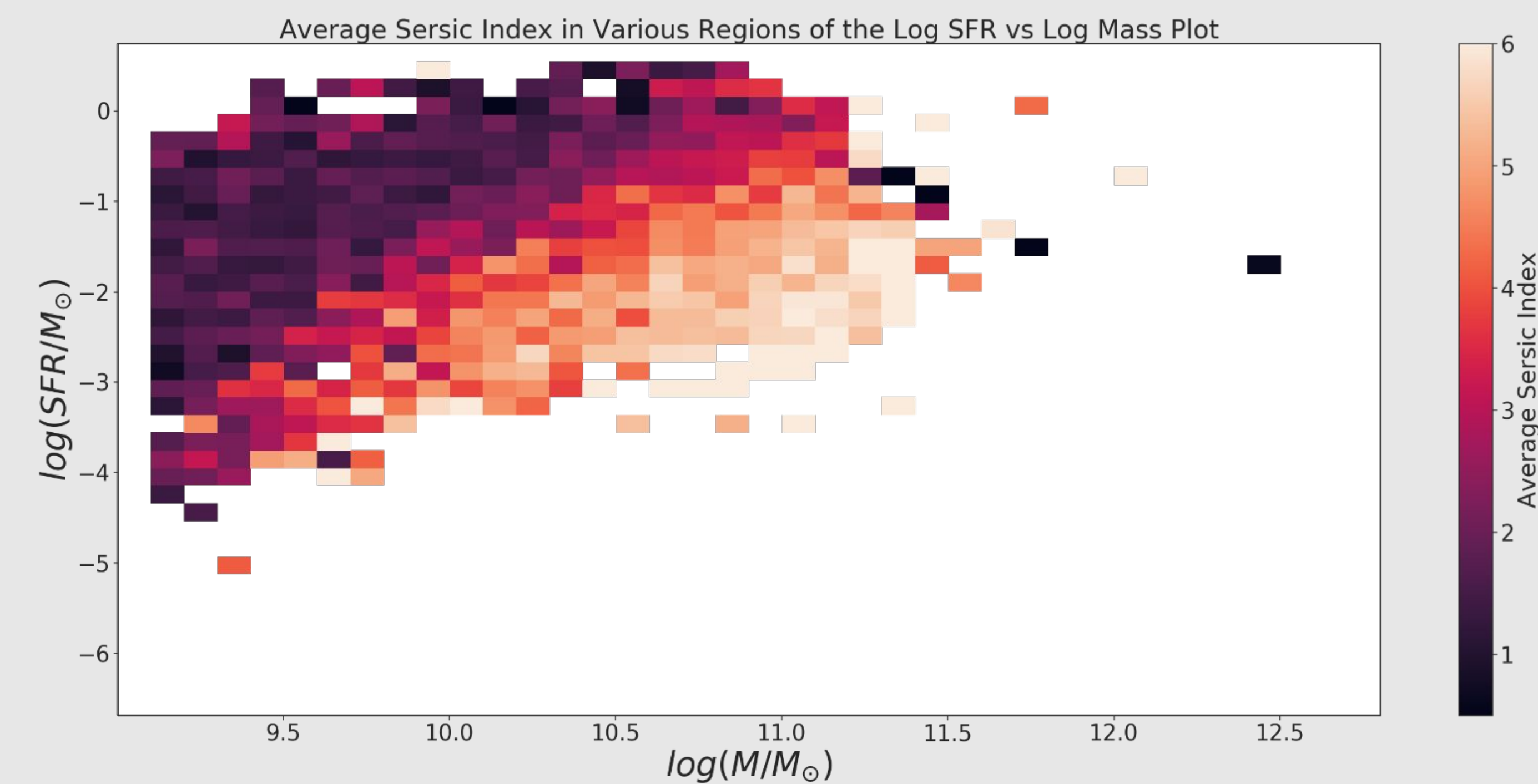


We can predict key properties of galaxies from their physical structure using machine learning

Exploring the Link Between the Star Formation History and the Morphology of Galaxies

INTRO

- A galaxy's stellar mass and star forming rate (SFR) are important as they can tell us a lot about what is going on in a galaxy.
- We already know that a link exist between galaxy morphology, mass and SFR. This shown in the plot below (right), where there are clearly two populations of galaxies based on their Sersic index.



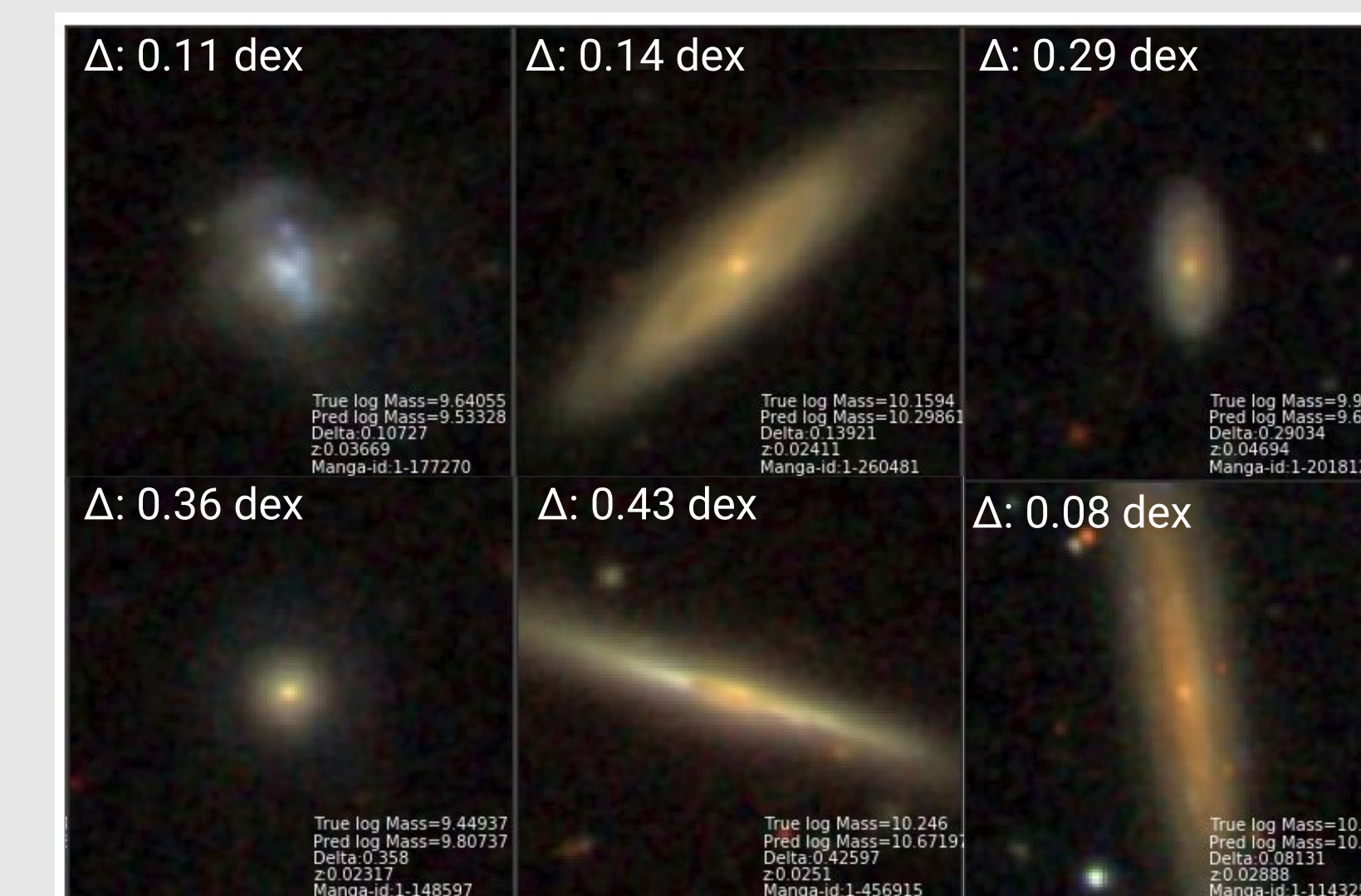
- Is the Sersic index enough to study morphology? Are there perhaps other ways to do so using machine learning methods

METHODS

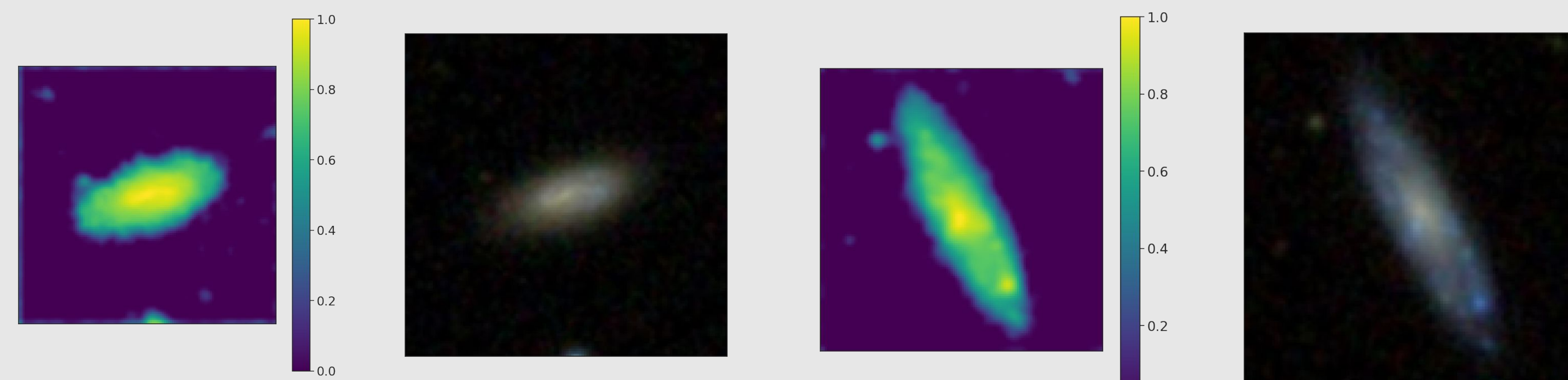
- A convolutional neural network (CNN) was trained on pictures from the SDSS MaNGA (DR15) in order to assess the galaxies masses and SFRs.
- The CNN has 3 convolutional layers and one linear layer. It has a learning rate of 0.001, trained for 1000 epochs using the Adam optimizer and Cross Entropy Loss function for classifiers and MSE loss for regression models .
- It was trained using the log of the SFR and mass and not the true values. Data augmentation was done by creating copies of the images with various transformations applied to them.

RESULTS

- The CNN can predict the SFR (left) and mass (right) of a galaxy from its morphology fairly accurately. The top 3 images of each plot are from the training set, while the bottom 3 are from the test set.



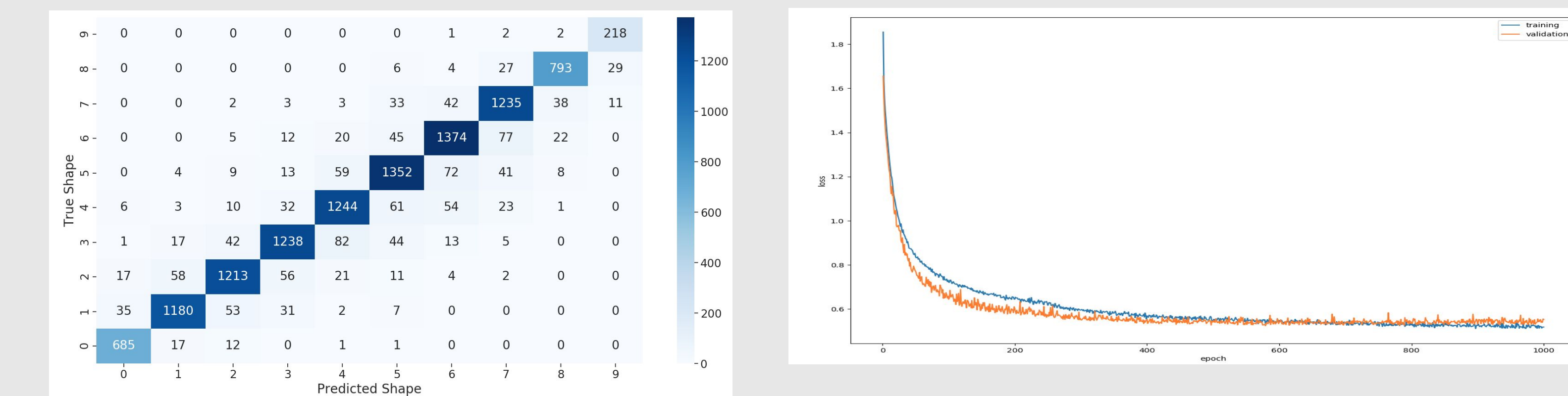
- Is the network learning features or just memorizing pictures? Grad-CAM can help us see what the network is focusing on to make classifications/predictions!



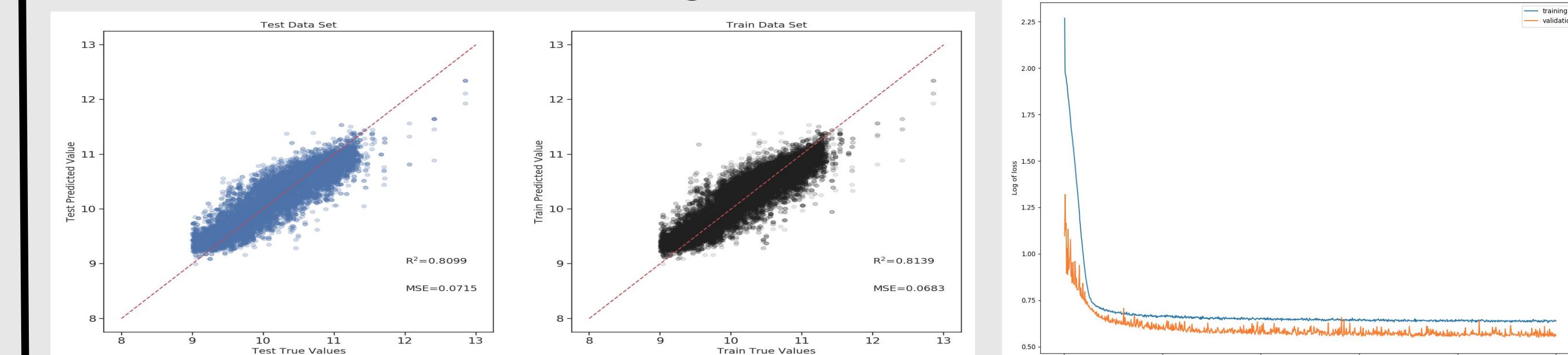
DISCUSSION

- We can expand this study further by examining Grad-CAM for the classification networks and understanding what parts of the galaxy are being focused on to classify them to a certain mass/SFR bin.
- With this we would have a new way to study galaxy morphology that does not solely rely on Sersic index

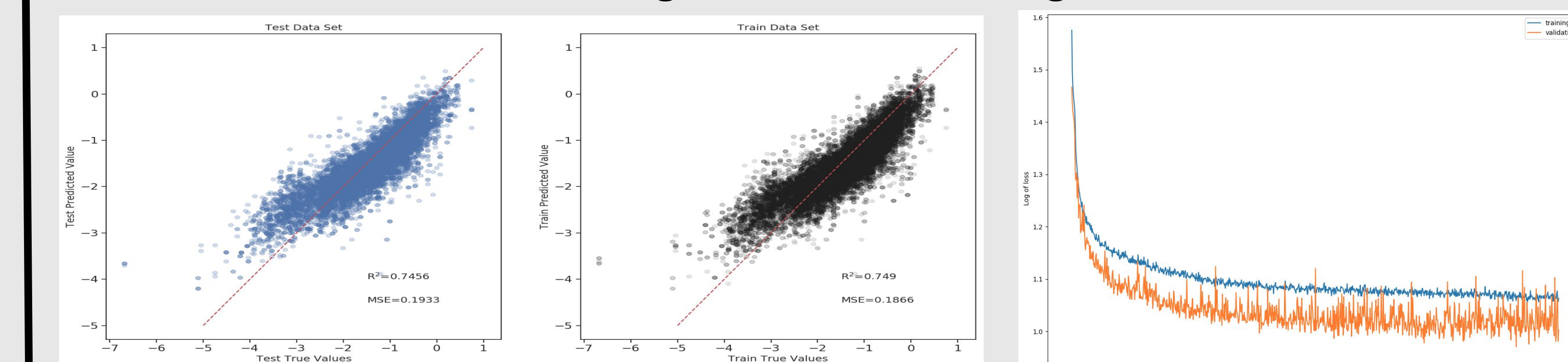
- How well is the mass classification network doing?



- How well is the mass linear regression network doing?



- How well is the SFR linear regression network doing?



- What parts of the galaxy does the network focuses on to classify a galaxy as very light (top) or very heavy (bottom)?

