# Sultan Hassan (he/him)
## Data-Driven Researcher

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Computational astrophysicist with over **five years** experience beyond PhD. I spent 50% of my time simulating the Universe using numerical simulation runs on super-computing facilities, and 50% developing new state-of-the-art machine learning models to accelerate and maximize scientific discovery. I am highly interested in Generative AI, Large Language Models (LLMs), Interpretability, Out-Of-Distribution (OOD) Detection, Domain adaptation, Optimal transport, Emulation, Robustness, and Large scale inference.

## SKILLS

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|---|---|
| **Tools and Languages** | Python, C/C++, Git, LaTeX, scikit-learn, TensorFlow, PyTorch, Pyro, Hugging Face. |
| **ML techniques** | Generative AI, Normalizing flows, Diffusion models, CNNs/ANNs, U-Nets/GANs/VAEs, Dimensionality reduction, density estimation, likelihood-free inference, symbolic regression, denoising, OODs, LLMs. |
| **Communication** | English (fluent speaker), Arabic (native) |

## TECHNICAL EXPERIENCE

**NASA Hubble Fellow** — Jan 2023 — Present
*New York University* — *New York, NY*

- Lead independent research applying machine learning models in astrophysics.
- Developed diffusion models to generate efficiently large scale maps of the Universe.

**Flatiron Research Fellow** — Sep 2020 — Dec 2022
*Flatiron Institute* — *New York, NY*

- Lead independent research applying machine learning models in astrophysics.
- Developed a normalizing flow model to efficiently map out the gas distribution in the Universe.

**Tombaugh Fellow** — Aug 2018 — Aug 2020
*New Mexico State University* — *Las Cruces, NM*

- Lead independent research applying machine learning models in astrophysics.
- Developed deep learning model to constrain both cosmology and astrophysics at the field-level.

## EDUCATION

**PhD in Physics**, *University of the Western Cape, South Africa* — April 2018
**MSc in Astrophysics & Space Science**, *University of Cape Town, South Africa* — Dec 2013
**Honours in Astrophysics & Space Science**, *University of Cape Town, South Africa* — Dec 2011

## ML PUBLICATIONS IN NeurIPS, ICLR. ICML.

- **Hassan, S** & Andrianomena, S., *HIDM: Emulating Large Scale HI Maps using Score-based Diffusion Models*, accepted to Machine Learning and the Physical Sciences Workshop, NeurIPS 2023.[Link to arXiv].

- Andrianomena, S. & **Hassan, S.**, *Latent space representations of cosmological fields*, accepted at the Machine Learning and the Physical Sciences Workshop, NeurIPS 2023. [Link to arXiv]

- Lovell, C. C., **Hassan, S.**, Anglés-Alcázar, D., Bryan, G., Fabbian, G., Genel, S., Hahn, C., Iyer, K., Kwon, J., de Santi, N., Villaescusa-Navarro, F., *A Hierarchy of Normalizing Flows for Modelling the Galaxy-Halo Relationship*, accepted for ICML 2023 Workshop on Machine Learning for Astrophysics, [Link to arXiv].

- Gondhalekar, Y., **Hassan, S.**, Saphra, N., Andrianomena, S., *Towards out-of-distribution generalization in large-scale astronomical surveys: robust networks learn similar representations*, accepted to Machine Learning and the Physical Sciences Workshop, NeurIPS 2023. [Link to arXiv].

- Friedman, R., & **Hassan, S.**, *HIGlow: Conditional Normalizing Flows for High-Fidelity HI Map Modeling*, accepted to the 36th Conference on Neural Information Processing Systems (NeurIPS) 2022 workshop on Machine Learning and the Physical Sciences on Oct 2022. [Link to arXiv].

- Masipa, M., **Hassan, S.**, Santos, M., Contardo, G., Cho, K., *Emulating Radiation Transport on Cosmological Scales using a Denoising U-Net*, accepted at the ICLR 2023 Workshop on Physics for Machine Learning. [Link to arXiv].

- Lin, Y., **Hassan, S.**, Blancard, R.B., Eickenberg, M., Modi, C., *Towards a non-Gaussian Generative Model of large-scale Reionization Maps*, accepted to the 36th Conference on Neural Information Processing Systems (NeurIPS) 2022 workshop on Machine Learning and the Physical Sciences on Oct 2022. [Link to arXiv].