# **Neural Networks** - Class 8 – (Final Class), May 25, 2016

* Started from essential brain functions
* Neurons receive signals
* Fire 0 or 1
* Stimuli -> Neuron -> 0 or 1
* **Single Layer Feed Forward**
  + Hidden units are comprised of transformations of linear combination of predictors
  + Where g(x) is sigmodial activation function resulting in values equal or close to 0 or 1
* **Components**
  + Loss Function
    - Various , RMSE (regresson)
    - Binary 0-1 Loss (Classification)
  + Restricted Class of Function
    - Sigmoidal Activation Function (logistic) with
  + Search Methodology
* **Classification**
  + To make Nueral Networks a classification, we need an outcome node for each class, then apply software to normalize and have everything sum to one and look like a probability.
  + **Softmax**: going from a probability to specific class by normalizing output nodes.
* **Variations**
* **Advantages**
  + Performs very well
  + Yields highly accurate predictions
  + Low signal to noise
  + Easy to add or remove complexity
  + Hidden units, hidden layers
* **Neural Networks** 
  + Not interpretable -> difficult to relate inputs to outcomes
  + Requires numeric inputs, typically scaled, centered
  + All parameters *betas* and *lambda* estimated simultaneously
  + A large number of parameters requires a larger dataset
    - Training can take a long time.
* **Solutions to Overfitting**
  + **Early stopping:**
    - iterative algorithms for solving for regression equations
  + **Weight Decay**
    - Add a penalty for large regression coefficients. Large values must have a significant effect on the model errors to be tolerated.
* **Deep Learning** 
  + Buzz word: Rebranding of (artificial) neural networks
  + Training speed Improvements (Hinton et. Al, 2013)
  + Hardware Improvements
  + Requirements
    - Multiple often many layers
    - Supervised or unsupervised learning at each layer
    - Each successive layer is a higher level of abstraction
    - Higher abstraction obviate feature engineering…to a point