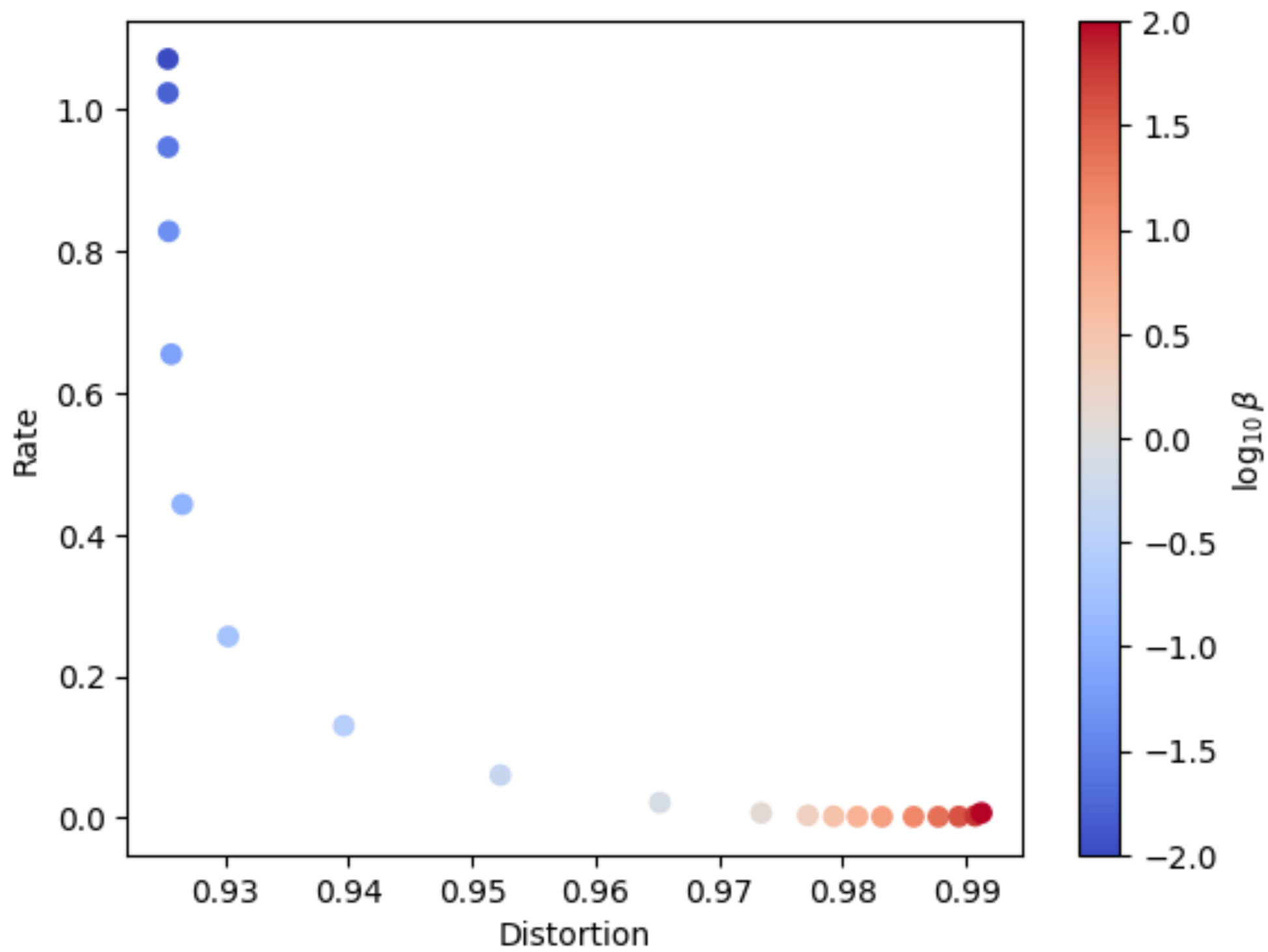


Siddhant Mishra-Sharma (MIT/AI FI) Summer School

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Controlling compression and disentanglement: β -VAEs



$$\text{ELBO} = \left\langle \log p_{\vartheta}(x \mid z) \right\rangle_{q_{\varphi}} - \textcolor{red}{\beta} \cdot D_{\text{KL}} \left(q_{\varphi}(z \mid x) \parallel p(z) \right)$$



Rate



Disortion

If the data-generating process is associated with a principled noise model, by using it (the *likelihood*) as the reconstruction loss we are aiming to reconstruct the mean data.

$$\log p(x \mid z; x') = -\frac{1}{2} \left(\frac{x - x'}{\sigma} \right)^2 + \log \left(\frac{1}{\sigma \sqrt{2\pi}} \right)$$

- Larger σ : More of the data variation is attributed to the likelihood \rightarrow larger " β ", more compression
- Smaller σ : Latents z try to capture more of the variation in the data (e.g. small perceptual features)

Controlling compression and disentanglement: β -VAEs

$$\text{ELBO} = \underbrace{\langle \log p_{\vartheta}(x | z) \rangle_{q_{\varphi}}}_{\text{Distortion}} - \underbrace{\beta \cdot D_{\text{KL}}(q_{\varphi}(z | x) \| p(z))}_{\text{Rate}}$$

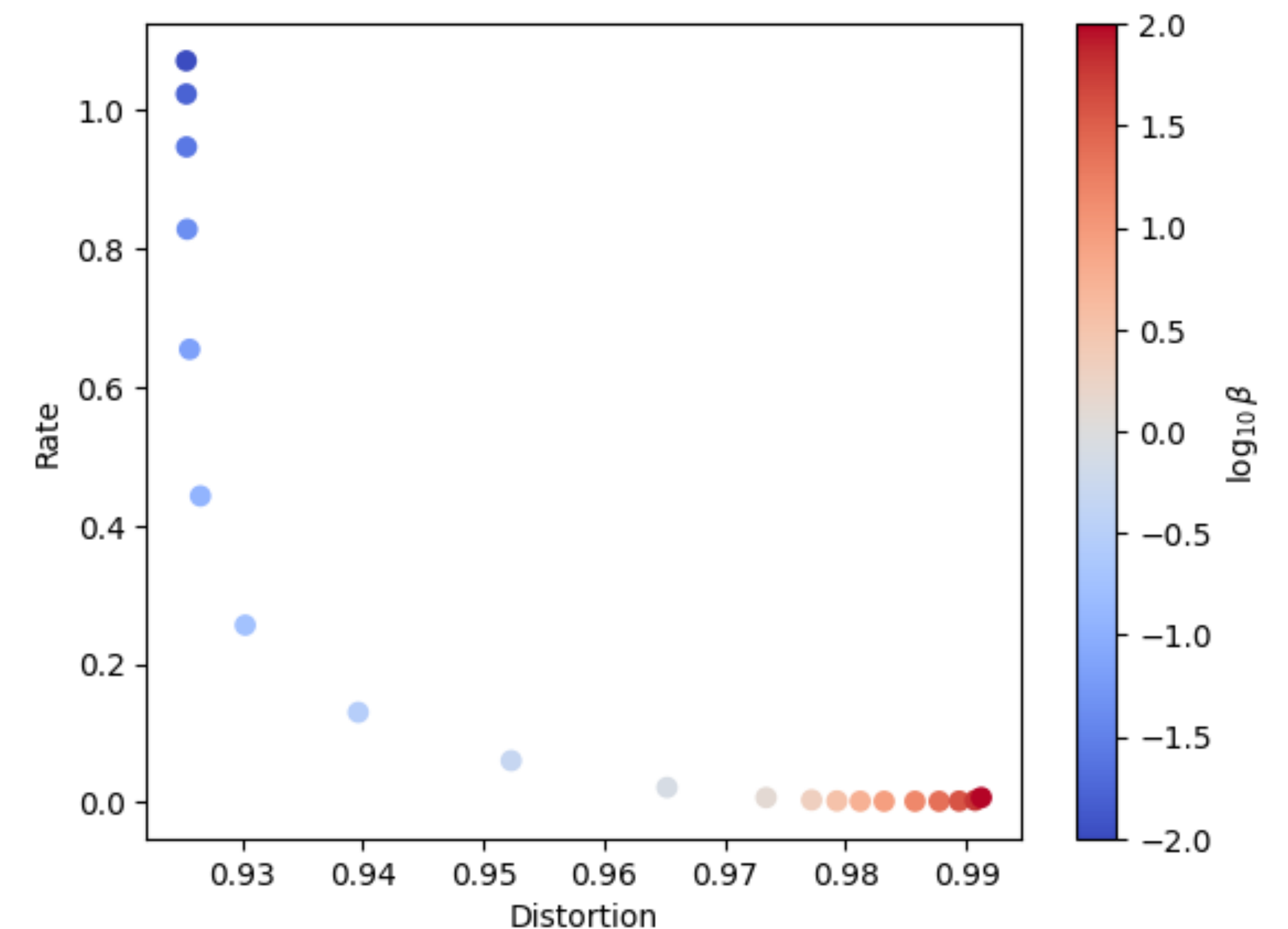
Distortion

Rate

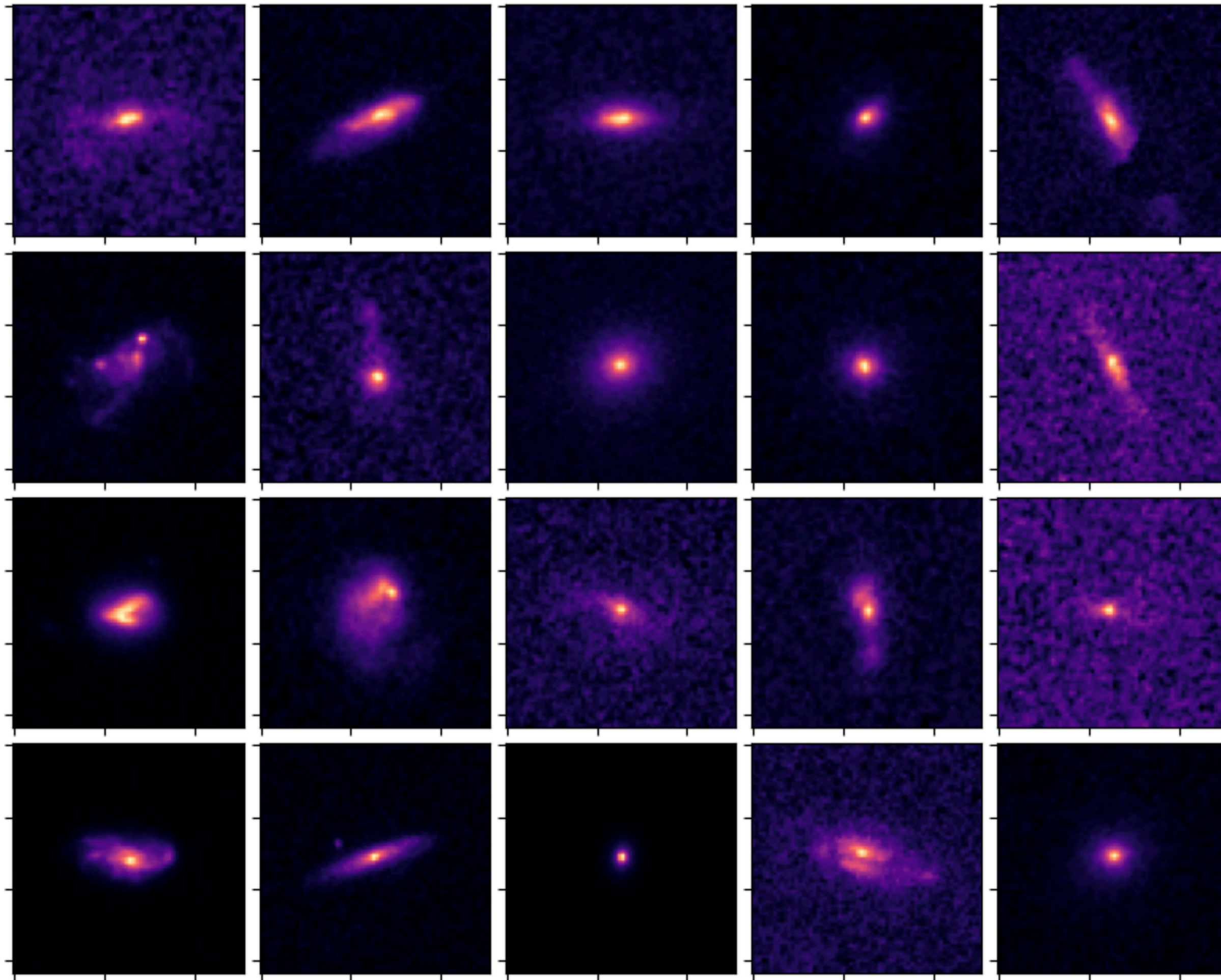
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Tutorial Task 1



- Construct a VAE and use it to build a generative model of galaxy images using samples from the HST COSMOS dataset
- Boilerplate code for training/reconstruction/sampling for quick iteration
- Experiment with trade-offs between reconstruction quality and a disentangled latent space

[Mandelbaum et al; <https://zenodo.org/record/3242143>]