Assignment 04 : Artificial Neurons (Neural Nets)

UTA027 : Artificial Neurons

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1 Synthetic Dataset

Define a synthetic dataset $\mathcal{D}$ (in 2D) so that,

$$y = ce^{ax} + \epsilon$$

Where,
ϵ is a random noise.
a, c are arbitrary constants, and
$0 \leqslant x, y \leqslant 1$

2 Neuron

Define a neuron parameterised by weight w, bias b and activation function $\mathcal{A}$, so that

$$f(x; w, b, \mathcal{A}) = \mathcal{A}(wx + b)$$

3 Gradient Descent

Define a training loop for learning the parameters of a neural network (a neuron here) for regression. Let the parameters be w, b and given are the dataset $\mathcal{D}$ and activation function $\mathcal{A}$.

Pseudocode for Training Loop:

```
Given :
  + X,Y :: Dataset
  + A :: Activation Function
  + dA :: Derivative of Activation Function
  + l :: learning rate
Initialise :
  + w,b :: NN Params with random values.
Loop until convergence:
  Y_hat = [A(wx+b) Forall x in X]
  Err = [(y_hat-y) Forall (y_hat,y) in {Y_hat,Y}]
  L = average(Err^2)
  dLdw = # TODO: compute dLdw here
  dLdb = # TODO: compute dLdb here
  w = w - l*dLdw
  b = b - l*dLdb
Return :
  w,b,L
```

4 Radial Basis Activation

Use the following activation function to learn the NN Params:

$$\mathcal{A}(x) = e^{-\frac{x^2}{2}}$$
$$\frac{\partial \mathcal{A}}{\partial x}(x) = -x\mathcal{A}(x)$$