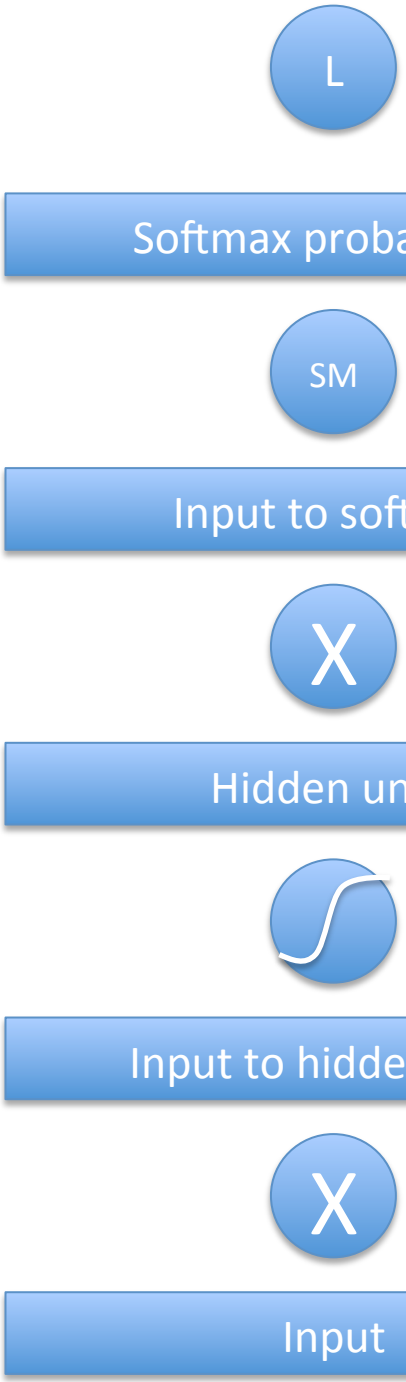
Assignment 2

- Published: *Feb 11*
- Deadline: *March 4*
- Implement backpropagation for a neural network
- Find hyperparameters for optimization and generalization



$$L = cross - entropy(y_1, \ldots, y_K)$$

$$y_k = softmax(o_1, o_2, \ldots, o_K)$$

$$o_k = \sum_{j=1}^{J} v_{jk} h_j$$

$$h_j = logistic(z_j)$$

$$z_j = \sum_{i=1}^{I} w_{ij} x_i$$

$$x_i$$

I: # input units
J: # hidden units
K: # output classes

Use chain rule to backpropagate gradients

Hidden to output weights:

$$\frac{\partial L}{\partial v_{jk}} = \frac{\partial L}{\partial o_k} \frac{\partial o_k}{\partial v_{jk}}$$

Input to hidden weights:

$$\frac{\partial L}{\partial w_{ij}} = \sum_{k=1}^{K} \frac{\partial L}{\partial o_k} \frac{\partial o_k}{\partial h_j} \frac{\partial h_j}{\partial z_j} \frac{\partial z_j}{\partial w_{ij}}$$

To Do, possible snags, and tips

- derive specific expressions for gradients
- derive expressions on paper before implementing them
- compute gradients for multiple training cases
- check specific expression for loss function, average gradients over minibatch
- vectorize expressions
- make use of gradient checker (not a guarantee for correct gradients but helpful)
- Helpful material:
  - Backprop video (Lecture 3d)
  - Backprop example
  - Code from Jan 23 tutorial
- Read assignment carefully