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A03: CNN Cheetah

In our Neural Network Zoo assignment, we explored the Convolutional Neural Network (CNN) through the metaphor of a cheetah. The Neural Network Zoo consists of CNN (Convolutional Neural Network /Cheetah): Fast and focused, excelling at image recognition. RNN (Recurrent Neural Network/Racoon): Good memory being able to handle sequences like speech and text. LSTM (Long Short-Term Memory/Lemur): Remembers long-term dependencies in time-series data. GAN (Generative Adversarial Network/Fox): Clever and creative being able to generate realistic images. Lastly, Transformer /Owl: Wise and global, being able to understand long-range context in language and vision.

However, before we can dive into CNNs and what they are, we must first explain what a neural network is. Neural Networks are machine learning models inspired by the human brain. They consist of interconnected units called neurons. These neurons process data by applying weights, summing inputs, and passing results through activation functions. These neurons are organized into layers: input, hidden, and output. They work together, learn patterns, and make predictions. Neural networks are the foundation of deep learning, enabling machines to recognize images, understand language, and make decisions.

The cheetah is known for its speed, precision, and sharp vision. CNNs, in a way, are like a cheetah. Convolutional Neural Networks are designed to process visual data efficiently, making them ideal for tasks like image classification, facial recognition, and medical imaging. A CNN is structured with specialized layers. Convolutional layers that detect features like edges and textures. Pooling layers that reduce dimensionality while

preserving important information. Fully connected layers that make final predictions. This layered approach mimics how humans visually process the world, all the way from simple shapes to complex objects.

In comparison to other neural networks, CNNs specialize in spatial data. Recurrent Neural Networks (RNNs/Raccoon) and Long Short-Term Memory (LSTM/Lemur) networks are better suited for sequential data like speech or text. CNNs are efficient, scalable, and widely used in real-world applications, from Tesla's autonomous vehicles to wildlife tracking.

An RNN is a Recurrent Neural Network which is an AI network generally designed to acknowledge patterns in sentences of data. Its correspondent to a neural network with "memory". Unlike traditional neural networks that treat each input independently, an RNN has capabilities to retrieve and remember information from previous inputs to influence the current input and output. This makes them well suited for tasks where the order of data is polar.

RNNs work in an analogous way as someone reading a sentence, in a sense that they can understand each word based on the words that came before it. They are also split into different architectures for various tasks. They process each piece of information and takes a note of it to pass it to the next step. The memory allows it to understand text which is the tech behind something like a phone's predictive text feature. Due to their ability to predict sequences within text, they prove to be super useful for speech recognition and analyzing. Some basic RNNs can sometimes have a short memory where it can battle to remember important details from the beginning of a long sequence of words.

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The RNN takes the current piece of data and the hidden state from the previous step into account in regards to memorizing and analyzing. They combine the two inputs to generate the output for the current step and update its own hidden state. The new hidden state is then passed to the next step carrying the context forward. This entire process uses the same set of weights at every step. These concepts are loosely inspired by the way neurons in the human brain are interconnected and can create feedback loops.

RNNs in a way are like cheetahs as well in a sense that cheetahs must know their prey's next move in order to strike and catch a kill. They have to be precise and also have a knowledge of context as well. Cheetah's brains process a sequence of visual data and must remember the prey's previous movements to anticipate its next turn sort of like how the RNN has to remember the previous inputs of the user in order to predict the next sequence.

In all, this assignment deepened our understanding of neural network architecture, RNNs, and highlighted the importance of choosing the right model for the task. The CNN Cheetah taught us that in deep learning, speed and structure are key to visual intelligence. The RNN was an intense demonstration of the network's memory and how crucial it can be in regards to interpreting and guessing the next word in a sequence of text. It was also very interesting comparing them both to how cheetahs process and analyze for survival.