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September 21, 2023

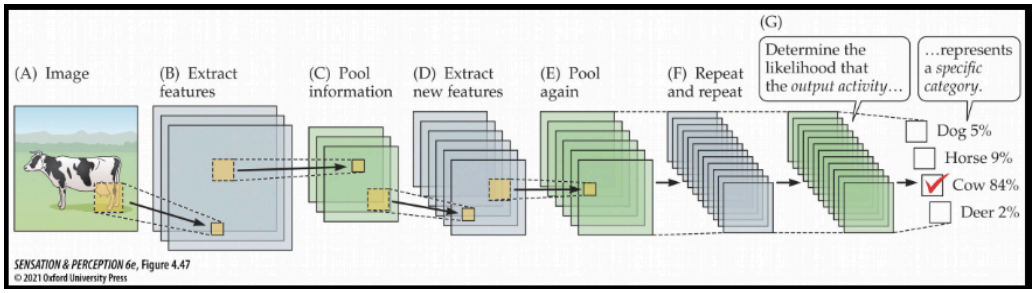
Week 4: Intro to Neural Networks – Hello World

Neural Networks

- Interconnected nodes inspired by the human brain → ML algorithms that mimic the operations of a human brain
    - Biologically: neurons are interconnected in a vast network allowing for complex information processing (sensation and perception), adaptation strengthens or weakens connections between neurons
    - Neural Networks: artificial neurons are organized in layers (with connections between layers → processing of info in a hierarchical manner, when training a neural network the weights and biases of the connections between artificial neurons are adjusted to minimize errors
    - Neural networks are computationally expensive but not as complex as the human brain
- Process data more efficiently and have better pattern recognition and problem-solving capabilities compared to traditional computers

Deep Neural Networks (DNNs):

- A type of ML in AI in which a computer is programmed to learn something (in this example it's object recognition, but it can also be knowledge)
- These are artificial neural networks that have a large number of layers of nodes with millions of connections
- First the network is "trained" using input for which the answer is known "that is a cow")
- Subsequently, the network can provide answers from input that it has never seen before



- DNNs are a more modern version of Selfiridge's Pandemonium proposal (only necessary to know about in CogSci)
- Multi-level neural networks that can be trained to recognize objects
- Many instances of an object are shown to the network, with feedback.
- Over time, the network can recognize new instances of the object that it has never been trained on

Other key concepts/terms

- Input Layer: Received raw data of neural network
- Hidden Layer: Process the input and extract features
- Output Layer: Produces the final prediction or decision
- Weights and Biases: Each connection between neurons has a weight, determining the strength of the signal. Biases adjust the output of a neuron
- Activation Functions: These functions introduce non-linearity, enabling the network to learn complex patterns. Common examples include ReLU, sigmoid, and tanh
- Backpropagation: An algorithm used to adjust weights and biases to minimize the difference between predicted and actual outputs
- Gradient Descent: An optimization algorithm that iteratively adjusts parameters to find the minimum of a loss function
- Convolutional Neural Networks (CNNs): Specialized for image and video data, CNNs use convolutional layers to extract features from images
- Recurrent Neural Networks (RNNs): Designed to process sequential data like time series and text, RNNs have feedback connections that allow them to remember past information
- Long Short-Term Memory (LSTM) Networks: A type of RNN that can learn long-term dependencies in data
- Generative Adversarial Networks (GANs): Composed of two networks, a generator and a discriminator, GANs can generate realistic data like images and text
- Computer Vision: Image classification, object detection, image segmentation, and facial recognition
- Natural Language Processing (NLP): Text classification, machine translation, sentiment analysis, and text generation

Teachable Machine

- This is a non-technical way to learn about NNs
- https://teachablemachine.withgoogle.com/train/image

Hello World Code

- I put it into a Colab notebook for easy sharing, but I think the .py file will also be in the folder?