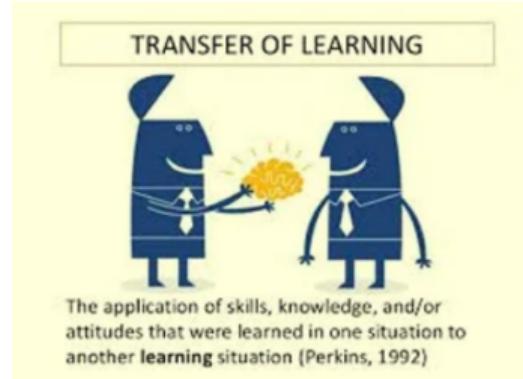


Передача информации

Московский Физико-Технический Институт

2022

Transfer learning



Родственные задачи

- Knowledge distillation
- Multidomain adaptation/learning
- Transfer learning
- Multiview learning
- Multimodal learning

Dataset shift

Dataset shift — явление, при котором распределение данных $p(\mathbf{X}, \mathbf{y})$ различается на этапе обучения и этапе контроля.

- Covariate shift — различие в $p(\mathbf{X})$
- Prior probability shift — различие в $p(\mathbf{y})$
- Concept shift — различие в $p(\mathbf{y}|\mathbf{X})$

Dataset shift

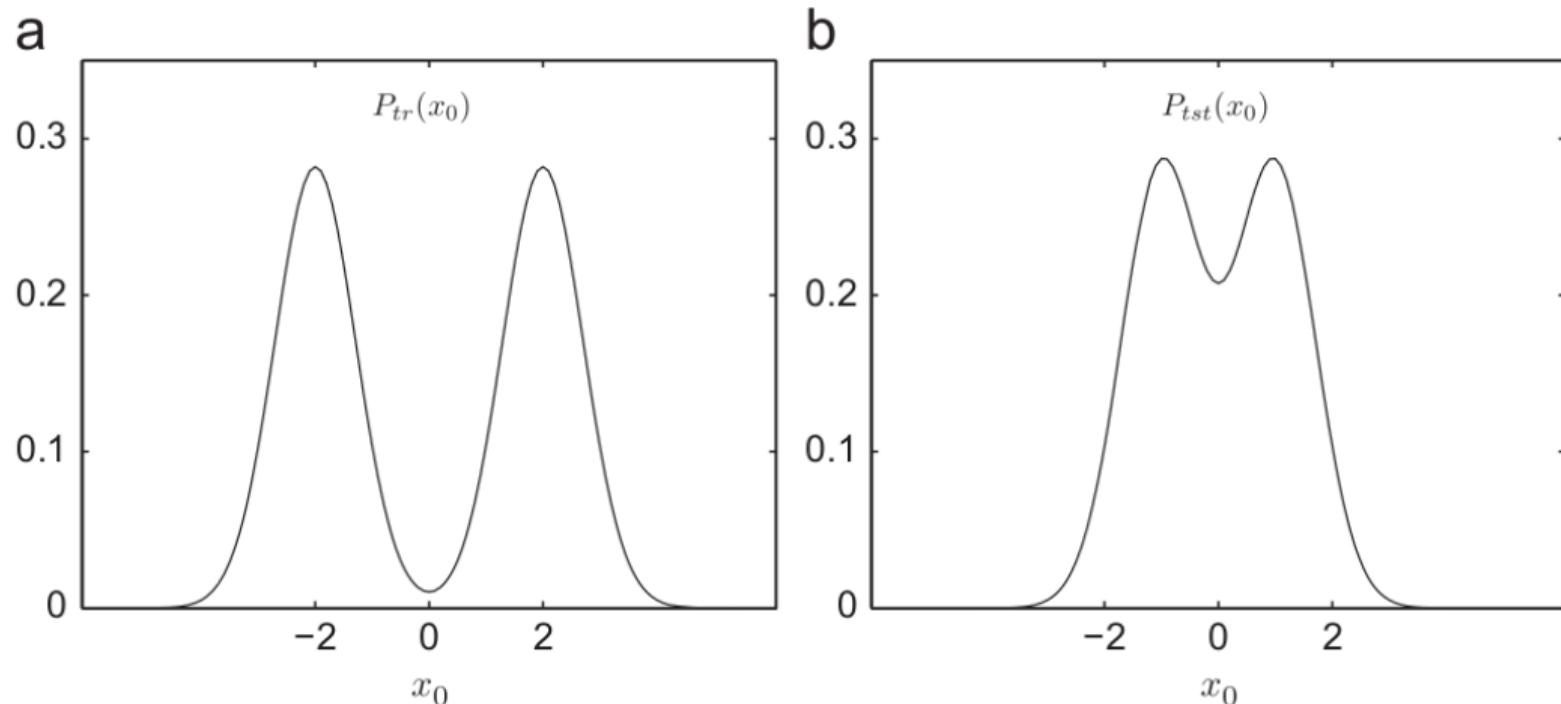
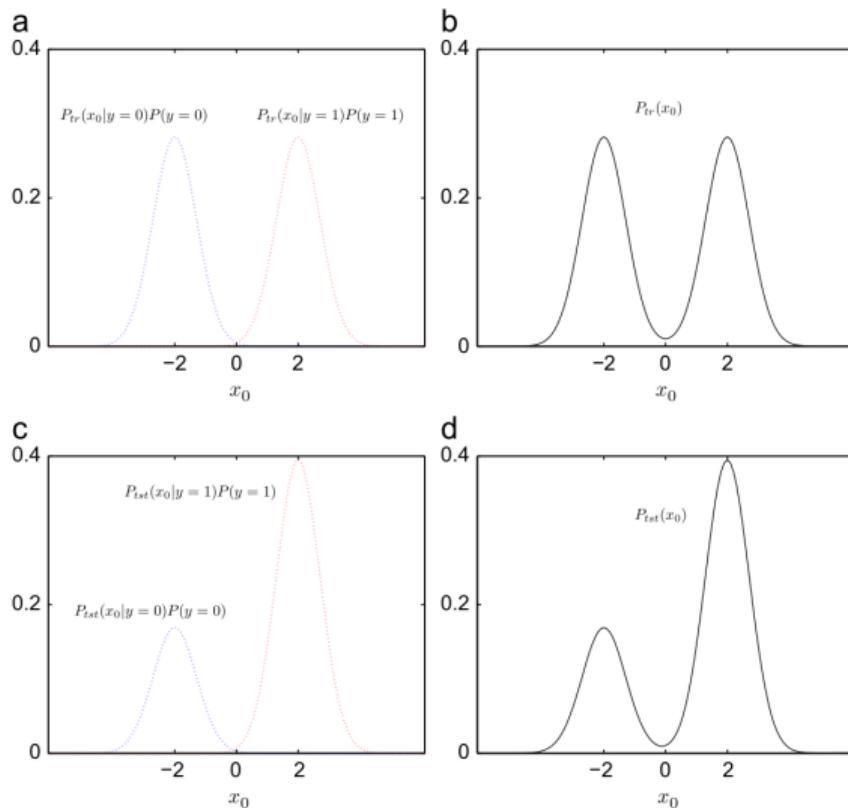


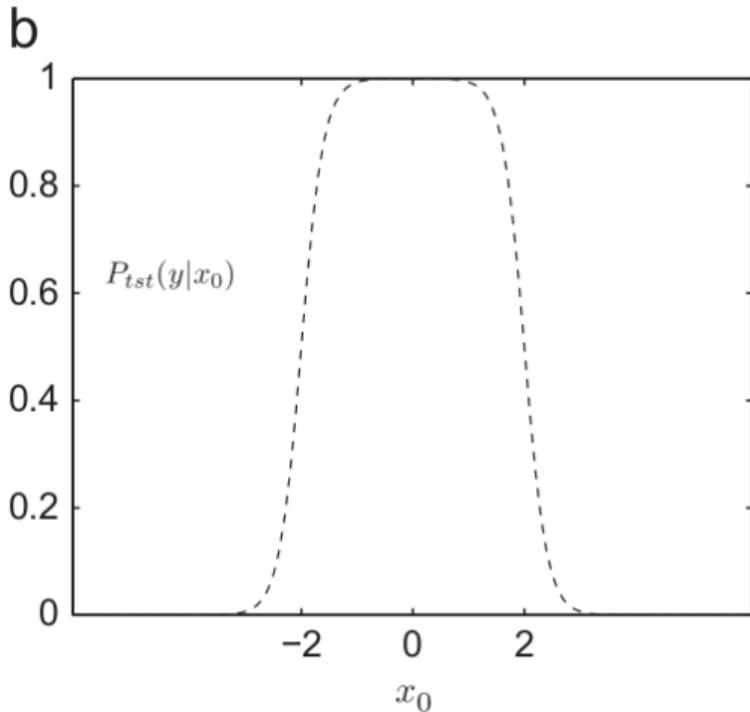
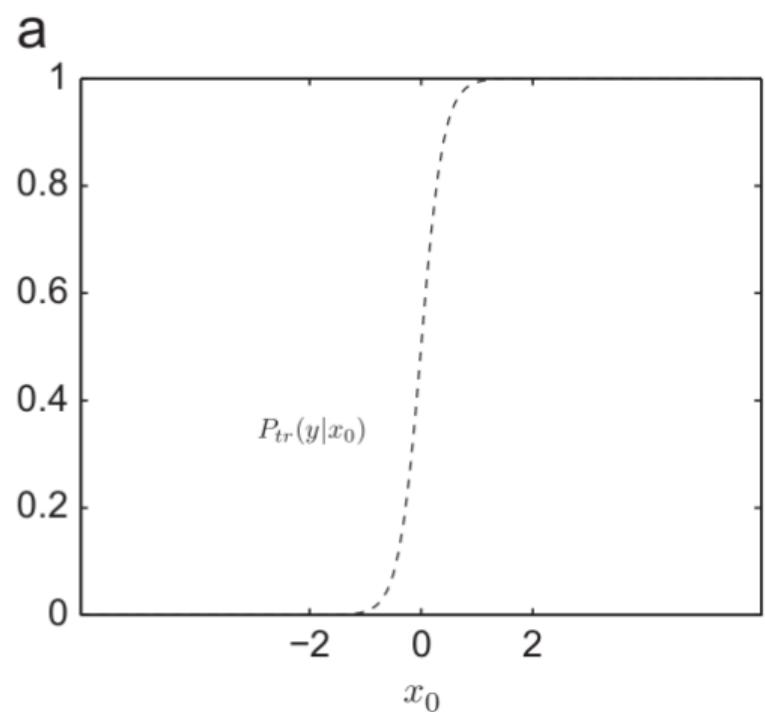
Fig. 1. Covariate shift: $P_{tst}(y|x_0) = P_{tr}(y|x_0)$ and $P_{tr}(x_0) \neq P_{tst}(x_0)$. (a) Training data and (b) test data.

Dataset shift



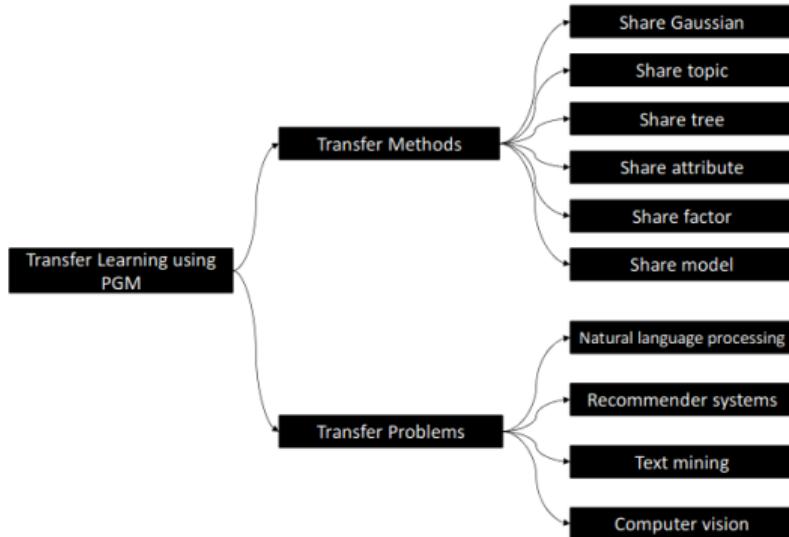
Moreno-Torres et al., 2012

Dataset shift

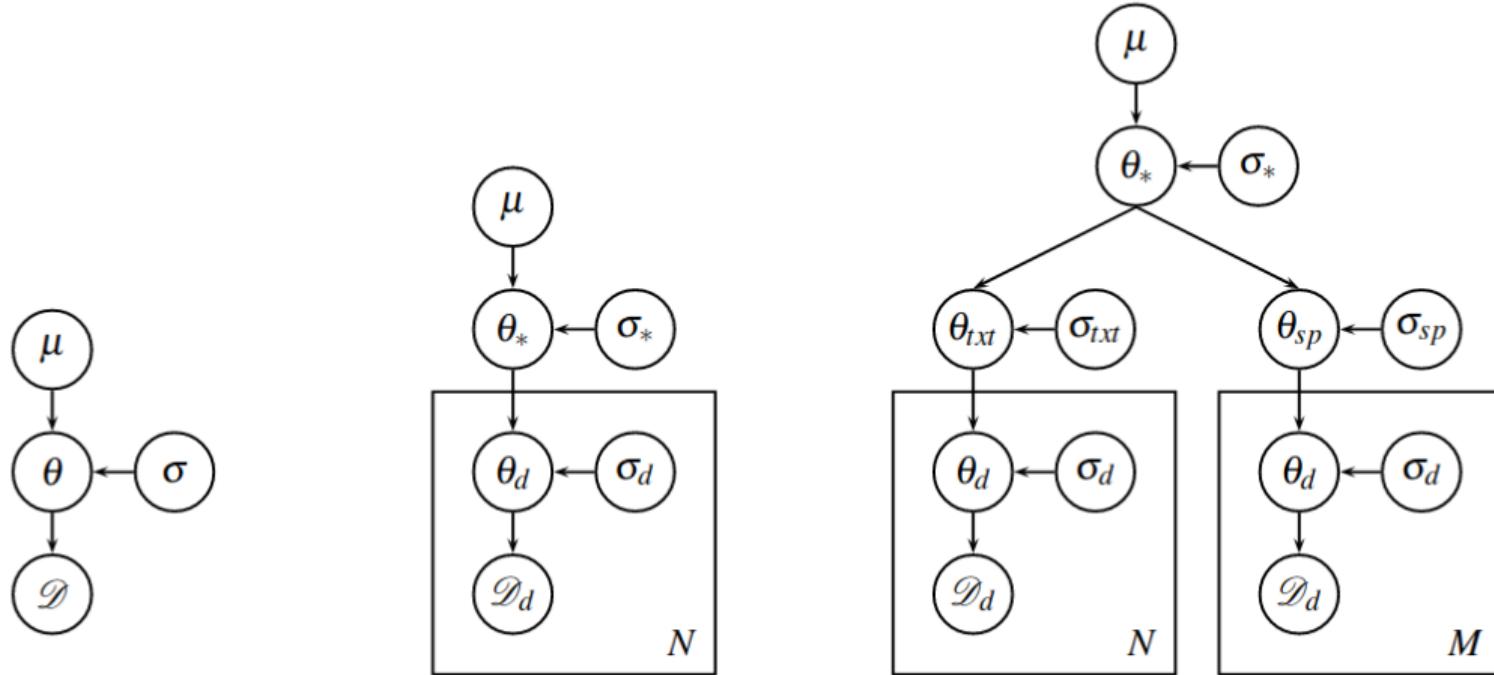


Moreno-Torres et al., 2012

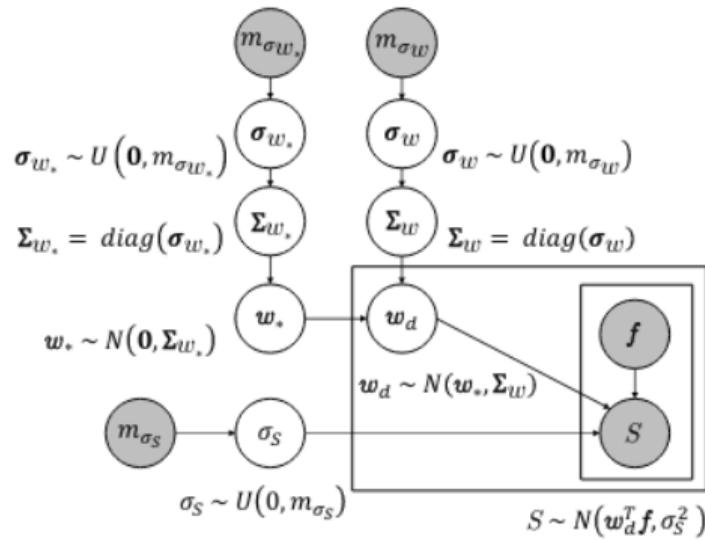
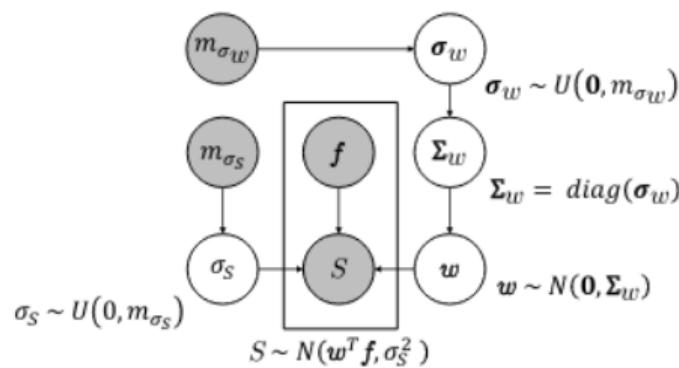
Transfer learning: основные методы



Share prior: Hierarchical Bayesian Domain Adaptation



Share prior: Bayesian Supervised Domain Adaptation for Short Text Similarity



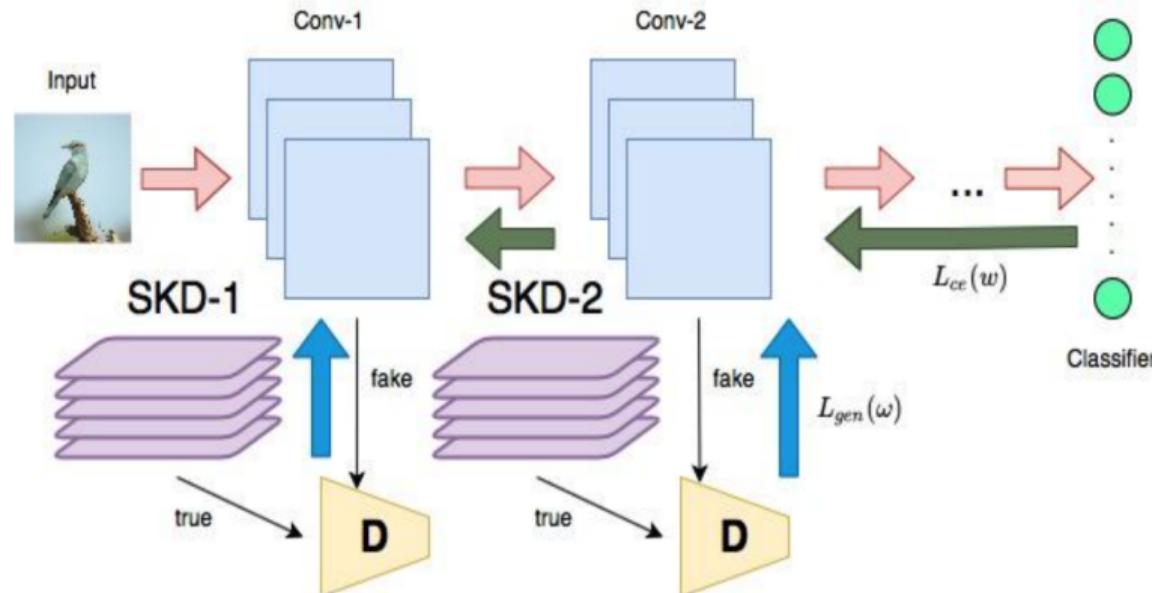
Transfer learning: наивные методы

- Hinton et al., 2007: используем сеть учитель как инициализацию сети-студента
- Li et al., 2019:

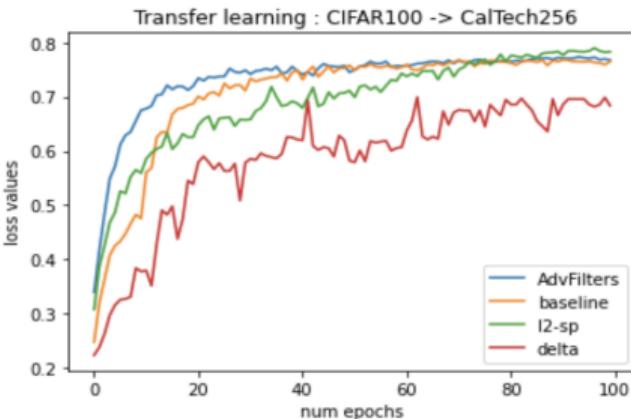
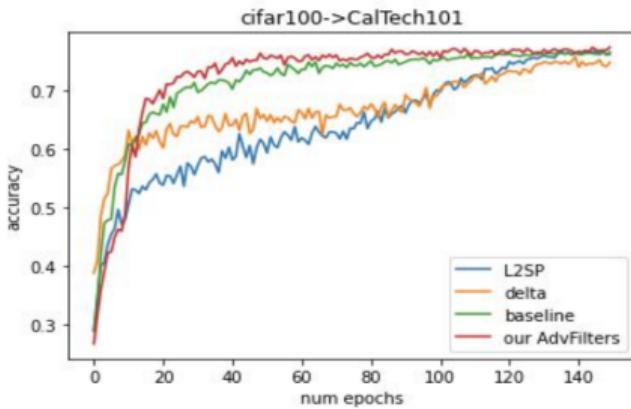
$$L = \log p(\mathbf{y}|\mathbf{X}, \mathbf{w}) + \lambda \|\mathbf{w} - \mathbf{w}^{\text{teacher}}\|_2^2.$$

Адверсариальный перенос информации, (Колесов, 2022)

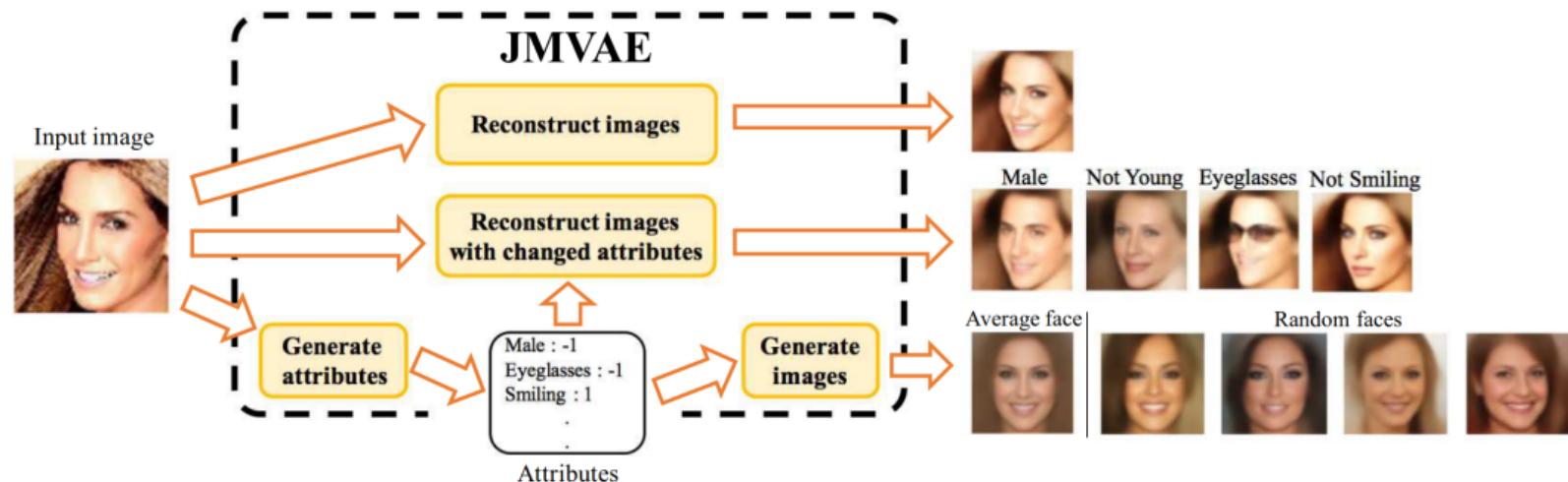
$$\mathcal{L}_{dis}^j(\theta) = -\frac{1}{2} \underbrace{\mathbb{E}_{w \sim p_{fake}} \log(1 - D_j(w, \theta))}_{\text{net-generated weights are fake}} - \frac{1}{2} \underbrace{\mathbb{E}_{w \sim p_{true}} \log D_j(w; \theta)}_{\text{SKD filters are real}}$$



Адверсариальный перенос информации, (Колесов, 2022)

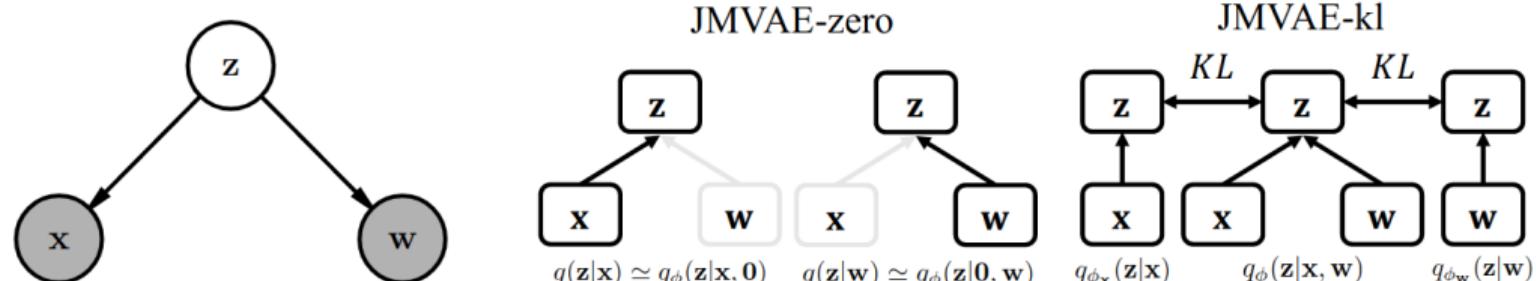


Share topic: Joint multimodal learning with deep generative models

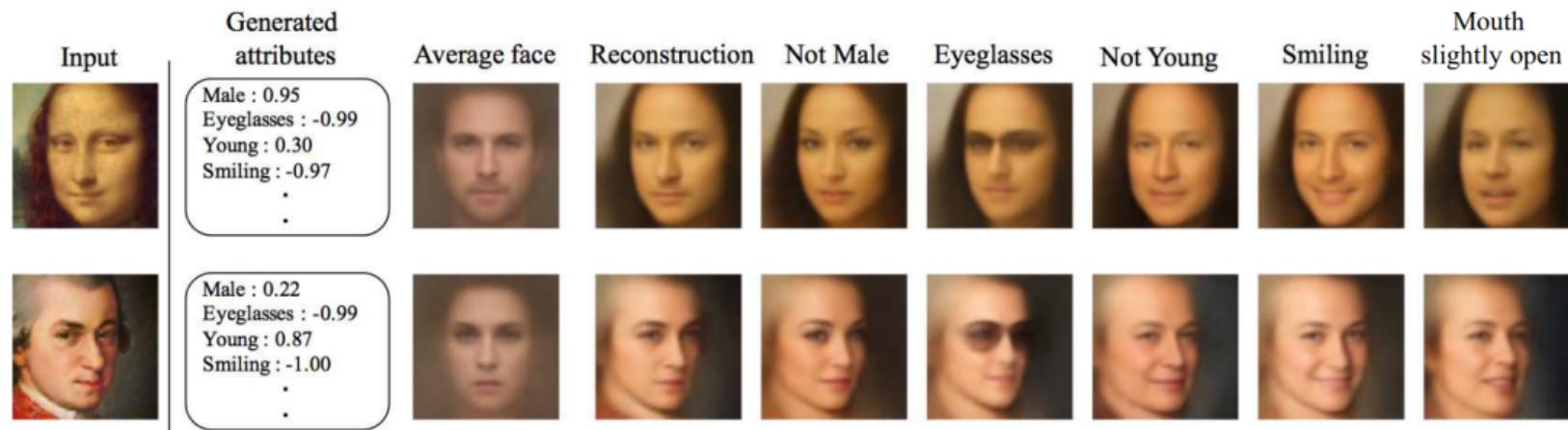


Joint multimodal learning with deep generative models

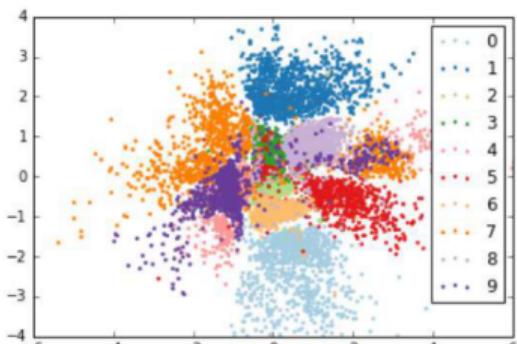
$$\begin{aligned}\mathcal{L}_{JM}(\mathbf{x}, \mathbf{w}) &= E_{q_\phi(\mathbf{z}|\mathbf{x}, \mathbf{w})}[\log \frac{p_\theta(\mathbf{x}, \mathbf{w}, \mathbf{z})}{q_\phi(\mathbf{z}|\mathbf{x}, \mathbf{w})}] \\ &= -D_{KL}(q_\phi(\mathbf{z}|\mathbf{x}, \mathbf{w}) || p(\mathbf{z})) \\ &\quad + E_{q_\phi(\mathbf{z}|\mathbf{x}, \mathbf{w})}[\log p_{\theta_x}(\mathbf{x}|\mathbf{z})] + E_{q_\phi(\mathbf{z}|\mathbf{x}, \mathbf{w})}[\log p_{\theta_w}(\mathbf{w}|\mathbf{z})].\end{aligned}$$



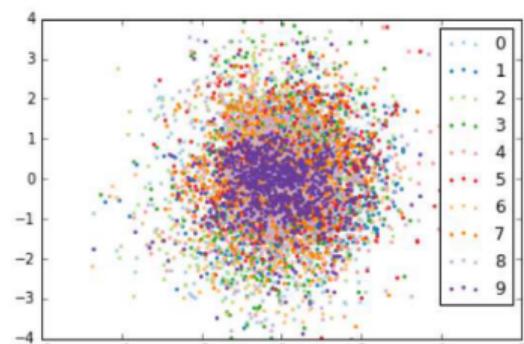
Joint multimodal learning with deep generative models



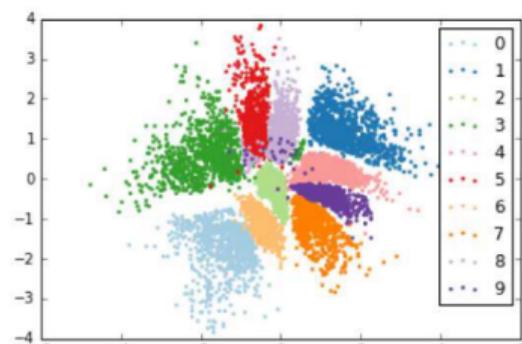
Joint multimodal learning with deep generative models



(a) VAE

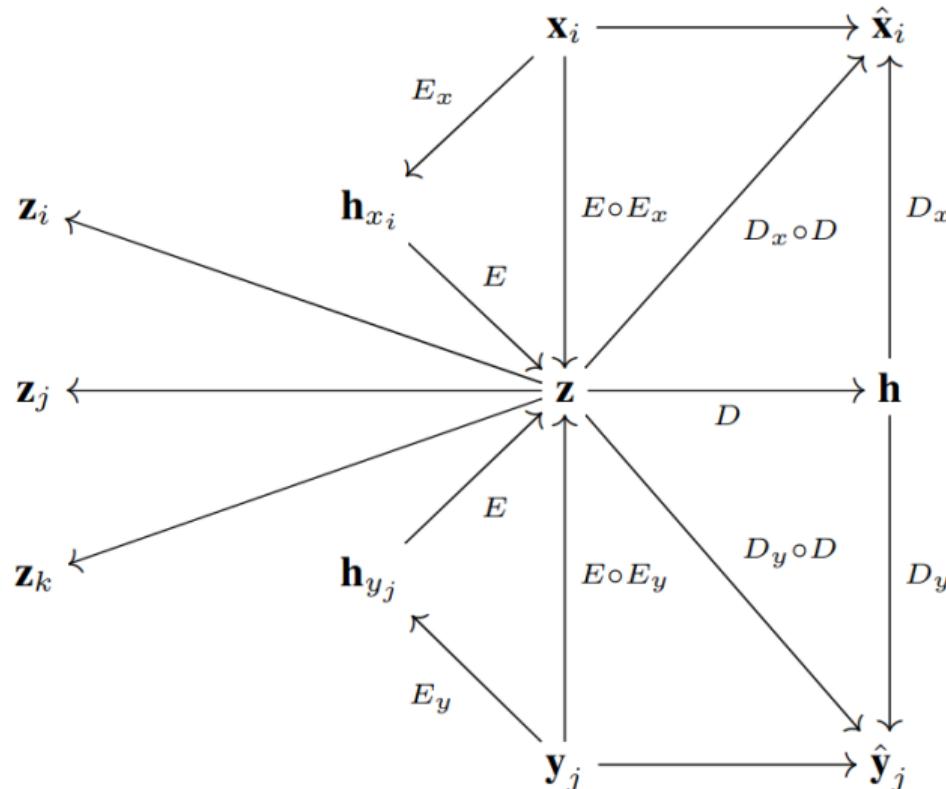


(b) CVAE

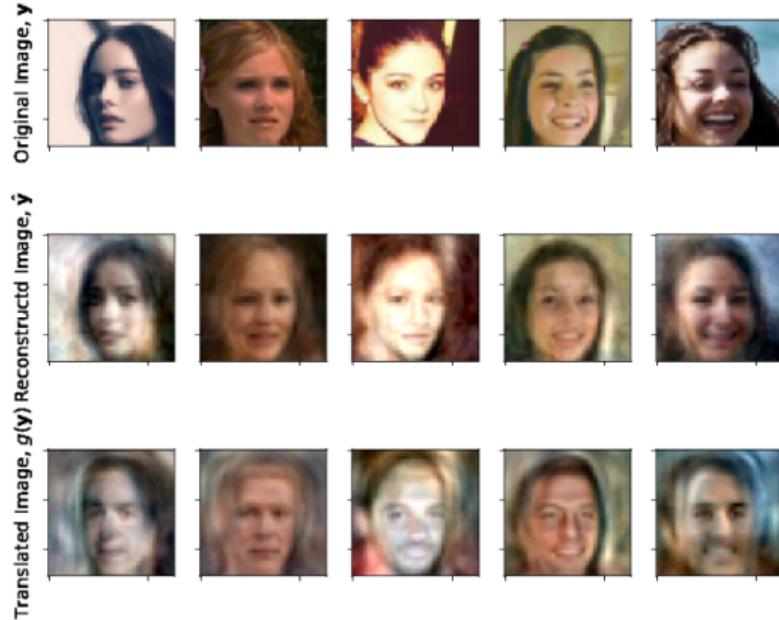
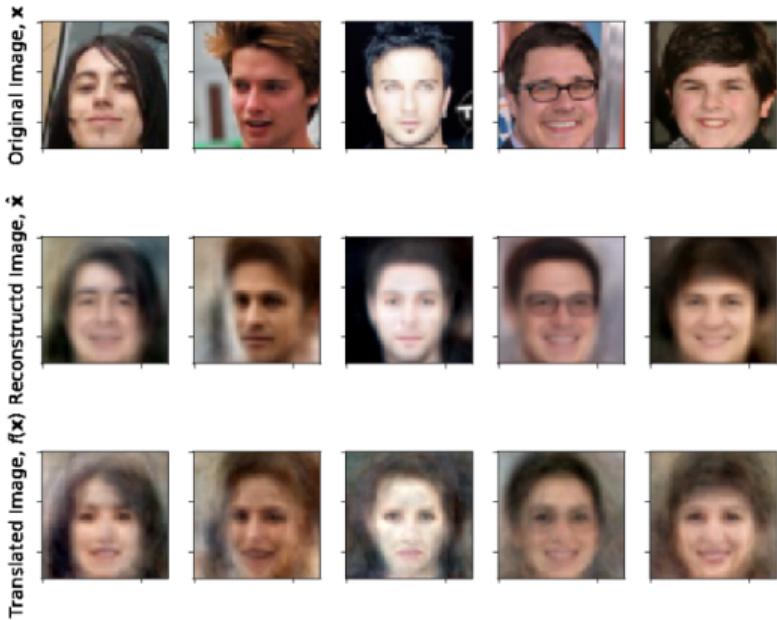


(c) JMVAE

Share topic: Variational learning across domains with triplet information



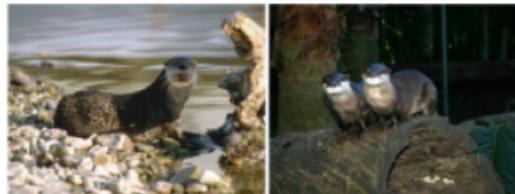
Share topic: Variational learning across domains with triplet information



Share attributes: Learning To Detect Unseen Object Classes by Between-Class Attribute Transfer

otter

```
black: yes  
white: no  
brown: yes  
stripes: no  
water: yes  
eats fish: yes
```



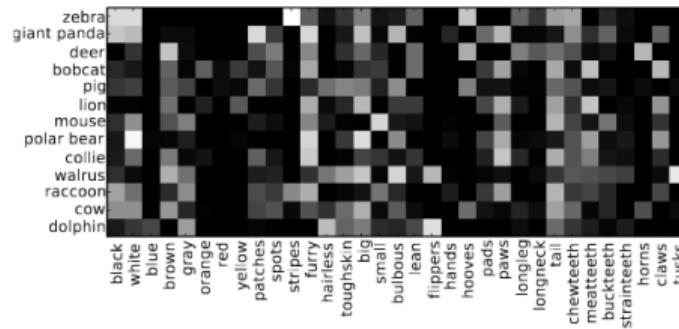
polar bear

```
black: no  
white: yes  
brown: no  
stripes: no  
water: yes  
eats fish: yes
```

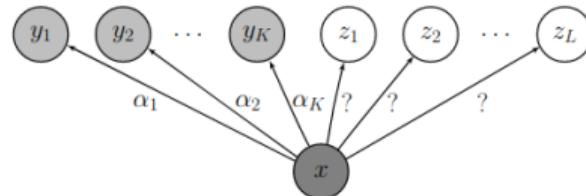


zebra

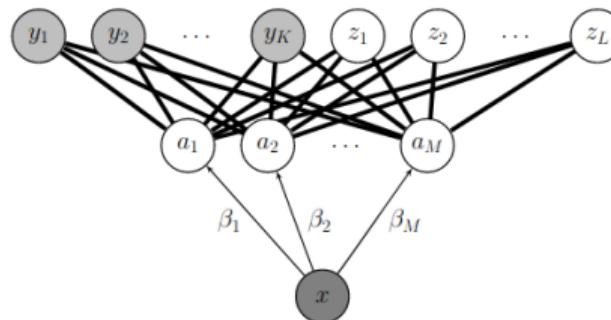
```
black: yes  
white: yes  
brown: no  
stripes: yes  
water: no  
eats fish: no
```



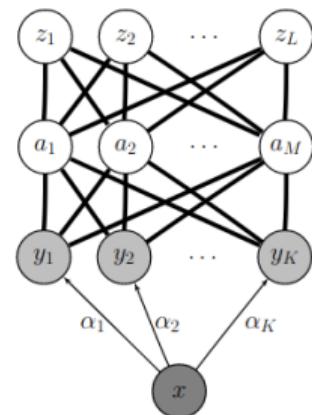
Share attributes: Learning To Detect Unseen Object Classes by Between-Class Attribute Transfer



(a) Flat multi-class classification

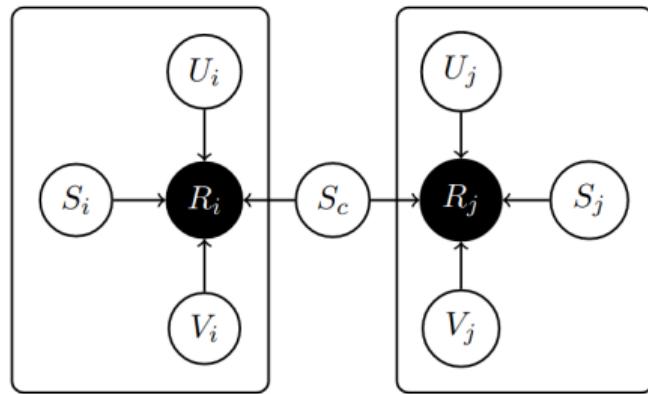
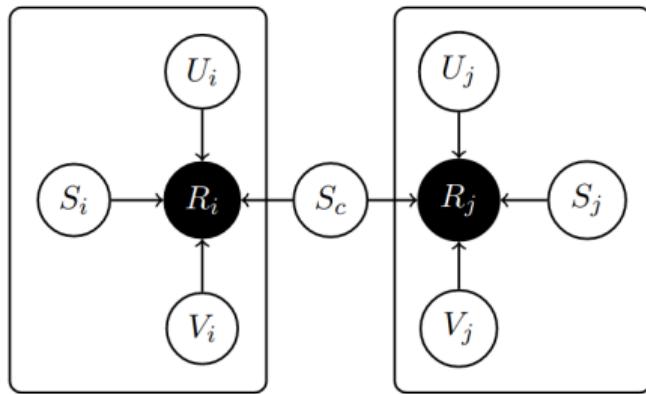


(b) Direct attribute prediction (DAP)

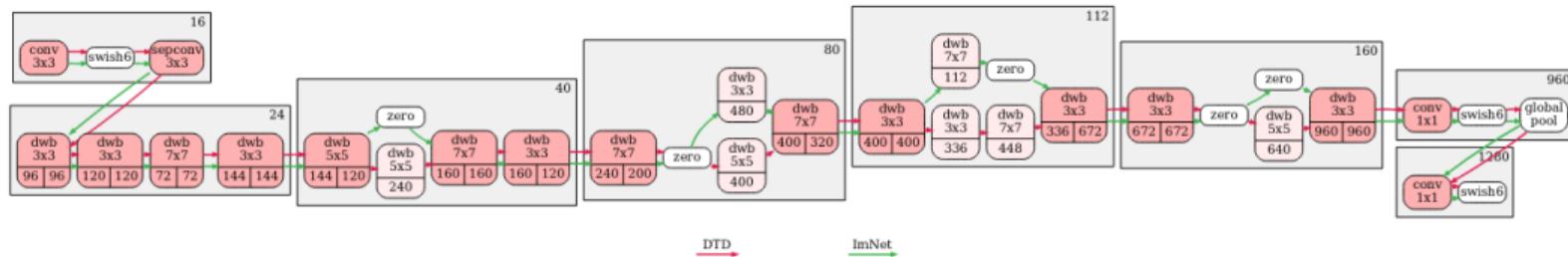


(c) Indirect attribute prediction (IAP)

Share factors



Share models



DTD

ImNet

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