

Fundamentals of Machine Learning - Assignment 9

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3 Method - Non-negative matrix factorization

$$\begin{aligned}\nabla \|x - wh\|^2 &= \nabla \left((x - wh)^T (x - wh) \right) = \nabla \left((x^T - h^T W^T) (x - wh) \right) = \nabla \left(x^T x - x^T W h - h^T W^T x + h^T W^T W h \right) : \\ &= -W^T x + W^T W h\end{aligned}$$

$$h_\ell - \eta \nabla h_\ell = h_\ell - \frac{h(-W^T x + W^T W h)}{W^T W h_\ell} = \frac{h_\ell W^T W h_\ell + h W^T x - h_\ell W^T W h_\ell}{W^T W h_\ell} = \frac{h W^T (W h_\ell + x - W h_\ell)}{W^T W h_\ell} = \frac{h_\ell W^T x}{W^T W h_\ell} = h_\ell \frac{W^T x}{W^T W h_\ell}$$