QUESTIONNAIRE TO FILL OUT

Application for the organization of a CIMPA School

Plan at least a 18-month delay between the receipt of this questionnaire and the period of the school

I. DESCRIPTION OF THE PROJECT

Name of the School : *Applied Mathematics and Engeneering*

Objective of the School : The main objective of the school is to boost the Uruguayan activities within Applied Mathematics, Computational Science and Engineering. This school will serve as a part of an ongoing project for the development of applied mathematics in Uruguay, which focuses among others in Networks, Numerical methods, Biomathematics, Mathematical Finance, Insurance, etc. In particular, we expect that the school will attract and eventually motivate more local students (for instance Bachelors in mathematics, statistics and Engineering) to enroll into an Engineering Mathematics Master program. At the same time, we have plans to establish and enlarge a team of qualified thesis supervisors.

This proposal is closely related to the master program "Ingeniería Matemática", based on the "Instituto de Matemática y Estadística" of the Universidad de la República, Uruguay. The idea is to follow the research directives defined by the "Agencia Nacional de Investigación e Innovación" in the light of the current favourable situation of the country. Accordingly to the mentioned directives, research areas in applied mathematics will mainly focused on topics like: Communication and information theory, Network modeling, Mathematical Finance with applications to Energy Risk Management, Biomathematics, Optimal development of natural resources, etc.

School location: Uruguay

Periods proposed for the School (you are advised to propose several dates): March 2010, August 2010.

List of speakers

Elvio Accinelli (México), Felipe Cucker (CityU, Hong Kong), Ernesto Mordecki (CMAT, Uruguay), Fernando Paganini (ORT - Uruguay), Gonzalo Perera (ANTEL, Uruguay), Adriana Piazza (DIM, Chile),Franco Robledo (LPE, Uruguay), Raúl Tempone (FSU, USA), Gonzalo Tornaría (CMAT, Uruguay).

List of all courses with a summary of about ten lines

Learning Sparse Representations to Restore, Classify, and Sense Images and Videos

Guillermo Sapiro, University of Minnesota, USA

Sparse representations have recently drawn much attention from the signal processing and learning communities. The basic underlying model consist of considering that natural images, or signals in general, admit a sparse decomposition in some redundant dictionary. This means that we can find a linear combination of a few atoms from the dictionary that lead to an efficient representation of the original signal. Recent results have shown that learning overcomplete non-parametric dictionaries for image representation, instead of using off-the-shelf ones, significantly improves numerous image and video processing tasks.

In this short course, I will first present our results on learning multiscale overcomplete dictionaries for color image and video restoration. I will present the framework and provide numerous examples showing state-of-the-art results. I will then briefly show how to extend this to image classification, deriving energies and optimization procedures that lead to learning non-parametric dictionaries for sparse representations optimized for classification. I will conclude by showing preliminary results on the extension of this to sensing. All the reported results reflect ongoing research by my group, colleagues, and others. The particular contribution of different people will be mentioned.

Optimal control and Stochastic Differential Equations

Anders Szepessy, Royal Institute of Technology, Sweeden

Stochastic and deterministic differential equations are fundamental for the modeling in Science and Engineering. As the computational power increase, it becomes feasible to use more accurate differential equation models and solve more demanding problems: for instance to determine input data from fundamental principles, to optimally reconstruct input data using measurements or to find the optimal construction of a design.

There are therefore two interesting computational sides of differential equations:

- the forward problem, to accurately determine solutions of differential equations for given data with minimal computation work and prescribed accuracy, and
- the inverse problem, to determine the input data for differential equations, from optimal estimates, based either on measurements or on computations with a more fundamental model.

The model can be stochastic by two reasons:

- if callibration of data implies this, as in financial mathematics, or
- if fundamental microscopic laws generate stochastic behavior when coarse-grained, as in molecular dynamics for chemistry, material science and biology.

In this course I will start with presenting some basic results in optimal control theory and stochastic differential equations and then apply these general techniques to

- the inverse problem of parameter reconstruction in mathematical finance,

- determination of reaction rates and reaction paths, using rare events, in stochastic differential equations,
- coarse-graining molecular dynamics.

Mathematical Modeling of Investment and Contract under Uncertainty

Jorge P. Zubelli - IMPA, Brazil

In this minicourse, motivated by applications to Financial Engineering, we introduce a number of techniques from stochastic calculus and optimal control. The set will be to illustrate how to price contingent claims and derivative contracts.

Contents: risk neutral pricing, martingales, diffusions and the Black-Scholes equation, Feyman-Kac, real options.

Topics in the analysis of performance, dependability and performability aspects of complex systems

Gerardo Rubino, INRIA, France

This course describes different topics related to the problem of assessing the performance of a complex system such as the information system of a company, a communication network, a streaming service over the Internet, or the dependability properties of the same kind of systems. Performance is associated with the work done by the system basically assuming it is perfect; dependability concerns the system's behavior in the presence of failures and possibly to repairs, regardless to quantitative measures of the provided work. In some cases, it is possible to combine both aspects into a single model, and we speak about the system's performability. The course presents some state-of-the-art techniques in the area, mainly with examples in the analysis of telecommunication networks.
Dimensioning of the course: 6 sessions of 1h30 each
Material: handouts plus references to documents available through the Web
Background needed: basics in probability theory and stochastic processes
Outline
1. Revision about main mathematical tools needed for the course (Markov models, queuing models, solving techniques)
2. Dealing with very large and complex models I: numerical schemes (basically, how to analyze very large –sometimes infinite- Markov models)
3. Dealing with very large and complex models II: Monte Carlo methods (how to address the main difficulty in the area with Monte Carlo techniques, namely, the rare event case)

4. From Quality of Service (QoS) to Quality of Experience (QoE) in Internet applications and services (dealing analytically –with specific models- with QoE)
5. Specific topics in queuing models: call centers analysis, transient analysis of queues, new queuing paradigms

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Expected scientific director(s) for the school: Raúl Tempone

In which language do you wish to work (you can choose one or more)?
(Please tick) French [ ] English [X] Spanish [X] other (precise) [   ]

Expected audience (indicate the prerequisites):

Professionals with a degree, with a strong contents of mathematical modeling.
Expected number of participants: 75

Name of the institution that will organize the School with CIMPA:
Name:
Instituto de Matemática y Estadística "Rafael Laguardia",
Address:
Facultad de Ingeniería, Julio Herrera y Reissig 565, Montevideo.
Country: Uruguay
Name and function of the legal representative who will sign the convention fixing the modalities of the organization and financing of the school:
Dr. Ing. Ismael Piedra-Cueva (Dean of the Facultad de Ingeniería)
Other partner institutions implied in the project:

Centro de Matemática, Facultad de Ciencias, Montevideo, Uruguay

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Coordinator of the School (who will be the local contact of CIMPA):
Name: Dr. Ernesto Mordecki
Institution: Centro de Matemática
Function: Professor
Address: Iguá 4225. CP 11400 Montevideo, Uruguay
Telephone: 525 25 22 int. 122
Fax: 522 06 53
Electronic mail: mordecki@cmat.edu.uy
In which language do you wish to receive any future correspondence?
(Please tick) French [ ] English [X]
In which language do you wish to receive official documents (in particular the convention to be signed between CIMPA and the co-organizing institution)?
(Please tick) French [ ] English [X]

II. IMPACT AND SCIENTIFIC ENVIRONMENT

This section include all questions concerning the impact and scientific environment of the school. Any complementary information will be added in an attached file.
You are advised to include in this file the patronage of scientific representatives who may recommend your application. Such patronages should be in the form of a short letter related to the themes of the following questions (impact, appropriateness to the local research environment, choice of the theme, expected outcome, etc.). You will specify name and address of scientific representatives, they might be contacted by CIMPA scientific advisors while examining of the application.
1) In a general way what scientific impact are you expecting ? State possible real applications if any.

We expect for young professionals to broad their view on modern applications of mathematics in industry and society, to see themselves
as future professionals working in this type of projects. To this end, we will expose them to cutting edge results, presented by researchers
who are well established in their areas. In time, this will have an impact in the training of human resources within applied mathematics and
related areas.

2) Is this school entering a more global project (In your university, country or region)? If it is, give a brief description of the project, enclose complementary information.

The School is included in a series of activities with the purpose of developing in the country applications of mathematics in several fields.
In connection to the Master in Mathematical Engineering (Maestría en Ingeniería Matemática), a series of related activities has been going on in the country since August 2007.
The current proposal is aligned to these efforts. It will help us to increase successfully the activity level within the Master in Mathematical Engineering and eventually, after some years of establishing and stabilizing a critical mass of resource, develop a doctoral degree in this field.

3) Which are the activities and realizations of your institution related to the field of the school? For example research groups, colloquiums, schools already organized or planned. Give a precise description of these activities.

The main activity related to the proposal is the "Maestría en Ingeniería Matemática" (Master in Mathematical Engineering) based on the Facultad de Ingeniería.
Other related activities are based on the "Laboratorio de Probabilidad y Estadística" (LPE). A subset of the staff that work at the LPE are professors and students of
the above mentioned master program. Other relevant activities are the organization of the group ARTES dedicated to the area of telecommunications. This group, under the supervision of Dr. Gonzalo Perera, has organized a CIMPA School in this topic in Uruguay in 2007. Other recent events organized in the country are the "Encuentro Regional de Probabilidad y Estadistica

Matematica" that gathers a relevant part of the south - american probabilists and mathematical statisticians. This events where held in Buenos Aires (november 2005 and november 2006) and in Solis, Uruguay in November 2007. The next event of this series is planned to take place in Solís, Uruguay, during November 2008. Another relevant activity related to the present project is the agreement ANTEL-FUNDACIBA. This is an agreement between mathematicians located mainly in the Centro de Matemática and engineers from the uruguayan national utility, namely ANTEL.

Its main research focus is in the area of cryptography and its practical applications.

4) How do you plan the follow up to the school ? by CIMPA itself or other organisms? State the concrete activities you may have already think about.

The School represents a step in the development of applied mathematics in the country. The main directions of this activity includes the
(a) training of professionals within applied mathematics to work in industry and as a dual activity, to convince the uruguayan industry of the potential gains involved in the hiring of such professionals,
(b) to establish cooperation agreements between the university and industrial enterprises (mainly state owned utilities related to communications,
and energy, but not only) in order to develop master level educational programs in which the final thesis is highly motivated by practical applications.

Scientific representative:
PABLO AUGUSTO FERRARI
Possition: Professor Titular da Universidade de São Paulo
Contact: pagfrr@usp.br

Support letter:

This school will be very important for the young students and researchers in Uruguay and the neighboring Countries. The themes are related to --but are wider-- the research already in course in the region. I expect that new research and contacts between students and senior researchers will emerge from this activity.

The organizers have experience in research and organization of this kind of events. The region is mature to receive and take advantage of the event.

Pablo Ferrari,

Universidade de Sao Paulo

Scientific representative:
ENRIQUE MARIO CABAÑA
Support letter:

Montevideo, 26 September 2008.

Chair of the Academic Committee
CIMPA

Dear Chairperson:
I am writing you to express my strong support to the application for the organization of a CIMPA School on Applied Mathematics in Uruguay, on 2010.

The proposal arises from a group of active researchers, nucleated around the Probability and Statistics Laboratory of the School of Engineering. The Laboratory is located at the Mathematics and Statistics Institute of the Engineering School (IMERL), and is also associated to the Mathematics Centre of the School of Science (CMAT).

Both the IMERL and the CMAT are the leading research institutes on mathematics in our Country.

The School shall give the chance to young students to be in connection with subjects that combine the mathematical flavour of very interesting theoretical areas with strongly appealing applications, and will stimulate the development of the existing postgraduate program in applied mathematics named "Mathematical Engineering".

One of the strengths of the organization is to combine the participation of members of our local academic staff with the collaboration of prestigious researchers residing abroad, but some of them strongly connected with the organising institutes, where each one has lectured in several opportunities,

In addition, the variety of subjects to be covered brings new or deeper approaches to subjects that are treated and discussed regularly in courses and seminars of the organising institutes so that a good number of candidates to attend the proposed School are well trained to obtain a significant return from the School lectures.

It will be my pleasure to add any specific comments at your request.

Yours, sincerely,

Enrique M. Cabaña

Director - Departamento de Métodos Matemático-Cuantitativos
Facultad de Ciencias Económicas y de Administración
Instituto de Estadística
Eduardo Acevedo 1139, Montevideo, Uruguay
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Coordinador. Area de Matemática del
Programa de Desarrollo de las Ciencias Básicas
(PEDECIBA)

FINANCING

A provisional budget has to be joined it to the application :

1) Previsional budget of the school ?

We estimate a total budget of 40.000 USD (20.000 of lodging and installation needs + 20.000 travels)

2) What will be the amount of CIMPA financial support you ask for? We recall that this support will be mainly used for the travel expenses and the accommodation of some participants coming from developing countries?

20.000 US, mainly devoted to lodging and local travels.

3) Which part will be taken in charge by your institution?

Total: 7000. We plan to apply for funds at University of around 2000 US, and to PEDECIBA around 2000 US and 3000 to Research Projects in related to the field.

4) Which complementary financings can you expect from other organisms (such as bilateral help, national, international, embassies, etc...)?

A total amount estimated in 13.000 US. We plan to ask main speakers and lecturers to pay their plane tickets with their grants when possible (8.000), and other Funds Agency as Agencia Nacional de Investigación e Innovación (ANII) (estimate 2000) and also to National Enterprises as ANTEL (2000 US) and Dirección Nacional de Energía (1000 US)

IMPORTANT :
CIMPA may support your request for complementary financial supports; You are advised to seek for them early and inform CIMPA as regards your applications and the answers obtained.