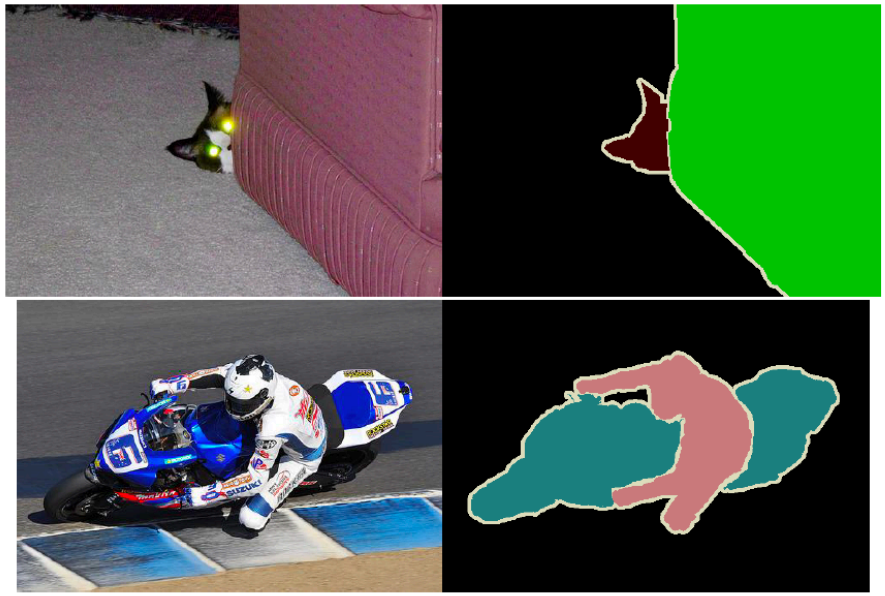
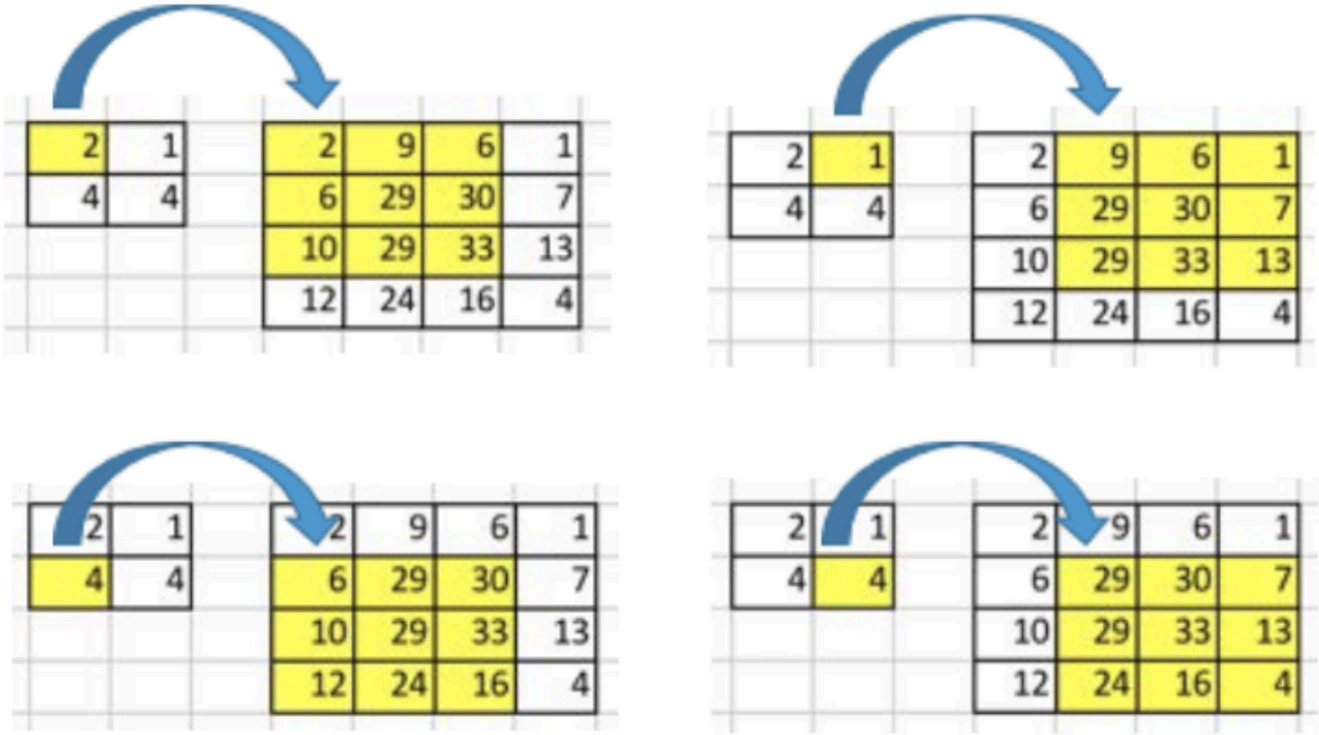
PART IV: AN INTRODUCTIN TO GENERATIVE MODELS

FIRST IMAGE SEGMENTATION WITH ENCODERS-DECODERS



TRANSPOSED CONVOLUTION

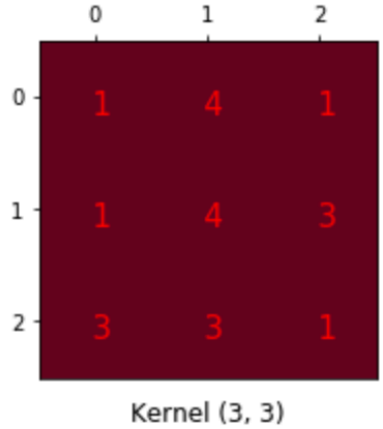
ALLOWS TO INCREASE THE SIZE



Going Backward of Convolution

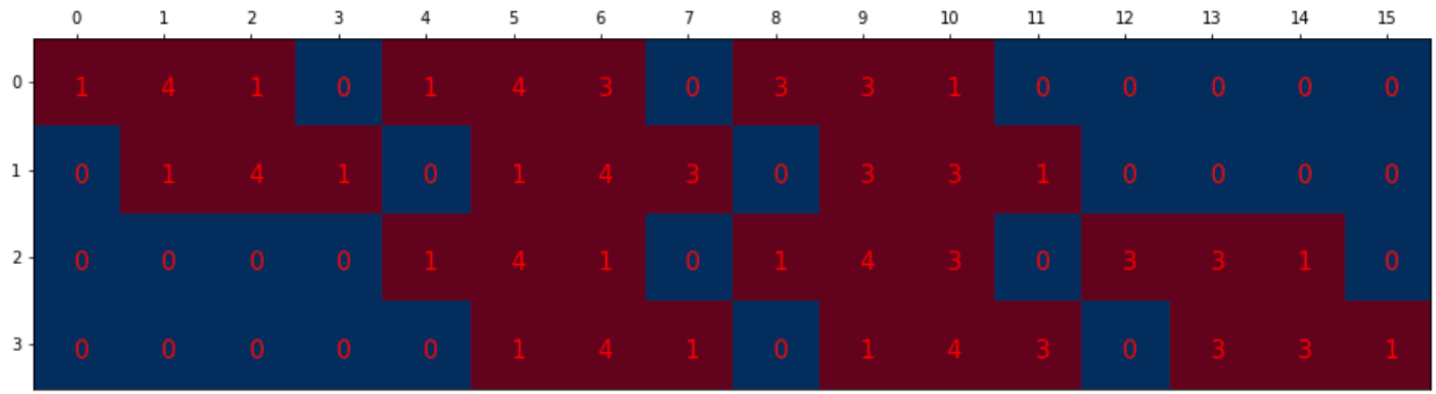
EXAMPLE TAKEN FROM HERE

CONVOLUTION MATRIX



Kernel (3, 3)

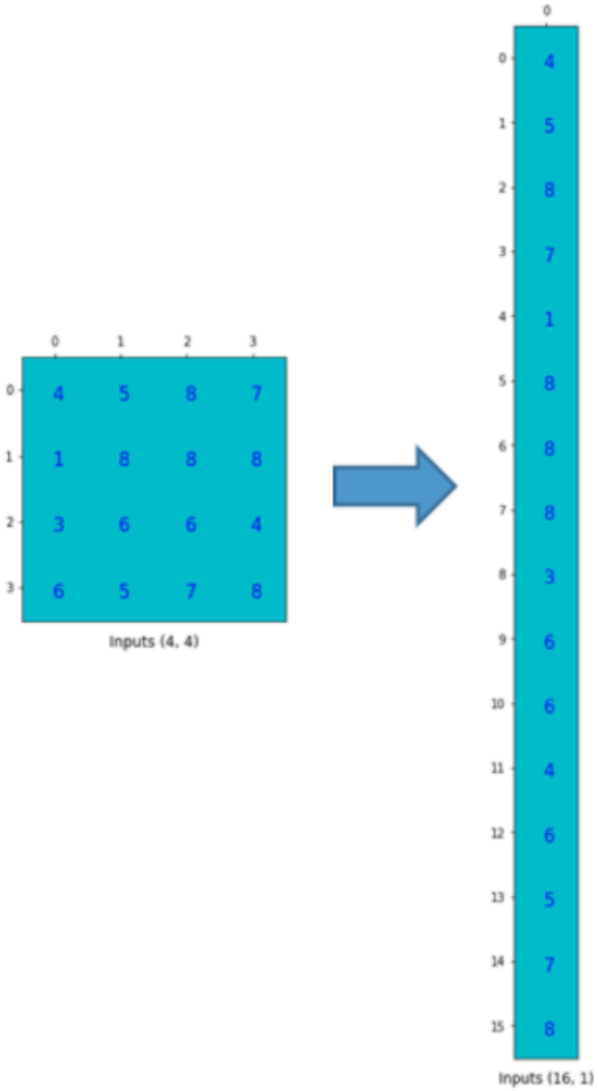
THE KERNEL CAN BE ARRANGED IN FORM OF A MATRIX:



Convolution Matrix (4, 16)

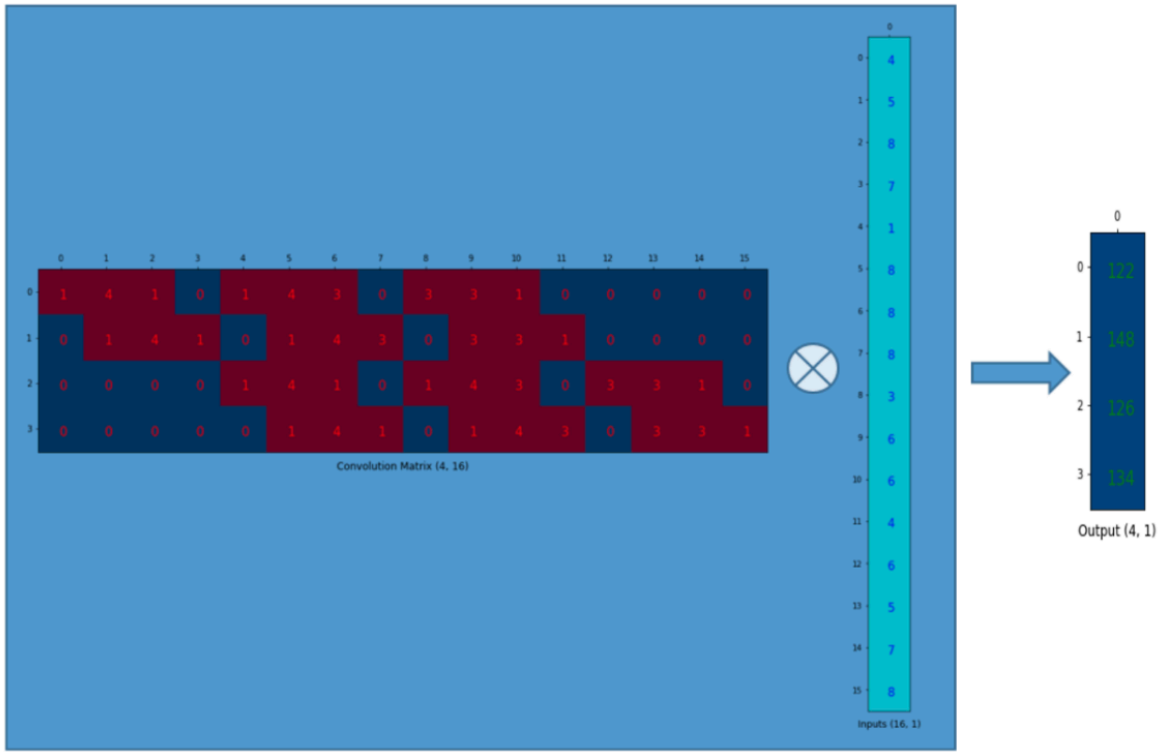
EXAMPLE TAKEN FROM HERE

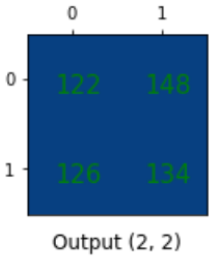
THE INPUT IS FLATTENED INTO A COLUMN VECTOR



EXAMPLE TAKEN FROM HERE

THE CONVOLUTION IS TRANSFORMED INTO A PRODUCT OF MATRICES

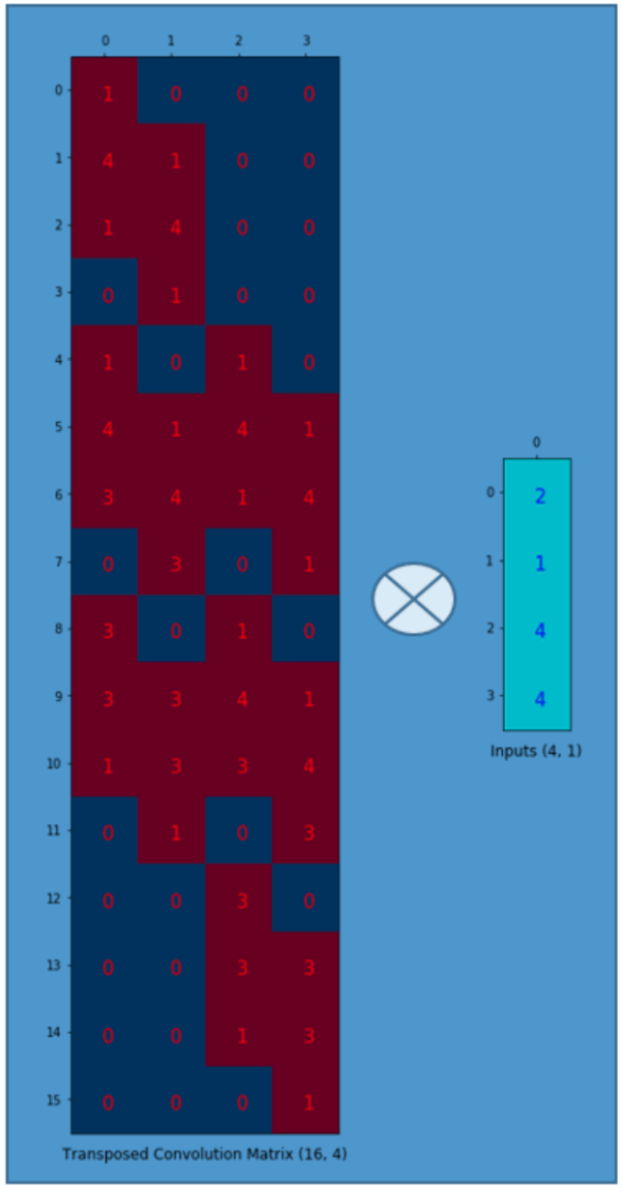


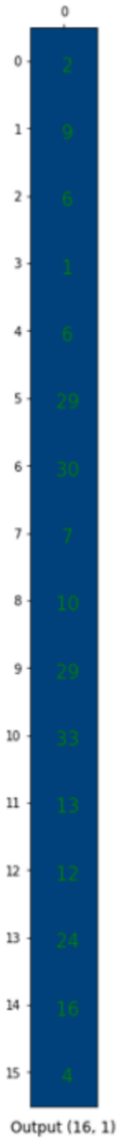


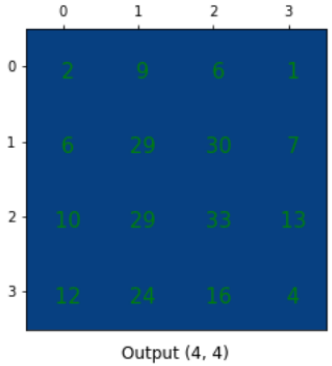
RESHAPED OUTPUT

EXAMPLE TAKEN FROM HERE

THE TRANSPOSED CONVOLUTION IS THE INVERSE OPERATION





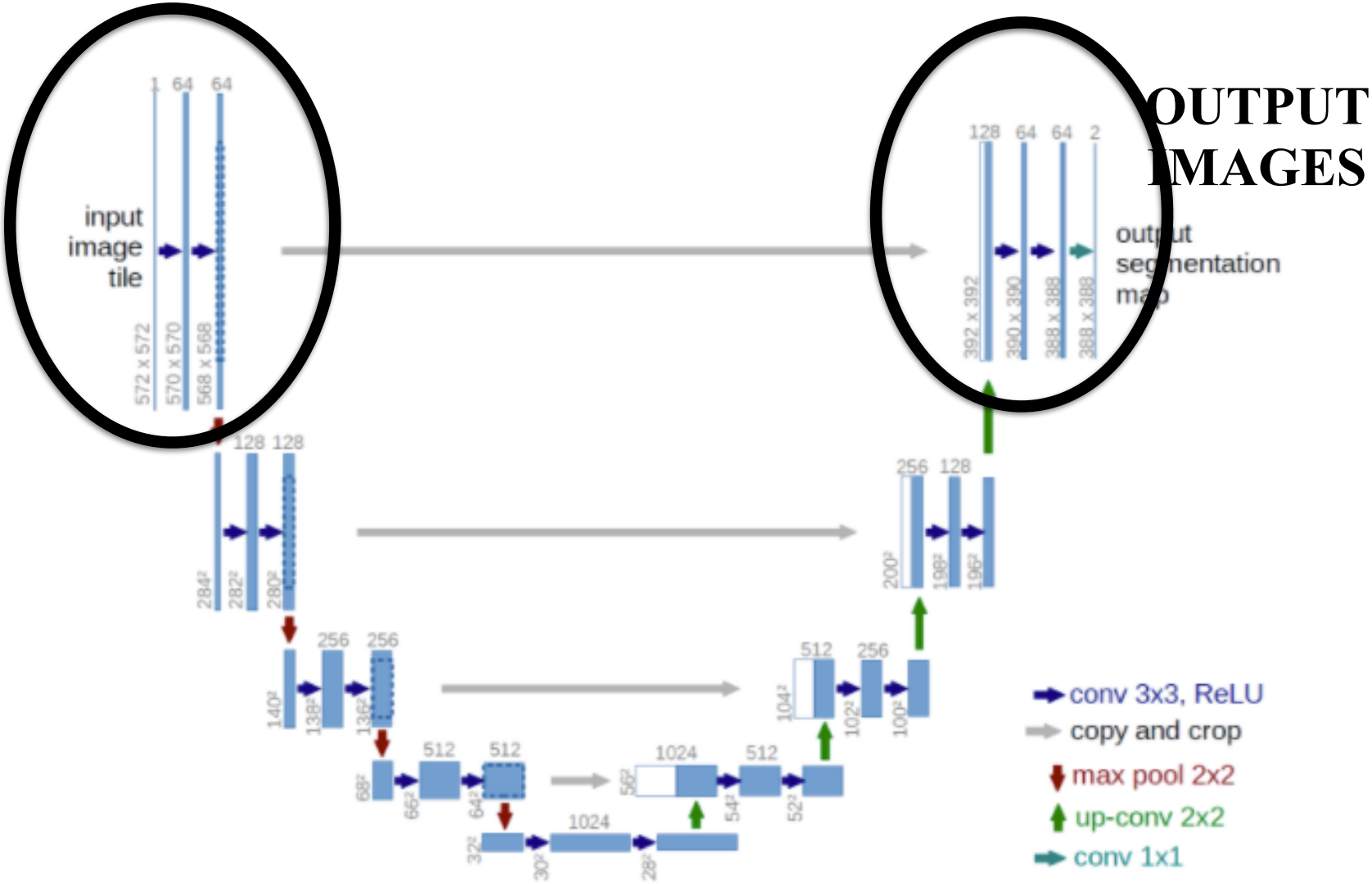


RESHAPED OUTPUT

EXAMPLE TAKEN FROM HERE

ENCODING-DECODING TO EXTRACT IMAGE FEATURES: U-NET

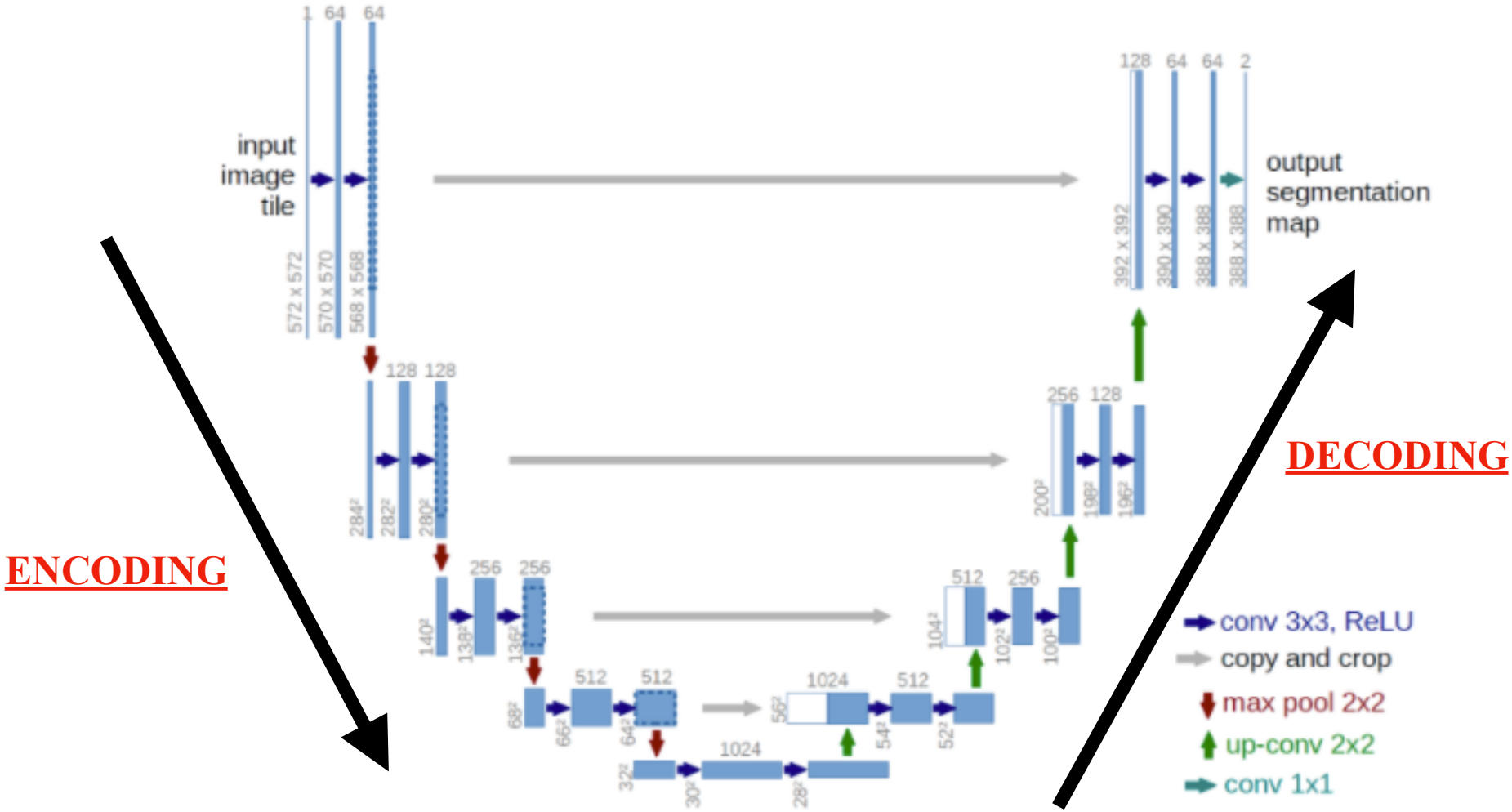
INPUT IMAGES



OUTPUT IMAGES

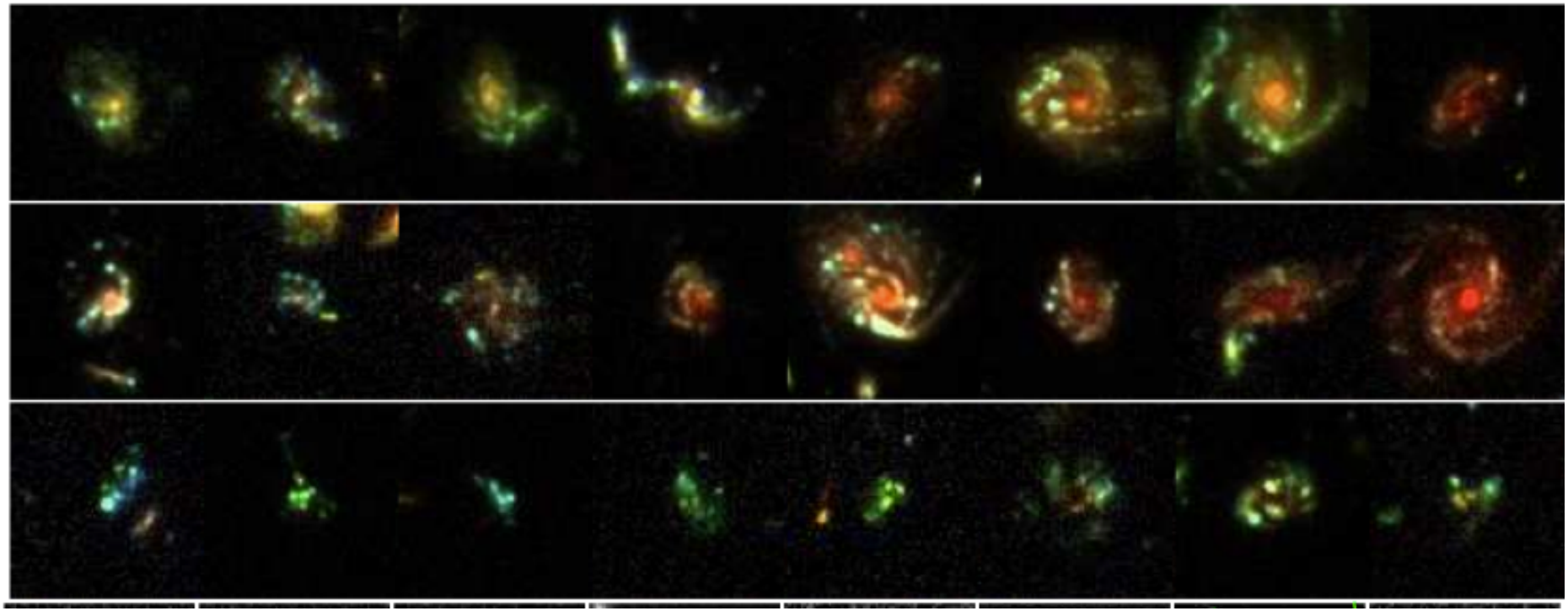
Ronnerberger+15

ENCODING-DECODING TO EXTRACT IMAGE FEATURES: U-NET



Ronnerberger+15

CLUMP DETECTION

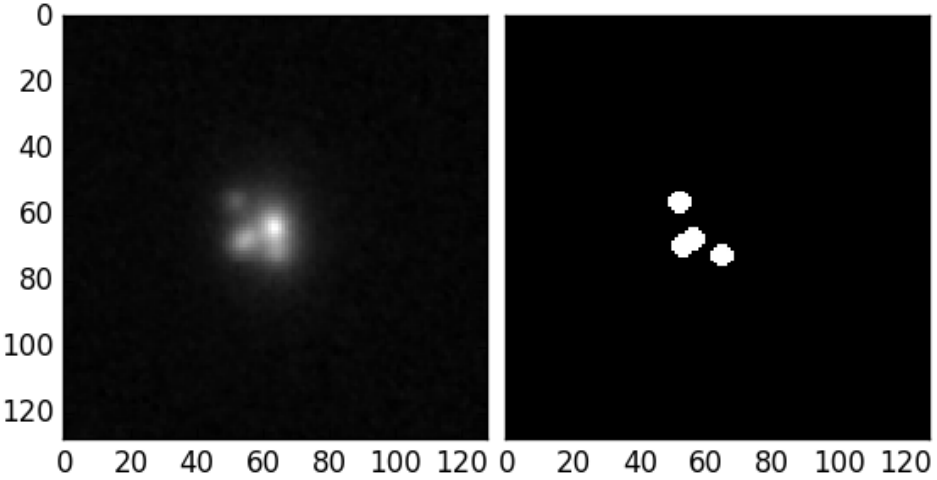


Guo+15,18

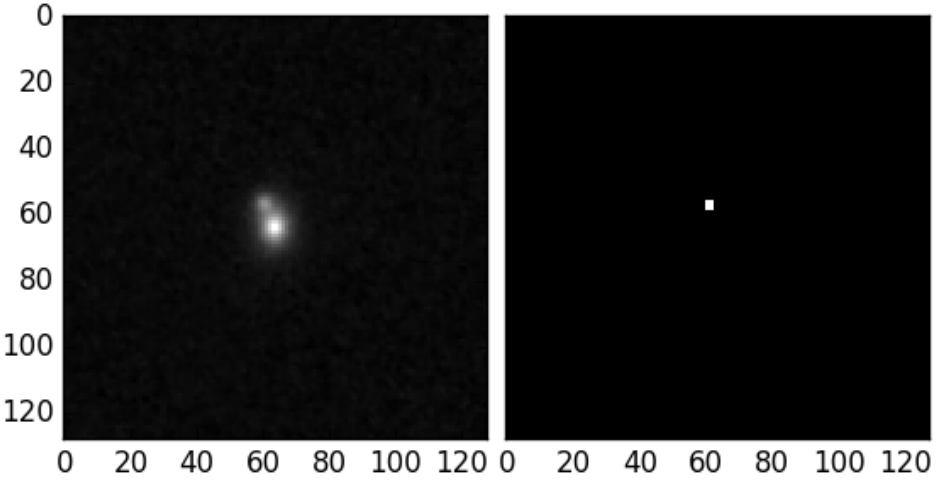
HIGH REDSHIFT GALAXIES PRESENT CLUMPS - THEIR ROLE IN BULGE FORMATION IS DEBATED

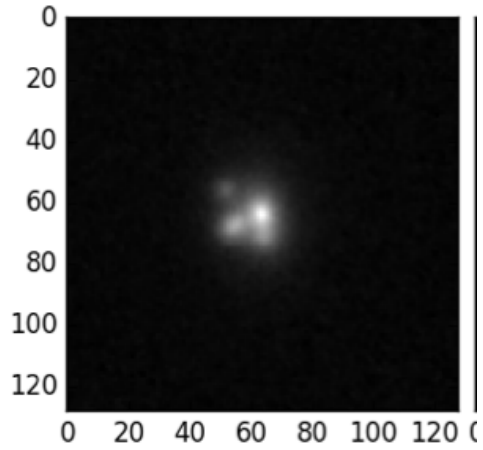
SIMULATED GALAXY

CLUMP MASK

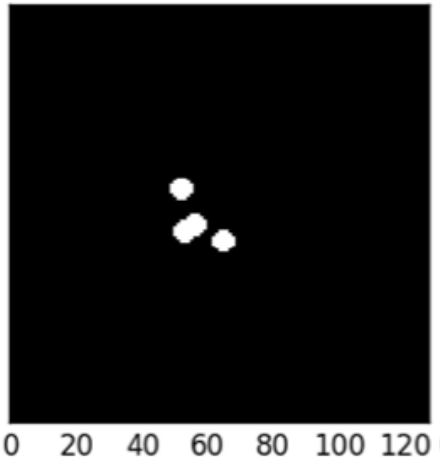


VERY SIMPLE ANALYTIC SIMULATIONS + UNRESOLVED CLUMPS





U-NET



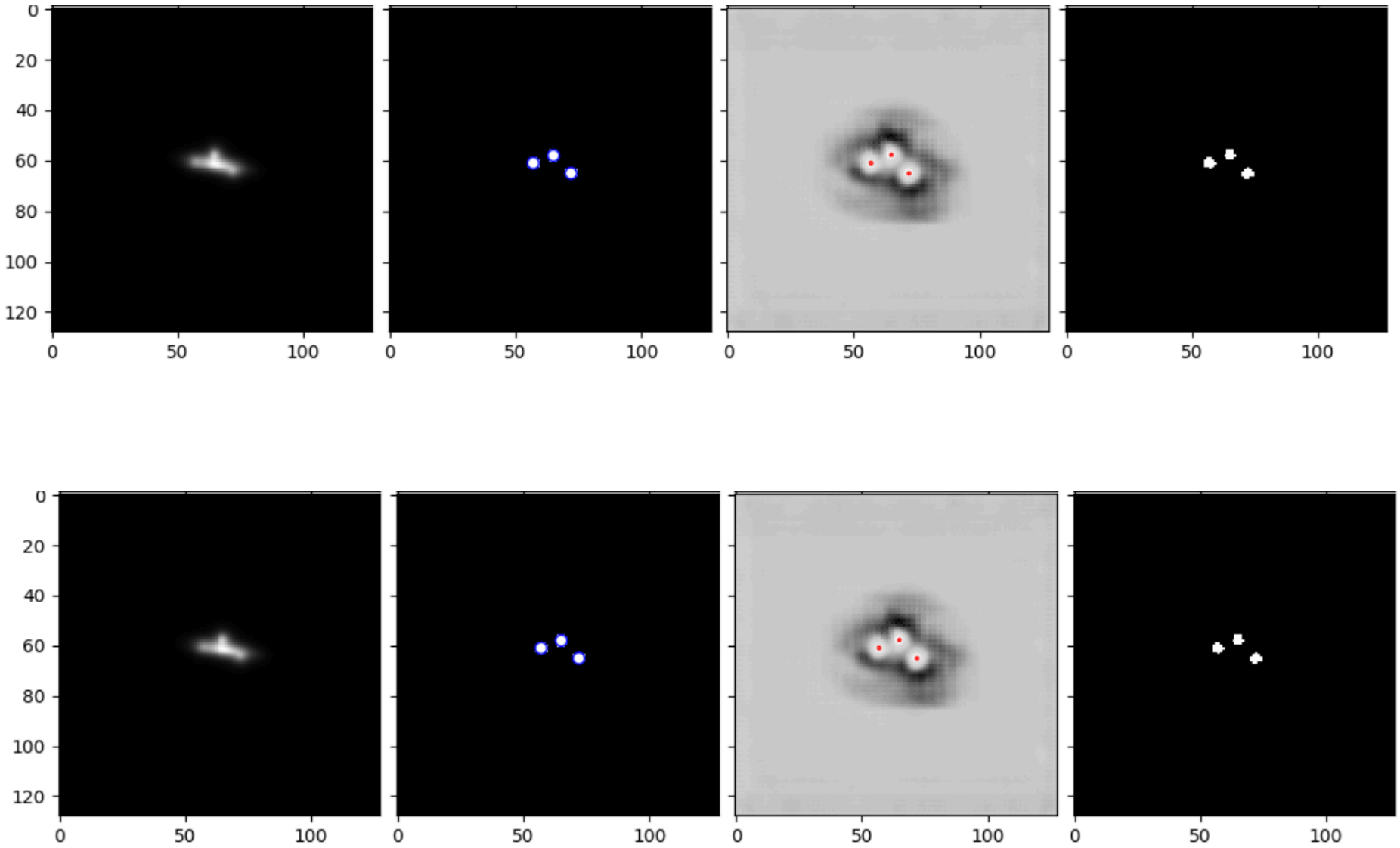
LEE, MHC, PRIMACK+ IN PREP

SIMULATED GALAXY

CLUMP MASK

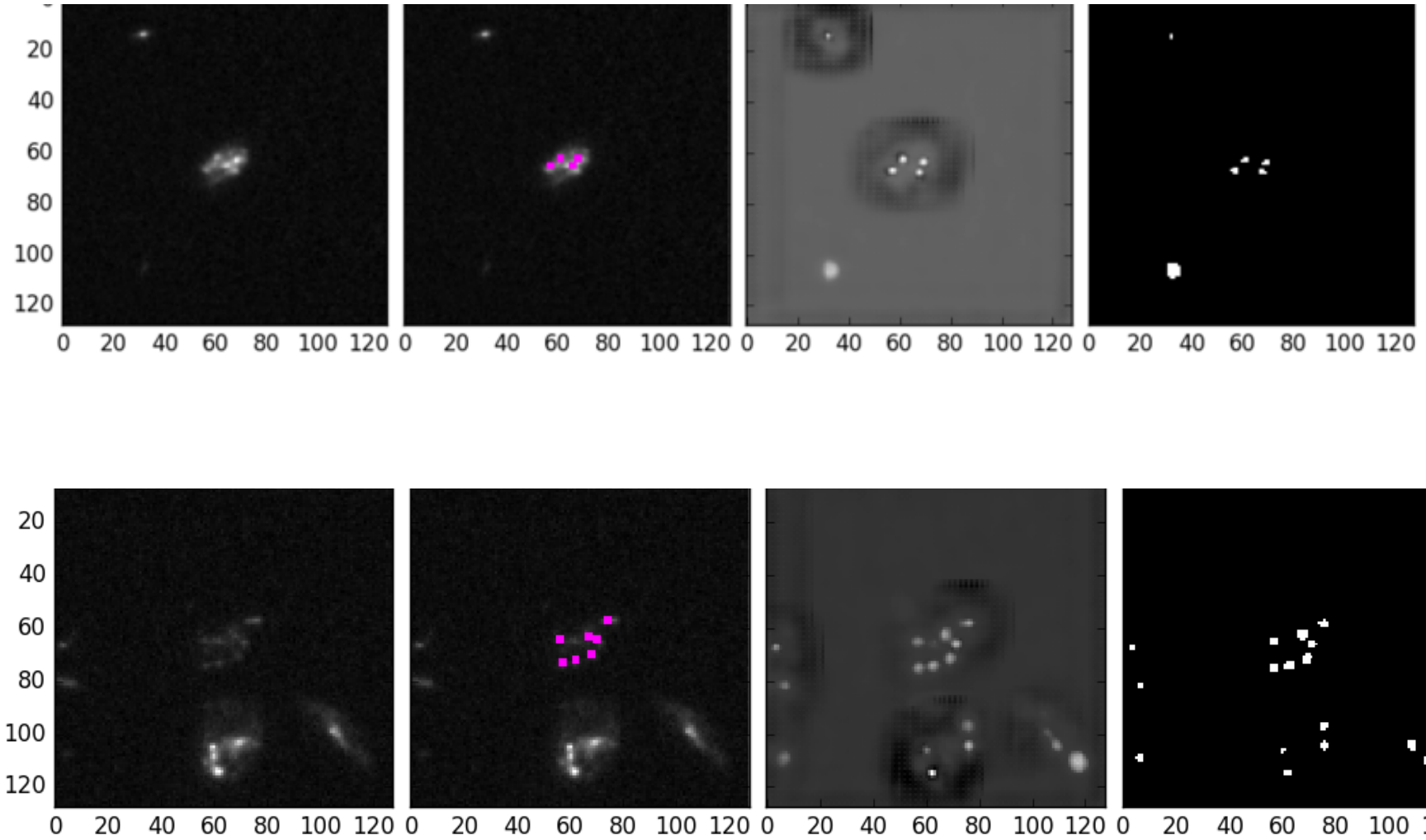
NETWORK PROBA MAP

NETWORK OUTPUT THRESHOLDED (SEXTRACTOR)



LEE, MHC, PRIMACK+ IN PREP

SEEMS TO WORK REASONABLY WELL ON REAL OBSERVATIONS

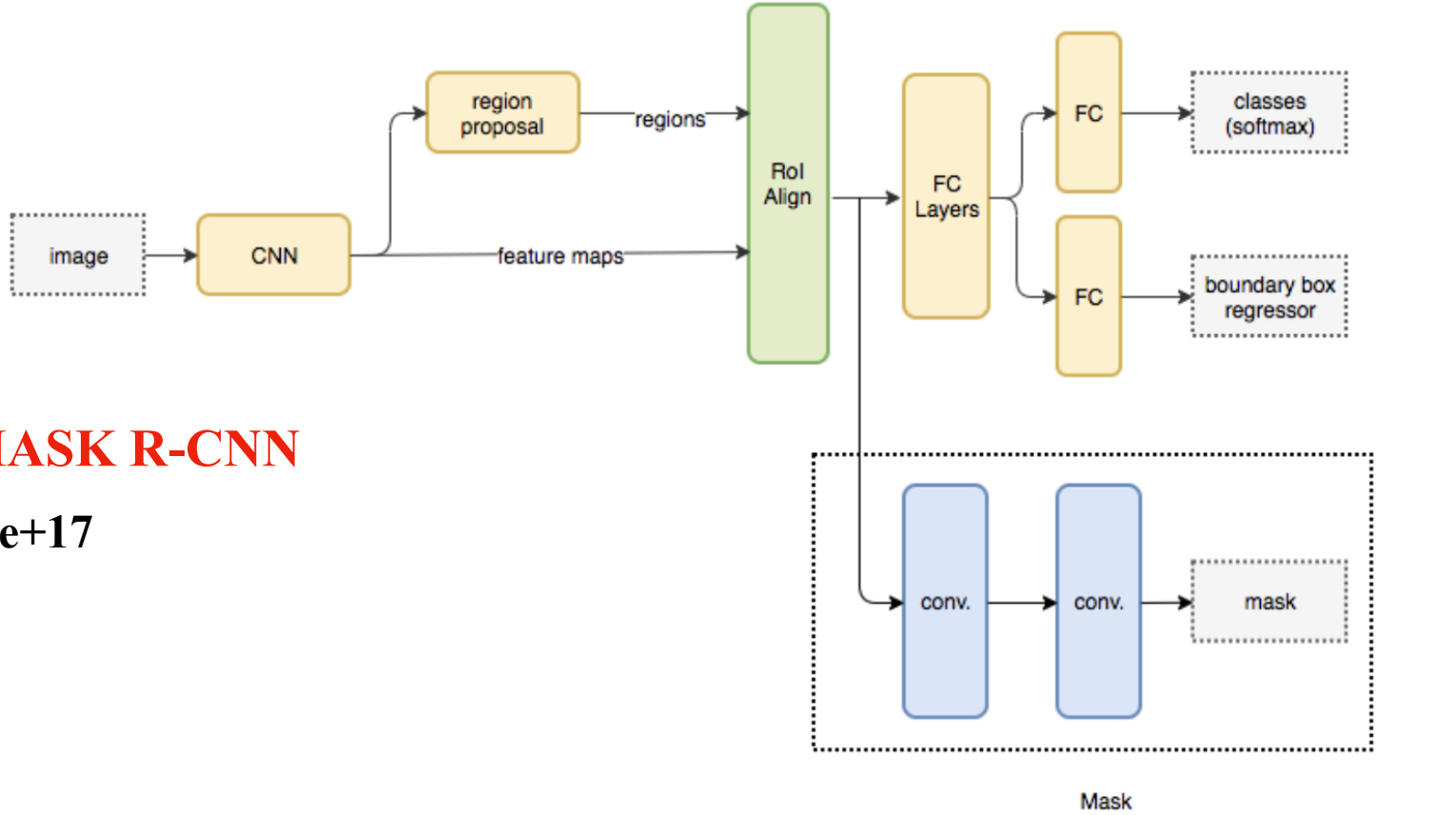


OBSERVED GALAXY

CLUMPS DETECTED BY GUO+

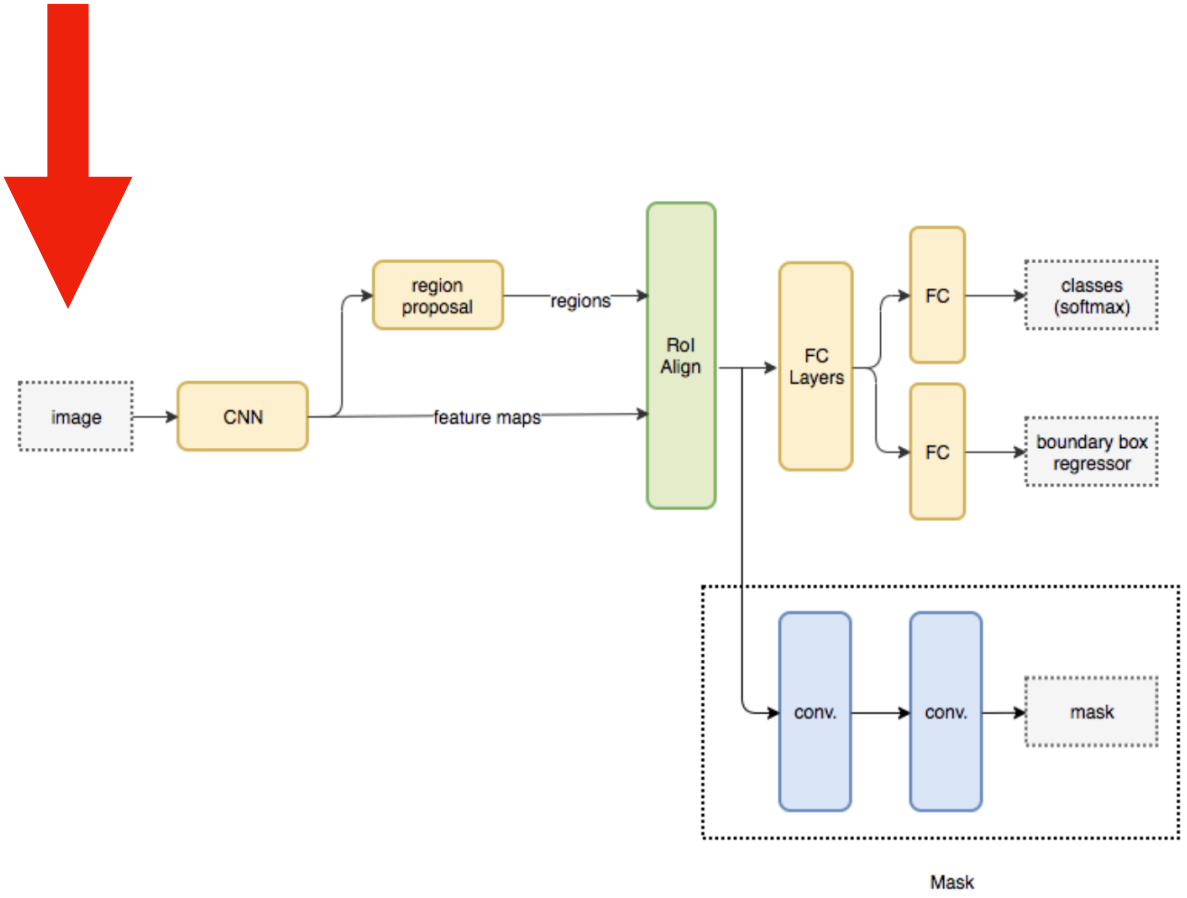
U-NET OUTPUTS

SIMULTANEOUS DETECTION + SEGMENTATION + CLASSIFICATION



MASK R-CNN

He+17



SEG-MAP

PHOTOMETRY

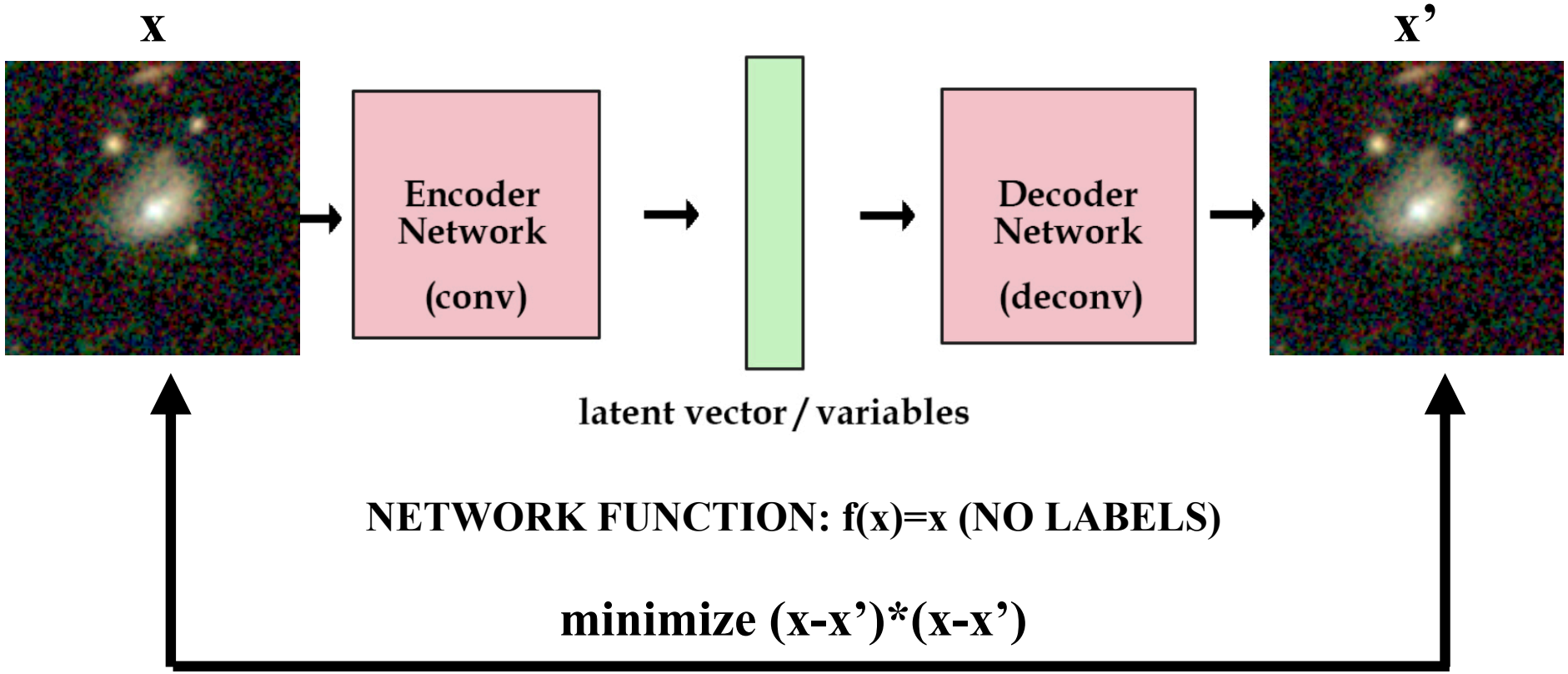
MORPHOLOGY

PHOTO-Z

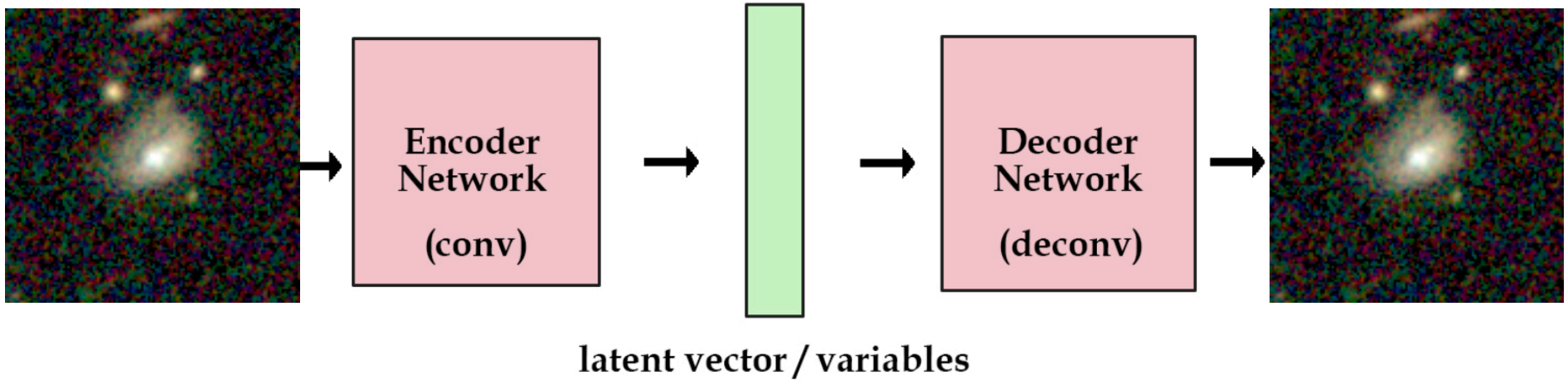
…

INTRODUCTION TO UNSUPERVISED DEEP LEARNING: GENERATIVE MODELS

AUTO-ENCODER

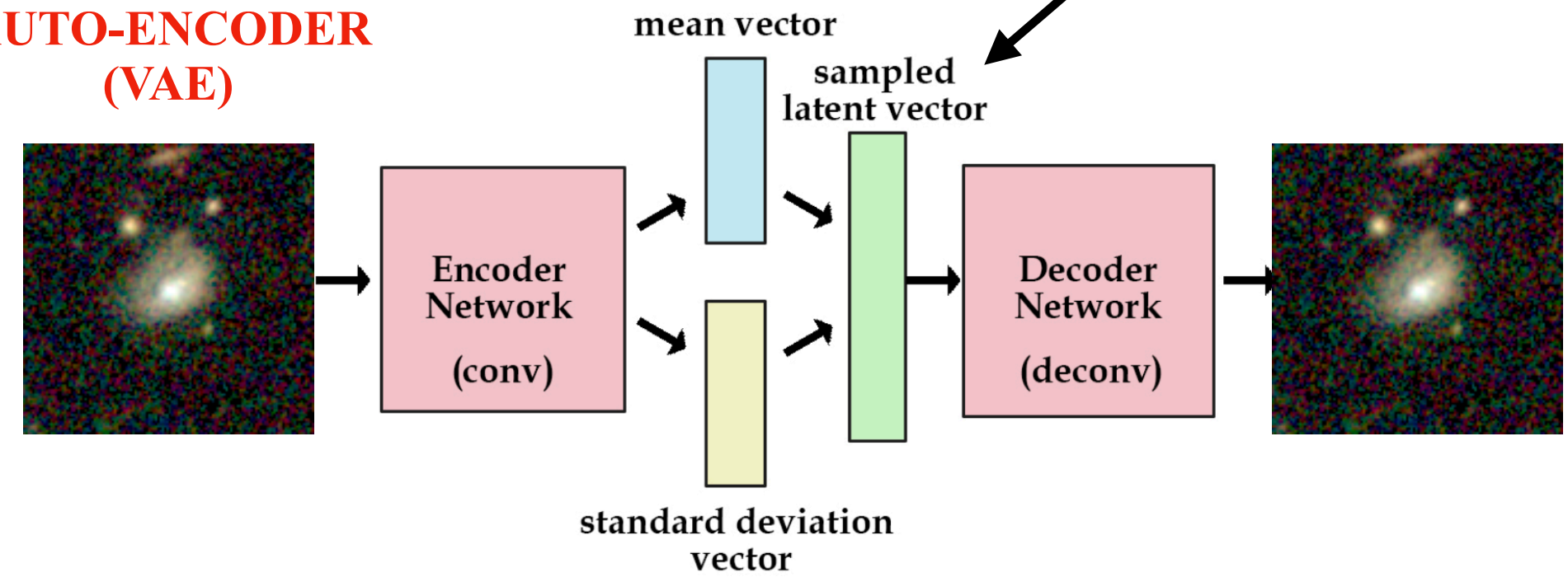


AUTO-ENCODER



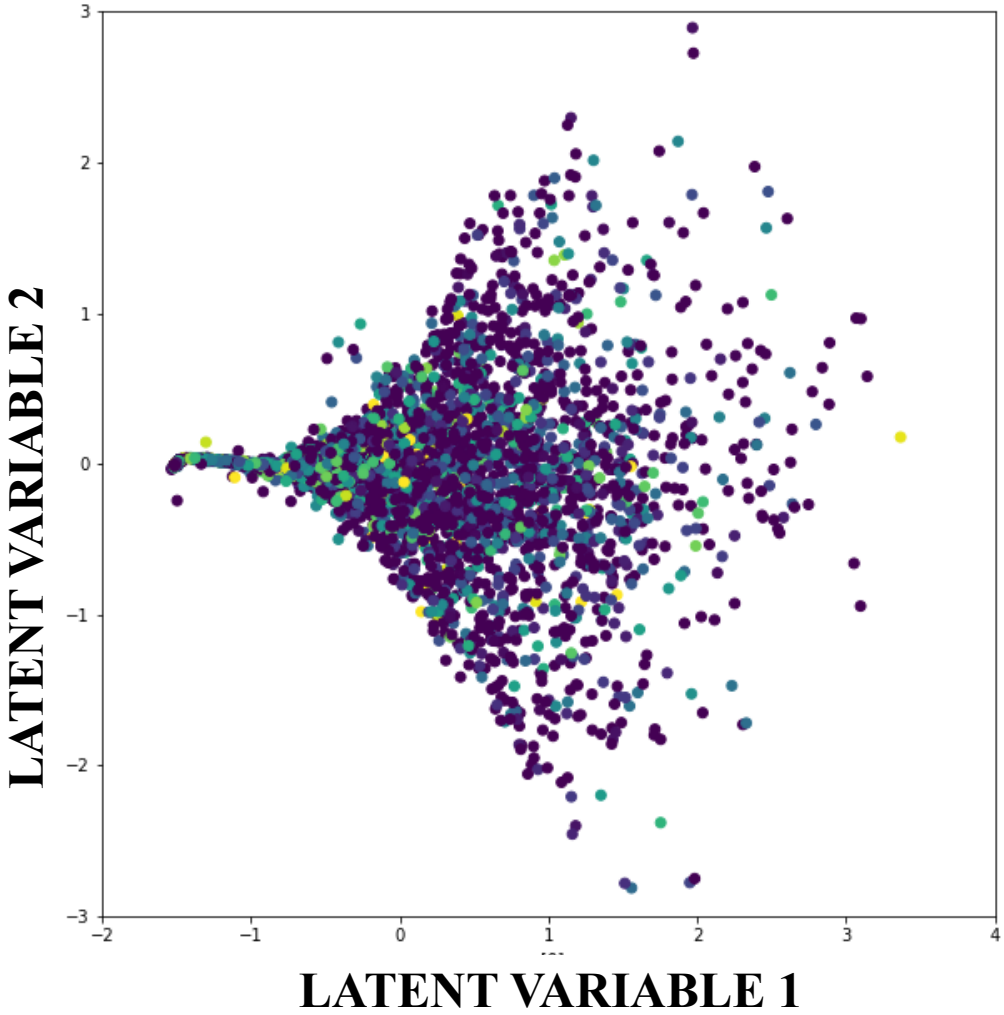
VARIATIONAL AUTO-ENCODER (VAE)

"OPTIMAL" REPRESENTATION OF THE DATA



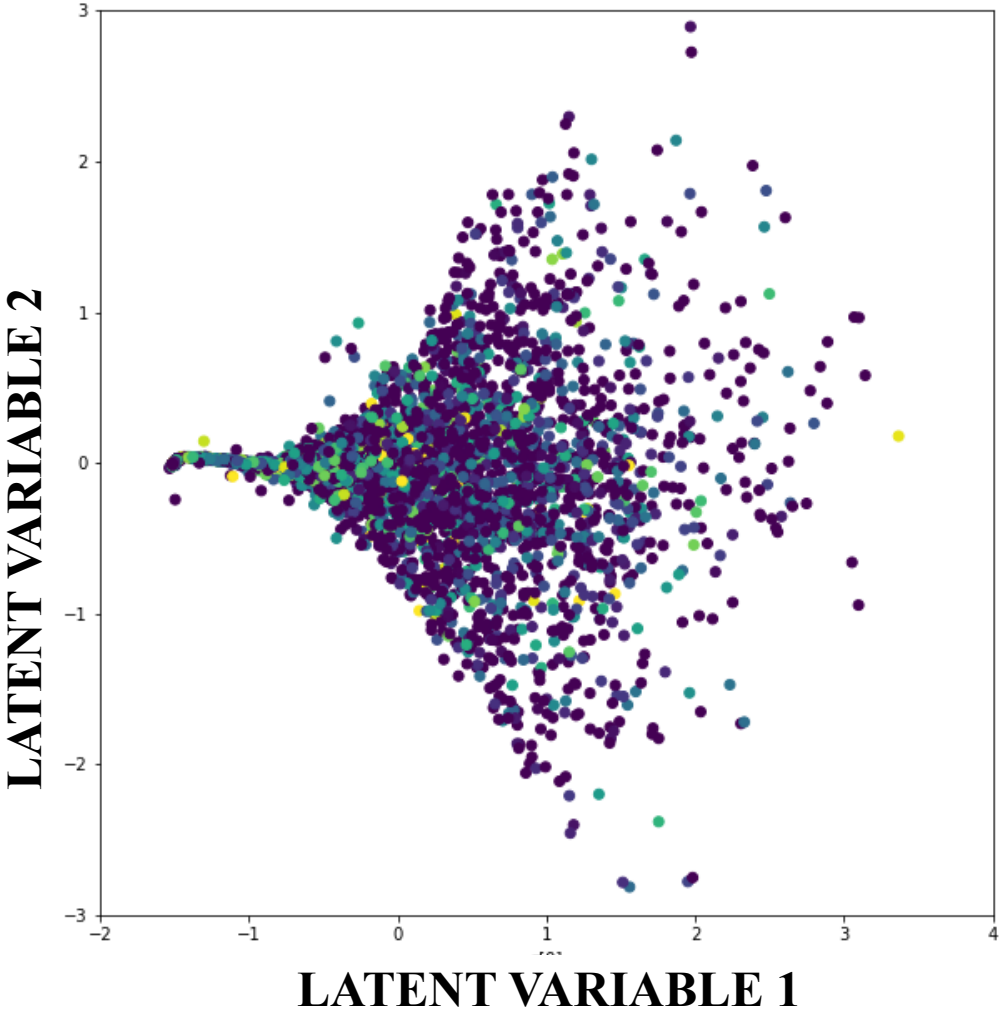
VAE DERIVED LATENT SPACE FOR CANDELS GALAXIES [H BAND]

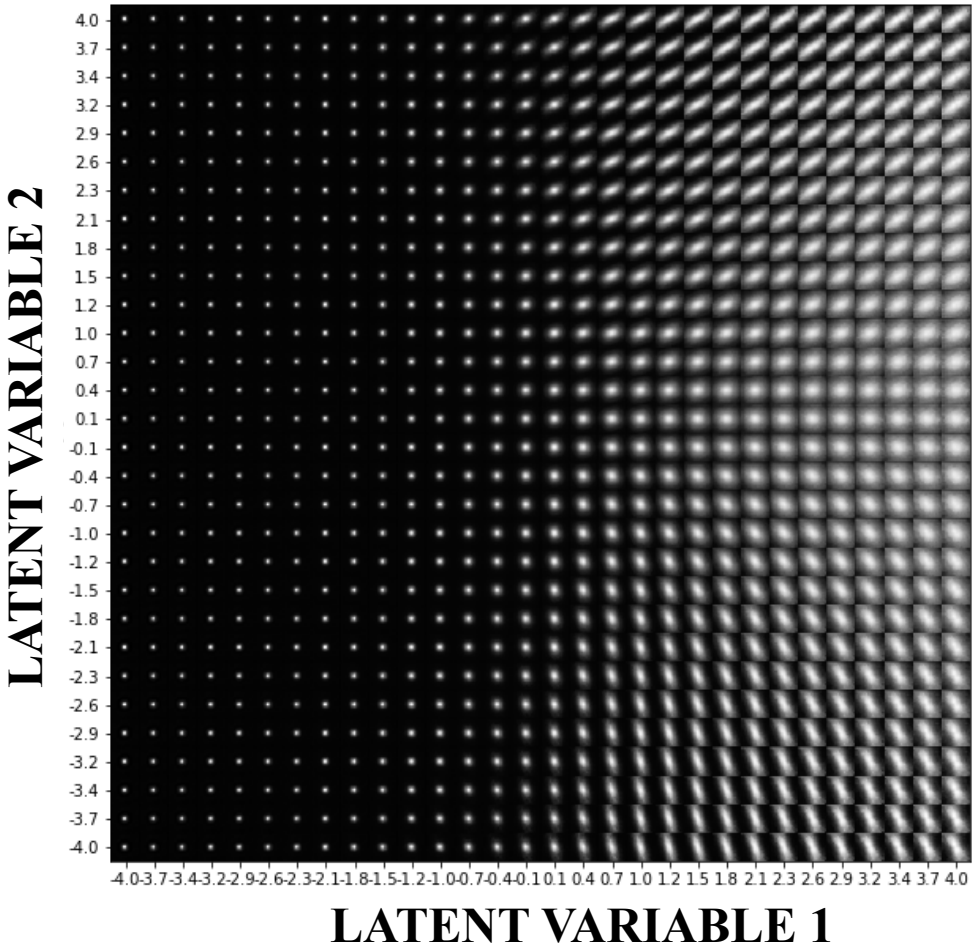
PRELIMINARY!



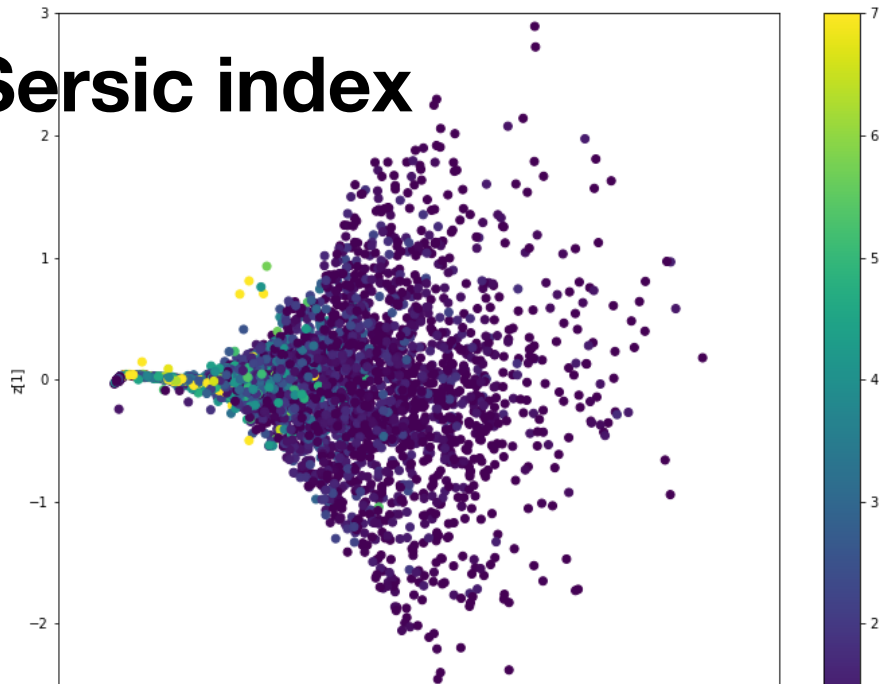
VAE DERIVED LATENT SPACE FOR CANDELS GALAXIES [H BAND]

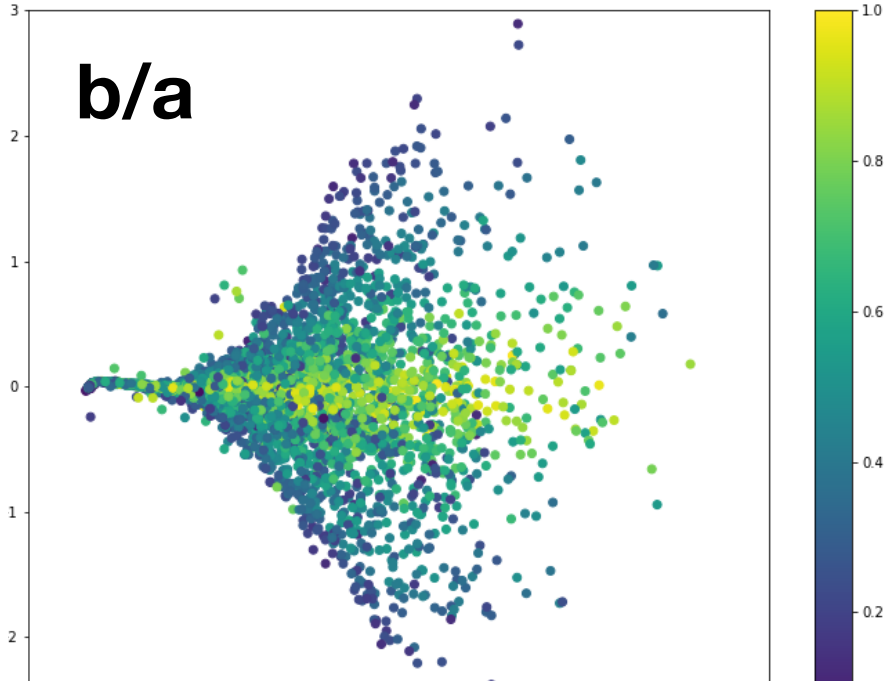
PRELIMINARY!



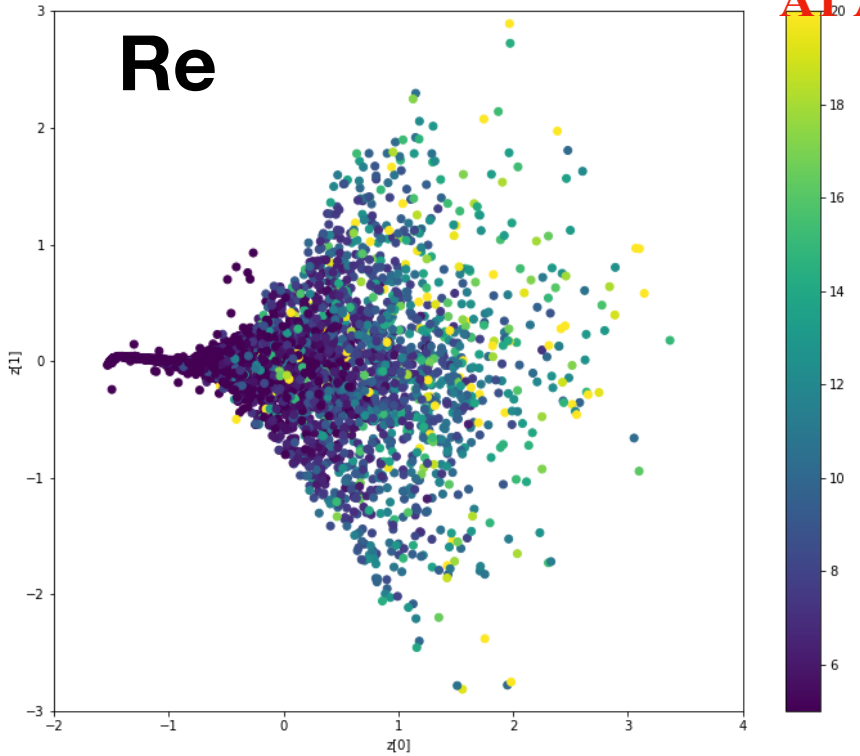


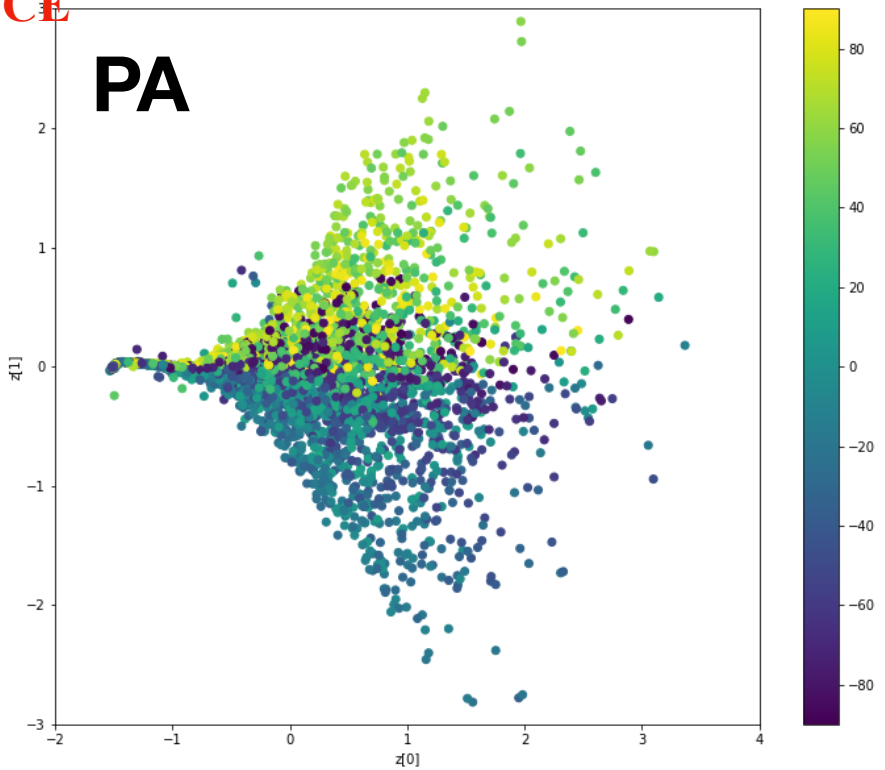
INTERPOLATION IN THE LATENT SPACE GENERATES GALAXIES WITH DIFFERENT PROPERTIES

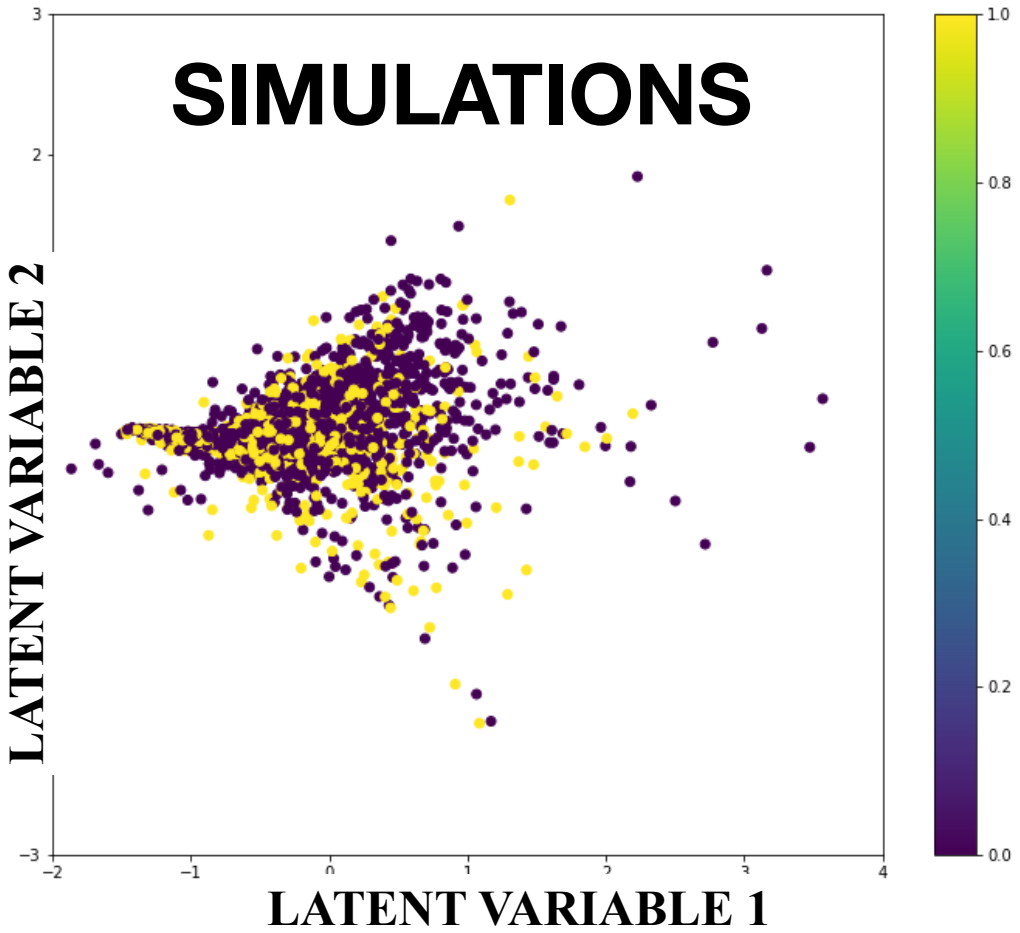


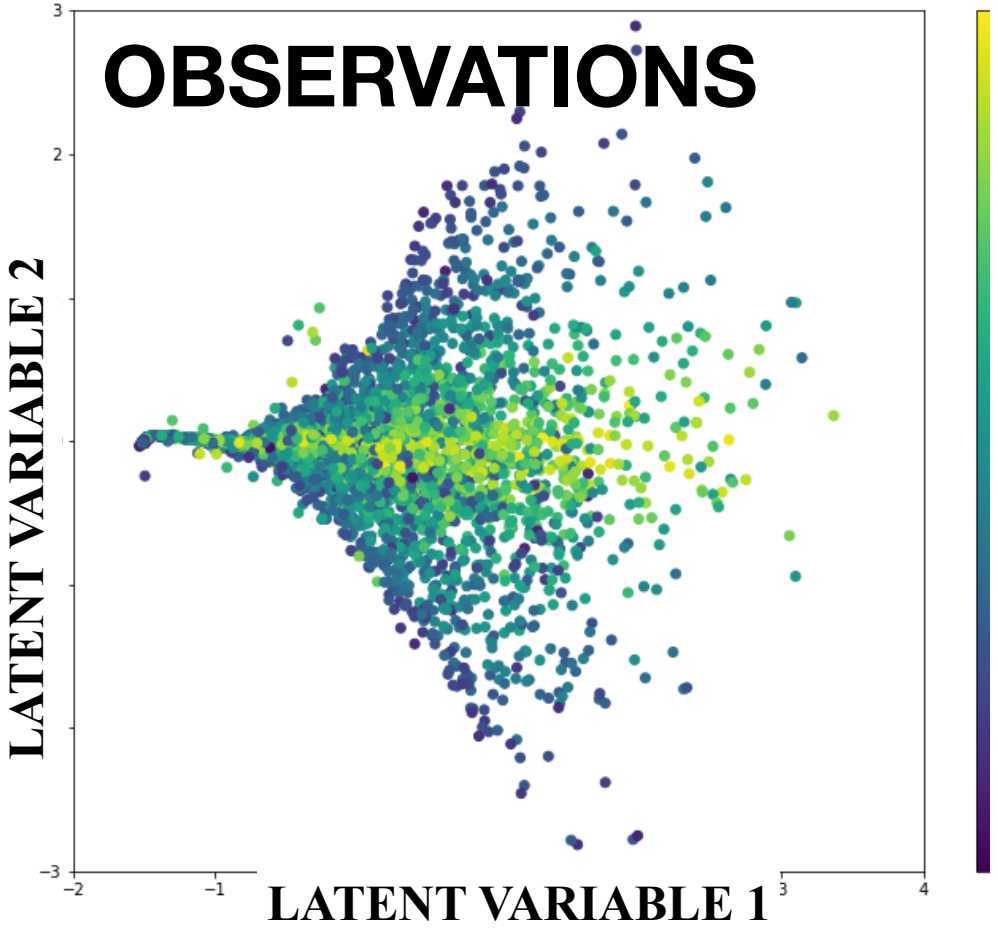


EXPLORE THE MORPHOLOGICAL DISTRIBUTION OF GALAXIES AT A GLANCE

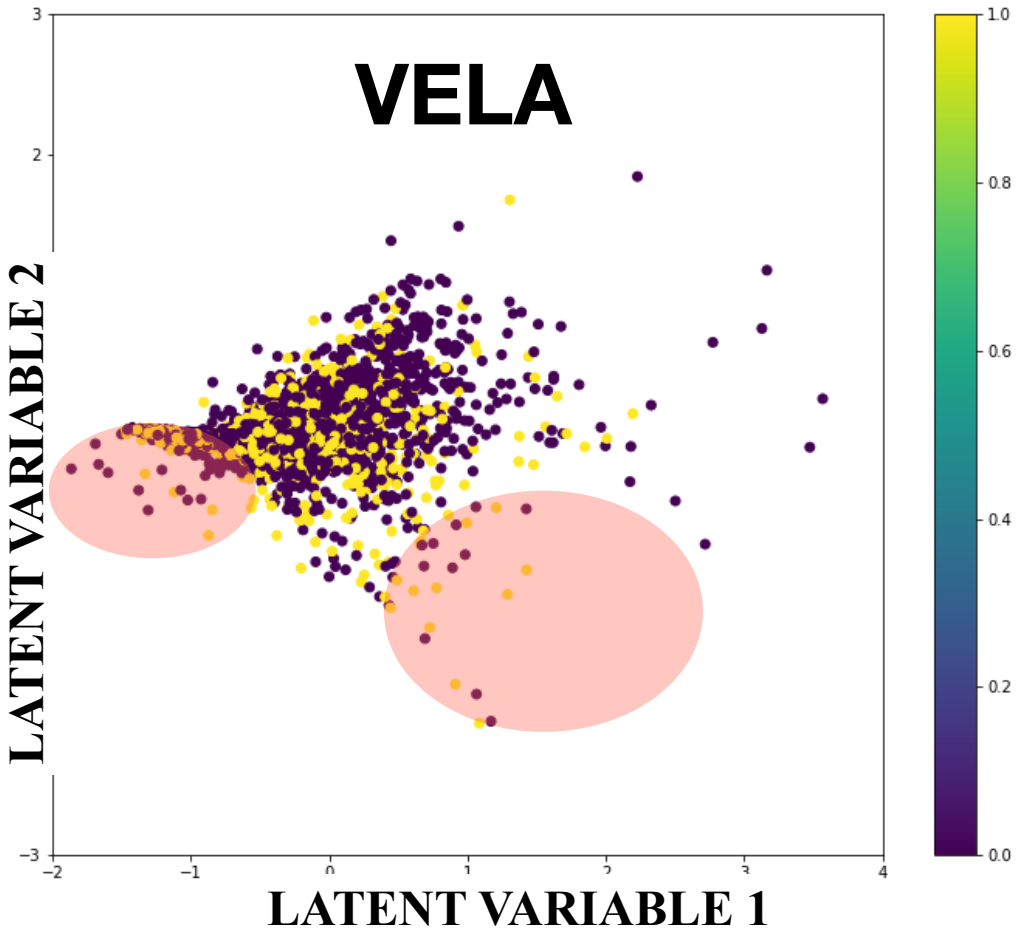


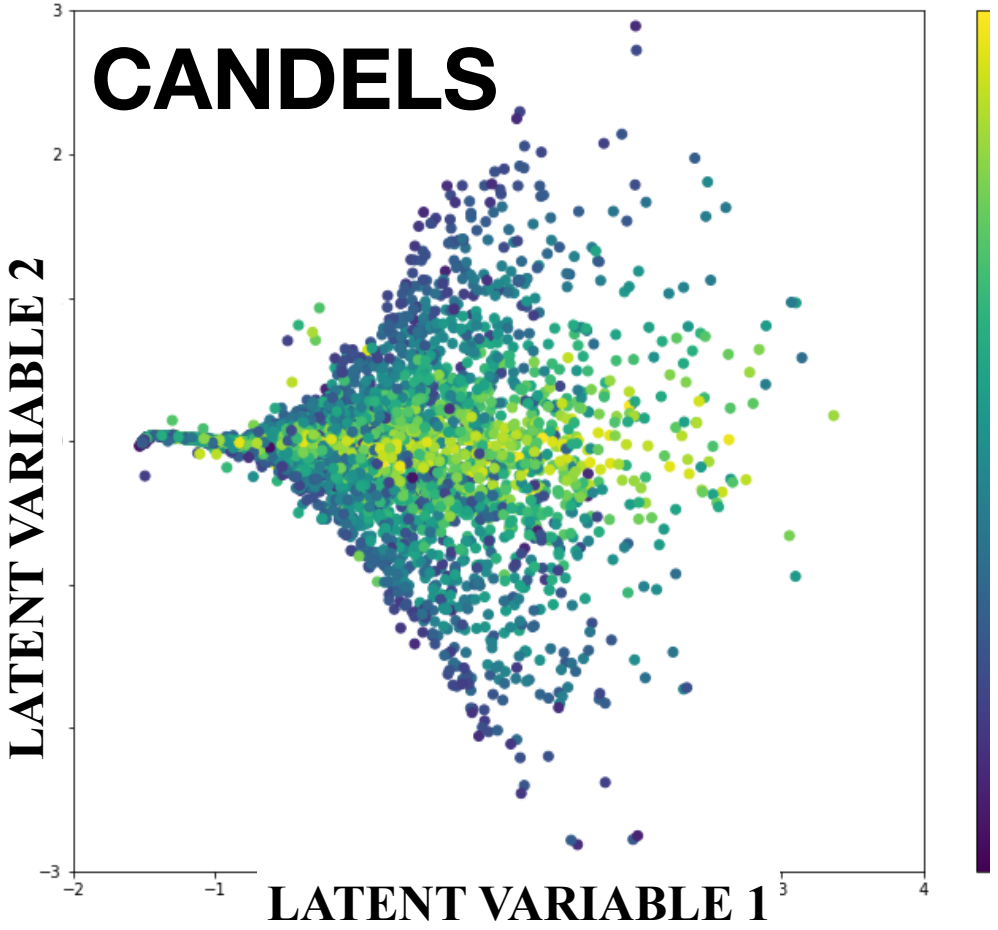






HOW SIMULATIONS POPULATE THE LATENT SPACE?



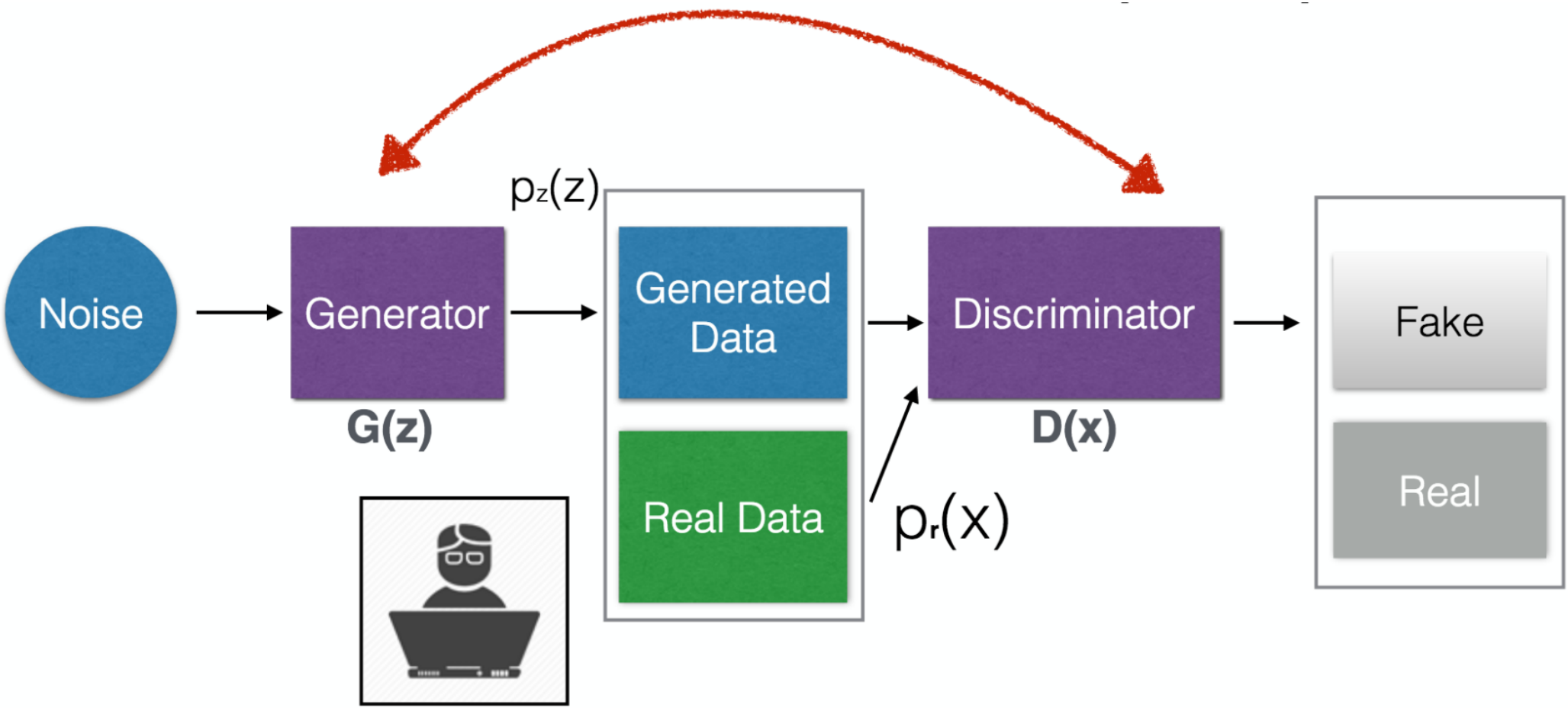


HOW SIMULATIONS POPULATE THE LATENT SPACE?

GENERATIVE ADVERSARIAL NETWORKS

(Goodfellow+)

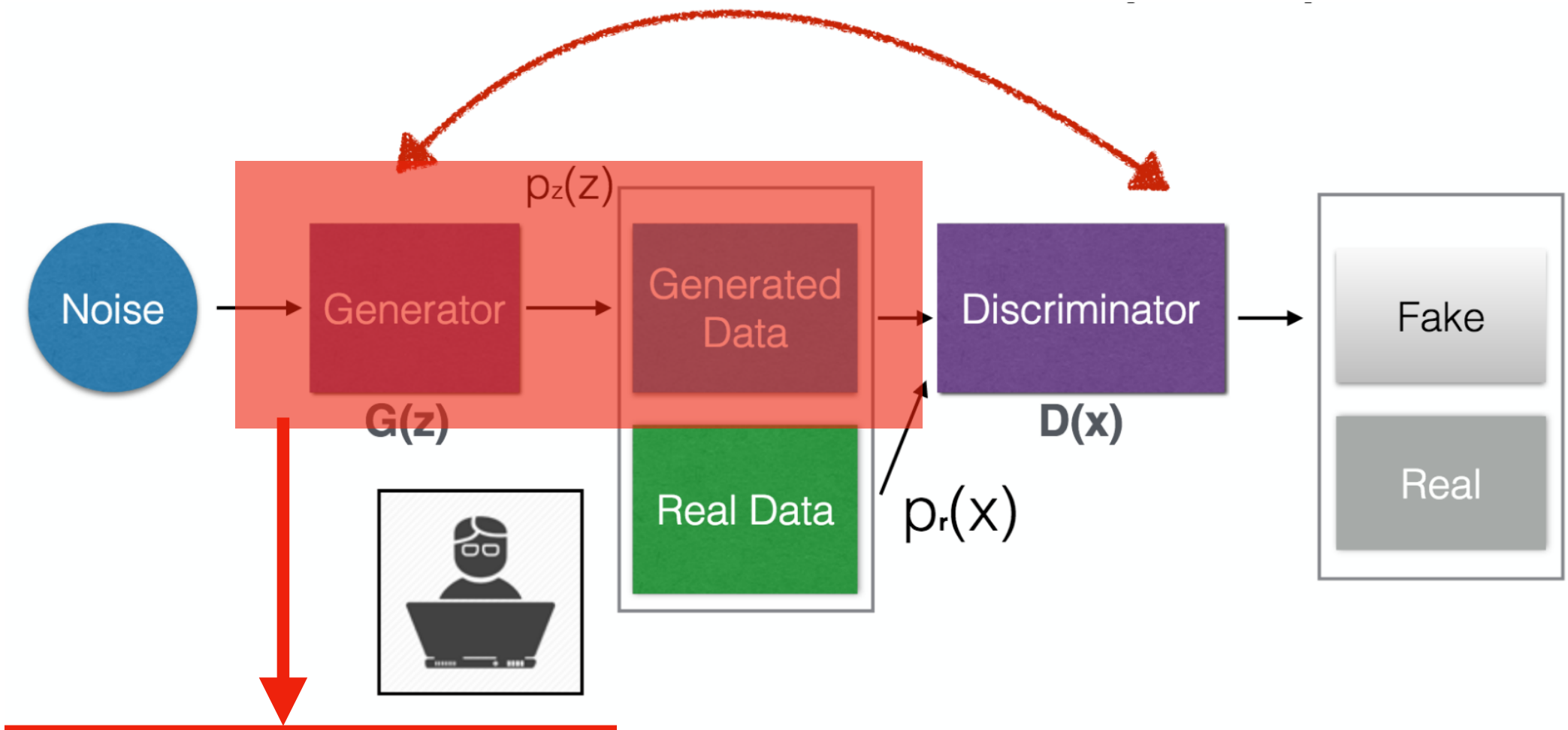
TWO COMPETING NETWORKS



GENERATIVE ADVERSARIAL NETWORKS

(Goodfellow+)

TWO COMPETING NETWORKS

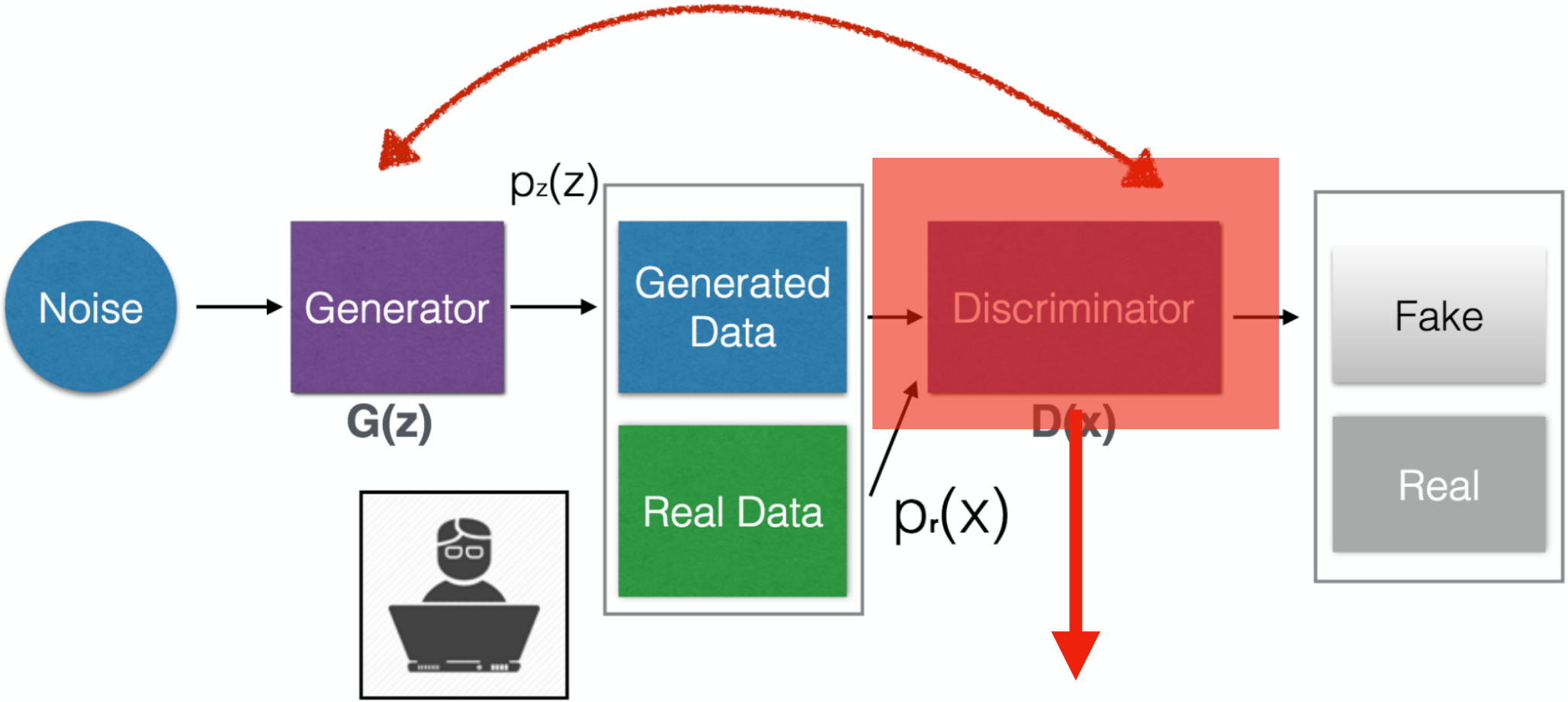


Every 2 iterations the generator is trained to force the discriminator to classify as real

GENERATIVE ADVERSARIAL NETWORKS

(Goodfellow+)

TWO COMPETING NETWORKS



Every 2 iterations the discriminator is trained to force to distinguish between real and fake

Progressive Growing of GANs for Improved Quality, Stability, and Variation

Tero Karras
NVIDIA

Timo Aila
NVIDIA

Samuli Laine
NVIDIA

Jaakko Lehtinen
NVIDIA
Aalto University

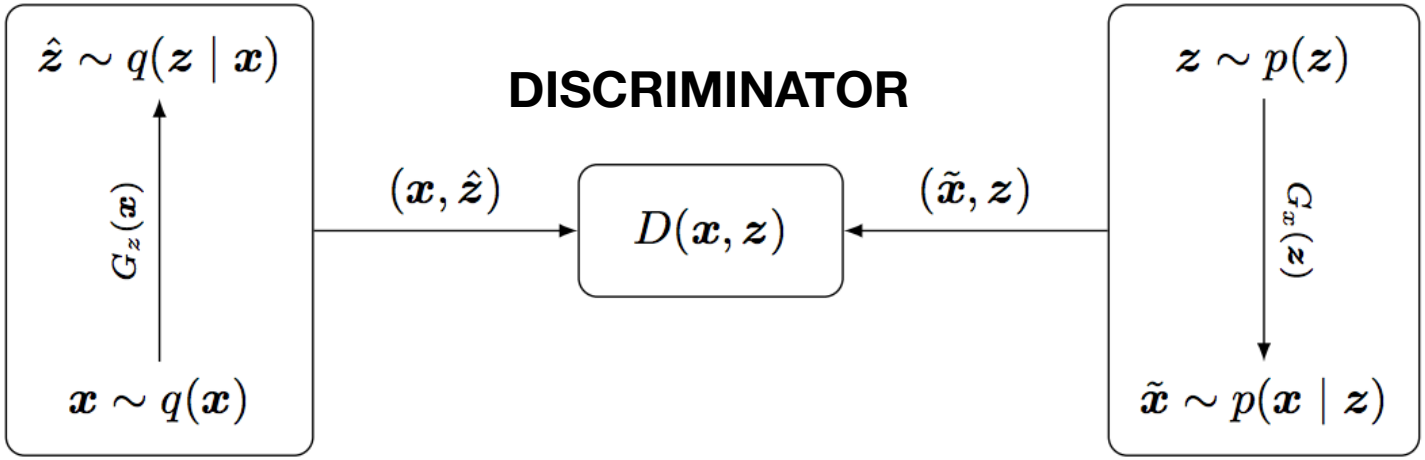
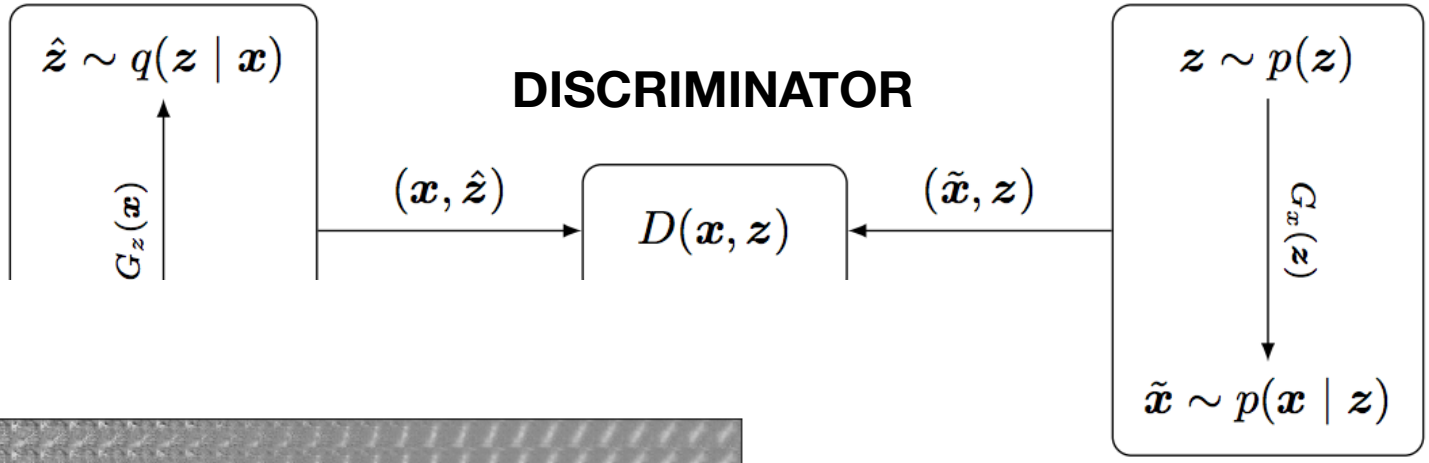
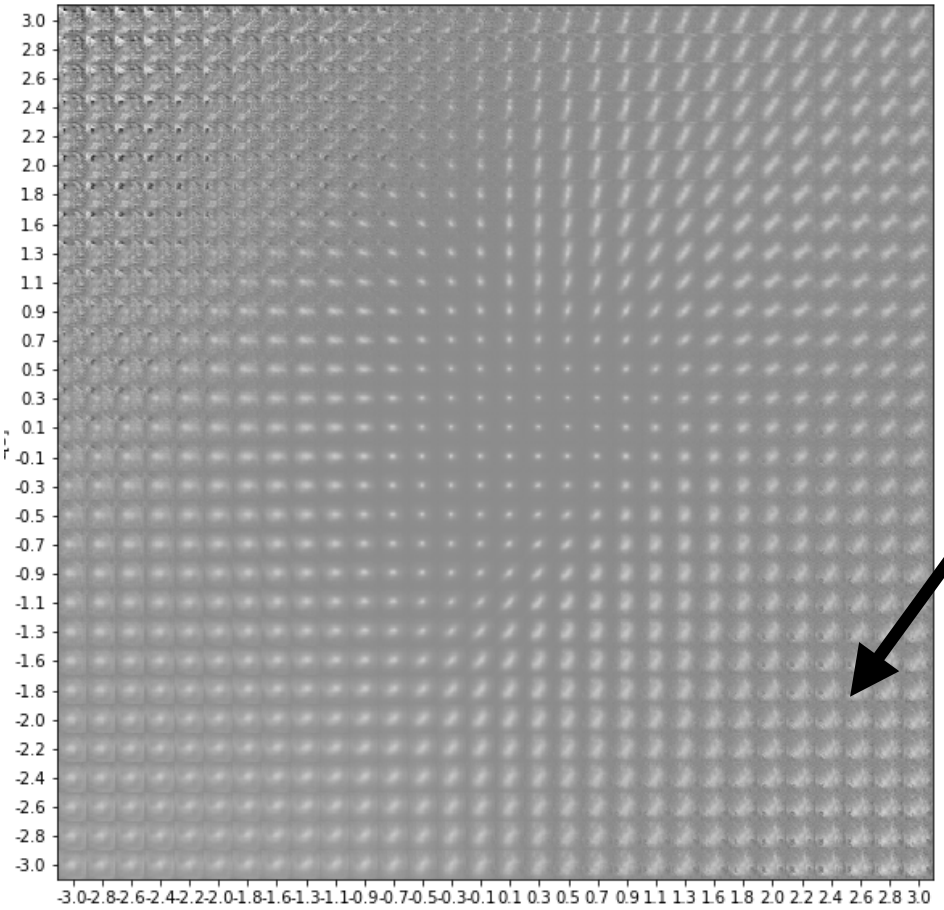


Figure 1: The adversarially learned inference (ALI) game. **Dumoulin+17**

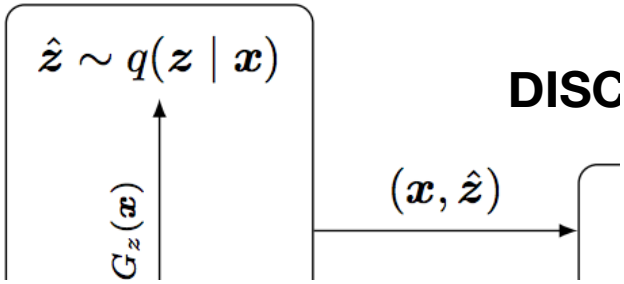


nference (ALI) game.

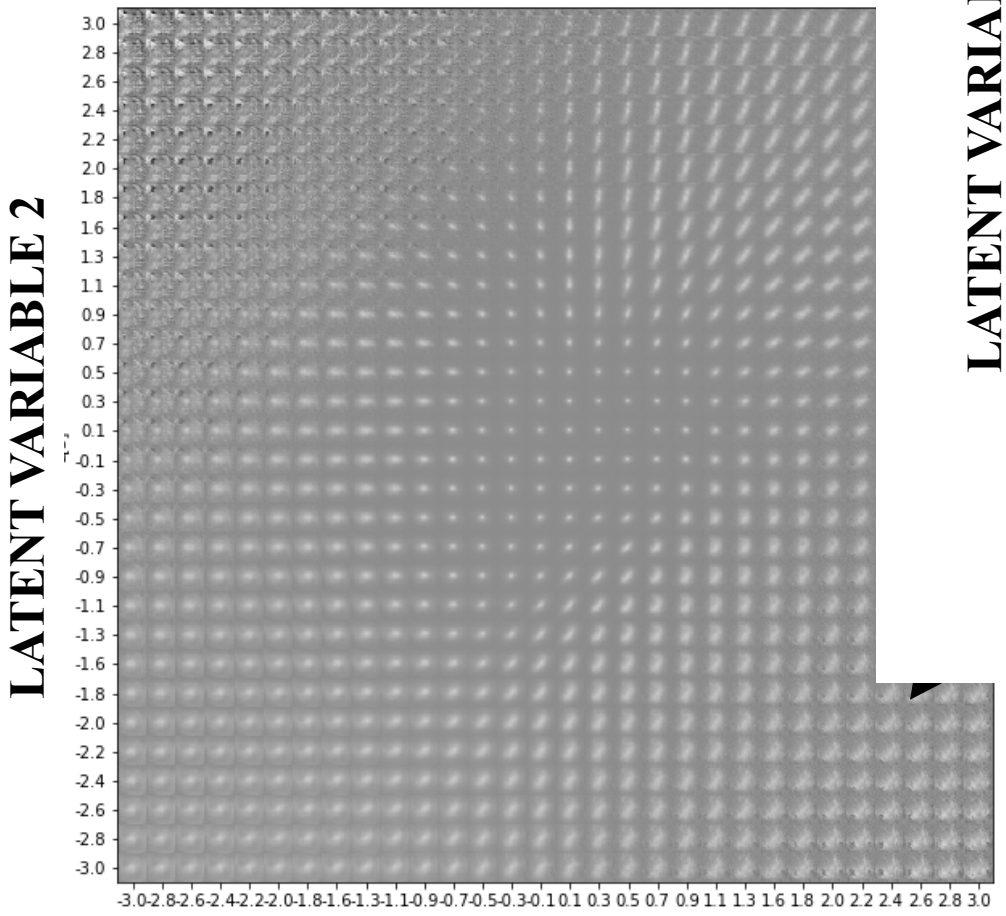
Dumoulin+17

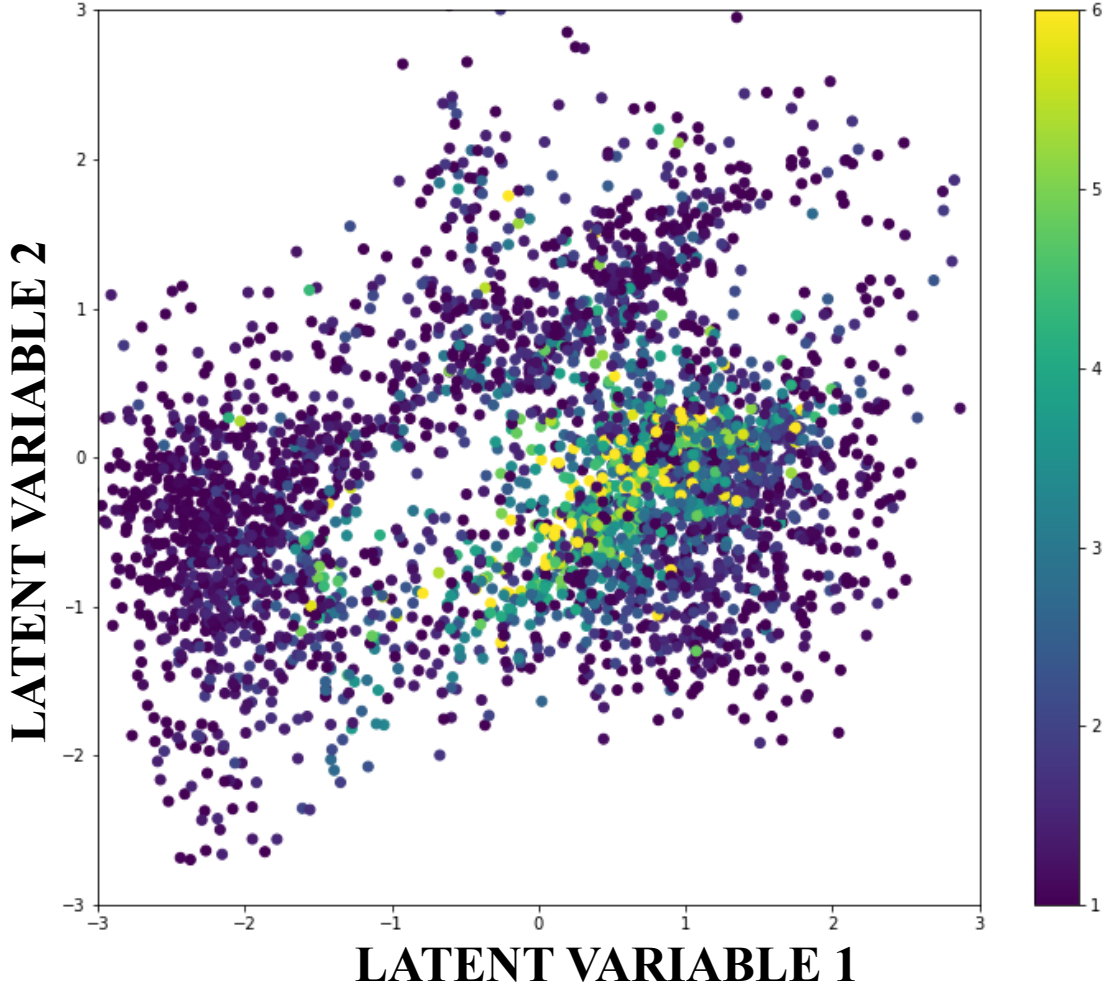


GENERATES MORE COMPLEX MODELS



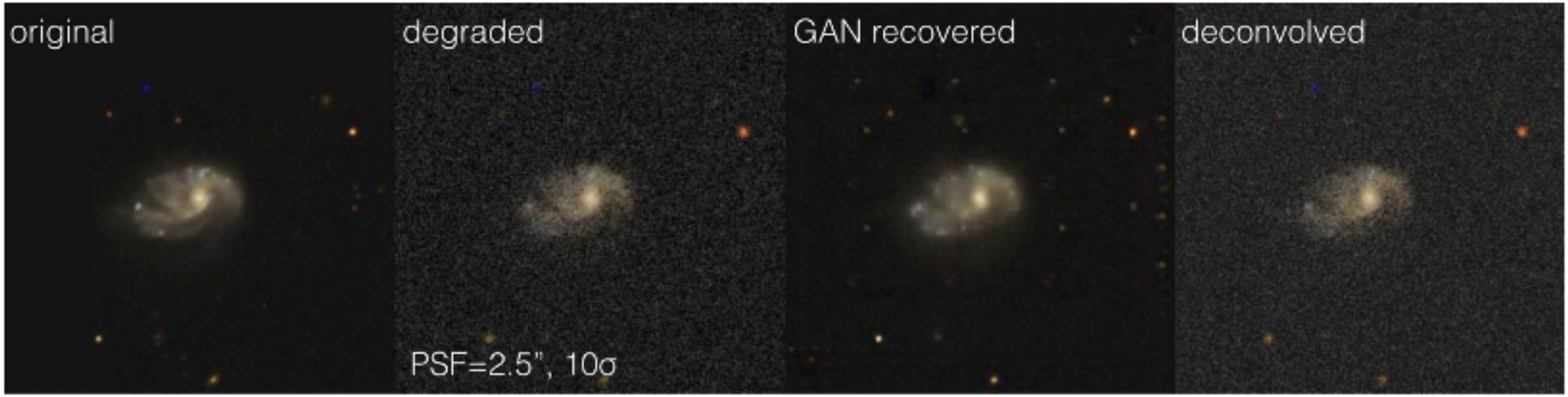
DISC

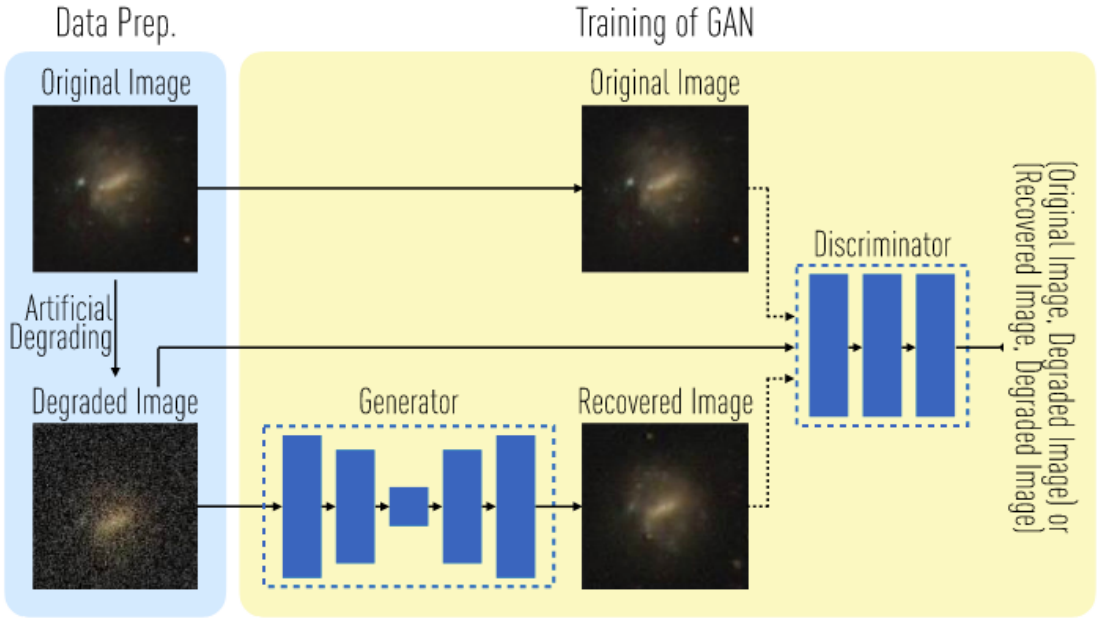




MORE DIFFICULT TO INTERPRET

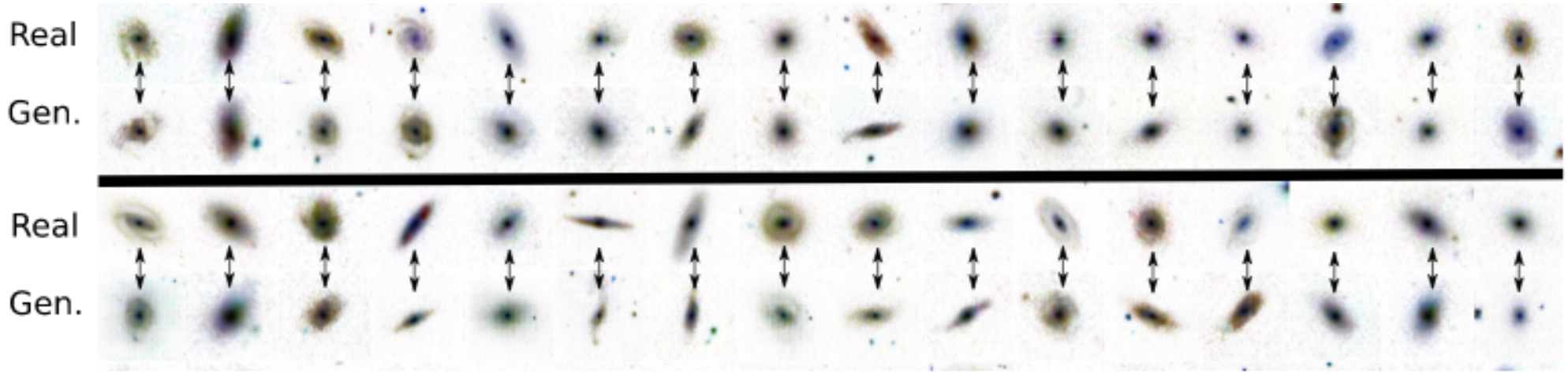
GANs: OTHER APPLICATIONS IN ASTRONOMY





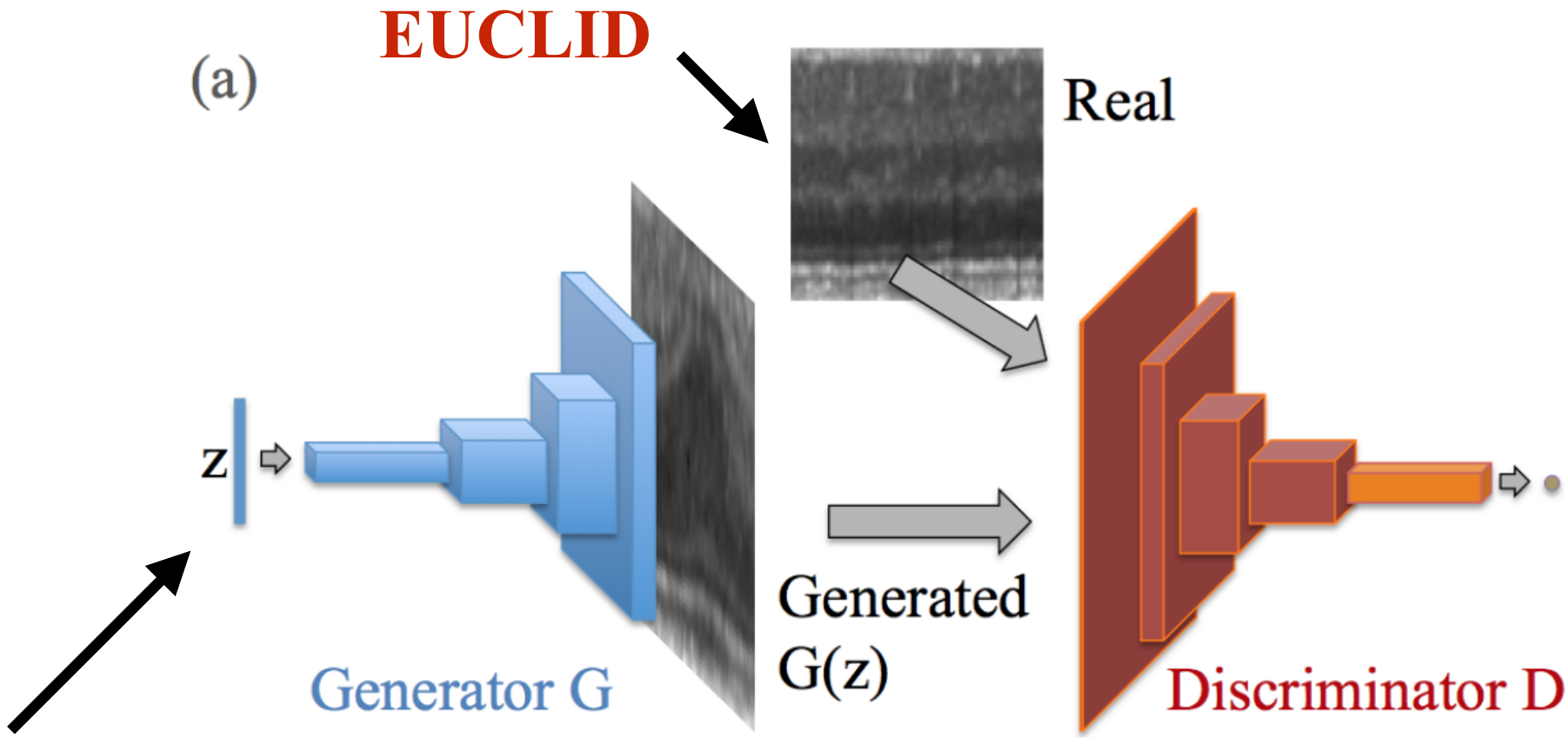
Schawinsky+17

GANs: OTHER APPLICATIONS IN ASTRONOMY



Ravanbakhsh+16

Getting machines ready for **discovering the unexpected**



"The expected Universe @ z 5-7"	**[EAGLE, Illustris, FIRE, VELA…]**