UNIVERSITY OF KWAZULU-NATAL
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COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE

School of Agriculture and Science

Scientific Presentation

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TOPIC

A Simple Neural-Network Bridge Between Galaxy Simulations and Surveys

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11h00

Physics Department Computer LAN,
Main Science Building, Level 2,
University of KwaZulu-Natal, Pietermaritzburg

ABSTRACT: Stellar mass is one of the most important quantities used to understand how galaxies form and evolve, but it is not something that can be measured directly. It is usually inferred from galaxy light using detailed modelling, which can be computationally expensive and dependent on a range of assumptions about stellar populations, dust, and star-formation history.

In this presentation, I offer a simpler approach: a deliberately lightweight, fully connected neural network developed from scratch to estimate galaxy stellar masses from broad-band photometry. Rather than using a deep or highly specialised architecture, the model uses a single hidden layer and learns directly from simulated galaxies produced by the SHARK semi-analytic model. Despite its simplicity, the network accurately recovers the known stellar masses of simulated galaxies across a wide mass range. To understand what the network has learned, an independently derived saliency-mapping method is used to identify which colours and magnitudes most strongly influence its predictions, showing that the model captures physically meaningful information in the input data.

To follow the method from simulation to observation, it is applied to real galaxies from the GAMA survey, reproducing stellar masses derived from conventional modelling with low scatter and only a small, correctable bias. It is also used to estimate masses for GAMA galaxies without existing stellar-mass measurements.

Overall, the work demonstrates that simple, transparent machine-learning models can provide a practical bridge between theoretical galaxy simulations and large observational surveys.