**Week 4 – Notes**

**Deep L-layer Neural Network**

We count the layers starting with the first one (the input layer), which is 0

Close-up of a white paper with blue writing

Description automatically generated with low confidence

**Forward Propagation in a Deep Network**

Regardless of how many layers we have, the equations for any layer are the following ones:

A picture containing handwriting, font, whiteboard, typography

Description automatically generated

Even when we want to vectorize these equations, we only replace z and a with Z and A

**Getting your Matrix Dimensions Right**

**For any layer, the dimensions are the following ones:**

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Description automatically generated + the derivatives of w and b have the same dimensions**

Additionally, z[l] and a[l] have the same dimensions as b[l]

In the vectorized implementation the dimensions are:

Z[l] -> (n[l], m)

A[l] -> (n[l], m)

However, even in the vectorized implementation, W[l] and b[l] have the same dimensions

**Why Deep Representations?**

We want to use deep neural networks because they can learn complex features, as initial layers detect simpler features and deeper and deeper layers combine the previous detected features into more complex representations

For examples a face detector detects: types of edges -> combine them in eyers / noses etc -> form faces

Circuit theory and deep learning: small and deep neural networks can compute the same functions as shallower and huge deep neural networks (small / huge in terms of the number of neurons) – example: computing x1 xor x2 xor x3 … xor xn

**Building Blocks of Deep Neural Networks**

During the forward propagation:

use a[l-1], w[l] and b[l] to compute a[l] and cache z[l], w[l] and b[l]

During the backward propagation:

Use da[l] and z[l] to compute the da[l-1], dw[l] and db[l]

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Description automatically generated

In the end we use dw[l] and db[l] to update w[l] and b[l]