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Latent space out-of-distribution detection of galaxies for deblending in weak lensing surveys

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Upcoming surveys such as the Legacy Survey of Space and Time (LSST) will image billions of galaxies to extract the faint weak lensing signal for cosmological parameter inference. A pressing issue is that 50% of the galaxies will be "blended", where its projection on our detectors will overlap with other astronomical objects along the same line of sight. Without appropriate "deblending"algorithms, the blends add an unacceptable bias and variance to the weak lensing signal.

The most promising deblending algorithms use deep neural networks (DNNs), which are known to be highly sensitive to a difference in the distributions of the training and validation datasets. Many galaxies and blends observed by the LSST will be out of distribution (o.o.d.) compared to the (simulated) training data and therefore the DNNs will perform poorly on them. We have developed a method to classify blends on being o.o.d. or in-distribution (i.i.d.) based on the distribution of an input blend sample in the latent space of a β-VAE, compared to the latent space distribution of the training sample.

The blends flagged as o.o.d. can, in future pipelines, be separated from the i.i.d. blends to prevent contamination of the weak lensing signal or be deblended with a method specifically tuned to o.o.d. blends. We will present the first results of the o.o.d. flagging and the resulting reduction on the error of shear and photometry measurements. Future work lies with increasing the diversity of the training data distribution to increase the i.i.d. to o.o.d. ratio.

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