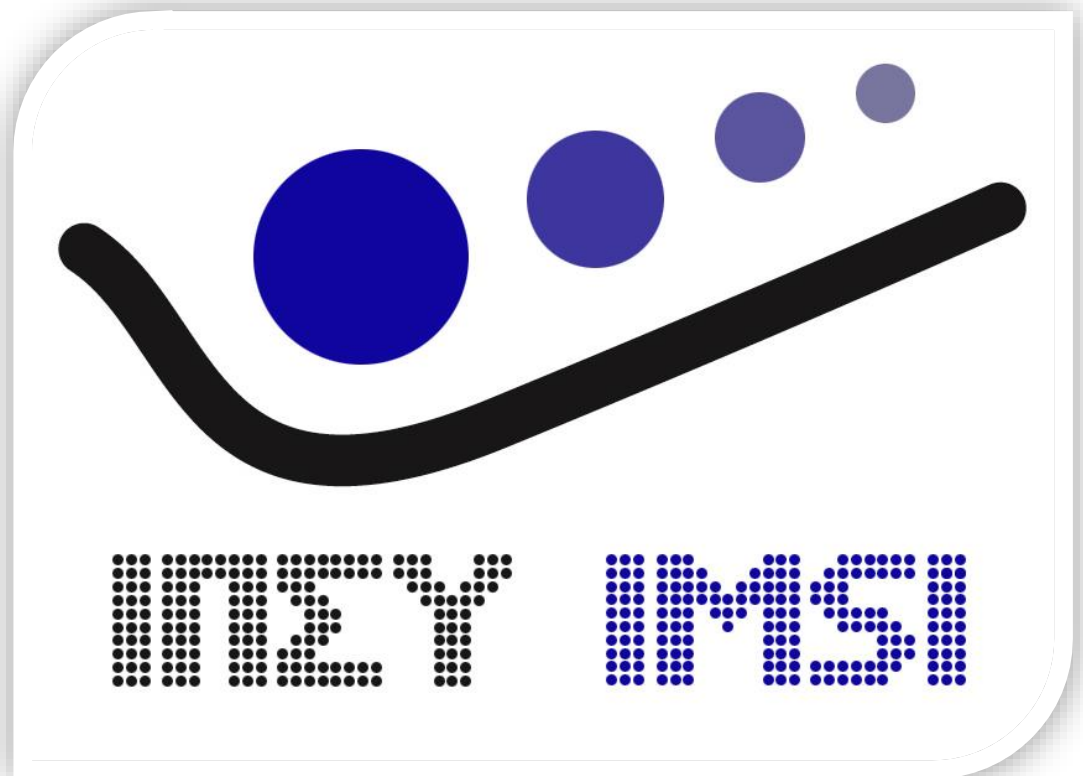
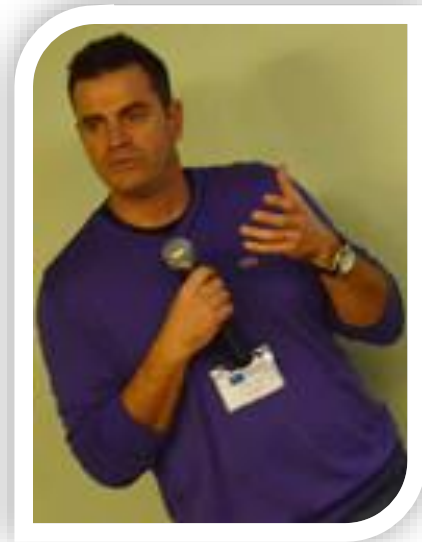


IMSI annual report 2020



Preface

Welcome to the Information Management Systems Institute (IMSI) of the ATHENA Research and Innovation Centre! Established in 2007, IMSI is today one of Greece's premier research centers in the areas of large-scale information systems and Big Data management. Over the past few years, IMSI researchers have been very successful in attracting and implementing numerous cutting-edge research & development projects, at both the national and international level; furthermore, IMSI has created strong collaborative ties with top European research institutions and has successfully promoted the development and use of state-of-the-art information systems in both local industry and various Greek government organizations.



As in previous years, in 2020, IMSI has significantly expanded the scope of its research efforts in a number of focus areas, including Big Data and Scalable Data Analytics, Web Data Management and Semantic Web Technologies, Geospatial Data Management, and Digital Curation and Research Infrastructures. In addition, IMSI researchers have led and/or participated in numerous activities promoting research and educational excellence in the areas of information systems and data management, as well as the development of novel software platforms and services, made available to the research community and employed by both local and international users.

Over the next few years, IMSI aims to continue to strengthen its collaborative ties with local and international industry and academia, promote the transfer of state-of-the-art information technology to national organizations and industry, and continue to strive for excellence further increasing the visibility of its research efforts and results.

Prof. Minos Garofalakis

Director, Information Management Systems Institute (IMSI)

ATHENA Research and Innovation Centre

Athens, Greece, 3/9/2021



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Profile

The Information Management Systems Institute (IMSI) is one of the research institutes of the Research and Innovation Center in Information, Communication and Knowledge Technologies "ATHENA", which is the first research center in Greece with a focus exclusively on Information Society. Established in Athens in 2003, it is a research and technology organization supervised by the General Secretariat for Research and Technology of the Ministry of Education and Religion. IMSI was founded in 2007 with the mission to conduct research in the area of data management and large-scale information systems. In 2009, the Digital Curation Unit, which had been established in 2007 in "ATHENA" R.C, became a unit of IMSI.

The research at IMSI has a strong collaborative aspect, and ranges from basic to applied research. The collaborative aspect is expressed in that research is conducted with national and international partners from industry as well as academia, often also in the context of novel and innovative projects.

The mission of IMSI is to conduct research, develop applications and products and to offer services in the areas of information management and large-scale information systems. IMSI is particularly interested in the areas of database technology, software engineering and development methodologies, managing and exploiting information resources, as well as their large-scale applications.

The objectives of IMSI are:

- to participate and carry out research and development projects in the area of information technology and to cooperate with the academic community in topics of research, education and knowledge transfer to the industry.
- to produce experimental and industrial prototypes, and to develop new innovative products in cooperation with industry.
- to transfer knowledge on research and development topics and to offer training and certifications on information technology and related processes for the management of information and information systems.

To attain these objectives, IMSI is structured as follows:

- The Department of Database and Business Intelligence is responsible for basic and applied research in (a) database management systems, and (b) business intelligence systems. The focus is on design, optimization, scalability, security, privacy and high availability of databases and data warehouses, data mining and ETL.



- The Department of Distributed and Web Information Systems conducts basic and applied research on data management problems rising in Web applications and distributed computing in general. Focus is on methods and technologies to support search and exploration on the Web during a creativity cycle: from the abstraction describing the search domain, the information harvest and retrieval tasks and the adaptation of results to user needs, to the classification of results and exchange with other users. One of the use-cases we adopt is based on R&D for Web applications for biosciences. Strong interest also exists for modeling and data management issues for the Semantic Web and ontologies, heterogeneous data source integration problems, web services, and semistructured data storage and querying. Finally, focus is also given on real-time information systems, like sensor networks and p2p/grid systems.
- The Department of Geoinformatics conducts basic research and development of prototypes in the areas of geospatial data management, i.e., Geographic Information Systems, Spatial Data Infrastructures, Location-based services, geospatial data management on the Web, and human-machine interaction with spatiotemporal information.
- The Department of Scientific Databases and Simulation conducts basic and applied research on the modeling and efficient implementation of data management systems that support scientific applications and simulation processes. The focus is on biological data, environmental data, the management of evolution in scientific databases, and the management of imprecise information. Moreover, the Department concentrates on issues of design, development, and management of Digital Libraries.
- The Department of Software Engineering and Project Management Software is responsible for developing innovative applications that integrate cutting-edge research results and responding to needs of the Public and the Private Sector, based on professional standards and methodologies. It also conducts studies and provides consulting services and technical support to entities involved with IMSI. It also offers certifications to individuals and institutions with respect to the proficiency in software development and management of software project lifecycle (technical project description, project contract, project coordination, project delivery). Furthermore, it has the responsibility of training programs in specialized software issues, software development environments and project management software.
- The Digital Curation Unit (DCU) has the mission to conduct research, develop technologies and applications, provide services and training, and act as a national focus point in the field of digital curation. Digital curation encompasses a set of activities aiming at the production of high quality, dependable digital assets; their organization, archiving and long-term preservation; and the generation of added value from digital assets by means of resource-based knowledge elicitation. To ensure the adequate capture of the context of digital resources and their subsequent creative and effective use, the DCU adopts a multidisciplinary approach that

considers the full lifecycle of digital assets, such as records, digital surrogates and scholarly/ scientific datasets.

The activities of IMSI departments are supported by the “ATHENA” R.C. Economic and Administration Office.



Infrastructures

IMSI IT Infrastructure provides the necessary resources and services to support the organizational needs of the Institute and the development and support of quality IT services and solutions. It consists of the hardware, software and network components that are used in order to achieve the above goal.

In an effort to combine the best services IMSI Infrastructure is built upon both cloud computing and traditional locally implemented solutions. Local IT Infrastructure consists of servers hosted in IMSI owned facilities in a dedicated server room and is largely based on Virtualization technologies in order to achieve server consolidation and maximize the hardware's efficiency. It is the base upon which most of the Institute's IT services are built while at the same time it provides the required resources for a large number of projects the Institute participates in. It is also used by the affiliated researchers and students for larger scale experimentation and research.

Along with maintaining its own private local servers, IMSI also takes advantage of the benefits of cloud infrastructures. The resources made available to the Greek academic and research community through GRNET "Okeanos" IAAS Service are heavily used by the Institute's users for research and development purposes. Also, in collaboration with Microsoft and its Academic program Office 365 is used for providing mail and collaboration services.

Through the described infrastructures IMSI provides to its members and affiliates a variety of services, such as:

- Mail Services
- Directory Services used for centralized authentication and authorization
- Source Control
- Shared storage
- Virtual Private Network
- Web publishing
- Project Management and Collaboration
- Communication Services

The above services are provided and implemented using both commercial and open source operating systems and software, such as but not limited to:



- Operating Systems: Debian Linux, Ubuntu Linux, CentOS Linux. Microsoft Windows Server
- Virtualization Software: KVM
- Database Server: PostgreSQL, MySQL, MariaDB
- Distributed Processing: Apache Hadoop

IMSI network infrastructure provides high speed connectivity to its users and the provided services. IMSI network connects to the Internet using a 1Gbps fiber optics connection to GRNET. It consists of several Gigabit switches that offer wired connectivity and takes advantage of the Research Center's Wireless Infrastructure to provide high speed and reliable Wireless Connectivity. Also, through the Research Center's participation to the Eduroam Initiative, IMSI members can use their account to gain wireless internet access in research and academic institutions in more than 70 territories in the world.



Highlights

Events

- The **EU (H2020-MSCA-ITN-2019) project GRAPES** organized successfully its **Kickoff & Recruitment Event**, that took place virtually on November 5th, 2020. Project scientific coordinator: [Ioannis Z. Emiris](#).
- Organization of the [“DH in the Time of Virus”](#) Twitter Conference, 2 April 2020, as a response to COVID-19 and while the onset of the pandemic was still in its very early stages. The conference, with the participation of Greek and international DH scholars and infrastructures, provided a platform of communication of DH research pursuits as well as of expression of an unprecedented human experience, and took DH Twitter by storm. The hashtag #DHgoesViral which was used for the conference was No5 trend on Twitter in Greece.
- Organization of the ["Facilitating archival research on the study of the turbulent 1940s"](#) online discussion in collaboration with [Europeana Research](#), 10 September 2020.
- A new collaboration between **IMSI, Intracom Telecom S.A. and Ericsson S.A.** started in *October 2017*. IMSI has been contracted to design and develop a big data solution and methods for stream analytics on network data coming from IoT devices. Project Coordinator from IMSI: [George Papastefanatos](#).
- 18/12/2020: [Circular Learning Hub Public Workshop](#)
- 15/12/2020 : Webinar [Recent Development Of The Circular Economy In The Region](#)
- 13/11/2020: Climate KIC Climathons 2020 in Greece (4 cities), ATHENA RC
- 02/11/2020: “Innovation and Technology for a Green, Digital and Just Recovery” The Greek EIT Ecosystem.
- Georgia Koutrika becomes co-editor-in-chief of the VLDB Journal.
- 19/10, 26/10, 02/11/2020: [Circular Economy Workshop for entrepreneurs and investors](#)
- “Intelligent Data Exploration” roundtable co-organized by Georgia Koutrika and Kurt Stockinger at VLDB2020 had the highest attendance
- 14/10/2020: Webinar - Circular, green and alternative procurement. CE Beacons project (ATHENA).
- 30/-9/2020: MEDFreeSUP Greek kick-off, ATHENA RC,EIT Climate-KIC Hub Greece
- 23/09/2020: Webinar - Importance of the interplay between energy and circular eco
- 17/08/2020: Understanding the Circular Economy at system level for business development, organised by CE BEACONS project.
- 29/07/2020: EIT Climate-KIC FRAME Sensemaking workshop - Deep Demonstration in Maritime Hubs.

- 09/07/2020: Webinar - Circular Economy in Balkan countries, organised by CE BEACONS project.
- 26/06/2020: Webinar - [Business towards Circular Economy](#)
- 19/06/2020: Second project meeting - [Circular Learning Hub \(EIT Climate-KIC\)](#)

Awards

- **Best Demo Paper Award at ACM CIKM 2020:** Nikos Giatrakos, David Arnu, Theodoros Bitsakis, Antonios Deligiannakis, Minos N. Garofalakis, Ralf Klinkenberg, Aris Konidaris, Antonis Kontaxakis, Yannis Kotidis, Vasilis Samoladas, Alkis Simitsis, George Stamatakis, Fabian Temme, Mate Torok, Edwin Yaqub, Arnau Montagud, Miguel Ponce de Leon, Holger Arndt, Stefan Burkard: INforE: Interactive Cross-platform Analytics for Everyone. CIKM 2020: 3389-3392
 - **Highly Cited Researchers 2020:** Theodore Dalamagas was recognised as a Highly Cited Researcher from Clarivate Analytics for 2020. Clarivate identifies scientists who have demonstrated significant and broad influence, reflected in the publication of multiple papers frequently cited by their peers during the last decade (Web of Science). Researchers are selected for their exceptional influence and performance in one or more of 21 fields (those used in Essential Science Indicators™ or ESI) or across several fields.
 - The article of M. Meimaris, G. Papastefanatos, P. Vassiliadis titled *Hierarchical Property Set Merging for SPARQL Query Optimization* has received the best paper award in the 22nd International Workshop on Design, Optimization, Languages and Analytical Processing of Big Data co-located with EDBT/ICDT 2020 Joint Conference, DOLAP@EDBT/ICDT 2020, Copenhagen, Denmark, March 30, 2020.
-
- “DH in the Time of Virus” Twitter Conference was voted 1st Runner Up in the Best DH Response to COVID19 category of the [DH Awards 2020](#).
 - The paper "Integrating archival materials for the study of the turbulent Greek 40s" presented by Vicky Dritsou, Maria Ilvanidou, Isidora Despotidou, Vicky Liakopoulou, Karmen Vourvachaki, and Panos Constantopoulos at the [DARIAH Virtual Annual Event 2020: Scholarly Primitives](#) received an Honorable Mention.
 - Prof. Phoebe Koundouri wins the first ERC Synergy Grant for Greece. The subsidized project, entitled "[Smart Water Futures: Designing the Next Generation of Urban Drinking Water Systems](#)" and the acronym "**Water-Futures**".
 - Prof. Phoebe Koundouri: Chair of the Scientific Advisory Board of the [European Forest Institute](#).
 - Prof. Phoebe Koundouri : Member of the National Climate Change Committee, Greek Ministry of Environment and Energy

- Prof. Phoebe Koundouri: Member of the 2021 Pissarides Committee (10 year Greek Development Plan) chaired by Nobelist Prof. C. Pissarides
- Prof. Phoebe Koundouri: Member of the [CEPR](#) (Center for European and Policy Research) Network on Climate Change
- Prof. Phoebe Koundouri Member Scientific Advisory Board, [Open Research Europe](#)
- Commissioner [The Lancet Commission on COVID-19](#) and Task Force co-Chair of "Jobs based Green Recovery" <https://covid19commission.org/commissioners>
- Lead Economist (with Prof. Jeff Sachs) of [UN SDSN Senior Working Group](#) on the UN SDSN for European Green Deal (EGD) implementation, Sustainable Shipping and Ports, 4-seas Blue Growth Initiative



Research Directions

IMSI research activities fall into the following areas.

Big Data and Scalable Data Analytics

Current (ongoing) research directions in this area include:

- **Analysis-aware Entity Resolution over Big Data**

Exploration and analysis of dirty data have gained great attention recently due to the emergence of data aggregators; i.e., organizations that harvest, aggregate and analyze data containing overlapping and usually contradicting information from multiple sources. Analysis-aware data processing refers to an exploratory analysis scenario, where users apply traditional data integration methods, such as cleaning, repairing and deduplicating, during query time. Analysis-aware Entity Resolution (ER) is a special case which aims at extending the results of the query by resolving duplicate entities (records that represent the same real-world entity) during query time. In this direction, we have proposed methods and a Framework, called *QueryER*, that integrates ER operations into the planning and execution of SPJ queries. To achieve that, we propose novel (ER-specific) query operators, which identify and resolve duplicates within a table by employing a schema-agnostic resolution approach with no configuration overhead; join duplicate entities between two or more tables and group/merge deduplicated entities into a single representation. We integrate these operators into normal query execution.

- **Physical optimization for large-scale, data science workloads**

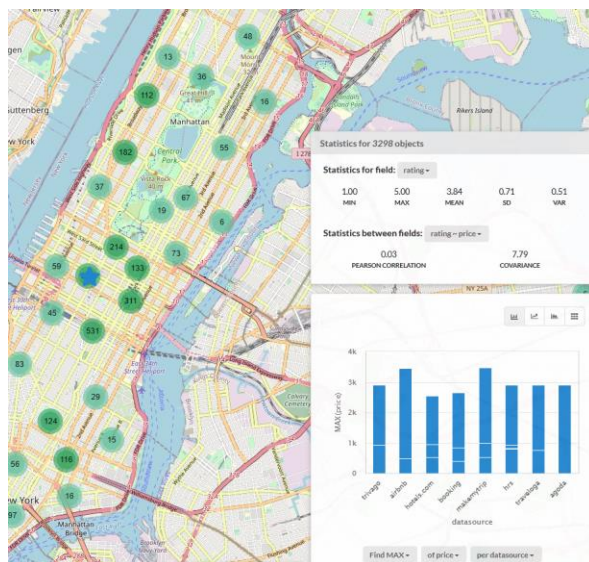
Modern Data Science processing workloads typically involve computations of extreme-scale analytics that can be encoded in various forms (e.g., queries, workflows, programs) and executed on more than one platform. Parts of the processing could be pushed to the edge level (e.g., input sensors), while other more computationally intensive parts (e.g., stock correlation in finance, gene simulations in life sciences) could be executed on one or more, potentially distributed, Big Data platforms or clusters (e.g., GPUs) of a supercomputer or in the cloud. The decision on what is the right platform and timing to execute a Data Science workload is based on a multitude of criteria and optimization objectives, including hardware and processing capabilities, scheduled and running workloads, available resources and pricing, and so on. In this project, we develop tools and techniques for optimizing (e.g., in terms of runtime, throughput, latency, scheduling, system resources, monetary resources) the execution of Data Science workloads across different computing platforms.

- **Transparent in-situ data processing**

Bringing computation closer to data is critical when dealing with large datasets in highly distributed systems with specialized hardware components. Examples include supporting in-situ data transformations (e.g., decrypt on read) and tier crossings (e.g., select the form of compression based on physical medium to be moved to). The goal of this work is to improve the performance of data processing engines by leveraging hardware specificities, without affecting the interface to applications. Our approach improves scalability by decoupling the engine primitives from the underlying data store platform, avoiding data transfers through the various levels of the stack, and leveraging specific hardware.

- **Self-service scalable visual analytics**

One of the major challenges in the Big Data era is that it has realized the availability of a great amount and variety of big datasets for analysis by non-expert data analysts, such as research scientists, data journalists, policy makers, SMEs and individuals. The level of difficulty in transforming a data-curious user into someone who can competently access, analyze and consume that data is even more burdensome now for a great number of users with little or no support and expertise on the data (pre)processing part. We are currently working in developing a scalable platform for self-service visual analytics. Self-service visual analytics is a new paradigm, in which users are enabled and encouraged to directly manipulate (explore, blend, analyze) underlying data in rich visual ways, in order to derive insights from information as quickly and efficiently as possible. Our platform called *VisualFacts* (<https://visualfacts.imsi.athenarc.gr/>), enables the visualization of big geo-located data and helps data explorers perform ad hoc analysis of raw data files collected from different sources of varying quality (with duplicates or missing data) in rich visual ways. The backbone of the platform is a visual aware in-memory index, which is constructed on the fly and adjusted to user interaction, as well as a powerful deduplication engine which offers on-the-fly visual entity matching and clustering over dirty data. The platform can scale up the visualization, interactive exploration and analysis to million data points on a map, with the use of commodity hardware. Furthermore, we have developed *Socioscope* (www.socioscope.gr), a visual analysis tool, used by social scientists, for the visualization and exploration of social and political data. Another application developed within the project *CitySense* aims



to integrate city data from disparate sources and provide a visual way to combine them and filter city areas.

- **Mathematical Modeling and Analysis**

Mathematical modeling of the physical world is crucial in a number of applications. Despite the complexity of three-dimensional models, current algorithms and software are making enormous progress in efficiently representing, handling, exchanging, and operating on such models. The ARCADES Network contributes in this direction by exploiting cutting-edge research in mathematics and algorithm design so as to design and implement robust methods in Computer-Aided Design and manufacturing (CAD/CAM). However, geometric modeling is facing new challenges in modern engineering analysis, simulation, manufacturing, and construction. This is becoming evident in new sectors such as the movie and game industry, where CAD methods are not penetrating fast enough, or are facing new challenges arising from massive and fast point acquisition (e.g. by laser scanners), big data and mobile computing. This captures precisely the challenge taken up by the ARCADES Network, namely to build the next generation of CAD software based on strong mathematical foundations from computer algebra, geometric computing, numerical analysis, and algorithm design. The crux of our method relies on algebraic representations, understood in the widest sense of the term, namely relying on polynomial expressions, and including parametric, implicit, and semi-algebraic representations, which can be converted to/from further representations such as point clouds or subdivision surfaces. Compared to classical discrete representations, algebraic representations not only drastically reduce the size of the data, but also provide a small number of parameters (e.g. control points). The Network participants represent a multidisciplinary and multisectoral spectrum for implementing this vision, thus also offering an excellent opportunity for career development to the ARCADES fellows.

- **Automatic Generation of Feature-Agnostic Datasets for Fake News Detection**

Fake news is growing into one of the most crucial issues for social media platforms, users, and news organizations. The development of efficient algorithmic solutions for detecting fake news in online social networks requires complete, up-to-date, and flexible training datasets. Fact-checking services can be very useful for providing fake news stories; however, existing datasets suffer from severe limitations and rely heavily on human annotators. In this work we developed PHONY, an infrastructure that leverages Twitter and fact-checking websites to automate as much as possible the generation of flexible, feature-agnostic datasets. This allows users to extract suitable feature-specific datasets according to the machine learning approaches used. Our feature-agnostic datasets support the wide range of features encountered in the literature, including semantic features and social network diffusion features, which have not received much attention.

- **Privacy Preservation**



The protection of user privacy in data analytics is one of the major challenges faces by modern information systems. IMSI has worked extensively in the field of data anonymization, where personal data are transformed to anonymous where the identities of individuals are hidden and sensitive properties can no longer be attributes to them. IMSI has developed a series of anonymization algorithms for complex data (tree structured, RDF, set-values) and a tool, AMNESIA, that allows non-expert users to use anonymization techniques on their data. AMNESIA is offered in the OpenAIRE infrastructure and it is also part of the European Open Science Cloud (EOSC). It is available at <https://amnesia.openaire.eu>. The work on privacy preservation has resulted in a series of publication and it is used in the *OpenAIRE*, *My Health My Data* and *MEDA* projects.

- **Scientific databases and bioinformatics**

We work on models, architectures and methods to store, preserve, process and query genomic and life science data. The vision is to provide high-performance computing methods and tools to perform real-time analysis and processing of big and complex life science datasets. In the past, emphasis was given to genomic data related to miRNAs sequencing process and their analysis.



IMSI, Univ. of Thessaly

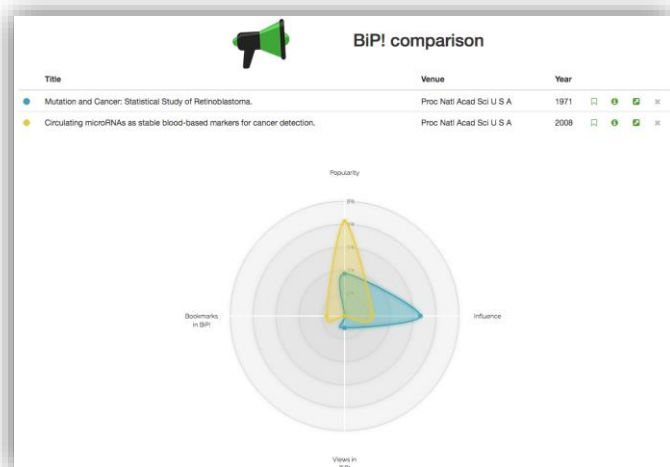
and GRNET have designed, implemented and maintained a research infrastructure for genomic data management, oriented to processing, analysis and visualization of computationally predicted miRNA targets (<http://diana.imis.athena-innovation.gr>). Part of the work is being integrated into the ELIXIR-GR research infrastructure that develops the Greek Node of the ESFRI European RI ELIXIR (<https://www.elixir-europe.org>), a distributed e-Infrastructure aiming to build a sustainable European infrastructure for biological information. In addition, we are currently leading the design and implementation of the ELIXIR-GR Cloud Infrastructure, which is based on containerization technologies to support all computational needs of the ELIXIR-GR community. The relevant research is supported by EXCELERATE, an H2020-INFRADEV project for fast-track ELIXIR implementation and ELIXIR-GR, a Greek project of the National Structural fund to support the Greek Roadmap for Research Infrastructures.

- **Text Mining and Information Retrieval for Scientific Publications**

Scientific publications retrieval and ranking based on their impact has been a long-established research topic, especially due to the massive number of papers being published annually.

We are working on technologies to identify high-impact research output, focusing on the study of impact aspects like long-term and short-term impact. Our approach is based on PageRank adaptations for citation

networks and machine learning on paper metadata. We also apply text mining techniques on scientific texts to automatically extract useful knowledge. Finally, we develop powerful information retrieval systems that are based on the previously described technologies to provide useful services to the research & science community (e.g., BIP! Finder and SciTo visualiser).



- **Information and Communications Technologies for Big Data**

Specifically broadband networks and converged telecommunications and media services, cloud based large data processing, storage and network programming systems. The research is supported by EU and National projects related to scientific data infrastructures, currently ELIXIR-EXCELERATE and ELIXRI-GR. Note that IMSI, in collaboration with GRNET and Univ. of Thessaly, has designed, implemented and maintained an e-science platform for genomic data management, oriented to processing, analysis and visualization of computationally predicted miRNA targets (<http://diana.imis.athena-innovation.gr>). The platform is running on GRNET's cloud, providing reliable and high-performance data analysis and processing services to more than 2K active users.

- **Big Data Analytics**

The attention Data Science receives recently is partly due to the availability of huge volumes of data and the opportunity to mine and extract useful knowledge. IMSI has already a significant activity and expertise around Big Data management, thus a natural next step is to focus on Data Science and Big Data Analysis. An interesting objective for IMSI is to examine how the machine learning techniques and statistical methods of Data Science can be combined with the Big Data need for scaling, particularly for non-conventional data types, like temporal, spatial, graph, stream, and scientific. This goal is actively pursued in MORE project (www.more2020.eu), which is funded by the EU. MORE aims to create a platform that will provide scalable Big Data analytics tools for sensor data coming from Renewable Energy Source, i.e., solar and wind parks. MORE will allow stakeholders in industry sectors

with huge volumes of sensor data, especially the RES industry, to: a) scale the management of streaming and historical time series beyond an order of magnitude beyond the state-of-art and b) to perform forecasting, prediction and diagnostics using the whole data that is available to them with accuracy that outperforms existing approaches. In this context also plan to investigate the processing of deep learning operations (e.g., matrix factorization) in modern CPU architectures. Finally, we continue to work on optimization for modern architectures, especially for join operations.

New (emerging) research directions in this area include:

- **Data-driven Circular Economy**

We have launched a multi-disciplinary research and innovation activity in data-driven approaches to unlock the circular economy potential. Contrary to the 'take, make, dispose' production model of a linear economy, in a circular economy, resource input, waste, emission, and energy leakage are minimised by narrowing material and energy loops through recycling, reuse, remanufacturing, repair, etc. Our aim is to build on state-of-the-art technologies and scientific solutions in data science and big data analytics, and provide novel methods, algorithms and tools to collect, process and analyze data to support key areas of circular economy, like smart waste management, automatic detection of resource/material flows in industrial networks, analysis and visualization of complex industrial symbiosis networks, etc.

- **Cloud Infrastructures**

Based on the experience from CONFES project that developed integrated wireless-wired transmission network infrastructure of ultra-high capacity optical technologies, project proposals are submitted to address challenges of the Future Internet especially in Network Function Virtualization - NFV / Software defined Networks -SDN for example by elaborating and constructing a dynamic Cloud infrastructure and in particular a converged Telco and IT node in access networks. One goal is to support advanced 5G/IoT services and applications with demanding QoS and edge analytics needs, with applications in many areas of great interest like in precision farming and 5G access and backhaul networks.

- **Domain specific Machine Learning and Analytics**

Based on the experience we have obtained by implementing ML solutions for various disciplines, we have identified that, quite often, applying state of the art ML algorithms and workflows is not adequate to effectively solve specialized, but quite significant for real-world application, tasks. On the contrary, generic algorithms and processes often need to be significantly adapted/extended in order to handle specialized problems. This has become evident in several Earth Observation and analytics settings, as well in medical image analysis. Our aim is research how state of

the art ML/DL algorithms and methodologies can be properly extended, utilizing domain knowledge, in order to effectively solve real-world problems.

Semantic Web Technologies

Current (ongoing) research directions in this area include:

- **OLAP Analytics in the Web of Data**

Another direction of research is related to the application of efficient analytics on multidimensional RDF data, i.e., data usually treated under the OLAP prism, where they are represented as observations that are instantiated over pre-defined dimensions and measures (similar to traditional DW modelling). The increasing volume and diversity of these data (statistical authorities, academic institutes, financial organizations and pharmaceutical companies publish such data) pose the challenge of finding hidden relations between them in a most efficient and accurate way, with the aim to detect inconsistencies or infer new facts. We have addressed this problem, by introducing new relationships (e.g., containment and complementarity of data) between multidimensional RDF data, and new algorithms for efficient and scalable computation of these relationships.

- **Scalable Query Processing in the Web of Data**

Another line of work addresses the need for efficient processing of SPARQL queries over voluminous RDF stores. Many indexing approaches have been proposed in this area; still few of them take into account the inherent structure of RDF graph data and how this structure can be exploited for efficient processing and optimization of SPARQL queries. For that, we have developed a scalable approach for query processing of RDF stores, based on a novel indexing technique, called Extended Characteristic Sets, which builds on top of the characteristics of the triples in an RDF dataset and enables the efficient processing of complex multi-join queries. We have also developed SRX, an extension of the popular RDF-3X system, which adds support for spatial data. SRX supports three types of spatial queries: range selections (e.g., find entities within a given polygon), spatial joins (e.g., find pairs of entities whose locations are close to each other), and spatial k -nearest neighbors (e.g., find the three closest entities from a given location).

New (emerging) research directions in this area include:

- **Distributed Storage and Parallel Query Execution**

Future interesting directions involve the distributed storage of the index and the parallel execution of such queries. Future directions include the extension of these techniques to cover more complex analytic techniques such as finding missing values, outliers and causalities on such data and make them scalable for very large volumes via parallelization. Some emerging directions, concern online entity

resolution techniques, which aim at integrating the blocking\metablocking\entity matching tasks (in the form of query operators) in the query processing phase. The goal is to enable users to seamlessly analyze on query-time heterogeneous (e.g., different schemas, disparate data sources) datasets that involve highly noisy data of different quality.

- **Efficient storage management and query processing for Large Knowledge graphs.**

An emerging area of work is in the area of RDF Indexing and Query Processing for Big Knowledge Graphs. We are working in a scalable approach for storing in relational databases and querying RDF knowledge graphs based on the notion of Characteristic sets (CS). CSs organize graphs based on the set of properties associated with their subject nodes. This concept was recently used in indexing techniques, as it can capture the implicit schema of RDF data. While most CS-based approaches yield significant improvements in space and query performance, they fail to perform well when answering complex query workloads in the presence of schema heterogeneity, i.e., when the number of CSs becomes very large, resulting in a highly partitioned data organization. We work on a novel technique, for merging CSs based on their hierarchical structure. Our method employs a lattice to capture the hierarchical relationships between CSs, identifies dense CSs and merges dense CSs with their ancestors. We implement our algorithm on top of a relational backbone, where each merged CS is stored in a relational table, and therefore, CS merging results in a smaller number of required tables to host the source triples of a data set.

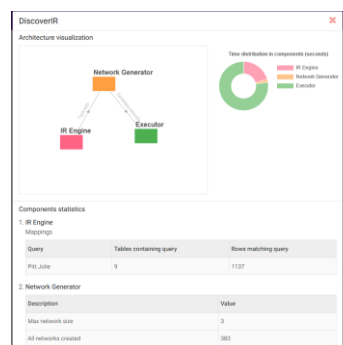
User-Data Interaction Systems

Current (ongoing) research directions in this area include:

- **Intelligent Data Interfaces**

The volume of data and the need for data democratization call for shift from the classical «query-based information access paradigm» popularized by existing systems to a novel information access paradigm, where the system takes upon a more conversational and active role in helping users effectively explore data of varying quality, complexity, and relevance.

We are looking into text-to-SQL systems, i.e., systems that allow users to ask queries using natural language. Numerous search systems have been implemented that allow users to pose unstructured queries over databases without the need to use a query language, such as SQL.





Unfortunately, the landscape of efforts is fragmented with no clear sight of which system is best, and what open challenges we should pursue in our research. We have developed and experimentally compared several systems that employ a wide range of techniques. We have developed THOR a system that allows

comparing different systems across multiple dimensions, including query categories and efficiency. THOR makes 4 important contributions: a query benchmark, a framework for comparing different systems, several search system implementations, and a highly interactive tool for comparing different search systems.

- **Intelligent Interactive Data Exploration**

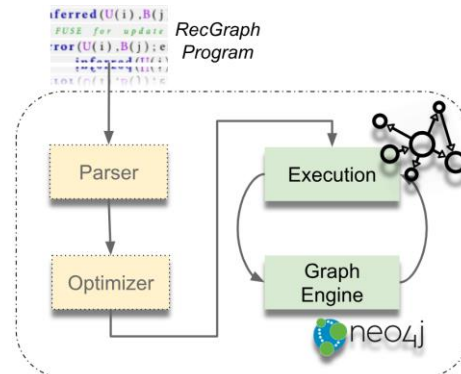
We are working on algorithms that allow the system to actively guide the user through their information access endeavor by offering query recommendations, exploration options, and help as needed.

Our focus is on novel recommendations, where the objective is to explore non-conventional types of data and inputs to recommendations, to study recommendation problems beyond typical ones focusing on user consumption problems (selecting movies to watch, products to buy, applications to download, and so forth), and to build on the newest algorithmic developments in the field of recommender systems.

Towards this direction, we are working on algorithms that can provide query recommendations based on data analysis without the use of query logs. We have also developed a model for defining recommendations as graph explorations and a prototype system over Neo4j.

- **Fair and Ethical Algorithmic Systems**

More and more aspects of our everyday lives are influenced by automated decisions made by systems that statistically analyze traces of our activities. It is thus natural to question whether such systems are trustworthy, particularly given the opaqueness and complexity of their internal workings. The dimensions of fairness, automatic bias factors discovery and user-interactive fairness corrections and explanation are



absent from such systems. We are looking into how fairness is defined and achieved in ML systems (e.g., machine-generated recommendations and rankings).

New (emerging) research directions in this area include:

- **Intelligent Data Interfaces to Databases**

Building natural language interfaces that can answer different types of questions is challenging. The use of deep learning methods opens new opportunities and challenges.

- **Intelligent Interactive Data Exploration**

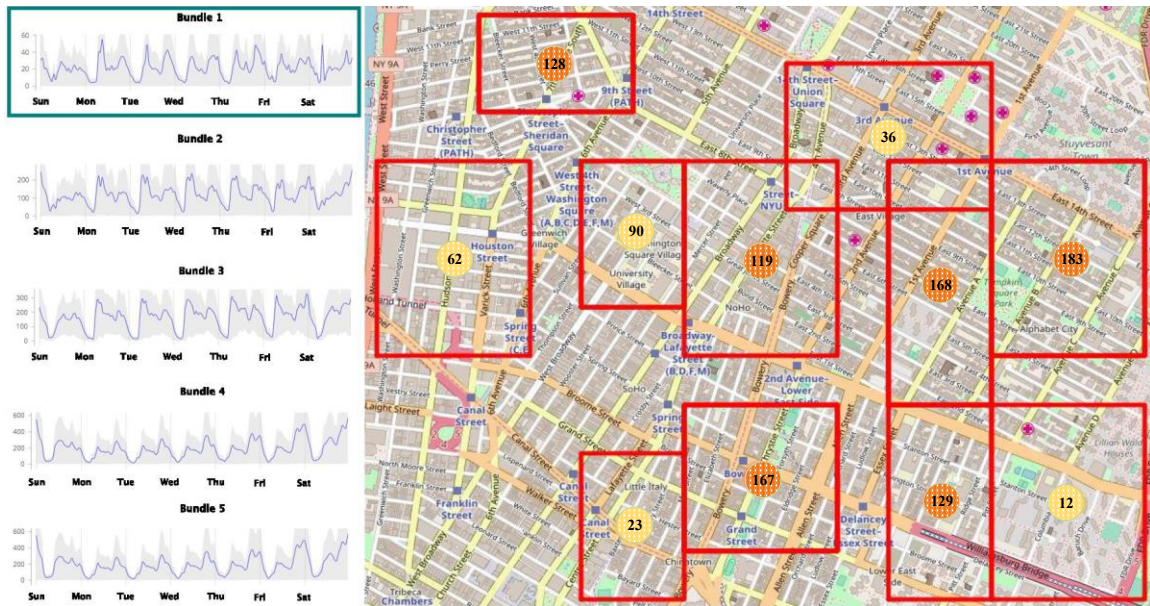
We are working on algorithms that allow the system to actively guide the user through their information access endeavor by offering query recommendations, exploration options, and help as needed. As recommendations are challenging, additional ways of understanding the user, the data, and the queries are needed in order to provide alternative or complementary recommendations that can help the user during data exploration.

Geospatial Data Management

Current (ongoing) research directions in this area include:

- **Geolocated Time Series**

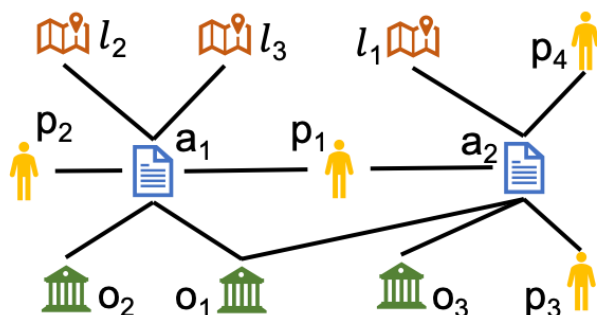
Geolocated time series are time series that correspond to specific locations. They can represent, for example, visitor check-ins at certain venues or readings of sensors installed at various places. The amount and significance of such time series have increased in many domains over the last years. However, although several works exist for time series visualization and visual analytics in general, there is a lack of efficient techniques for visual exploration and analysis of geolocated time series in particular. In our work, we have developed two approaches that rely on hybrid spatial-time series indices to allow for efficient map-based visual exploration and summarization of geolocated time series data. In particular, we use the B TSR-tree index and we introduce a new variant of the iSAX index, called geo-iSAX. The former is a spatial-first hybrid index that extends the R-tree by maintaining bounds for the time series indexed at each node. Following a similar rationale, geo-iSAX is a time series-first hybrid index that maintains spatial MBRs of the geolocated time series indexed in each node. Based on these indices, we show how to efficiently produce map-based visualizations of geolocated time series at different levels of granularity.



New (emerging) research directions in this area include:

- **Heterogeneous Information Networks**

Heterogeneous Information Networks (HINs) are graphs comprising different types of nodes (entities) and edges (relationships). HINs offer an intuitive and generic model for representing complex information in various domains. A core concept for analyzing HINs is that of metapath, which is a path defined on the schema of the HIN. Metapaths represent relationships of different semantics between entities of the same or different type, providing a mechanism for exploring and analyzing a HIN from multiple perspectives. Thus, they are fundamental for several types of analyses in HINs, ranging from similarity joins to HIN embeddings and recommendations. These tasks become even more complex in the presence of entity types that are additionally associated with spatial or temporal properties. Spatial and temporal proximity are important factors in several analyses. Yet, since spatial and temporal relationships are typically not represented explicitly in the network structure, they cannot be captured by metapaths. Thus, analysis methods that are purely metapath-based will inevitably overlook these aspects, resulting in significant loss of information that is present in the data. Our works aims at finding the top-k most similar entities to a query with respect to different weighted combinations of both metapaths and/or spatio-temporal attributes.



- Extracting value from (underutilized) Big Geospatial Data via Deep Learning**
 Boosting the data economy and supporting the development of data value chains has been a major goal of the EC during the last years. In this spirit, our future work focuses on building Deep Learning and Transfer Learning methods for extracting and modelling knowledge from underutilized geospatial datasets and exploiting it to solve real-world problems. As an indicative example, cadastration companies have obtained, through years of manual efforts, big datasets of annotated aerial images on rural, semi-urban and urban areas. The volumes of these datasets allow the effective training of Deep Learning models for object detection, semantic segmentation and instance segmentation. Such models are directly applicable and can produce great value in several land management applications, including Cadastrals and Land Parcel Identification Systems. To this end, several research challenges need to be addressed, including the varying resolution and quality of aerial images, the low separability of certain object classes in rural areas and the appropriate/optimal application of Transfer Learning methodologies on the above processes. Another real-world application involves the existence of large open and proprietary databases of toponyms and addresses that can be utilized to build domain specific, distributed representations of spatio-textual entities, exploitable in various data integration and annotation tasks.

Digital Curation and Research Infrastructures

Current (ongoing) research directions in this area include:

- Digital Curation**
 Digital curation encompasses a set of activities aiming at the production of high quality, dependable digital assets; their organization, archiving and long-term preservation; and the generation of added value from digital assets by means of resource-based knowledge elicitation. To ensure the adequate capture of the context of digital resources and their subsequent creative and effective use, the DCU adopts a multidisciplinary approach that considers the full lifecycle of digital assets, such as records, digital surrogates and scholarly/ scientific datasets.
- Digital research infrastructures**

A strategic action line is the development of digital research infrastructures for the humanities at the national and european levels. At the national level, IMSI leads the APOLLONIS Greek Infrastructure for Digital Arts, Humanities and Language Research and Innovation (P. Constantopoulos, coordinator) resulting from the unification of CLARIN-EL and DARIAH-GR. At the european level, IMSI actively participates in the European Digital Research Infrastructure for the Arts and Humanities (DARIAH) since the preparatory phase, currently with leading roles in VCC2, DARIAH's Virtual Competence Centre for Research and Education (A. Benardou is VCC2 Co-Chair, C. Dallas chairs the Working Group "Digital Methods and Practices Observatory"). IMSI, through DCU, has been heavily involved in building the ARIADNE infrastructure for archaeology. It provides advanced aggregation services for the Europeana ecosystem. It has developed the ESF NeDiMAH methods ontology (NeMO), now used to drive the automatic extraction of research processes. Collaborations with other research infrastructures, also in areas besides the humanities, are actively pursued.

New (emerging) research directions in this area include:

- **Digital storytelling**

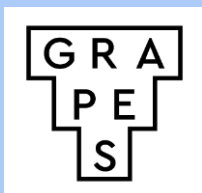
The initiation of project SHARE3D marked a new line of work on issues of information delivery and publication as an integral part of the digital content lifecycle and establishing an efficient continuum from data curation to creative uses and dissemination. The specific project focuses on enabling users to explore, create and experience 3D objects as stories. This project was the first in which we employed methods of digital storytelling. SHARE3D was one of the projects which offered hands-on digital storytelling exercises to students of the MSc in Digital Methods in the Humanities, Athens University of Economics and Business.

- **European Open Science Cloud.**

The European Open Science Cloud (EOSC) is an environment for hosting and processing research data to support EU science, to provide European researchers, innovators, companies and citizens with a federated and open multi-disciplinary environment where they can publish, find and re-use data, tools and services for research, innovation and educational purposes. IMSI participates in the development of Core Services of the EOSC ecosystem, and more specifically it develops the catalogue of services of the EOSC portal, that offers research-infrastructures and commercial service providers to integrate and list their research services in uniform way in the EOSC portal.

Projects

EU R&D Projects



GRAPES - Learning, processing and optimising shapes

Project manager	Ioannis Z. Emiris
Coordinator	IMIS
IMIS - funding	486,035 euros
Programme	Marie Skłodowska-Curie Innovative Training Networks
Start date	1/11/2019
Duration	4,5 years
Website	http://grapes-network.eu/

GRAPES aims at considerably advancing the state of the art in a variety of fields ranging from Computational and Numerical Mathematics, to Geometric Modelling and CAD, up to Data Science and Machine Learning, in order to promote game changing approaches for generating, optimising, and learning 3D shapes. Research is articulated around 3 scientific work packages (WPs):

1. High-order methods and representations,
2. Algebraic & numeric tools in shape optimisation and analysis, and
3. Machine Learning for shapes.

Concrete applications include simulation and fabrication, design and visualisation, retrieval and mining, reconstruction, and urban planning. Our 15 PhD candidates shall benefit from both top-notch research as well as a strong innovation component through a nexus of intersectoral secondments and Network-wide workshops. Innovation and technology transfer rely on the active participation of SMEs, either as beneficiary, or as partner organisations hosting secondments.



XMANAI - Explainable Manufacturing Artificial Intelligence

Project manager	Theodore Dalamagas
Coordinator	IMSI
IMIS - funding	318,000 euros
Programme	H2020-ICT-2018-20, ICT-38-2020
Start date	11/2020
Duration	40 months
Website	https://ai4manufacturing.eu

Despite the indisputable benefits of AI, humans typically have little visibility and knowledge on how AI systems make any decisions or predictions due to the so-called “black-box effect” in which many of the machine learning/deep learning algorithms are not able to be examined after their execution to understand specifically how and why a decision has been made. The inner workings of machine learning and deep learning are not exactly transparent, and as algorithms become more complicated, fears of undetected bias, mistakes, and misconceptions creeping into decision making, naturally grow among manufacturers and practically any stakeholder. In this context, Explainable AI (XAI) is today an emerging field that aims to address how black box decisions of AI systems are made, inspecting and attempting to understand the steps and models involved in decision making to increase human trust. XMANAI aims at placing the indisputable power of Explainable AI at the service of manufacturing and human progress, carving out a “human-centric”, trustful approach that is respectful of European values and principles, and adopting the mentality that “our AI is only as good as we are”. XMANAI, demonstrated in 4 real-life manufacturing cases, will help the manufacturing value chain to shift towards the amplifying AI era by coupling (hybrid and graph) AI “glass box” models that are explainable to a “human-in-the-loop” and produce value-based explanations, with complex AI assets (data and models) management-sharing-security technologies to multiply the latent data value in a trusted manner, and targeted manufacturing apps to solve concrete manufacturing problems with high impact.



LinkGeoML

automatic and accurate interlinking of geospatial data using machine learning

Project manager	Giorgos Giannopoulos
Coordinator	Giorgos Giannopoulos
IMIS - funding	199300.00
Programme	Competitiveness, Entrepreneurship, Innovation - ESPA 2014-2020 – Research, Create, Innovate – II. Partnerships between Enterprises and Research Organizations.
Start date	9/7/2018
Duration	2 years
Website	https://linkgeoml.gr/

The automatic and accurate interlinking of geospatial data poses an important scientific challenge, with direct application in several business fields. The major requirement is achieving high accuracy in identifying similar entities within datasets. For example, in a cadastral database, it is crucial that the land parcels, that were gathered from several different databases, are uniquely and clearly identified. In another example, for a geo-marketing company, it is of high importance to be able to accurately cross-reference the location/addresses of customers and companies, so that they are properly targeted. LinkGeoML aims at researching, developing and extending machine learning methods, utilizing the vast amount of available, open geospatial data, in order to implement automated and highly accurate algorithms for interlinking geospatial entities. The proposed methods will implement novel training features, based on domain knowledge and on the analysis of open and proprietary geospatial datasets. Further, they will extend and specialize machine learning models on classification and similarity learning. The implemented technologies will be published as open source software and, also, will be integrated into existing, commercial applications for cadastration, geocoding and geomarketing, aiming at improving their functionality and increasing their commercial value and application domains. LinkGeoML comprises a partnership between enterprises and research organizations, aiming to perform high quality, industrial research with a twofold purpose: Provide SMEs with useful geospatial data integration tools to solve real-world problems, and advance the state of the art on machine learning methods for geospatial data integration. To achieve these purposes, LinkGeoML identifies use cases based on real-world integration problems, elicited by its two industrial partners, and researches how machine learning-based, interlinking methods can be applied to these use cases and facilitate their handling, in real-world data.



INSPIRED - The National Research Infrastructures on Integrated Structural Biology, Drug Screening Efforts and Drug target functional characterization

Project manager	prof Yannis Ioannidis
Coordinator	NHRF
IMIS - funding	140.000,00 Euros
Programme	2014-2020 (EPAnEK) - Operational Programme competitiveness, Entrepreneurship and Innovation
Start date	03/09/2018
Duration	4 years
Website	https://www.inspired-ris.gr/

INSPIRED is a national distributed research infrastructure unique in the field of Structural Biology that combines studies on bioactive (macro)molecules interactions and biomarkers identification. It offers services mainly in the field of biology, diagnostics and pharmacology, addressing the needs of the health sector with significant impact on agrofood and concerns a large number of organizations (potential users and collaborators). It bridges basic research with the Industry and SMEs supporting innovative actions by either providing services or in the frame of funded programmes. It comprises two complementary infrastructures: INSTRUCT-EL | UPAT-RISF. INSPIRED addresses the needs of the field of Health Sciences and Pharmaceuticals. The partners cover all the Greek Regions. It is a distributed Research Infrastructure across Greece.



DESIRA- Digitisation: Economic and Social Impacts in Rural Areas

Project manager	prof Yannis Ioannidis
Coordinator	UNIFI

IMIS - funding	347.208,75 €
Programme	H2020-RUR-2018-2020 (Rural Renaissance)
Start date	01/06/2019
Duration	4 years
Website	https://desira2020.eu/

The project aims to improve the capacity of society and political bodies to respond to the challenges that digitalisation generates in agriculture, forestry and rural areas. The project approaches all activities considering digitalisation as a process of social transformation driven by digital technologies. It acknowledges the transformative nature of digitalisation and the impacts it can have in shaping the way rural communities and actors learn, work, travel, interact, etc., acting as a 'game changer' for rural territories and sectors. The digital transformation of rural areas generates winners (who benefit from the change), but also losers (who are marginalised by the change), as well as opponents (who resist to change) and proponents (who support or advocate for the change). To reap the benefits and reduce the risks associated with digitalisation, rural communities need to improve their capacity of understanding the impacts and changes in their context and to develop and plan appropriate actions in order to adapt. Sustainable digitalisation is key to minimise the costs and maximise the benefits of digital transformation, contributing to the Sustainable Development Goals (SDGs). The analytical work is conceptualised on the basis of the interconnection between society, plant and/or animals (Social, beings), data (Cyber, software) and things (Physical, Hardware) within the rural systems or contexts.



NI4OS-Europe 2020 - National Initiatives for Open Science in Europe

Project manager	Natalia Manola
Coordinator	GRNET
IMIS - funding	807.000,00 €
Programme	H2020-INFRAEOSC-2018-2020 (Implementing the European Open Science Cloud)
Start date	01/09/2019
Duration	3,5 years
Website	https://ni4os.eu/

National Initiatives for Open Science in Europe – NI4OS Europe, aims to be a core contributor to the European Open Science Cloud (EOSC) service portfolio, commit to EOSC governance and ensure inclusiveness on the European level for enabling global Open Science. Support the development and inclusion of the national Open Science Cloud initiatives in 15 Member States and Associated Countries in the EOSC governance. Instill within the community the EOSC philosophy and FAIR principles for data Findability, Accessibility, Interoperability and Reusability. Provide technical and policy support for on-boarding of service providers into EOSC, including generic services (compute, data storage, data management), thematic services, repositories and data sets. NI4OS-Europe exploits and engages a strong human network covering a wide range of stakeholders, as well as the infrastructure and service providers in the region, to support the overall EOSC vision, architecture and governance. NI4OS-Europe will federate the existing EOSC-relevant services in the 15 target countries and include them in the EOSC service offering. NI4OS-Europe will collaborate with the other EOSC-related initiatives to contribute to the common EOSC platform including a set of policies, rules and principles for managing services and research data across the EOSC ecosystem. NI4OS-Europe will facilitate access to infrastructures, data, resources and services for users to benefit from know-how sharing and exploitation, thus creating opportunities for increasing innovation capacity of regional Science. In parallel, NI4OS-Europe collaboration with other EOSC related projects will leverage developments in the European Open Science landscape, contributing in a decisive manner to the EOSC vision of open and inclusive science and innovation. NI4OS-Europe will trigger EOSC-relevant technical advancements in the area by supporting a full stack of open and sustainable services. It will provide equal access to infrastructures, data and services for all European researchers, ensuring inclusiveness. NI4OS-Europe will enable collaborative and innovative research of highest excellence by connecting the regional scientific and research community between them and to the wider EOSC landscape. A wide range of ICT and science professionals in the region will be involved in the provisioning and use of EOSC-relevant services and data. NI4OS-Europe will contribute to the retention of these professionals in the area, providing them with equal opportunities.



EOSC Secreteriat- The European Open Science Cloud for Research Secreteriat Project

Project manager prof Yannis Ioannidis

Coordinator	Technopolis Consulting Group Belgium
IMIS - funding	402.500,00 €
Programme	H2020-INFRAEOSC-2018-2020 (Implementing the European Open Science Cloud)
Start date	01/01/2019
Duration	2,5 years
Website	https://www.eoscsecretariat.eu/

EOSCsecretariat.eu addresses the call Support to the EOSC Governance subtopic (a), Setup of an EOSC coordination structure. It will deliver an EOSC Secretariat that is a proactive, dynamic and flexible organisational structure with all the necessary competences, resources and vision to match the ambition of the call. The 30-month project will maintain a practical approach addressing all the specific needs of the coordination structure required for the EOSC. The project will adopt a Co-creation approach working with the community to deliver many of the activities and has reserved a substantial portion of the budget for organisations not in the consortium. This approach will enable a high degree of flexibility in order to address any foreseen or unforeseen challenges that may arise during the project. EOSCsecretariat.eu is characterised by being neutral towards the community it is serving and by having a pragmatic approach that is fully dedicated to realising the outcomes of the EOSC design as stated in the Implementation Roadmap Staff Working Document and adopted Council Conclusions to deliver an operational open science cloud for all European stakeholders. The outputs of EOSCsecretariat.eu include: Secretariat organisational structure, processes & procedures, rules & legal framework; business models; press & media office; pan-European awareness increase; open consultation; knowledge base; coordination services to WGs; coordination with EOSC-related projects; organisation & support to Boards & events; two Stakeholders Forums; liaison with non-EU countries; engaged community with all stakeholder groups represented. The Consortium is competent, lean and complementary: Coordinated by an independent research and consulting organisation with 30 years' experience and track record in services to the R&I community, and supported by 10 experienced partners, from academia & industry, with strategic and practical involvement in design and delivery of the EOSC.

Project manager	prof Yannis Ioannidis
Coordinator	UPEM
IMIS - funding	141.250,00 €
Programme	H2020-INFRAIA-2018-1
Start date	01/01/2019
Duration	4 years
Website	https://www.risis2.eu/

The European Research infrastructure for science, technology and innovation policy studies (RISIS2) aims at building a data and services infrastructure supporting the development of a new generation of analyses and indicators. To develop a deeper understanding of knowledge dynamics and policy relevant evidence, the project goes beyond established quantitative indicators, developing positioning indicators, which take into account critical features of knowledge dynamics i.e. the importance of asymmetries in producers, in places and in themes. RISIS datasets are built keeping information on these three dimensions. To exploit them, new services dealing with actor identification, geographical information and thematic foci are developed, as well as semantic analytical capabilities. This project builds on RISIS1 (2014-18), which has demonstrated the relevance of such an approach and opened access to a first set of databases and services. RISIS2 gathers 19 partners aiming to transform the field of STI studies into an advanced research community. This step change is achieved by: (i) developing an e-infrastructure that supports full virtual transnational access by researchers, (ii) providing a vastly enlarged set of services tailored to field-specific needs (for problem-based integration of datasets, for exploring open data, and for supporting analytical capabilities of researchers), (iii) maintaining datasets dealing with firm innovation capacities, public research developments, R&I outputs and projects, and policy learning, (iv) developing new datasets on 4 key issues for research and policy (social innovation, non technological innovation, the role of PhDs in society, portfolios of public funding instruments). As reflected in the strong role of OpenAire in RISIS2, the infrastructure is fully inscribed into the open science movement. It is accompanied by a strong training, dissemination and communication effort to support the important widening of the community we aim at.



FRESQO - Freshness REcording System for fish Quality Observation

Project manager	prof Yannis Ioannidis
Coordinator	IMIS
IMIS - funding	122.951,09 €
Programme	Fisheries and Maritime 2014-2020
Start date	04/05/2018
Duration	4,5 years

Website

The main objective of the FRESQO project is the construction of an innovative product (hardware and software) which will allow the automatic recognition of the freshness of the most important commercial catches of the Greek market with possibility of expanding the detection facilities to an unlimited set of marketable and non-marketable fish. This product will essentially consist of a small (portable) spectral camera which, with a simple photograph of the fish, can provide specific indications about the freshness of a fish. The camera will communicate wired or wireless with a small-sized controller that will communicate with the specialized repository to collect and manage the relevant data as a supporting independent infrastructure (multiple capture images, chemical analysis data and organoleptic measurements as well as auxiliary data for export safer conclusions).



OpenAire Advance- OpenAIRE Advancing Open Scholarship

Project manager	prof Yannis Ioannidis
Coordinator	NKUA
IMIS - funding	1.413.261,75 €
Programme	H2020-EINFRA-2017
Start date	01/01/2018
Duration	3 years
Website	https://www.openaire.eu/advance/

OpenAIRE-Advance continues the mission of OpenAIRE to support the Open Access/Open Data mandates in Europe. By sustaining the current successful infrastructure, comprised of a human network and robust technical services, it consolidates its achievements while working to shift the momentum among its communities to Open Science, aiming to be a trusted e-Infrastructure within the realms of the European Open Science Cloud. In this next phase,

OpenAIREAdvance strives to empower its National Open Access Desks (NOADs) so they become a pivotal part within their own national data infrastructures, positioning OA and open science onto national agendas. The capacity building activities bring together experts on topical task groups in thematic areas (open policies, RDM, legal issues, TDM), promoting a train the trainer approach, strengthening and expanding the pan-European Helpdesk with support and training toolkits, training resources and workshops. It examines key elements of scholarly communication, i.e., co-operative OA publishing and next generation repositories, to develop essential building blocks of the scholarly commons. On the technical level OpenAIRE-Advance focuses on the operation and maintenance of the OpenAIRE technical TRL8/9 services, and radically improves the OpenAIRE services on offer by: a) optimizing their performance and scalability, b) refining their functionality based on end-user feedback, c) repackaging them into products, taking a professional marketing approach with well-defined KPIs, d) consolidating the range of services/products into a common e-Infra catalogue to enable a wider uptake. OpenAIRE-Advance steps up its outreach activities with concrete pilots with three major RIs, citizen science initiatives, and innovators via a rigorous Open Innovation programme. Finally, via its partnership with COAR, OpenAIRE-Advance consolidates OpenAIRE's global role extending its collaborations with Latin America, US, Japan, Canada, and Africa.



DARE- Delivering Agile Research Excellence

Project manager prof Yannis Ioannidis

Coordinator NCSR

IMIS - funding 224.588,21 €

Programme H2020-EINFRA-2017

Start date 01/01/2018

Duration 3 years

Website <http://project-dare.eu/>

DARE (Delivering Agile Research Excellence on European e-Infrastructures) aims to provide scientific communities with a unifying hyper-platform and development context to allow for user-friendly and reproducible carrying out of huge data-driven experiments, and rapid prototyping. DARE specifically addresses the requirements of innovating teams of research developers and

scientists, who work on the intersection of software engineering and scientific domains, and on data, complexity and computing extremes. The size and complexity of scientific data, as well as the difficulty in formulating domain-specific solutions in reproducible and reusable ways, may often lead to throw-away, unsustainable end-user products, or long release cycles. This complexity increases exponentially with the size and diversity of input and produced data. Furthermore, widely used big-data technologies and analytics, while they are known to lead to increased productivity in commercial settings, they are often not taken advantage of in scientific. The requirement to deal with diverse exascale data resources dictates the need to ensure and increase productivity through the controlled disruption of the current modus operandi of European RIs. DARE aims to be the technological pivot for this transition, while providing transparent, traceable and developer-friendly bridges over existing infrastructures and services. Building on extensive experience in research e-infrastructures, semantification and the handling of metadata, and on big-data technologies and domain applications, DARE will equip teams of innovators with meaningful abstractions and tools allowing for rapid prototyping of reproducible and efficient research solutions. DARE will improve further and integrate tried and tested programmatic dataflow specification APIs, big-data technologies and provenance/datalineage solutions to address the requirements of European RIs, initially of EPOS, on Earth science, and IS/ENES2, on climate.



RDA 4.0- The European plug-in to the global Research Data Alliance

Project manager	prof Yannis Ioannidis
Coordinator	Trust-IT
IMIS - funding	100.525,00 €
Programme	H2020-INFRA-SUPP-2017-1 (3rd Party)
Start date	01/03/2018
Duration	2.5 years
Website	https://www.rd-alliance.org/

RDA Europe 4.0 addresses the INFRA-SUPP-02-2017 call targeting the area “European support to the Research Data Alliance, RDA” designing Europe’s contribution to implementation of an effective governance model and strategy in RDA global, while ensuring that RDA delivers on locally relevant issues. RDA Europe 4.0 focuses on the need for open and interoperable sharing of research data

& on the need to build social, technical and cross-disciplinary links to enable such sharing on a global scale. It strives to do this with its community-driven and bottom-up approach launched since 2012. In fact, RDA Europe 4.0 directly builds on the current RDA Europe effort, by efficiently bringing in the organisations that implemented RDA Europe since 2012. The scope of RDA Europe 4.0 is to become the centrepiece for an EU Open Science Strategy through a consolidated European network of National Nodes, bringing forward an RDA legacy in Europe, providing skilled, voluntary resources from the EU investment to address DSM issues, by means also of an open cascading grant process. The ambitious, 27-month project is implemented by 5 beneficiaries (Trust-IT Services, Gottingen State University Library, the Digital Repository of Ireland at the Royal Irish Academy, the Digital Curation Centre and the RDA Foundation), skillfully supported by 9 National Nodes which carry out specific operational activities & act as national champions for their respective region. One of the specific goals of RDA Europe 4.0 is to complete a capillary European network by on-boarding additional 13 nodes by project end. Main Outputs: Expansion from 9 to 22 national nodes in EU; 7500+ individual members & 75 organisational members; 9 RDA recommendations as ICT technical specifications; consolidated programme for experts, early careers, ambassadors & adoption projects; 5 international RDA plenary meetings; integration with EOSC, ESFRI & other pan-EU initiatives; RDA Europe self-sustained after project completion.



ARIADNEplus - Advanced Research Infrastructure for Archaeological Data Networking in Europe - plus

Project manager	prof Yannis Ioannidis
Coordinator	PIN
IMIS - funding	136.875,00 €
Programme	H2020-INFRAIA-2018-1
Start date	01/01/2019
Duration	4 years
Website	https://ariadne-infrastructure.eu/

The ARIADNEplus project is the extension of the previous ARIADNE Integrating Activity, which successfully integrated archaeological data infrastructures in Europe, indexing in its registry about 2.000.000 datasets. ARIADNEplus will build

on the ARIADNE results, extending and supporting the research community that the previous project created and further developing the relationships with key stakeholders such as the most important European archaeological associations, researchers, heritage professionals, national heritage agencies and so on. The new enlarged partnership of ARIADNEplus covers all of Europe. It now includes leaders in different archaeological domains like palaeoanthropology, bioarchaeology and environmental archaeology as well as other sectors of archaeological sciences, including all periods of human presence from the appearance of hominids to present times. Transnational Activities together with the planned training will further reinforce the presence of ARIADNEplus as a key actor. The technology underlying the project is state-of-art. The ARIADNEplus data infrastructure will be embedded in a cloud that will offer the availability of Virtual Research Environments where data-based archaeological research may be carried out. The project will furthermore develop a Linked Data approach to data discovery. Innovative services will be made available to users, such as visualization, annotation, text mining and geo-temporal data management. Innovative pilots will be developed to test and demonstrate the innovation potential of the ARIADNEplus approach. Fostering innovation will be a key aspect of the project, with dedicated activities led by the project Innovation Manager.



HBP SGA3 - Human Brain Project Specific Grant Agreement 3

Project manager	prof Yannis Ioannidis
Coordinator	PIN
IMIS - funding	3.764.481,00 €
Programme	H2020-SGA-FETFLAG-HBP-2019
Start date	01/04/2020
Duration	3 years
Website	https://www.humanbrainproject.eu/en/

The last of four multi-year work plans will take the HBP to the end of its original incarnation as an EU Future and Emerging Technology Flagship. The plan is that the end of the Flagship will see the start of a new, enduring European scientific research infrastructure, EBRAINS, hopefully on the European Strategy Forum on Research Infrastructures (ESFRI) roadmap. The SGA3 work plan builds on the strong scientific foundations laid in the preceding phases, makes structural

adaptations to profit from lessons learned along the way (e.g. transforming the previous Subprojects and Co-Design Projects into fewer, stronger, well-integrated Work Packages) and introduces new participants, with additional capabilities. The SGA3 work plan is built around improved integration and a sharpening of focus, to ensure a strong HBP legacy at the end of this last SGA. In previous phases, the HBP laid the foundation for empowering empirical and theoretical neuroscience to approaching the different spatial and temporal scales using state-of-the-art neuroinformatics, simulation, neuromorphic computing, neurorobotics, as well as high-performance analytics and computing. While these disciplines have been evolving for some years, we now see a convergence in this field and a dramatic speedingup of progress. Data is driving a scientific revolution that relies heavily on computing to analyse data and to provide the results to the research community. Only with strong computer support, is it possible to translate information into knowledge, into a deeper understanding of brain organisation and diseases, and into technological innovation. In this respect, the underlying Fenix HPC and data e-infrastructure, co-designed with the HBP, will be key. The services offered by EBRAINS will be grouped in six Service Categories:

SC1: Curated and shared data: EBRAINS FAIR data services - neuroscience data publishing

SC2: Brain atlas services: navigate the brain in 3D - find, contribute and analyse brain data, based on location

SC3: Brain modelling and simulation workflows: integrated tools to create and investigate models of the brain

SC4: Closed loop AI and robotics workflows: design, test and implement robotic and AI solutions

SC5: Medical brain activity data platform: human intracerebral EEG database and analysis service

SC6: Interactive workflows on HPC or NMC: Europe-wide access to scalable and interactive compute services



HumanE-AI-Net- HumanE AI Network

Project manager	prof Yannis Ioannidis
Coordinator	DFKI
IMIS - funding	200.000,00 €
Programme	H2020-ICT-2019-3
Start date	01/09/2020

Duration 3 years

Website <https://www.humane-ai.eu/>

The HumanE AI Net brings together top European research centers, universities and key industrial champions into a network of centers of excellence that goes beyond a narrow definition of AI and combines world leading AI competence with key players in related areas such as HCI, cognitive science, social sciences and complexity science. This is crucial to develop a truly Human Centric brand of European AI. We will leverage the synergies between the involved centers of excellence to develop the scientific foundations and technological breakthroughs needed to shape the AI revolution in a direction that is beneficial to humans both individually and societally, and adheres to European ethical values and social, cultural, legal, and political norms. The core challenge is the development of robust, trustworthy AI capable of what “understanding” humans, adapting to complex real-world environments, and appropriately interacting in complex social settings. The aim is to facilitate AI systems that enhance human capabilities and empower individuals and society as a whole while respecting human autonomy and self-determination. The HumanE AI Net project will engender the mobilization of a research landscape far beyond direct project funding, involve and engage European industry, reach out to relevant social stakeholders, and create a unique innovation ecosystem that provides a many fold return on investment for the European economy and society. We will make the results of the research available to the European AI community through the AI4EU platform and a Virtual Laboratory, develop a series of summer schools, tutorials and MOOCs to spread the knowledge, develop a dedicated innovation ecosystem for transforming research and innovation into an economic impact and value for society, establish an industrial Ph.D. program and involve key industrial players from sectors crucial to European economy in research agenda definition and results evaluation in relevant use cases.



SmartDataLake - Sustainable Data Lakes for Extreme-Scale Analytics

Project manager Dimitris Skoutas
Coordinator IMIS
IMIS - funding € 853,125.00
Programme RIA, H2020-ICT-2018-2
Start date 1/1/2019
Duration 3 years

Website <https://smartdatalake.eu/>

Data lakes are raw data ecosystems, where large amounts of diverse data are retained and coexist. They facilitate self-service analytics for flexible, fast, ad hoc decision making. SmartDataLake enables extreme-scale analytics over sustainable big data lakes. It provides an adaptive, scalable and elastic data lake management system that offers: (a) data virtualization for abstracting and optimizing access and queries over heterogeneous data, (b) data synopses for approximate query answering and analytics to enable interactive response times, and (c) automated placement of data in different storage tiers based on data characteristics and access patterns to reduce costs. The data lake's contents are modelled and organised as a heterogeneous information network, containing multiple types of entities and relations. Efficient and scalable algorithms are provided for: (a) similarity search and exploration for discovering relevant information, (b) entity resolution and ranking for identifying and selecting important and representative entities across sources, (c) link prediction and clustering for unveiling hidden associations and patterns among entities, and (d) change detection and incremental update of analysis results to enable faster analysis of new data. Finally, interactive and scalable visual analytics are provided to include and empower the data scientist in the knowledge extraction loop. This includes functionalities for: (a) visually exploring and tuning the space of features, models and parameters, and (b) enabling large-scale visualizations of spatial, temporal and network data. The results of the project are evaluated in real-world use cases from the business intelligence domain, including scenarios for portfolio recommendation, production planning and pricing, and investment decision making. SmartDataLake will foster innovation and enable European SMEs to capitalize on the value of their own data lakes.



INODE - Intelligent Open Data Exploration

Project manager	Georgia Koutrika
Coordinator	ZHAW
IMIS - funding	798.000 Euros
Programme	EU H2020 - H2020-EU.1.4.1.3. - Development, deployment and operation of ICT-based e-infrastructures, inode-project.eu
Start date	1/11/2019
Duration	3.5 years

Website <https://www.inode-project.eu/>

The core principle of INODE is that users should interact with data in a more dialectic and intuitive way similar to a dialog with a human. To achieve this principle, INODE builds innovative services for exploration of open data sets that help users (a) link and leverage multiple datasets, (b) access and search data using natural language, using examples and using analytics (c) get guidance from the system in understanding the data and formulating the right queries, and (d) explore data and discover new insights through visualizations.



INFORE - Interactive Extreme-Scale Analytics and Forecasting

Project manager	Antonios Deligiannakis
Coordinator	IMIS
IMIS - funding	834 687,50 Euros
Programme	H2020, ICT-12-2018-2020 - Big Data technologies and extreme-scale analytics
Start date	1/1/2019
Duration	3.25 years
Website	https://www.infore-project.eu/

At an increasing rate, industrial and scientific institutions need to deal with massive data flows streaming in from a multitude of sources. For instance, maritime surveillance applications combine high-velocity data streams, including vessel position signals emitted from hundreds of thousands of vessels across the world and acoustic signals of autonomous, unmanned vessels; in the financial domain, stock price forecasting and portfolio management rely on stock tick data combined with real-time information sources on various pricing indicators; at the fight against cancer, complex simulations of multi-cellular systems are used, producing extreme-scale data streams in an effort to predict the effects of drug synergies on cancer cells. In these applications, the data volumes are expected to dramatically grow in the future. Processing this data often requires not only using an HPC infrastructure, but also having data scientists, who are typically not expert programmers, program complex workflows, with a vast number of parameters to tune through time-consuming repeated programming and testing. INFORE will address these challenges and pave the way for real-time, interactive extreme-scale analytics and forecasting. The ability to forecast, as early as possible, a good

approximation to the outcome of a time-consuming and resource-demanding computational task allows to quickly identify undesired outcomes and save valuable amount of time, effort and computational resources, which would otherwise be spent in vain. Consider, for example, the ability to forecast the outcome of a complex multi-cellular system simulation for tumor evolution, without the need to wait for the simulation to be completed. INFORE will also design and develop a flexible, pluggable, distributed software architecture that is programmable and set up by graphical data processing workflows. The INFORE prototype will be tested on massive real-world data from the life sciences, financial and maritime domains.



Lawful evidence collecting and continuity platform development (LOCARD)

Project manager	Constantinos Patsakis
Coordinator	Athena Research Center
IMIS - funding	700.000
Programme	SU-FCT02
Start date	1/5/2019
Duration	36 months
Website	https://locard.eu/

Digital evidence is currently an integral part of criminal investigations, and not confined to pure cybercrime cases. Criminal behaviours like financial frauds, intellectual property theft, industrial espionage, and terrorist networks leverage the Internet and cyberspace. The very ubiquity of digital devices, e.g. smartphones, in modern society makes digital evidence extremely relevant for investigations about all kinds of criminal behaviour like murder, contraband activities, and people smuggling, to name a few. Due to its nature, the use of digital evidence in a court of law has always been challenging. It is critical that it should be accompanied by a proper chain of custody, guaranteeing its source and integrity. LOCARD aims to provide a holistic platform for chain of custody assurance along the forensic workflow, a trusted distributed platform allowing the storage of digital evidence metadata in a blockchain. Each node of LOCARD will be able to independently set its own permission policies and to selectively

share access to digital evidence with other nodes when deemed necessary and upon proper authorization through fine-grained policies. LOCARD's modularity will also allow diverse actors to tailor the platform to their specific needs and role in the digital forensic workflow, from preparation and readiness, to collection, to analysis and reporting. LOCARD will have a crowdsourcing module to collect citizen reports of selected violations, a crawler to detect and correlate online deviant behaviour, and a toolkit for investigators that will assist them in collecting online and offline evidence. This will be powered by an immutable storage and an identity management system that will protect privacy and handle access to evidence data using a Trusted Execution Environment. Blockchain technology will not only guarantee that information about the evidence cannot be tampered with, but allow interoperability without the need for a trusted third party.



GRACIOUS - Grouping, Read-Across, Characterisation and classification framework for regulatory risk assessment of manufactured nanomaterials and Safer design of nano-enabled products

Project manager	Georgia Tsiliki
Coordinator	Heriot-Watt University
IMIS - funding	124 037.5 Euros
Programme	H2020-NMBP-2017-two-stage
Start date	1/1/2018
Duration	3.5 years
Website	https://www.h2020gracious.eu

The GRACIOUS project will develop a highly innovative science-based framework that supports the assessment of risk posed by the ever increasing array of nanomaterials on the market and under development. The framework will streamline the process for assessing their risk by logically grouping nanomaterials thereby allowing extrapolation between (read-across) nanomaterials and reducing the need to assess exposure to and toxicity on a case by case basis. The project will work continuously with stakeholders in an iterative cycle of design, testing and refinement to ensure that the Framework effectively meets the needs of both regulators and industry. Application of the Framework will allow movement away from the case-by-case risk assessment paradigm, thereby improving the efficiency of risk analysis and decision making for safer design of quality

nano-enabled products.



NEP4DISSENT – New Exploratory Phase in Research on East European Cultures of Dissent. European Cooperation in Science and Technology

Project coordinator	Costis Dallas
Coordinator	Polish Academy of Sciences (PL)
IMSI - funding	About 50,000 euros (The funding of COST actions is adjusted yearly)
Programme	Open Call Collection OC-2016-2
Start date	16/10/2017
Duration	4 years
Website	http://www.cost.eu/COST_Actions/ca/CA16213

Resistance and dissent in former socialist Europe 1945-1989 constitutes a remarkable chapter of Europe's recent past, which not only informs in a decisive way the identities of post-socialist societies, but has also reshaped the continent as a whole and still provides an important reference for contemporary social movements worldwide. The proposers of this Action believe that, after a period of growth and consolidation, this field of study and the respective domain of cultural heritage have stalled and fell short of its true significance. This state of affairs results from (1) the inheritance of Cold War-era conceptual distinctions, (2) confinement of research within national silos and (3) neglecting the problem of access to original archival sources for digitally enabled research due to both their heterogeneity and uneven investment in research infrastructures.



Novel EOSC Services for Emerging Atmosphere, Underwater & Space Challenges (NEANIAS)

Project manager	George Papastefanatos
Coordinator	National Kapodistrian University of Athens

IMIS - funding	470.625 Euros
Programme	H2020-EU.1.4.1.3
Start date	01/11/2019
Duration	3 years
Website	https://www.neanias.eu/

NEANIAS is an ambitious project that comprehensively addresses the 'Prototyping New Innovative Services' challenge set out in the recent 'Roadmap for EOSC' foreseen actions. NEANIAS will drive the co-design, delivery, and integration into EOSC of innovative thematic services, derived from state-of-the-art research assets and practices in three major sectors: underwater research, atmospheric research and space research. Each of these sectors engages a diverse set of research and business groups, practices, and technologies. Each thematic service will not only address its community-specific needs but will also enable the transition of the respective community to the EOSC concept and Open Science principles. In doing so, NEANIAS provides its communities with plentiful resource access, collaboration instruments, and interdisciplinary research mechanisms, which will amplify and broaden each community's research and knowledge generation activities. From a technological perspective, NEANIAS will deliver a rich set of services that are designed to be flexible and extensible; they will be able to accommodate the needs of communities beyond their original definition and to adapt to neighboring cases, fostering reproducibility and re-usability. From a sustainability perspective, NEANIAS identifies promising, cutting-edge business cases across several user communities and lays out several concrete exploitation opportunities.



Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport

Project coordinator	George Papastefanatos
Coordinator	University of Greenwich
IMSI - funding	-
Programme	COST ACTION
Start date	23/7/2017
Duration	4 years
Website	https://wise-act.eu/

Autonomous vehicle (AV) trials are currently taking place worldwide and Europe has a key role in the development of relevant technology. Yet, very limited research exists regarding the wider implications of the deployment of such vehicles on existing road infrastructure, since it is unclear if and when the transition period will start and conclude. It is anticipated that improved accessibility and road safety will constitute the primary benefits of the widespread use of AVs, whilst co-benefits may also include reduced energy consumption, improved air quality or better use of urban space. Therefore, the focus of this COST Action is on observed and anticipated future mobility trends and implications on travel behaviour, namely car sharing, travel time use or residential location choice to name a few. Other important issues to be explored under different deployment scenarios are social, ethical, institutional and business impacts. To achieve this, it is essential to culminate co-operation between a wide range of stakeholders at a local, national and international level, including academics and practitioners. Consequently, this COST Action will facilitate collaboration within Europe and beyond about this emerging topic of global interest.



ELIXIR CONTAINERS - Deploying Reproducible Containers and Workflows Across Cloud Environments

Project manager	Thanasis Vergoulis
Coordinator	EMBL
IMIS - funding	€ 3,231.25
Programme	Strategic Implementation Study (ELIXIR Commissioned Services)
Start date	24/10/2019
Duration	17 months
Website	https://www.imsi.athenarc.gr/en/projects/project/66

The project will realize a study to convene and establish a consensus on high-level community-driven standards for deploying reproducible containers and workflows across cloud environments.



ELIXIR-CONVERGE: Development and long-term sustainability of new pan-European research infrastructures

Project manager	Thanasis Vergoulis
Coordinator	EMBL
IMIS - funding	€ 50,047.50
Programme	H2020-INFRADEV-2018-2020 (RIA)
Start date	1/2/2020
Duration	43 months
Website	https://elixir-europe.org/about-us/how-funded/eu-projects/converge

ELIXIR-CONVERGE is a project funded by the European Commission to help standardise life science data management across Europe. To achieve this standardisation, the project will develop a data management toolkit for life scientists. The toolkit will help ensure more research data is in the public domain, which will give scientists access to more data. This will allow them to discover new insights into the challenges facing society, such as food security and health in old age, and help stimulate innovation in biomedicine and biotechnology.



Deep Demonstrations for Zero-Net Emissions in the port of Piraeus – Frame Phase (EIT Climate-KIC)

Project manager	Phoebe Koundouri
Coordinator	Athena Research And Innovation Center In Information, Communication And Knowledge Technologies
IMIS - funding	€ 111,250.00 (co-funded)
Programme	European Institute of Innovation & Technology (EIT)
Start date	03/2020 (End Date 12/2020)

Duration 9 months

Website

<https://www.athenarc.gr/el/institoyto-pliroforiakon-systimaton/projects/deep-demonstrations-zero-net-emissions-port-piraeus>

In 2019 we have set solid foundation by looking at the current state-of-play through a deep understanding of the specificities of the Port of Piraeus -maritime system. This initial step allows us, in a co-design process with the port, to develop a systemic future vision and a transition pathway, setting up the base for the FRAME phase. In 2020 we will finalize this work by reinforcing the roadmap co-created with the port, and continue to define the field of innovation action needed to reach the port's vision. We will look for instance at innovations and alternative solutions related to mobility, and in the field of alternative sources of energy and reduction of energy consumption. At the same time the iterative, participative approach taken by this project will allow us, throughout a process of constant building of understanding (involvement of the relevant stakeholders at each steps of the process to provide regular feedback), to explore alternative fields of innovations which might be better suited to ultimately reach the port's vision. These steps will allow us in the following years to develop an experiment portfolio, supported by EIT Climate-KIC network, for our prioritized areas to test impactful solutions, support mutual learning and communicate our work to a wider audience, with the aim to replicate similar transformation globally.

MEDFreeSUP



Single-use plastic free systemic local applications along the Mediterranean east coast, path for a common set of protocols through experiments in Italy, Croatia and Greece (EIT Climate-KIC)

Project manager Phoebe Koundouri

Coordinator Alma Mater Studiorum - Università di Bologna

IMIS - funding € 86,250.00


Programme European Institute of Innovation & Technology (EIT)

Start date 03/2020 (End Date: 12/2021)

Duration 9 months

Website <https://www.athenarc.gr/el/medfreesup-single-use-plastic-free-systemic-local-applications-along-mediterranean-east-coast-path>

The objective of the project is to set replicable protocols voluntary for free single-use plastics food packaging adoption enforced at the city level, for several types of foodservice operators (FO) (cafes, restaurants, foods stores, hotel, beach facilities). The project will provide FO with an inventory of innovative solutions based at environmental and financial levels. FO and cities will promote the protocol and innovation solutions adopted through a platform to engage consumers in proactive behaviours contributing to the solutions replication.



X-KIC Activities

Cross-KIC Water Scarcity Activities (EIT Climate-KIC)

Project manager Phoebe Koundouri

Coordinator Athena Research And Innovation Center In Information, Communication And Knowledge Technologies

IMIS - funding € 25,187.00

Programme European Institute of Innovation & Technology (EIT)

Start date 01/2020 (End Date 12/2020)

Duration 12 months

Website <https://www.athenarc.gr/en/athena-rc-information-management-systems-institute/projects/cross-kic-water-scarcity-activities-eit>

The main overall objective of EU water policy is ensuring access to good quality water, sufficient quantity for all Europeans, and ensuring the good status of all water bodies across Europe. Good-quality water supply is a prerequisite for economic and social progress, especially in RIS regions targeted, which are at the same time some of the main affected ones. As for that, water scarcity has been

identified as a common issue to tackle for the four participating KICS, being a fundamental topic for the whole southern region development but still being weakly integrated in the current activities, establishing a clear opportunity for collaboration. This Cross-KIC RIS project, led by EIT Food, and involving Climate-KIC, EIT Manufacturing and Raw Materials will enable the involved KICs to work together and with external relevant actors across RIS countries to build a stronger framework to tackle water scarcity in innovation, education and policy in Southern Europe region.



Circular Learning Hub (CL-hub):

A learning hub for the engagement and ecosystem transition towards circular thinking (phase2) (EIT Climate-KIC)

Project manager	Phoebe Koundouri
Coordinator	Università Politecnica Delle Marche
IMIS - funding	€ 55,675.00
Programme	European Institute of Innovation & Technology (EIT)
Start date	01/2020 (End date 12/2020)
Duration	12 months
Website	https://www.athenarc.gr/el/institoyto-pliroforiakon-systimaton/projects/circular-learning-hub-learning-hub-engagement-and

This project works on an awareness-intention-action path fostering problem-owners in the ecosystem to a deeper understanding of circular thinking. On the basis of a debiasing experiment, the co-creation of innovative learning and nudging initiatives on circular thinking and investing will be carried out in 2020.



CE Beacons

Western Balkan Circular and Climate Innovation Beacons (EIT Climate-KIC)

Project manager	Phoebe Koundouri
Coordinator	Privredna komora Srbije, Chamber of Commerce and Industry of Serbia
IMIS - funding	€ 26,446.00
Programme	European Institute of Innovation & Technology (EIT)
Start date	01/2020 (End date:12/2020)
Duration	12 months
Website	https://circular-beacons.net/

The aim of this project is to establish centers (Beacons) that will trigger circular innovation and implementation in business and supply chain management. Beacons will launch novel circular economy services for small and medium size enterprises. The main goal is to create unique eco-system that would support innovative thinking and circular economy implementation. Additionally, the idea is to organize spaces for innovation display, testing, boosted implementation and commercialization.



SysMa 4 Transition

System Mapping as a Service for post-COVID Regional Transition (EIT Climate-KIC)

Project manager	Phoebe Koundouri
Coordinator	Cleantech Bulgaria Ltd
IMIS - funding	€ 18,000.00
Programme	European Institute of Innovation & Technology (EIT)

Start date	01/2020 (End date:12/2020)
Duration	12 months
Website	https://www.athenarc.gr/en/information-management-systems-institute/projects/system-mapping-service-post-covid-regional

SysMa 4 Transition - System Mapping as a Service for post-COVID Regional Transition EIT Climate-KIC funded project: activates communities spread across 10 most vulnerable countries in Southern Europe in the recovery phase to set system mapping as a strategic knowledge intensive service, aimed to provide new indicators and understanding of system and, thereby, supporting local authorities in the needed post-COVID 19 transition and related strategic planning challenges. Through orchestrated co- creations process, a diverse cohort of partners and non-traditional partners from private bodies and civil society, will work with stakeholders & decision makers to generate practice-based knowledge and strategies.

National R&D Projects



Project manager	Theodore Dalamagas
Coordinator	IMSI
IMIS - funding	250,000 euros
Programme	RESEARCH - CREATE - INNOVATE, Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020
Start date	6/2020
Duration	30 months
Website	https://i4metal.gr

The i4metal project will design and develop innovative ICT tools for organizing, processing and analyzing the data being collected during the operation of scrap processing facilities. Scrap (recyclable materials left over from product

manufacturing and consumption, such as parts of vehicles, building supplies, and surplus materials) are an important source of secondary raw materials, with a key role in successfully transitioning to Circular Economy. These ICT tools, developed by the i4metal project, will support the creation of a data value chain in the scrap processing cycle to: (a) improve quality control of these materials; (b) increase accuracy standardization of scrap on the basis of their qualitative characteristics; (c) identifying and limiting cases of malicious practices; (d) optimizing the operation of scrap valorization processes; and (e) distributing open data regarding the collected scrap and the extracted secondary raw materials.

URBANA

URBANA - Innovative Data Science Technologies for Scrap Valorization

Project manager	Theodore Dalamagas
Coordinator	IMSI
IMIS - funding	143,000 euros
Programme	RESEARCH - CREATE - INNOVATE, Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020
Start date	5/2020
Duration	30 months
Website	http://www.imsi.athenarc.gr/en/projects/project/69

In recent decades, the population percentage in most of the developed EU countries has been rising constantly, which has a negative impact both on the natural and productive resources of the urban centers and large provincial cities. As a consequence, the failure of the aforementioned to effectively respond to the demographic reality affects not only the urban landscape quality but also the environment in general, as the management of urban waste and sewage disposal is becoming increasingly difficult and the quality of air and water resources is constantly deteriorating and on the other hand the development of the economy, as insufficient employment opportunities can be created, especially for disadvantaged groups. The proposed project (URBANA) will create a technologically innovative platform to build a bridge of knowledge exchange between Agricultural Advisors and Urban Cultivators, fostering social innovation and collective awareness of the sustainability of cities. In particular, through URBANA, users will be able to present small-scale urban cultivation as well as other activities that they have implemented or implement on urban agriculture in the form of Do It Yourself (DIY) projects, while at the same time they will be able

to make use of information and advice collected from crowdsourcing, IoT and social networks.



VR-Park: Augmented reality platform for urban parks

Project manager	Yannis Stavrakas
Coordinator	H.A.O. "Demeter"
IMSI - funding	204,000 euros
Programme	RESEARCH - CREATE - INNOVATE, Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020
Start date	9/2018
Duration	30 months
Website	https://vr-park.org/

Urban parks and open green areas are important attractions of environmental interest to city residents and visitors. Careful and well-targeted promotion of these areas, not only enhances the importance of their existence in the urban space, but at the same time can assist in the development of alternative forms of "green tourism", and towards the direction of environmental awareness among citizens, which is particularly important nowadays and crucial for the future of the planet. New technologies are a key tool in enhancing the experience of touring urban parks, as they can make the tour much more attractive, highlighting interesting information about the flora and fauna of the park, as well as various other points of interest. At the same time, they can help guide the visitor inside relatively large parks, and easily identify his/her paths, thus highlighting areas of the park that would otherwise be neglected. They can also assist park managers in organizing events, thus solving one of the key operating problems mainly of large-scale urban parks, which is the failure to exploit their entire site due to reduced or problematic accessibility. This project will build an integrated system that comprises an augmented reality mobile application for visitors of urban parks, and a corresponding park management web application for the managers of such park. Through the mobile app, an attractive, interactive touring environment will be created which will highlight the environmental and historical interest of those sites. At the same time, the web application will receive multimedia data from the users and will automatically collect anonymous data that may be useful to park managers to improve the visitors' touring experience and to better highlight the

advantages of visiting such parks.



CLIMPACT – Flagship Initiative for Climate Change

Project coordinator	Alkis Simitsis
Coordinator	National Observatory of Athens
IMSI - funding	-
Programme	GSRT project
Start date	2019
Duration	3 years
Website	-

The initiative brings together a National Network of 11 scientific organizations to study and analyze at scale scientific indicators and measures related to Climate Change, aiming at generating innovative scientific tools, methods, and technology to mitigate the results of the Climate Change. The Athena RC leads the design and development of the first National Repository for the Climate Change.



Design and Development of the YouWeP platform

Project manager	George Papastefanatos
Coordinator	IMSI - Athena RC
IMIS - funding	24,800 euros
Programme	Contract
Start date	29/06/2018
Duration	2 years
Website	http://www.socioscope.gr/ , http://www.youwho.gr

Following a long-standing collaboration between IMSI-ATHENA R.C and the National Centre for Social Research (EKKE) the project aims at extending and providing new features to the Socioscope platform, a data platform developed by IMSI and used for hosting and visualizing data collected from social surveys by the National Centre for Social Research (EKKE).

Moreover, the project will implement the YouWeP platform, which will be a web platform for social and political scientists to conduct online surveys and visualize the results in interactive ways. The platform will offer new novel ways of conducting surveys based on chat-based questionnaires for interacting with users and getting their feedback. The platform will be evaluated during the implementation of a large-scale online survey for the identification of trends and behaviors in young people aged 18-29 years old.



Visual Facts - Democratizing Visual Analytics, A Self-Service Platform for Big Data Exploration

Project manager	George Papastefanatos
Coordinator	IMSI - Athena RC
IMIS - funding	172,000 euros
Programme	1st Call for Postdoc Research Projects - Hellenic Foundation for Research and Innovation (ELIDEK)
Start date	16/10/2018
Duration	3 years
Website	https://visualfacts.imsi.athenarc.gr/

Self-service visual analytics is a new paradigm, widely promoted in modern corporate environments, in which business users are enabled and encouraged to directly manipulate (explore, blend, analyze) underlying data in rich visual ways, in order to derive insights from business information as quickly and efficiently as possible. Allowing less tech-savvy end users to make decisions based on their own queries and analyses, frees up the organization's business intelligence and information technology (IT) teams from the tedious work of data preparation.

The aim of VisualFacts is to develop a scalable platform for providing self-service visual analytic capabilities to a wide range of corporate and non-corporate users to access, explore, analyze open and privately-held data and collaborate on the analytic results of their work by sharing, annotating and reusing them in the form of visual facts.



LinkGeoML: Automatic and accurate interlinking of geospatial data using machine learning

Project manager	Giorgos Giannopoulos
Coordinator	IMSI
IMIS - funding	199.300,00 Euros
Programme	Competitiveness, Entrepreneurship, Innovation - ESPA 2014-2020 – Research, Create, Innovate – II. Partnerships between Enterprises and Research Organizations
Start date	9/7/2018
Duration	2 years
Website	https://linkgeoml.gr/

The automatic and accurate interlinking of geospatial data poses an important scientific challenge, with direct application in several business fields. The major requirement is achieving high accuracy in identifying similar entities within datasets. For example, in a cadastral database, it is crucial that the land parcels, that were gathered from several different databases, are uniquely and clearly identified. In another example, for a geo-marketing company, it is of high importance to be able to accurately cross-reference the location/addresses of customers and companies, so that they are properly targeted. LinkGeoML aims at researching, developing and extending machine learning methods, utilizing the vast amount of available, open geospatial data, in order to implement automated and highly accurate algorithms for interlinking geospatial entities. The proposed methods will implement novel training features, based on domain knowledge and on the analysis of open and proprietary geospatial datasets. Further, they will extend and specialize machine learning models on classification and similarity learning. The implemented technologies will be published as open source software and, also, will be integrated into existing, commercial applications for cadastration, geocoding and geomarketing, aiming at improving their functionality and increasing their commercial value and application domains. LinkGeoML comprizes a partnership between enterprises and research organizations, aiming to perform high quality, industrial research with a twofold purpose: Provide SMEs with useful geospatial data integration tools to solve real-world problems, and advance the state of the art on machine learning methods for geospatial data integration. To achieve these purposes, LinkGeoML identifies use cases based on real-world integration problems, elicited by its two industrial partners, and researches how machine learning-based, interlinking methods can be applied to these use cases and facilitate their handling, in real-world data. Check out our

initially prescribed use cases, as well as our first results.



Big Data in Monitoring and Analyzing Sea Area Traffic: innovative ICT and analysis models

Project manager	Theodore Dalamagas
Coordinator	IMSI
IMIS - funding	150,000 euros
Programme	RESEARCH - CREATE - INNOVATE, Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020
Start date	7/2018
Duration	30 months
Website	https://www.imsi.athenarc.gr/el/projects/project/59

The project will design and develop an innovative ICT platform for the collection and analysis of big traffic data, spatial data, environmental data and meteorological data, to support sea area monitoring and observation. The vision is to provide effective and efficient data integration, processing and analysis technologies with the aim to deliver (a) a "Combined Real-time Operational Snapshot", and (b) a "Combined Historical Snapshot" of sea areas. The project will exploit state-of-the-art IT, and design and develop innovative IT based on in-memory database algorithms, models and methods for parallel computation, and methods for big data analytics.



ELIXIR-GR - Information Infrastructure for the Life Sciences

Project manager	Theodore Dalamagas (Deputy: Stelios Sartzetakis)
Coordinator	Biomedical Science Research Center Alexander Fleming
IMSI - funding	92,600 euros
Programme	National Roadmap for Research Infrastructures
Start date	9/2017

Duration 3 years

Website <http://www.elixir-greece.org>

ELIXIR (<http://www.elixir-europe.org/>) is one of the ESFRI's pan-European research infrastructures (RIs) with key importance for the research and innovation in the life sciences. The aim of ELIXIR is to provide the facilities necessary for Europe's life scientists to manage and safeguard the massive amounts of data being generated every day by publicly funded research. Greece has recently joined ELIXIR, which has already entered its construction phase. ELIXIR operates a distributed research infrastructure based on ELIXIR nodes (at national level) which are connected to the ELIXIR Hub in order to provide infrastructure for data, tools, standards and training, as well as support for other ESFRI biological and medical science infrastructures. BSRC A. Fleming is joining forces with Athena RC and GRNET to lead the construction of the Greek component, ELIXIR-EL. Setting up ELIXIR- EL will be a dynamic process, taking into account user needs, available tools and datasets and technological advancements. The RI will be designed and setup using GRNET's Okeanos cloud IaaS service (<http://okeanos.grnet.gr/>) and ViMa service (<http://vima.grnet.gr>). The proposed RI aims to develop ELIXIR-EL RIs at the following levels: computing resources, data-intensive programming components, data resources, and tools.



MEDA 2: Moving from Big Data Management to Data Science

Project manager Theodore Dalamagas

Coordinator IMSI

IMSI - funding 800,000 euros

Programme National Roadmap for Research Infrastructures

Start date 9/2017

Duration 3 years

Website <http://web.imsi.athenarc.gr/projects/meda.2>

The Information Management Systems Institute (IMSI) has already established a strong technical and scientific background on big data technologies. IMSI has recently completed MEDA, a national funded R&D project focusing on the efficient management of big data, in three important data categories: operational, scientific and social data. The project comprised a significant development action for IMSI, offering added value to existing research results and delivering novel

algorithms, models and prototype tools for managing big data. MEDA.2 makes a step ahead towards data science, exploiting S&T results from MEDA. The objectives of MEDA.2 are: (a) study and experiment with data science tools and technologies, (b) setting up a data science infrastructure (tools and data collections), (c) delve into pilot cases relevant to national RIS3 smart specialization requirements, and identify related data science problems to deal with (d) design and develop innovative technologies and data services to deal with problems in (c).



APOLLONIS

**Greek Infrastructure for Digital Arts, Humanities and
Language Research and Innovation**

Project coordinator	Panos Constantopoulos
Coordinator	IMSI
IMSI - funding	615,500 euros
Programme	ESPA
Start date	1/11/2017
Duration	3 years
Website	https://apollonis-infrastructure.gr/ https://services.apollonis-infrastructure.gr/

APOLLONIS is the Greek Infrastructure for Digital Arts, Humanities and Language Research and Innovation, recently formed by the union of two existing ESFRI-related national research infrastructures: clarin:el, the CLARIN-related Greek network for language resources, technologies and services; and DARIAH-GR/DYAS, the DARIAH-related Greek network for digital research in the Humanities. The development of the APOLLONIS infrastructure advances the existing clarin:el and DARIAH-GR/DYAS services within a common framework that will ensure interoperability and reach to broader user communities, as well as promoting open science principles. Clarin:el will provide a permanent, stable infrastructure for accessing language resources and language processing web services, will support all kinds of language-related activities (regardless of subject), and collaborative workspace for application development environment. DARIAH-GR/DYAS will provide access to curated digital resources and services for the development, analysis and visualization of data, best practice guidelines, and

dissemination and training activities on the use of digital methods and tools in the Humanities. A Digital Humanities Observatory will monitor the penetration of digital practices in the Humanities.



eLib GGDE - eLib of Independent Authority for Public Revenue

Project coordinator	George Papastefanatos
Coordinator	Remaco S.A.
IMSI - funding	61,200 euros
Programme	NSRF - Public Tender
Start date	30/7/2015
Duration	7 years (ongoing)
Website	http://www.publicrevenue.gr/elib/

The project eLib aims at developing a digital library for the Independent Authority of Public Revenue (I. A.P.R). eLib analyzes and provides information to public servants and citizens on the legislation concerning the areas of IAPR competence (taxation, public revenues, etc). Legal documents are automatically harvested from institutional sources (National Printing Office, Di@ygeia), their content and metadata are extracted, semantically analyzed and structured according to the AKOMA NTOSO, and ELI) specifications. Moreover, content is indexed for full-text search, browsing and faceted filtering. Users can search and navigate the legal content and create personal collections with references to whole documents or parts of them.



«Προσεγγιστικοί γεωμετρικοί αλγόριθμοι και συσταδοποίηση με εφαρμογές στα χρηματοοικονομικά»

Project manager	Ioannis Z. Emiris
Coordinator	IMIS

IMIS - funding	41,041 euros
Programme	Υποστήριξη ερευνητών με έμφαση στους νέους ερευνητές – κύκλος B
Start date	01-03-2020
Duration	16 Months

Website

Αντικείμενο της δράσης είναι η υλοποίηση της ερευνητικής πρότασης «Προσεγγιστικοί γεωμετρικοί αλγόριθμοι και συσταδοποίηση με εφαρμογές στα χρηματοοικονομικά». Στόχος της παρέμβασης είναι η ενίσχυση του ακαδημαϊκού βιογραφικού των ερευνητών και των ερευνητικών δεξιοτήτων τους, προκειμένου να βελτιωθούν οι προοπτικές ακαδημαϊκής / ερευνητικής καριέρας τους.

Other Projects



Europeana DSI-4

Project coordinator	Dimitris Gavrilis
Coordinator	STICHTING EUROPEANA(EF)
IMSI - funding	97,372 euros
Programme	Service Contract-“Deployment and Maintenance of Europeana DSI Core Services-SMART-2017/1136”
Start date	1/9/2018
Duration	24 months
Website	https://pro.europeana.eu/project/europeana-dsi-4

The Europeana DSI-4 project builds on and continues operation of the existing Europeana Digital Service Infrastructure’s (DSI) Core Service Platform (CSP) following on from the Europeana DSI-1, DSI-2 and DSI-3 actions under CEF. It is the fourth project for the completion of Europeana’s strategy 2015-2020. It is in line with the Connecting Europe Facility (CEF) Trans-European Telecommunications Network’s work programme for 2015, delivering interoperability, connectivity and coordination for digital cultural heritage at a European level and providing efficient solutions for access and distribution of multilingual and multi-domain resources in digital European cultural heritage. IMSI participates in DSI-4 both as a technical partner with the MORE platform

(supporting the CARARE network as part of DSI) and also through European Research.



Digital Curation Services

Project coordinator Panos Constantopoulos

Coordinator IMSI

IMSI - funding 48,786 euros

Programme Internal project

Start date 1/2/2016

Duration 4 years

Website <http://www.dcu.gr/en/υπηρεσίες-ψηφιακής-επιμέλειας/>

The internal project Digital Curation Services supports the advancement of research and development efforts in the research directions and work programme of IMSI by using chiefly funds remaining from the execution of service provision projects. In view of parallel externally funded projects, this project on one hand ensures the continuity of our work programme, while on the other it enables actions of topical interest for which external funds may be insufficient at the time. It also allows better integrating and employing results of completed projects in sustained and new digital curation services, thus supporting the capitalization of those results.

Industry – Funded R&D Projects



Design and Development of big data solution and methods for stream analytics on network data

Project manager George Papastefanatos

Coordinator Intracom Telecom S.A.

IMIS - funding	509,000 euros
Programme	Contract
Start date	16/10/2017
Duration	52 months (ongoing)
Website	=

A new collaboration between **IMSI, Intracom Telecom and Ericsson** started in *October 2017*. IMSI has been contracted to design and develop a big data solution and methods for stream analytics on network data coming from IoT devices. The solution is based on well-established big data and cloud platforms, i.e., Microsoft Azure, Cloudera Ecosystem and SPARK streaming and enables the collection of vast amount of network measurement streams from connected devices, their scalable processing, analysis and storage and the visualization of several KPIs.



Design and Development of Ericsson Device EcoSystem

Project manager	George Papastefanatos
Coordinator	Intracom Telecom S.A.
IMIS - funding	44,888 euros
Programme	Contract
Start date	20/12/2019
Duration	7 months
Website	=

The project concerns the provision of design and development services for Ericsson Device EcoSystem, a digital marketplace for collecting compliance specifications of IoT devices and manufacturers with international standards.



GeCoInt – Geometric Computation for the design of Integrated Circuit

Project manager	Ioannis Z. Emiris
Coordinator	IMIS
IMIS - funding	21,000 euros
Programme	ANSYS S.A.
Start date	01-01-2020
Duration	6 Months

Website

A joint project between Athena RC and ANSYS Hellas, that is focused on: spatial indexing data structures for facilitating region queries in the context of random walk-based capacitance extraction, enhancement, and extension of the solutions for optimal insertion order into the spatial index and lastly, evaluation of data-driven data structure for MEC queries.

Our 5 collaborators (Master students, PhD candidates and Post-Docs) shall benefit from both top-notch research as well as a strong innovation component through a nexus of intersectoral secondments and the interaction with the highly qualified ANSYS Hellas R&D personnel.



Publications

Books

- Laura Po, Nikos Bikakis, Federico Desimoni and George Papastefanatos. **Linked Data Visualization**. Series in Synthesis Lectures on the Semantic Web, In Morgan & Claypool Publishers, **2020**. (ISBN: 9781681737256 (softcover) | 9781681737263 (ebook) ISBN: 9781681737270 (hardcover), DOI: 10.2200/S00967ED1V01Y201911WBE019, <http://www.linkeddatavisualization.com/>

Book chapters

- Christos Katrakazas, Athanasios Theofilatos, George Papastefanatos, Jerome Härrri, Costas Antoniou. **Cyber security and its impact on Connected Autonomous Vehicles safety: State-of-the-art, policy needs and challenges**. Book Chapter in Volume “Policy Implications of Autonomous Vehicles”, Elsevier, Advances in Transport Policy and Planning, Volume 5, Pages 73-94, **2020**
- A. Katifori, F. Tsitou, M. Pichou, V. Kourtis, E. Papoulas, Y. Ioannidis, M. Roussou: “Exploring the potential of visually-rich animated digital storytelling for cultural heritage”, Visual Computing for Cultural Heritage, Springer Nature, 2020, pp. 325-345.
- Lorna Hughes, Agiatis Benardou and Ann Gow: **English language and digital cultural heritage**. In Adolphs, S. and Knight, D. (eds.) The Routledge Handbook of English Language and Digital Humanities. Routledge: London (2020).
- Agiatis Benardou: **The Digital Community Archives**. In Varvarousis, A. (ed) The Uncommon Planner: To Whom Does Athens Belong? Athens. Onassis Foundation Publications (2020).

Journal Publications

- N. Giatrakos, E. Alevizos, A. Artikis, A. Deligiannakis, M. Garofalakis: Complex Event Recognition in the Big Data Era: A Survey. VLDB Journal, Volume 29, Issue 1, Pages 313-352, 2020.
- I. Flouris, N. Giatrakos, A. Deligiannakis, M. Garofalakis: Network-wide complex event processing over geographically distributed data sources. Information Systems 88 (2020).
- N. Giatrakos, A. Deligiannakis, M.N. Garofalakis, Y. Kotidis: Omnibus Outlier Detection in Sensor Networks using Windowed Locality Sensitive Hashing. Future Generation Computer Systems 110: 587-609 (2020).



- George Papadakis, Dimitrios Skoutas, Emmanouil Thanos, Themis Palpanas: Blocking and Filtering Techniques for Entity Resolution: A Survey. ACM Comput. Surv. 53(2): 31:1-31:42 (2020)
- Evangelos Bartzos, Ioannis Z. Emiris, Josef Schicho. On the multihomogeneous Bézout bound on the number of embeddings of minimally rigid graphs. Appl. Algebra Eng. Commun. Comput. 31(5-6): 325-357 (2020), <https://doi.org/10.1007/s00200-020-00447-7>
- Zeta Avarikioti, Ioannis Z. Emiris, Loukas Kavouras, Ioannis Psarros. High-Dimensional Approximate r-Nets. Algorithmica 82(6): 1675-1702 (2020), <https://doi.org/10.1007/s00453-019-00664-8>
- Ioannis Z. Emiris, Bernard Mourrain, Elias P. Tsigaridas. Separation bounds for polynomial systems. J. Symb. Comput. 101: 128-151 (2020), <https://doi.org/10.1016/j.jsc.2019.07.001>
- Ioannis Z. Emiris, Ioannis Psarros. Products of Euclidean Metrics, Applied to Proximity Problems among Curves: Unified Treatment of Discrete Fréchet and Dynamic Time Warping Distances. ACM Trans. Spatial Algorithms Syst. 6(4): 27:1-27:20 (2020), <https://doi.org/10.1145/3397518>
- Giorgos Alexiou, Marios Meimaris, George Papastefanatos, Ioannis Anagnostopoulos: **LinkZoo: A Collaborative Resource Management Tool Based on Linked Data**. In International Journal on Semantic Web and Information Systems (IJSWIS) Volume 16, Issue 3, 1-19 (2020).
- George Papastefanatos et. al.: **Sun4Patients Web Platform: Facilitating Long-Term Monitoring of Stroke Patients**. In Studies in Health Technology and Informatics (IOS Press), 01 Jun 2020, 272:411-412 DOI: 10.3233/shti200582 (2020)
- Konstantinos P. Ferentinos, Yannis Stavrakas, Harry Nakos, Kostis Pristouris, and Myrto S. Barda. Initial Design and Features of an Augmented Reality System for Urban Park Touring and Management. Presented in 12th International Conference on Computer Science and Information Technology (ICCSIT 2019), Barcelona, December 18-20, 2019. Published in International Journal of Computer Theory and Engineering (IJCTE, ISSN: 1793-8201), Vol. 12, Num. 5, Oct 2020
- O. Konstantakopoulou et al.: **Patients' Experiences Database After Hospital Discharge**: Another Step in Improving Stroke Care. In Studies in Health Technology and Informatics (IOS Press), 01 Jun 2020, 272:441-444, DOI: 10.3233/shti200590 (2020)
- Aarestrup et al. : "Towards a European health research and innovation cloud (HRIC)", Genome Medicine, Vol. 12, No. 1, pp. 1-14, December 2020.
- M. Vayanou, O. Sidiropoulou, G. Loumos, A. Kargas, Y. Ioannidis: "Investigating the Artist's Role in Social Group Games." EAI Endorsed Trans. Creative Technol., Vol. 6, No. 21, October 2020.
- A. Katifori, S. Perry, M. Vayanou, A. Antoniou, I. Ioannidis, S. McKinney, A. Chrysanthi, Y. Ioannidis: ""Let Them Talk!": Exploring Guided Group Interaction in Digital Storytelling Experiences". ACM Journal on Computing and Cultural Heritage, Vol. 13, No. 3, August 2020.

- Dr Stella Tsani, Professor Phoebe Koundouri, Dr Ebun Akinsete, (2020). Resource management and sustainable development: A review of the European water policies in accordance with the United Nations' Sustainable Development Goals. *Environmental Science & Policy*, Volume 114, 2020, Pages 570-579, <https://doi.org/10.1016/j.envsci.2020.09.008>
- Serafeim Chatzopoulos, Kostas Patroumpas, Alexandros Zeakis, Thanasis Vergoulis, Dimitrios Skoutas: SPHINX: A System for Metapath-based Entity Exploration in Heterogeneous Information Networks. *Proc. VLDB Endow.* 13(12): 2913-2916 (2020)

International Conference / Workshop Publications

- Nikos Giatrakos, David Arnu, Theodoros Bitsakis, Antonios Deligiannakis, Minos N. Garofalakis, Ralf Klinkenberg, Aris Konidaris, Antonis Kontaxakis, Yannis Kotidis, Vasilis Samoladas, Alkis Simitsis, George Stamatakis, Fabian Temme, Mate Torok, Edwin Yaqub, Arnau Montagud, Miguel Ponce de Leon, Holger Arndt, Stefan Burkard: INforE: Interactive Cross-platform Analytics for Everyone. *CIKM 2020*: 3389-3392
- M. Kiriakidi, G. Koutrika, Y. Ioannidis. Recommendations as Graph Explorations. *RecSys 2020*.
- Theofilos Bellmpas, O. Gkini, G. Koutrika. Analysis of Database Search Systems with THOR. *ACM SIGMOD (demo paper)*.
- Antonis Kontaxakis, Nikos Giatrakos, Antonios Deligiannakis: A Synopses Data Engine for Interactive Extreme-Scale Analytics. *ACM CIKM 2020*: 2085-2088.
- Serafeim Chatzopoulos, Kostas Patroumpas, Alexandros Zeakis, Thanasis Vergoulis, Dimitrios Skoutas: SPHINX: A System for Metapath-based Entity Exploration in Heterogeneous Information Networks. *Proc. VLDB Endow.* 13(12): 2913-2916 (2020)
- Xiaoying Wu, Dimitri Theodoratos, Dimitrios Skoutas, Michael Lan: Exploring Citation Networks with Hybrid Tree Pattern Queries. *ADBIS/TPDL/EDA Workshops 2020*: 311-322
- Pantelis Chronis, Dimitrios Skoutas, Spiros Athanasiou, Spiros Skiadopoulos: Link Prediction in Bibliographic Networks. *ADBIS/TPDL/EDA Workshops 2020*: 335-340
- Hamid Shahrivari, Matthaios Olma, Odysseas Papapetrou, Dimitrios Skoutas, Anastasia Ailamaki: A Parallel and Distributed Approach for Diversified Top-k Best Region Search. *EDBT 2020*: 265-276
- George Papadakis, Leonidas Tsekouras, Emmanouil Thanos, Nikiforos Pittaras, Giovanni Simonini, Dimitrios Skoutas, Paul Isaris, George Giannakopoulos, Themis Palpanas, Manolis Koubarakis: JedAI3: beyond batch, blocking-based Entity Resolution. *EDBT 2020*: 603-606
- Georgios Chatzigeorgakidis, Kostas Patroumpas, Dimitrios Skoutas, Spiros Athanasiou: A Visual Explorer for Geolocated Time Series. *SIGSPATIAL 2020*: 413-416

- Kostas Patroumpas, Dimitrios Skoutas: Similarity search over enriched geospatial data. GeoRich@SIGMOD 2020: 1:1-1:6
- Xiaoying Wu, Dimitri Theodoratos, Dimitrios Skoutas, Michael Lan: Leveraging Double Simulation to Efficiently Evaluate Hybrid Patterns on Data Graphs. WISE (1) 2020: 255-269
- Apostolos Chalkis, Ioannis Z. Emiris, Vissarion Fisikopoulos. Practical Volume Estimation of Zonotopes by a New Annealing Schedule for Cooling Convex Bodies. ICMS 2020: 212-221, https://doi.org/10.1007/978-3-030-52200-1_21
- Federico Desimoni, Nikos Bikakis, Laura Po, George Papastefanatos: **A Comparative Study of State-of-The-Art Linked Data Visualization Tools**. In Proceedings of the Fifth International Workshop on Visualization and Interaction for Ontologies and Linked Data co-located with the 19th International Semantic Web Conference (ISWC 2020), November 02, 2020, VOILA@ISWC 2020: 1-13.
- George Papastefanatos, Elli Papadopoulou, Marios Meimaris, Antonis Lempesis, Stefania Martziou, Paolo Manghi, Natalia Manola: **Open Science Observatory: Monitoring Open Science in Europe**. In ADBIS/TPDL/EDA Workshops 2020: 341-346.
- Marios Meimaris, George Papastefanatos, P. Vassiliadis: **Hierarchical Property Set Merging for SPARQL Query Optimization**. In Proceedings of the 22nd International Workshop on Design, Optimization, Languages and Analytical Processing of Big Data co-located with EDBT/ICDT 2020 Joint Conference, DOLAP@EDBT/ICDT 2020, Copenhagen, Denmark, March 30, 2020.
- G. L. Andrienko, N.V. Andrienko, S. Mark Drucker, J-D Fekete, D. Fisher, S. Idreos, T. Kraska, G. Li, K-L Ma, J.D. Mackinlay, A. Oulasvirta, T. Schreck, H. Schumann, M. Stonebraker, D. Auber, N. Bikakis, P. K. Chrysanthis, G. Papastefanatos, M.A. Sharaf: **Big Data Visualization and Analytics: Future Research Challenges and Emerging Applications**. In 3rd International Workshop on Big Data Visual Exploration and Analytics (BigVis2020) co-located with EDBT/ICDT 2020 Joint Conference Copenhagen, Denmark, March 30, 2020.
- Wouter Klijn, Sandra Diaz, Sebastian Spreizer, Thomas Lippert, Spiros Athanasiou, Yannis Ioannidis, Abigail Morrison, Evdokia Mailli, Katrin Amunts, Jan G Bjaalie: “Introducing EBRAINS: European infrastructure for brain research”, 29th Annual Computational Neuroscience Meeting (CNS*2020), 2020.
- K. El Raheb, M. Stergiou, A. Katifori, Y. Ioannidis: “Symbolising Space: From Notation to Movement Interaction”, Int'l Conference on Technologies for Music Notation and Representation - TENOR'20, pp. 91-99, May 2020.
- H. Kllapi, I. Pietri, V. Kantere, Y. Ioannidis: “Automated Management of Indexes for Dataflow Processing Engines in IaaS Clouds”. EDBT 2020, virtual , pp. 169-180, March 2020.
- Maria Vayanou, Olga Sidiropoulou, George Loumos, Antonis Kargas, Yannis E. Ioannidis: “Playing with the Artist”, ArtsIT 2019, DLI 2019, pp. 566-579, July 2020.

- M. Kyriakidi, G. Koutrika, Y. Ioannidis: “Recommendations as Graph Explorations”. 14th ACM Conference on Recommender Systems (RecSys), virtual, pp. 289-298, September 2020.
- K. El Raheb, M. Stergiou, A. Katifori, Y. Ioannidis: “Mirror-mirror on the screen am I the most aligned than I have ever been?”, Human Computer Interaction and Emerging Technologies: Adjunct Proceedings from the INTERACT 2019 Workshops, F. Loizides, M. Winckler, U. Chatterjee, J. Abdelnour-Nocera, A. Parmaxi (eds.), 2020, pp. 355–360, 2020.
- Ektor Vrettakis, Christos KLougiakis, Akrivi Katifori, Vassilis Kourtis, Stamatis Christoforidis, Manos Karvounis, Yannis E. Ioannidis: The Story Maker - An Authoring Tool for Multimedia-Rich Interactive Narratives, International Conference on Interactive Digital Storytelling, pp. 349-352, October 2020.
- Vicky Dritsou, Maria Ilvanidou, Isidora Despotidou, Vicky Liakopoulou, Karmen Vourvachaki, Panos Constantopoulos: **Integrating archival materials for the study of the turbulent Greek 40s**. In DARIAH Annual Event 2020, November 2020 (honorable mention), DOI 10.5281/zenodo.4271531.
- Phoebe Koundouri, “Circular economy in national S3: the case of Greece”. Workshop & Webinar: Smart Specialisation Strategy (S3) In The Adriatic - Ionian Macro-Regional Strategy (Eusair)”
- Ladjel Bellatreche, Fadila Bentayeb, Mária Bieliková, Omar Boussaid, Barbara Catania, Paolo Ceravolo, Elena Demidova, Mírian Halfeld Ferrari, María Teresa Gómez López, Carmem S. Hara, Slavica Kordic, Ivan Lukovic, Andrea Mannocci, Paolo Manghi, Francesco Osborne, Christos Papatheodorou, Sonja Ristic, Dimitris Sacharidis, Oscar Romero, Angelo A. Salatino, Guilaine Talens, Maurice van Keulen, Thanasis Vergoulis, Maja Zumer: Databases and Information Systems in the AI Era: Contributions from ADBIS, TPD and EDA 2020 Workshops and Doctoral Consortium. ADBIS/TPDL/EDA Workshops 2020: 3-20
- Serafeim Chatzopoulos, Thanasis Vergoulis, Ilias Kanellos, Theodore Dalamagas, Christos Tryfonopoulos: ArtSim: Improved Estimation of Current Impact for Recent Articles. ADBIS/TPDL/EDA Workshops 2020: 323-334
- Thanasis Vergoulis, Serafeim Chatzopoulos, Theodore Dalamagas, Christos Tryfonopoulos: VeTo: Expert Set Expansion in Academia. TPD 2020: 48-61
- Konstantinos Zagganas, Thanasis Vergoulis, Spiros Skiadopoulos, Theodore Dalamagas: Efficient Calculation of Empirical P-values for Association Testing of Binary Classifications. SSDBM 2020: 10:1-10:12

National Conference / Workshop Publications

- A. Glenis, G. Koutrika. NLonSpark: NL to SQL translation on top of Apache Spark. HILDA@SIGMOD2020

- Vassilis Kaffes, Giorgos Giannopoulos, Nontas Tsakonas, Spiros Skiadopoulos: **Determining the provenance of land parcel polygons via machine learning.** SSDBM 2020: 21:1-21:4
- Konstantinos Alexis, Vassilis Kaffes, Ilias Varkas, Andreas Syngros, Nontas Tsakonas, Giorgos Giannopoulos: **Improving geocoding quality via learning to integrate multiple geocoders.** SSDBM 2020: 20:1-20:4
- Konstantinos Alexis, Vassilis Kaffes, Giorgos Giannopoulos: **Boosting toponym interlinking by paying attention to both machine and deep learning.** GeoRich@SIGMOD 2020: 4:1-4:5
- Giorgos Giannopoulos, Vassilis Kaffes, Georgios Kostoulas: **Learning Advanced Similarities and Training Features for Toponym Interlinking.** ECIR (1) 2020: 111-125

Other Publications / Technical Reports

- Antonis Kontaxakis, Nikos Giatrakos, Antonios Deligiannakis: A Synopses Data Engine for Interactive Extreme-Scale Analytics. CoRR abs/2003.09541 (2020)
- Apostolos Chalkis, Ioannis Z. Emiris, Vissarion Fisikopoulos, Panagiotis Repouskos, Elias P. Tsigaridas. Efficient Sampling from Feasible Sets of SDPs and Volume Approximation. CoRR abs/2010.03817 (2020)
- Apostolos Chalkis, Ioannis Z. Emiris. Modeling asset allocation strategies and a new portfolio performance score. CoRR abs/2012.05088 (2020)
- K. El Raheb, Y. Ioannidis: "Dance Education and Digital Technologies". ERCIM News, No. 120, p. 32-33, January 2020.
- Phoebe Koundouri & Lydia Papadaki, 2020. "[Transforming cities toward sustainability transition](#)," [DEOS Working Papers](#) 2003, Athens University of Economics and Business.
- Ilias Kanellos, [Thanasis Vergoulis](#), Dimitris Sacharidis, Theodore Dalamagas, Yannis Vassiliou: Ranking Papers by their Short-Term Scientific Impact. CoRR abs/2006.00951 (2020)
- [Thanasis Vergoulis](#), Ilias Kanellos, Giorgos Giannopoulos, Theodore Dalamagas: Simplifying Impact Prediction for Scientific Articles. CoRR abs/2012.15192 (2020)

Dissemination Activities

Invited / Keynote Talks

IMSI members participated in the following invited / keynote talks:

- A. Simitsis. Optimization and Runtime Adaption in Infore. Infore meeting, Athens, Greece, January 20, 2020.
- A. Simitsis. Design and Development of the National Repository for the Climate Change. NOA, Athens, Greece, July 16, 2020.
- 1/2020, “**Amnesia : Data Anonymization made easy**”, Manolis Terrovitis, invited speaker at Workshop : “Towards pseudo/anonymised health data: methodologies, tools and practical solutions “,by EOSC-Life .
- Amnesia was presented by Manolis Terrovitis is a series of invited webinars in multiple events including: “OpenAIRE Week: OpenAIRE for Researchers and Beyond”, Tech Clinics for OpenAIRE noads, OpenAIRE Turkey event.
- G. Koutrika. “Democratizing Data Access Through Intelligent Data Exploration Tools”. Keynote at ACM WomENCourage 2020.
- “Intelligent Data Exploration” roundtable co-organized by Georgia Koutrika and Kurt Stockinger at VLDB2020 had the highest attendance.

Scientific Community Service

IMSI members have served in the **Program Committee** of more than 15 International Conferences and Workshops in 2020, including well-known Conferences like VLDB, ACM KDD, CIKM, SIGSPATIAL, MDM and more.

IMSI members have participated in the **organization** or co-organization of the following events:

- ACM DOLAP: ACM International Workshop on Data Warehousing and OLAP: Steering Committee. Alkis Simitsis, steering committee.
- Data Science Workshop for the Climate Change, Virtual Event, April 23, 2020. Alkis Simitsis, organizer.
- Data & Knowledge Engineering, Elsevier: Alkis Simitsis, Editorial Board Member.
- 3rd International Workshop on Big Data Visual Exploration and Analytics (BigVis2020) in conjunction with EDBT/ICDT. George Papastefanatos, organizer.
- Elsevier Big Data Research Journal. Special Issue on Big Data Exploration, Visualization and Analytics. George Papastefanatos, guest editor.

- Agiatis Benardou served DARIAH-EU as VCC2 (Research and Education Liaison) Co-Chair.
- Agiatis Benardou served as Programme Committee member at the annual DARIAH-EU event, held virtually in May 2020.
- Thanasis Vergoulis co-organised the [AIMiniScience 2020](#) international workshop.
- Thanasis Vergoulis was the proceedings chair of the [SSDBM 2020](#) international conference.



Systems

- **SPHINX**

SPHINX is a system for metapath-based entity exploration in Heterogeneous Information Networks (HINs), developed in the context of the EU funded project SmartDataLake. SPHINX allows users to define different views over a HIN based on both automatically selected and user-defined metapaths. Then, entity ranking and similarity search can be performed over these views to find and explore entities of interest, taking also into account any spatial or temporal properties of entities. A Web-based user interface is provided to facilitate users in performing the various functionalities supported by the system, including metapath-based view definition, index construction, search parameters specification, and visual comparison of the results.

<https://www.vldb.org/pvldb/vol13/p2913-chatzopoulos.pdf>

1. Select source entity type

Article ▼

2. Select search preferences

Determine search preferences based on existing indices.

+ Add new index

i) Preferences on source entities

Type	Preferences	Weights
<input checked="" type="radio"/> Temporal	Select Date	0 0.25 0.5 0.75 1

ii) Metapath preferences

Metapath	Preferences on target entities	Weights
<input checked="" type="radio"/> Article - Organisation	twitter ×	0 0.25 0.5 0.75 1
<input checked="" type="radio"/> Article - Person	donald trump × barack obama ×	0 0.25 0.5 0.75 1

3. Select value for k

50

Q Search

Results

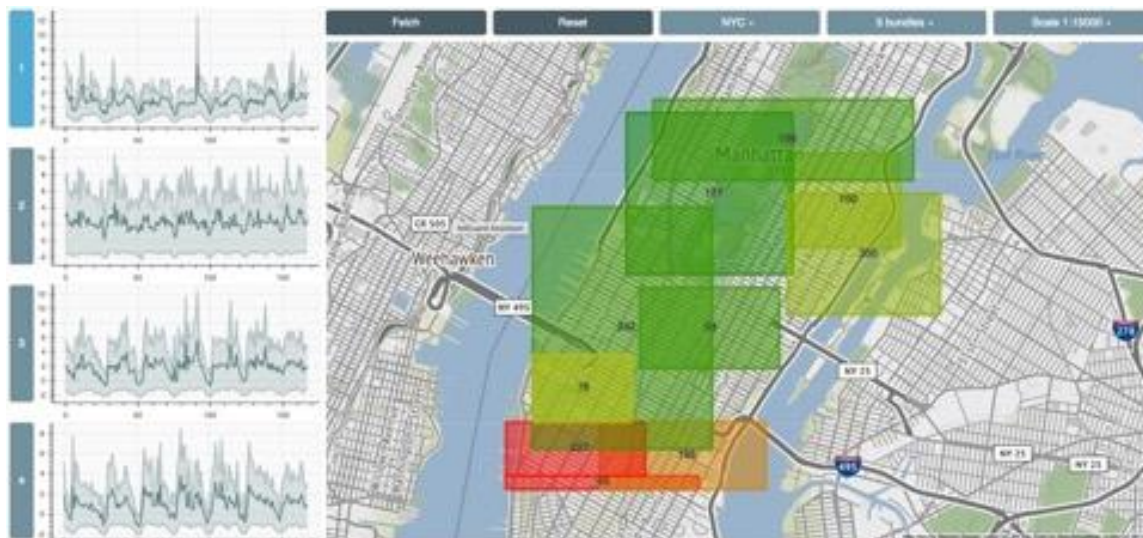
#	Article	Score	Article - Organisation	Article - Person
1	20190520_filtered.csv:20190520200000-1330	0.74000000000000017	huawei, twitter, cnn, white house, facebook, united states score: 3.3382377953649984e-15	barack obama, donald trump score: 1

- **spaTScope**

spaTScope is a web application for visual exploration of geolocated time series developed in the context of the EU-funded projects SLIPO and SmartDataLake. spaTScope allows users to visually explore large collections of geolocated time series

and obtain insights about trends and patterns in their area of interest. The provided functionalities leverage a hybrid index that allows to navigate and group the available time series based not only on their similarity but also on spatial proximity. The results are visualized using linked plots combining maps and timelines.

<https://github.com/smartdatalake/spaTScope>



- **Mopseus**

MOPSEUS is a scalable, curation-aware repository system designed to be metadata schema agnostic. It can support any complex data model either at the digital resource level or at the collection level. This means that content can be organized using any structure ranging from simple hierarchies to complex graphs. The entire structure both at the digital resource level and at the collection level is stored and represented in RDF and can be accessed through a SPARQL endpoint. MOPSEUS employs an expressive data model that supports both intra- and inter- object relations thus allowing arbitrary organization of objects. In particular, all entities in MOPSEUS are digital objects each of which may include an unlimited number of metadata and/or data files and may be associated with multiple metadata schemas. A special class of digital objects, the containers, are used in order to organize information (digital evidence). Containers can be interconnected using semantic links thus giving rise to semantic graph structures of arbitrary complexity. Metadata can be represented either as XML or RDF triples. MOPSEUS gives special focus on interoperability and digital preservation and is compliant with the PREMIS standard ensuring that the entire lifecycle of each digital resource is stored and semantically annotated. In order to access the MOPSEUS services a modular architecture is employed whereby the user interacts with the system through a set of Web-based interfaces that allow one to define metadata schemas and thesauri and to manage the entire content stored within the system. A SKOS editor supports maintaining term thesauri, while a linked data approach is adopted in associating terms

with relevant data objects. Moreover, semantic relationships between objects are supported and can be defined through the GUI. Finally, all operations are organized in workflows which are also defined via the GUI. Supported site installations of the Mopseus repository system include: “Digital Academy” – Repository of the digital collections of the Academy of Athens, and “Pyxida” – Academic repository and digital library, Athens University of Economics and Business.

<http://mopseus.dcu.gr/>

- **MORe**

The Metadata and Object Repository (MORe) is a metadata aggregator designed to: harvest content (metadata records) from different sources and providers; enrich/curate; map to a target schema (e.g. EDM); and deliver the metadata using the OAI-PMH protocol to other systems, such as the Europeana library. MORe focuses on enriching / curating the aggregated content. This is accomplished through a set of micro-services that are streamlined in a workflow. These micro-services perform various curation actions like normalizing, associating records (e.g. those in close proximity to each other), transforming spatial coordinates to a given coordinate system (e.g. WGS84), creating elements like place labels, etc. MORe is OAIS-compliant and preserves the whole lifecycle of each digital object. All ingestion and curation actions create new versions of metadata streams that are stored and semantically annotated, thus allowing to view the entire history of changes associated with each digital resource. MORe is tuned to support massive imports in the order of about 0.8 million records per hour. Online services with the MORe system are provided to Europeana and the related communities formed and supported through the projects CARARE, 3-D ICONS, ARIADNE, LoCloud and CEF Europeana. A total of approximately 70 content providers in over 20 countries, are being regularly served by the MORe aggregation service to aggregate, enrich and deliver content to Europeana, with approximately 10 million heritage asset records processed so far.

<http://more.dcu.gr/>

- **NeMO and SO**

The NeDiMAH Methods Ontology (NeMO) is a comprehensive ontological model of scholarly practice in the arts and humanities, offered and maintained by DCU/IMSI, the development of which was undertaken through the ESF Research Network [NeDiMAH](#). NeMO is a CIDOC CRM - compliant ontology which explicitly addresses the interplay of factors of agency (actors and goals), process (activities and methods) and resources (information resources, tools, concepts) manifest in the scholarly process. It builds on the results of extensive empirical studies and modeling of scholarly practices performed by DCU/IMSI in projects [DARIAH](#) and [EHRI](#). NeMO incorporates existing relevant taxonomies of scholarly methods and tools, such as TaDIRAH, the arts-humanities.net

and Oxford taxonomies of ICT methods, DHCommons, CCC-IULA-UPF and DiRT, through appropriate mappings of the concepts defined therein onto a semantic backbone of NeMO concepts. It thus enables combining documentary elements on scholarly practices of different perspectives and using different vocabularies. NeMO was subsequently generalized to the domain-neutral Scholarly Ontology (SO).

<http://nemo.dcu.gr/>

- **DAIAD system**

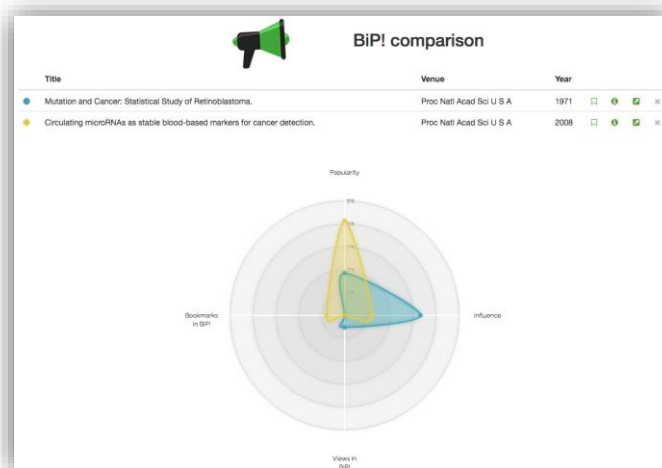
DAIAD is the first *integrated residential demand management* system for water. It applies Big Data and Machine Learning technologies to leverage smart water meter data, engaging and informing consumers to induce sustainable changes in consumption behaviour, as well as providing novel large-scale analytics to improve short-, medium-, and long-term demand management for water utilities. DAIAD provides personalized pricing and non-pricing interventions to consumers through mobile and web applications, adapted to their profile, individual determinant sensitivity, and consumption behaviour. Water utilities have access to several analysis services (segmentation, clustering, forecasting) enabling them to understand consumption behaviour at the household level, target specific consumer groups, and anticipate demand under various time scales. The average sustainable total water savings in residential water consumption achieved by the DAIAD system is -12%. DAIAD is available as an open source software under the Apache License.

<https://github.com/DAIAD>

<https://www.youtube.com/watch?v=YuLU9nitlss>

- **BIP! Finder**

BIP! Finder is a tool that assists the discovery of high-impact publications in the field of life sciences. This tool supports ranking and comparing of scientific articles based on different aspects of their impact in their discipline, like their popularity (i.e., the current attention they receive) or influence (i.e., their long-term impact in the discipline). Furthermore, the tool



provides useful features like intuitive infographics for each article and a mechanism of bookmarks.

<http://bip.imis.athena-innovation.gr/>

- **BUFET**

BUFET is an open-source software under the GPL v.3 licence, designed to speed up Bleazard's unbiased miRNA enrichment analysis algorithm. BUFET generates an empirical distribution of genes targeted by miRNA and calculates p-values for related biological processes. Benjamini-Hochberg FDR correction produces a '*' or '**' for significance at 0.05 FDR and 0.01 FDR respectively.

<https://github.com/diwis/BUFET>

- **PaperRanking**

PaperRanking is an open source library containing implementations of paper ranking methods that have been proposed in the literature. Our implementations utilise a suite of MapReduce scripts and can be used either on a single machine, or a Hadoop cluster. All codes were developed in the context of a paper ranking survey that aimed to evaluate each method's strengths and weaknesses.

<https://github.com/diwis/PaperRanking>

- **SciNeM**

SciNeM (Data Science tool for heterogeneous Network Mining), an open-source tool that offers a wide range of functionalities for exploring and analysing HINs and utilises Apache Spark for scaling out through parallel and distributed computation. SciNeM provides an intuitive, Web-based user interface to build and execute complex constrained metapath-based queries and to explore and visualise the corresponding results. Under the hood, all the supported state-of-the-art HIN analysis types have been implemented in a scalable manner supporting the distributed execution of analysis tasks on computational clusters. SciNeM has a modular architecture making it easy to extend it with additional algorithms and functionalities. Currently, it supports the following operations, given a user-specified metapath: ranking entities using a random walk mode, retrieving the top-*k* most similar pairs of entities, finding the most similar entities to a query entity, and discovering entity communities.

<http://scinem.imsi.athenarc.gr/>

- **SCHeMa**

SCHeMa (Scheduler for scientific Containers on clusters of Heterogeneous Machines) an open source platform to facilitate the execution and reproducibility of computational experiments on heterogeneous clusters. The platform exploits containerization, experiment packaging, and workflow management technologies to ease reproducibility, while it leverages machine learning technologies to automatically identify the type of

node that is more suitable to undertake each submitted computational task.

<https://github.com/athenarc/schema>

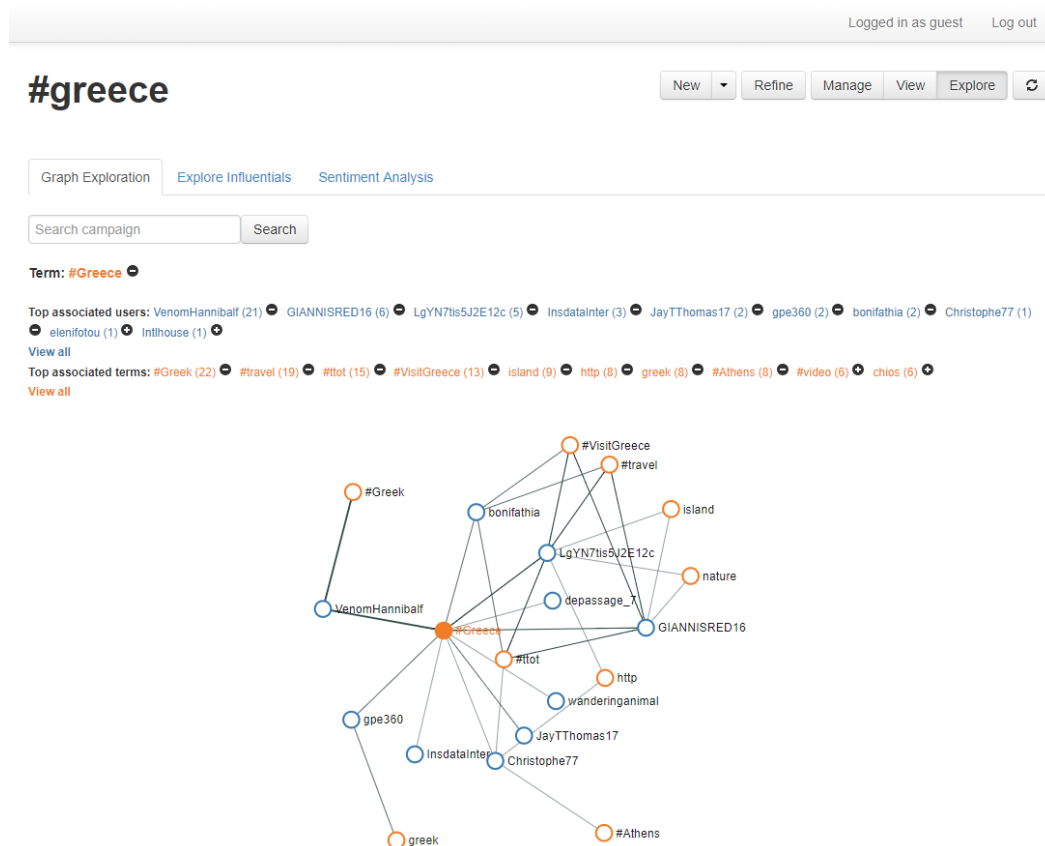
- **SheerMP**

Optimizer for streaming analytics in cross-platform and cross-site environments.

<https://infore-project.eu/deliverables.html>

- **TwitHoard**

An increasing number of innovative applications use data from online social networks. In many cases data analysis tasks, like opinion mining processes, are applied on platforms such as Twitter, in order to discover what people think about various issues. In our view, selecting the proper data set is paramount for the analysis tasks to produce credible results. This direction, however, has not yet received a lot of attention. TwitHoard is a platform for supporting processes such as opinion mining on Twitter data, with emphasis on the selection of the proper data set. The key point of our approach is the representation of term associations, user associations, and related attributes in a single model that also takes into account their evolution through time. This model enables flexible queries that combine complex conditions on time, terms, users, and their associations.



<http://twithoard.imis.athena-innovation.gr:8080/twithoard>

- **eLib**

The project eLib aims at developing a digital library for the Independent Authority for Public Revenue. eLib analyzes and provides information to public servants and citizens on the legislation concerning the areas of IAPR competence (taxation, public revenues, etc). Legal documents are automatically harvested from institutional sources (National Printing Office, Di@ygeia), their content and metadata are extracted, semantically analyzed and structured according to the AKOMA NTOSO, and ELI) specifications. Moreover, content is indexed for full-text search, browsing and faceted filtering. Users can search and navigate the legal content and create personal collections with references to whole documents or parts of them.

<http://www.publicrevenue.gr/elib>

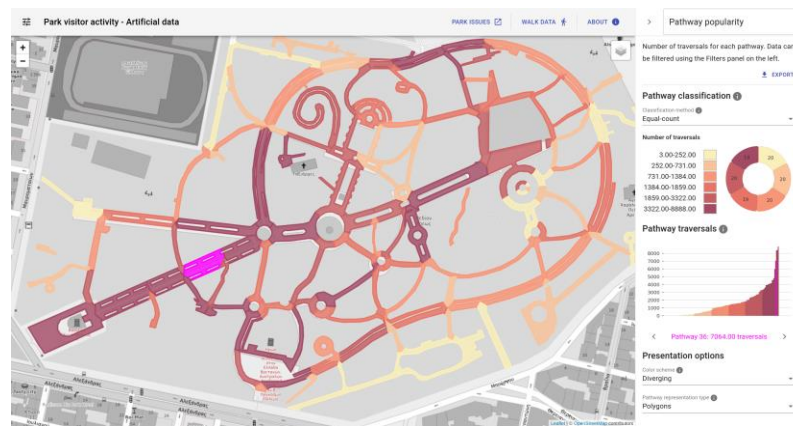
- **PHONY: Automatic Dataset Generation for Fake News Detection**

Fake news is growing into one of the most crucial issues for social media platforms, users, and news organizations. The development of efficient algorithmic solutions for detecting fake news in online social networks requires complete, up-to-date, and flexible training datasets. Fact-checking services can be very useful for providing fake news stories; however, existing datasets suffer from severe limitations and rely heavily on human annotators. In this work we developed PHONY, an infrastructure that leverages Twitter and fact-checking websites to automate as much as possible the generation of flexible, feature-agnostic datasets. This allows users to extract suitable feature-specific datasets according to the machine learning approaches used. Our feature-agnostic datasets support the wide range of features encountered in the literature, including semantic features and social network diffusion features, which have not received much attention.

- **Park Visitor Activity**

Urban parks are a vital part of cities around the world, accepting millions of visitors daily. However, in most cases urban parks do not enjoy the technological support that could enhance visitor experience and facilitate park administrators. VR-Park is a project that addresses the above issues and uses as a case study the “Pedion Areos” park, a prominent park in Athens, Greece. It comprises a mobile phone application used by the park visitor, and web-based applications used by the park administrator. Our work focuses on Park Visitor Activity, an innovative application used by the park administrator to collectively assess visitor movement and activity in general. The movement of visitors inside the park is collected and analyzed, to provide patterns of usage of the park areas:

spots where people gather, pathways that are used the most, months of the year / time of day when visits have a peak, etc. Such information is invaluable for taking informed decisions about the



management of the park. Comprehending how people tend to move and how they use an open area can be very useful in a wide spectrum of cases that go beyond urban park administrators.

- **Socioscope**

A visual analysis tool, used for visualization and exploration of social and political data (www.socioscope.gr) seeks to deliver a visual analytics platform for the social scientist to explore and analyze social facts through a user-friendly visual interface. The

Socioscope platform offers a variety of interactive visualizations for each different type of data: charts and histograms, pies



and tacked diagrams for numerical data; timelines for indices; and choropleth and point maps for geographical data. The platform is based on a multidimensional modeling approach and offers several visual operations for data exploration and analysis, such as filtering through faceted browsing, hierarchical representation of coded lists in charts, free keyword search of literal values, and capabilities for combining different datasets along common dimensions. Moreover, it makes knowledge reusable by making all data available for download in various formats including Linked Open Data.

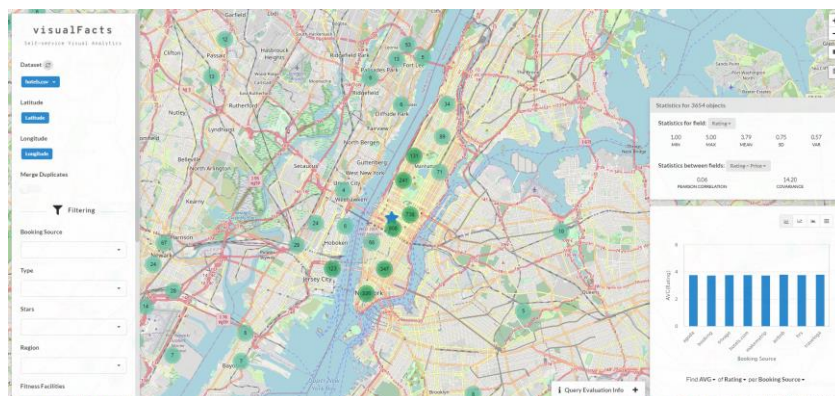
www.socioscope.gr

- **VisualFacts**

VisualFacts is a self-service visual analytics platform for big geo-located data that helps data explorers perform ad hoc analysis of raw data files collected from different sources of varying quality (with duplicates or missing data) in rich visual ways, even though

they do not have a background in notebooks, data integration, or machine learning techniques. VisualFacts platform allows users to open their own data file(s) and via a map-centric

Dashboard UI start visually interacting with the data without loading or indexing the data in a database. The backbone of the platform is a visual aware in-memory



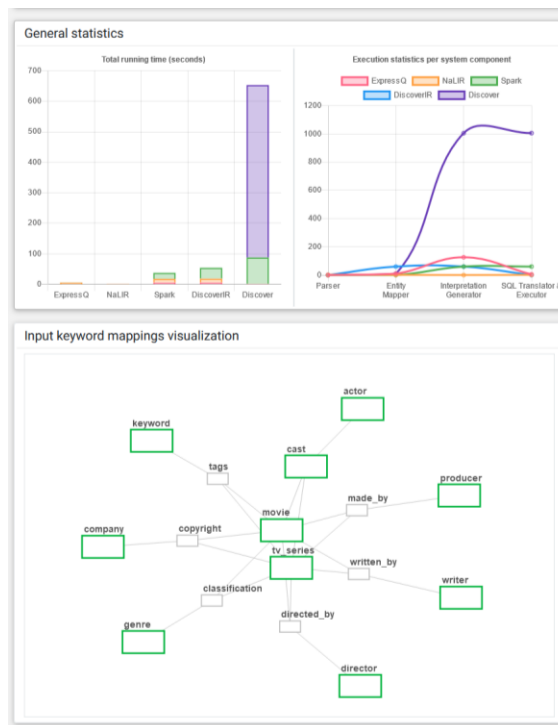
index (called rawViz), which is constructed on the fly and adjusted to user interaction, as well as a powerful deduplication engine (called QueryER) which offers on-the-fly visual entity matching and clustering over dirty data. The platform can scale up the visualization, interactive exploration and analysis to million data points on a map, with the use of commodity hardware.

<https://visualfacts.imsi.athenarc.gr/software.html>

The two libraries are offered as standalone tools and as an integrated platform.

• THOR

Numerous search systems have been implemented that allow users to pose unstructured queries over databases without the need to use a query language, such as SQL. Unfortunately, the landscape of efforts is fragmented with no clear sight of which system is best, and what open challenges we should pursue in our research. To help towards this direction, we present THOR that makes 4 important contributions: a query benchmark, a framework for comparing different systems, several search system implementations, and a highly interactive tool for comparing different search systems.



<https://darelab.imsi.athenarc.gr/thor/home>

- **QueryER**

QueryER is the SQL engine behind VisualFacts which integrates entity resolution (ER) operations in the planning and execution of select-project-join queries. It offers three novel query operators, which (1) identify and resolve duplicates within a table employing a schema agnostic resolution approach; (2) enables joins between two or more tables containing duplicate entities; and (3) group/merge deduplicated entities into a single representation.

<https://github.com/VisualFacts/queryER>

- **rawVis: A System for In-situ Visual Exploration & Analytics**

RawVis enables efficient in-situ visual exploration and analytics directly over large raw data files without the need of an underlying DBMS or a query engine. RawVis exhibited low response time over large datasets (e.g., 50G & 100M objects) using commodity hardware.

<https://github.com/VisualFacts/RawVis>

- **TripleGeo**

TripleGeo is an ETL utility that can extract geospatial features from various sources (e.g. shapefiles, spatial DBMSs) and transform them into Basic Geo or GeoSPARQL compatible RDF triples, in several serialization formats. It copes with most common spatial data types, like points, linestrings and multi-linestrings, polygons and multi-polygons and supports on-the-fly transformations between different coordinate reference systems. Also, TripleGeo supports the transformation of INSPIRE-aligned spatial data and metadata into RDF, using XSL stylesheets, for selected INSPIRE data themes.

<https://github.com/SLIPO-EU/TripleGeo>

- **OSMRec**

OSMRec is a tool that trains on a set of spatial entities annotated with categories and provides category recommendations for new geospatial entities. OSMRec's goal is to exploit the richness of available geospatial datasets than contain entities already annotated with several categories (e.g., OpenStreetMap), to enrich new geospatial entities. OSMRec supports two modes of deployment: a generic command line, and a JOSM plugin, which allows the real-time recommendation of OSM categories for geospatial entities created within the JOSM user interface.

<https://github.com/SLIPO-EU/OSMRec>

<http://wiki.openstreetmap.org/wiki/JOSM/Plugins/OSMRec>

- **Amnesia anonymization tool**

Amnesia transforms a dataset with direct identifiers and quasi identifiers to an anonymized dataset, where formal privacy guaranties hold. Amnesia allows the use to

customize the anonymization process, to choose the trade-off between data utility and privacy protection. Moreover, it allows users who are not IT experts to visually explore the data and the impact of different anonymization settings on them. It helps users to create supportive material to the anonymization process, like generalization hierarchies. Amnesia offers k-anonymity and km-anonymity and a parallel scalable anonymization algorithm, it is available through the OpenAIRE infrastructure.

- **FAGI**

FAGI is a tool that allows the fusion of geospatial Linked Data. It is designed to retrieve data through SPARQL endpoints, and implements a wide range of fusion actions both on spatial properties of the entities and on non-spatial metadata. These include moving, rotating, scaling and aligning the geometries of the entities, combining multiple, semantically related properties, maintaining both descriptions of a property of two linked geospatial entities, etc. It also supports batch fusion actions, automatic classification of fused entities using OSM categories, and provides a map-based UI.

<https://github.com/SLIPO-EU/FAGI>

Education

PhD / MSc / Diploma Thesis Co-supervision

IMSI members actively co-supervise several undergraduate and graduate university students, who often conduct their work in IMSI premises. As a result, in 2020 several MSc and Diploma thesis have been co-supervised by IMSI members, who often serve as members in the respective examination committees.

IMIS members also co-supervise PhD students. The following PhD dissertations have been completed in 2020:

- Giorgos Chatzigeorgakidis. Topic: **Scalable Indexing and Exploration of Big Time Series Data**. Joint supervision with the University of Peloponnese. Collaborating researcher: Dimitris Skoutas.
- Ilias Kanellos. Topic: **Data extraction from scientific publications and research analytics**. Joint supervision with the National Technical University of Athens. Collaborating researchers: Theodore Dalamagas, Thanasis Vergoulis.

The following PhD and MSc students collaborated closely with / supervised by IMSI members in their research during 2020:

- Alexandros Zeakis. Topic: **Similarity Joins with multiple matching criteria**. Joint supervision with the University of Athens. Collaborating researcher: Dimitris Skoutas.
- Theodora Galani. Topic: **Modeling and querying the data evolution and provenance**. Joint supervision with the National Technical University of Athens. Collaborating researchers: Yannis Stavrakas, George Papastefanatos.
- Danai Pla-Karidi. Topic: **Recommendation models using Social Networks**. Joint supervision with the National Technical University of Athens. Collaborating researcher: Yannis Stavrakas.
- Giorgos Alexiou. Topic: **Entity disambiguation and data interlinking**. Joint supervision with the National Technical University of Athens. Collaborating researcher: George Papastefanatos.
- Konstantinos Theocharidis, Topic: **Social Data Management**. Joint supervision with the University of Peloponnese. Collaborating Researcher Manolis Terrovitis
- Dimitris Tsitsigkos, Topic: **Join Operators for Complex Data**. Joint supervision with the University of Ioannina. Collaborating Researcher Manolis Terrovitis

- Serafeim Chatzopoulos. Topic: **Text mining and Information Retrieval for Scientific Texts**. Joint supervision with the University of Peloponnese. Collaborating researchers: Theodore Dalamagas, Thanasis Vergoulis.
- Konstantinos Zagganas. Topic: **Efficient techniques for data intensive analysis and processing in life sciences**. Joint supervision with the University of Peloponnese. Collaborating researchers: Theodore Dalamagas, Thanasis Vergoulis.
- Christos Tsapelas (University of Athens) – Deep Learning for Query Optimization - supervisor: Georgia Koutrika
- Antonis Mandamadiotis (University of Athens) – Query Recommendations using Multi-armed Bandits - supervisor: Georgia Koutrika
- George Katsogiannis-Meimarakis (University of Athens) – Deep Learning for NL2SQL Translation co-supervisor: Georgia Koutrika

Other Educational Activities

Other educational activities involving IMIS members include the following.

- The DSIT Program is organized by the ATHENA Research Center, the Biomedical Research Foundation of the Academy of Athens (BRFAA) and the Department of Informatics & Telecommunications of the National & Kapodistrian University of Athens (NKUA). IMSI Directors of Research, Theodore Dalamagas and Georgia Koutrika are responsible for two classes, and supervise several diploma theses.
- George Papastefanatos was an Adjunct Lecturer in “Advanced Topics in Data Engineering” (In MSc in Business Analytics, Full-time Program – Athens University of Economic and Business).
- George Papastefanatos was an Invited Lecturer in “Analysis and Design of Information Systems” (Undergraduate course – Athens University of Economic and Business - Department of Informatics).
- Manolis Terrovitis co-taught the **Privacy and Legal Issues in Business Analytics** course of the Business Analytics MSc program of AUEB.
- Thanasis Vergoulis taught the “Data Management” course of the post-graduate program “Data Science” of NCSR Demokritos.

Facts and Figures

Financial report

In 2020, IMSI continued its participation in EC and national funded research and development projects. The key economic indicators regarding the expenses and revenues in 2020 are shown in Table 1 and their distribution in categories is illustrated in Figure 1. We can see that the highest percentage of the revenue stream, about 75%, comes from EC funded projects. It is important to note that the revenues from the activities of IMSI (EC projects, national funded projects, Product and Service Sales) are more than 17 times the public expenditure received by IMSI.

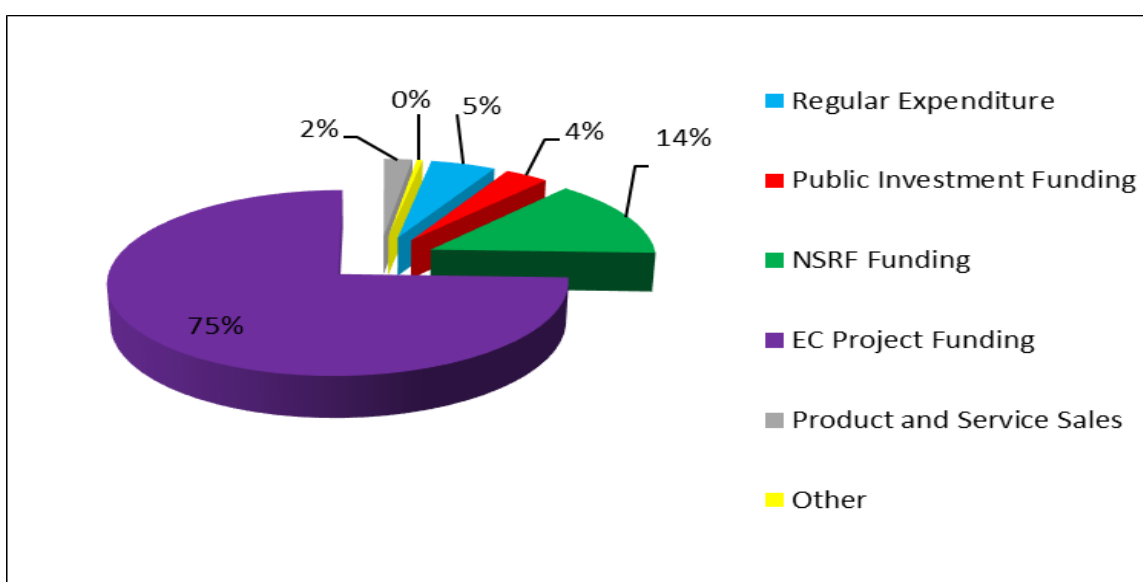


Figure 1. Distribution of revenues in 2020

Table 1. Expenses and Revenues for 2020

Expenses 2020 (in Euros)	
Travel Expenses	58.274,37
Operational Costs	42.150,61
Equipment	164.219,75
Other Expenses	321.747,64
Personnel fees and payments to third parties	4.290.908,26
Total	4.877.300,63
Revenues 2020 (in Euros)	

Regular Expenditure	330.874,24
Public Investment Funding	222.884,40
NSRF Funding	900.019,00
EC Project Funding	4.747.206,63
Product and Service Sales	143.597,65
Other	29.847,85
Total	6.374.429,77

Staff

Director & Researchers

- Garofalakis Minos, Professor, Technical University of Crete, Director
- Koutrika Georgia, Researcher A
- Sartzetakis Stylianos, Researcher A
- Simitsis Alkiviadis, Researcher A
- Dalamagas Theodore, Researcher A
- Stavrakas Yannis, Researcher A
- Skoutas Dimitris, Researcher C
- Terrovitis Manolis, Researcher C

Adjunct or under contract Professors

- Alepis Efthimios, Assistant Professor, University of Piraeus
- Chatzopoulos Michael, Emeritus Professor, University of Athens
- Constantopoulos Panos, Professor, AUEB
- Dallas Costis, Assistant Professor, Toronto University
- Deligiannakis Antonis, Assistant Professor, Technical University of Crete
- Douligeris Christos, Professor, University of Piraeus
- Emiris Ioannis, Professor, University of Athens
- Ioannidis Yannis, Professor, University of Athens
- Karantzalos Konstantinos, Associate Professor, NTUA
- Kotidis Yannis, Associate Professor, AUEB
- Kountouri Phoebe, Assistant Professor, AUEB
- Maravelakis Manolis, Associate Professor, Hellenic Mediterranean University
- Papandreou Andreas, Professor, University of Athens
- Papatheodorou Christos, Professor, University of Athens
- Patsakis Konstantinos, Assistant Professor, University of Piraeus
- Samoladas Vasilis, Associate Professor, Technical University of Crete
- Vassilopoulos Achilleas, Assistant Professor, University of Ioannina
- Vazirgiannis Michalis, Professor, AUEB

Postdoctoral Researchers / Scientific Collaborators

- Arkoumanis Constantinos, Elec. & Comp. Eng. NTUA, PhD NTUA
- Benardou Agiatis, BA, PhD in Ancient History, King's College London
- Bikakis Nikos, Elec. & Comp. Eng., Technical University of Crete, PhD NTUA

- Boile Maria, Department of History and Archaeology, UoA, MA Aristotle University of Thessaloniki, MA Hellenic Open University, PhD Aristotle University of Thessaloniki
- Casino Fran, BSc in Computer Science, URV, MSc in Computer Security and Intelligent Systems, URV, PhD in Computer Science, Rovira i Virgili University
- Dasaklis Thomas, Department of Industrial Management and Technology, University of Piraeus, MSc NTUA, University of Piraeus, PhD University of Piraeus
- Dimitropoulos Charalampos, Elec. & Elec. Eng. City University London, PhD University of London
- Dritsou Vicky, BSc in Informatics, AUEB, MSc in Information Systems, AUEB, PhD in Informatics, AUEB
- El Raheb Katerina, BSc in Chemical Engineering, NTUA, MSc & PhD, Dept. of Inform. and Telecom. UoA
- Gavrilis Dimitris, Elec. Comp. & Eng. University of Patras, PhD University of Patras
- Giannopoulos Giorgos, Elec. & Comp. Eng. NTUA, PhD NTUA
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- Grypari Ioanna, BSc in Applied Mathematics & Economics, Brown University, MSc LSE, PhD in Economics, University of Minnesota
- Kanellos Ilias, Elec. & Comp. Eng. NTUA, PhD NTUA
- Karagiannis Fotis, Elec. & Comp. Eng. NTUA, PhD NTUA
- Katifori Akrivi, BSc, MSc, PhD, Dept. of Inform. and Telecom. UoA
- Konaxis Christos, Dept. of Mathematics UoA, PhD . Dept Informatics & Telecoms, UoA
- Mailis Theofilos, Elec. & Comp. Eng. NTUA, PhD NTUA
- Mihota Alexandra, BSc, MSc, PhD, Dept. of Digital Systems, University of Piraeus
- Ntantogian Christoforos, BSc, MSc, PhD, Dept. of Inform. and Telecom. UoA
- Papastefanatos George, Elec. & Comp. Eng. NTUA, PhD NTUA
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- Ragia Lemonia, Department of Rural and Surveying Engineering, Aristotle University of Thessaloniki, PhD University of Bonn
- Raouzaïou Amaryllis, Elec. & Comp. Eng. NTUA, MSc & PhD NTUA
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- Tsiavos Prodromos, Dep. of Law UoA, Master of Laws (LL.M), Univ. of London, MSc Analysis Design & Management of Information Systems, LSE & Political Science, PhD LSE
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