

Biomedical Technologies and Innovation Doctoral Programme (BIOTIN)



Title of the PhD Project	Extending query processing with big data pipelines of multi-omics data for better understanding of complex phenotypes.
Acronym	(MOD-QP) Multi-Omics Data Query Processing
Research Fields of the Project	Data science, Genomics, Immunology, Metagenomics
Keywords	big data, query processing, multi-omics data, complex phenotypes
Host Institution, Department and Campus Location	Izmir Institute of Technology (IZTECH), Department of Computer Engineering, Urla, İzmir
PhD Awarding Institution and Graduate Programme	Izmir Institute of Technology, Graduate School, PhD in Computer Engineering
Name and Affiliation of Main Supervisor	Assoc. Prof. Belgin Ergenç Bostanoğlu (IZTECH)
Name and Affiliation of Cosupervisors	Assoc. Prof. Efe Sezgin (IZTECH) Assoc. Prof. Gökhan Karakulah (IBG)
Research Environment and Infrastructure	IZTECH Computer Engineering Department will provide candidate modern technological and research-oriented infrastructure. https://dworld.iyte.edu.tr/
Scientific Context of the Project	Graph databases (GDB) have recently been arisen to overcome the limits of traditional databases for storing and managing data with graph-like structures. Graph-like structures are frequently used to represent the complex and arbitrary relations among attributes of real world data, such as atoms (nodes) and bonds (edges) in chemical structures, proteins (nodes) and protein interactions (edges) in biological networks. Most of the techniques, applied to optimize queries in graph databases, have been used in traditional databases, distributed systems or they are inspired from graph theory. However, their reuse in graph databases should take care of the main characteristics of graph databases, such as size of data, dynamic structure, highly interconnected data, and ability to efficiently access data relationships. Characteristics of nucleic acid based data and querying this data for targeting various nucleic acid based treatments can benefit the technological support provided by specifically designed big data query processing pipelines. This research should investigate big data query processing methods for multi-omics data for better understanding of the genetic factors underlying complex phenotypes.

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Brief Workplan	<ol style="list-style-type: none"> 1) Understanding multi-omics data and databases 2) Understanding query processing on big data 3) Getting familiar with the technological tools of query processing 4) Proposing a methodology of query processing for the domain 5) Development of specific tools for query processing
Innovative Aspects of the Project	<p>Despite enormous time and money costs to generate them, the biological multi-omics data is rather heterogeneous in nature and very big in size that prevents effective utilization by scientists in the life sciences domains. The project will develop novel integration and query processing methods to overcome these challenges.</p>
Training Opportunities of the Project	<p>The candidate will be able to work with integrative approaches that overcome the typical challenges of multidimensional data integration, including high dimensionality, sparsity, and multiple connectivity, to identify biologically meaningful relationships in multi-omic datasets.</p>
Interdisciplinary Aspects	<p>The project integrates data science, genomics, and metagenomics fields.</p>
Intersectoral Mobility <input checked="" type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	<p><i>Host: Solaris Genomic Health</i></p> <p><i>Context of Mobility: New skills and techniques for research in genomic, metagenomics, functional genomics and bioinformatics</i></p>
Intersectoral Mobility <input checked="" type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	<p><i>Host: Istanbul Health Industry Cluster (ISEK)</i></p> <p><i>Context of Mobility: Entrepreneurship Training, Thematic Pre-incubation Program</i></p>
International Academic Secondment	<p><i>Host Supervisor: Osman Ünsal</i></p> <p><i>Host Institution: Barcelona Supercomputing Center</i></p> <p><i>Host Department: Computer Sciences - Computer Architecture for Parallel Paradigms</i></p> <p><i>Duration: 6 months</i></p> <p><i>Estimated Time of Mobility: 2nd year of the PhD</i></p> <p>OR</p> <p><i>Host Supervisor: Marisa Gil</i></p> <p><i>Host Institution: Polytechnic University of Catalonia</i></p>

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Main Supervisor													
Brief CV	<p>Assoc. Prof. Belgin Ergenç Bostancıoğlu</p> <p>E-mail: belginergenc@iyte.edu.tr</p> <p>ACADEMIC DEGREES</p> <table><tr><td>Ph.D.</td><td>Computer Engineering</td><td>Paul Sabatier University, France</td><td>2008</td></tr><tr><td>M.Sc.</td><td>Computer Engineering</td><td>İzmir Institute of Technology, Turkey</td><td>2002</td></tr><tr><td>B.Sc.</td><td>Computer Engineering</td><td>Middle East Technical University</td><td>1983</td></tr></table> <p>Google Scholar: https://scholar.google.com/citations?hl=tr&user=e00LSrIAAAAJ https://orcid.org/0000-0001-6193-9853</p>	Ph.D.	Computer Engineering	Paul Sabatier University, France	2008	M.Sc.	Computer Engineering	İzmir Institute of Technology, Turkey	2002	B.Sc.	Computer Engineering	Middle East Technical University	1983
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Brief CV	<p>Assoc. Prof. Efe Sezgin</p> <p>E-mail: efesezgin@iyte.edu.tr</p> <p>ACADEMIC DEGREES</p> <table><tr><td>Ph.D.</td><td>Ecology and Evolution</td><td>Stony Brook University, USA</td><td>2005</td></tr><tr><td>B.Sc.</td><td>Biology</td><td>Ege University, Turkey</td><td>1998</td></tr></table> <p>Google Scholar: https://scholar.google.com/citations?hl=tr&user=L_OzpkMAAAAJ https://orcid.org/0000-0002-8000-7485</p>	Ph.D.	Ecology and Evolution	Stony Brook University, USA	2005	B.Sc.	Biology	Ege University, Turkey	1998				
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Brief CV	<p>Assoc. Prof. Gökhan Karakülah</p> <p>E-mail: gokhan.karakulah@ibg.edu.tr</p> <p>ACADEMIC DEGREES</p> <table><tr><td>Ph.D.</td><td>Bioengineering</td><td>Dokuz Eylül University, Turkey</td><td>2014</td></tr><tr><td>M.Sc.</td><td>Medical Informatics</td><td>Dokuz Eylül University, Turkey</td><td>2009</td></tr><tr><td>B.Sc.</td><td>Biology</td><td>Ege University, Turkey</td><td>2005</td></tr></table> <p>Google Scholar: https://scholar.google.com/citations?hl=tr&user=ac2JQN8AAAAJ https://orcid.org/0000-0001-6706-1375</p>	Ph.D.	Bioengineering	Dokuz Eylül University, Turkey	2014	M.Sc.	Medical Informatics	Dokuz Eylül University, Turkey	2009	B.Sc.	Biology	Ege University, Turkey	2005
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