Use of Neural Networks in calculating the abundance of different species in exoplanet atmospheres

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Idea

- Implementing a trained neural network to accurately reproduce the chemical kinetics codes used to calculate chemical abundances in exoplanet atmospheres with disequilibrium chemistry.

Dataset

- To be constructed using VULCAN (Tsai et al. 2017) (Chemical kinetics code)

Papers

- Hendrix, J. L., Louca, A. J., & Miguel, Y. (2023). Using a neural network approach to accelerate disequilibrium chemistry calculations in exoplanet atmospheres. *Monthly Notices of the Royal Astronomical Society*, stad1763.
- Cobb, A. D., Himes, M. D., Soboczenski, F., Zorzan, S., O'Beirne, M. D., Baydin, A. G., ... & Angerhausen, D. (2019). An ensemble of bayesian neural networks for exoplanetary atmospheric retrieval. *The astronomical journal*, *158*(1), 33.

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Baseline

- To successfully curate the dataset using VULCAN (Tsai et al. 2017) and to apply the LSTM neural network

Midway Expectations

- To successfully train neural network accurately reproducing the results from chemical kinetics code with less computational time.

Final Goal

- To achieve sufficient accuracy with the model when applied to a new exoplanet and possibly incorporate the model into atmospheric retrievals.