Automatic difference measure between movies using dissimilarity measure fusion and rank correlation coefficients

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Abstract

In this work, we propose a fusion strategy between movie textual metadata and low level image features. The originality of this paper is the use of the rank correlation coefficients with the movie's information, and also the proposal of the successive sorting method to produce the fused measure. The final aim is to get similarity between movies.

Dissimilarity measures

Original title	Year	Duration	Country
Casa	2003	07:07	France
Circuit marine	2003	07:50	France Canada
David	1977	08:45	Netherlands
Gazoon	1998	03:30	France

Audience	Genre
12-15_years Young_adults Adults	Artistic Dramatic
All_publics	Adventure
All_publics	Funny
All_publics	Artistic

Category	Technique
Short-film	Drawing_on_cels
Short-film	Drawing_on_paper Painting Cuts...
Short-film	Drawing_on_cels
Graduation-film	3D_Animation

English synopsis (after lemmatization)
Casablanca summer woman live return young_man ...
eat not be question
eternal battle big small here main character never ...
facetious bird torment ostrich help friend elephant

Producer	Director
Folimage Arte	Sylvie_Lonard
Folimage ONF_Canada	Isabelle_Favez
Cine_Cartoon_Centre	Paul_Driessen
Sparx_Animation_Studios	Romain_Villemaine

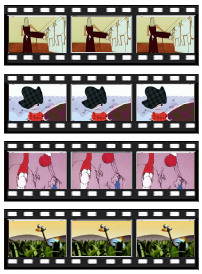
Textual data

$$d_{year}(x,y) = \frac{|year(x) - year(y)|}{50} \qquad d_{dur}(x,y) = \min\left(1\,,\ \frac{|dur(x) - dur(y)|}{1200}\right)$$

Jaccard index: $d_{\cdot}(x,y) = 1 - \frac{|E_x \cap E_y|}{|E_x \cup E_y|}$

Movie couple	d_{year}	d_{dur}	d_{ctry}	d_{gnr}
Casa / Circuit marine	0	0.036	0.5	0
Casa / David	0.52	0.082	1	0
Casa / Gazoon	0.1	0.181	0	0.5
Circuit marine / David	0.52	0.046	1	0
Circuit marine / Gazoon	0.1	0.217	0.5	0
David / Gazoon	0.42	0.263	1	0

Textual dissimilarities



Low level image features characterizing color and rhythm

Movie couple	d_{Weight}	$d_{Choquet}$
Casa / Circuit marine	0.157	0.297
Casa / David	0.318	0.339
Casa / Gazoon	0.134	0.161
Circuit marine / David	0.385	0.465
Circuit marine / Gazoon	0.263	0.336
David / Gazoon	0.184	0.217

Low level dissimilarities

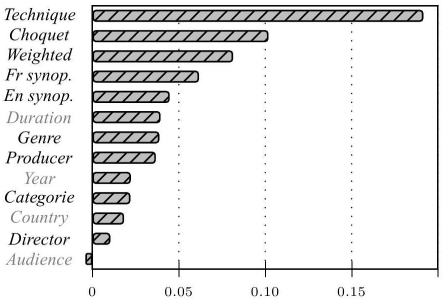
Perceptual dissimilarity annotation on a 5 category scale

Movie couple	d_{Human}
Casa / Circuit marine	0.5
Casa / David	0.5
Casa / Gazoon	0.7
Circuit marine / David	0.5
Circuit marine / Gazoon	0.7
David / Gazoon	0.7

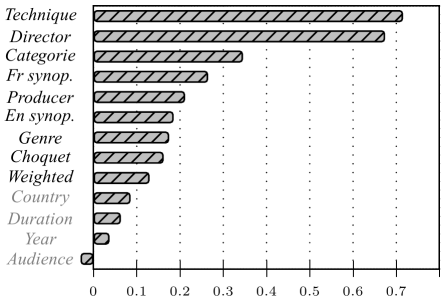
Human annotation dissimilarity

Rank correlation coefficients between human annotation and automatic dissimilarity measure

Kendall's tau: $\tau = \frac{C_3 - D_3}{N_3}$



Goodman-Kruskal's gamma: $\gamma = \frac{C_3 - D_3}{C_3 + D_3}$



C_3 and D_3 are the number of concordant and discordant triples amongst the N_3 considered triples

An object triple (x_i, x_j, x_k) is:

(i) *concordant* if:

$$\begin{cases} d_1(x_i,x_j) < d_1(x_i,x_k) \\ d_2(x_i,x_j) < d_2(x_i,x_k) \end{cases} \text{ or } \begin{cases} d_1(x_i,x_j) > d_1(x_i,x_k) \\ d_2(x_i,x_j) > d_2(x_i,x_k) \end{cases}$$

(ii) *discordant* if:

$$\begin{cases} d_1(x_i,x_j) > d_1(x_i,x_k) \\ d_2(x_i,x_j) < d_2(x_i,x_k) \end{cases} \text{ or } \begin{cases} d_1(x_i,x_j) < d_1(x_i,x_k) \\ d_2(x_i,x_j) > d_2(x_i,x_k) \end{cases}$$

(iii) *tied* (neither concordant nor discordant) if:

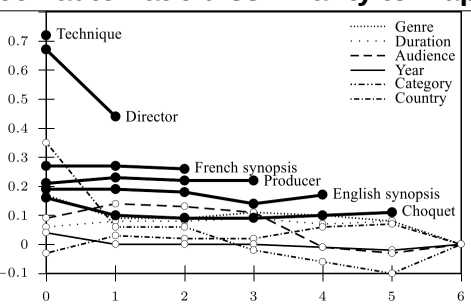
$$d_1(x_i,x_j) = d_1(x_i,x_k) \ \text{ or } \ d_2(x_i,x_j) = d_2(x_i,x_k)$$

According to tau and gamma, it appears that Technique is the most concordant dissimilarity with human annotations

Identifying a fusion strategy between automatic dissimilarity to map human annotation

Movie couple	d_{ctry}	d_{year}	d_{dur}	rk	d_f
Casa / Gazoon	0	.	.	1	0.167
Casa / Circ. m.	0.5	0	.	2	0.333
Circ. m. / Gazoon	0.5	0.1	.	3	0.5
David / Gazoon	1	0.42	.	4	0.667
Circ. m. / David	1	0.52	0.046	5	0.833
Casa / David	1	0.52	0.082	6	1

Successive sorting fusion sample using the lexicographic order d_{ctry}, d_{year}, d_{dur}



Remaining gamma across successive sorting steps (bold lines = used dissimilarities, thin lines = unused)

The remaining gamma technique provides the lexicographic order: Technique, Director, French synopsis, Producer, English synopsis and Choquet. With this lexicographic order, the fused dissimilarity obtained by a successive sorting gives a 0.260 Kendall's tau which increases the 0.192 value for Technique taken alone

Conclusion

A cross validation has been applied. On the training set, Kendall's tau average is 0.294 and standard deviation (std) is 0.02. On the test set, these Kendall's tau statistics reach respectively 0.268 and 0.05.

Future works can extend the present approach in many ways. When thinking about a potential application, one can imagine a system relying on a global ranking such as the fused dissimilarity discussed in the paper. It would allow a user to query the system with its own movie and retrieve all the resembling media within a database. Another way of improvement could be done on "Technique" or "Genre" dissimilarities by using ontologies rather than the Jaccard index which does not operate on semantic dimension of this data. Similarly, for synopsis, semantic networks could be used instead of cardinal index.