Multi-modal Information Retrieval via Joint Embedding

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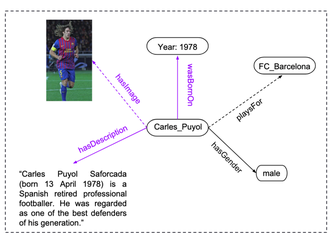
INTRODUCTION

Finding connected information among the vast amount of different data in current world is an interesting and difficult problem. In this work, we propose a solution for the multi-modal information retrieval problem using the concept of Joint Embedding. Video and text are embedded in a low dimensional shared joint embedding space by restraining documents with similar ontology, relations and entities to have similar embeddings. Video frames are extracted as a sequence of actions using Deep Video Captioning framework. For each document, Subject-Relation-Object triplets and topics are extracted using Open IE and LDA. These embeddings would provide a common representation for video and text data, and they can be used to provide users on specific missions with data of their preference without any intervention.

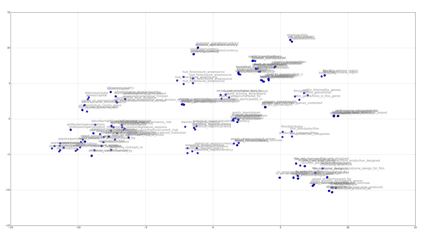
OBJECTIVES

- ❑ Retrieve **knowledge** for multiple users *changing* needs and mission
- ❑ Relate **multi-modal** data and update the existing **knowledge** for users
- ❑ Complete the **unfulfilled data needs** for missions
- ❑ Discover new **knowledge** that can benefit mission

MOTIVATION



Multimodal Knowledge Base

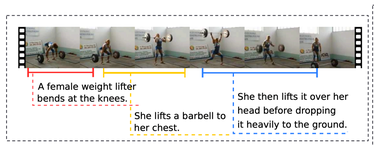


Relation Embeddings (DistMult)

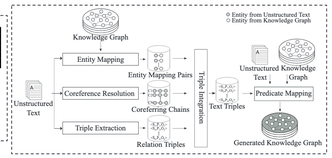
- [1] learned representations for entities and relations for KB represented as a list of relation triplets (subject, relation, object) via a NN.
- Relations are limited and entities come from a fixed, enumerable set of entities that appear in the knowledge base.
- [2] used encoders to learn from text descriptions and image for entities, and then used decoders to generate missing attributes for entities.
- Images, videos and text have more finer details than to just act as an attribute for entities in a KB.

METHODS AND MATERIALS

- Videos and unstructured text (twitter) are used as data sources for demonstrating multi-modality.
- For understanding videos, we use dense video captioning. It localizes distinct events in a long video stream, and generates captions for the localized events.
- [3] uses 3D convolutional network (C3D) to encode all incoming video frames. Convolution and pooling in spatiotemporal space preserves temporal sequence information within the video.
- Using the pooled features from C3D, [3] proposes variable-length temporal events and generates their captions using a two-level hierarchical captioning module that keeps track of context.

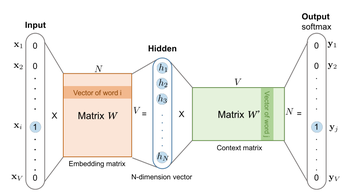


Joint Event Detection and Description in Continuous Video Streams

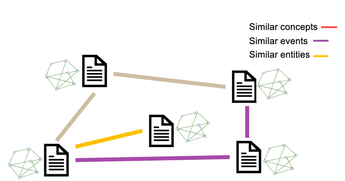


Architecture of the T2KG System

- Proposed method follows similar methodology as first half of the T2KG architecture [7] to generate the formulated text triplets.
- **Extracting triplets from text:** Open IE 5.0 [4] system is used to extract triplets consisting of [Subject-relation-Object] structure from both the unstructured text and the event descriptions from video.
- **Entity and Relation Mapping:** If an extracted entity or relation can be mapped to an identical entity in any KG, the URI of such an entity is used as a representative. Otherwise, a new URI is given to the entity or relation.
- **Concept Extraction:** For each of the text description, we generated topics using Latent Dirichlet Allocation (LDA) [6].
- **Joint Embeddings:** Following the intuition of Word2Vec [7], we train a neural network to restrict the low dimensional embeddings of documents and videos by following these objective functions –
  - ❑ Docs and videos with similar entities should have similar embeddings
  - ❑ Docs and videos with similar concepts should have similar embeddings
  - ❑ Docs and videos with similar relations should have similar embeddings

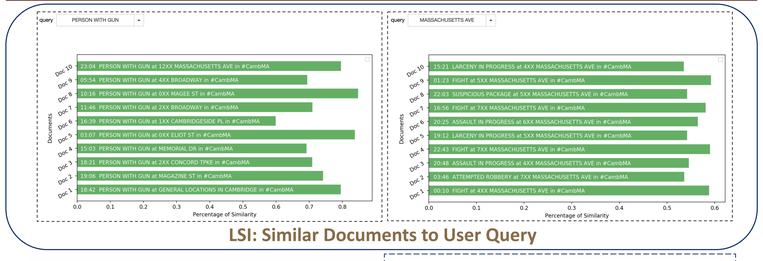


Model architecture of Word2Vec

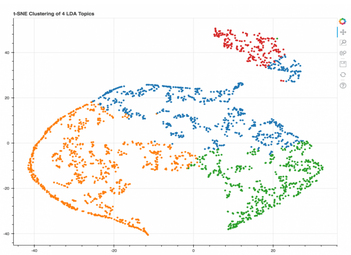


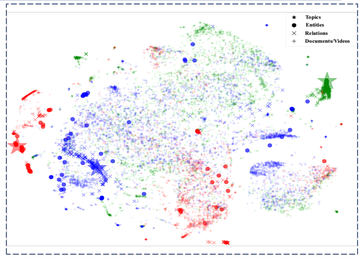
Information network for Joint Embedding

RESULTS



LSI: Similar Documents to User Query





Expected t-SNE Embeddings

CONCLUSIONS

- ❑ Proposed an end-to-end DNN architecture to integrate fine grained information from multiple data sources into a Knowledge Base
- ❑ Derived embeddings can be used as indices for finding events or information of interest
- ❑ Embeddings in same vector space depicts to similar interest to the mission and the user

FUTURE DIRECTIONS

- ❑ Complete and experiment the proposed architecture in Semantic Text Understanding and Information Similarity task
- ❑ Improvement of the Open IE task for triplet detection
- ❑ Experiment with other datasets in REALM

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