Neural networks
Restricted Boltzmann machine - example
Topics: RBM, visible layer, hidden layer, energy function

Energy function: \( E(x, h) = -h^T W x - c^T x - b^T h \)

\[
E(x, h) = - \sum_j \sum_k W_{j,k} h_j x_k - \sum_k c_k x_k - \sum_j b_j h_j
\]

Distribution: \( p(x, h) = \exp(-E(x, h))/Z \)

\[
p(x, h) = \exp(-E(x, h))/Z
\]
EXAMPLE OF DATA SET: MNIST
FILTERS
(LAROCHELLE ET AL., JMLR2009)
DEBUGGING

Topics: stochastic reconstruction, filters

- Unfortunately, we can’t debug with a comparison with finite difference
- We instead rely on approximate “tricks”
  - we plot the average stochastic reconstruction $||\mathbf{x}^{(t)} - \tilde{\mathbf{x}}||^2$ and see if it tends to decrease:
  - for inputs that correspond to image, we visualize the connection coming into each hidden unit as if it was an image
    - gives an idea of the type of visual feature each hidden unit detects
  - we can also try to approximate the partition function $Z$ and see whether the (approximated) NLL decreases