



Network for computing
and mathematical
modeling

Réseau de calcul
et de modélisation
mathématique

What is the ncm₂?



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WHAT IS THE **ncm₂**?

The Network for Computing and Mathematical Modeling, **ncm₂** (in French: Réseau de calcul et de modélisation mathématique, **rcm₂**), was established in 1997 thanks to a grant from the Natural Sciences and Engineering Research Council (NSERC). It brings together seven research centres based in the Montreal area in a unique collaboration, which allows it to respond to the needs of industry in a large number of fields related to the common theme of computing and mathematical modeling. The centres of the **ncm₂** maintain links with l'Université de Montréal, McGill University, l'Université du Québec à Montréal (UQAM), Concordia University, l'Université Laval, l'École Polytechnique, l'École des Hautes Études Commerciales as well as a number of Canadian and foreign universities.

These centres are:

CERCA: Centre for Research on Computation and its Applications

CIRANO: Center for Interuniversity Research and Analysis on Organizations

CRIM: Centre de Recherche Informatique de Montréal

CRM: Centre de Recherches Mathématiques

CRT: Centre for Research on Transportation

GERAD: Group for Research in Decision Analysis

INRS-Télécommunications: Institut National de la Recherche Scientifique - Télécommunications

The **ncm₂** brings together, within a light administrative framework, more than two hundred top researchers, thus providing industry with unparalleled access to a wide range of expertise.

WHAT ARE THE FIELDS OF INTEREST OF THE NETWORK?

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- Management of financial risk and mathematical finance
 - Management of insurance risk and transport security
 - Management of environmental risks
 - Experimental economics
 - Signal and image processing
 - Imaging and data amalgamation
 - Real-time decision-making problems
 - Automated learning: neural networks, data mining
 - Intensive numerical computing
 - Operations research, optimisation of schedules and location
 - Health management and optimisation
 - Intelligent transport networks
 - Telecommunication networks
 - Computer and economic aspects of e-commerce
 - Applied computer science.

These areas of expertise are developed within three major themes: (1) risk management, (2) information processing, imaging and parallel computing, and (3) transport and telecommunications.

WHY A NETWORK?

Industrial benefits

The **ncm₂** provides industrial partners with a uniquely advantageous access to computational and modeling know-how. Real life problems often comprise several aspects, requiring different areas of expertise in various fields of mathematics, computer science or economics. These areas of expertise are almost always available within the network, thus allowing rapid transfer of the most recent developments of university research to industry.

Scientific benefits

The **ncm₂** allows its various partners to take advantage of each other's expertise and to collaborate in new ventures. The network organises activities designed to integrate these different areas of expertise (workshops, seminars). In addition, through its Distinguished Lecture series, the **ncm₂** draws on internationally renowned experts.


Training benefits

The **ncm₂** provides extensive multidisciplinary training to undergraduates, graduate students and postdoctoral fellows.

Computing benefits

The **ncm₂** provides access to first rate computing facilities. Among its members are partners of the Quebec Network for High Performance and Computing (RQCHP), a network which benefited from a substantial grant from the Canada Foundation for Innovation (CFI) in 1999. In addition, the **ncm₂** fosters collaboration and sharing of its computing, human and infrastructure resources.

THE **ncm₂** PARTNERS




The **ncm₂** has been involved in joint projects with, among others, AD OPT, Atlantic Nuclear Services, AXA Assurances, Banque Nationale, Beauce Composites, Bell, Bell Mobility, the Canada Insurance Bureau, Agra Monenco, Canadian Pacific, Environment Canada, GIRO Inc., Hydro-Québec, Hydrossoft, INRO Consultants, Lockheed Martin, the Department of National Defence, Silicon Graphics, la Société d'Assurance Automobile du Québec and Urgences Santé.

A few examples of work carried out by members of the **ncm₂**:

- A frequency allocation project for cellular telephones
- A portfolio management project using neural networks
- The GAMME electronic auction project
- Real-time analysis of images for aerial monitoring
- Microcalcification analysis on mammograms through neural networks and multi-fractals
- An automatic fraud detection system
- A flood risk analysis system, combining hydrological models and meteorological predictions.

THE BELL UNIVERSITY LABORATORY (BUL)



The **ncm₂** signed an agreement with Bell Canada in December 1998 to develop the Bell University Laboratory, BUL (in French: Laboratoire Universitaire Bell, LUB). Through this contract, worth \$12M over three years, the **ncm₂** became Bell's main partner in Quebec for its university research.

The BUL objectives are to create innovations in the field of multimedia research and applications (in particular, interactive services for the public at large, e-commerce and new generations of developed networks) and also to promote the training of highly qualified manpower. To attain these objectives, the BUL finances diverse research projects.

The BUL infrastructure consists mainly of two laboratories. The first, the e-commerce and experimental economics laboratory (LUB-C3E), aims to develop and test interactive applications for the public at large and applications of e-commerce and virtual shared work spaces, and to develop experimental protocols to test organizational changes. The second laboratory, the multimedia laboratory, is used for experimenting with new generations of developed networks.

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**Centre for Research
on Computation
and its Applications (CERCA)**

Director: *Jean-Jacques Rousseau*

CERCA is a liaison and transfer centre established in 1992 to promote research training and university research on computation and its applications related to the needs of industry and public service organisations. This is achieved through the development and transfer of work tools, highly qualified personnel and new knowledge.

CERCA is developing tools in the following fields:

- Industrial mechanics: design of structures, equipment and industrial machinery requiring expertise in aerodynamics, hydrodynamics, thermodynamics and plasma dynamics
- Pharmaceutical chemistry: new drug design
- Environmental predictions: analysis of their effects on infrastructures and economic activities, and decision-making relative to the management of these infrastructures and activities
- Industrial geophysics: structures for geophysics and applications for petroleum exploration, mining exploration and civil engineering work
- Astrophysics: internal structure of stars
- Nanostructures: design of nanocomponents
- Scientific visualisation: visualisation of the behaviour of complex physical systems of any kind through numerical simulations
- High performance computing.



Center for Interuniversity Research and Analysis on Organizations (CIRANO)

**President and Chief
Executive Officer:** *Marcel Boyer*

CIRANO is essentially an intensive network of university researchers sharing the specific vision and mission of the centre, namely:

- The advancement of knowledge
- The development of research programs based on the needs expressed by its corporate partners (bi-directional liaison)
- The transfer and, where appropriate, efficient implementation of results for the users, who are partners in financing consortia.

The expertise of the CIRANO research program presently comprises about thirty projects grouped under four themes:

- Human resources: employment and employability; work environment and employee performance; pay equity; outsourcing of human resources management; economy of education and training of human capital.
- Finance: asset allocation models and methods (neural networks); portfolio management with intertemporal choices in continuous time; corporate finance and governance; derivatives (options and futures); credit risk; forecasting; international financial markets.
- Innovation and new technologies: innovation indicators and obstacles to innovation in a KBE (Knowledge Based Economy); new performance indicators in a KBE; virtual market sites (Toward Electronic Market Places (TEM)); new organizational forms in a KBE; economic analysis of technological choices for site rehabilitation.
- Organisational design and incentives: sharing common costs; public sector performance; delegated water management; integrated risk management; management of major technological risks (MTR); high technology-content product sales force management system.

Centre de Recherche Informatique de Montréal (CRIM)

President and Chief

Executive Officer: *Yves Sanssouci*

CRIM has been working in state-of-the-art information technology (IT) and computer application sectors since its establishment as a nonprofit organization in 1985. CRIM was created to strengthen bonds between business and the academic community in the sectors it serves. CRIM is primarily interested in research and development, skill and technology transfer, forging of strategic alliances, networking, technological watch activities and customized, innovative training.

CRIM's leading-edge research teams help design new technologies incorporated in profitable business solutions for private enterprise. Experts in many disciplines, assisted by master's and doctoral students, work with universities, businesses and various organizations on a range of precompetitive and industrial research projects. CRIM researchers are also deeply involved in the international scientific community.

In 1998-1999, CRIM performed research in the fields of telecommunications technologies, development of telecommunications networks, vision and speech recognition, interface engineering, human-computer interfaces, guided learning technologies, software development and engineering, knowledge engineering and natural language comprehension.

CRIM is a dynamic consortium supported by an elaborate network of members. Its partners and clients actively participate in the sharing and renewal of its technological heritage. CRIM has more than one hundred members, including small and large companies, universities and service organizations.

CRIM

Centre de Recherches Mathématiques (CRM)

Director: *Jacques Hurtubise*

Established in 1969, CRM is a national research centre whose mission is to promote research in pure and applied mathematics. It is supported by an NSERC grant and by a Fonds FCAR grant. To carry out its task:

- It organises thematic years on a topic in mathematics, for example number theory (1998-1999), mathematical physics (1999-2000), mathematical biology and genomics (2000-2001). Activities include programs for visitors, students and postdoctoral fellows, in addition to various scientific initiatives. Short programs of approximately one-month duration are also offered.
- It includes research teams active in different fields such as, in applied mathematics, imaging, data mining, telecommunications, cryptography and modeling.
- With its partners in Toronto and Vancouver, it manages MITACS (Mathematics of Information Technology and Complex Systems), a network of centres of excellence which provides access to expertise in mathematics across Canada.
- It manages a publications program, including two joint series with the American Mathematical Society and two with Springer-Verlag.

Centre for Research on Transportation (CRT)

Director: *Michel Gendreau*

Established in 1971, CRT is a joint centre of the Université de Montréal, École des Hautes Études Commerciales and École Polytechnique. It presently brings together about forty professors, one hundred graduate students and fifteen research professionals with various academic backgrounds. The CRT mission is threefold: research and development, training of highly qualified personnel and technological transfer to industry and government agencies.

The CRT activities cover transport of persons and freight, in any mode, and telecommunication networks. These activities are grouped into five major research themes: planning and management of transport systems, intelligent transport systems, transport economics and policies, transport security, planning and management of telecommunication networks.

Numerous software packages for assisting decision-making in transport have been developed at CRT (EMME/2, HASTUS, STAN, TRIO, etc.). Several are now distributed on a commercial basis in more than sixty countries by spin-off firms of the centre (INRO and GIRO).

Group for Research in Decision Analysis (GERAD)

Director: *Pierre Hansen*

GERAD, a multi-university centre of École des Hautes Études Commerciales, École Polytechnique, McGill University and Université du Québec à Montréal, is a focal point for the development of important research projects combining management and systems engineering problems. GERAD groups about 30 professors, over 100 graduate students and 10 research professionals.

The field of expertise of GERAD is related to:

- The development of mathematical analysis techniques for the solution of complex problems in operations research and management science
- The application of these techniques to problems in other scientific disciplines such as artificial intelligence, classification and mathematical chemistry
- The application of optimisation models to the planning of large technico-economic systems like energy systems, and communication and transport networks
- The integration of operations research and computer-aided production for assistance in decision-making in the areas of fabrication and services.

New software developed at GERAD is being used in numerous companies and administrations, notably in the area of air transportation with the start-up company AD OPT, an offspring of the center.

GERAD

Institut National de la Recherche Scientifique - Télécommunications (INRS-Télécommunications)

Director: *André Girard*

The only university institution in Canada exclusively dedicated to telecommunications, INRS-Télécommunications is involved in the design of technologies to promote global telecommunications. Three research themes define the general framework of the activities of the centre: networks and protocols, multimedia and signal processing, and personal communication systems. As a consequence, researchers cover a wide range of fields related to the production and development of tomorrow's telecommunication systems, in order to make them more widely accessible, to increase and refine their performance, and also to give a personal touch to their use. INRS-Télécommunications offers four Master's and PhD programs: professional Master's in software engineering, Master's in telecommunications, professional Master's in telecommunications, and PhD in telecommunications. INRS-Télécommunications is a partner of the Canadian Institute in Telecommunications Research (ICRT in French), a network of Canadian centres of excellence. It is also host to the Cyrille-Duquet industrial chair in telecommunications software, and to the personal telecommunications chair supported by NSERC, Nortel Networks, Bell Mobility and Bell Quebec, with activities in transmission of signals for words, video and data on wireless cellular networks.