

Davide Baldelli

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Personal Profile

PhD Student at MILA and Polytechnique Montréal.

Education

Polytechnique Montréal

PhD in Computer Engineering

- **Supervisors:** Sarath Chandar, Amal Zouaq.

Montréal, Canada

Jan 2025 - Current

University of Bologna

MSc in Artificial Intelligence

- Grade: 110/110 cum laude.
- **Courses:** Programming for Data Science, Knowledge Representation and Reasoning, Statistical Theory and Methods, Machine Learning, Deep Learning, Computer Vision, Natural Language Processing.

Bologna, Italy

Sept 2021 - Oct 2023

University of Florence

BSc in Mathematics

- Grade: 110/110.
- **Courses:** Mathematical Analysis, Linear Algebra, Group Theory, Geometry, Probability and Statistics, Logic and Computability.

Florence, Italy

Sept 2017 - Mar 2021

Liceo Scientifico Guido Castelnuovo

Scientific High School

- Passed with 96/100.

Florence, Italy

Sept 2012 - June 2017

Publications

CONFERENCE PROCEEDINGS

TWOLAR: a TWO-step LLM-Augmented distillation method for passage Reranking

Davide Baldelli, Junfeng Jiang, Akiko Aizawa, Paolo Torrioni

Proceedings of the European Conference on Information Retrieval (ECIR 2024), 2024

Research Experience

National Institute of Informatics

MSc Thesis - International Internship Program

- **Advisors:** Akiko Aizawa, Junfeng Jiang, Paolo Torrioni
- **Title:** A TWO-step LLM Augmented distillation method for passage Reranking
- Conducted research on Text Information Retrieval. We have investigated recent advancements in open-sourced Large Language Models, text retrievers, rerankers, knowledge distillation and ranking losses. Our approach is to adapt a T5 model to solve the reranking task, training it on GPT augmented labels. We have obtained SoTA results on the TREC-DL test sets and on the BEIR benchmark.

Tokyo, Japan

Mar 2023 - Aug 2023

University of Florence

BSc Thesis

- **Advisor:** Francesca Romana Nardi
- **Title** (translated): Big Deviations for Markov Chains
- The thesis focused on presenting a theorem describing the asymptotic behavior of Markov chains for studying rare events within the context of large deviations theory.

Florence, Italy

Sept 2020 - Mar 2021

Work Experience

Loop AI Group

Full Time - Fully Remote

Machine Learning Engineer

Sept 2023 - Present

- Co-supervised a master's thesis titled "Self Assessment Tool for Medical Exam Candidates" in collaboration with the University of Padova. Guided the candidate in applying machine learning techniques to develop a self-assessment tool. Assisted in research direction, methodology selection, and technical problem-solving.
- Conducted deep learning project for musical Deepfake detection algorithm achieving 94% of F1 score on a proprietary italian deepfake music dataset.
- Conducted deep learning project for automatic translation of audio data for content creation.
- Implemented statistical and deep learning based time series analysis models to solve demand forecasting.
- Implemented BERT-based email classifier tool for an italian University's administrative office, achieving 98% accuracy.
- **Technical Skills:** Python with PyTorch, NumPy, Matplotlib, Pandas, Scikit-learn, Ubuntu Linux, Linux tools, Scripting, Git.
- **Soft Skills:** Teamwork, Time Management, Communication, Presentation skills, Project Management.

Loop AI Group

Part Time - Fully Remote

Data Scientist Consultant

Sept 2022 - Sept 2023

- Implemented closed-domain generative question-answering systems on technical topics, exploiting SoTA Pretrained Seq2Seq Language Models.
- Implemented rule-based and transformers-based text retrievers.
- **Technical Skills:** Python with PyTorch, NumPy, Matplotlib, Pandas, Scikit-learn, Ubuntu Linux, Linux tools, Scripting, Git.
- **Soft Skills:** Teamwork, Time Management, Communication, Presentation skills.

Projects

🇪🇺 belleparoleaps.it Website Development

Florence, Italy

Personal Project

Sept 2024

- Developed the official website for Belle Parole APS using HTML, CSS, and Webflow.

🇯🇵 TWOLAR: a TWO-step LLM-Augmented distillation method for passage Reranking

Tokyo, Japan

National Institute of Informatics

Jan 2024

- This repository hosts the implementation for "TWOLAR", a novel method for passage reranking. The TWOLAR approach involves a two-step distillation process augmented by language models, enhancing the performance in various reranking benchmarks.
- Key features include a comprehensive framework for training and evaluating the TWOLAR method, supporting different reranking datasets like BEIR and TREC-DL2019/2020.
- The repository includes detailed instructions for training the model, evaluating performance, and understanding the unique approach of TWOLAR, including language model augmentation.
- Special focus is given to replicability and ease of use, ensuring that researchers and practitioners can easily adapt the TWOLAR method for their specific needs in passage reranking challenges.

🇯🇵 Exploring the deepdreaming phenomenon with recent vision architectures: Vision Transformers (ViT), ConvNeXt, and CLIP models

Tokyo, Japan

University of Bologna

Aug 2023

- Updated a github repository to support the newest vision models and pretrained checkpoints. With our implementation, images can be deep-dreamed either by maximizing the activation of a specific layer or by maximizing the similarity score with a text embedding, allowing the user to inject a visual concept in the form of a phrase while deepdreaming (only with CLIP models).

🇮🇹 Comparison of bag-of-words text retrieval models

Bologna, Italy

University of Bologna

Mar 2023

- Implemented TF-IDF and several BM25 variants, and evaluated on three different information retrieval datasets.

🇮🇹 A Pipeline for an explainable, extractive-generative multi-hop QA model

Bologna, Italy

University of Bologna

Feb 2023

- Implemented a pipeline for an extractive-generative Question-Answering model featuring a Retriever-Reader architecture, trained on the HotPotQA dataset.

🇮🇹 A NetLogo simulation for the study of the friendship paradox

Bologna, Italy

University of Bologna

Feb 2023

- Studied the robustness of the Friendship Paradox running simulation with NetLogo.

🇮🇹 POS tagging with different recurrent neural architectures

Bologna, Italy

University of Bologna

Dec 2022

- Tuned and evaluated a few modifications of a baseline BiDirectional LSTM on a POS tagging corpus.

📌 Question Answering with Encoder-Decoder architectures on CoQA

Bologna, Italy

University of Bologna

Dec 2022

- Implemented four different encoder-decoder models, based on Pretrained BERT-like architectures, and studied the effect of inputting the history of the dialogues.

📌 Loop Q prize competition - Emotion detection from speech

Bologna, Italy

University of Bologna

May 2022

- Implemented a solution based on multi audio features extraction and a BiLSTM architecture to tackle the emotion recognition task on the datasets: CREMA, SAVEE, TESS, RAVDESS.

📌 Combinatorial optimization solution to VLSI

Bologna, Italy

University of Bologna

Jul 2022

- Implemented a combinatorial optimization approach to the Very Large Scale Integration problem with four different technologies: Constraint Programming, Propositional SATisfiability, Satisfiability Modulo Theories, and Linear Programming.

📌 Intelligent agent that plays Tablut

Bologna, Italy

University of Bologna

Dec 2021

- Developed an intelligent system based on the Monte Carlo Tree Search algorithm able to play Tablut, an ancient board game.

Achievements

2022 **4th place**, Loop Q prize competition

Italy

Miscellaneous Experience

Belle Parole Arci APS

Florence, Italy

Leadership in Non-Profit Organization

Nov 2023 - Present

- Involved in founding and leading Belle Parole Arci APS, a non-profit organization.
- Responsible for organizing community events and managing bar operations as part of the organization's activities.
- Emphasized community engagement, cultural enrichment, and team coordination in a non-profit setting.
- Built the website of the organization: belleparoleaps.it.

Skills

Programming Python (fluent); HTML, CSS, R, MatLab, Minizinc, NetLogo (familiar).

Data Science Numpy, Pandas, Scikit-learn, Matplotlib, Seaborn.

Deep Learning Pytorch, Pytorch-lightning, Tensorflow.

NLP HuggingFace, Transformers, Prompt Engineer, OpenAI GPT.

Web Development Flask, Webflow

Miscellaneous Linux, Shell, \LaTeX (Overleaf/R Markdown), Git, Docker.

Soft Skills Time Management, Teamwork, Problem-solving, Documentation, Engaging Presentation.

Languages

English Professional proficiency

Italian Native proficiency

References available upon request.