Target prop(agation)

R Decoder \tilde{y} initialise

Given an observation **y**,

- $oldsymbol{\cdot}$ Compute $ilde{oldsymbol{z}} = \operatorname{Enc}(oldsymbol{y})$
- $oldsymbol{\cdot}$ Compute $\check{oldsymbol{z}} = rg\min E(oldsymbol{y}, oldsymbol{z})$
- Minimise $\mathcal{L}(F_{\infty}(ilde{\,\cdot\,}),oldsymbol{Y})$:

$$oldsymbol{w}_{\mathrm{Dec}} \leftarrow oldsymbol{w}_{\mathrm{Dec}} - \eta
abla_{oldsymbol{w}_{\mathrm{Dec}}} C(oldsymbol{y}, ilde{oldsymbol{y}})$$

$$oldsymbol{w}_{\mathrm{Enc}} \leftarrow oldsymbol{w}_{\mathrm{Enc}} - \eta
abla_{oldsymbol{w}_{\mathrm{Enc}}} oldsymbol{D}(\check{oldsymbol{z}}, \widetilde{oldsymbol{z}})$$

$$egin{aligned} E(oldsymbol{y},oldsymbol{z}) &= \ C(oldsymbol{y}, ilde{oldsymbol{y}}) + R(oldsymbol{z}) \ &+ D(oldsymbol{z}, ilde{oldsymbol{z}}) \end{aligned}$$

Encoder <

Non-linear actvtn

R \longrightarrow Sp Dec \longrightarrow \widetilde{y} initialise C

Given an observation
$$y$$
,

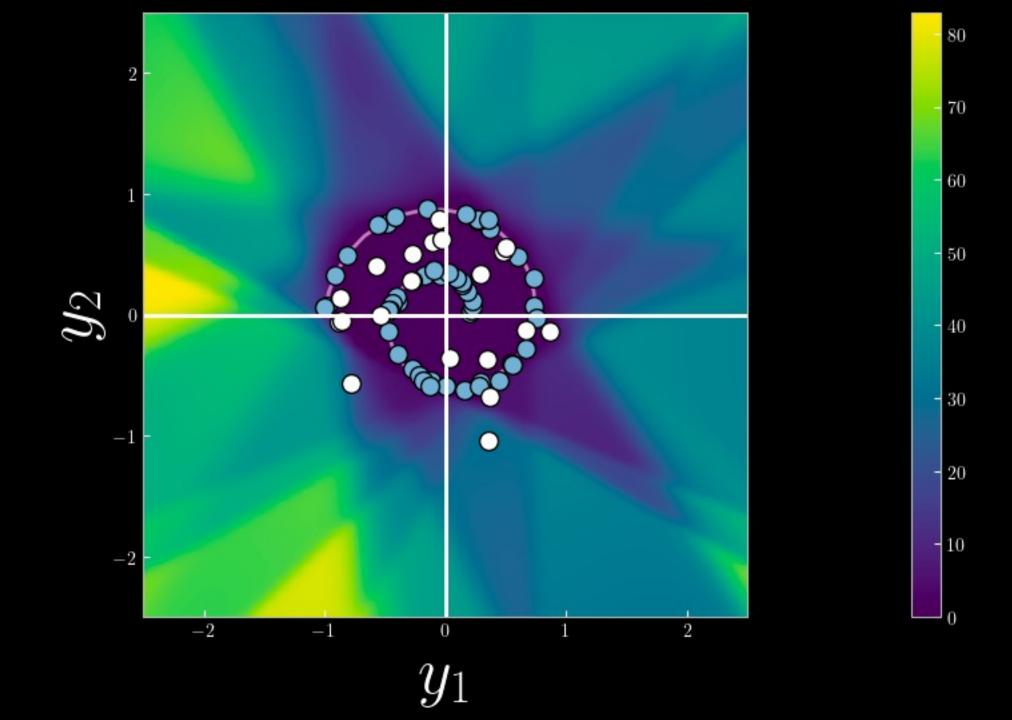
- $oldsymbol{\dot{z}} = \operatorname{Enc}(oldsymbol{y})$
- ullet Compute $oldsymbol{\check{z}} = rg\min E(oldsymbol{y}, oldsymbol{z})$
- Minimise $\mathcal{L}(F_{\infty}(\overset{oldsymbol{z}}{\cdot}), \overset{oldsymbol{Z}}{oldsymbol{Y}})$:

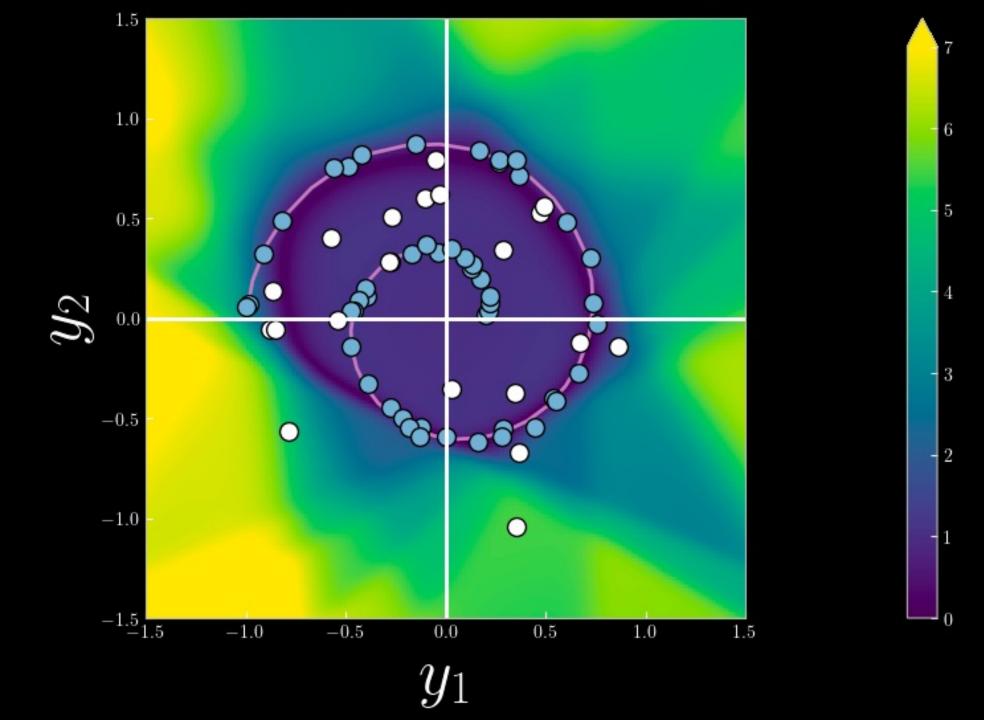
$$oldsymbol{w}_{\mathrm{Dec}} \leftarrow oldsymbol{w}_{\mathrm{Dec}} - \eta
abla_{oldsymbol{w}_{\mathrm{Dec}}} oldsymbol{C}(oldsymbol{y}, ilde{oldsymbol{y}})$$

$$oldsymbol{w}_{\mathrm{Enc}} \leftarrow oldsymbol{w}_{\mathrm{Enc}} - \eta
abla_{oldsymbol{w}_{\mathrm{Enc}}} oldsymbol{D}(\check{oldsymbol{z}}, \widetilde{oldsymbol{z}})$$

$$egin{aligned} E(oldsymbol{y},oldsymbol{z}) &= \ C(oldsymbol{y}, ilde{oldsymbol{y}}) + R(oldsymbol{z}) \ &+ D(oldsymbol{z}, ilde{oldsymbol{z}}) \end{aligned}$$

Encoder <





Target prop(agation)

R Decoder \tilde{y} initialise C

Given an observation \boldsymbol{y} ,

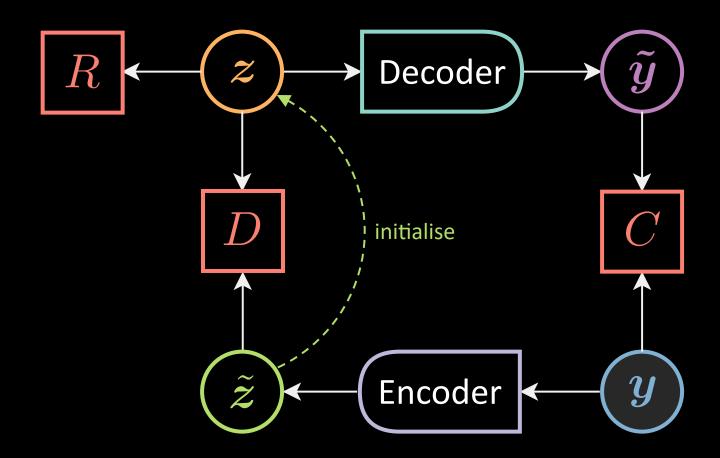
- $oldsymbol{\cdot}$ Compute $ilde{oldsymbol{z}} = \operatorname{Enc}(oldsymbol{y})$
- $oldsymbol{\cdot}$ Compute $oldsymbol{\check{z}} = rg\min E(oldsymbol{y}, oldsymbol{z})$
- Minimise $\mathcal{L}(F_{\infty}(ilde{\,\cdot\,}), oldsymbol{Y})$:

$$oldsymbol{w}_{\mathrm{Dec}} \leftarrow oldsymbol{w}_{\mathrm{Dec}} - \eta
abla_{oldsymbol{w}_{\mathrm{Dec}}} C(oldsymbol{y}, ilde{oldsymbol{y}})$$

$$oldsymbol{w}_{\mathrm{Enc}} \leftarrow oldsymbol{w}_{\mathrm{Enc}} - \eta
abla_{oldsymbol{w}_{\mathrm{Enc}}} D(\check{oldsymbol{z}}, \widetilde{oldsymbol{z}})$$

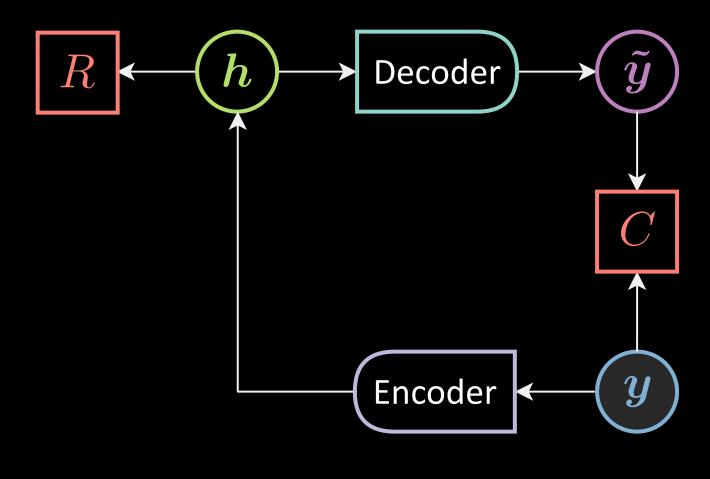
$$egin{aligned} E(oldsymbol{y},oldsymbol{z}) &= \ C(oldsymbol{y}, ilde{oldsymbol{y}}) + R(oldsymbol{z}) \ &+ D(oldsymbol{z}, ilde{oldsymbol{z}}) \end{aligned}$$

Encoder <



Autoencoder

$$egin{aligned} m{h} &= f(m{W_h}m{y} + m{b_h}) \ m{ ilde{y}} &= g(m{W_{ ilde{y}}}m{h} + m{b_{ ilde{y}}}) \ m{y}, m{ ilde{y}} &\in \mathbb{R}^K \ m{h} &\in \mathbb{R}^d \ m{W_h} &\in \mathbb{R}^{d imes K} \ m{W_{ ilde{y}}} &\in \mathbb{R}^{K imes d} \end{aligned}$$



$$m{h} = \mathrm{Enc}(m{y}) \quad ilde{m{y}} = \mathrm{Dec}(m{h})$$

$$F(y) = C(y, \tilde{y}) + R(h)$$

Reconstruction costs

real valued input

$$C(\boldsymbol{y}, \tilde{\boldsymbol{y}}) = \|\boldsymbol{y} - \tilde{\boldsymbol{y}}\|^2 = \|\boldsymbol{y} - \operatorname{Dec}[\operatorname{Enc}(\boldsymbol{y})]\|^2$$

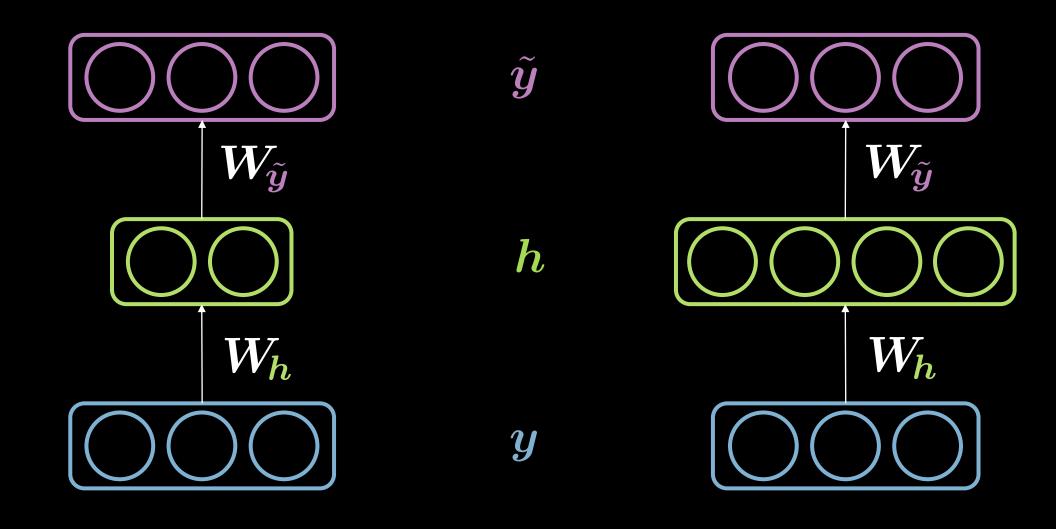
$$egin{align*} egin{align*} egin{align*} egin{align*} K \ oldsymbol{C}(oldsymbol{y}, ilde{oldsymbol{y}}) &= -\sum_{k=1}^K [y_k \log(ilde{y}_k) + (1-y_k) \log(1- ilde{y}_k)] \end{aligned}$$

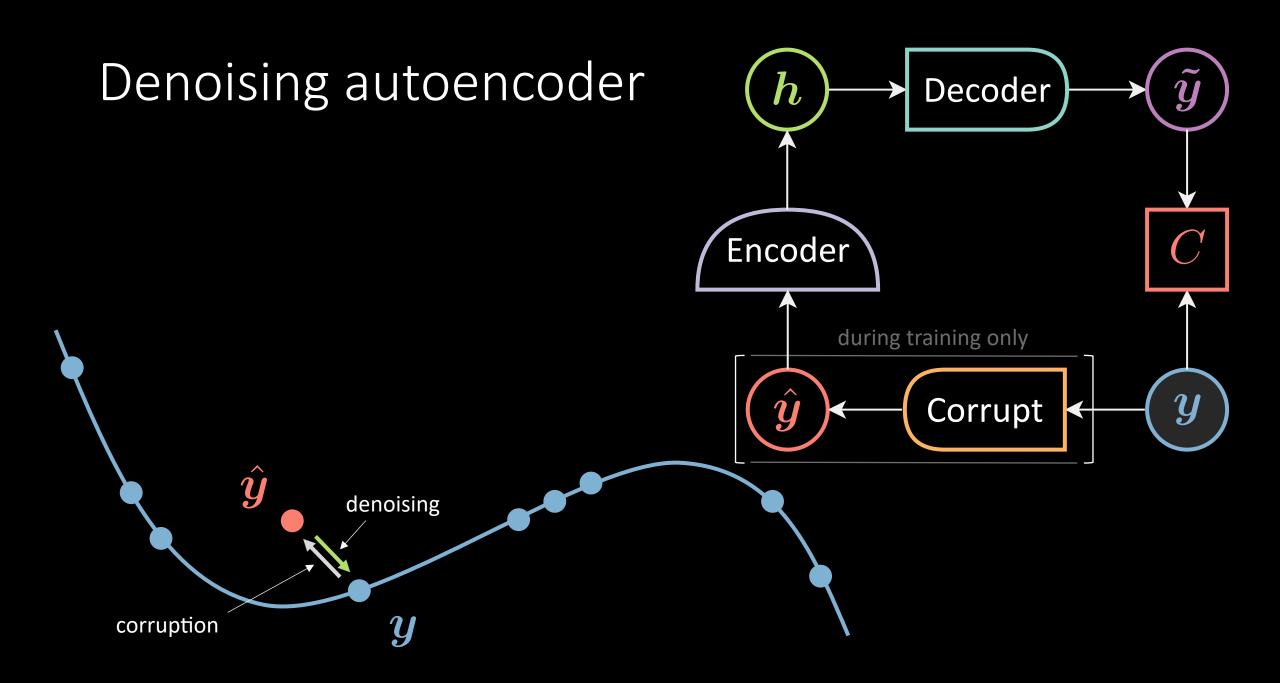
Loss functional

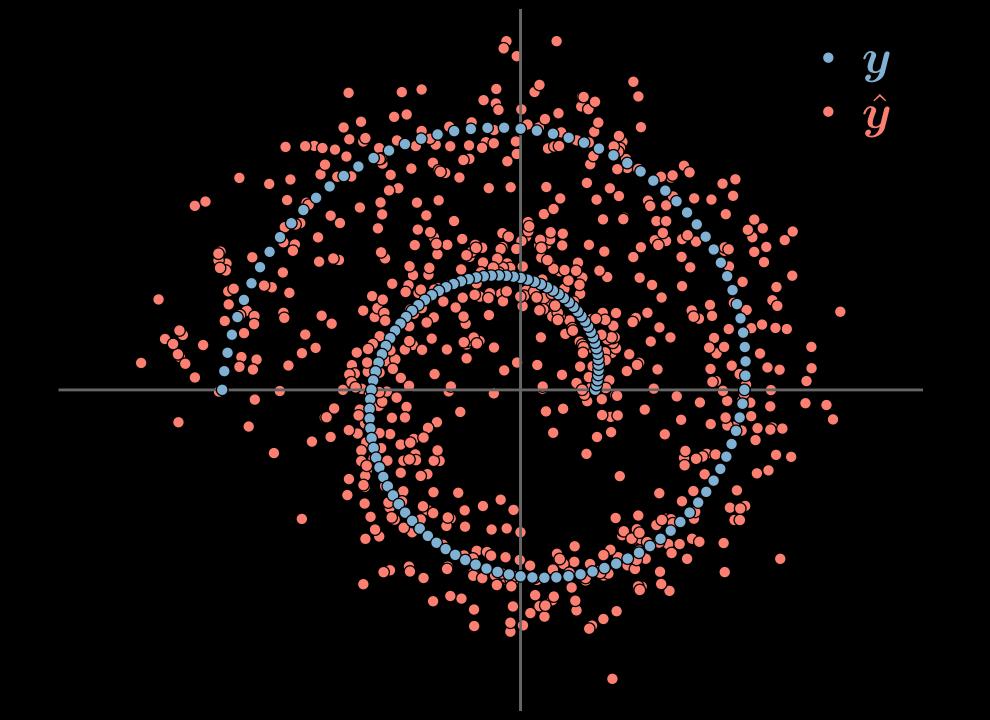
$$\mathcal{L}[F(\mathcal{Y}), \mathcal{S}] \doteq rac{1}{P} \sum_{p=1}^{P} L[F(\mathcal{Y}), oldsymbol{y}^{(p)}]$$

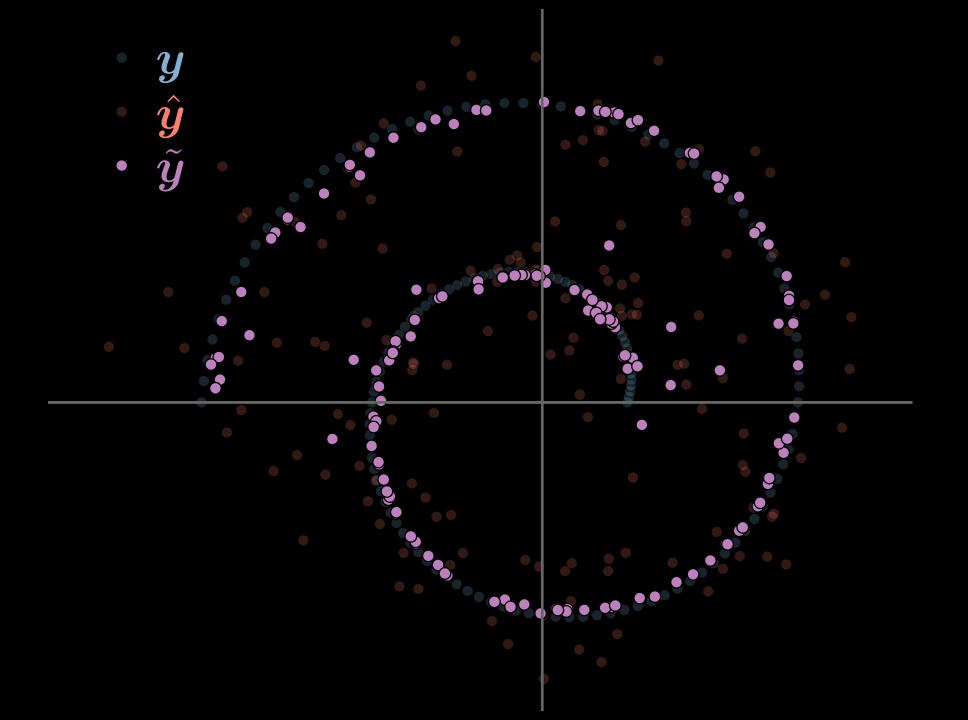
$$L_{ ext{energy}}[F(\mathcal{Y}), oldsymbol{y}] = F(oldsymbol{y})$$

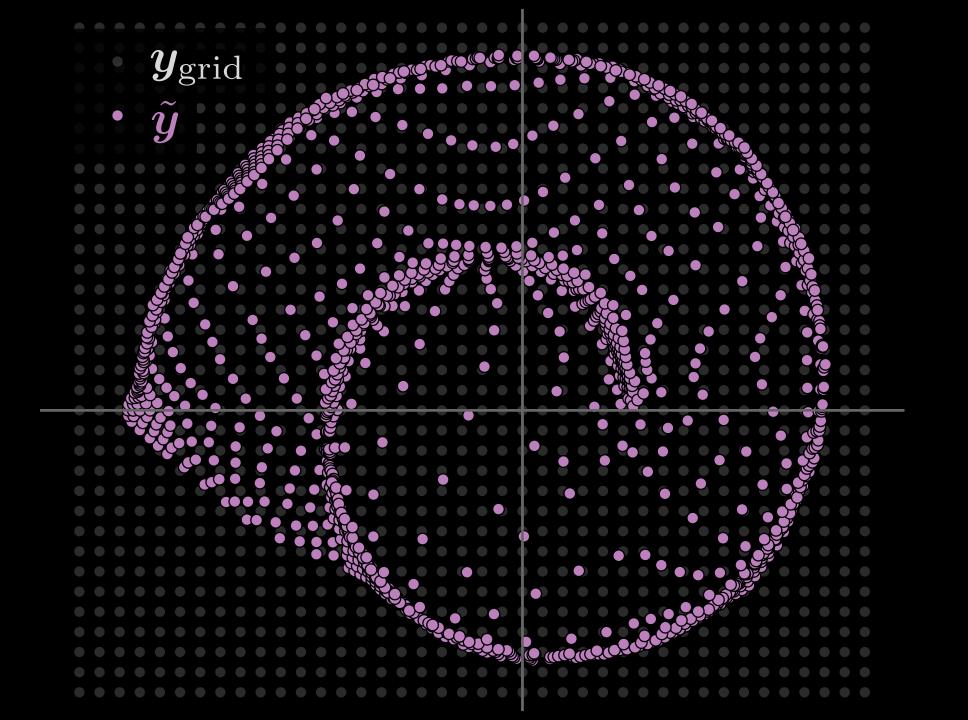
Under-/over-complete hidden layer



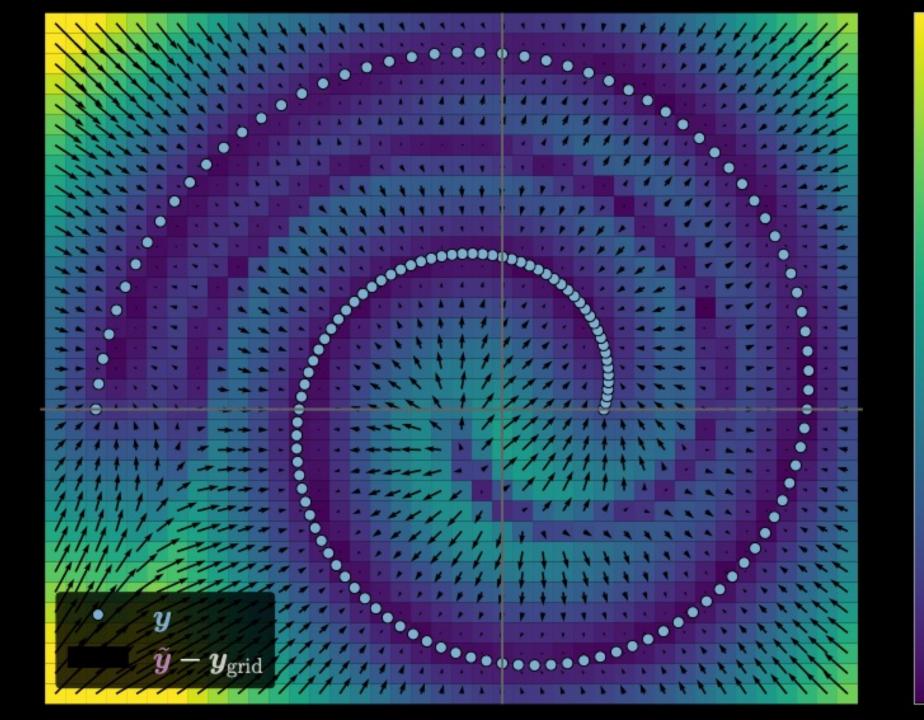








Denoising AE



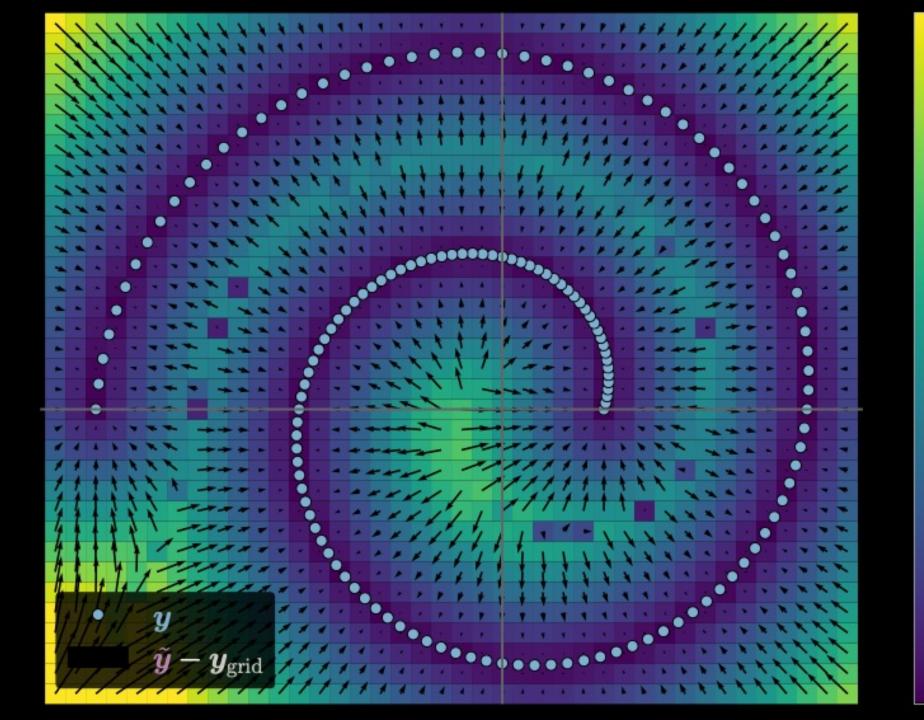
0.8

0.6

0.4

0.2

neig near. **b** 0



0.4