Variational Canonical Correlation Analysis

Week 1

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Deep Variational Canonical Correlation Analysis[1]

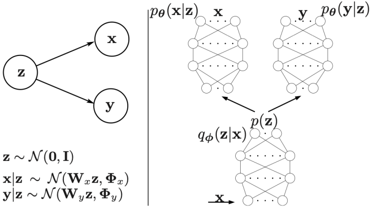
Challenge: it is hard to satisfy the constraints set by Deep Canonical
Solution: extends the latent variable interpretation to nonlinear observation models.

DCCA:

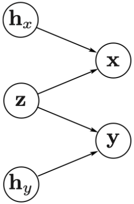
$$\max_{f,g,U,V} \operatorname{tr}(U^\top f(X) g(Y)^\top V)$$

$$\text{s.t.} \quad U^\top (f(X) f(X)^\top) U = V^\top (g(Y) g(Y)^\top) V = N \cdot I.$$

Probalistic CCA vs VCCA:



VCCA-private: the challenge is that large variations in the input space can not be explained by **z**.



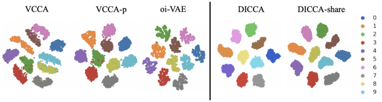
Results: outstanding performance with reduced training efforts.

[1] Wang W. et. al, Deep Variational Canonical Correlation Analysis, 2017

Variational Interpretable Deep Canonical Correlation Analysis[2]

Challenge: it is challenging to build an interpretable model understanding.
Solution: interpretable sparsity prior.
Sparsity prior

$$
\begin{aligned}
&Z \sim N(0, I),\ Z^m \sim N(0, I),\\
&X^m \sim N(f_m(\Lambda^m Z + W^m Z^m), \Psi^m)\\
&\gamma_{mj}^2 \sim \Gamma((d_m+1)/2, \lambda^2/2)\\
&\Lambda_{\cdot,j}^{(m)}, W_{\cdot,j}^{(m)} \sim N(0, \gamma_{mj}^2 I)
\end{aligned}
$$



The learned features of the images are well separated.

Method	View 1 MSE (STD)	View 2 MSE (STD)
oi-VAE	0.059 (0.009)	0.172 (0.009)
DPCCA	0.052 (0.012)	0.134 (0.003)
VCCA	0.023 (0.011)	0.088 (0.0042)
VCCA-p	0.024 (0.011)	0.084 (0.005)
DICCA (Ours)	**0.016 (0.005)**	**0.080 (0.005)**

The proposed method outperforms all existing baselines.

[2] Qui L. et. al, Variational Interpretable Deep Canonical Correlation Analysis, 2022