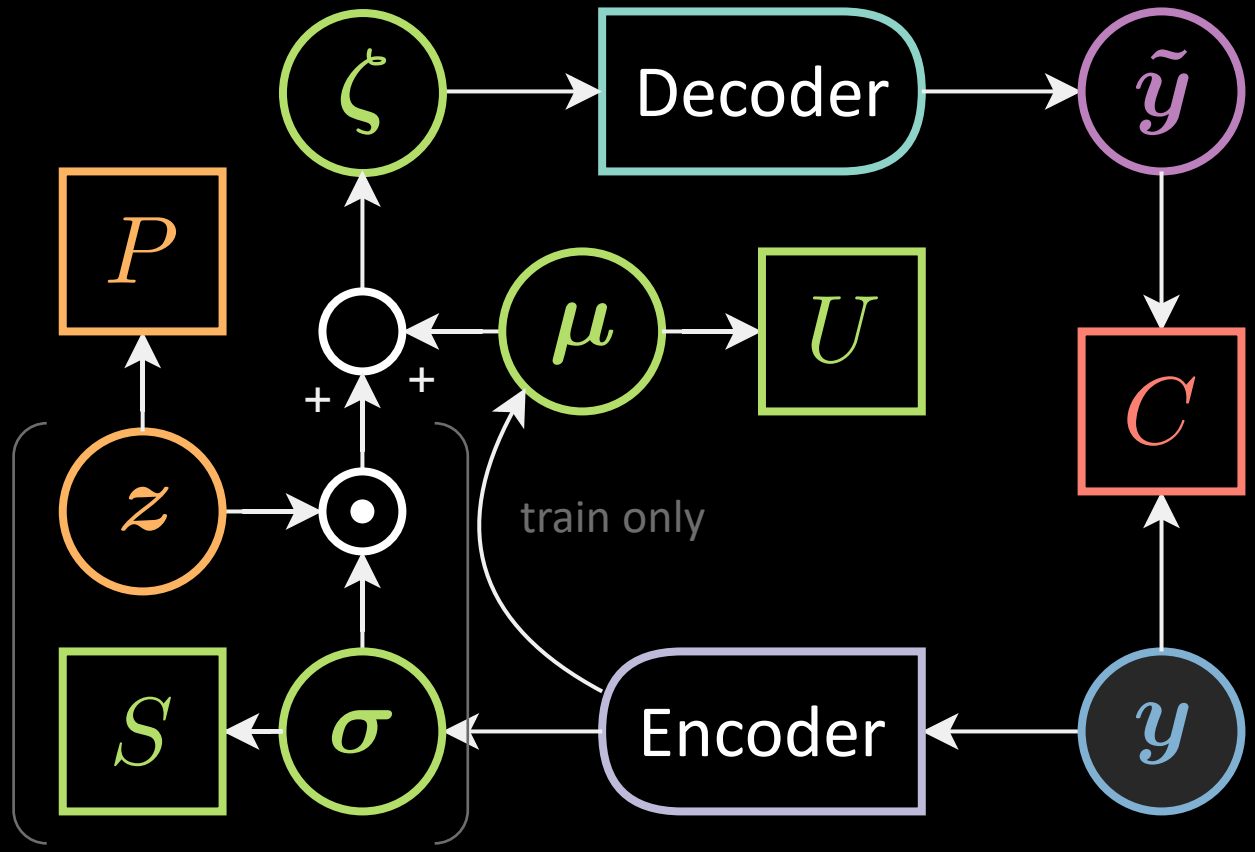
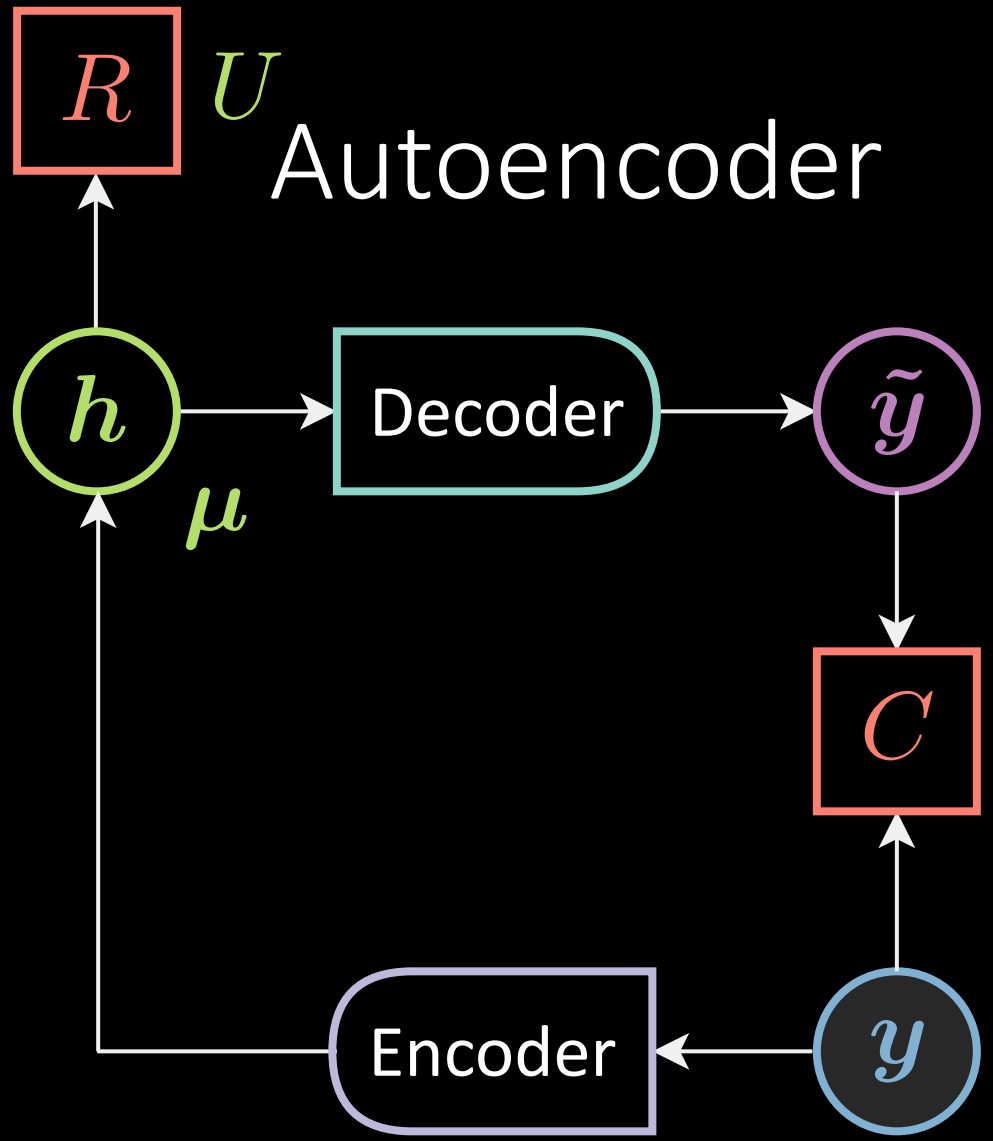
Variational AE

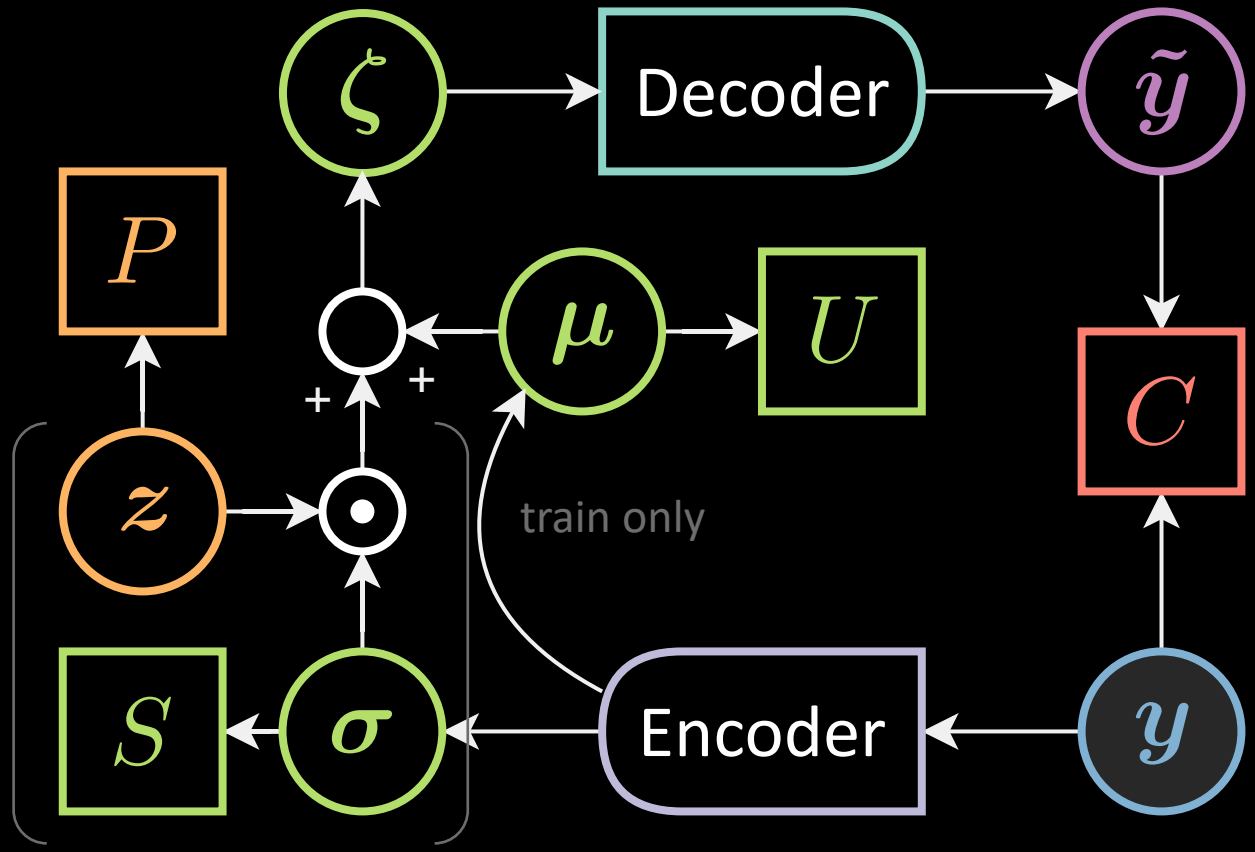


Autoencoder

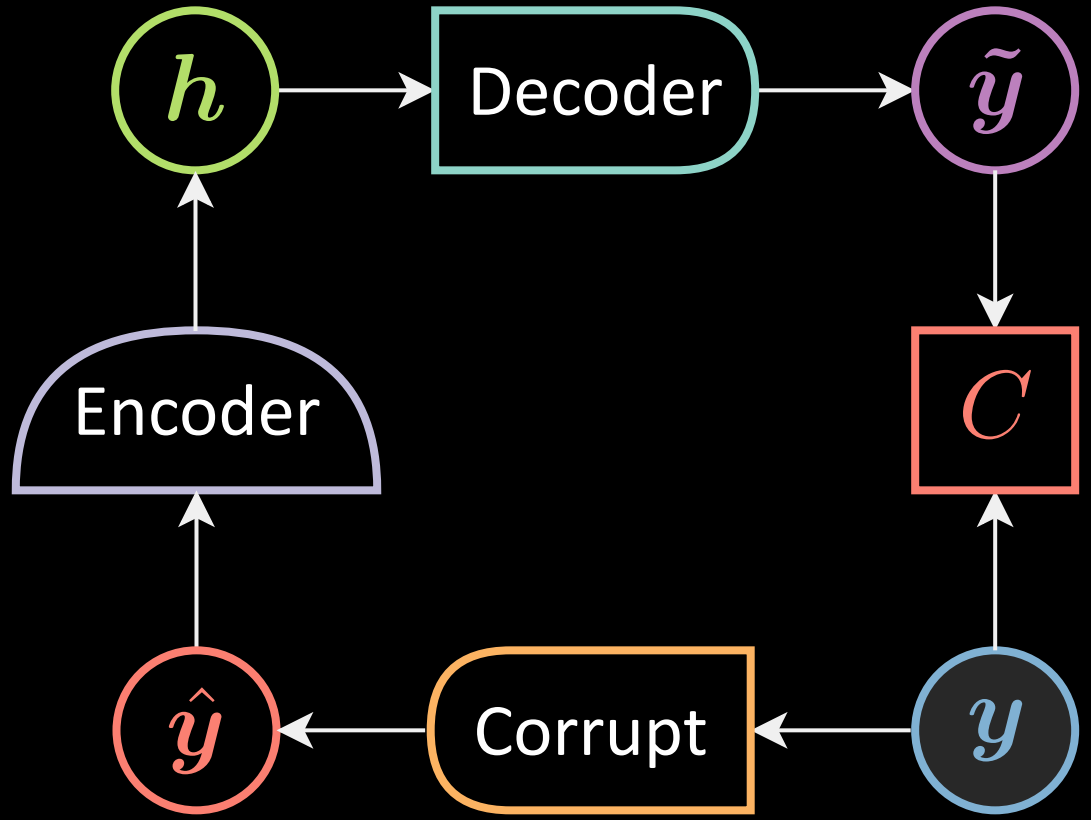


$$P(\boldsymbol{z}) = \tfrac{1}{2}\|\boldsymbol{z}\|^2 \qquad D_{\mathrm{KL}}\left[q(\boldsymbol{\zeta} \mid \boldsymbol{y}) \parallel p(\boldsymbol{z})\right] = U(\boldsymbol{\mu}) + S(\boldsymbol{\sigma})$$

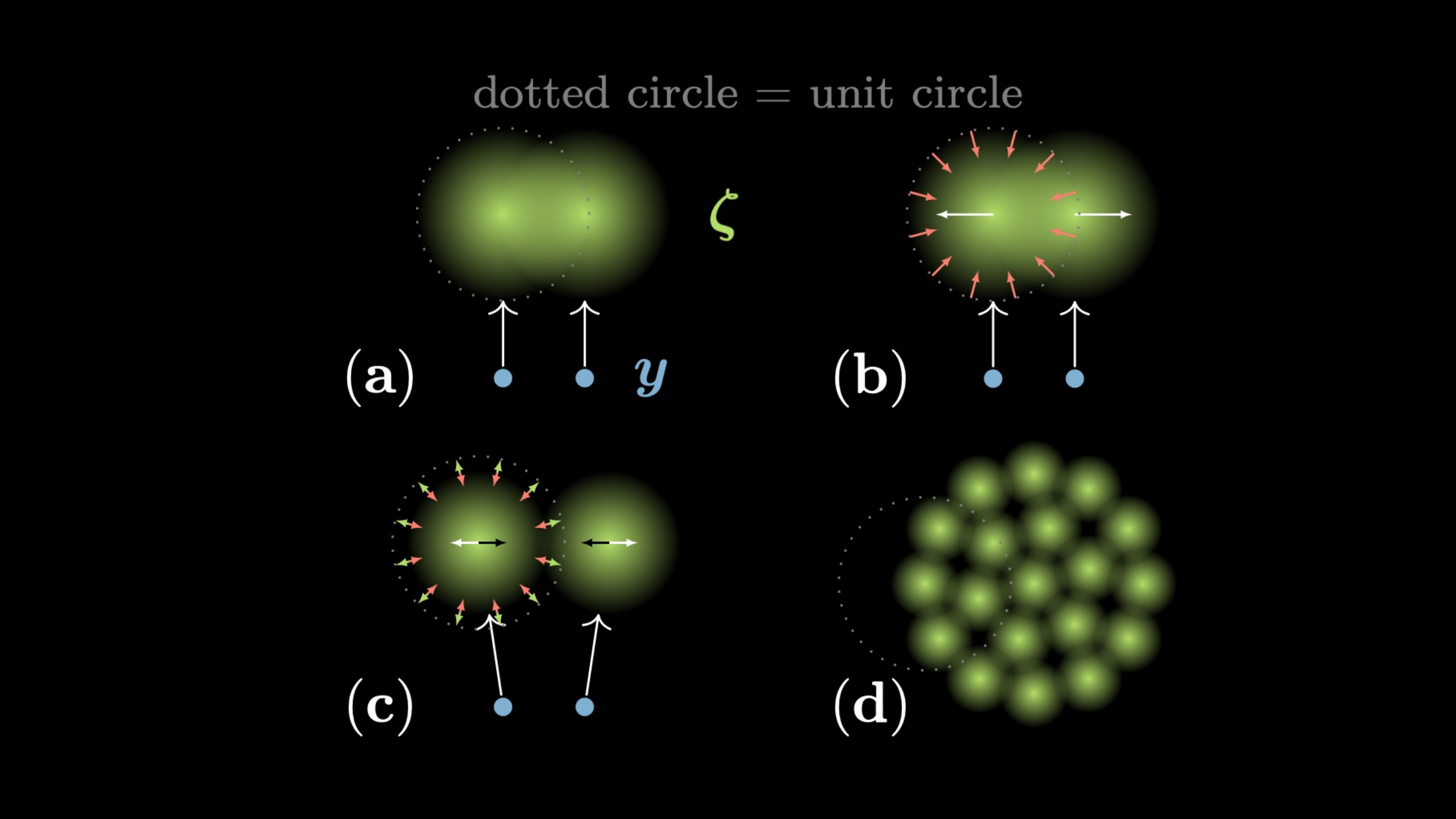
Variational AE

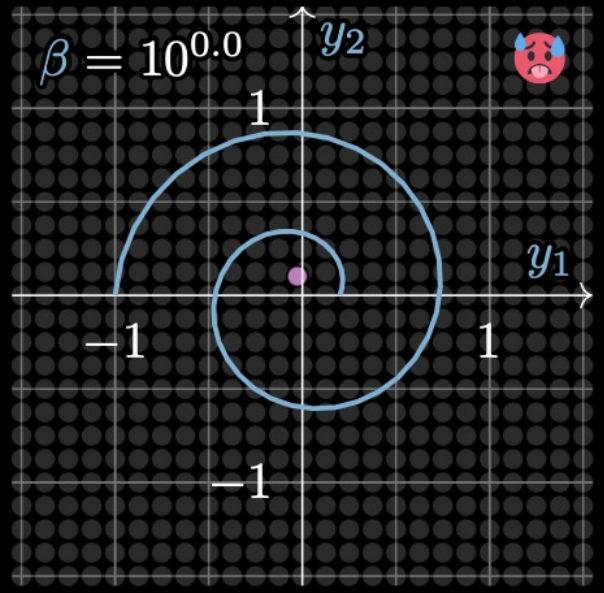


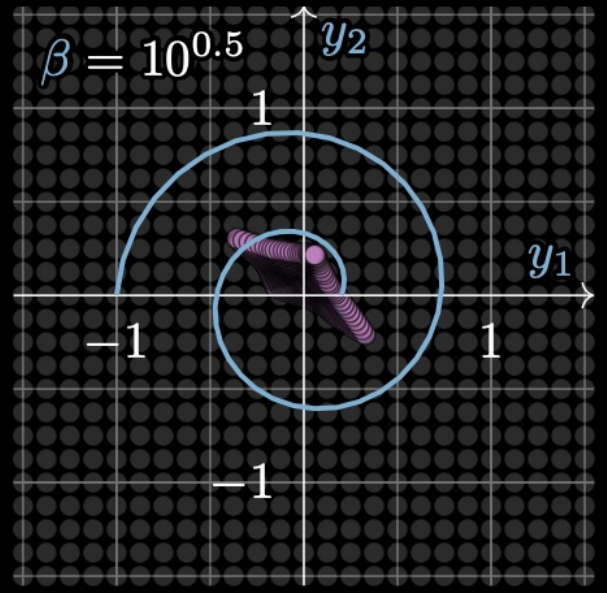
Denoising AE

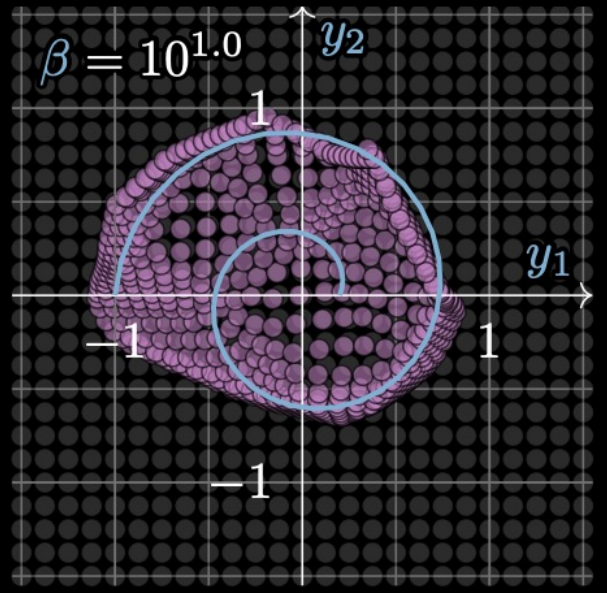


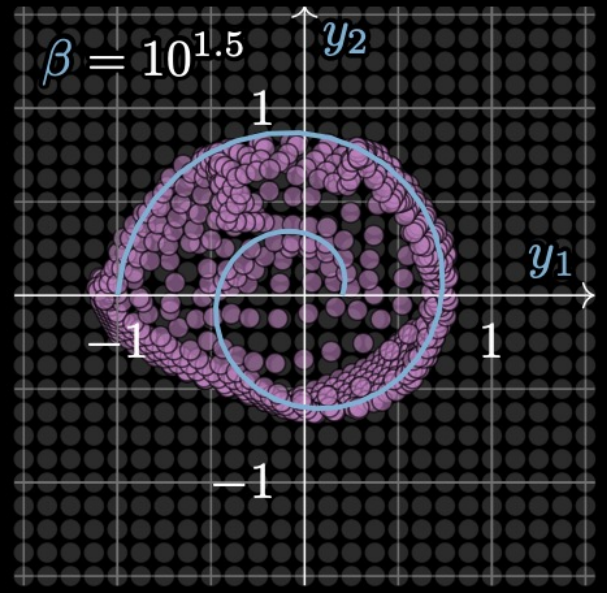
$$P(\boldsymbol{z}) = \tfrac{1}{2}\|\boldsymbol{z}\|^2 \quad D_{\mathrm{KL}}\left[q(\boldsymbol{\zeta} \mid \boldsymbol{y}) \parallel p(\boldsymbol{z})\right] = U(\boldsymbol{\mu}) + S(\boldsymbol{\sigma})$$

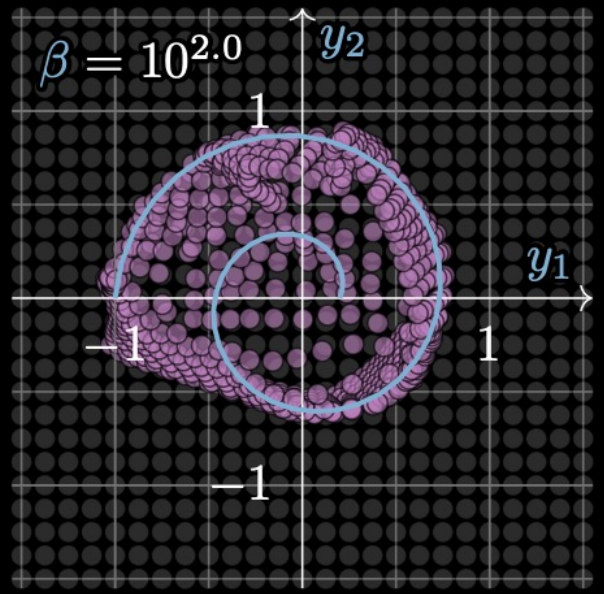

dotted circle = unit circle
ζ
(a)
y
(b)
(c)
(d)

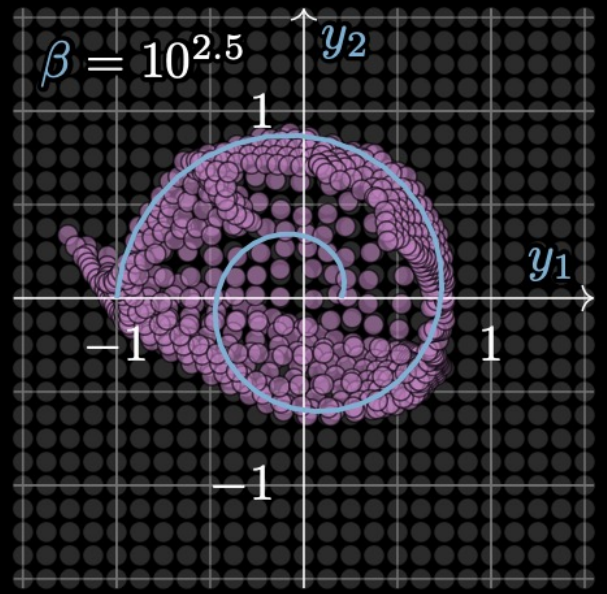


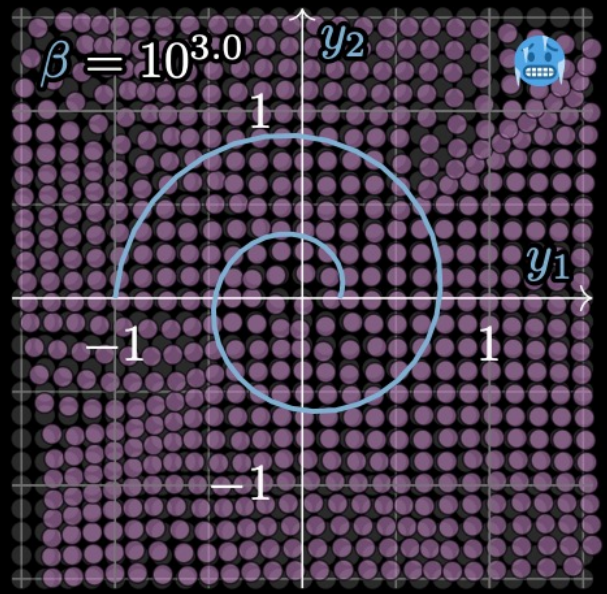








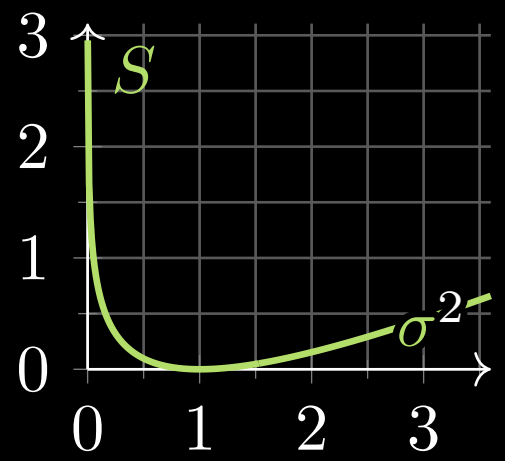


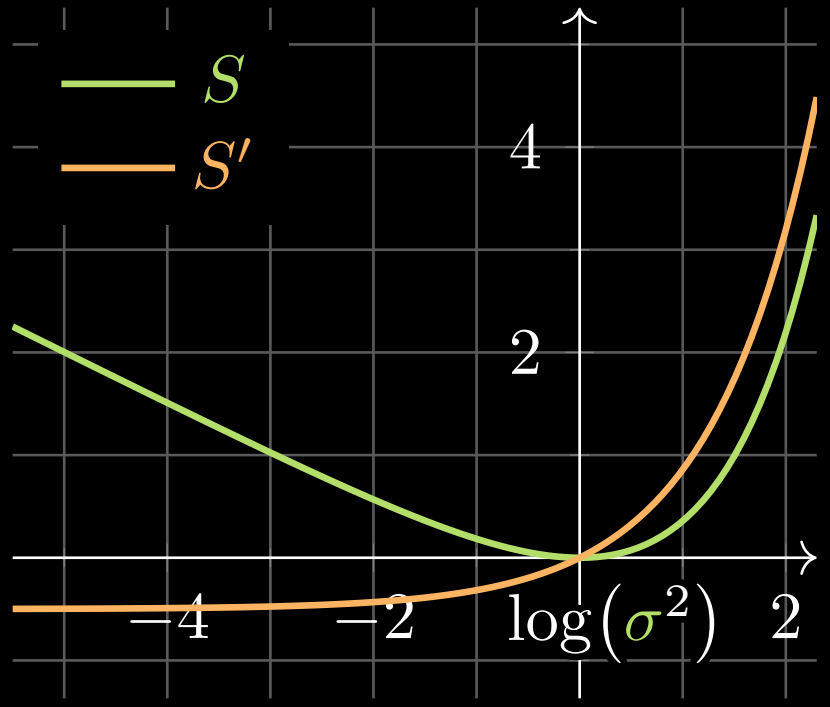


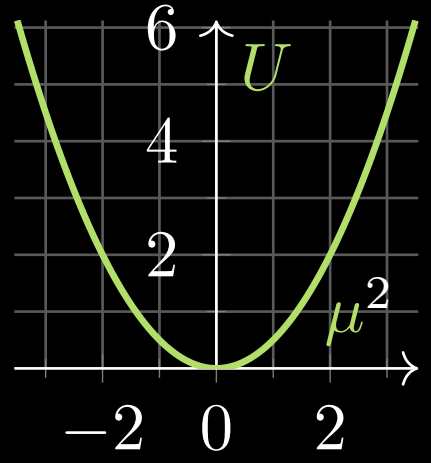
$L\beta$	$\langle C \rangle$	$\langle U \rangle$	$\langle S \rangle$	$-\langle V \rangle$
0.0	0.405	0.000	0.000	0.00
0.5	0.365	0.117	0.003	0.28
1.0	0.096	0.770	0.647	2.87
1.5	0.028	0.946	1.496	4.94
2.0	0.010	1.033	2.322	6.79
2.5	0.004	1.100	3.220	8.77
3.0	0.002	1.179	4.740	12.00

$$L(\boldsymbol{w}, \boldsymbol{y}) = C(\boldsymbol{y}, \tilde{\boldsymbol{y}}) + \frac{1}{\beta}\Big(S\big[\boldsymbol{\sigma}(\boldsymbol{y})\big] + U\big[\boldsymbol{\mu}(\boldsymbol{y})\big]\Big)$$

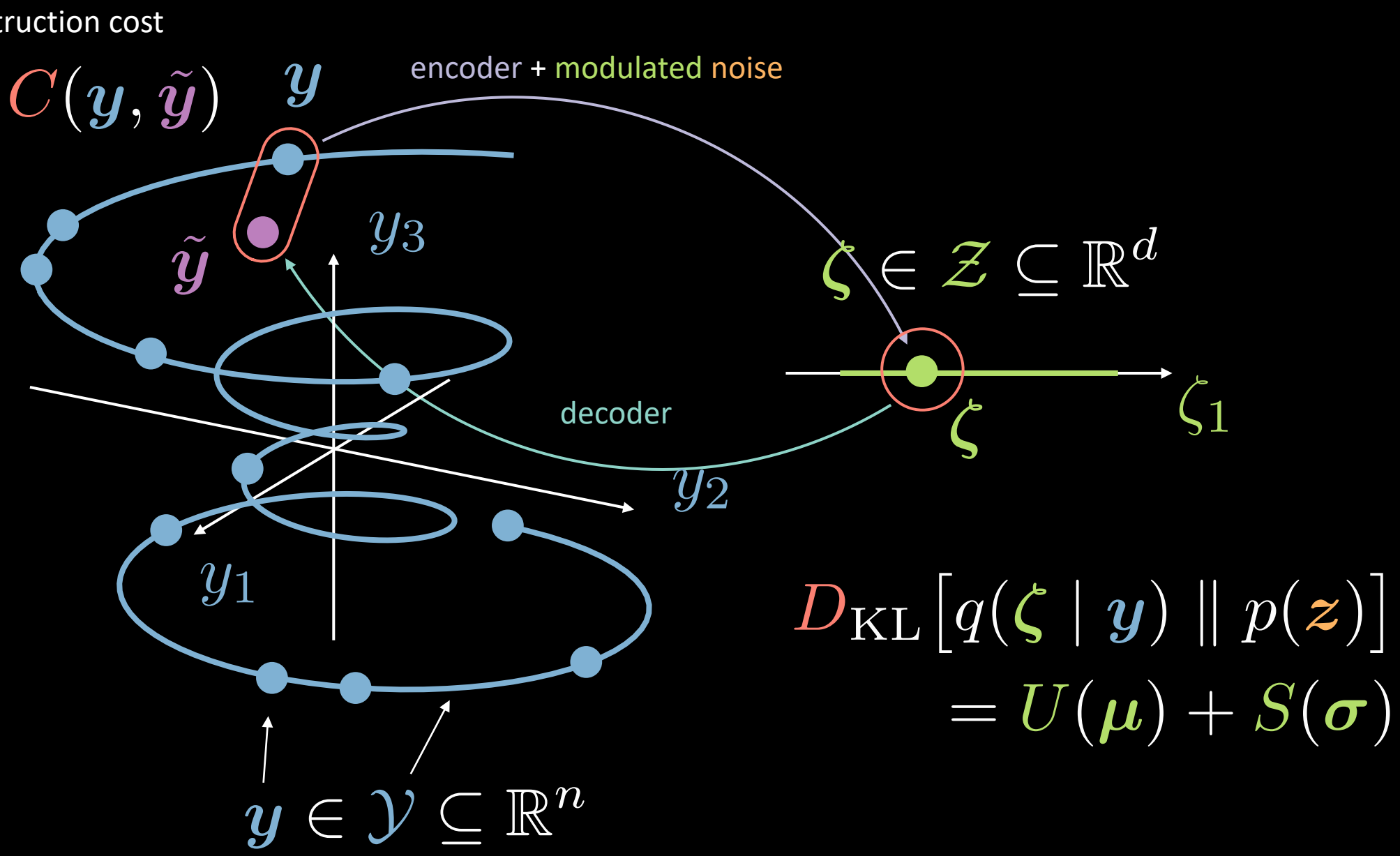
$$S(\boldsymbol{\sigma}) \doteq \frac{1}{2}\sum_{d=1}^{D} \sigma_d^2 - \log\left(\sigma_d^2\right) - 1, \quad U(\boldsymbol{\mu}) \doteq \frac{1}{2}\sum_{d=1}^{D} \mu_d^2$$







Variational autoencoder illustration



$$D_{\mathrm{KL}}\left[q(\boldsymbol{\zeta} \mid \boldsymbol{y}) \parallel p(\boldsymbol{z})\right] = U(\boldsymbol{\mu}) + S(\boldsymbol{\sigma})$$