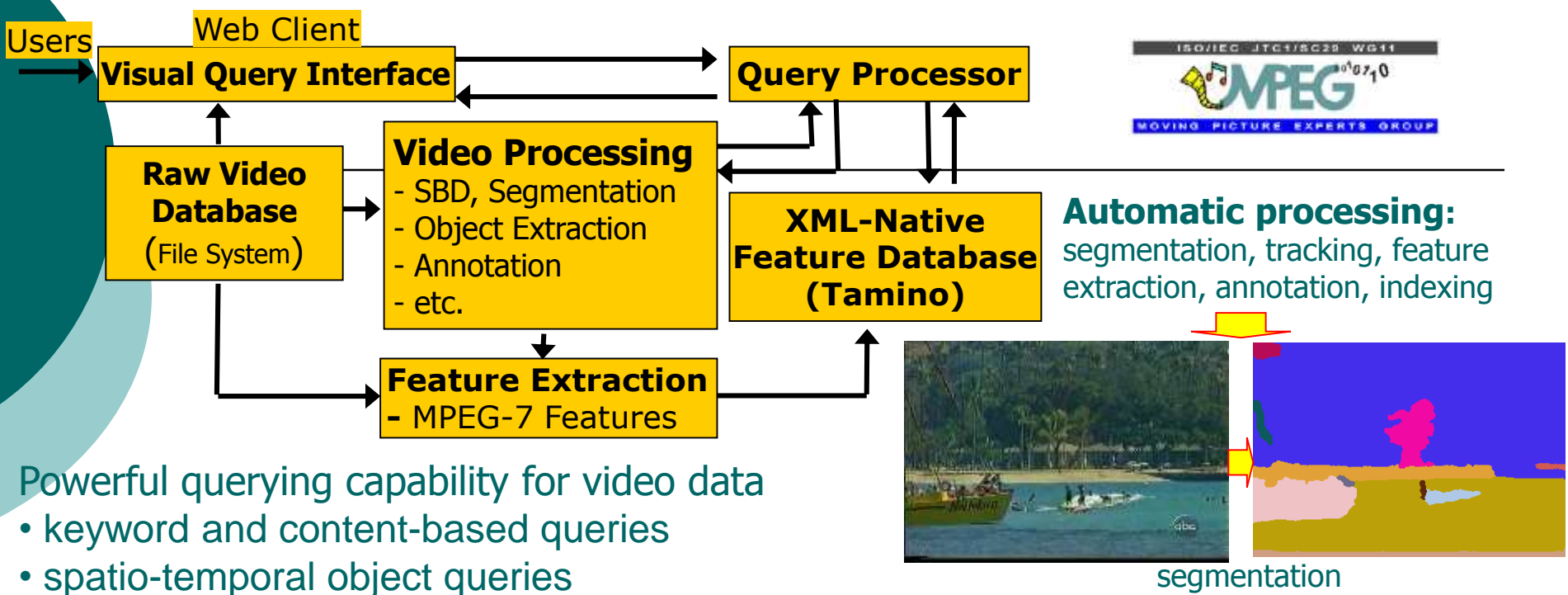


TRAJECTORY QUERY GUI



SYSTEM ARCHITECTURE

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



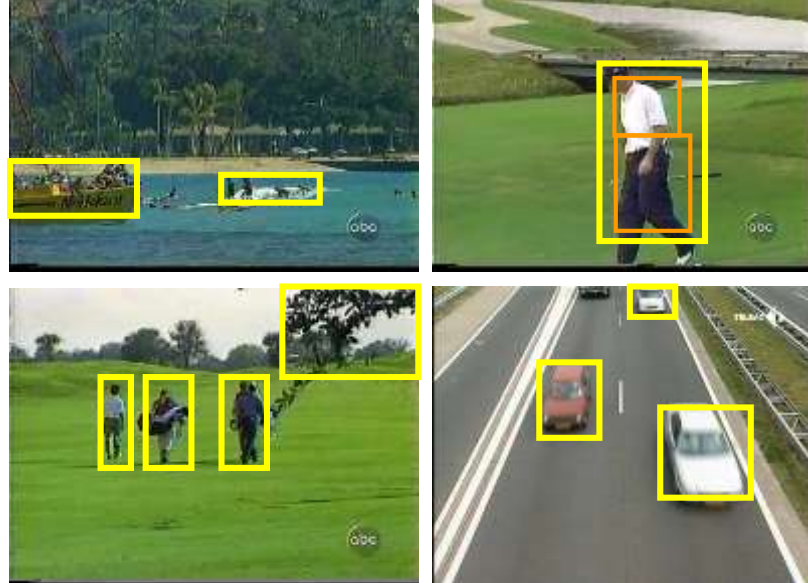
Powerful querying capability for video data

- keyword and content-based queries
- spatio-temporal object queries

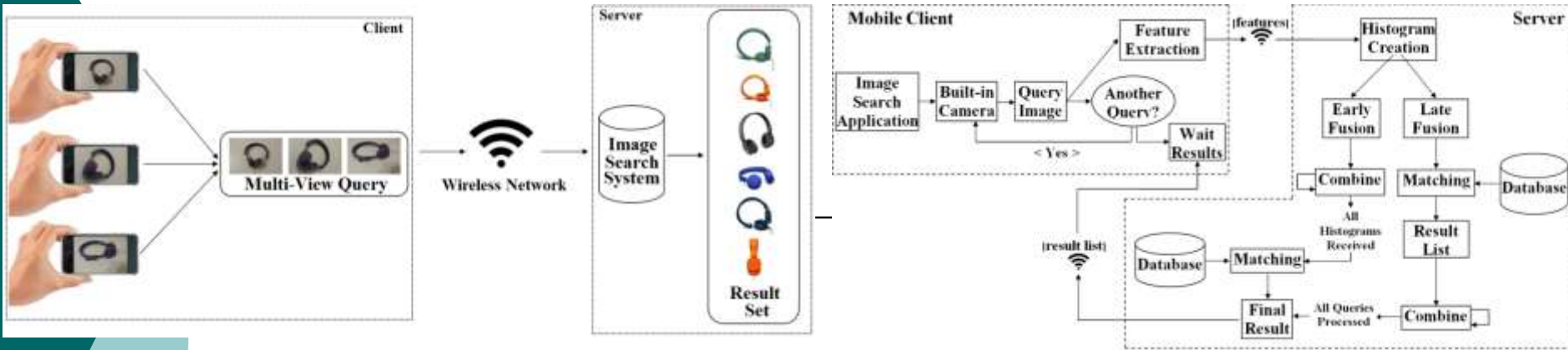


Example query formulation

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



Mobile Image Search Using Multi-Image Queries

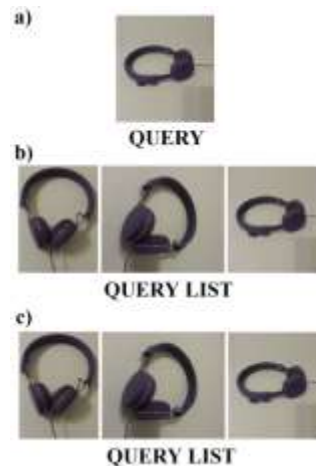


Workflow of the Search System

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)