Deep Neural Networks

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Motivace

Motivace I

Komplexita

Složité problémy vyžadují složitá řešení.

Motivace II

Efektivita

Hluboké struktury mohou být reprezentačně efektivnější.

Motivace III

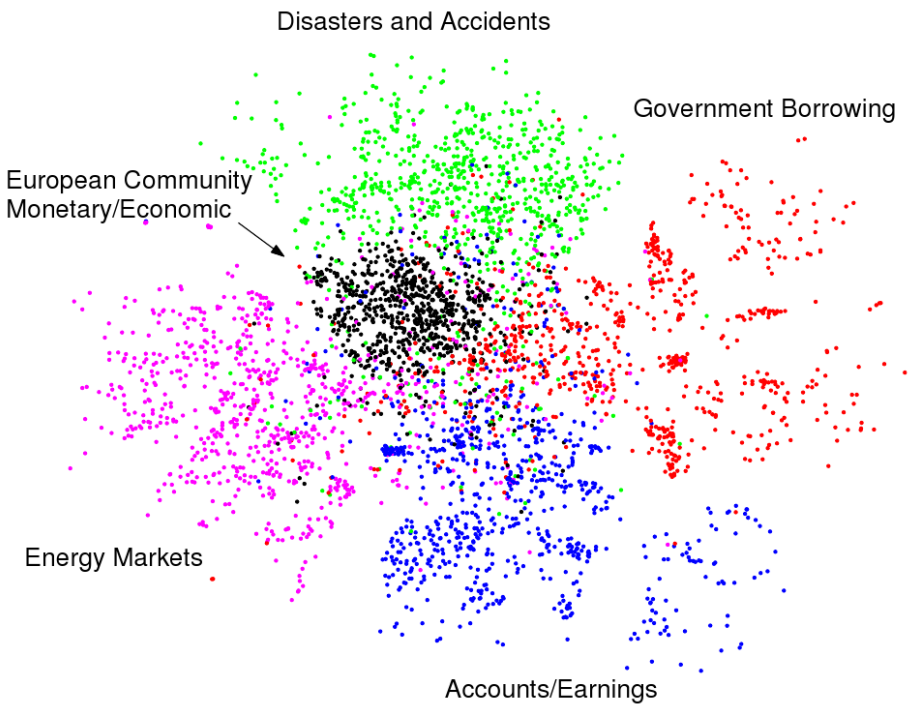
Obtížnost

Nastavení parametrů rozsáhlých modelů je obtížné.

Modely

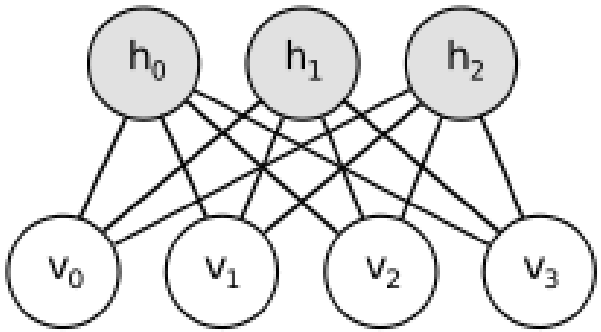
Postup

Data → hustota dat → generativní model → klasifikátor.



(Restricted) Boltzmann Machine

- Asociativní paměť
- Stochastický model



Pravděpodobnost excitace neuronu:

$$p(x_i^{t+1} = 1) = \frac{1}{1 + e^{-b_i - \sum_j w_{ij} x_j^t}} \tag{1}$$

Energie:

$$E(v, h) = -\sum_i b_i v_i - \sum_j c_j h_j - \sum_{i,j} v_i h_j w_{ij} \tag{2}$$

RBM – učení

Máme:

$$p(v,h) = \frac{e^{-E(v,h)}}{\sum_{v',h'} e^{-E(v',h')}} \tag{3}$$

Chceme:

$$p(v) = p_{train}(v) \tag{4}$$

Uděláme:

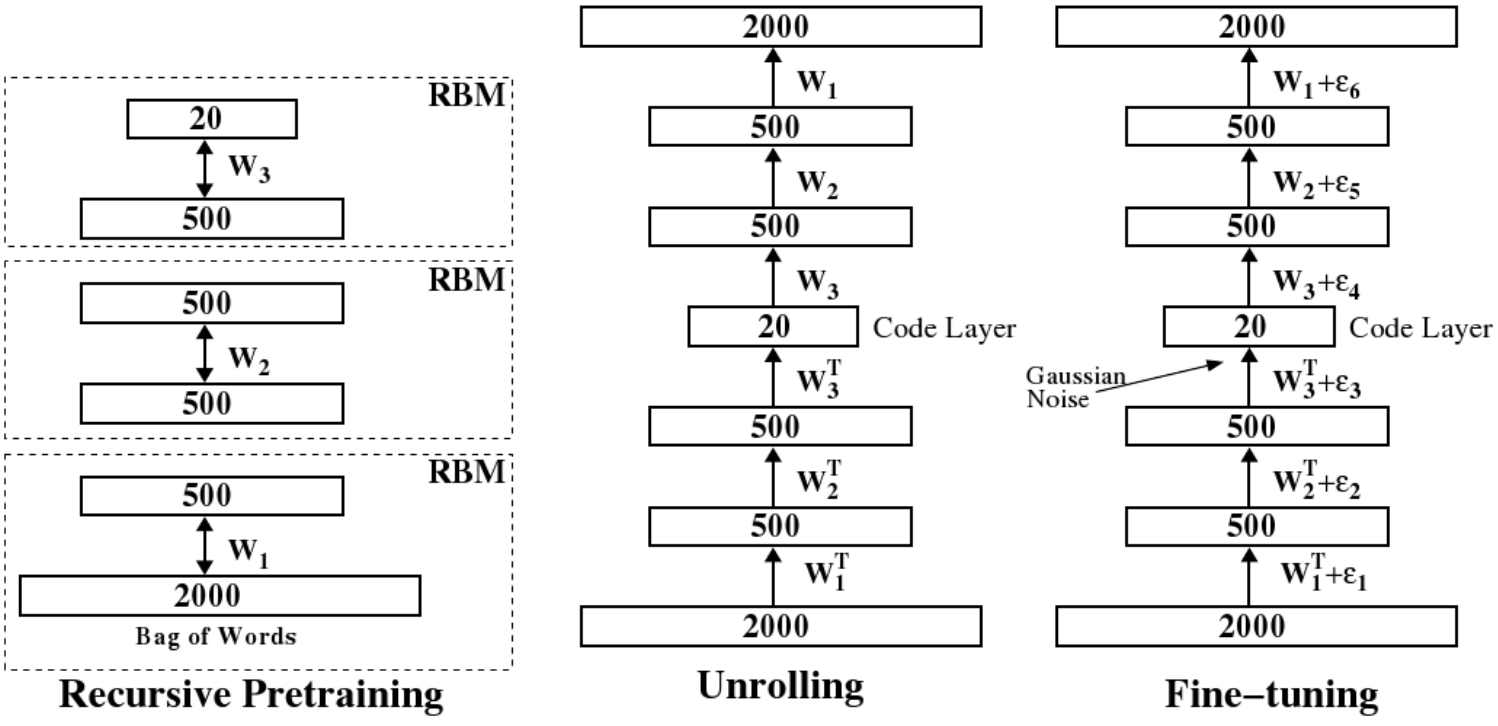
$$\frac{\partial log\ p(x)}{\partial w_{ij}} = v_i^0 h_j^0 - v_i^\infty h_j^\infty \tag{5}$$

$$\approx v_i^0 h_j^0 - v_i^n h_j^n \tag{6}$$

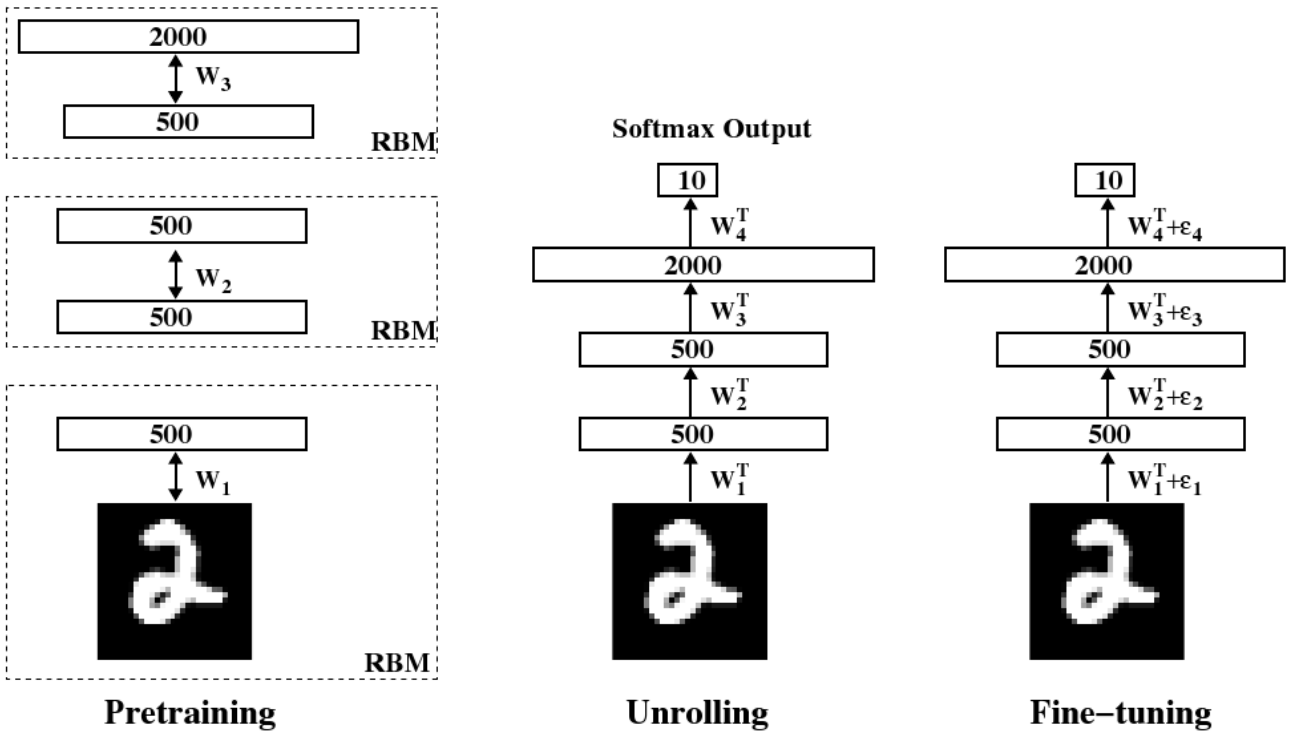
$$\approx v_i^0 h_j^0 - v_i^1 h_j^1 \tag{7}$$

$$w_{ij}^{t+1} = w_{ij}^t + \alpha \frac{\partial log\ p(x)}{\partial w_{ij}} \tag{8}$$

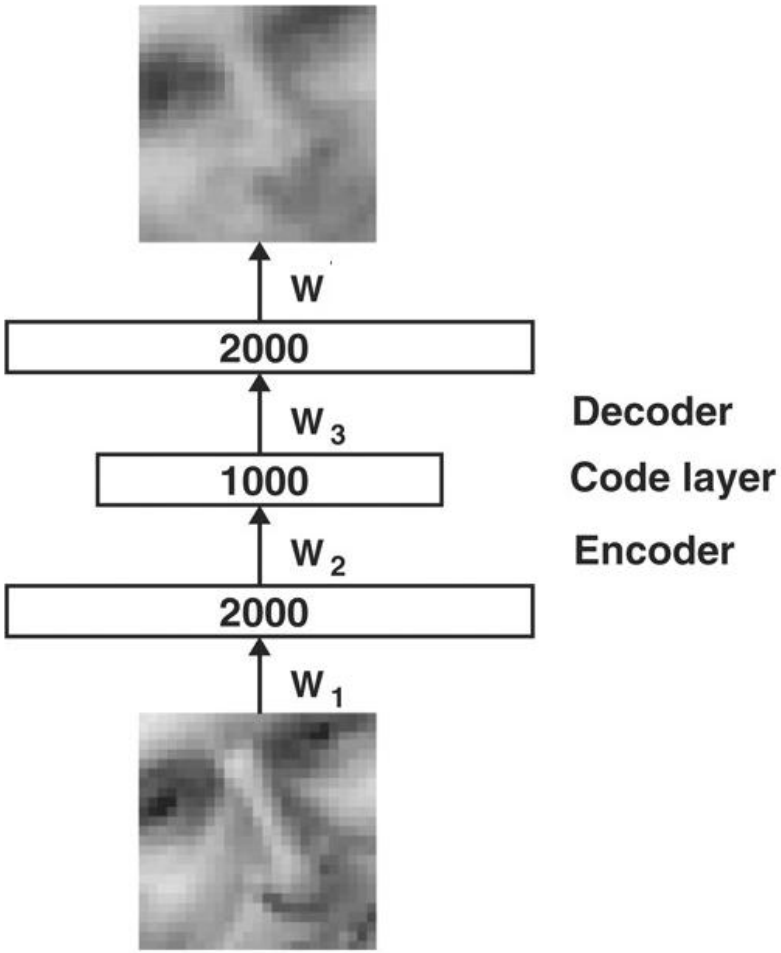
Deep Belief Networks – Architektura, činnost, učení



Deep Belief Networks – Architektura, činnost, učení



(Denoising) Autoencoders



Stacked (Denoising) Autoencoders – Architektura, činnost, učení

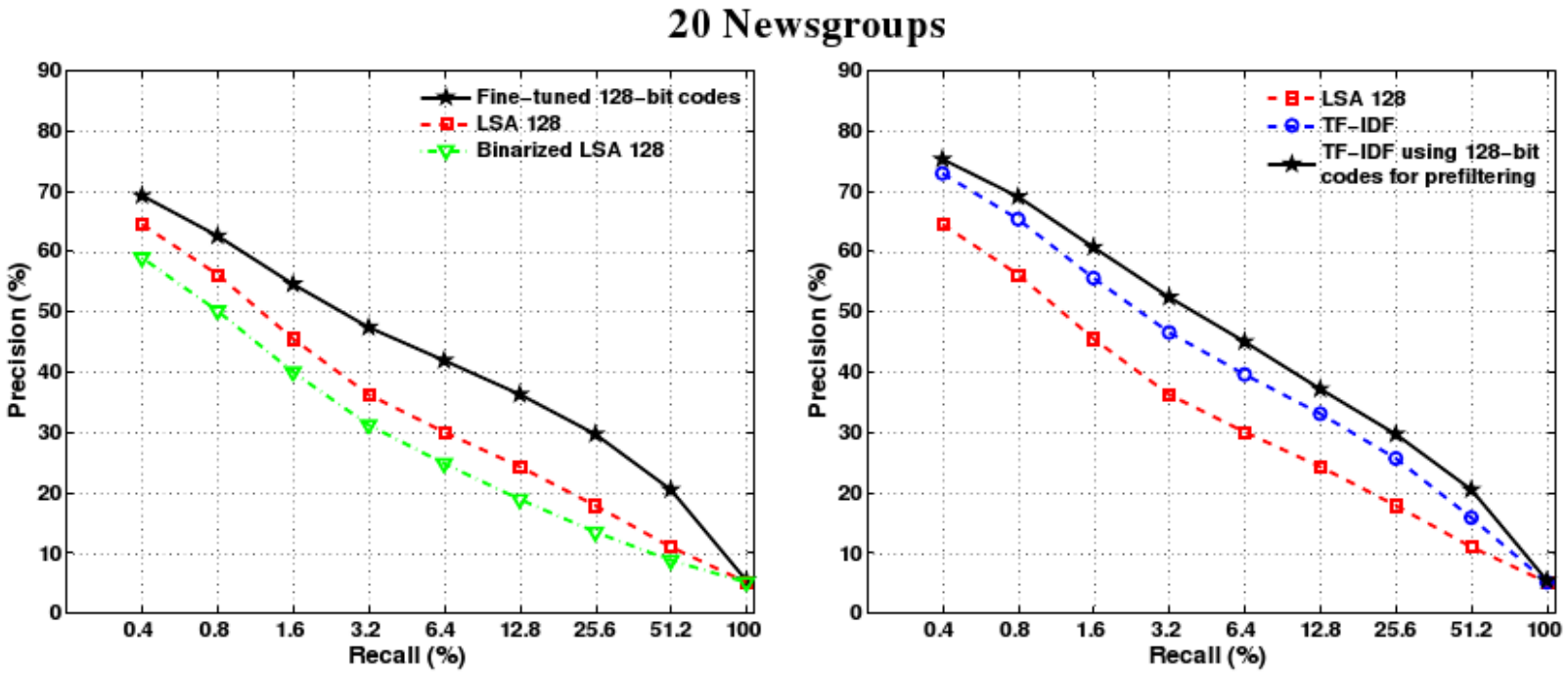
Čtenář snadno nahlédne.

Experimenty

Rozpoznávání čísel

- MNIST (60 000 + 10 000)
- Architektura DBN: 784-2500-2000-1500-1000-500-10 (11 965 000 vah)
- Chyba:
  - DBN: 0.35 %
  - conv. SAE: 0.39 % (50 – 50 – 200 – 10)
  - SVM: 0.54 %
  - Backprop: 1.6 % (300 HU)
  - KNN (L2): 3.09 %
  - KNN (P2DHMDM): 0.52 %

Sématické hashování



Architektura DBN: 2000 – 500 – 500 – 128

Zdroje I

- `http://deeplearning.net`
- `http://yann.lecun.com/exdb/mnist/`
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- D. C. Ciresan, U. Meier, L. M. Gambardella, J. Schmidhuber: Deep Big Simple Neural Nets Excel on Handwritten Digit Recognition; arxiv.org, March 1^{st} 2010, arXiv:1003.0358v1 [cs.NE]
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Zdroje II

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