Yohan Chatelain

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Summary

I am a postdoctoral fellow at the University of Concordia Montreal. My research activities include computer arithmetic, numerical analysis, floating-point optimizations, and High-Performance Computing. I am currently focusing on neuroimaging pipelines to characterize numerical stability and improve performance.

Experience

Postdoctoral Fellowship | **Concordia University** | **Canada, Quebec, Montreal** 09/2020 - Present
Big Data Infrastructures for Neuroinformatics - Gina Cody School of Engineering and Computer Science
Goal: Studying numerical instabilities in neuroimaging pipelines
Projects involved:
- **LivingPark**, to improve the generalizability and robustness of MRI-derived biomarkers of Parkinson's Disease (project) **Python**
- **InterFLOP** project aims at providing a modular and scalable platform to analyze floating-point arithmetic (project) **C | C++**
- **ReproVIP** aims to evaluate and improve the reproducibility of scientific results in the field of medical imaging (project) **Python**
- **Non-regression tests for MRI preprocessing**, statistical tests using numerical uncertainties to quantify acceptable variation bounds
- **Numerical stability evaluation of human brain tractometry within PyAFQ**, AccelNet IN-BIC funding (project) **Python**
- **Pytracer**, a trace-based Python tool for visualizing numerical instabilities of Python codes (project / paper) **Python**
- **Fuzzy**, an ecosystem for evaluating the effect of numerical errors on computational tools (project / paper) **Python | C**
- **Significantdigit**, Python package for solid statistical analysis of stochastic arithmetic (project) **Python**

Ph.D. student | **UVSQ** | **France, Île-de-France, Versailles** 10/2016 - 12/2019
Li-Parad - Université de Versailles Saint Quentin-en-Yvelines (UVSQ)
Goal: Develop tools for debugging and optimizing floating-point computations in HPC
Projects involved:
- **Veritracer**, a tool for visualizing numerical instabilities over time (project / paper) **C | C++**
- **VPREC**, a verificarlo's backend to simulate reduced floating-point precision (paper) **C**
- **Verificarlo** is a tool for debugging and assessing floating point precision and reproducibility. (project) **C | C++ | Python**

Software Engineer Intern | **Intel Corporation** | **USA, Oregon, Hillsboro** 01/2019 - 07/2019
Numerics US team - Intel Jones Farm
Goal: Development of optimized mathematic libraries (Numerics US team)
- Contribution to the development of elementary mathematical functions (libm) **C | C++**
- Code modernization (half of the library's function) to ensure quality standards
- Setting up continuous integration for validation tests suite with internal tools

Software Developer Intern | **UVSQ** | **France, Île-de-France, Versailles** 04/2016 - 09/2016
Li-Parad - Université de Versailles Saint Quentin-en-Yvelines (UVSQ)
Goal: Internship for Master's degree validation
Projects involved:
- **CERE**, Code Extractor and REplayer (project / paper) **C | C++**
- **Construction of an energetic prediction model in the HPC context**

Software Developer Intern | **ECR (CEA, Intel, UVSQ)** | **France, Île-de-France, Bruyères-le-Châtel** 05/2015 - 09/2015
Exascale Computing Research
(Commissariat a l'Energie Atomique, Intel and Université de Versailles Saint Quentin-en-Yvelines joined laboratory)
Goal: C codes piecewise specialization based on value profiling
- Implementation of an automatic functions specializer in LLVM **C++**
- Implementation of a value profiling method in **Python**
- Characterization of speedups gained with specialization

Software Developer Intern | **LRI** | **France, Île-de-France, Saclay** 05/2015 - 09/2015
Laboratoire de Recherche en Informatique - Université Paris-Sud XI and CNRS
Goal: Implementation of program termination criterion for a generic first-order call-by-value language in ML style in **OCaml**

Education

Ph.D. **Université Paris-Saclay | Versailles, Île-de-France** 12/2019

Supervisors: William JALBY, Pablo DE OLIVEIRA CASTRO
Title: "Tools for debugging and optimizing floating-point computations in HPC"
Field: Computer sciences

Master **Université de Versailles Saint Quentin-en-Yvelines | Versailles, Île-de-France** 09/2016

Université de Versailles Saint Quentin-en-Yvelines (UVSQ) member of Université Paris-Saclay
Field: High-Performance Computing

Bachelor **Université Paris-Sud XI | Orsay, Île-de-France** 06/2014

Université Paris-Sud XI (UPSud) replaced by Université Paris-Saclay
Field: Computer sciences

Teaching

UVSQ | France, Île-de-France, Versailles
Université de Versailles Saint Quentin-en-Yvelines (UVSQ)

Compilers | Bachelor level | 72h 2018-2019
Overview of compilation from language parsing to assembly generation with practical implementation in LLVM

Advanced Algorithms | Bachelor level | 72h 2016-2018
Time and space complexity, recursive schemes and graph traversal

Parallel Architectures | Master level | 40h 2016-2018
Shared and distributed memory parallelization, cache policy, network topology and analysis of research publications

Mentoring

Ph.D. level

Ines GONZALES PEPE | **Concordia University** | Canada, Quebec, Montreal 09/2023 - present
- Subject: *"Numerical stability of deep learning in bioinformatics"*
- Supervisor: Tristan GLATARD | Mentoring: Gregory KIAR (50%)

Ali SALARI | **Concordia University** | Canada, Quebec, Montreal 10/2020 - 02/2022
- Subject: "*The effect of Computational Environments on Big Data Processing Pipelines in Neuroimaging*"
- Supervisor: Tristan GLATARD | Mentoring: Gregory KIAR (50%)

Master level

Ines GONZALES PEPE | **Concordia University** | Canada, Quebec, Montreal 09/2021 - 09/2023
- Subject: *"Numerical stability of DeepGoPlus infererence"* (**preprint paper**)
- Co-supervisor: Tristan GLATARD (50%)

Damien THENOT | **UVSQ** | France, Versailles | 06/2018 - 09/2018
- Subject: *"Development of a Java IDE for Veritracer"*
- Co-supervisor: Pablo DE OLIVEIRA CASTRO (50%)

Undergraduate level

Nigel YONG | **Concordia University** | Canada, Quebec, Montreal 05/2021 - 06/2021
- Subject: *"Optimizing performance of PyTracer"*
- Co-supervisor: Tristan GLATARD (50%)

Marc VICUNA | **Concordia University** | Canada, Quebec, Montreal 01/2021 - 05/2021
- Subject: *"Reducing numerical precision preserves classification accuracy in Mondrian Forests"* (**published paper**)
- Co-supervisors: Martin KHANNOUZ (33%) | Tristan GLATARD (33%)

Grants

AccelNet IN-BIC 10/2021
PI: Yohan Chatelain $10,000 (USD)
Understanding the magnitude, origins, and implications of numerical instabilities for human brain tractometry within PyAFQ

Concordia Horizon Post-doctoral Fellowship 2020-2022
PI: Yohan Chatelain $50,000/yr. (USD)
Studying numerical instabilities in neuroimaging

Research

Peer-reviewed publications in journals

1. PyTracer: Automatically profiling numerical instabilities in Python
   Yohan Chatelain, Nigel Yong, Gregory Kiar, Tristan Glatard. IEEE Transactions on Computers (IEEE TC) (2022)
2. Data Augmentation Through Monte Carlo Arithmetic Leads to More Generalizable Classification in Connectomics
   Gregory Kiar, **Yohan Chatelain**, Ali Salari, Alan C. Evans, Tristan Glatard In Neurons, Behavior, Data Analysis and Theory, 2021.
3. Numerical Uncertainty in Analytical Pipelines Lead to Impactful Variability in Brain Networks
   Gregory Kiar, **Yohan Chatelain**, Pablo de Oliveira Castro, Eric Petit, Ariel Rokem, Gaël Varoquaux, Bratislav Misic, Alan C. Evans, Tristan Glatard. In PLOS ONE (2021).
4. Piecewise holistic autotuning of parallel programs with CERE
   Mihail Popov, Chadi Akel, **Yohan Chatelain**, William Jalby, and Pablo de Oliveira Castro,
   Concurrency and Computation: Practice and Experience, vol. 29, Aug 2017.

Peer-reviewed publications in conferences

1. Reproducibility of tumor segmentation outcomes with a deep learning model
   Morgane Des Ligneris, Axel Bonnet, **Yohan Chatelain**, Tristan Glatard, Michaël Sdika, Gaël Vila, Valentine Wargnier-Dauchelle, Sorina Pop, Carole Frindel. International Symposium on Biomedical Imaging (ISBI), 2023.
2. Reducing numerical precision preserves classification accuracy in Mondrian Forests
   Marc Vicuna, Martin Khannouz, Gregory Kiar, **Yohan Chatelain**, Tristan Glatard.
   6th Workshop on Real-time Stream Analytics, Stream Mining, CER/CEP & Stream Data Management
   In 2021 IEEE International Conference on Big Data (Big Data) (pp. 2785-2790).
3. Accurate simulation of operating system updates in neuroimaging using Monte-Carlo arithmetic
   A. Salari, **Y. Chatelain**, G. Kiar, T. Glatard.
   Uncertainty for Safe Utilization of Machine Learning in Medical Imaging (UNSURE, MICCAI) (2021) pp. 14–23. Springer Publishing.
4. Automatic exploration of reduced floating-point representations in iterative methods
   Yohan Chatelain, Eric Petit, Pablo de Oliveira Castro, Ghislain Lartigue, & David Defour (2019, August).
   In the European Conference on Parallel Processing (Euro-Par) (pp. 481-494). Springer, Cham.
5. VeriTracer: Context-enriched tracer for floating-point arithmetic analysis
   Yohan Chatelain, Pablo de Oliveira Castro, Eric Petit, David Defour, Jordan Bieder, and Marc Torrent.
   In 2018 IEEE 25th Symposium on Computer Arithmetic (ARITH) (pp. 61-68). IEEE

Preprints

1. A numerical variability approach to results stability tests and its application to neuroimaging
   Yohan Chatelain, Loïc Tetrel, Christopher J Markiewicz, Mathias Goncalves, Gregory Kiar, Oscar Esteban, Pierre Bellec, Tristan Glatard. arXiv:2307.01373
2. Longitudinal brain structure changes in Parkinson{\textquoteright}s disease: a replication study
   Andrzej Sokolowski, Nikhil Bhagwat, **Yohan Chatelain**, Mathieu Dugre, Alexandru Hanganu, Oury Monchi, Brent McPherson, Michelle Wang, Jean-Baptiste Poline, Madeleine Sharp, Tristan Glatard. bioRxiv:2023.04.28.538743
3. Predicting Parkinson's disease progression using MRI-based white matter radiomic biomarker and machine learning: a reproducibility and replicability study
   Mohanad Arafe, Nikhil Bhagwat, **Yohan Chatelain**, Mathieu Dugre, Andrzej Sokolowski, Michelle Wang, Yiming Xiao, Madeleine Sharp, Jean-Baptiste Poline, Tristan Glatard. bioRxiv:2023.05.05.539590.
4. Numerical Stability of DeepGOPlus Inference
   Ines Gonzalez Pepe, **Yohan Chatelain**, Gregory Kiar, Tristan Glatard. arXiv preprint arXiv:2212.06361.

Communications at international conferences (summary)

1. Testing the long-term reproducibility of fMRIPrep results

Yohan Chatelain, Loïc Tetrel, Christopher J. Markiewicz, Gregory Kiar, Oscar Esteban, Pierre Bellec and Tristan Glatard. OHBM 2022, Glasgow, Scotland.

2. Fuzzy environments for the perturbation, evaluation, and application of numerical uncertainty via MCA in the scientific Python ecosystem
   Gregory Kiar, **Yohan Chatelain**, Ali Salari, Eric Petit, Pablo de Oliveira Castro, and Tristan Glatard. SciPy Conference, 2021.
3. Towards Abinit on ExaScale supercomputers: the challenge for electronic structure physicists
   Jordan Bieder, Marc Torrent, and **Yohan Chatelain**. APS Meeting Abstracts. 2018

Communications at international conferences (summary)

1. **IXPUG 2019**: Intel Extreme Performance Users Group, CERN, Geneva, Switzerland
2. **IXPUG 2018**: Intel Extreme Performance Users Group, Intel Corporation, Hillsboro, OR, USA
3. **ESTN 2018**: 8èmes École Thématique de Simulation Numérique, Cargèse, 2018
4. **RAIM 2017**: 9èmes Rencontres «Arithmétique de l'Informatique Mathématique», Lyon, 2017
5. **ABIDEV 2017**: The 8th ABINIT developer's workshop, Frejus, 2017