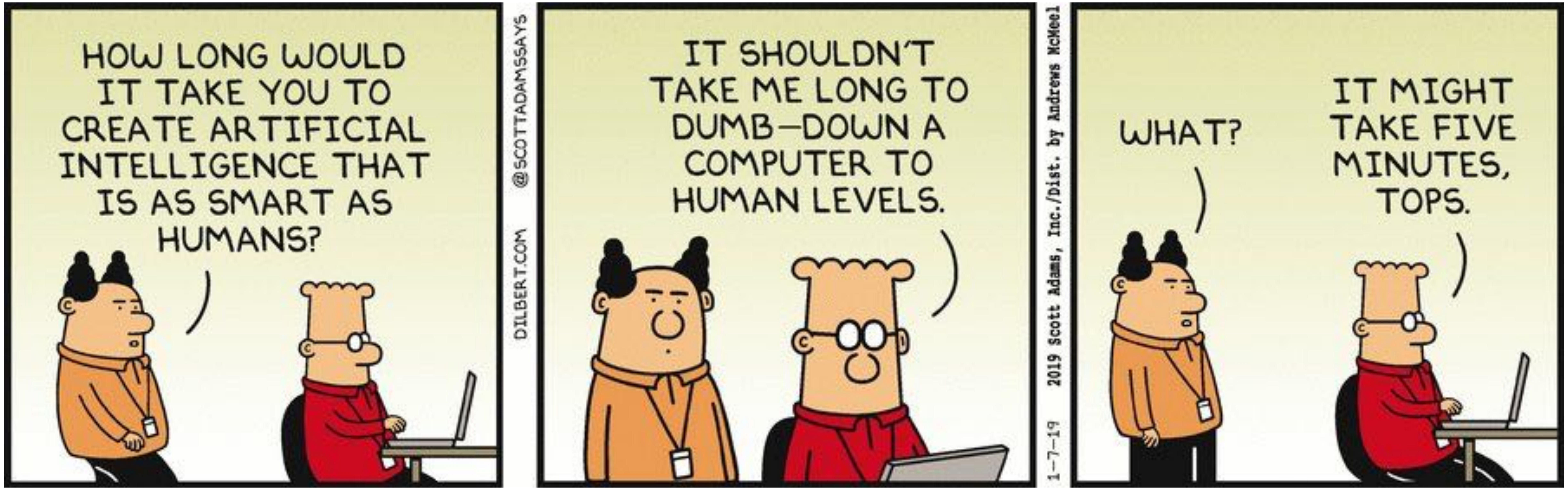
Status of Machine Learning in Astronomy

Nikhel Gupta

CSIRO Future Science Platform for MLAI

CSIRO Space & Astronomy



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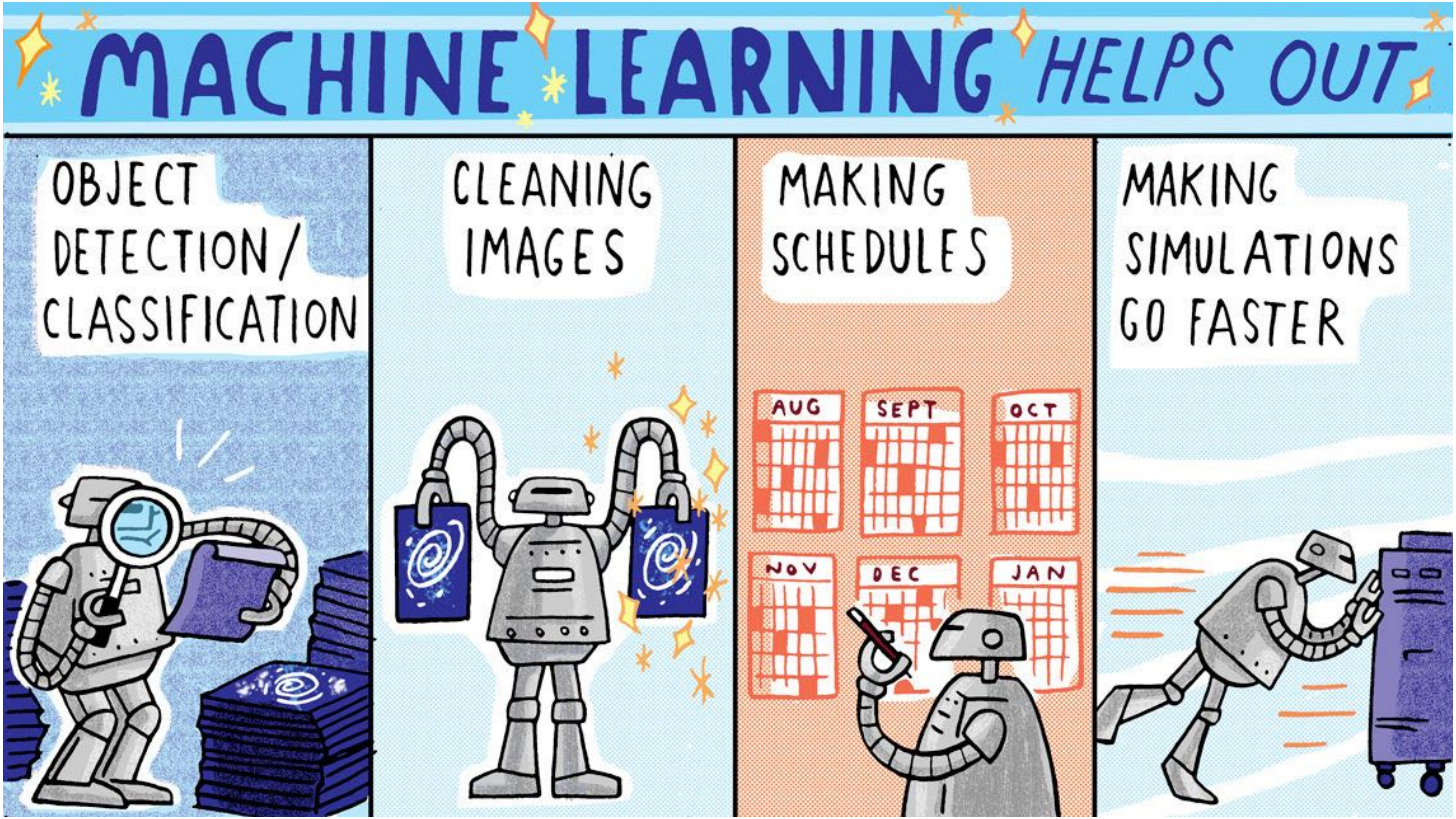

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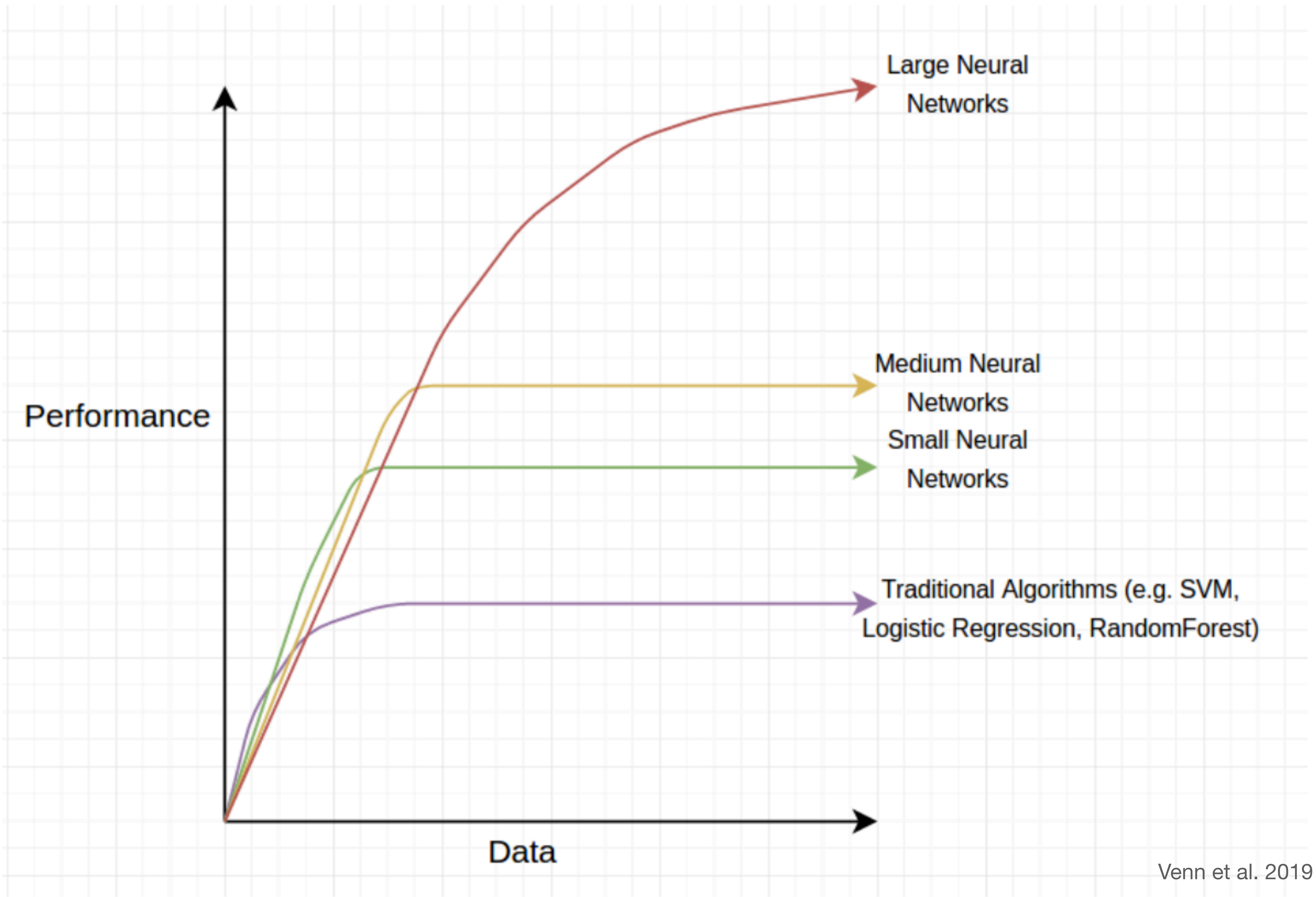

Venn et al. 2019

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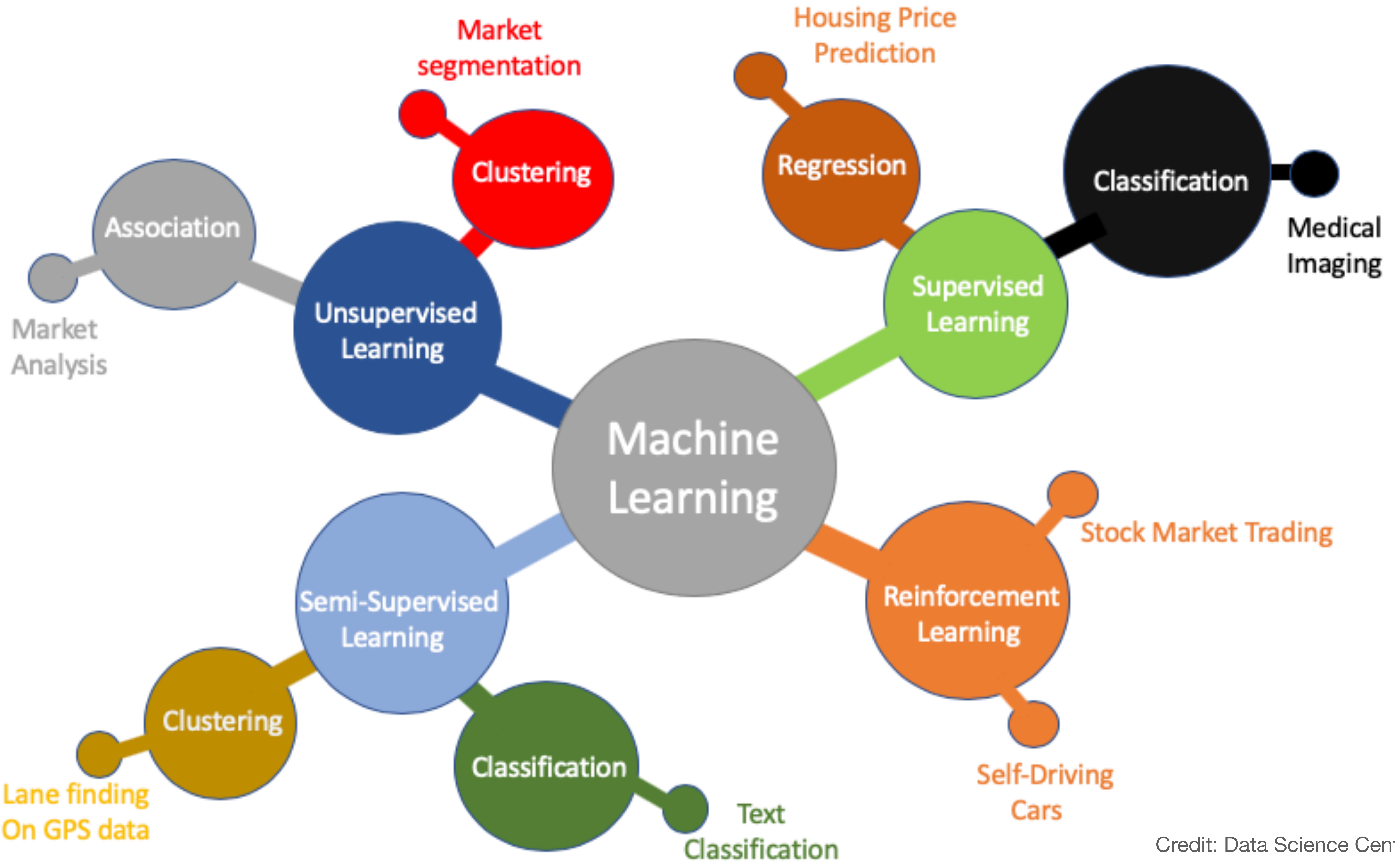

Credit: Data Science Central

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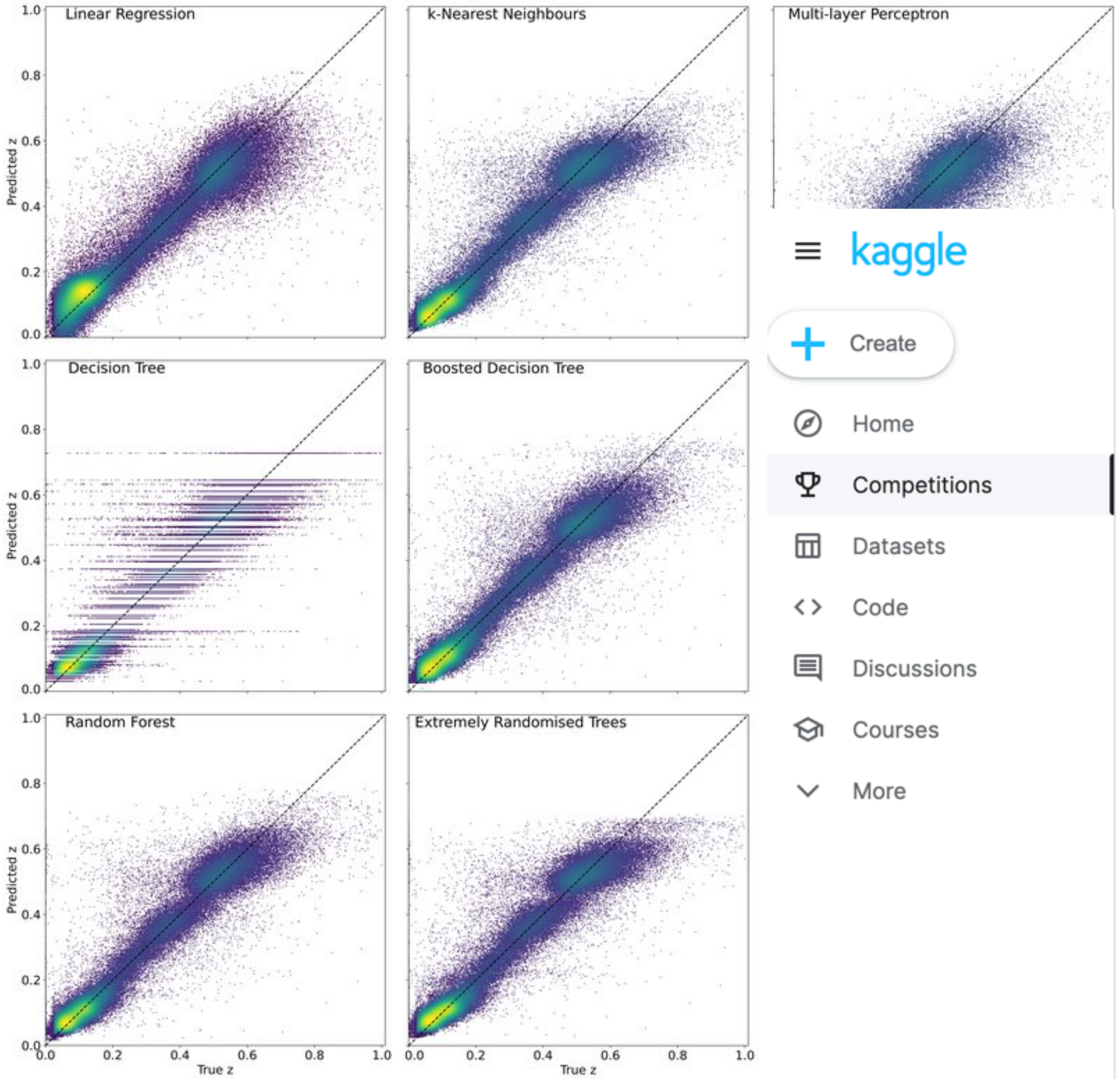
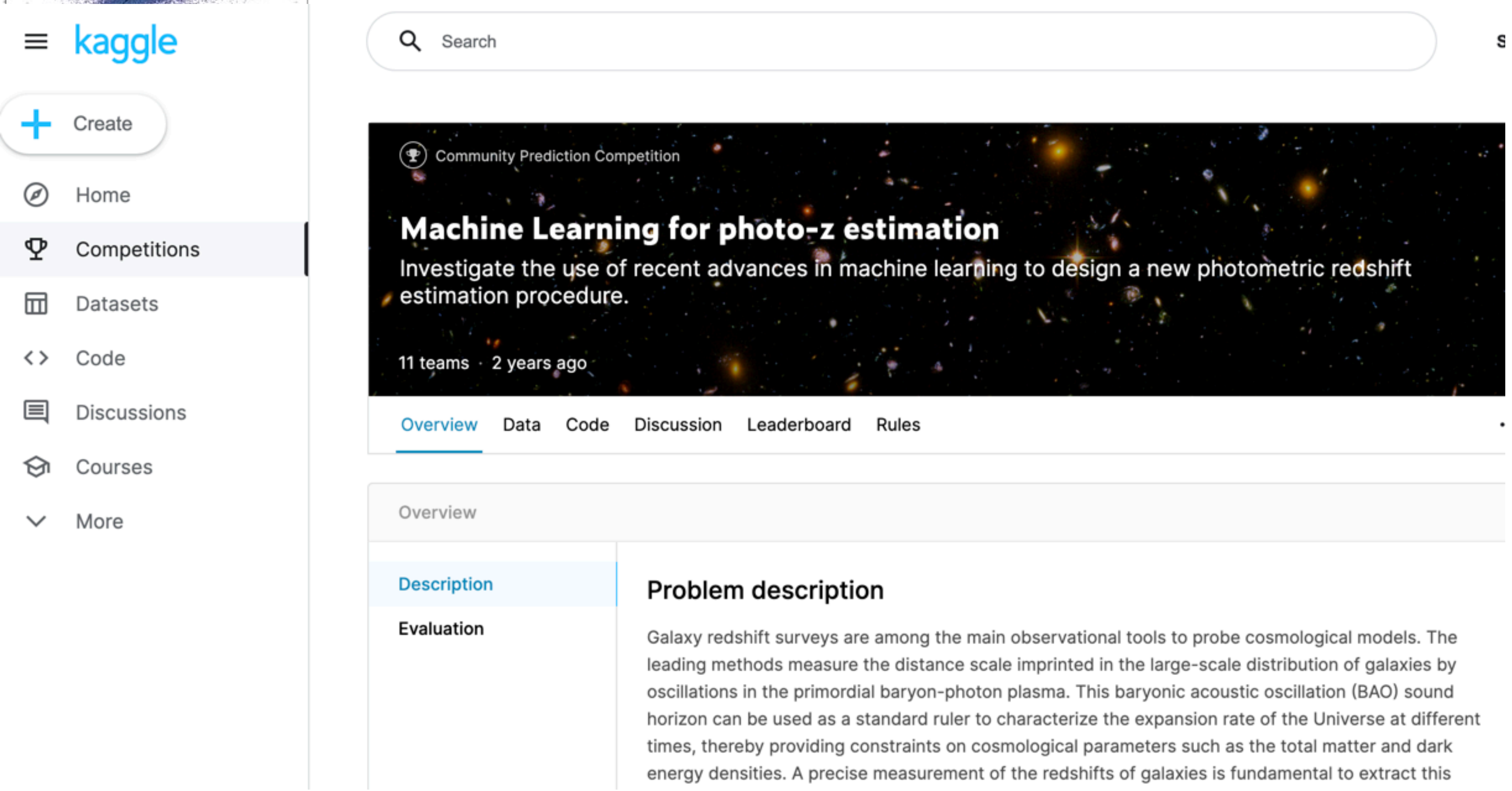
Supervised Learning in Astronomy Examples



Henghes et al. 2021

Redshift estimations
Catalog space i.e. using tables



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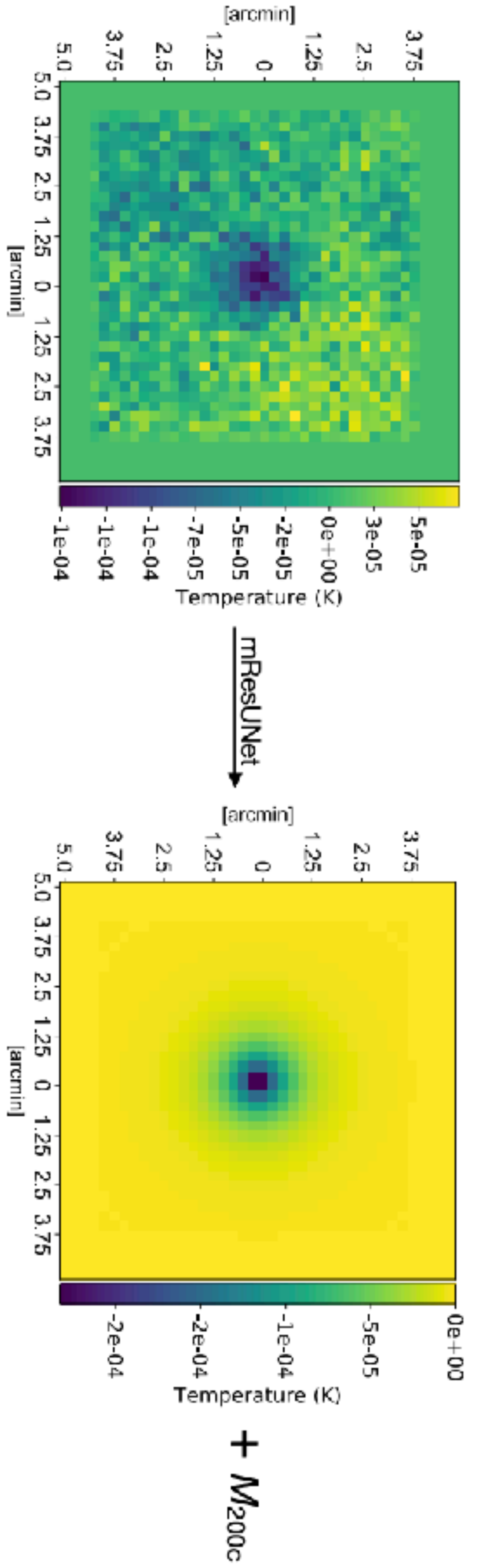
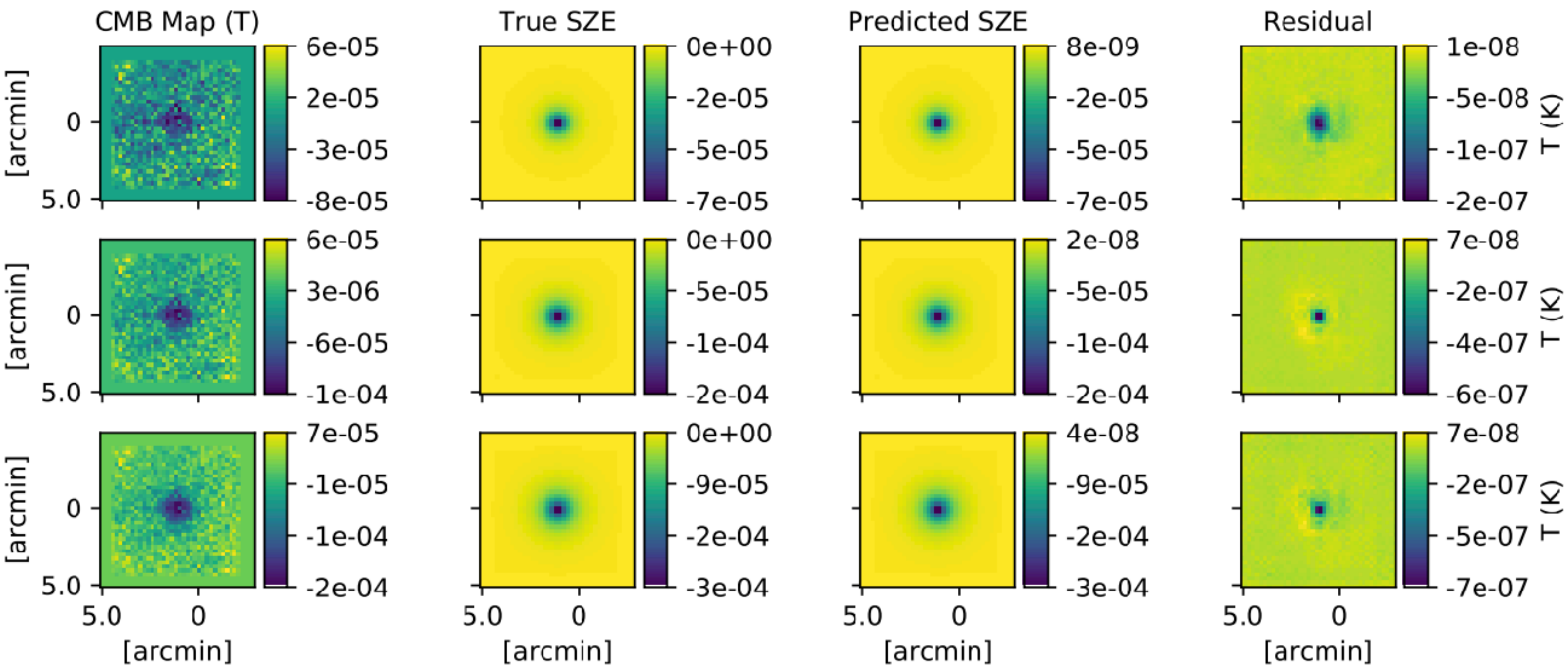
Supervised Learning in Astronomy Examples



Mass Estimatation (Image Space)

Gupta et al. 2020, 2021



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Supervised Learning in Astronomy Examples

Making simulations fast (Image Space)

Y. Li et al. 2021

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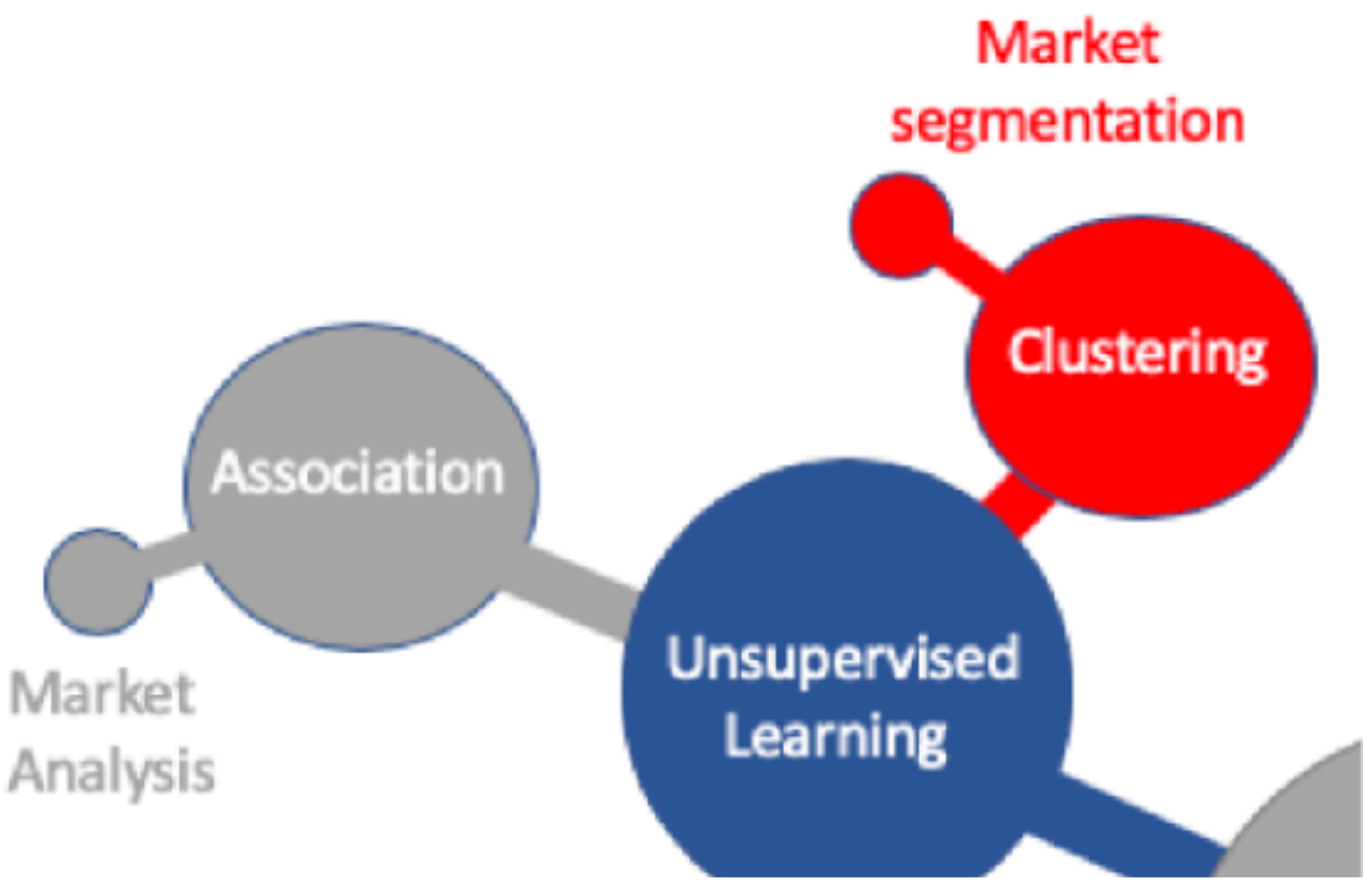
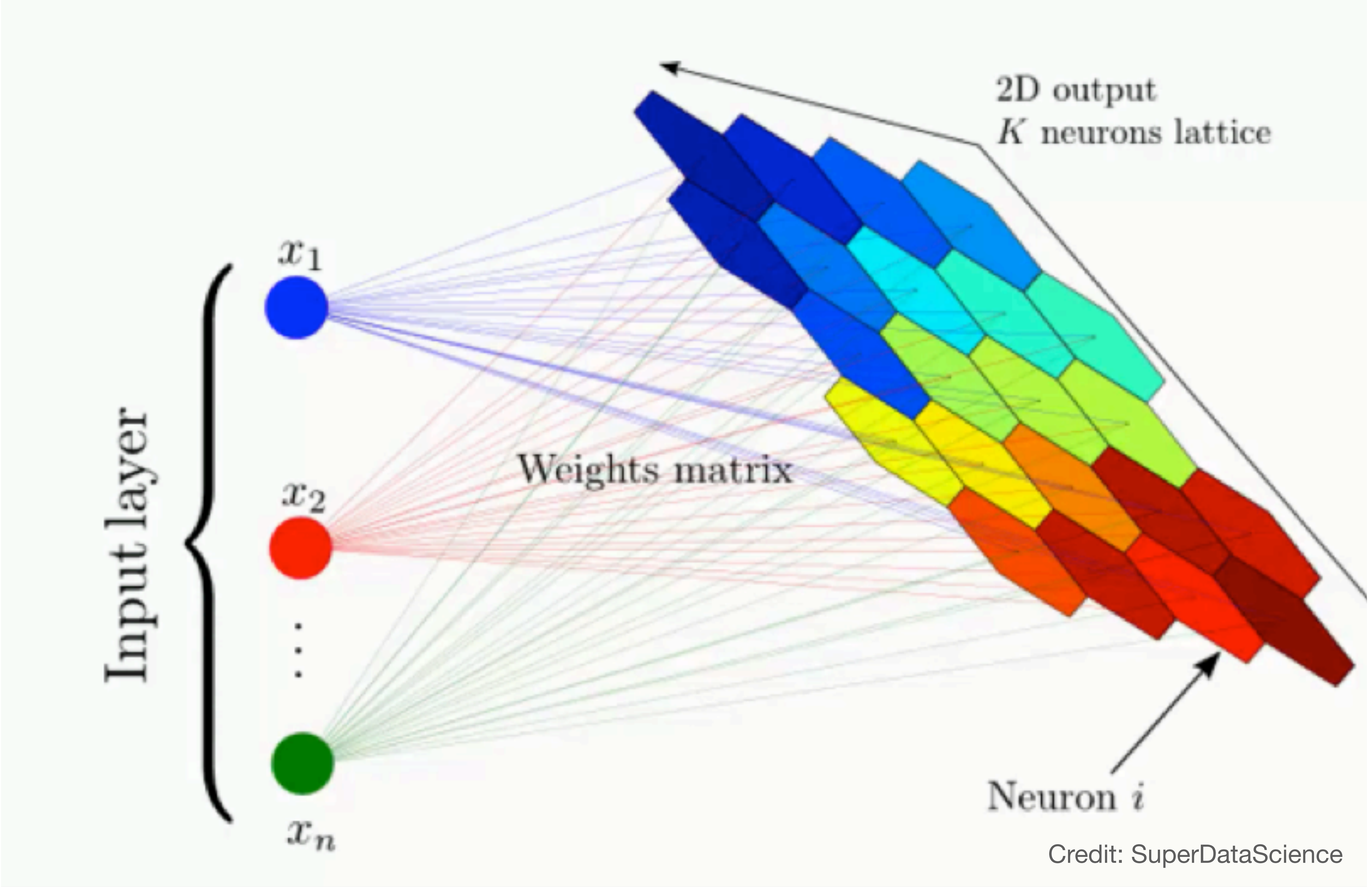
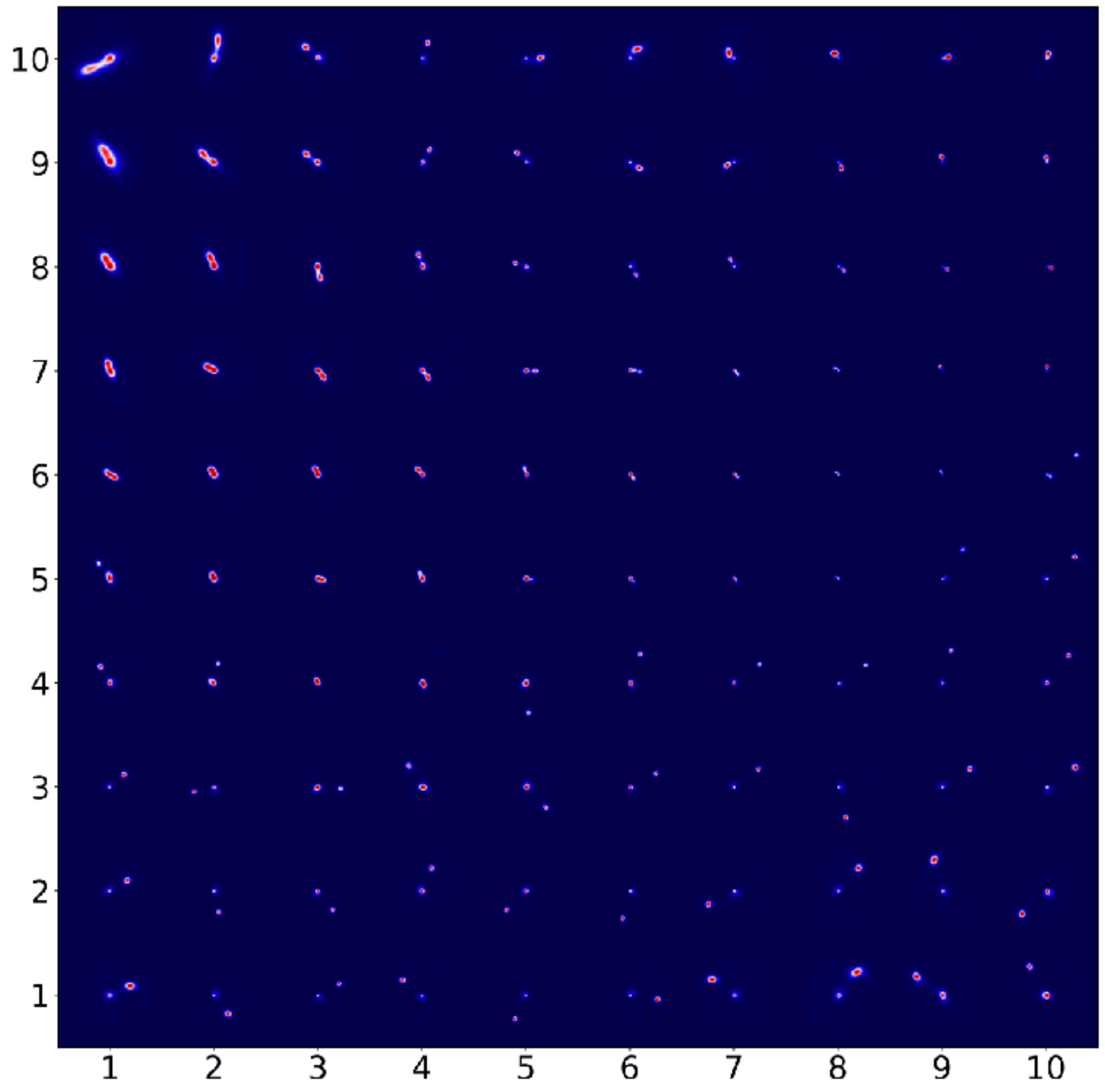


Credit: Data Science Central

Un-supervised Learning in Astronomy Examples

(1) feature extraction, (2) clustering, (3) visual representation





Self Organising Maps

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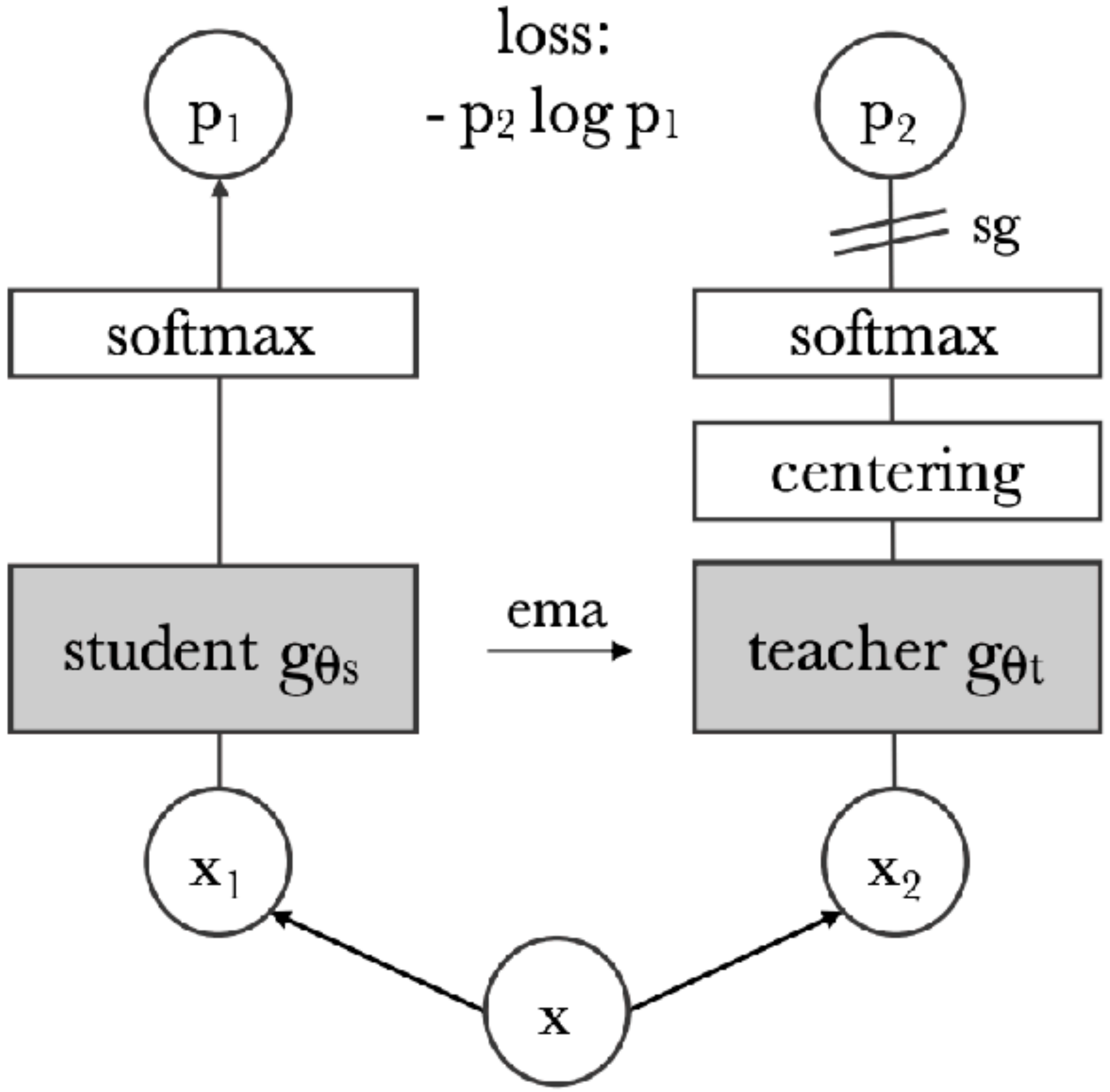
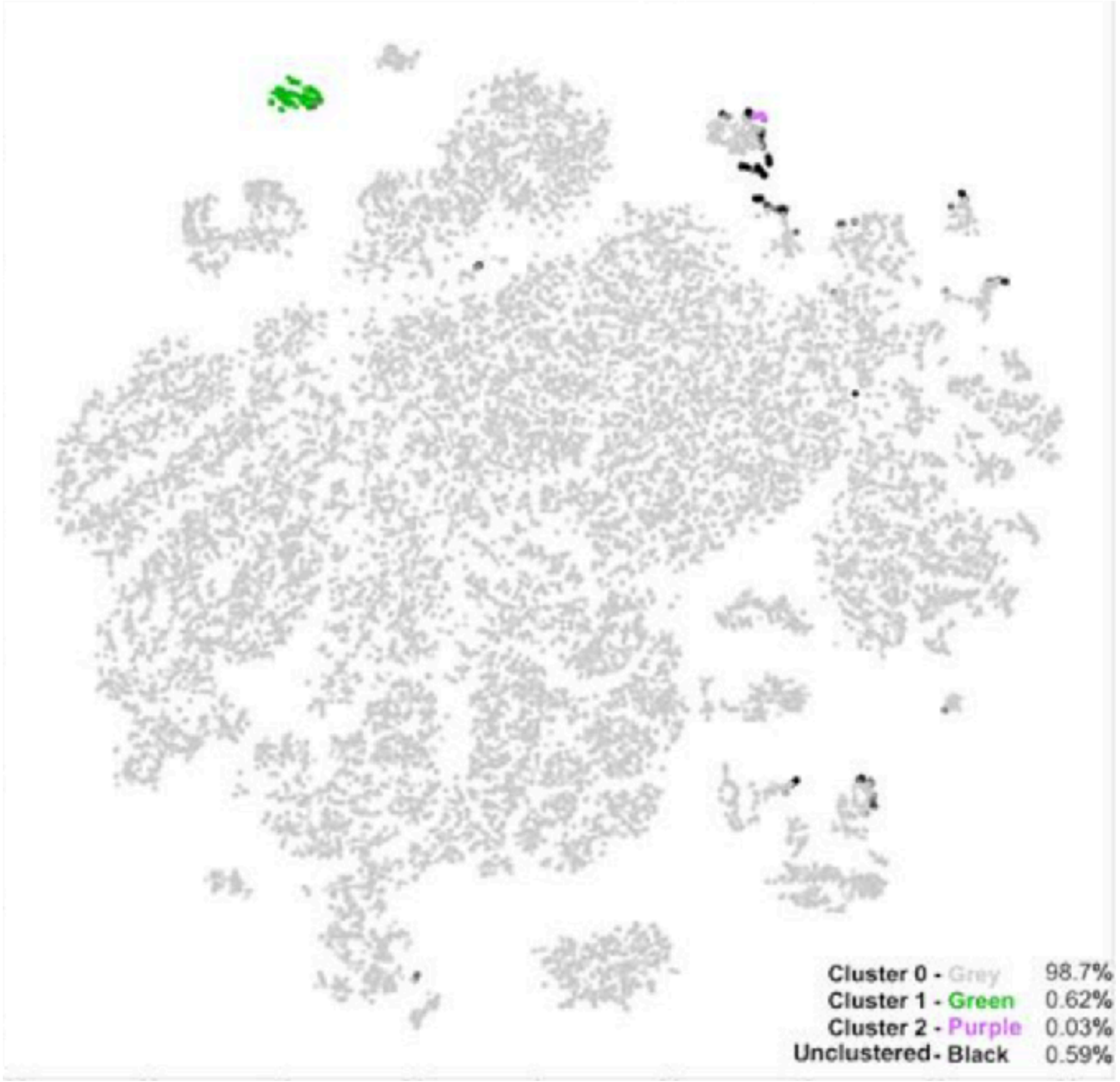
Un-supervised Learning in Astronomy Examples

(1) feature extraction, (2) clustering, (3) visual representation



Student Teacher self-supervised networks



Webb et al. 2020

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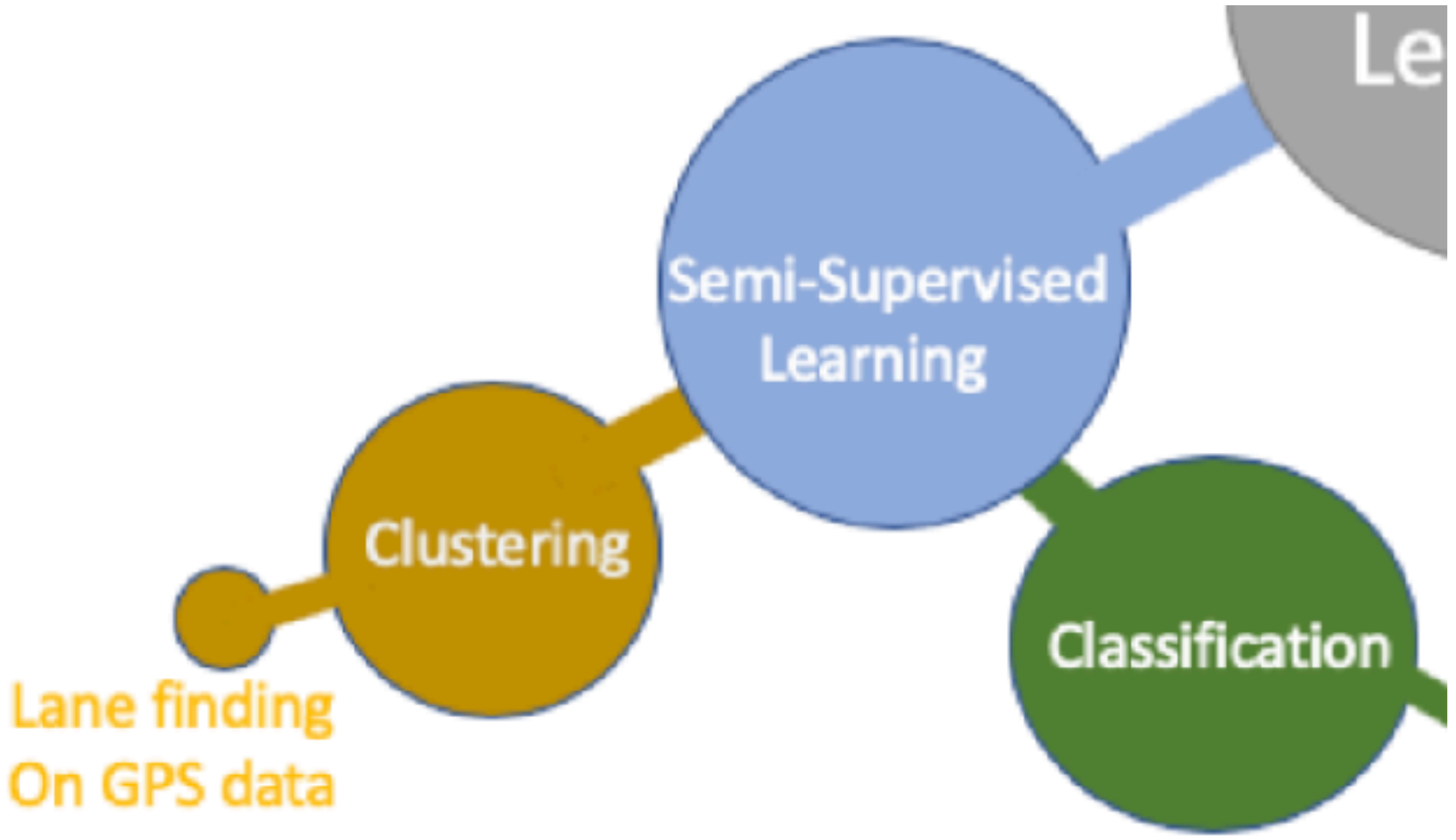

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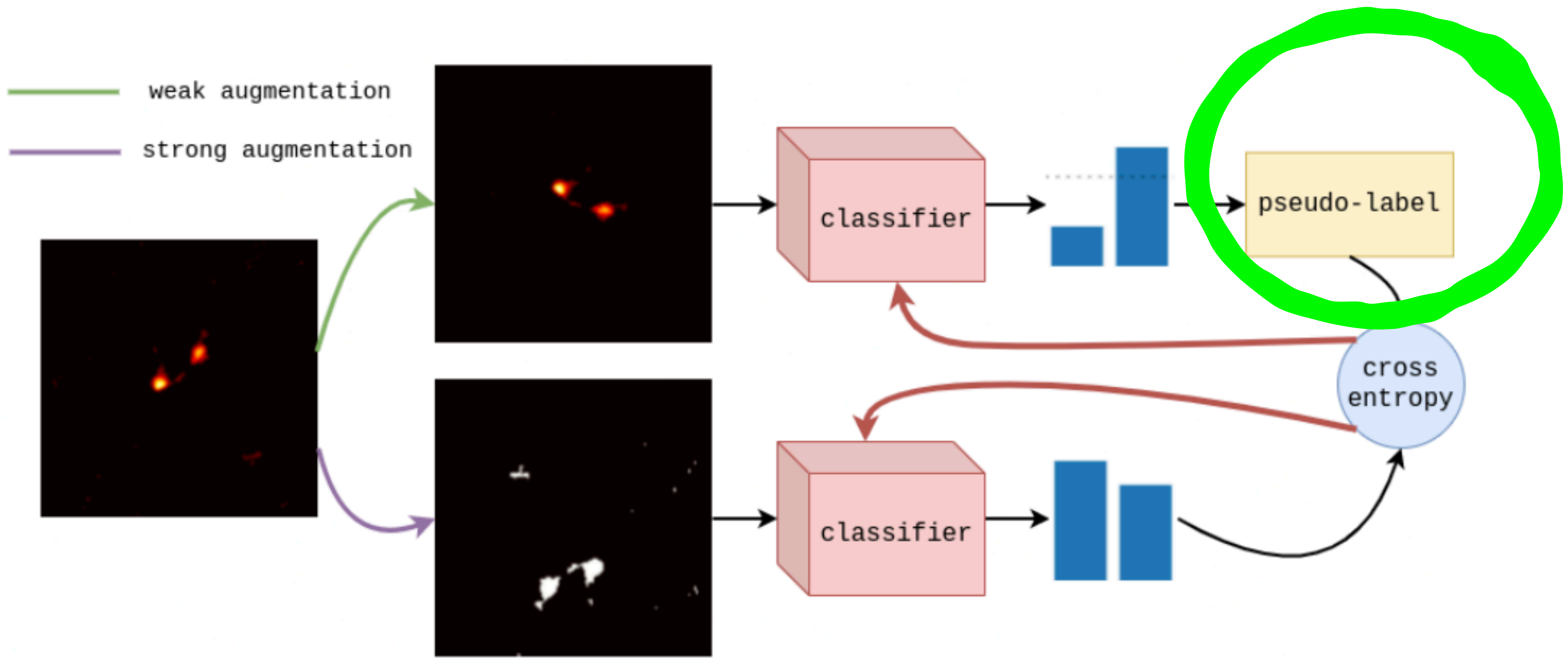
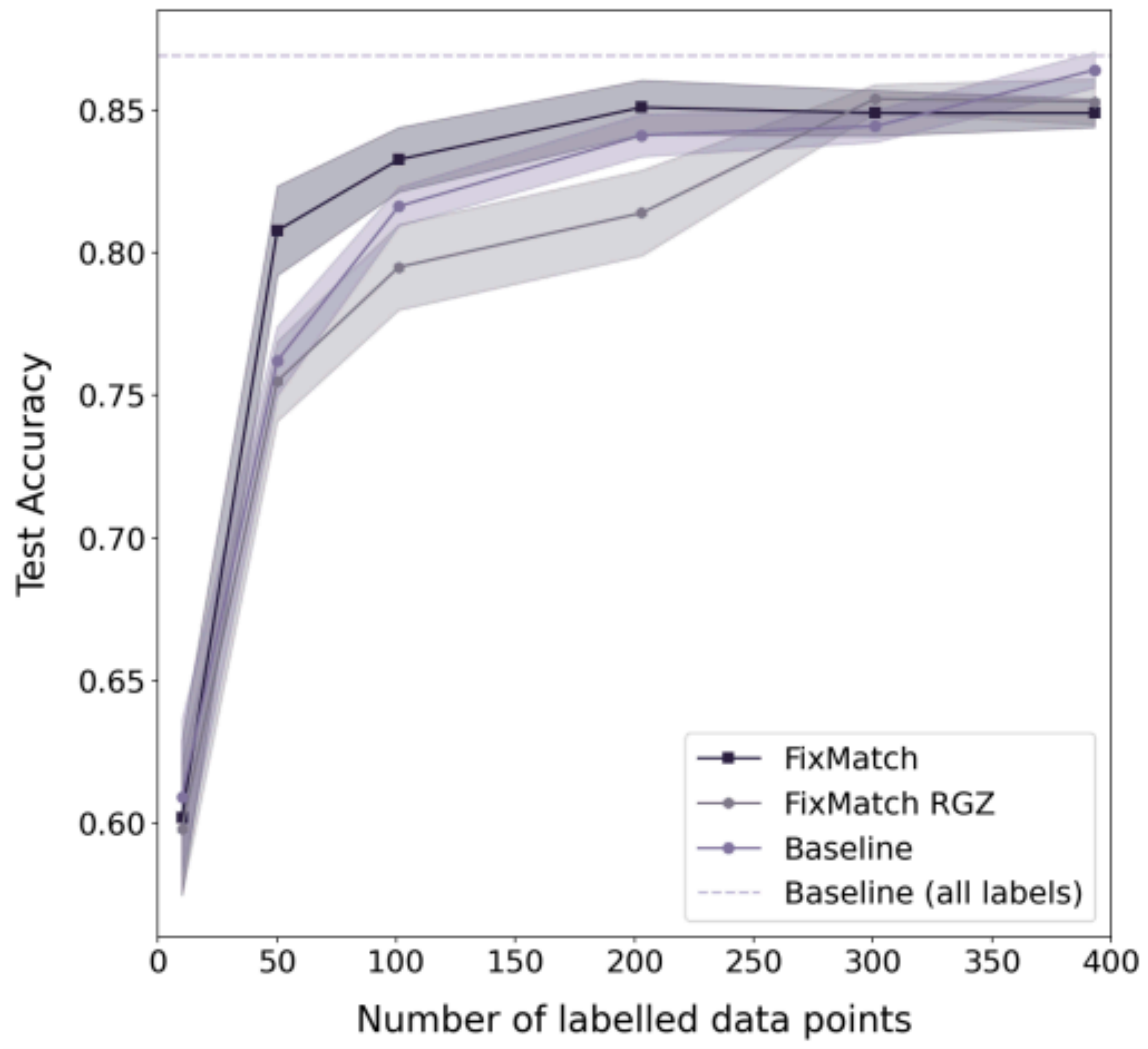
Semi-supervised Learning in Astronomy Examples

(1) feature extraction, (2) clustering/classification (few labels), (3) visual representation





Slijepcevic et al. 2021

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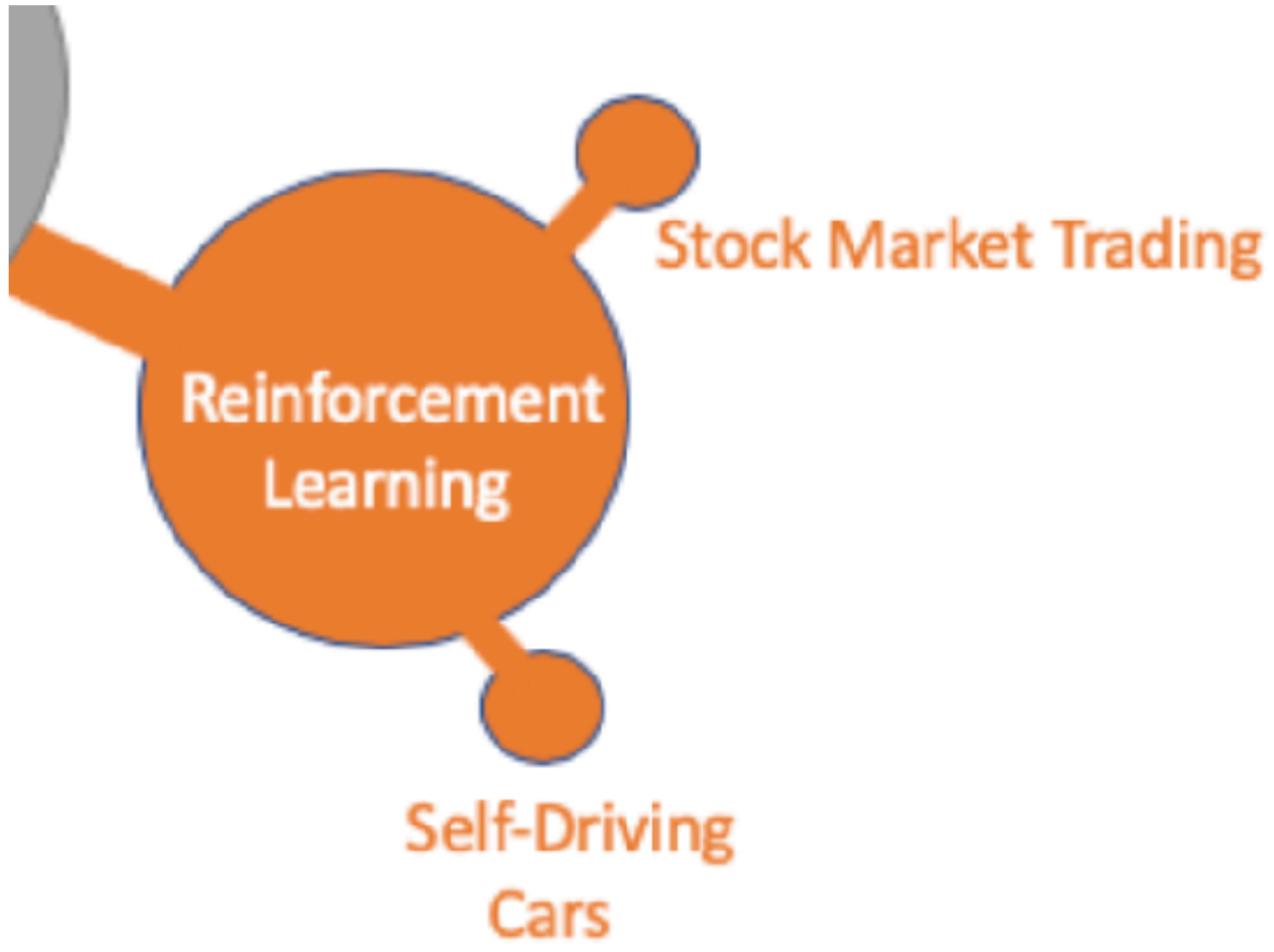

Credit: Data Science Central

Reinforcement Learning in Astronomy Examples

Deep reinforcement learning for smart calibration of radio telescopes

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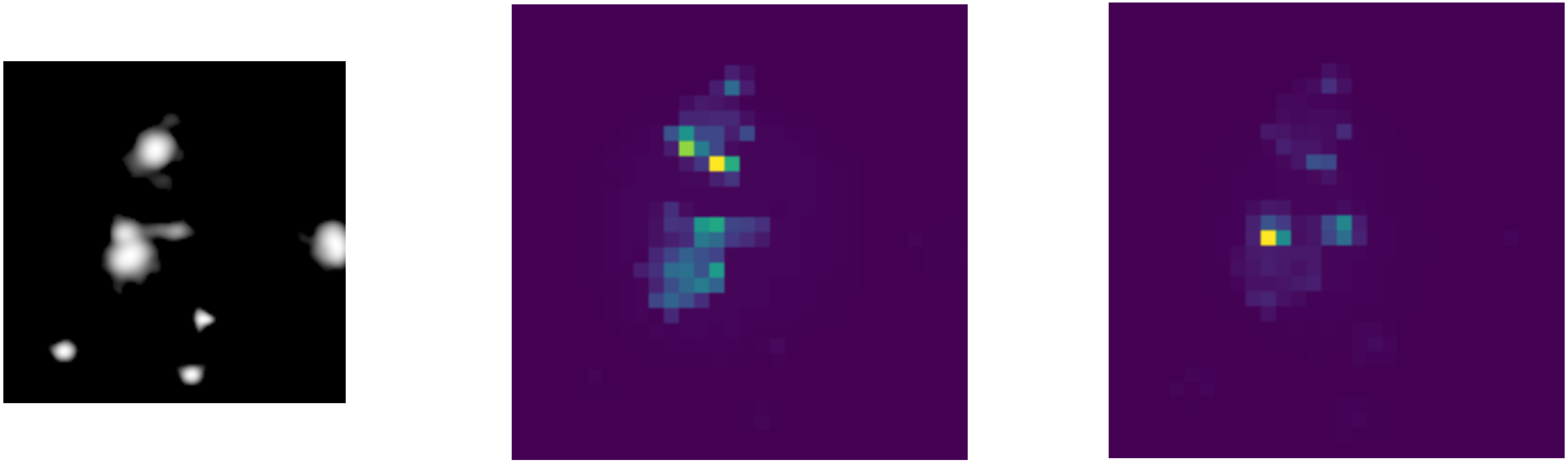
13 May 2021

ABSTRACT
Modern radio telescopes produce unprecedented amounts of data, which are passed through many processing pipelines before the delivery of scientific results. Hyperparameters of these pipelines need to be tuned by hand to produce optimal results. Because many thousands of observations are taken during a lifetime of a telescope and because each observation will have its unique settings, the fine tuning of pipelines is a tedious task. In order to automate this process of hyperparameter selection in data calibration pipelines, we introduce the use of reinforcement learning. We test two reinforcement learning techniques, twin delayed deep deterministic policy gradient (TD3) and soft actor-critic (SAC), to train an autonomous agent to perform this fine tuning. For the sake of generalization, we consider the pipeline to be a black-box system where the summarized state of the performance of the pipeline is used by the autonomous agent. The autonomous agent trained in this manner is able to determine optimal settings for diverse observations and is therefore able to perform *smart* calibration, minimizing the need for human intervention.

Key words: Instrumentation: interferometers; Methods: numerical; Techniques: interferometric

New Networks other than Convolutional Neural Network



Vision Transformers with Attention Layers instead of Convolutional Layers

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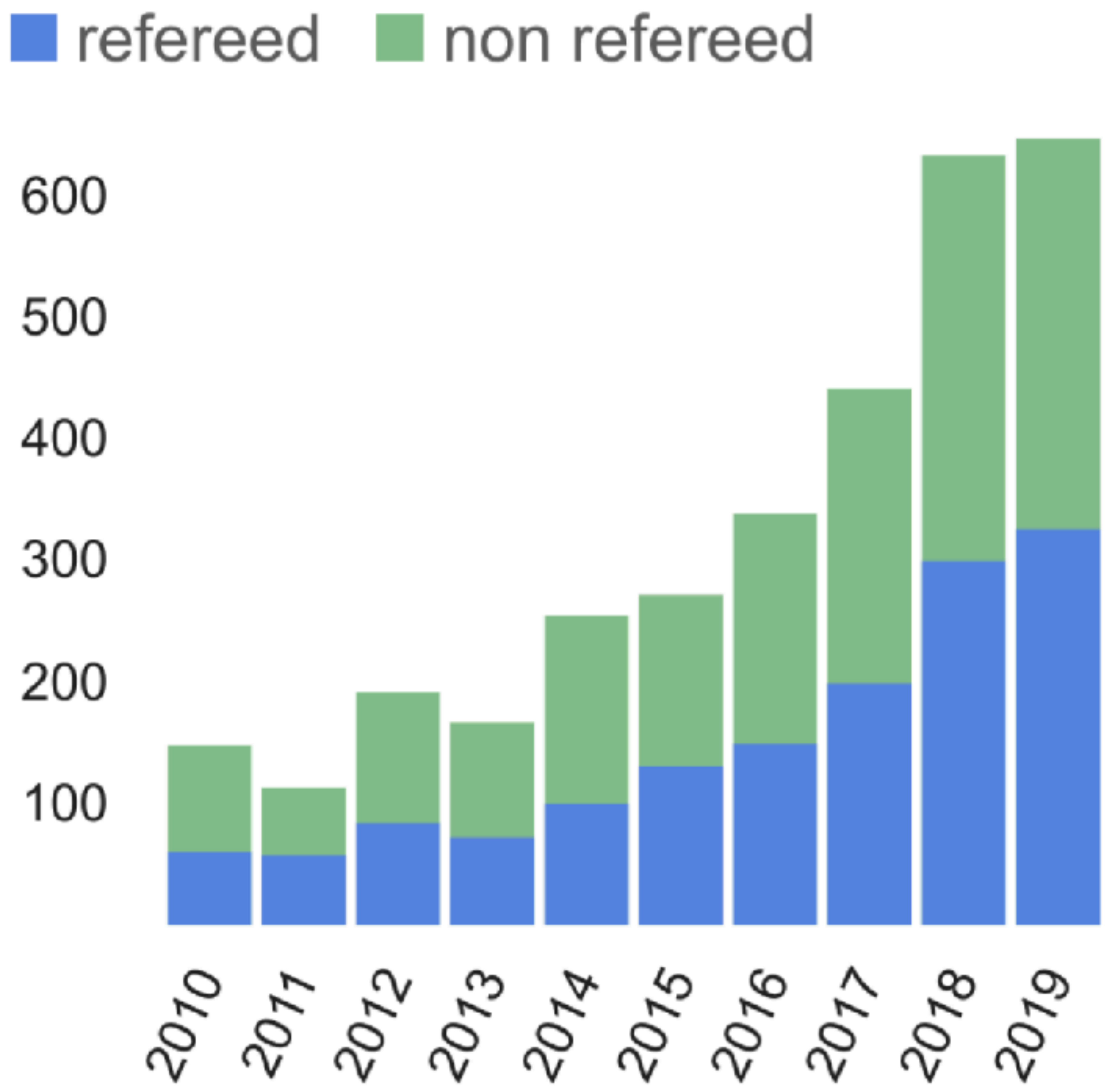
Astronomy papers that include machine learning methods in the abstract or title!



Source ADS, Venn et al. 2019

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