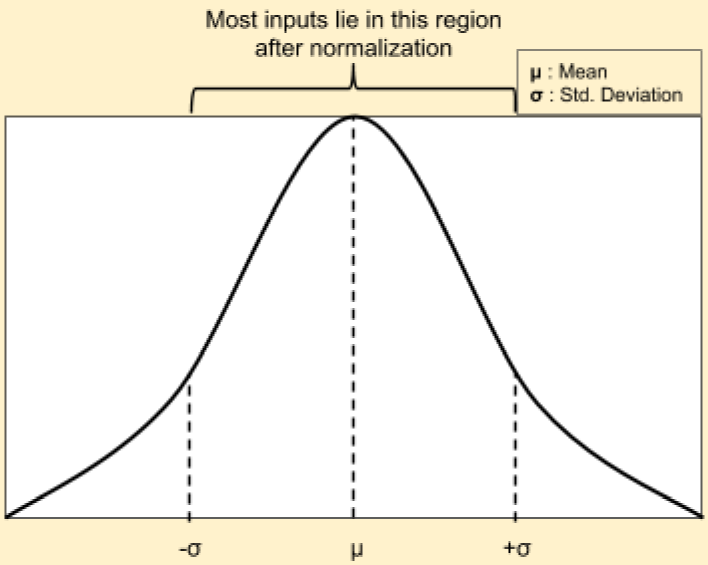
PadhAI: Batch Normalization and Dropout

One Fourth Labs

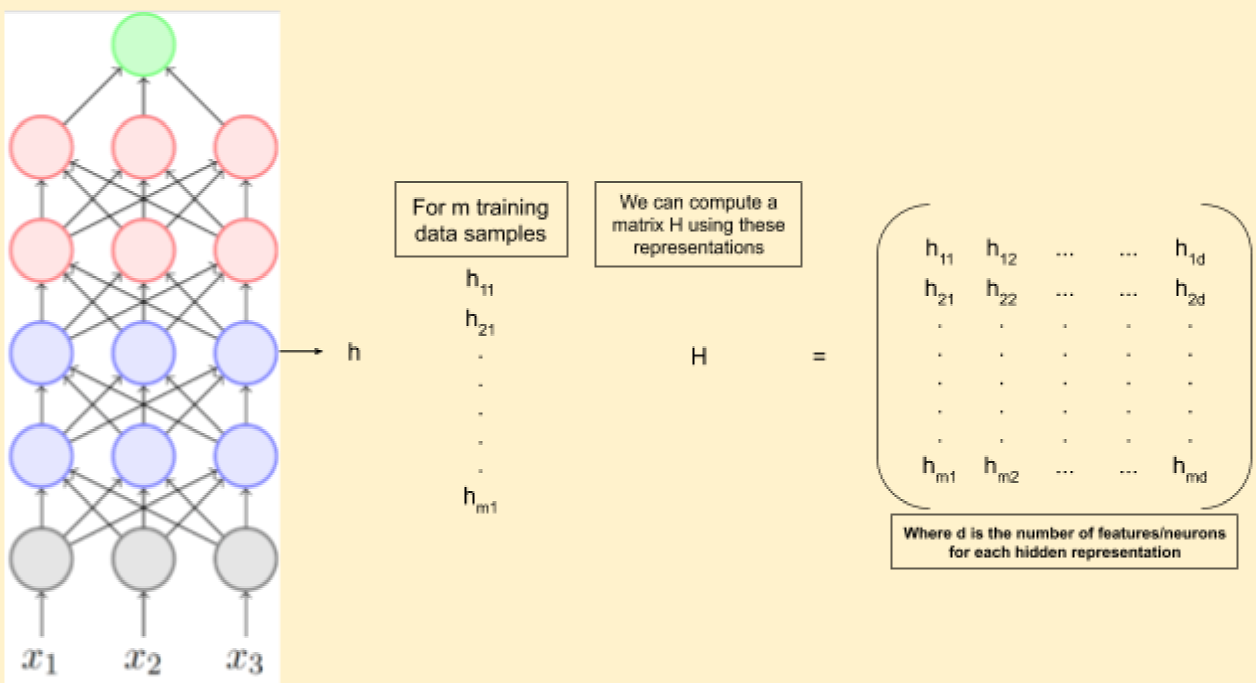
Batch Normalization

We have standardized inputs but what about hidden representations?

1. When we normalize/standardize the inputs, most of the inputs lie around the mean value, in the standard deviation range for all inputs X_{mn} where (m: no. of training samples, n: no. of features)



2. Now, let's try applying normalizations to any particular hidden representations. Consider one particular Hidden representation H



3. Now, standardization is done on the H matrix so that all of the columns are in the same range.
4. In a sense, the H matrix acts as an input to the next layer.
5. Thus, to learn the weights effectively, Standardization is done on all the columns to bring them to a comparable range.

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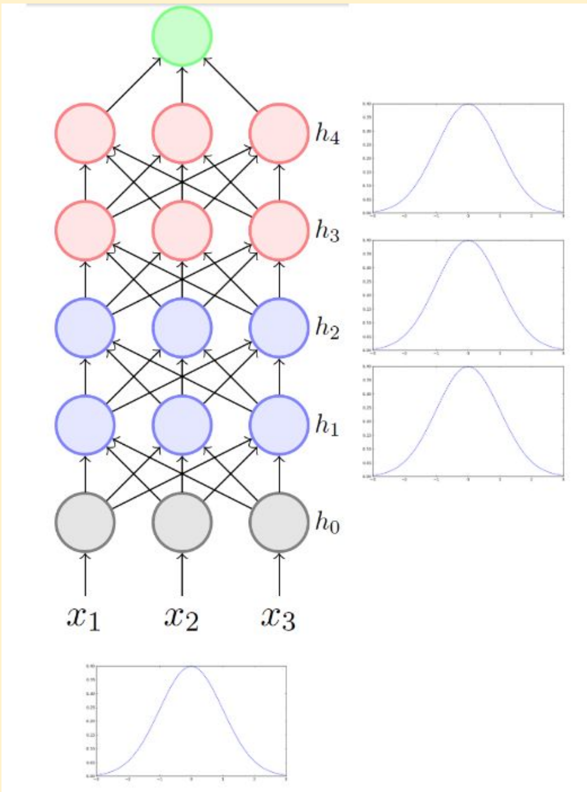
6. Just as we standardize the inputs, we standardize the activations at all layers



7. Now, why is it called batch normalization?
8. Let's take a look at the formulae for Batch normalizing H
   a. $h_{ij}^{(norm)} = \frac{h_{ij} - \mu_j}{\sigma_j}$ for each feature of each training sample.
   b. Where mean: $\mu_j = \frac{1}{k} \sum_{i=1}^{k} h_{ij}$
   c. And Variance/Standard deviation: $\sigma_j = \sqrt{\frac{1}{m} \sum_{i=1}^{k} (h_{ij} - \mu_j)^2}$
9. Now, for the input normalization, we consider the entire training size (m) when computing mean and std. However, here we only consider a smaller subset of samples (k). **Mean (μ) and Std (σ) are calculated using a batch of k samples, hence it is called batch normalization.** K = 32 is commonly used.