Luigi Belli

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ABOUT ME

Physics of Data Master's student combining astrophysics with data science, machine learning, and HPC. Seeking an internship to apply and enhance my technical skills for scientific discovery and research.

EDUCATION

University of Padua
MSc student in Physics of Data *2024-2026*

University of Padua
BSc in Astronomy *2019-2024*

- *Thesis:* Formation of binary systems Black Hole-Star: the case of Gaia BH1 and Gaia BH2.
  - Analyzed population synthesis simulations (SEVN code) for Gaia BH1/BH2, providing strong evidence that a dynamical formation scenario, rather than isolated evolution, is probable origin for these systems.

PROJECTS

Galaxy Classification using CNN TEAM PROJECT
- Built and benchmarked CNNs for morphological classification on the Galaxy Zoo 2 dataset.
- Optimized hyperparameters with Optuna, achieving RMSE of $\simeq 0.06$.
- Validated model scalability for large-scale astronomical surveys.

Data analysis of hierarchical mergers of black holes simulations TEAM PROJECT
- Analyzed hierarchical binary BH merger simulations across diverse star clusters (Python, Pandas).
- Investigated cluster conditions in BH evolution by comparing mass, spin, and merger generation distributions.
- Applied Random Forest to identify key drivers of higher-generation BH formation.
- Quantified clusters' influence on merger remnant retention and high mass BH populations detected via GWs.

Distributed analysis of Cord-19 dataset TEAM PROJECT
- Executed large-scale text analysis ($\simeq$ 200k papers) using Dask for distributed computation.
- Developed parallel word-count algorithm and generated NLP embeddings to compute cosine similarity.
- Benchmarked cluster performance, analyzing scalability and overhead to improve efficiency at scale.

Learning the topology of a Bayesian Network using the K2 algorithm TEAM PROJECT
- Implemented the K2 Bayesian Network structure-learning algorithm in R.
- Developed automated node order search methods using brute force and simulated annealing.
- Benchmarked and validated algorithm performance against the standard bnstruct R library.

Automated Tournament Data Processing and Analytics SOLO PROJECT
- Developed and deployed an MVP Telegram bot (Python, Docker, MySQL) for automated tournament management and data analysis, enabling reproducible deployment and robust statistics computation.

SKILLS

Coding Languages: Python [proficient], R, SQL, Bash, C
Frameworks: Pytorch, Optuna, Dask
Tools: Git, Docker
Languages: Italian [native], English [B2, professional proficiency]