Hugo Monzon

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Summary

Postdoctoral Researcher specializing in Probabilistic Machine Learning and Multi-Objective Optimization. I have experience in research and development of model merging algorithms and optimizers to improve accuracy, safety, and training efficiency of Large Models (LMs). My interest lies within the intersection of probabilistic machine learning and multi-objective optimization, to create more accurate, robust and explainable models.

Work Experience

Postdoctoral Researcher, RIKEN AIP, Tokyo Jun 2022 - present

- Developed and implemented state-of-the-art *model merging* algorithms to synthesize multiple fine-tuned checkpoints into a single model.
- Conceptualize and implemented custom *PyTorch optimizers* using multi-objective techniques to handle conflicting tasks during training.
- *Orchestrated large-scale training* and Supervised Fine-Tuning (SFT) jobs on HPC clusters using qsub/SGE.
- Managed multi-GPU environments to train and evaluate diverse model architectures such as ViT, BERT, and ResNet18.
- Applied *Variational Inference* and *Bayesian Deep Learning* in model merging and multi-objective multitask learning.

System Solutions Engineer, Technopro IT, Yokohama Apr 2021 - Apr 2022

- Implemented a label making software (SQL queries, UI design, *business logic programming*), created installation packages for the product.
- Communicated with clients via email, wrote operation manuals and documentation in Japanese.

Skills

Tools & Infrastructure	Linux, CLI, HPC (qsub/SGE), Git, LaTeX, SQL
Frameworks	**Python:** PyTorch, JAX, **R:** Tiddyverse
Research	Proof of Concepts, Publishing and Reviewing for International Conferences, such as Neurips, ICML, ICLR, AISTATS, GECCO, EvoCOP, CEC, PPSN
Languages	**Spanish:** Native, **English:** Proficient **Japanese:** Intermediate - JLPT N2.

Education

Oct 2017 - Mar 2021	**Shinshu University**, Doctor in Engineering.
Oct 2015 - Sep 2017	**Shinshu University**, Master in Engineering.
Feb 2009 - Sep 2014	**National University of Asuncion**, Computer Engineering.

Publications

Pre-print

- **Hugo Monzon**, Thomas Möllenhoff, Nico Daheim, Iryna Gurevych, Mohammad Emtiyaz Khan, *How to Weight Multitask Finetuning? Fast Previews via Bayesian Model-Merging.* Preprint, December 2024. Pages 21 https://arxiv.org/abs/2412.08147

Journal

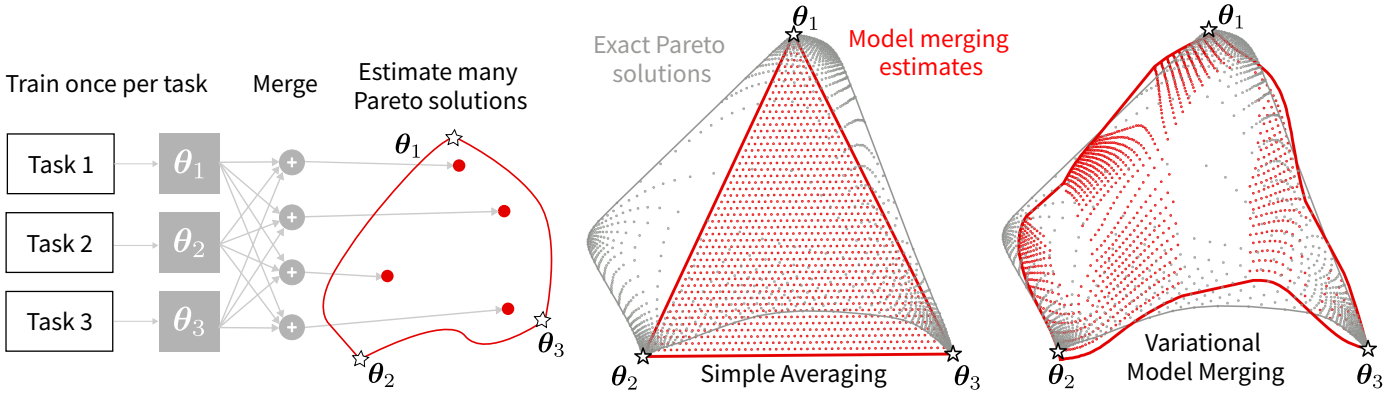
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Understanding Population Dynamics in Multi- and Many-objective Evolutionary Algorithms for High-Resolution Approximations.* In Advances in Operation Research, Hindawi. December, 2021. Pages 16. https://doi.org/10.1155/2021/6699277.
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Estimating Hypervolume using Population Features from Dynamic Compartmental Models.* In Transactions of the Japanese Society for Evolutionary Computation. December, 2020. Pages 14. https://doi.org/10.11394/tjpnsec.12.12

Conferences

- **Hugo Monzon**, Saul Zapotecas-Martinez. *A Dynamic Penalty Function within MOEA/D for Constrained Multi-objective Optimization Problems.* In Proceedings of IEEE Congress on Evolutionary Computation (CEC), Krakow, July, 2021. Pages 8 (1470-1477). https://doi.org/10.1109/CEC45853.2021.9504940
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Dynamic Compartmental Models for Large Multi-objective Landscapes and Performance Estimation.* In Proceedings of the European Conference on Evolutionary Computation in Combinatorial Optimization (EvoCOP '20), Seville, April, 2020. Pages 15 (99-113). https://doi.org/10.1007/978-3-030-43680-3_7. **Best Paper Nomination**
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Dynamic compartmental models for algorithm analysis and population size estimation.* In Proceedings of the Companion Publication of the Genetic and Evolutionary Computation Conference (GECCO '19), Prague, July, 2019. Pages 4 (2044-2047). https://dl.acm.org/doi/10.1145/3319619.3326912 **Best Student Paper Nomination**
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Studying compartmental models interpolation to estimate MOEAs population size.* In Proceedings of the Companion Publication of the Genetic and Evolutionary Computation Conference (GECCO '19), Prague, July, 2019. Pages 2 (227-228). https://dl.acm.org/doi/10.1145/3319619.3321985
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Studying MOEAs Dynamics and their Performance using a Three Compartmental Model.* In Companion Publication of the Genetic and Evolutionary Computation Conference (GECCO '18), Kyoto, July, 2018. Pages 2 (191-192). https://dl.acm.org/doi/10.1145/3205651.3205739
- **Hugo Monzon**, Hernan Aguirre, Sebastien Verel, Arnaud Liefooghe, Bilel Derbel, Kiyoshi Tanaka. *Closed State Model for Understanding the Dynamics of MOEAs.* In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO'17), Berlin, July, 2017. Pages 8 (606-616). https://dl.acm.org/doi/10.1145/3071178.3071259
- Christian von Lucken, **Hugo Monzon**, Carlos Brizuela, Benjamin Baran. *Dimensionality Reduction in Many-objective Problems Combining PCA and Spectral Clustering.* In Companion Publication of the Genetic and Evolutionary Computation Conference (GECCO '15), Madrid, July, 2015. Pages 2 (1511-1512). https://dl.acm.org/doi/10.1145/2739482.2764636

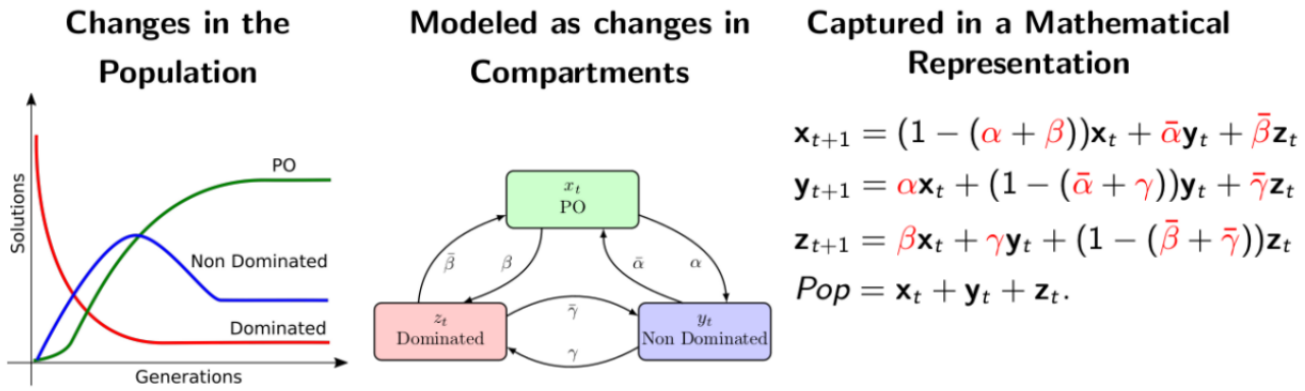
Recent Projects

Variational Model Merging for Pareto Front Estimation in Multitask Finetuning



I worked on variational Bayesian learning, my project connects the weighting used to merge models to Pareto trade-offs on an equivalent multi-task finetuned single model on all the tasks. Using probabilistic machine learning and variational inference, we show an unified framework for Simple Averaging, Task Arithmetic and other merging methods, by connecting it different complexity classes of Gaussian posteriors, allowing the development of new and more accurate merging methods like one based on mixture of Gaussians. Our framework allowed to explore multiple ways of weighting each task to achieve a desired trade-off between them, avoiding the costly retraining and using model merging as a proxy for the underlying multitask finetuning problem. Currently I am developing a new multi-objective optimizer that extends the classic Multi-Objective Gradient Descent Algorithm and Multi-Objective Newton to optimize instead of a single set of parameters a distribution over them, and allow a more robust descent on conflicting tasks, for example during the training of LLMs on instruction following and safety.

Dynamic Compartmental and Performance Models for Analysis and Configuration of MOEAs



During my doctoral course I studied Multi-Objective Evolutionary Algorithms (MOEAs), a method that simulates natural evolution by a population of solutions, and uses operators such as recombination (takes parameters from two solutions and merges them) and mutation (changes parameters at random) iteratively improving them and reaching the Pareto Set of optimal and non-dominated solutions. I proposed a model that captures changes in the optimality of solutions present in the population and correlates it to performance of the algorithm. Dynamic Compartmental Models (DCM) simulate how individuals in different stages of evolution (optimality) in the population interact and affect each other. Compartments are determined based on Pareto dominance status and presence or not at certain iteration of the solutions. The proportion in each compartment changes as the algorithm progresses in the search of the Pareto Set and this can be used to predict its performance.