Week 4 Notes: Deep Learning Architecture

By: Rachael Girardey, Lauren Clarke, Alex Jones

Difference between DL & ML

Deep Learning

- **A Representation Learning Method:** people have traditionally collected data from various sources but these features aren't powerful to predict information from this data
- A learning alternative and more useful visual representations of data
    a. Many layers instead of feature extractor (form useful representations for the problem) = automated the task = Representation Learning Methods
    b. Anybody can be a data scientist as long as they have good data

Machine Learning

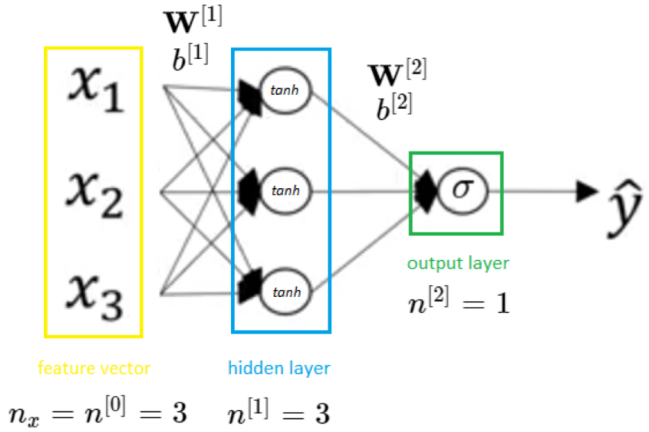
- Looks at the features and to determine best possible outcome
    - Ex: Determining the price of a house based on specific features
- Does not have enough power to look at multiple features
- Works well with raw data by:
    a. Building a feature extractor from domain experts (humans)
    b. Get complicated unintelligible features
    c. Feed into a standard ML model (such as SVM)
    d. Get outcome

Four Models of Deep Learning

- Use of these models depends on the task
- There is no rule on which one to use
- The size and depth of neural networks are increasing

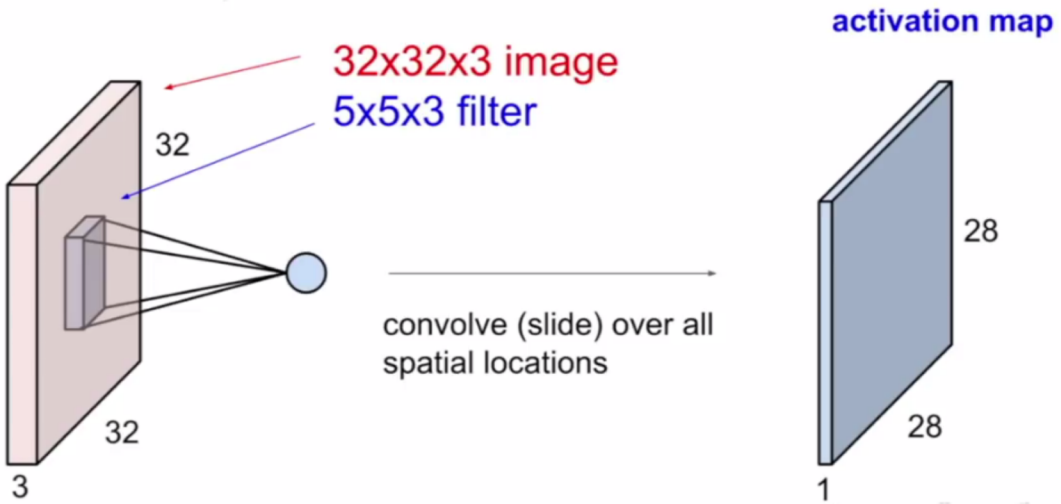
1. Standard Vanilla
2. Convolutional Neural Networks (CNN)
3. Recurrent Neural Networks (RNN)
4. Generative Adversarial Network (GAN)

Standard ‘Vanilla’ Deep Learning



- Use when data has no particular structure
  - Gradient descent
- Each neuron is deciding its output
- Contains a set of numeric features
- Typically remains in tabular form

Convolution Neural Networks (CNN)

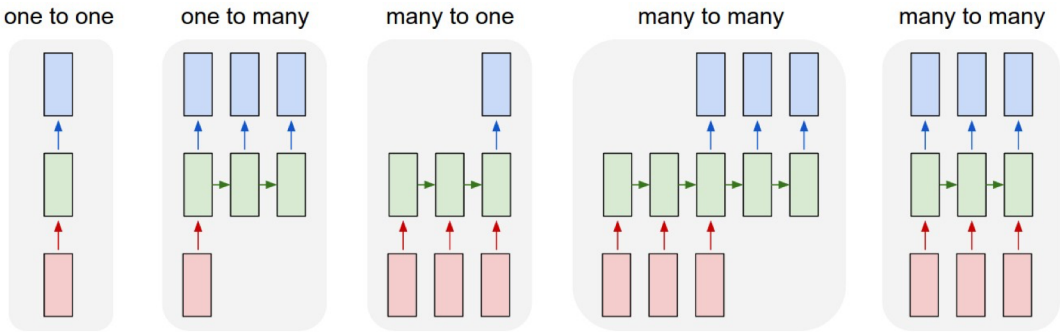


- Spatial dependence
  - Ex: Images, heat maps, CT scans
- Exploits objects in images and allows for exploration of confidence scale once completed
- D, W, H : preserve the natural spatial structure in which each pixel becomes a feature

- Convolutional layer
  - 1. Convolve the filter with the image (slide over the image spatial computing dot products)
  - 2. Place filter over original image giving the next level of features to see the correspondence amongst the two

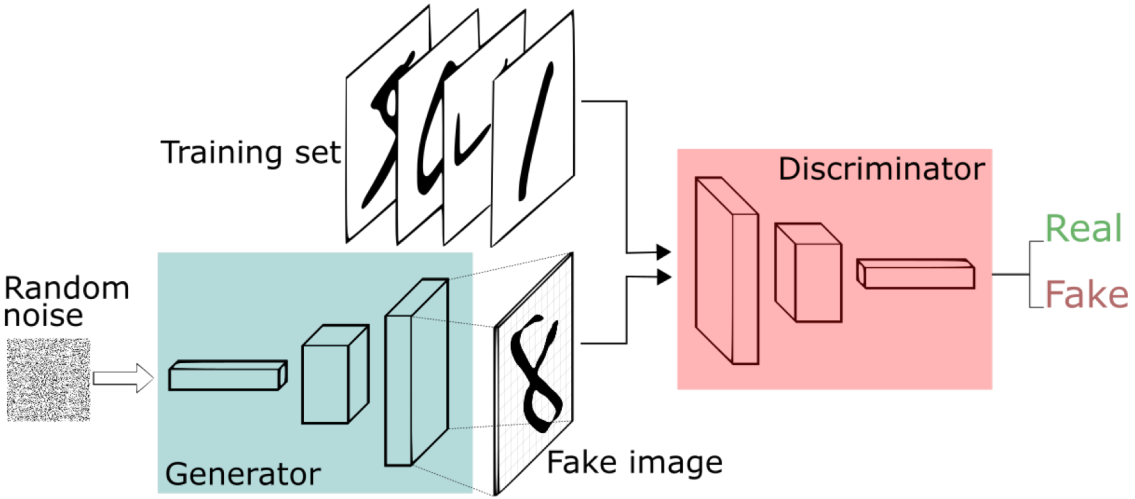
Recurrent Neural Networks (RNN)

- Used when data has sequential structure and dependence on past
- Recursively feeds the output into its vector
  - Output is a vector of things, such as, an entire sentence, a frame from a video, etc.
- Focuses its attention at a different spatial location when generating each word and it's sentiment classification
- Process sequences: one-to-one networks, one-to-many networks, and many-to-many networks
- Inputs are passed into these unit network models and undergoes feedback loops
- New state = the function of parameters W = (old state, input vector)
- Examples: LSTM (Long Short Term model) & GRU (ways for connecting networks)
- Examples: videos, textraised data, image captioning, and translation of languages
  - I am feeling= 3 different features- RNN tries to predict the next word



Generative Adversarial Networks (GAN)

- Used to generate new data that mimics properties of original data (Deep Fakes)
- Contains 2 parts:
    1. **Generator Network:** responsible for generating new data (leads to new videos, images, data points, etc.)
    2. **Discriminator Network:** takes the new input that is being constructed and distinguishes what data belongs to each set.
- If the discriminator makes a mistake, it's reframed so it doesn't make the same mistake again



References

"Gradient Descent for Neural Networks." *Master Data Science*, 2 Aug. 2019, http://datahacker.rs/gradient-descent-for-neural-networks/.

Karpathy, Andrej."Recurrent Neural Networks." *The Unreasonable Effectiveness of Recurrent Neural Networks*, May 2015, http://karpathy.github.io/2015/05/21/rnn-effectiveness/.

Silva, Thalles. "A Beginner's Guide to Generative Adversarial Networks (GANs)." *Skymind*, https://skymind.ai/wiki/generative-adversarial-network-gan.

Udofia, Udeme. "Basic Overview of Convolutional Neural Network (CNN)." *DataSeries*, DataSeries, 20 Sept. 2019, https://medium.com/@udemeudofia01/basic-overview-of-convolutional-neural-network-cnn-4fcc7dbb4f17.