Multi-modal Analysis

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Multimodal learning combines different types of data or sensory channels

INTRODUCTION

- We use five senses to perceive
- Mimic human learning processes
- Combine text, video/images, audio to better understand

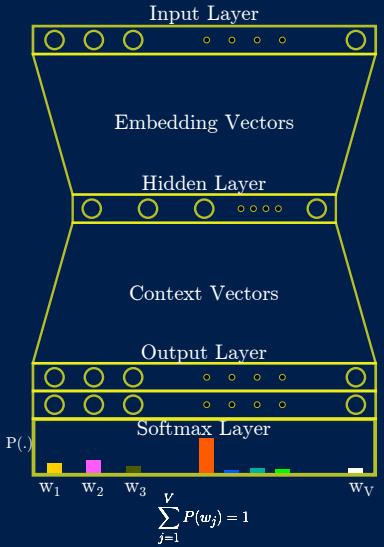
MULTI-MODAL PERCEPTION

- A thought on good coffee
- Visualize the scene
- Sequence of related words and context
- Describe them using speech
- Exhibit emotions - nostalgic
- Some draw the south Indian coffee on a traditional vessels
- . . .

Word Embedding

- Form dense vectors for every word to capture its semantic nature
- Allows similar words to be close in a feature space
- Algorithms - HALS, COALS, Word2Vec, GloVe, FastText

WORD2VEC MODEL



SIMILAR WORDS FOR VIRUS

Vocab size	Words in the corpus
637722	222502540

Word	Similarity
virus,	0.889620
viral	0.785719
(herpesvirus)	0.764385
avirus	0.759567
fluav)	0.757418
polio-virus	0.724740
⋮	⋮
(vsv;	0.723436
(denv-2)	0.722825
(cowpox)	0.717185
⋮	⋮

UNDERSTANDING LONG CONTEXT

- Encoder-Decoder Architectures
  - Solve the challenge of mapping long input sequences of different lengths
- Attention Mechanism: Enables models to focus on relevant information
- Transformer Architecture Advantages
  - Self attention mechanism
  - Perform parallel operations
  - Pretrained and fine-tuning capabilities for a specific content
  - Deep Network Capabilities

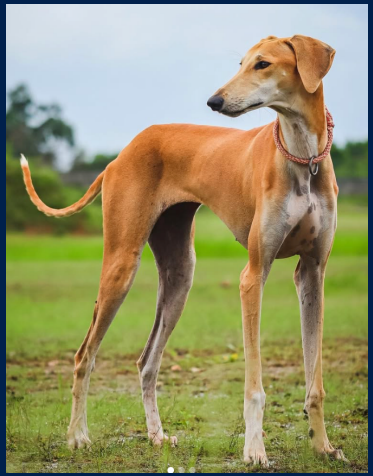
CHALLENGES

- Deep learning models operate on numeric data
- Challenges in converting unstructured inputs to numeric formats
- How to combine multi-modal information
- Identifying relationship across the senses - both contextual (in text) and spatial (in images)

  Connecting thoughts, words and images
- Thought of a dog $\rightarrow$ description in text $\rightarrow$ understand the text $\rightarrow$ translate the meaning into visual representation

Text-to-Image Generation

- Input - Chippiparai
- Output - The Chippiparai is a breed of sighthound from the State of Tamil Nadu in southern India.
  The Chippiparai has typical streamlined sighthound features with long legs and a lean and lithe frame built for speed. The breed is usually white in color, although other colors can be found.



VIDEO BASED TEXT ANALYSIS

Input - A lecture video (video and audio)

Output

- classification of the topic
- Summary of the lecture, a chapter/section of the topic
- Translation to another language,
- Create transcription in another language
- Identification of words for lip synchronization
- ...

ADVANCES IN ARCHITECTURE

- Transformers - CLIP, DALL-E for combining modalities
- Idenify embeddings across modalities
- Fusing modalities
- Combining contextual and spatial relationships -Develop embeddings that capture deeper relationships
- Scalable Systems - Transformers reached its full potential -What next? Develop embeddings that capture deeper relationships.

COMMON PATTERNS

- Classification
- Regression
- Clustering
- Dimensionality reduction
- Contextual Association

STATE OF THE ART - NLP

content...

CNN: CONVOLUTIONAL NEURAL NETWORK

- CNN: A class of deep learning models designed for image and spatial data
- ResNet: Introduces residual connections to improve training of very deep networks

Good at extracting the spatial features from data

- Convolutional Layers: Extract features.
- Pooling Layers: Reduce spatial dimensions.
- Fully Connected Layers: Map features to output.

RESNET

STATE OF THE ART - COMPUTER VISION

advances in CV