## **Computing derivatives w.r.t Hidden Layers**

### **Part 1**

The derivatives corresponding to the hidden layers

1. What we are interested in is
   1. This formula is the summation of all the paths that lead from the concerned neuron to the loss function
   2. Here, *i* = layer number, *m* = neuron number for a, *j* = neuron number for h
   3. From the previous section, we already know how to compute so we need to only focus on
   4. However, when we compute the derivative of the neuron ai+1, m w.r.t hi,j we are left with the weight component Wi+1, m, j
   5. This refers to the weight component between the output neuron(ai+1, m) and input neuron (hi,j)
2. Thus we have
3. Now consider these two vectors

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| .  .  . |
|  |
|  |  |  |  |
| .  .  . |
|  |

* 1. Here, refers to the gradient vector of the loss function w.r.t to all output neurons from ai+1,1 to ai+1,k
  2. And refers to all rows of the *j*-th column of the Wi+1 matrix, ie a vector.

1. The dot product of these two vectors is
2. Here, the RHS is the same as the value from step 2. Therefore, the derivative of the loss function with respect to the hidden layers is the dot-product between the gradient of loss w.r.t output layer and the corresponding weights.