Exploiting Music text corpora, Semantic Enrichment of musical text and MIR applications

Music information is around us everywhere in our daily lives. They can be seen as numerous digital libraries in which massive amounts of musical information are being published from as far back as several centuries ago. This kind of information has great impact in musicological studies and also some well-known tasks within Music Information Retrieval(MIR) such as music recommendation. This review will showcase some of the challenging NLP tasks posed from the music domain and how NLP could be leveraged in MIR and musicology applications.

Entity Linking

Entity Linking is one of the main challenges in MIR. Most of the structured information about music is incomplete which is caused by storing merely popular artists and some relevant biographical information. Other music information remains implicit in unstructured texts. At the very first of Entity Linking, it is the Entity Recognition that comes in confusion.

1. The Symphony No. 9 in D minor, Op. 125
2. Beethoven's best masterpiece is the 9th
3. Carmen the opera
4. Carmen, the main character in the opera

The idiosyncratic format in the first example will create an unambiguous case with the second one. The following two are referring to different entities. Essentially album and artist names are shortened in casual language, moreover, they could be the same. Due to the lack of sensitivity to musical text, generic software is not performing well in Entity Linking.
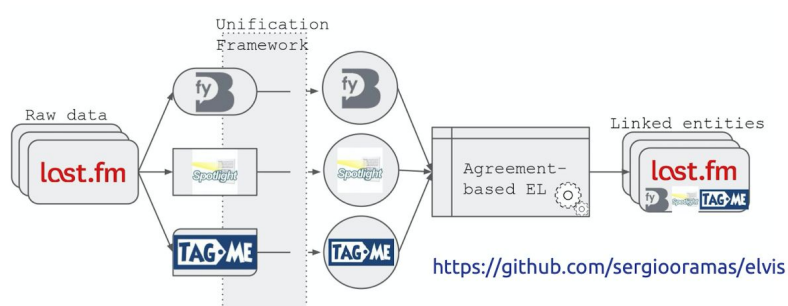

ELVIS: Entity Linking Voting and Integration System

Oramas, S., Espinosa-Anke, L., Sordo, M., Saggion, H., & Serra, X. (2016a). ELMD: An Automatically Generated Entity Linking Gold Standard Dataset in the Music Domain. In In proceedings of the 10th international conference on language resources and evaluation, lrec.

The ELVIS method envisioned a text corpus annotated with a vast number of music entities, such as Album, Song, Artist. Nonetheless, not all occurrences in text would be annotated but only those who have very high Precision. In the raw data set from "Last.fm", there are 13000 artist biographies and they are connected via over 90k inner hyperlinks. Entities are linked from hyperlinks to other annotated entities, then linked to DBpedia using ELVIS with 97% precision.

	ELVIS Score	Precision	Annotations
type-equivalent	=3	**0.97**	31,180
	>=2	0.96	46,544
	>=1	0.94	59,680
all	=3	0.94	33,455
	>=2	0.90	51,802
	>=1	0.81	72,365

Semantic Enriched Graph

Besides Entity Linking, we can perform semantic enrichment of musical texts by applying graph-based methodologies as follows.
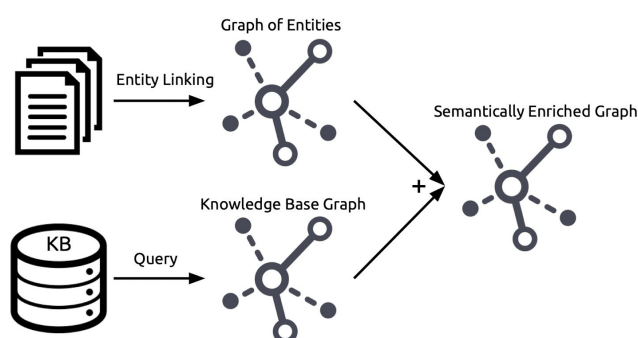
Knowledge graph creation is used to further describe the relevance between entities. We can construct from both music Knowledge Base and Entity Linking.
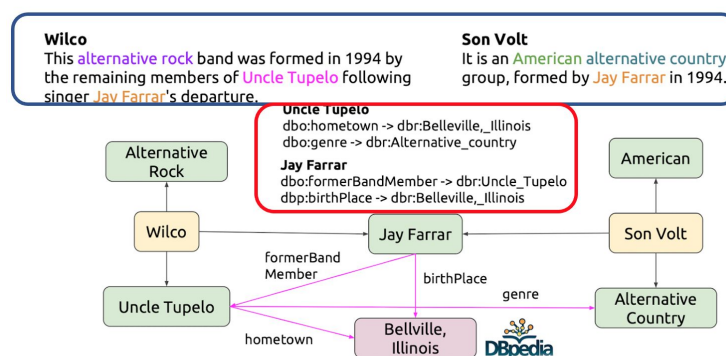

The blue bubble shows the information for Entity Linking while the red one is from Knowledge Base. After merging two parts of information, we can infer more information among entities and even the genre(purple edges) from this semantic enriched graph

MIR Applications

There are various music information retrieval applications in our day lives in which the most common ones are from calculating artist similarity, album classification and music recommendation.

Artist similarity can be calculated by generating h-hop item neighborhood graph and embedding parameters to it. Embedding method as such flat embedding, path-based embedding ,etc.

Subsequently, the similarity could be calculated by Maximal Common Subgraph in which artist biographies from "Last.fm" and Entity Linking were used.
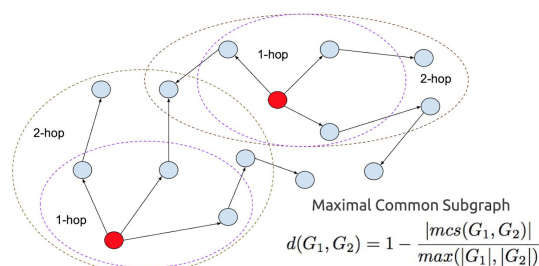
Maximal Common Subgraph

$$d(G_1, G_2) = 1 - \frac{|mcs(G_1, G_2)|}{max(|G_1|, |G_2|)}$$

Oramas, S., Sordo, M., Espinosa-Anke, L., & Serra, X. (2015). A Semantic- based Approach for Artist Similarity. In Proceedings of 16th the international society for music information retrieval conference (ismir).

Gorillaz are a british virtual band formed in 1998 by Damon Albarn of Blur, and Jamie Hewlett, co-creator of the comic book Tank Girl.

Extracted Knowledge Base Graph
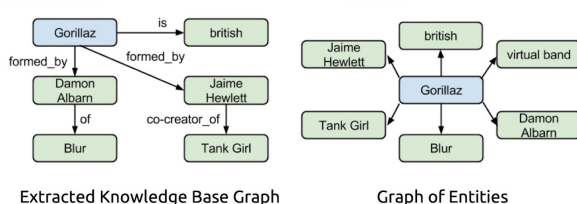
Graph of Entities

Approach	P@5
Text-based approach (BoW)	0.090
Extracted KB Graph	0.055
Graph of Entities	0.136
Semantically Enriched Graph	0.160

The Semantically Enriched Graph approach has the best precision result. As a result, there is a Genre Classification study to compare performance of different methods such as bag-of-words uni-grams/bi-grams, Entity Linking(Semantic), positiveness ratio(Sentiment) and low-level descriptors(Acoustic).
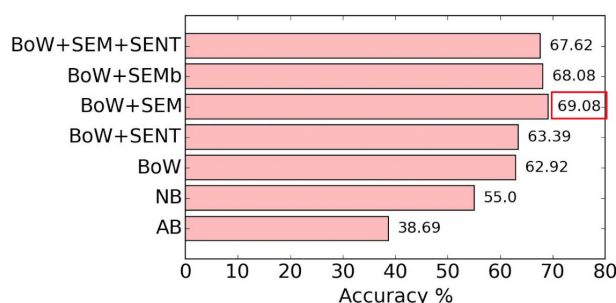
Bag-of-words together with Semantic approaches achieve the highest accuracy among all other methods.

In the part of Music Recommendation, the traditional approaches such as Collaborative filtering and content-based, or a hybrid of both can be used. The hybrid approach is an aggregation of item features and a regression model is trained on every user. The model can learn and be improved by Implicit feedback such as downloads and streaming listening habits.

Conclusion

The Semantic Enriched Graph improves novelty and diversity and the combination with collaborative gestures ensures impressive accuracy. The further improvement lies in an even better explanation of the relation between two entities through NLP.

Reference

1. Oramas, S., Espinosa-Anke, L., Sordo, M., Saggion, H., & Serra, X. (2016a). ELMD: An Automatically Generated Entity Linking Gold Standard Dataset in the Music Domain. In In proceedings of the 10th international conference on language resources and evaluation, lrec.

2. Fang, L., Sarma, A. A. Das, Yu, C., & Bohannon, P. (2011). REX: Explaining Relationships Between Entity Pairs. Proceedings of the VLDB Endowment (PVLDB).

3. Voskarides, N., & Meij, E. (2015). Learning to Explain Entity Relationships in Knowledge Graphs. Proceedings of the 53rd Annual Meeting of the Association for Computational Linguistics, 564–574.

4. Oramas, S., Sordo, M., Espinosa-Anke, L., & Serra, X. (2015). A Semantic- based Approach for Artist Similarity. In Proceedings of 16th the international society for music information retrieval conference (ismir).

5. Oramas, S., Espinosa-Anke, L., Lawlor, A., & Others. (2016). Exploring Cus- tomer Reviews for Music Genre Classification and Evolutionary Studies. In Proceedings of the 17th international society for music information retrieval conference (ismir 2016).