



# AIAI2016

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Artificial Intelligence (AI) is a rapidly evolving and growing research area. During the last decades it has expanded from a field of promise to one of actual delivery, with good practical application in almost every scientific domain. More specifically, during the last 5 years, AI algorithms are applied more and more by Google in Facebook, by Microsoft (e.g. the CNTK that is an open source deep learning toolkit on GitHub) by Amazon and by Baidu in China. The common core of all these recent research efforts is deep learning. Joaquin Candela, head of Facebook's Applied Machine Learning group, stated: *"We're trying to build more than 1.5 billion AI agents, one for every person who uses Facebook or any of its products"*. Facebook is using a machine learning platform known as the FBLeaRner Flow. In fact, Facebook is already building AI that builds AI! Deep Learning, deep neural networks, multi agent systems and autonomous agents, image processing, biologically inspired neural networks (spiking ANN) are already a reality. Deep neural networks are changing the Internet.

The International Federation for Information Processing (IFIP) was founded in 1960 under the auspices of UNESCO, following the first historical World Computer Congress held in Paris in 1959. The 1<sup>st</sup> AIAI conference (Artificial Intelligence Applications and Innovations) was organized in Toulouse, France in 2004 by the IFIP. Since then, it has always been technically supported by the Working Group 12.5 *"Artificial Intelligence Applications"*. After 12 years of continuous presence, it has become a well known and recognized mature event, offering AI scientists from all over the globe, the chance to present their research achievements and to cope with the AI research explosion that is taking place in a meteoric speed. The 12<sup>th</sup> AIAI was held in Thessaloniki Greece, during September 16-18, 2016.

Following a long standing tradition, this Springer volume belongs to the IFIP AICT series and it contains the accepted papers that were presented orally in the AIAI 2016 main conference and in the workshops that were held as parallel events. Three workshops were organized, by invitation to prominent and distinguished colleagues, namely:

- The 3<sup>rd</sup> MT4BD 2016 (Workshop on New Methods and Tools for Big Data)
- The 5<sup>th</sup> MHDW 2016 (Mining Humanistic Data Workshop) and
- The 1<sup>st</sup> 5G-PINE (Workshop on 5G-Putting Intelligence to the Network Edge)

It is interesting that two of the above workshops have a continuous presence in the AIAI events, which means that they are well established in the AI community.

All papers went through a peer review process by at least 2 independent academic referees. Where needed, a third and a fourth referee were consulted to resolve any potential conflicts. For the 12<sup>th</sup> AIAI conference, totally 65 papers were submitted. Out of these submissions, 30 papers (46.15%) were accepted for oral presentation as full ones and 8 as short.

All workshops had a high correspondence from scientists from all parts of Europe and some from Asia (e.g. UK, Greece, India, Italy, Spain, Turkey) and we would like to thank all participants for this. The workshops received totally 33 submissions of which 17 were accepted as full papers while 7 were selected to be presented as short ones.

The 12<sup>th</sup> organization of AIAI is a real proof of the brand name that the conference has gained among the circles of the international scientific community. After so many years of hard efforts, it is recorded as a mature event with loyal followers and it has plenty of new and qualitative research results to offer to the international scientific community. We hope that the readers of these proceedings will be highly motivated and stimulated for further research in the domain of AI in general.

September 2016

Lazaros Iliadis  
Ilias Maglogiannis

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## Barbara Hammer



Barbara Hammer received her Ph.D. in Computer Science in 1995 and her *venia legendi* in Computer Science in 2003, both from the University of Osnabrueck, Germany. From 2000-2004, she was chair of the junior research group 'Learning with Neural Methods on Structured Data' at University of Osnabrueck before accepting an offer as professor for Theoretical Computer Science at Clausthal University of Technology, Germany, in 2004. Since 2010, she is holding a professorship for Theoretical Computer Science for Cognitive Systems at the CITEC cluster of excellence at Bielefeld University, Germany. Several research stays have taken her to Italy, U.K., India, France, the Netherlands, and the U.S.A. Her areas of expertise include hybrid systems, self-organizing maps, clustering, and recurrent networks as well as applications in bioinformatics, industrial process monitoring, or cognitive science. She has been chairing the IEEE CIS Technical Committee on Data Mining in 2013 and 2014, and she is chair of the Fachgruppe Neural Networks of the GI and vice-chair of the GNNS. She has been elected as IEEE CIS AdCom member for 2016-2018. She has published more than 200 contributions to international conferences / journals, and she is coauthor/editor of four books.

### Discriminative dimensionality reduction for data inspection and classifier visualization

The amount of electronic data available today increases rapidly; hence humans rely on automated tools which allow them to intuitively scan data volumes for valuable information. Dimensionality reducing data visualization, which displays high dimensional data in two or three dimensions, constitutes a popular tool to directly visualize data sets on the computer screen. Dimensionality reduction, however, is an inherently ill-posed problem, and the results vary depending on the chosen technology, the parameters, and even random aspects of the algorithms — there is a high risk to display noise instead of valuable information.

In the presentation, we discuss discriminative dimensionality reduction techniques, i.e. methods which enhance a dimensionality reduction method by auxiliary information such as class labels. This allows the practitioner to easily focus on those aspects he is interested in rather than noise. We will discuss two different approaches in this realm, which rely on a parametric resp. non-parametric metric-learning scheme, and display their effect in several benchmarks. We discuss how these methods can be extended to non-vectorial and big data, and how they open the door to a visualization of not only the given data but any given classifier.

## Aristidis Likas



Aristidis Likas is a Professor in the Department of Computer Science and Engineering of the University of Ioannina, Greece. He received the Diploma in electrical engineering from the National Technical University of Athens, Greece, in 1990 and the Ph.D. degree in electrical and computer engineering from the same university in 1994. Since 1996, he has been with the Department of Computer Science and Engineering, University of Ioannina, Greece. He is interested in developing methods for machine learning/data mining problems (mainly classification, clustering, statistical and Bayesian learning) and in the application of those methods to video analysis, computer vision, medical diagnosis, bioinformatics and text mining. His recent research focuses on techniques for estimating the number of clusters, kernel-based clustering and multi-view clustering. He has published more than 80 journal papers and more than 80 conference papers attracting more than 5000 citations. Recently, he received a Best Paper Award at the ICPR 2014 conference. He has participated in several National and European research and development projects. He is a Senior Member of the IEEE. He served as an Associate Editor of the IEEE Trans. on Neural Networks journal and as General co-Chair of the ECML PKDD 2011 and the SETN 2014 conferences.

### Number of clusters estimation, multi-view clustering and their use for video summarization

Clustering constitutes an essential problem in machine learning and data mining with important applications in science, technology and business. The aim is to partition a dataset into groups, called clusters, such that instances falling in the same cluster are similar to each other and dissimilar to those of other clusters according to some similarity/dissimilarity measure. A significant issue in clustering research is the estimation of the number of clusters in a dataset. We will present the recently proposed 'dip-dist' criterion for estimating the homogeneity of a group of instances based on statistical tests of unimodality. Then we will describe the use of this criterion for developing incremental and agglomerative clustering methods that automatically estimate the number of clusters. We will also briefly discuss analogous methods for sequence segmentation that use the dip-dist criterion for deciding on segment boundaries. Another active area of clustering research relates to multi-view clustering. In this case multiple representations (views) are available for each data instance, coming from different sources and/or feature spaces. Typical multi-view approaches treat all available views as being equally important, which may lead to a considerable drop in performance if degenerate views (e.g. noisy views) exist in the dataset. We will present approaches that assign a weight to each view. Such weights are automatically tuned to reflect the quality of the views and determine their contribution to the clustering solution accordingly. Finally, we will present our experience from the application of the above methods for video summarization, and, more specifically, for video sequence segmentation and extraction of representative key-frames.



## Jan Peters



*Jan Peters is a full professor (W3) for Intelligent Autonomous Systems at the Computer Science Department of the Technische Universitaet Darmstadt and at the same time a senior research scientist and group leader at the Max-Planck Institute for Intelligent Systems, where he heads the interdepartmental Robot Learning Group.*

*Jan Peters has received the Dick Volz Best 2007 US PhD Thesis Runner-Up Award, the Robotics: Science & Systems – Early Career Spotlight, the INNS Young Investigator Award, and the IEEE*

*Robotics & Automation Society's Early Career Award. Jan Peters has been honored for the development of new approaches to robot learning, robot architecture and robotic methods and their applications for humanoid robots. In 2015, he was awarded an ERC Starting Grant. Jan Peters has studied Computer Science, Electrical, Mechanical and Control Engineering at TU Munich and FernUni Hagen in Germany, at the National University of Singapore (NUS) and the University of Southern California (USC). He has received four Master's degrees in these disciplines as well as a Computer Science PhD from USC.*

### Machine Learning of Motor Skills for Robots: From Simple Skills to Table Tennis and Manipulation

Autonomous robots that can assist humans in situations of daily life have been a long standing vision of robotics, artificial intelligence, and cognitive sciences. A first step towards this goal is to create robots that can learn tasks triggered by environmental context or higher level instruction. However, learning techniques have yet to live up to this promise as only few methods manage to scale to high-dimensional manipulator or humanoid robots. In this talk, we investigate a general framework suitable for learning motor skills in robotics which is based on the principles behind many analytical robotics approaches. It involves generating a representation of motor skills by parameterized motor primitive policies acting as building blocks of movement generation, and a learned task execution module that transforms these movements into motor commands. We discuss learning on three different levels of abstraction, i.e., learning for accurate control is needed to execute, learning of motor primitives is needed to acquire simple movements, and learning of the task-dependent, „hyperparameters“ of these motor primitives allows learning complex tasks. We discuss task-appropriate learning approaches for imitation learning, model learning and reinforcement learning for robots with many degrees of freedom. Empirical evaluations on several robot systems illustrate the effectiveness and applicability to learning control on an anthropomorphic robot arm. These robot motor skills range from toy examples (e.g., paddling a ball, ball-in-a-cup) to playing robot table tennis against a human being and manipulation of various objects.

## Harris Papadopoulos



*Harris Papadopoulos is an Assistant Professor at the Department of Computer Science and Engineering of Frederick University where he is also heading the Machine Learning division of the Computational Intelligence (COIN) Laboratory. He obtained his PhD in Machine Learning from Royal Holloway University of London, UK in 2004. His research interests focus on the development of machine learning techniques that accompany their predictions with well-calibrated measures of confidence and their applications to a variety of problems. He published more than 50 research papers in international refereed journals and conferences and co-edited the book "Measures of Complexity: Festschrift in Honor of Alexey Chervonenkis", Springer. He has received several research grants from national research funding programmes and the industry. He is an Associate Editor of the Evolving Systems Journal (Springer) and he served as guest editor and reviewer for numerous journals. He also organized several international conferences and workshops.*

### Uncertainty Quantification in Machine Learning using Conformal Prediction

Quantifying the uncertainty of predictions produced by classification and regression techniques is of paramount importance in real-world applications and especially in risk sensitive domains. Conformal Prediction (CP) is a recently developed framework, based on ideas originating from the theory of algorithmic randomness (closely connected to Kolmogorov Complexity), for complementing the predictions of Machine Learning techniques with reliable measures of confidence. Unlike the probability/confidence values produced by other approaches the confidence measures produced by CP are provably valid under only the assumption that the data are generated independently by the same probability distribution (i.i.d.) and have a clear probabilistic interpretation. Moreover the flexibility of the framework allows it to be used for extending almost any conventional Machine Learning algorithm into a reliable confidence predictor. Both these properties make it ideal for use in real-world applications.

Since its development, the framework has been used for extending a number of popular Machine Learning techniques such as Support Vector Machines, Artificial Neural Networks and Random Forests and has been successfully applied to a variety of challenging real-world problems ranging from medical decision support to the prediction of space weather. The promising results and the guarantee of well-calibrated confidence measures, led to the development of extensions of the framework to additional problem settings such as semi-supervised learning, anomaly detection, feature selection, outlier detection, change detection in streams and active learning. This tutorial will present the CP framework from a practical point of view focusing on examples, with the aim of demonstrating the qualities of the framework and providing attendees with the main know-how needed to start utilizing it in their work.

5<sup>th</sup> Mining Humanistic Data Workshop**MHDW 2016**

<https://conferences.cwa.gr/mhdw2016/>

The abundance of available data that is retrieved from or is related to the areas of Humanities and the human condition challenges the research community in processing and analyzing it. The aim is two-fold: on the one hand, to extract knowledge that will help understand human behavior, creativity, way of thinking, reasoning, learning, decision making, socializing and even biological processes; on the other hand, to exploit the extracted knowledge by incorporating it into intelligent systems that will support humans in their everyday activities.

The nature of humanistic data can be multimodal, semantically heterogeneous, dynamic, time and space-dependent, and highly complicated. Translating humanistic information, e.g. behavior, state of mind, artistic creation, linguistic utterance, learning and genomic information into numerical or categorical low-level data is a significant challenge on its own. New techniques, appropriate to deal with this type of data, need to be proposed and existing ones adapted to its special characteristics.

The workshop aims to bring together interdisciplinary approaches that focus on the application of innovative as well as existing data matching, fusion and mining and knowledge discovery and management techniques (like decision rules, decision trees, association rules, ontologies and alignments, clustering, filtering, learning, classifier systems, neural networks, support vector machines, preprocessing, post processing, feature selection, visualization techniques) to data derived from all areas of Humanistic Sciences, e.g. linguistic, historical, behavioral, psychological, artistic, musical, educational, social etc., Ubiquitous Computing and Bioinformatics.

Ubiquitous Computing applications (aka Pervasive Computing, Mobile Computing, Ambient Intelligence, etc.) collect large volumes of usually heterogeneous data in order to effect adaptation, learning and in general context awareness. Data matching, fusion and mining techniques are necessary to ensure human centred application functionality.

An important aspect of humanistics centers around managing, processing and computationally analyzing Biological and Biomedical data. Hence, one of the aims of this workshop will be to also attract researchers that are interested in designing, developing and applying efficient data and text mining techniques for discovering the underlying knowledge existing in Biomedical data, such as sequences, gene expressions and pathways.

Topics of interest include but are not limited to:

- Humanistic data collection and interpretation
- Data pre-processing
- Feature selection methodologies
- Supervised or unsupervised learning of humanistic knowledge
- Clustering/Classification techniques
- Fuzzy modeling
- Heterogeneous data fusion
- Knowledge representation and reasoning
- Linguistic data mining
- Educational data mining
- Music information retrieval
- Data-driven profiling/personalization
- User modeling
- Behavior prediction
- Recommender systems
- Web sentiment analysis
- Social data mining
- Data visualization techniques
- Integration of data mining results into real-world applications with humanistic context
- Ontologies, ontology matching and alignment
- Mining humanistic data in the cloud
- Game data mining
- Virtual-world data mining
- Speech and audio data processing
- Data mining techniques for knowledge discovery
- Biomedical data mining
- Bioinformatics
- Content creation, annotation and modeling for semantic and social web
- Computational intelligence for media adaptation and personalization
- Semantics-driven indexing and retrieval of multimedia contents
- Semantic context modeling and extraction
- Context-aware applications
- Social web economics and business
- Privacy/security issues in social and personalized applications
- Privacy preserving data mining and social networks
- Social data analytic

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### 3<sup>rd</sup> Workshop on New Methods and Tools for Big Data

#### MT4BD 2016

<http://mt4bd.ceid.upatras.gr/>

The provision of large amount of data from various sources (Internet, Social Media, Application Logs, Data Warehouses, Sensors, Mobiles, Open Data, etc.) is now emerging into the collection and processing of “Big Data”. While Big Data notion is adopted by both academic and enterprise communities, there is currently a wide gap between its potential and its realization. Variety, velocity, scale, complexity, interpretation and security problems with Big Data raise challenges at all phases of the pipeline that can extract information and knowledge from it. Thus, there is a natural interest in using these data assets to improve a variety of applications. It is very interesting to explore how researchers utilize data-driven strategies and discover what disciplines will change because of the advent of data. With the vast amount of data now available, modern businesses are facing the challenges of storage, management, analysis, privacy, visualization, security and data integration. The aim of 3<sup>rd</sup> Workshop on “New Methods and Tools for Big Data (MT4BD-2016)” is to serve as an interdisciplinary forum for bringing together specialists from the scientific areas of Computer Engineering, Bioinformatics-Personalized Medicine, Finance and Operational Research. The focus of this workshop is on current technological advances and challenges about the development of big data-driven algorithms and methods and tools. Furthermore, it would be very interesting to investigate if the use of a vast amount of data leads to more accurate models or not.

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## Seferina Mavroudi



*Dr. Seferina Mavroudi is a lecturer in the Department of Social Work of the TEI of Western Greece and worked as an adjunct lecturer (407/80) in the Department of Computer Engineering and Informatics of the University of Patras, Greece. Her research interests include computational intelligence, bioinformatics, and scientific computing. She graduated in 1998 from the Department of Electrical and Computer Engineering, School of Engineering of the Aristotle University of Thessaloniki. In 2000 she received a Master's degree from the European Postgraduate*

*Program on Biomedical Engineering, organized by the Faculty of Medicine of the University of Patras, the Faculty of Mechanical Engineering and the Faculty of Electrical and Computer Engineering of the National Technical University of Athens, in collaboration with more than 20 European Universities. In the same program, in February of the year 2003 she completed her Ph.D. Thesis with title "Development of advanced computational intelligence models for complex bioinformatics – and biosignal processing applications". During her phd studies she visited the Bioinformatics Center of the University of Pennsylvania as a visiting researcher. She has over 40 publications in international scientific journals, proceedings of international conferences and book chapters.*

### Machine Learning Based Bioinformatics as a Tool for Big-Bata Analytics on Molecular Biology Datasets

Deciphering the underlying biological mechanisms that lead to disease could pave the way for personalized medicine hopefully leading to early prevention of disease and drugs with minimal side-effects. Fulfilling this premise however is very demanding since Biology is complex, with thousands of key players interacting with each other in systems at various scales. In the light of the curse of dimensionality it is obvious that only the advent of big data in modern molecular biology provides the ground for building meaningful models that could formulate novel hypothesis. Moreover, extracting valuable biological knowledge in such environments is usually not feasible with simple statistical methods and sophisticated machine learning paradigms have to be encountered.

In the present talk we will briefly introduce the systems biology perspective according to which all essential biological molecules from genes, proteins, metabolites to cells and organs form "a network of networks". We will mention the genomic, proteomic and other heterogeneous medical data sources of big data production and we will ultimately elaborate on the analysis of these kinds of data with modern machine learning techniques. The challenges, pitfalls and perspectives of the analysis will be discussed.

Specific case studies concerning proteomic and transcriptomic data analysis aiming at biomarker discovery will be presented. The first case study is related to big

data proteomics analysis and specifically to the case of analyzing TMT based Mass Spectrometry datasets which is not only a big data problem but is also related to complex analysis steps. Due to the huge amount of the processing data, standard approaches and serial implementations fail to deliver high quality biomarkers while being extremely time consuming. For this task machine learning and more specifically meta-heuristic methods were deployed combined with high performance parallel computing techniques to provide biomarkers of increased predictive accuracy with feasible and realistic time requirements.

The second case study which will be presented includes big data analytics on transcriptomics data related to the diagnosis of early stage Parkinson disease. Specifically, a unique network medicine pipeline has been used to combine multiple gene expression datasets created from both microarrays and RNA-sequencing experiments. The proposed methodology not only uncovered significantly fewer biomarkers than the standard approach but also came out with a set of biomarkers which present higher predictive performance and are highly relevant to the underlying mechanisms of Parkinson disease. Cloud computing technology has been used to ease the application of the proposed pipeline in multiple datasets.

## 1<sup>st</sup> Workshop on 5G – Putting Intelligence to the Network Edge

### 5G-PINE 2016

<http://83.212.99.227/conference/>

Internet grows into a more “complex” and “sophisticated” entity than it was originally intended to be some years ago. Actually, it is much more than “simply a modern communication system” as it comprises of numerous essential parts and/or “components” of modern networks, platforms, infrastructures and of related (usually innovative) facilities together with multi-generated “content” and a variety of connected equipment and devices. Internet is the essential “core” of our modern world towards creating a real knowledge-based society and a variety of businesses providing numerous challenges for development and growth. New and unexpected applications and services are nowadays emerging from cutting-edge technological developments that “shape” the requirements for future progress and this dynamic evolution makes the entire context of reference “more fascinating”. Internet’s rapid evolution also influences socio-economic, environmental and cultural aspects of modern society. The Future (Internet-based) Networks aim to enable smart connectivity for all, anywhere, at any time at the highest speed and efficiency fulfilling the overwhelming demands of today’s modern societies, but also overcoming challenges about security, privacy, etc.

The convergence of telecommunications and IT systems in future networks will also result in open platforms, which will enable new opportunities for innovation and new business models, especially for the SMEs. This will in turn require more systematic adoption of software defined networking (SDN) concepts to adapt future networks to new requirements allowing continuous and fast innovation cycles in the communication infrastructures and in the Internet.

In any case, the communication network and service environment of the future will be enormously enhanced and much more complex than the one of today. The corresponding network infrastructures will be capable of connecting everything according to a diversity of application specific requirements that is: People, things, processes, computing centres, content, knowledge, information, goods; and all these in a quite flexible, really mobile, and powerful way. Thus, it is expected that the Future Internet (FI) -based context will encompass an intense variety of connected sensors, connected (smart) vehicles, smart meters and smart home gadgets way beyond our current experience of tablet and smartphone connectivity. As a consequence, the 5G technological framework promotes the design/establishment and operation of a next generation network that will provide reliable, omnipresent, ultra-low latency, broadband connectivity, and will be able of managing critical and demanding applications/services, which are

further modified by new challenging personalised applications, proliferate at an immense rate.

Therefore, 5G aims to deliver intelligence directly to network’s edge, exploiting the emerging paradigms of Network Functions Virtualisation (NFV) and Edge Cloud Computing (ECC). In particular, 5G targets at offering rich virtualisation and multi-tenant capabilities, not only in term of partitioning network capacity among multiple tenants, but also offering dynamic processing capabilities on-demand, optimally deployed close to the user. Moreover, the Small Cell concept, will be enriched in the context of 5G with virtualization and edge computing capabilities, so as to support improved cellular coverage, capacity and applications for homes and enterprises, as well as dense metropolitan and rural public spaces in a dynamic and flexible manner.

The potential benefits from such a combined approach of Network Virtualization, Edge Computing and Small Cells trigger the interest of Communications Service Providers (CSPs) such as Mobile Network Operators (MNO), Mobile Virtual Network Operators (MVNO) and Over-The-Top (OTT) content and service providers, by generating the emerging of new business models and allowing them to gain an extra share in the network market by pursuing emerging business models.

Among others, the Special Session on “5G- Intelligence at the Network Edge” aims to investigate and give answers to the following research questions:

What are the requirements for the successful “combination” of the three fundamental concepts, i.e. NFV, Small Cells and Edge Computing?

- Which applications/services may benefit most, e.g., Internet of Things and Fog Computing?
- Which may be the new business models that may arise due to the “Intelligence at the network edge”?
- What are the security and privacy implications of placing intelligence at the network edge?
- How to guarantee continuity and quality of service, also within the framework of the wider “quality of experience”, while placing intelligence at the network edge?
- Are there any foreseen trade-offs, e.g., low latency vs. increase of intra-domain traffic?
- How to handle the explosion of the traffic and provide the necessary capacity, spectrum?
- How to flexibly accommodate novel classes of services (IoT, M2M, or content-based, and others which are not known today) whilst keeping low CAPEX and OPEX?

## PROGRAM CHAIRS

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**Nikolaos Bompetsis**, *OTE, Greece*

FRI16

08:30-09:00	REGISTRATION	
09:00-10:00	Plenary 1 - Keynote <b>HAMMER</b> pages 8, 24	
10:00-11:40	Session 1 <b>MAIM</b> pages 24	Session 2 <b>CLASPR</b> pages 25
11:40-12:00	COFFEE	
12:00-13:20	Session 3 <b>OWESOM</b> pages 26	Session 4 <b>ENAIM</b> pages 27
13:20-14:20	LUNCH	
14:20-15:35	Workshop <b>MHDW1</b> pages 12, 26	Session 5 <b>AIRUMO</b> pages 27
15:35-16:00	COFFEE	
16:00-17:00	Workshop <b>MT4BD1</b> pages 15, 28	Workshop <b>MHDW2</b> pages 12, 29
17:05-18:45	Workshop <b>MT4BD2</b> pages 15, 28	
.....		
19:00-20:00	WELCOME RECEPTION	

↑  
ROOM A

↑  
ROOM B

SAT17

08:30-09:00	REGISTRATION	
09:00-10:00	Plenary 2 - Keynote <b>PETERS</b> pages 10, 30	
10:00-11:20	Session 6 <b>MALL</b> pages 30	Session 7 <b>OP SVM</b> pages 31
11:20-11:40	COFFEE	
11:40-13:00	Session 3 <b>AROC</b> pages 30	Session 4 <b>ANNMO</b> pages 31
13:00-14:00	LUNCH	
14:00-15:00	Plenary 3 - Tutorial <b>PAPADOPOULOS</b> pages 11, 32	
15:05-16:35	Workshop <b>MHDW3</b> pages 12, 32	Workshop <b>5G-PINE</b> pages 18, 33
16:35-17:00	COFFEE	
17:00-18:00	Plenary 4 - Keynote <b>LIKAS</b> pages 9, 34	
18:00-18:15	CLOSING SESSION	
.....		
21:00	CONFERENCE DINNER	

↑  
ROOM A

↑  
ROOM B

SUN18

09:30	Departure
GUIDED TRIP TO VERGINA	

- KEYNOTES / TUTORIAL
- MAIN SESSIONS
- WORKSHOPS



Full Papers are assigned 20 minutes  
Short Papers are assigned 15 minutes  
Workshop Papers are assigned 15 minutes

08:30  
↓  
09:00

Registration

Room A

09:00  
↓  
10:00

**Plenary Session 1**  
Keynote  
**Discriminative Dimensionality Reduction for Data Inspection and Classifier Visualization**  
**Barbara Hammer**

Chair **Ilias Maglogiannis, Greece**

10:00  
↓  
11:40

Room A **MAIM** AIAI Session 1  
**Medical Artificial Intelligence Modeling**

Chair **Harris Papadopoulos, Greece**

*Terence Fusco and Yaxin Bi (full)*

**A Cumulative Training Approach to Schistosomiasis Vector Density Prediction**

*Ana Silva, Tiago Oliveira, Vicente Julian, Jose Neves and Paulo Novais (full)*

**A Mobile and Evolving Tool to Predict Colorectal Cancer Survivability (full)**

*Mandani Ntekouli, Maria Marouli, Georgia Konstantopoulou, George Anastassopoulos and Dimitrios Lymperopoulos (full)*

**An Implementation of a Decision-Making Algorithm Based on a Novel Health Status Transition Model of Epilepsy (full)**

*Georgia Kontogianni, Olga Papadodima, Ilias Maglogiannis, Konstantina Frangia-Tsivou and Aristotelis Chatziioannou (full)*

**Integrative Bioinformatic Analysis of a Greek Epidemiological Cohort Provides Insight into the Pathogenesis of Primary Cutaneous Melanoma (full)**

*Theodoros Iliou, Georgia Konstantopoulou, Mandani Ntekouli, Dimitrios Lymperopoulos, Konstantinos Assimakopoulos, Dimitrios Galiatsatos and George Anastassopoulos (short)*

**Machine Learning Preprocessing Method for Suicide Prediction (short)**

11:40  
↓  
12:00

Coffee break

10:00  
↓  
11:40

AIAI Session 2 **CLASPR** Room B  
**Classification – Pattern Recognition**

Chair **Nikolaos Mitianoudis, Greece**

*Jean Marc Pokou, Philippe Fournier-Viger and Chadia Moghrabi (full)*

**Using Frequent Fixed or Variable-Length POS Ngrams or Skip-grams for Blog Authorship Attribution**

*Christos K. Aridas, Sotiris Kotsiantis and Michael Vrahatis (full)*

**Increasing diversity in Random Forests using Naive Bayes**

*Konstantinos Arvanitakis and Markos Avlonitis (full)*

**Identifying Asperity Patterns via Machine Learning Algorithms**

*Christos K. Aridas, Sotiris B. Kotsiantis and Michael N. Vrahatis (full)*

**Combining Prototype Selection with Local Boosting**

*Spiros Georgakopoulos, Konstantina Kottarii, Konstantinos Delibasis, Vassilis Plagianakos and Ilias Maglogiannis (full)*

**Convolutional Neural Networks for Pose Recognition in Binary Omni-Directional Images**

11:40  
↓  
12:00

Coffee break

Room A

OWESOM

**Ontology-Web & Social Media AI Modeling**

AIAI Session 3

Chair **Phivos Mylonas, Greece**

*Michalis Vafopoulos, Gerasimos Razis, Ioannis Anagnostopoulos, Georgios Vafeiadis, Dimitrios Negkas, Eleftherios Galanos, Aggelos Tzani, Ilias Skaros and Konstantinos Glykos* (full)

**The eLOD Ontology: Modeling Economic Open Data**

*Nicolas Tsapatsoulis* (full)

**Web Image Indexing Using WICE and a Learning-free Language Model**

*Will Serrano and Erol Gelenbe* (full)

**An Intelligent Internet Search Assistant based on the Random Neural Network**

*Tomas Gogar, Ondrej Hubacek and Jan Sedivy* (short)

**Deep Neural Networks for Web Page Information Extraction**

Lunch

Room A

MHDW1

**Mining Humanistic Data**

Workshop

Chair **Katia Kermanidis, Greece**

*Christos Makris and Pantelis Vikatos* (short)

**Community Detection of Screenplay Characters**

*Vasileios Athanasiou and Manolis Maragoudakis* (full)

**Dealing with High Dimensional Sentiment Data Using Gradient Boosting Machines**

*Marios Koniaris, Ioannis Anagnostopoulos and Yannis Vassiliou* (full)

**Diversifying the Legal Order**

*Evaggelos Spyrou, Apostolos Psallas, Vasileios Charalampidis and Phivos Mylonas* (short)

**Discovering Areas of Interest using a Semantic Geo-Clustering Approach**

Coffee break

ENAIM

Room B

AIAI Session 4

**Environmental AI Modeling**

Chair **Georgios Anastassopoulos, Greece**

*George Tsekouras* (full)

**Modeling Beach Rotation Using a Novel Legendre Polynomial Feedforward Neural Network Trained by Nonlinear Constrained Optimization**

*Romanos Kalamatianos, Katia Kermanidis, Markos Avlonitis and Ioannis Karydis* (full)

**Environmental Impact on Predicting Olive Fruit Fly Population Using Trap Measurements**

*Vardis Dimitrios Anezakis, Kostantinos Demertzis, Lazaros Iliadis and Stefanos Spartalis* (full)

**A Hybrid Soft Computing Approach Producing Robust Forest Fire Risk Indices**

*Mihaela Oprea, Sanda Florentina Mihalache and Marian Popescu* (short)

**Applying Artificial Neural Networks to Short-Term PM2.5 Forecasting Modeling**

Lunch

AIRUMO

Room B

AIAI Session 5

**AI Rule Based Modeling**

Chair **George Tsekouras, Greece**

*Lucas Rizzo, Pierpaolo Dondio, Sarah Jane Delany, and Luca Longo* (full)

**Modeling mental workload via a rule-based expert system: a comparison with NASA-TLX & Workload Profile**

*Dimitrios Mallis, Thomas Sgouros and Nikolaos Mitianoudis* (full)

**Convolutional Audio Source Separation using Robust ICA and reduced Likelihood Ratio Jump**

*S. Mohssen Ghafari and Christos Tjortjis* (full)

**Association Rules Mining Using the Imperialism Competitive Algorithm (ARMICA)**

*Jan Boril, Miroslav Jirgl and Rudolf Jalovecky* (short)

**Use of Flight Simulators in Analyzing Pilot Behavior**

Coffee break

16:00  
↓  
17:00

Room A

MT4BD1

**New Methods and Tools for Big Data**

Workshop

Chair **Seferina Mavroudi**, Greece

*Dimitrios Tzovaras, Dimosthenis Ioannidis, Stelios Krinidis, Spiridon Likothanassis and Pantelis Tropios* (full)

**Building Multi-Occupancy Analysis & Visualization through Data Intensive Processing**

*Sevasti Bostantjopoulou, Charalambos Papaxanthis, Dimitrios Tzovaras, Anastasios Drosou, Elias Kalamaras, Zoe Katsarou, Konstantinos Votis, Panagiotis Moschonas, Stavros Papadopoulos and Vassilia Hatzitaki* (full)

**Discovering the Discriminating Power in Patient Test Features using Visual Analytics: A Case Study in Parkinson's Disease**

*Ali Yazici, Cansu Gokhan, Ziya Karakaya* (short)

**Systematic Mapping Study on Performance Scalability in Big Data on Cloud Using VM and Container**

Room A

MT4BD2

**New Methods and Tools for Big Data**

Workshop

Chair **Spiros Likothanassis**, Greece

Keynote

*Seferina Mavroudi*

**Machine Learning Based Bioinformatics as a Tool for Big-Bata Analytics on Molecular Biology Datasets**

*Christos Alexakos, Thomas Amorgianiotis, Andreas Papalambrou, George Raptis, Konstantinos Arvanitis and Nikolaos Zervos* (full)

**ERMIS: Extracting Knowledge from Unstructured Big Data for Supporting Business Decision Making**

*Christos Alexakos, Georgios Alexopoulos, Konstantinos Giannoulis, Konstantinos Theofilatos, Spiros Likothanassis, Seferina Mavroudi, Charalampos Moschopoulos, Georgios Panges-Tserres, Maria Tserirzoglou-Thoma and Eleni Tsitsouli* (full)

**Superclusteroid 2.0: A Web Tool for Processing Big Biological Networks**

*Achilleas Chytas, Dimitris Babalis, Dimitris Georgopoulos, Ioanna Chouvarda, Nicos Maglaveras, Katerina Vaporidi* (short)

**Ineffective Efforts in ICU Assisted Ventilation: Feature Extraction and Analysis Platform**

Welcome Reception

19:00  
↓  
20:00

MHDW2

Room B

Workshop

**Mining Humanistic Data**

Chair **Manolis Maragkoudakis**, Greece

*Vassiliki Gkantouna, Giannis Tzimas, Basil Tampakas and John Tsaknakis* (full)

**Mining Domain-Specific Design Patterns**

*Ioannis Karydis, Aggelos Gkiokas and Vassilis Katsouras* (full)

**Musical Track Popularity Mining Dataset**

*Hasan Ogul and Basar Kirmaci* (full)

**Lyrics Mining for Music Meta-data Estimation**

*Maximos Kaliakatsos-Papakostas, Asterios Zacharakis, Costas Tsougras and Emilios Cambouropoulos* (short)

**Modelling Cadence Perception via Musical Parameter Tuning to Perceptual Data**

16:00  
↓  
17:15

Welcome Reception

19:00  
↓  
20:00

08:30  
↓  
09:00

Registration

Room A

**Plenary  
Session 2  
Keynote**

Machine Learning of Motor Skills for Robots:  
From Simple Skills to Table Tennis and Manipulation  
**Jan Peters**

Chair **Kostas Margaritis, Greece**

09:00  
↓  
10:00

Room A

**MALL**

Machine Learning-Learning

AIAI Session 6

Chair **Christos Makris, Greece**

*Everton Cherman, Grigorios Tsoumakas and Maria-Carolina Monard* (full)

**Active Learning Algorithms for Multi-label Data**

*Zohreh Akbari and Rainer Unland* (full)

**Automated Determination of the Input Parameter of DBSCAN Based on Outlier Detection**

*Yiannis Kokkinos and Konstantinos Margaritis* (full)

**Exemplar Selection via Leave-one-out Kernel Averaged Gradient Descent and Subtractive Clustering**

*Paul Stefan Popescu, Mihai Mocanu, Costellonascu and Cristian Mihaescu* (full)

**Design of an Advanced Smart Forum for Tesys e-Learning platform**

10:00  
↓  
11:20

11:20  
↓  
11:40

Coffee break

Room A

**AROC**

Agents-Robotics-Control

AIAI Session 8

Chair **Aristidis Likas, Greece**

*Ilias Sakellariou, Petros Kefalas, Suzie Savvidou, Ioanna Stamatopoulou and Marina Ntika* (full)

**The Role of Emotions, Mood, Personality and Contagion in Multi-agent System Decision Making**

11:40  
↓  
13:00

10:00  
↓  
11:20

**OPSV**

Room B

AIAI Session 7

Optimization-SVM

Chair **Ilias Sakellariou, Greece**

*Xanthoula Eirini Pantazi, Dimitrios Moshou, Alexandra Tamouridou and Stathis Kasderidis* (full)

**Leaf Disease Recognition in Vine Plants based on Local Binary Patterns and One Class Support Vector Machines**

*Stefanos Ougiaroglou, Konstantinos Diamantaras and Georgios Evangelidis* (full)

**Efficient Support Vector Machine Classification using Prototype Selection and Generation**

*Ilya Isaev and Ivan Smetannikov* (short)

**MeLiF+: Optimization of Filter Ensemble Algorithm with Parallel Computing**

*Viacheslav Shalamov, Andrey Filchenkov and Anatoly Shalyto* (short)

**Genetic Search of Pickup and Delivery Problem Solutions for Self-Driving Taxi Routing**

11:20  
↓  
11:40

Coffee break

**ANNMO**

Room B

AIAI Session 9

Artificial Neural Network Modeling

Chair **Petros Kefalas, Greece**

*Nestoras Georgiou, Andreas Konstantinidis and Harris Papadopoulos* (full)

**Malware Detection with Confidence Guarantees on Android Devices**

11:40  
↓  
13:00



Zhenglong Sun and Nico Roos (full)  
**A Controller for Improving Lateral Stability in a Dynamically Stable Gait**

Lochan Babani, Sadhana Jadhav and Bhalchandra Chaudhari (full)  
**Scaled Conjugate Gradient Based Adaptive ANN Control for SVM-DTC Induction Motor Drive**

Christina Semertzidou, Nikolaos Dourvas, Michail-Antisthenis I. Tsompanas, Andrew Adamatzky and Georgios Ch. Sirakoulis (short)  
**Introducing Chemotaxis to a Mobile Robot**

Tiehang Duan (full)  
**Auto Regressive Dynamic Bayesian Network and its Application in Stock Market Inference (full)**

Fotios Kalaganis, Dimitrios A. Adamos and Nikos Laskaris (full)  
**A consumer BCI for Automated Music Evaluation within a Popular On-demand Music Streaming Service**

Mehdi Ben Lazreg, Morten Goodwin and Ole-Christoffer Granmo (full)  
**Information Abstraction from Crises Related Tweets Using Recurrent Neural Network**

13:00  
↓  
14:00

Lunch

Lunch

13:00  
↓  
14:00

Room A

**Plenary Session 3**  
**Tutorial**  
**Uncertainty Quantification in Machine Learning using Conformal Prediction**  
**Harris Papadopoulos**

Chair **Konstantinos Diamantaras, Greece**

Room A

MHDW3

**Mining Humanistic Data**

Workshop

Chair **Nicolas Tsapatsoulis, Greece**

Costas S. Iliopoulos, RituKundu and Manal Mohamed (full)  
**Efficient Computation of Clustered-Clumps in Degenerate Strings**

Charalampos Michail, Aigli Korfiati, Konstantinos Theofilatos, Spiros Likothanassis and Seferina Mavroudi (full)  
**On the Computational Prediction of miRNA Promoters**

Maximos Kaliakatsos-Papakostas, Dimos Makris, Asterios Zacharakis, Costas Tsougras and Emiliios Cambouropoulos (short)  
**Learning and Blending Harmonies in the Context of a Melodic HarmonisationAssistant**

Emmanouil Stergiadis, Athanassios Kintsakis, Fotis Psomopoulos and Pericles Mitkas (short)  
**A Scalable Grid Computing Framework for Extensible Phylogenetic Profile Construction**

Stavros Anastasios Iakovou, Andreas Kanavos and Athanasios Tsakalidis (full)  
**Customer Behaviour Analysis for Recommendation of Supermarket Ware**

5G-PINE

Room B

Workshop

**5G – Putting Intelligence to the Network Edge**

Chair **Yiannis Kokkinos, Greece**

Ioannis Chochliouros, Anastasia Spiliopoulou, Vassilios Vassilakis, Mick Wilson, Charles Turyagyenda and Athanassios Dardamanis (full)  
**Security Analysis of Mobile Edge Computing in Virtualized Small Cell Networks**

Ioannis Chochliouros, Anastasia Spiliopoulou and Athanassios Dardamanis (full)  
**A Model for an Innovative 5G-oriented Architecture, based on Smalls Cells Coordination for Multi-Tenancy and Edge Services**

Leonardo Goratti, Cristina Costa, Jordi Perez-Romero, Oriol Sallent, Cristina Ruiz, August Betzler, Pouria Sayyad Khodashenas, SeiamakVahid, Karim Nasr, Babangida Abubakar, Alan Whitehead, Maria Belesioti and Ioannis Chochliouros (full)  
**Network Architecture and Essential Features for 5G: The SESAME Project Approach**

Juan Sanchez-Gonzalez, Jordi Pérez-Romero, Ramon Agusti and Oriol Sallent (full)  
**On Learning Mobility Patterns in Cellular Networks**

Bego Blanco, Jose Oscar Fajardo and Fidel Liberal (full)  
**Design of Cognitive Cycles in 5G Networks**

15:05  
↓  
16:35

16:35  
↓  
17:00

Coffee break

Room A

Plenary  
Session 4  
KeynoteMultimodality in Data Clustering:  
Application to Video Summarization  
**Aristidis Likas**Chair **Barbara Hammer**, Germany17:00  
↓  
18:00

Room A

Closing Session

Chair **Lazaros Iliadis**, Greece18:00  
↓  
18:1521:00  
↓

Conference Dinner

09:30  
↓

Departure to Vergina

Vergina is a small town in northern Greece, located in the regional unit of Imathia, Central Macedonia. Since the 2011 local government reform it is part of the municipality Veroia, of which it is a municipal unit.

The town is better known for its remains of Aigai, the first capital of Macedonia. It was here in 336 BC that Philip II was assassinated in the theatre and Alexander the Great was proclaimed king.

Aigai has been awarded UNESCO World Heritage Site status as "an exceptional testimony to a significant development in European civilization, at the transition from classical city-state to the imperial structure of the Hellenistic and Roman periods".

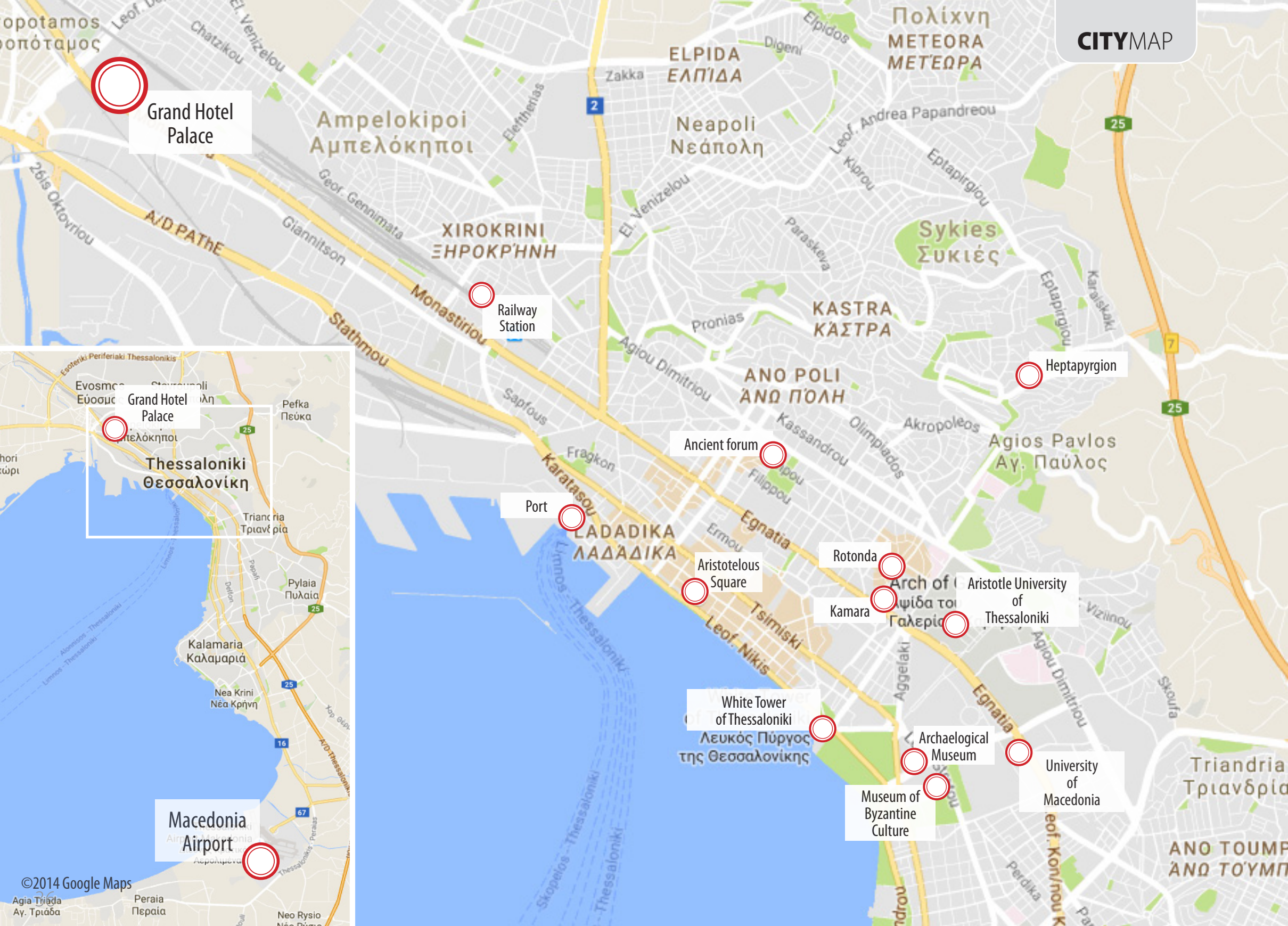
It became internationally famous in 1977, when the Greek archaeologist Manolis Andronikos unearthed the burial site of the kings of Macedon, including the tomb of Philip II, father of Alexander the Great which unlike so many other tombs had not been disturbed or looted. It is also the site of an extensive royal palace and of many rich ancient tombs. A museum now contains Philip's tomb and a new museum is being constructed for the palace and other finds. The objects and paintings found in the tombs at Vergina are also of extraordinarily high quality and historical importance.

The Greek archaeologist Manolis Andronikos became convinced that a hill called the Great Tumulus concealed the tombs of the Macedonian kings. In 1977, Andronikos undertook a six-week dig at the Great Tumulus and found four buried tombs, two of which had never been disturbed. Andronikos claimed that these were the burial sites of the kings of Macedon, including the tomb of Philip II, father of Alexander the Great (Tomb II) and also of Alexander IV of Macedon, son of Alexander the Great and Roxana (Tomb III). This view was challenged by some archaeologists, but in 2010 research based on detailed study of the skeletons, vindicated Andronikos and supports the evidence of facial asymmetry caused by a possible trauma of the cranium of the male, evidence that is consistent with the history of Philip II. More recent research by a team of Greek researchers has confirmed that the bones indeed belong to the Macedonian King Philip II.

From 1987 the burial cluster of the queens was discovered including the tomb of Queen Eurydice. In March 2014, five more royal tombs were discovered in Vergina, possibly belonging to Alexander I of Macedon and his family or to the family of Cassander of Macedon.

Some artifacts excavated at Vergina may be treated as influenced by Asian practices or even imported from Achaemenid Persia in late 6<sup>th</sup> and early 5<sup>th</sup> centuries BC, which is during the time Macedon was under the Persian sway.





Grand Hotel Palace

Railway Station

Heptapyrgion

Ancient forum

Port

Aristotelous Square

Rotonda

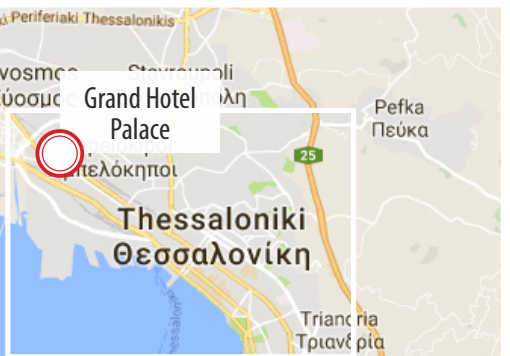
Kamara

Aristotle University of Thessaloniki

White Tower of Thessaloniki

Archaeological Museum  
Museum of Byzantine Culture

University of Macedonia

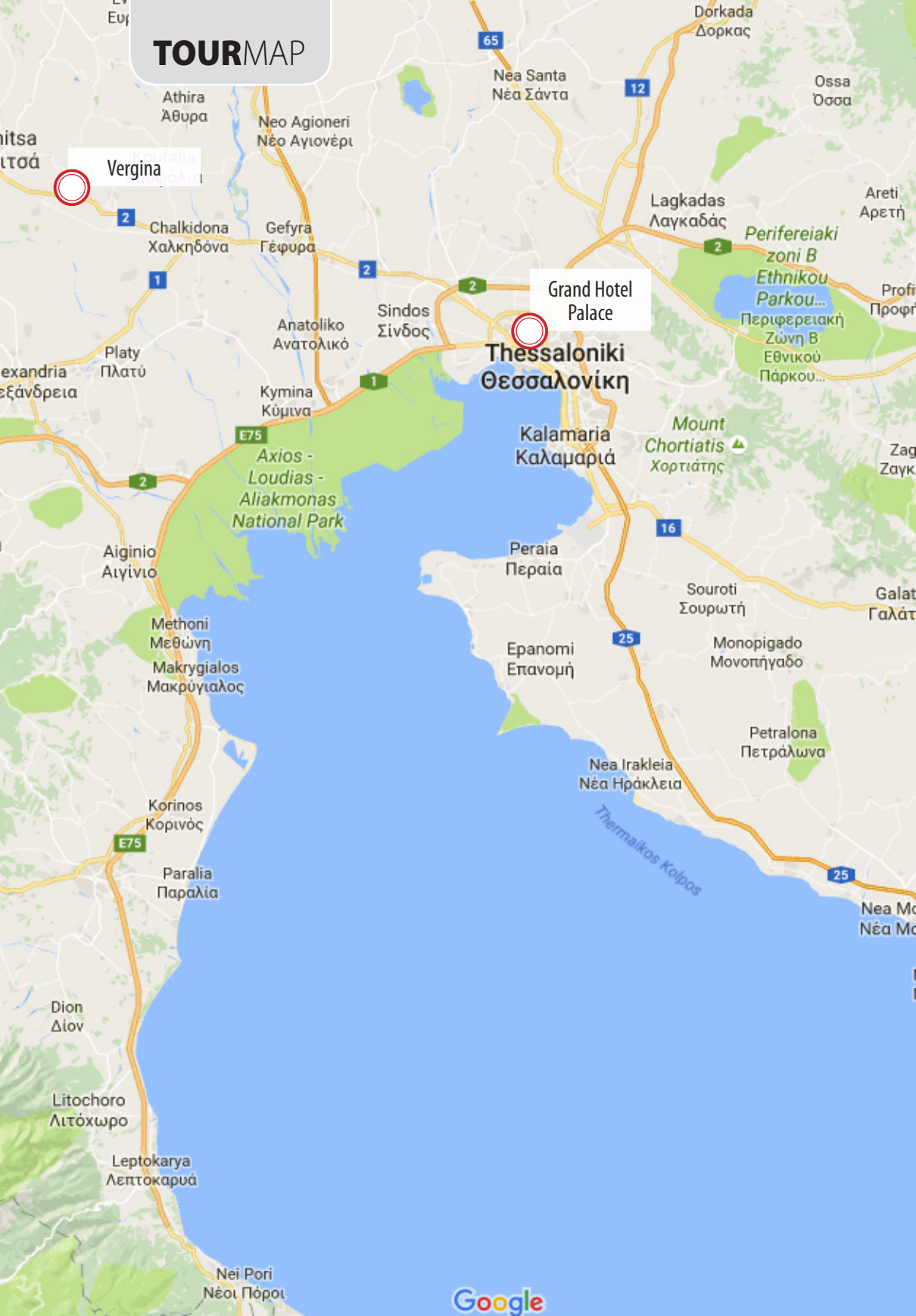


Grand Hotel Palace

Thessaloniki  
Θεσσαλονίκη

Macedonia  
Airport





Conference Venue

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City of Thessaloniki official webpage

[www.visitgreece.gr/en/main\\_cities/thessaloniki](http://www.visitgreece.gr/en/main_cities/thessaloniki)

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Information Centre +30 231 047 3212, 231 047 3312

Flights information +30 231 047 3977, 231 047 3720

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## About Thessaloniki

Thessaloniki (520 km. north of Athens) is the second largest city of Greece and the most important centre of the area. Built near the sea (at the back of the Thermaikos Gulf), it is a modern metropolis bearing the marks of its stormy history and its cosmopolitan character, which give it a special beauty and charm. Take a tour in the centre of Thessaloniki and plan to visit its nearby destinations. Also, while being in Thessaloniki it is worth going up to Halkidiki.

### *Visit Thessaloniki's Archaeological sites*

The **ancient forum** (dated to the late 2<sup>nd</sup> or the early 3<sup>rd</sup> century AD) with squares, porticoes, additional buildings and odeum (293-395 AD), the palace complex of Galerius Maximianus (4<sup>th</sup> c. AD), the thermae, the hippodrome, the temples and other monuments and moveable finds (among them mosaics of exquisite art) brought to light in excavations and surveys. In the south square, is the famous Stoa of the Idols, which was two-storeyed and lavishly decorated. The **Triumphal Arch of Galerius (Kamara)**, built in AD 305 to commemorate his military successes in general in the eastern provinces of the Roman Empire. The **Rotunda** is an early 4<sup>th</sup> century building which later was converted into a Christian church.

### *Visit Thessaloniki's Byzantine monuments*

Thessaloniki, with its host of Byzantine monuments (due to its significance during the Byzantine period), justifiably is considered an open-air museum of Byzantine art. Wandering through the city, it is worthwhile to see:

The **churches** of Acheiropoietos (5<sup>th</sup> century) a three-aisled, timber-roofed basilica, the Holy Wisdom of God (Hagia Sophia) (7<sup>th</sup> century), the Panaghia (Virgin) Chalkeon (1028), Hosios David (12<sup>th</sup> century), St Panteleemon (late 13<sup>th</sup> or the early 14<sup>th</sup> century), is of four-columned cross-in-square type, Ayioi Apostoloi (1310-1314), Taxiarches (14<sup>th</sup> century), Panagouda a three-aisled basilica with significant icons, Agios Ioannis Prodromos (Nymphaion), Vlatadon monastery a 14<sup>th</sup> century foundation of which only the katholikon and two cisterns within the precinct survive, Ayios Demetrios a splendid basilica dedicated to the patron saint and protector of the city, etc.

The **byzantine walls** of the city

The **archaeological site** in 3 Septemvriou St., with remnants of a cemetery basilica, a martyrium and Early Christian graves.

The **byzantine bathhouse** (late thirteenth century).

The **Heptapyrgion castle** was raised in stages, from the early years of the Byzantine Age into the Ottoman period.

### *Amazing Ottoman monuments*

The **White Tower** (15<sup>th</sup> century), the hallmark of the city. The **Mosques of the Hamza Bey Cami** (15<sup>th</sup> century), the Aladja Imaret Cami (1484) and the Yeni Cami (1902). Hamams (turkish bathhouses): The **Pazar Hamam** (15<sup>th</sup> century), the **Pasha Hamam** (15<sup>th</sup> century), **Bey Hamam** (16<sup>th</sup> century), **Yeni Hamam** and the **Yahudi Hamam. Bezesteni**, a rectangular building with lead-covered domes and four entrances was built in the late fifteenth century and operated as a cloth market.

### *Discover neighbourhoods and focal points in the city*

The **Old City (Ano Polis)**, in which many notable examples of Ottoman and traditional Macedonian architecture still stand, alongside humble dwellings put up by the refugees who reached Thessaloniki in droves, after the Greek defeat in Asia Minor, in 1922.

The historical quarter of the **Ladadika**. In recent years, a series of interventions to rehabilitate the urban fabric have helped to enhance the Ladadika as a quarter for leisure pursuits.

The traditional markets: the **Modiano**, which is housed in a rectangular building of 1922, with pedimented facade and glass roof; the **Kapani** or **Vlalis market; Athonos Square** and the '**Louloudadika**' (literally flower market).

**Vasilissis Olgas Avenue**, lined with many representative Neoclassical buildings and examples of late 19<sup>th</sup> century eclectic architecture.

The central **Aristotelous Square**, surrounded by monumental buildings and open to the waterfront for a width of 100 metres.

### *Other monuments and buildings in the city*

**Mylos** (literally mill). An old industrial complex, built in 1924, today have been remodelled to house cultural events and leisure activities, as well as the industrial buildings of the old FIX Brewery and the VILKA plant.

**Lazarist monastery** (1886) by the monastic order of the Brothers of Mercy, and now used for cultural events.

### **Royal Theatre**

**Thessaloniki Concert Hall**. A newly-built, magnificent yet austere, multi-purpose venue for cultural and other events.

**YMCA Building**, a building of 1924, with a mixture of Neocolonial and Byzantinesque architectural elements.

### *Museums*

It's worth seeing the **Archaeological Museum**, the **Museum of Byzantine Culture**, the **Folk and Ethnographic Museum**, the **State Museum of Contemporary Art**, the **Teloglion Foundation of Art**, the **Thessaloniki Cinema Museum**, the **Thessaloniki Science Center and Technology Museum**, et. al.

