neural.html

A Neural Network that lives in a single HTML page

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Outline

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A Neural Network in JavaScript

- Works on any platform in a web browser.
- No installation, no additional runtime engines needed (e.g. Python, Matlab).
- A single plain-text HTML file.
- Offline use or distributed by a web server (without server-side requirements).

Outline

Forward propagation

$x^k := \varphi(\sum_{i=1}^{n} W_{j,i}^{k} x_i^{k-1} + b_j)$

k: layer index
i: input index
j: output index
φ: activation function

Forward propagation: iteratively compute x^{k+1} from x^k.

Back propagation

Quadratic loss: $\frac{1}{2}||f(x; W, b) - y||^2$
Error: $v = f(x; W, b) - y$

Propagate v through the network:
$dW^k = (\varphi'(\tilde{x}^k) \bigodot v)(x^{k-1})^T$
$db^k = (\varphi'(\tilde{x}^k) \bigodot v)$

v for $k - 1$: $(W^k)^T(\varphi'(\tilde{x}^k) \bigodot v)$

Regularization and Parameter Update

- L2-Regularization:
  $dW_{i,j}^k := dW_{i,j}^k + \lambda \frac{1}{\sqrt{(W_{i,j}^k)^2 + \epsilon}}$
- Parameter Update:
  $W^k := W^k - \tau dW^k$
  $b^k := b^k - \tau db^k$

Learning

Stochastic descent approach:

Repeat until the max. number of iterations has been reached:

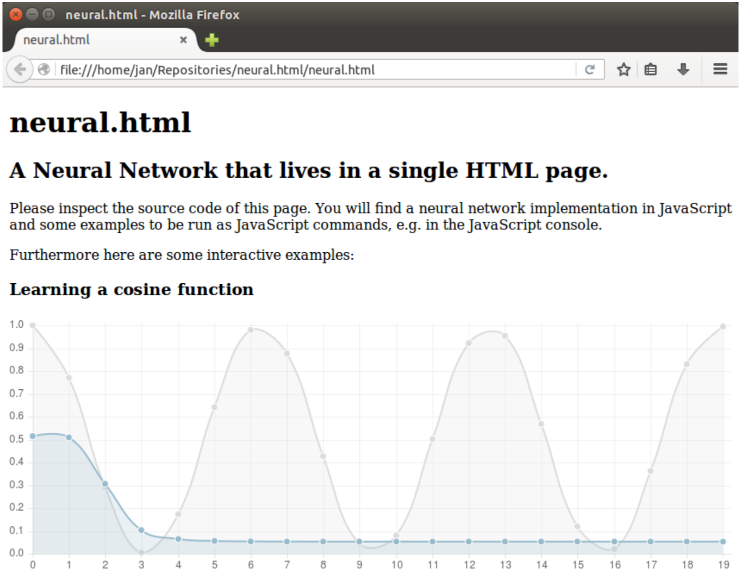
- For each training sample:
  - Forward propagation with the training sample as input
  - Calculate error
  - Back propagate error through the network
  - Perform regularization
  - Parameter update
- If the new loss is not smaller then the previous loss:
  - Restore old parameters
  - $\tau := \mu\tau$

Outline

JavaScript Prototype Objects

- **Layer**
  Functions: init, setActivationFunction, calculateIntermediates, forward, back, backup, undo, regularization
- **NeuralNetwork**
  Functions: init, setActivationFunction, forward, back, learning
- **ActivationFunctions**
  Sigmoid, ReLU and derivatives
- **HelperFunctions**
  Matrix multiplication, Hadamard product
- **Tests**
  Forward and Back propagation, Linear function, XOR, Cosine

Demo


neural.html - Mozilla Firefox
neural.html
file:///home/jan/Repositories/neural.html/neural.html

neural.html

A Neural Network that lives in a single HTML page.

Please inspect the source code of this page. You will find a neural network implementation in JavaScript and some examples to be run as JavaScript commands, e.g. in the JavaScript console.

Furthermore here are some interactive examples:

Learning a cosine function

Thank you!