Separation of overlapped galaxies with Variational AutoEncoder for weak gravitational lensing

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The next generation of cosmological surveys, such as the Vera Rubin Observatory Legacy Survey of Space-Time (LSST) and Euclid will record great volumes of data. Efficient usage of this data will permit strong constraints on cosmological parameters and particularly on the nature of dark energy. One crucial probe which will constrain these parameters is weak gravitational lensing: the coherent deformation of galaxy shapes due to the mass residing between the observer and the observed galaxies. To use this cosmological probe a large sample of galaxies over a range of distances with accurate measurements of their shapes is needed. The further you look in the universe the older you see, however the further the distance the higher the risk of superposition of galaxies with other astrophysical objects along the line of sight (blending). Blending will be a major challenge for upcoming ground-base, deep, photometric surveys such as LSST, it will contribute to the systematic error budget of weak lensing studies by perturbing object detection and affecting photometric and shape measurements. To accurately measure the shapes of blended galaxies methods are needed to separate (deblend) the galaxies. Here we present a method using a machine learning tool: the variational autoencoder (VAE). We show that our method benefits from the combination of ground and space based surveys data for galaxy shape reconstruction and is robust to decentering due to pixelisation.