CSE508 Information Retrieval

Winter 2024
Assignment-2

Name: Aniketh 5th March Roll No: 2020360

---

1. Image Feature Extraction

- Pre-processing Techniques: Various image pre-processing techniques are applied, such as altering contrast, resizing, geometrical orientation, random flips, brightness and exposure adjustments, or any other relevant operations to enhance the images.
- CNN Architecture: A pre-trained Convolutional Neural Network (CNN) architecture is used to extract relevant features from the images in the given training set. The chosen network was MobileNetv2 pretrained on the ImageNet Dataset.
- Normalization: The extracted features are normalized to ensure consistent and comparable representations across different images.

2. Text Feature Extraction

- Pre-processing Techniques: Relevant pre-processing techniques are implemented on the given text reviews, including Lower-Casing, Tokenization, removing punctuations, Stop Word Removal, Stemming, and Lemmatization. These techniques help in cleaning and standardizing the textual data.
- TF-IDF Calculation: Term Frequency-Inverse Document Frequency (TF-IDF) scores are calculated for the textual reviews. TF-IDF is a statistical measure that evaluates the importance of a word in a document relative to a collection of documents (corpus). It helps in identifying the significance of words in each review.

3. Image Retrieval

- Input: The system takes an input (image, review) pair.
- Image Feature Extraction: Extracted features or embeddings from the input image are used. The features are obtained using a pre-trained Convolutional Neural Network (CNN) architecture, such as MobileNet, and then normalized.
- Similarity Calculation: Cosine similarity is used as the similarity measure between the input image's features and the features of other images in the dataset.
- Data Structure: A suitable data structure, such as a list or dictionary, is used to store and manage the similarity scores between the input image and other images.

- Top Similar Images: The system retrieves the top three most similar images based on the cosine similarity scores and their corresponding reviews and similarities as well.

4. Text Retrieval

- Input: The system takes an input review from the (image, review) pair.
- Text Feature Extraction: Relevant pre-processing techniques are applied to the input review, followed by the calculation of TF-IDF scores.
- Similarity Calculation: Cosine similarity is used to calculate the similarity between the input review's TF-IDF scores and the TF-IDF scores of other reviews in the dataset.
- Data Structure: Similar to image retrieval, a suitable data structure is used to store and manage the similarity scores between the input review and other reviews.
- Top Similar Reviews: The system retrieves the top three most similar reviews based on the cosine similarity scores and the corresponding best images and similarities as well.

5. Combined Retrieval

- Input: The system takes an input (image, review) pair.
- Composite Similarity Score: Calculate the composite similarity score for each pair generated in the image and text retrieval steps (3a and 3b). The composite score can be an average of the similarity scores from both steps.
- Ranking: Rank the (image, review) pairs based on the composite similarity score.

6. Results and Analysis

- Image Retrieval
    - Input image:
    - 
    - Input review: *“Loving these vintage springs on my vintage strat. They have a good tension and great stability. If you are floating your bridge and want the most out of your springs than these are the way to go.”*
    - Results:
    - Top 1 - Image URL: (Same)['https://images-na.ssl-images-amazon.com/images/I/81q5+IxFVUL._SY88.jpg']
    - ID: 1205
    - Review: ['Loving these vintage springs on my vintage strat. They have a good tension and great stability. If you are floating your bridge and want the most out of your springs than these are the way to go.']
    - Image Similarity: 0.9832489490509033
    - Textual Similarity: 0.9999431108858823

    - Composite Similarity: 0.9915960299683928
    -
    - Top 2 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/71nSUnv7znL._SY88.jpg']
    - ID: 1734
    - Review: ["I bought the classical guitar case. It fits my Ruben Flores 1200 perfectly. I had my doubts for the low price. It's very solid constructed. It comes with two keys for a lockable latch. It has a nice surface texture that feels like leather. The whole thing feels really well-built."]
    - Image Similarity: 0.8629798293113708
    - Textual Similarity: 0.0
    - Composite Similarity: 0.4314899146556854
    -
    - Top 3 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/61QP1AW0rDL._SY88.jpg']
    - ID: 2227
    - Review: ['Squier Vintage Modified Jazz Bass.', '', "If your reading this you already know all the major features so I won't dig into that.", 'This is an outstanding bass for the price...And even if it had a larger price tag it would still be an excellent choice. The quality is excellent , it has great pickups and it sounds just as good as my Fender custom shop jazz.', "Don't be fooled by the price, you don't need to spend this month's rent on a bass to get an excellent instrument that is well beyond expectations. Add a gator hard shell case and you have a super sweet jazz bass.", '-EXCELLENT OVERALL QUALITY', '-EXCELLENT FIT AND FINISH', '-NO SHARP FRET EDGES', '-GREAT STOCK DUNCAN DESIGNED PICKUPS ..EXCELLENT', '-KILLER BASS AT TWICE THE PRICE', 'Highly Recomended. You will only note one major difference if you audition the squire jazz and the fender jazz side by side. ...the decal.']
    - Image Similarity: 0.8610721230506897
    - Textual Similarity: 0.04525149144620295
    - Composite Similarity: 0.45316180724844635
- Text Retrieval:
    - Input image:
    - 
    - Input review: *“Loving these vintage springs on my vintage strat. They have a good tension and great stability. If you are floating your bridge and want the most out of your springs than these are the way to go.”*
    - Top 1 - Image URL: (Same)['https://images-na.ssl-images-amazon.com/images/I/81q5+IxFVUL._SY88.jpg']

    - ID: 1205
    - Review: ['Loving these vintage springs on my vintage strat. They have a good tension and great stability. If you are floating your bridge and want the most out of your springs than these are the way to go.']
    - Image Similarity: 0.9832489490509033
    - Textual Similarity: 0.9999431108858823
    - Composite Similarity: 0.9915960299683928
    -
    - Top 2 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/81Z1d7HaBfL._SY88.jpg']
    - ID: 3430
    - Review: ['Nice solid springs and defeinitely more silent. Easy installation and the black looks cool.', '', 'Pictured with some old uninstalled springs next to them.']
    - Image Similarity: 0.5509961247444153
    - Textual Similarity: 0.3004787532110201
    - Composite Similarity: 0.42573743897771765
    -
    - Top 3 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/71t4gm+RcYL._SY88.jpg']
    - ID: 3480
    - Review: ["All I can say is I'm loving it."]
    - Image Similarity: 0.715172529220581
    - Textual Similarity: 0.26303869497749127
    - Composite Similarity: 0.48910561209903614
- Combined Retrieval
    - Input image:
    - 
    - Input review: *“Loving these vintage springs on my vintage strat. They have a good tension and great stability. If you are floating your bridge and want the most out of your springs than these are the way to go.”*
    - Top 1 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/81q5+IxFVUL._SY88.jpg']
    - ID: 1205
    - Review: ['Loving these vintage springs on my vintage strat. They have a good tension and great stability. If you are floating your bridge and want the most out of your springs than these are the way to go.']
    - Image Similarity: 0.9832489490509033
    - Textual Similarity: 0.9999431108858823
    - Composite Similarity: 0.9915960299683928
    -

    - Top 2 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/71t4gm+RcYL._SY88.jpg']
    - ID: 3480
    - Review: ["All I can say is I'm loving it."]
    - Image Similarity: 0.715172529220581
    - Textual Similarity: 0.26303869497749127
    - Composite Similarity: 0.48910561209903614
    -
    - Top 3 - Image URL: ['https://images-na.ssl-images-amazon.com/images/I/61QP1AW0rDL._SY88.jpg']
    - ID: 2227
    - Review: ['Squier Vintage Modified Jazz Bass.', '', "If your reading this you already know all the major features so I won't dig into that.", 'This is an outstanding bass for the price...And even if it had a larger price tag it would still be an excellent choice. The quality is excellent , it has great pickups and it sounds just as good as my Fender custom shop jazz.', "Don't be fooled by the price, you don't need to spend this month's rent on a bass to get an excellent instrument that is well beyond expectations. Add a gator hard shell case and you have a super sweet jazz bass.", '-EXCELLENT OVERALL QUALITY', '-EXCELLENT FIT AND FINISH', '-NO SHARP FRET EDGES', '-GREAT STOCK DUNCAN DESIGNED PICKUPS ..EXCELLENT', '-KILLER BASS AT TWICE THE PRICE', 'Highly Recomended. You will only note one major difference if you audition the squire jazz and the fender jazz side by side. ...the decal.']
    - Image Similarity: 0.8610721230506897
    - Textual Similarity: 0.04525149144620295
    - Composite Similarity: 0.45316180724844635
- Analysis
    - a)
    - From comparing results
    - Image retrieval results (by ids): 1205, 1734, 2227
    - Text retrieval results (by ids): 1205, 3430, 3480
    - Combine retrieval (by ids): 1205, 3480, 2227
    - Seeing from these results we can see that both individual methods ignore important similarities captured in combined, and neither is able to retrieve the correct ID 3480 in the top position (2nd).
    - b)
    - After comparing manual results and images, ID 2227 is a much better result as compared to 3480, despite the high similarity in text, it is not a good indicator of similar product, because of the low number of words in the review it can mislead with a high similarity score despite low similarity. In this case 3480 is a different product entirely. Hence image retrieval was a better method in this case.
    - c)
    - Ideal retrieval ID 2227 was placed third due to misleading high similarity from text

- I faced challenges of efficiency where repeated computation of text similarity was slowing down the whole process, errors in the links leading to undownloadable images. Had to combat these by optimizing and setting failed indexes. Another was the confusion of including multiple images from the same ID or not, I solved this by taking the image with maximum similarity for any given ID.
- This can be improved by considering more sophisticated similarity measures, setting filters on the length of texts, normalizing the scores by the length, considering semantic similarities as well, asses linear combinations of both methods and select an optimal linear combination which improves results by giving weighted importance to relevant channel(text/image). By only one example image was better but through more examples and comparison with combined method we can figure out an ideal combination, for example where image similarity is more important