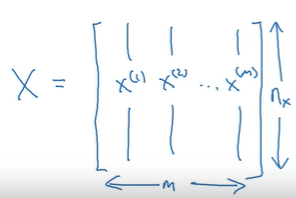
**Week 2 – Notes**

**Logistic Regression as a Neural Network**

**Binary Classification**

The notation used throughout the course:

 - features: one example per column (m columns) nx features (rows)

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Description automatically generated - targets: one target per column

**Logistic Regression**

**Text

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**Logistic Regression Cost Function**

We denote

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We cannot define the loss function as below because it isn’t convex

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We define it as

Text

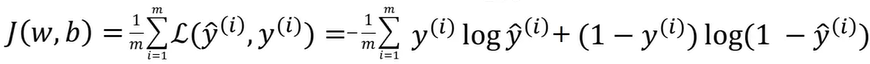
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The cost function is the average of all loss functions for each pair of y and y hat

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**Gradient Descent**



We want to minimize J(w, b) – the cost function

The derivative represents the slope of the function in a point

With d we denote derivatives and with sigma we denote partial derivatives

This algorithm implies moving towards the minimum values of the function by repeatedly subtracting from each parameter the value given by alpha (learning rate) \* the derivative of the function with respect to that parameter

**Derivatives**

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Computes what’s the ratio between the change in the value of the function and the change of the variable, if we increase the variable just by a little (represents the height / width of the triangle that we draw it with the hypotenuse as being the tangent)

**More Derivative Examples**

In machine learning the log always denotes the ln

**Computation graph**

Forward pass -> compute the outputs of the network

Backward pass -> Compute the gradients / derivatives

**Computing derivatives**

**Diagram

Description automatically generated**

In this course, dvar is the notation of the derivative of the cost function with respect to the variables

To compute the derivative of J with respect to a, we use the chain rule:

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To compute derivates we can use the defined formula, or to use the definition, but in which we consider x0 to be a small value, such as 0.001

**Logistic Regression Gradient Descent**

Diagram

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We have to update w1, w2 and b; for example w1 := w1 – alpha \* dw1

**Gradient Descent on m Examples**

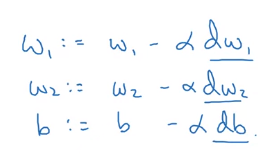
The superscript notation denotes the indices / number of the data example

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We initialize J, dw1, dw2 and db with 0 and we compute them by adding the value computed in relation with each training example; after that we divide each variable with the number of examples

One iteration of the gradient descent means that we update w1, w2 and b:



Because we want to avoid having many for loops, we’ll use the vectorized implementation

**Python and Vectorization**

**Vectorization**

Just by multiplying vectors / matrices without using for loops we can speed up the code by hundred of times

For example we can use np.dot(vec1, vec2) to multiply 2 vectors

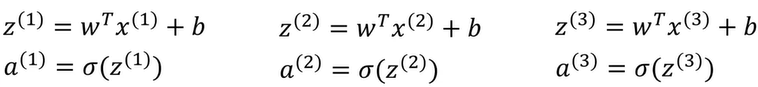
Vectorized implementation benefit because of the SIMD instructions that are implemented on the CPU and GPU

**More Vectorization Examples**

Even the computation of the e^ of each elements of a vector can be vectorized with np.exp(vector)

To vectorize the logistic regression, we would use dw as a vector instead of using dw1, dw2 and so on

**Vectorizing Logistic Regression**

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To compute z1, z2 etc we can use a vectorized implementation

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Description automatically generated, when you add a number to a vector, that number is added to each value from the vector; this operation is called broadcasting

**Vectorizing Logistic Regression's Gradient Output**

The gradient descent algorithm can be vectorized, so that for one iteration we won’t use any for loop

Graphical user interface, text, application

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