

Lê Nguyễn Hoàng

*Ph.D. Student, École Polytechnique Montreal
Founder of Science4All.org*

Interests

Mechanism Design, Social Choice, Game Theory, Bayesian Models, Microeconomics, Computation, Optimization, Combinatorics.

I am also highly involved in mathematics and science popularization.

Academic Training

2010– **Ph.D. in Applied Mathematics**, *École Polytechnique*, Montreal, GERAD.

I did a fast-track from Master's to Ph.D. My thesis is on mechanism design and applications to shift scheduling, under the supervision of François Soumis and Georges Zaccour. I passed all courses (Mathematical Programming, Graph Theory, Modeling, Integer Programming, Stochastic Programming) with A*, and preliminary exams in optimization.

2007–2011 **Engineering Degree**, *École Polytechnique ParisTech*, Palaiseau.

Polytechnique is one of France's leading university for high-level scientific training. The first year is a generalist training. Then, I specialized in *Applied Mathematics*.

2005–2007 **Preparatory Years**, *Lycée Louis le Grand*, Paris.

Intensive preparation in advanced mathematics and physics for competitive examination to the elite *Grandes Écoles*. I ranked 20th out of 15,000 candidates in the nationwide examination entrance for *École Polytechnique*.

Awards and Honors

2013 **3 Minute Thesis**, *École Polytechnique*, Montreal, 1st Prize.

<http://polymtl.ca/carrefour/en/article.php?no=4155>

2010–2013 **Research Grant**, GERAD, Montreal, 20,500\$ per year.

2010 **3-Month Research Grant**, *Chaire Microsoft-CNRS Optimisation et développement durable*, 3,400\$.

2010 **3-Month Research Grant**, *University of Auckland*, 3,000\$.

2008 **National Defense Medal**, *French Army*, for outstanding service.

2008 **Military Skiing Award and Military Paratrooper Award**, *French Army*.

2007-2011 **Military Pay**, *École Polytechnique ParisTech*, Palaiseau, 13,200\$ per year.

2006 **French Physics Olympiads**, *Lycée Louis le Grand*, 15th in national ranking.

2001-2005 **Math Kangaroo Contest**, *France*, 4th, 15th, 7th, 2nd, 10th in national rankings.

Appointments

- 2012– **Founder, Owner, Webmaster, Author**, *Science4All.org*, Quality Popular Science. Science4All.org is a website where users can read and write quality popular science. Built upon Wordpress, I implemented several additional features in php and javascript. The website now hosts 64 articles. It has had over 120,000 views, with about 350 per day and an exponential growth. We had collaborations with renowned science popularizers, like James Grime and Derek Müller. I wrote 53 articles and contributed to others through reviews and corrections. <http://science4all.org>
- 2010– **Ph. D. Thesis**, *École Polytechnique*, Montreal, GERAD. A major part of my research built solid mathematical foundations for Bayesian mechanism design. Based on this work, I implemented a generic structure for mechanism design. This represents 100,000 lines of code in Java. Finally, I worked in collaboration with company KRONOS, 2 professors, 2 post-doctoral fellows and a programmer. I am in charge of the coordination of the project. which involves the 100,000 line of code of KRONOS.
- 2011–2012 **Founder, Manager, Developer**, *Spicilège*, Videomaking Software. Spicilège used the library OpenCV in C to analyze collections of images and produce quality video in an automatized way. The code is about 200,000 lines in C++.
- 2010 **Research Assistant**, *University of Auckland*, Electricity Market Regulation, supervised by professor Andy Philpott. I studied a taxing of the HVDC inter-island line in New Zealand from a game theoretical perspective. Research gave conclusive evidence of market powers for Southern power generators. <http://science4all.org/wp-content/uploads/2013/12/HoangPhilpott2010.pdf>
- 2009 **Research Assistant**, *OrangeLabs*, Issy-les-Moulineaux, Pricing in Telecommunication, with Khaled Sellami and supervised by F. Bonnans, M. Bouhtou and M. Chardy. We used optimization by intervals to solve efficiently a pricing model. New techniques were introduced and implemented to control the interval widths for faster computations. <http://science4all.org/wp-content/uploads/2013/12/HoangSellami2009.pdf>
- 2009 **Research Project**, *École Polytechnique ParisTech*, Palaiseau, Image Compressing using Fractals, with Chiheb Chouchane. Compression is obtained by matching small areas of the image to bigger ones, up to symmetry and light adjustment. Decompression is done by iteration of copying bigger area into smaller ones accordingly to symmetry and light adjustment. Convincing results have been obtained.
- 2008–2009 **Manager in Team Scientific Project**, *École Polytechnique ParisTech*, Palaiseau, Sports Bets. I was manager of a 7-student team for a research project on sports bets. The decision making of a bookmaker was modeled as an optimization problem, which involves a model of football games and behaviors of betters. Experiments were carried out to test our models. <http://science4all.org/wp-content/uploads/2013/12/Paris%20Sportifs.pdf>
- 2007–2008 **Lieutenant**, *7th RMAT in French Army*, Lyon. I had mountain training, including building and sleeping in an igloo. I then was chief assistant of a military cadet training section.
- 2006–2007 **Individual Research Project**, *Lycée Louis le Grand, Paris*, supervised by professor Franck Taïeb, A Model of Football Games. I modeled football games to give a prediction of the 2006 world cup. This model involved a computation of team levels based on observed results. Particular interest has been given to the existence and uniqueness of the likelihood optimizers. http://science4all.org/wp-content/uploads/2013/03/tipe_final_ens.pdf

Ph.D. Thesis

- Title** **Personalized Shift Scheduling**, *École Polytechnique*, Montreal, GERAD.
Supervised by François Soumis and Georges Zaccour, in collaboration with company KRONOS.
- Work in Progress** **The Return Function: A New Computable Perspective on Bayesian-Nash Equilibria**, *with François Soumis and Georges Zaccour*.
The return function is a mapping of a player's action with a probability distribution on the outcomes. Crucially, a strategy profile is mapped to a return function profile. This map preserves the best-reply correspondence structure and the Bayesian-Nash equilibria, which means that computations of fixed points can be done nearly equivalently in the space of return functions. By using this equivalence, we show experimentally and theoretically how a new general approach succeeds in computations of Bayesian-Nash equilibria in a cake-cutting problem with 20 players.
<http://gerad.ca/fichiers/cahiers/G-2012-70.pdf> (deprecated)
- Optimization in Mechanism Design, with an Application to Cake-Cutting**, *with François Soumis and Georges Zaccour*.
We define a principal's objective function as a mapping of direct mechanisms with real numbers. Mechanism design is restated as the optimization of the principal's objective function over the set of incentive-compatible direct mechanisms. By considering a set of parameterized mechanisms, computing their equilibria and using the revelation principle to turn them into Bayesian Incentive-Compatible (BIC) direct mechanisms, we propose an optimization procedure based on thus exploring a set of parameterized BIC direct mechanisms. Applications to cake-cutting provide new computational results.
- New Quantifiable Definitions of Fairness**, *with François Soumis and Georges Zaccour*.
First, we define a fairness gap for von Neumann-Morgenstern (VNM) utility functions. It consists in comparing each player's utility for his good to the probability distribution of his utility for another player's good chosen uniformly randomly. More precisely, a player's normalized utility counts how many standard deviations his utility is above the average when trading. This determines the two degrees of freedom of VNM utility functions, and make reasonable comparisons of utilities of different players. The fairness gap is then defined as the standard deviation of normalized utilities. A variant is later defined for multi-attribute linear utility functions, as we argue that players may then compare the details of each attribute.
- Shift Scheduling with Employees' Preferences**, *with Nabila Azi, Guy Desaulniers, Mahsa Elahipanah, François Lessard, François Soumis and Georges Zaccour*.
We apply the three first papers of the thesis to shift scheduling, in collaboration with KRONOS. We propose a two-step optimization which guarantees that including employees' preferences does not increase company costs by over a given percentage. An experiment is planned to test the incentive-compatibility of our methods.

Teaching

- 2013 **Instructor**, *École Polytechnique*, Montreal, MTH2302C: Probability and Statistics.
Random variables, discrete and continuous laws, hypothesis tests, regression, variogram.
4 hours of lecture and 2 hours of exercices per week, for 13 weeks.
<http://polymtl.ca/etudes/cours/details.php?sigle=MTH2302C>
- 2011 **Instructor**, *École Polytechnique*, Montreal, MTH1101: Calculus I.
Sequences, series, Taylor developments, differentiability, optimization, Lagrange multipliers.
2 hours of lecture and 2 hours of exercices per week, for 13 weeks.
<http://polymtl.ca/etudes/cours/details.php?sigle=MTH1101>

Preprints

- 2012 **A Fast and Accurate Algorithm for Stochastic Integer Programming, Applied to Stochastic Shift Scheduling**, with Rémi Pacqueau and François Soumis, Les Cahiers du GERAD.
<http://gerad.ca/fichiers/cahiers/G-2012-29.pdf>
- 2010 **Allocating Physical Capacity Rights on an Electricity Transmission Line**, with Andy Philpott, Electric Power Optimization Centre.
<http://epoc.org.nz/papers/HVDCPaperv3.pdf>

Conferences

- 2013 **9th ISDG Workshop**, *Universitat de Barcelona*, New Quantifiable Definitions of Fairness, with François Soumis and Georges Zaccour.
- 2013 **26th European Conference on Operational Research**, *Sapienza University, Rome*, New Quantifiable Definitions of Fairness, with François Soumis and Georges Zaccour.
- 2013 **5th Colloquium on Building the Scientific Mind**, *Bosscha Observatory, Bandung*, The Importance of Popular Science.
<http://youtube.com/watch?v=437q26DoVes>
- 2013 **3 Minute Thesis Final**, *Université de Laval, Québec*, Favoriser l'Honnêteté.
<http://youtube.com/watch?v=34EIL-EoCxA>
- 2013 **Optimization Days**, *GERAD, Montreal*, Modeling Fairness, with François Soumis and Georges Zaccour.
- 2013 **10th International Conference on Computational Management Science**, *HEC Montreal*, The Return Function: A New Tool to Compute Bayesian-Nash Equilibria, with François Soumis and Georges Zaccour.
- 2012 **4th Workshop on Dynamic Games and Management Science**, *University of Padova*, Fairness for Non-Normalized Utility Functions, with François Soumis and Georges Zaccour.
- 2012 **15th International Symposium on Dynamic Games and Applications**, *Bysice, GERAD*, The Return Function: A New Tool for Mechanism Designers, with François Soumis and Georges Zaccour.
- 2012 **Optimization Days**, *CIRRELT, Montreal*, The Return Function: A New Tool for Mechanism Designers, with François Soumis and Georges Zaccour.
- 2011 **3rd Workshop on Dynamic Games and Management Science**, *HEC Montreal*, The Return Function: A New Tool for Mechanism Designers, with François Soumis and Georges Zaccour.

Seminars

- 2013 **Séminaire Pas Ordinaire**, *GERAD, Montreal*, More Hiking in Modern Math World.
http://youtube.com/playlist?list=PL8ovs-QtxcNyEH9orwrREzt60ttCiIr_6
- 2013 **Séminaire Pas Ordinaire**, *GERAD, Montreal*, A Trek through 20th Century Mathematics.
<http://youtube.com/playlist?list=PL8ovs-QtxcNzktDhALJgVYxrG4dRTbWmm>

- 2012 **Séminaire Pas Ordinaire**, GERAD, Montreal, Mechanism Design through Optimization.
- 2011 **Séminaire Pas Ordinaire**, GERAD, Montreal, Choosing the Right Rules.
- 2011 **Séminaire Pas Ordinaire**, GERAD, Montreal, Introduction to Computational Complexity Theory.

Non-Exhaustive List of Popularization Articles

- 2013 **Kin vs Group Selection: Evolutionary Biology on Trial.**
<http://science4all.org/le-nguyen-hoang/kin-vs-group-selection>
- 2013 **Numbers and Constructibility.**
<http://science4all.org/le-nguyen-hoang/numbers-and-constructibility>
- 2013 **Entropy and the Second Law of Thermodynamics.**
<http://science4all.org/le-nguyen-hoang/entropy>
- 2013 **Optimization by Integer Programming.**
<http://science4all.org/le-nguyen-hoang/integer-programming>
- 2013 **The Beauty of Ellipses, Parabolas and Hyperbolas.**
<http://science4all.org/le-nguyen-hoang/ellipses-parabolas-hyperbolas>
- 2013 **Euler's Formula and the Utilities Problem.**
<http://science4all.org/le-nguyen-hoang/eulers-formula-and-the-utilities-problem>
- 2013 **Spacetime of General Relativity.**
<http://science4all.org/le-nguyen-hoang/spacetime-of-general-relativity>
- 2013 **Hypothesis Test with Statistics: Get it Right!**
<http://science4all.org/le-nguyen-hoang/hypothesis-test-with-statistics>
- 2013 **The Amazing Physics of Water in Trees.**
<http://science4all.org/le-nguyen-hoang/the-amazing-physics-of-water-in-trees>
- 2013 **Poincaré Conjecture and Homotopy.**
<http://science4all.org/le-nguyen-hoang/poincare-conjecture>
- 2013 **Shannon's Information Theory.**
<http://science4all.org/le-nguyen-hoang/shannons-information-theory>
- 2013 **Dynamics of the Wave Function: Heisenberg, Schrödinger, Collapse.**
<http://science4all.org/le-nguyen-hoang/dynamics-of-the-wave-function>
- 2013 **Space Deformation and Group Representation.**
<http://science4all.org/le-nguyen-hoang/space-deformation-and-group-representation>
- 2013 **Construction and Definition of Numbers.**
<http://science4all.org/le-nguyen-hoang/construction-of-numbers>
- 2012 **Bayesian Games: Math Models for Poker.**
<http://science4all.org/le-nguyen-hoang/bayesian-games-how-to-model-poker>
- 2012 **Darwin's Theory of Evolution.**
<http://science4all.org/le-nguyen-hoang/darwins-theory-of-evolution>
- 2012 **Geological Wonders of Iceland.**
<http://science4all.org/le-nguyen-hoang/geological-wonders-of-iceland>

- 2012 **Advanced Game Theory Overview.**
<http://science4all.org/le-nguyen-hoang/advanced-game-theory-overview>
- 2012 **Model-Dependent Realism.**
<http://science4all.org/le-nguyen-hoang/model-dependent-realism>
- 2012 **P versus NP: A Crucial Open Problem.**
<http://science4all.org/le-nguyen-hoang/pnp>
- 2012 **Duality in Linear Programming.**
<http://science4all.org/le-nguyen-hoang/duality-in-linear-programming>
- 2012 **Mechanism Design and the Revelation Principle.**
<http://science4all.org/le-nguyen-hoang/mechanism-design>
- 2012 **Fair Division and Cake-Cutting.**
<http://science4all.org/le-nguyen-hoang/fair-division>

Skills

Languages French (native), English (bilingual, TOEFL: 110/120), German, Vietnamese (spoken).
 Computer C, C++, Java, PHP, Javascript, Latex, Inkscape, GIMP, Adobe Premiere.

Others

- 2012-2013 **Player and Captain**, *Bruno Sports Bar*, football team.
- 2008-2010 **President and Actor**, *Impro Binet*, theatrical improvisation.
 I organized weekly trainings and monthly shows for hundreds of spectators, in collaborations with many different events and associations. I wrote the anthem and produced 5 video clips of promotion or commemoration. Also, I put on a stand-up show for 1,000 spectators at the going-away party at the *École Polytechnique ParisTech*.
- 2008-2009 **Treasurer and Tutor**, *Tremplin*, advanced scientific courses for high school students.
 With a yearly budget of 80,000\$, Tremplin is a growing organization which promotes advanced science to good high school students in underprivileged environments.
<http://association-tremplin.org>
- 2008-2009 **Vice-President and in Charge of Activities**, *Jour de Foot*, charity day event.
 We launched the first edition. We organized a 32-team tournament, diverse activities and a charity event game in collaboration with *Football Sans Frontière*. The event had a turnover of 10,000€ and raised a 1,750€ donation for *Afghanistan Demain*, an association dedicated to the schooling of Afghan kids.
- 2005-2009 **Player and Vice-Captain**, *Tifosis*, football team.
- 2006 **Founder and Player**, *Table Tennis Tournament*, Lycée Louis le Grand, Paris.
- 2004 **Writer and Coordinator**, *Et si le lycée...*, édition Le Manuscrit.
 I am one of the three main authors of a collection of poems. I was nicknamed Charles Bol d'Air. The poems were first published on a website and then submitted and accepted for publication by the publisher Le Manuscrit. The poems include a reflection on the Education system and criticizes established approaches.
<http://books.google.ca/books?id=jg-ZAMnKUzYC>
- Sports Football, Hiking, Squash, Tennis, Handball, Table Tennis.
- Travel France, Canada, New Zealand, United States, Eastern Asia, Europe.