

IEEE CIS School on Computational Intelligence:
Theory and Applications



2nd IEEE CITA' 2015

November 12-15, 2015 - Ramada Plaza Tunis Hotel - Tunisia



IEEE



2nd IEEE CIS School - CITA 2015

Program at a Glance

November 12-15, 2015, Ramada Plaza Hotel, Tunis - Tunisia

	November 12, 2015	November 13, 2015	November 14, 2015	November 15, 2015
09:00-9:30	Excursion: Visit to Bardo Museum	Talk 3 - <i>The State of the Art of Neurodynamic Optimization – Past, Present, and Prospect</i> Jun Wang (China)	Talk 6 - <i>Recent trends in parallel metaheuristics</i> Pavel Kromer (Czech Republic)	Talk 10 - <i>Computer Supported Collaborative Design: Technologies, Systems, and Applications</i> Weiming Shen (Canada)
09:30-10:00		Coffee Break	Coffee Break	Coffee Break
10:00-10:30				
10:30-11:00		Talk 4 - <i>Neurodynamic Optimization Approaches to Parallel Data Selection in the Era of Big Data</i> Jun Wang (China)	Talk 7 - <i>Bio-inspired Methods for Wireless Sensor Networks – Overview, Applications, and Examples</i> Pavel Kromer (Czech Republic)	Evaluation Exam and Closing Ceremony
11:00-11:30				
11:30-12:00	Open Networking	Lunch	Lunch	Lunch
12:00-12:30				
12:30-13:00				
13:00-13:30				
13:30-14:00	Registration			
14:00-14:30	Opening Session	Talk 5 - <i>Convexity, Sparsity, Nullity and all that....in Machine Learning</i> Hamid Karim (USA)	Talk 8 - <i>Practical Swarm Optimization – Part 1</i> Nizar Rokban (Tunisia)	Networking / Free Time
14:30-15:00	Talk 1 - <i>Intelligent Data analysis and its Applications</i> Vaclav Snasel (Czech Republic)			
15:00-15:30				
15:30-16:00	Coffee Break	Poster Session: Doctoral Consortium	Talk 9 - <i>Practical Swarm Optimization – Part 2</i> Nizar Rokban (Tunisia)	
16:00-16:30				
16:30-17:00	Talk 2 - <i>Geometrical Approach to Big Data</i> Vaclav Snasel (Czech Republic)			
17:00-17:30				
17:30-18:00				

LIST OF SPEAKERS

Vaclav Snasel

VSB-Technical University of Ostrava, Czech Republic



Topics: *Data mining, soft computing, evolutionary computing, neural networks, social networks.*

CITA 2015 talks

- **Thursday 12 November 2015/ 14:30-16:00: Talk 01 - Computational Topology an Introduction**
- **Thursday 12 November 2015/ 16:30-18:00: Talk 02 - Particle Swarms Heuristics in Optimization**

Biography

Vaclav Snasel is Professor of Computer Science at VŠB – Technical University of Ostrava, Czech Republic. He works as researcher and university teacher. He is Dean Faculty of Electrical Engineering and Computer Science. He is head of research programme IT4 Knowledge management at European center of excellence IT4Innovations. His research and development experience includes over 30 years in the Industry and Academia. He works in a multi-disciplinary environment involving artificial intelligence, social network, conceptual lattice, information retrieval, semantic web, knowledge management, data compression, machine intelligence, neural network, web intelligence, nature and Bio-inspired computing, data mining, and applied to various real world problems. He has given more than 16 plenary lectures and conference tutorials in these areas. He has authored/co-authored several refereed journal/conference papers, books and book chapters. He has supervised many Ph.D. students from Czech Republic, Slovak Republic, Libya, Jordan, Yemen, China and Vietnam. He supervised 20 PhD students who successfully defended PhD theses. He is also served as a Guest Editor of number of journals, e.g. Neurocomputing, Elsevier, Journal of Applied Logic, Elsevier etc. He was responsible investigator and cooperating investigator of 15 research projects in the field of basic and applied research. He is senior member IEEE, and he is the Chair of IEEE SMC Czechoslovak chapter.

Abstract Talk 1

The primary motivation for lecture is the significance and utility of topological concepts in solving problems in computer science. These problems arise naturally in computational geometry, graphics, robotics, structural biology, and chemistry. Often, the questions themselves have been known and considered by topologists. Unfortunately, there are many barriers to interaction: Computer scientists do not know the language of topologists. Topology, unlike geometry, is not a required subject in high school mathematics and is almost never dealt with in undergraduate computer science. The axiomatic nature of topology further compounds the problem as it generates cryptic and esoteric terminology that makes the field unintelligible and inaccessible to non-topologists. Topology can be very unintuitive and enigmatic and therefore can appear very complicated and mystifying, often frightening away interested computer scientists. Topology is a large field with many branches. Computer scientists often require only simple concepts from each branch. We select a number of offerings in topology in this course concerned with deep questions and existential results.

Abstract Talk 2

Optimization methods are widely used in various fields, including engineering, economics, management, physical sciences, social sciences. The process of using optimization methods to solve a practical problem mainly involves these two steps. First, formulate the optimization problem which involves determining the decision variables, objective function and constraints, and possibly an analysis of the optimization problem. Second, select an appropriate numerical method, solve the optimization problem, test the optimal solution and make a decision accordingly. A metaheuristic or a metaheuristic method is formally defined as an iterative generation process which guides a subordinate heuristic by combining intelligently different concepts for exploring and exploiting the search space. Learning strategies are used to structure information in order to find efficiently near-optimal solutions. In the last two decades, PSO has been frequently used as an optimization algorithm because of its effectiveness in performing difficult optimization tasks. In addition, the scheme obtains better results in a faster and cheaper way compared to several other methods with fewer parameters to adjust. Application areas can be found in multi-objective optimization problems, min-max problems, integer programming problems, combinatorial optimization problems, clustering and classification problems and numerous engineering applications.

Jun Wang

IEEE Fellow, CIS Distinguished Lecturer, Chinese Univ. of Hong Kong, China



Topic: Neurodynamic, Optimization

CITA 2015 talks

- **Friday 13 November 2015/ 09:00-10:30: Talk 03 - *The State of the Art of Neurodynamic Optimization – Past, Present, and Prospect***
- **Friday 13 November 2015/ 11:00-12:30: Talk 04 - *Neurodynamic Optimization Approaches to Parallel Data Selection in the Era of Big Data***

Biography

Jun Wang is a Professor and the Director of the Computational Intelligence Laboratory in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. Prior to this position, he held various academic positions at Dalian University of Technology, Case Western Reserve University, and University of North Dakota. He also held various short-term visiting positions at USAF Armstrong Laboratory (1995), RIKEN Brain Science Institute (2001), Universite Catholique de Louvain (2001), Chinese Academy of Sciences (2002), Huazhong University of Science and Technology (2006–2007), and Shanghai Jiao Tong University (2008-2011) as a Changjiang Chair Professor. Since 2011, he is a National Thousand-Talent Chair Professor at Dalian University of Technology on a part-time basis. He received a B.S. degree in electrical engineering and an M.S. degree in systems engineering from Dalian University of Technology, Dalian, China. He received his Ph.D. degree in systems engineering from Case Western Reserve University, Cleveland, Ohio, USA. His current research interests include neural networks and their applications. He published over 170 journal papers, 15 book chapters, 11 edited books, and numerous conference papers in these areas. He is the Editor-in-Chief of the *IEEE Transactions on Cybernetics* since 2014 and a member of the editorial board of *Neural Networks* since 2012. He also served as an Associate Editor of the *IEEE Transactions on Neural Networks* (1999-2009), *IEEE Transactions on Cybernetics* and its predecessor (2003-2013), and *IEEE Transactions on Systems, Man, and Cybernetics – Part C* (2002–2005), as a member of the editorial advisory board of *International Journal of Neural Systems* (2006-2013), as a guest editor of special issues of *European Journal of Operational Research* (1996), *International Journal of Neural Systems* (2007), *Neurocomputing* (2008, 2014), and *International Journal of Fuzzy Systems* (2010, 2011). He was an organizer of several international conferences such as the General Chair of the 13th International Conference on Neural Information Processing (2006) and the 2008 IEEE World Congress on Computational Intelligence, and a Program Chair of the IEEE International Conference on Systems, Man, and Cybernetics (2012). He has been an IEEE Computational Intelligence Society Distinguished Lecturer (2010-2012, 2014-2016). In addition, he served as President of Asia Pacific Neural Network Assembly (APNNA) in 2006 and many organizations such as IEEE Fellow Committee (2011-2012); IEEE Computational Intelligence Society Awards Committee (2008, 2012, 2014), IEEE Systems, Man, and Cybernetics Society Board of Directors (2013-2015), He is an IEEE Fellow, IAPR Fellow, and a recipient of an *IEEE Transactions on Neural Networks* Outstanding Paper Award and APNNA Outstanding Achievement Award in 2011, Natural Science Awards from Shanghai Municipal Government (2009) and Ministry of Education of China (2011), and Neural Networks Pioneer Award from IEEE Computational Intelligence Society (2014), among others.

Abstract Talk 1

Optimization is omnipresent in nature and society, and an important tool for problem-solving in science, engineering, and commerce. Optimization problems arise in a wide variety of applications such as the design, planning, control, operation, and management of engineering systems. In many applications (e.g., online pattern recognition and in-chip signal processing in mobile devices), real-time optimization is necessary or desirable.

For such applications, conventional optimization techniques may not be competent due to stringent requirement on computational time. It is computationally challenging when optimization procedures have to be performed in real time to optimize the performance of dynamical systems.

The past three decades witnessed the birth and growth of neurodynamic optimization. Although a couple of circuit-based optimization methods were developed in earlier, it was perhaps Hopfield and Tank who spearheaded the neurodynamic optimization research in the context of neural computation with their seminal works in mid-1980's. Tank and Hopfield extended the continuous-time Hopfield network for linear programming. Kennedy and Chua developed a neural network for nonlinear programming. It is proven that the state of the neurodynamics is globally convergent and an equilibrium corresponding to an approximate optimal solution of the given optimization problems. Over the years, the neurodynamic optimization research has made significant progresses with numerous models with improved features for solving various optimization problems. Substantial improvements of neurodynamic optimization theory and models have been made in several dimensions.

In this talk, starting with the idea and motivation of neurodynamic optimization, we will review the historic review and present the state of the art of neurodynamic optimization with many models and selected applications. Theoretical results about the state stability, output convergence, and solution optimality of the neurodynamic optimization models will be given along with many illustrative examples and simulation results. Four classes of neurodynamic optimization model design methodologies (i.e., penalty methods, Lagrange methods, duality methods, and optimality methods) will be delineated with discussions of their characteristics. In addition, it will be shown that many real-time computational optimization problems in information processing, system control, and robotics (e.g., parallel data selection and sorting, robust pole assignment in linear feedback control systems, robust model predictive control for nonlinear systems, collision-free motion planning and control of kinematically redundant robot manipulators with or without torque optimization, and grasping force optimization of multi-fingered robotic hands) can be solved by means of neurodynamic optimization. Finally, prospective future research directions will be discussed.

Abstract Talk 2

In the present information era, huge amount of data to be processed daily. In contrast of conventional sequential data processing techniques, parallel data processing approaches can expedite the processes and more efficiently deal with big data. In the last few decades, neural computation emerged as a popular area for parallel and distributed data processing. The data processing applications of neural computation included, but not limited to, data sorting, data selection, data mining, data fusion, and data reconciliation. In this talk, neurodynamic approaches to parallel data processing will be introduced, reviewed, and compared. In particular, my talk will compare several mathematical problem formulations of well-known multiple winners-take-all problem and present several recurrent neural networks with reducing model complexity. Finally, the best one with the simplest model complexity and maximum computational efficiency will be highlighted. Analytical and Monte Carlo simulation results will be shown to demonstrate the computing characteristics and performance of the continuous-time and discrete-time models. The applications to parallel sorting, rank-order filtering, and data retrieval will be also discussed.

Hamid Krim

***IEEE Fellow, SPS Distinguished Lecturer, North Carolina State Univ.,
USA***



Topics: Communications and Signal Processing (Including Digital Communications, Digital Signal Processing, Image Analysis and Computer Vision), Control, Robotics and Mechatronics, Machine learning

CITA 2015 talks

- ***Friday 13 November 2015/ 14:00-15:30: Talk 05 - Convexity, Sparsity, Nullity and all that....in Machine Learning***

Biography

Hamid Krim, received his degrees in Electrical Engineering. As a member of technical staff at AT&T Bell Labs, he has worked in the area of telephony and digital communication systems/subsystems. In 1991, he became a NSF Post-doctoral scholar at Foreign Centers of Excellence (LSS Supelec/Univ. of Orsay, Paris, France). In 1992, he joined the Laboratory for Information and Decision Systems, MIT, Cambridge, MA, as a Research Scientist performing/supervising research in his area of interest. In 1998, he joined the Electrical and Computer Engineering Department at North Carolina State University, Raleigh, N.C., where he is currently Professor and directing the Vision, Information, Statistical Signal Theories and Applications (VISSTA) Laboratory. Dr. Krim's editorial activities include: Editorial Board Member, *IEEE Transactions on Signal Processing* (2002-2004); Editorial Board Member, *IEEE Signal Processing Magazine* (2014). Dr. Krim is an IEEE Fellow and was a Fellow, Japanese Foundation for the Advancement of Research in Science and Engineering at the University of Tokyo, Japan. Dr. Krim is a Member of SIAM and of Sigma Xi. He is an original contributor and now an Affiliate of the Center for Imaging Science, sponsored by the Army. He is a recipient, NSF Career Young Investigator Award. Dr. Krim's research interests are in statistical signal processing and mathematical modeling with a keen emphasis on applications. He has been particularly interested in introducing geometric and topological tools to statistical signal processing problems and applications. His research has primarily centered on estimation theoretic problems and modeling. Dr. Krim has published extensively on these areas with an impact amounting to over 5000 citations to date.

Abstract

High dimensional data exhibit distinct properties compared to its low dimensional counterpart; this causes a common performance decrease and a formidable computational cost increase of traditional approaches. Novel methodologies are therefore needed to characterize data in high dimensional spaces. Considering the parsimonious degrees of freedom of high dimensional data compared to its dimensionality, we study the union-of-subspaces (UoS) model, as a generalization of the linear subspace model. The UoS model preserves the simplicity of the linear subspace model, and enjoys the additional ability to address nonlinear data. We show a sufficient condition to use l_1 minimization to reveal the underlying UoS structure, and further propose a bi-sparsity model (RoSure) as an effective algorithm, to recover the given data characterized by the UoS model from errors/corruptions. As an interesting twist on the related problem of Dictionary Learning Problem, we discuss the sparse null space problem (SNS). Based on linear equality constraint, it first appeared in 1986 and has since inspired results, such as sparse basis pursuit, we investigate its relation to the analysis dictionary learning problem, and show that the SNS problem plays a central role, and may naturally be exploited to solve dictionary learning problems. Substantiating examples are provided, and the application and performance of these approaches are demonstrated on a wide range of problems, such as face clustering and video segmentation.

Pavel Krömer

VSB-Technical University of Ostrava, Czech Republic

Topics: *Parallel metaheuristics* Wireless Sensor Networks



CITA 2015 talks

- **Saturday 14 November 2015/ 09:00-10:30- Talk 06 - Recent trends in parallel metaheuristics**
- **Saturday 14 November 2015/ 11:00-12:30 – Talk 07 - Bio-inspired Methods for Wireless Sensor Networks – Overview, Applications, and Example**

Biography

Pavel Krömer is an associate professor of Computer Science. He obtained M.Sc. and Ph.D. in Computer Science from the VSB – Technical University of Ostrava in 2006 and 2010, respectively. Between 2005 and 2010, he was employed as a software specialist by a large software company. In 2010, he returned to academia as an assistant professor and junior researcher at the Department of Computer Science, VSB – TU Ostrava, Czech Republic. During 2014, he served as a postdoctoral fellow at the Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada. Upon returning to the VSB – TU Ostrava, he gained the rank of associate professor and senior researcher. He is now affiliated with VSB – TU Ostrava and the IT4Innovations National Supercomputing Center. He is also a member of the IEEE, System, Man, and Cybernetics Society. He serves in the SMC Technical Committees on Soft Computing and Big Data Computing. He is also a member of steering committee of the Neural Network World Journal and served in various chairing roles at several international conferences including WSC17 (PC Chair), IBICA 2013, 2014 (publicity co-chair), AECIA 2014, 2015 (publicity co-chair), IBICA 2015 (PC co-chair), INCoS 2013 (workshop co-chair), WSC18 (special events co-chair), etc. Pavel's areas of interest include computational intelligence, information retrieval, data mining, knowledge discovery, and parallel and distributed computing.

Abstract Talk 1

Manycore processors, Graphic Processing Units (GPUs), floating-point accelerators, and cloud environments represent an exciting new family of platforms for a truly parallel and distributed implementation and execution of Nature and Bio-inspired Algorithms. Manycore processors offer an unparalleled flexibility and power while the GPUs are a massively parallel single-instruction multiple-data (SIMD) devices that can nowadays reach peak performance of hundreds and thousands of giga FLOPS (floating-point operations per second). Nature-inspired Algorithms implement parallel optimization strategies in which a single candidate solution, a group of candidate solutions (population), or multiple populations seek for an optimal solution or a set of solutions of a given problem. Genetic Algorithms (GA) constitute a family of traditional and very well-known nature-inspired populational meta-heuristic algorithms that have proved its usefulness on a plethora of tasks through the years. Differential Evolution (DE) is another efficient populational meta-heuristic algorithm for real-parameter optimization. Particle Swarm Optimization (PSO) can be seen as a nature-inspired multiagent method in which the interaction of simple independent agents yields intelligent collective behavior. Simulated annealing (SA) is global optimization algorithm which combines statistical mechanics and combinatorial optimization with inspiration in metallurgy.

Abstract Talk 2

Wireless sensor networks have recently emerged as a new class of distributed, multi-agent networks for large scale monitoring with high spatio-temporal resolution. These networks are faced with many requirements and challenges that include autonomous operation, strict energy constraints, low computing power, multi-hop communication, robustness, reliability, adaptability, and the ability to operate under harsh environmental conditions. Activity scheduling and routing are two complementary hard optimization problems that need to be tackled in order to optimize the operations of Wireless Sensor Networks. Bio-inspired methods including Ant Colony Optimization, Particle Swarm Optimization, Evolutionary Computation, and many others, have been in the last decade identified as a powerful class of algorithms that can be used to model and solve this type of problems. This lecture provides an overview of the most used applications of bio-inspired methods to the area of wireless sensor networks as well as several examples of recent algorithms and their applications.

Nizar Rokbani

University Sousse, Tunisia



Topic: *Practical Swarm Optimization, Robotics*

CITA 2015 talks

- **Saturday 14 November 2015/ 14:00-15:30 - Talk 08 - Practical Swarm Optimization – Part 1**
- **Saturday 14 November 2015/ 16:00-17:30 - Talk 09 - Practical Swarm Optimization – Part 2**

Biography

Nizar Rokbani graduated in Electrical Engineering from the National Engineering School of Tunis, ENIT in 1995. He obtained a Master degree in industrial computing in 2003 from the National Engineering School of Sfax, ENIS, and a PHD in Electrical Engineering in 2013. He was an automation & process engineer until 1998, he was then a technologic trainer at the institute of technological studies of Gabes, occupied a post of training adviser engineer at the national agency of vocational training from 2003 to 2006. Since 2006, he was back to university as assistant lecturer at the universities of Gabes and Sousse and conducted his research within the research group on intelligent machines, REGIM-Lab, National Eng school of Sfax. His research interests include applications of intelligent techniques such as Swarm intelligence, computational intelligence, fuzzy logic, evolutionary algorithms to robotic systems and industrial processes. He served as PC member in several National and international conferences including ISA, IEEE ICBR, CEIT, AMTM, ICSMC'2015 and ISA'2015... He organised the IEEE Robocomp robotics competition since 2010. Dr. Nizar Rokbani is also an IEEE member; he served in several volunteering positions in IEEE RAS and SMC Tunisia Chapters since 2009, his know the IEEE RAS Tunisia Chapter Chair (2015-2016). He is very active in promoting open hard electronics with a specific focus on robotics and related applications. Since 2014 he is the President of Tunarduino for academic and educational activities where he organized several workshops and tutorials on open hard for robotics and embedded industrial electronics.

Abstract

Computational Intelligence (CI) is a set of nature inspired computational methods complex and real-world problems to which traditional approaches showed their limits. CI covers neural networks, evolutionary algorithms, fuzzy systems, and hybrid intelligent systems. This talk will focus on evolutionary techniques essentially inspired from the collective behavior of group of animals or nature inspired Swarms. The first part of the workshop is composed by a plenary talk, the second part includes a tutorial in which participants could experiment the key issues of CI using PSO. Particle Swarm optimization, PSO, is one of the major techniques of this field and one of the most popular and effective meta-heuristics ; the first talk will review the inspiration, the key aspects and the major developments as well as the trends in this field. Particle Swarm optimization 2, is a tutorial where details about how to implement such techniques to solve a problem? What is the impact of PSO parameters and how they could affect the results? The impact of Key PSO variants is also surveyed. The final part of the tutorial explains the statics based approach to proof the convergence of such algorithms when solving a problem. The Tutorial is based on matlab simulations and is organized as follows:

- A brief on PSO and Firefly Algorithm
- How to use PSO to solve problem, seen particles in action.
- Impact of PSO parameters & variants
- How to Proof the Convergence Based on Statics

Weiming Shen

National Research Council of Canada, Univ. Western Ontario and
McMaster Univ., Canada



Topic: Computer, Collaborative Design

CITA 2015 talks

- ***Sunday 15 November 2015/ 09:00-10:30 - Talk 10 - Computer Supported Collaborative Design: Technologies, Systems, and Application***

Biography

Weiming Shen is a Senior Research Scientist at the National Research Council Canada and an Adjunct Professor at University of Western Ontario and McMaster University. He is a Distinguished Lecturer of the IEEE SMC Society. He is Fellow of IEEE, Fellow of Engineering Institute of Canada (EIC), and Professional Engineer of Ontario (PEO). He received his Bachelor and Master's degrees from Northern (Beijing) Jiaotong University, China and his PhD degree from the University of Technology of Compiègne, France. He is an internationally-recognized expert on Agent-Based Collaborative Technologies and Applications. During the past eight years, he has been leading a number of major projects on IoT and Big Data with smart applications (Smart Home, Smart Building, and Smart Factory). He has published several books and over 350 papers in scientific journals and international conferences in the related areas. His work has been cited over 8,000 times with an h-index of 43. He is a member of the Steering Committee for the IEEE Transactions on Affective Computing and an Associate Editor or Editorial Board Member of over ten international journals (including IEEE Transactions on Automation Science and Engineering; IEEE Transaction on SMC: Systems; IEEE SMC Magazine; Advanced Engineering Informatics; Computational Intelligence; Intelligent Buildings International; Service Computing and Applications) and served as guest editor for several other international journals.

Abstract

Industries and societies today require new technologies to address increasingly complex design issues for products, structures, buildings, systems, processes, and services while meeting the high expectation of customers. Computer Supported Collaborative Design (CSCD) has emerged in response to this requirement. With the rapid advancement of Internet and Web-based technologies, CSCD was a very active R&D area in the past two decades and progressed dramatically. To achieve its full potential, more and more research and commercial CSCD systems have been recently developed. The depth and breadth of these systems and applications are far beyond the traditional definition of concurrent engineering. CSCD is carried out not only among multidisciplinary design teams within the same company, but also across the boundaries of companies and time zones, with increased numbers of customers and suppliers involved in the process. This talk presents a comprehensive overview of this R&D area, particularly CSCD technologies, systems, and applications. Research challenges and opportunities on CSCD will also be discussed and highlighted.

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Welcome to Tunisia

Bienvenue en Tunisie

مرحبا بكم في تونس

Although the smallest nation in North Africa, Tunisia's eventful and often dramatic history has been the result of its strategic position. Over the centuries, the country which was once the exclusive home of the Berbers, has, at one time or another, been settled on by most the world's greatest powers; from the Phoenicians, Romans and Vandals to Byzantines, Arabs, Ottomans and French. These people have come and gone, leaving their mark upon Tunisia in varying degrees, and providing a rich cultural and social heritage that is unique to this land.



Neptune (Bardo Museum)



The trip of Odysseus (Bardo Museum)

The Phoenicians introduced the alphabet to the Mediterranean region, but sadly little of their writings have survived. Tunisian literature really starts in the Roman and Byzantine periods. St Augustine was the most outstanding writer in the area of present-day Tunisia, later, the widespread reading of the Koran played an important role in the development of Arab literature. Many folk tales and poems existed in the past, often told by wandering storytellers at marketplaces and festivals. Modern Tunisian literature grew from a cultural renaissance in the early 20th century, with poetry being dominant genre.



Al-Zaytuna Mosque



El Ghriba Synagogue



Cathedral of St Vincent de Paul

Its unusual combination of Islamic culture and European approach makes Tunisia the most popular North African holiday destination and, with a climate that rarely dips under 20 degrees, it's a real hot spot all year round.

