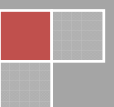


# Quantum Inspired Soft Computing

Global Initiative on Academic Network  
(GIAN)

October 27 – 31, 2017



## Overview

Quantum computing takes advantage of the rather odd and counterintuitive rules of quantum mechanics, like superposition (a quantum system can be in more than one state or even more than one place simultaneously), entanglement (instantaneous interaction at a distance), and quantum tunneling (a quantum system can switch states without surmounting an energy barrier between.) Using these, a quantum computer can solve classical computing “hard problems”, and even quantum problems that are classically impossible to formulate and/or solve. The downsides are that quantum computers are very difficult to build and operate on a large scale, and that designing algorithms that take advantage of quantum mechanics is very difficult.

In this Course, we will give an introduction to quantum mechanics, to reach a workable understanding of its rules. We will then show how to exploit these rules to do quantum computing, to do classically difficult problems. We will then discuss quantum inspired soft computing, and show how imitating quantum dynamics and thermodynamics can be a powerful tool to deal with both downsides mentioned above, and can faster lead to better solutions. In the tutorials, we will explore specific examples of quantum machine learning.

## Objectives

The major objectives of the course are as follows:

- Exposing participants to the fundamentals of quantum mechanics
- Building understanding of the tools of quantum computing and quantum inspired soft computing
- Introducing the applications of quantum inspired soft computing to engineering problem solving
- Enhancing capability of participants to use these tools to solve problems
- Teaching Faculty with allotment of Lectures and Tutorials

## Course details

The proposed course will cover several topics including fundamentals of quantum mechanics, quantum inspired soft computing encompassing quantum neural networks and quantum inspired metaheuristics to name a few. The course will include special tutorial sessions including lab demonstration covering several topics such as Schrodinger algorithm, quantum backpropagation, quantum Multilayer Self Organizing Neural Network Architecture (QMLSONN), quantum Hopfield network, quantum neural entanglement and designing of several quantum inspired metaheuristic algorithms.

## Teaching Faculty

**Prof. Elizabeth C. Behrman** earned her bachelor's in mathematics from Brown University in 1979, her master's in chemistry and her PhD in physics from University of Illinois at Urbana-Champaign in 1981 and 1985, respectively.

She is currently full professor of both physics and mathematics at Wichita State University in Wichita, Kansas. She served as Chair of the department from 2003 to 2006, as Associate Director of the university Honors program from 1999 to 2003, as Faculty Fellow from 2003 to 2009, and as Faculty Senate President from 2003 to 2004. Prior to this, she was Associate Professor of Physics at Wichita State from 1994 to 2002, and Assistant Professor of Physics at Wichita State from 1990 to 1994. Before coming to Wichita State she was Assistant Professor of Ceramic Engineering at the New York State College of Ceramics at Alfred University, in Alfred, NY, and before that a Postdoctoral Research Associate at the State University of New York at Stony Brook, NY.

She has won numerous honors, including, at Wichita State, the President's Distinguished Service Award (2015), and the Academy for Effective Teaching Award (2012.) She was appointed a Kavli Institute for Theoretical Physics Scholar (2006-2009) and a Lady Davis Fellow at Hebrew University in Jerusalem, Israel. She is a member both Sigma Xi and Phi Kappa Phi, and received both graduate and undergraduate research fellowships.

Her research interests and publications are broad, with over 80 papers in subjects ranging from chemical kinetics and reaction pathways to ceramic superconductors to nuclear waste vitrification. She was the first to predict the stability of inorganic buckyballs and buckytubes. Her major focus for several decades has been quantum information, particularly quantum machine learning, where her group has published seminal papers on temporal and spatial quantum backpropagation, quantum Hopfield networks, quantum genetic algorithm, and quantum ants.

**Prof. Siddhartha Bhattacharyya** did his Bachelors in Physics, Bachelors in Optics and Optoelectronics and Masters in Optics and Optoelectronics from University of Calcutta, India in 1995, 1998 and 2000 respectively. He completed PhD in Computer Science and Engineering from Jadavpur University, India in 2008. He is the recipient of the University Gold Medal from the University of Calcutta for his Masters. He is the recipient of the coveted National Award Adarsh Vidya Saraswati Rashtriya Puraskar for excellence in education and research in 2016. He is the recipient of the Distinguished HoD Award and Distinguished Professor Award conferred by Computer Society of India, Mumbai Chapter, India in 2017. He is also the recipient of the coveted Bhartiya Shiksha Ratan Award conferred by Economic Growth Foundation, New Delhi in 2017.

He is currently the Principal of RCC Institute of Information Technology, Kolkata, India. In addition, he is serving as the Dean (Research and Development and Academic Affairs) of the institute. Before this, he was the Professor of Information Technology of the institute. He served as the Head of the Department from March, 2014 to December, 2016. Prior to this, he was an Associate Professor of Information Technology of the institute from 2011-2014. Before that, he served as an Assistant Professor in Computer Science and Information Technology of University Institute of Technology, The University of Burdwan, India from 2005-2011. He was a Lecturer in Information Technology of Kalyani

Government Engineering College, India during 2001-2005. He is a co-author of 4 books and the co-editor of 8 books and has more than 180 research publications in international journals and conference proceedings to his credit. He has got a patent on intelligent colorimeter technology. He has been the member of the organizing and technical program committees of several national and international conferences. He is the Associate Editor of International Journal of Pattern Recognition Research. He is the member of the editorial board of International Journal of Engineering, Science and Technology and ACCENTS Transactions on Information Security (ATIS). He is the Associate Editor of the International Journal of BioInfo Soft Computing since 2013. He is the Editor of International Journal of Pattern Recognition Research since January 2016. He is the member of the editorial board of Applied Soft Computing, Elsevier, B. V. He is serving as the Series Editor of the IGI Global Book Series Advances in Information Quality and Management (AIQM) from January 01, 2017. He is also the Series Editor of Frontiers in Computational Intelligence; Publisher: De Gruyter, Germany. He is the founder Editor in Chief of the International Journal of Hybrid Intelligence; Publisher: Inderscience.

His research interests include soft computing, pattern recognition, multimedia data processing, hybrid intelligence and quantum computing. Dr. Bhattacharyya is a fellow of Institute of Electronics and Telecommunication Engineers (IETE), India. He is also a senior member of Institute of Electrical and Electronics Engineers (IEEE), USA, International Institute of Engineering and Technology (IETI), Hong Kong and Association for Computing Machinery (ACM), USA. He is a member of Institution of Engineering and Technology (IET), UK, International Rough Set Society, International Association for Engineers (IAENG), Hong Kong, Computer Science Teachers Association (CSTA), USA, Institute of Doctors, Engineers and Scientists (IDES), India, International Association of Academicians, Scholars, Scientists and Engineers (IAASSE), USA and International Society of Service Innovation Professionals (ISSIP). He is a life member of Computer Society of India, Optical Society of India, Indian Society for Technical Education and Center for Education Growth and Research, India.

### **Eligibility for Participation**

- Students (Masters and Ph.D), postdocs and scientists/faculty members from academic and technical institutions.
- Researchers and engineers from R&D laboratories and industries

**To apply for the course, follow the instructions given here:**

Send your formal application along with your recent resume within **September 21, 2017** to Prof. (Dr.) Siddhartha Bhattacharyya by email.

**Email id:** [dr.siddhartha.bhattacharyya@gmail.com](mailto:dr.siddhartha.bhattacharyya@gmail.com)

## Registration Fees

One-Time GIAN Registration: Please visit <http://www.gian.iitkgp.ac.in/GREGN/> and register by paying Rs. 500/- (those who have already been paid, need not pay again). The participation fees for taking the course is as follows:

<b>Participants from abroad:</b>	\$250
<b>Industry/Research Organization:</b>	INR 25,000
<b>Academic Institution:</b>	
Students:	INR 3,000
Scientists/Faculty members:	INR 6,000

**Payment procedure will be intimated after short listing of candidates.**

The above fees include all instructional materials, computer use for tutorials and assignments (if any). The participants have to arrange their own accommodation.

## Course Co-ordinator

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## Course Co-Coordinator

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