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MAXIMIZING THE VALUE OF NETWORKED AUDIOVISUAL LIBRARIES THROUGH GROUP FORMING AGENTS

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Abstract

We make sense of the world around us through stories. They connect us with our past, relate us to the present, and teach us to anticipate future consequences of our actions. The stories collected in audiovisual libraries represent an important part of the accumulated knowledge, beliefs, and values of a community. Therefore, the conservation, preservation, and interoperability of these libraries protect a community's cultural heritage while also improving a community's market potential in exploiting such libraries. This paper presents an agent-based model that increases the potential value of an audiovisual library by searching for synergistic collections to add to the available product range.

1. INTRODUCTION

The art of storytelling, whether through gestures, words, music, pictures, or motion pictures, has an intangible value. Recording these stories on some medium that outlives the storyteller has been a human endeavor since the first pigmented scratches were made on a cave wall. In primitive times, these stories had the effect of increasing the mental fitness, and therefore survival, of individuals in an affinity group. Groups that routinely share knowledge and enforce a value system among its members accumulate cognitive capital and increase internal cohesiveness, both of which are essential for wealth building activities. When affinity groups develop rules of trade with other affinity groups, communities emerge and a trading society develops. A trading society invents financial instruments, such as the securitization of intellectual property[1], in order to facilitate market transactions and tap into the wealth of illiquid assets--including audiovisual libraries.

[1] In 1997, David Pullman engineered a $55 million securitization of David Bowie's intellectual property backed by future revenues from music royalties. Though the practice of securitizing future revenues was not new, the application of this financial vehicle to intellectual property was. Soon after in February 1998, a much larger $294 million securitization deal backed by a 1,200 title film library containing Italian and international films (including the Italian rights to James Bond movies) was announced by Vittorio Cecchi Gori and Merrill Lynch. [1]

2. BUNDLING FOR VALUE

The idea of bundling two or more products for sale as a value pack is not new. There is an incentive for the consumer to choose the bundle since the price of the package deal is (optimally) lower than the sum of the individual items. In the television broadcast industry, content suppliers can, and often, sell licenses as a bundle in order to boost the performance of under-performing titles. The higher performing title in a bundle is a locomotive engine that pulls along other titles that may not otherwise receive exposure. The benefit in exposing less popular titles is an increase in chance that a small following may develop for these works.

In certain cases, the bundle may be priced higher than the sum of the individual items by virtue of being more valuable through the combination, such as for collectible items. In the direct-to-home video market, a collector's edition or a video collection of televised episodes is an added value that some consumers are willing to pay for.

It is essential to create different bundles that optimally target specific customer groups. The general idea is to group audiovisual works into specifically targeted packages that appeal directly to customer types grouped by interest clusters, such that the predicted profit derived from the association is maximized. Content aggregators that cater to specific community demographics should be able to find the audiovisual collections most relevant to their subscriber base.

3. VALUATION OF A NETWORKED AUDIOVISUAL LIBRARY

There are several reasons why it may be necessary to valuate an audiovisual collection. Securitization is just one of the many financial vehicles used to unlock tomorrow's money for use today. The valuation of intellectual property is a difficult and time-consuming task. The determination of the income generating potential of an audiovisual collection depends on a daunting number of factors, most of which are difficult to estimate.

There are three laws on the theoretical value of networked objects. The first law is Sarnoff's Law, which states that the value of a network grows in proportion to the number of nodes on the network.

(1)

$$\textit{Sarnoff value} = a(n)$$

*(where **a** is a weight and **n** is the number of nodes)*

The valuation of an audiovisual library is traditionally based on an "income approach" [2], which conforms to Sarnoff's Law and assumes that value grows linearly with the number of works. For each work in the library, you have to make a projection of the future revenue in each medium or channel of distribution based on historical revenue. If the historical revenue data does not exist, you must then calculate the work's similarity to other works with actual revenue and, using a weighted average, project the future revenue. An estimated "decay rate" is applied to determine the annual

decline in value of the work. Finally, you add up all the projected future revenues and deduct contribution margins. The total future cash flow is discounted to finally arrive at the present day valuation [2]. This valuation does not take into account the possibility that bundling audiovisual works can produce added value because it only sums up the individual revenue generating potential of each component. The value creation effect of two or more complementing or synergistic audiovisual works can, and often does, outweigh the value of each component separately.

Then there is Metcalfe's Law, which states that the value of the network increases in proportion to the square of the number of participants in the network. Phone and email systems are good examples of this law. Every new addition to the network increases the number of potential connections to the new node by the previous population.

(2)

$$\textit{Metcalfe value} = b((n^2 - n)/2)$$

*(where **b** is a weight and **n** is the number of participants)*

For networked audiovisual libraries, Metcalfe's Law has a very detrimental effect on the value of the collection as a whole. The addition of every new library into the network imposes a burden on the existing set of libraries because they must now each establish a communications channel with the new library in order to exchange metadata information. Furthermore, since each new library is a collection of works, assimilating *m* new works into an existing collection of *n* works requires at least $m * n$ operations. (Such "Metcalfe" operations are necessary, for example, to avoid duplicates in a collection.) Interoperability has a high price and Metcalfe's Law indicates just how steep the price will be with each additional library.

If Metcalfe's Law takes value away from network libraries, Reed's Law gives it right back--exponentially. The Group Forming Law [3], otherwise known as Reed's Law, states that networks that encourage the formation of communities can have a value that grows exponentially with each new member.

(3)

$$\textit{Reed value} = c(2^n - n - 1)$$

*(where **c** is a weight and **n** is the total number of members)*

In terms of networked audiovisual libraries, there are an exponentially greater number of groups that each audiovisual work can belong to. However, searching this space for the optimal set of groups is a *hard* problem. To model this problem, we have simulated networked film libraries using an agent-based model where each agent represents a single audiovisual work. Using Reed's Law we have an upper bound on the number of possible groupings of agents, which is computationally out of reach even for modest **n**. Each agent in the model can be seen as an advocate (or fan/aficionado) of the audiovisual work it has been assigned. Agents then try to form groups by interacting with other agents to determine how closely their "interests" coincide.

4. GROUP FORMING AGENTS

Before agents can form groups, they first have to be identified uniquely across all participating film libraries. Although multiple film libraries can catalog the same work, there should still be a single identifier to reference a work that is truly one and the same.

4.1 Standardized Identification is the First Step

The International Standard Audiovisual Number (ISAN) is a numbering system used to uniquely identify audiovisual works [4]. The ISAN is a 96-bit number consisting of 16 hexadecimal digits (12 digits for the root and 4 for the episode) followed by an alphanumerical check character, this is optionally followed by 8 hexadecimal digits to hold the version identifier followed by the corresponding check character.

Film libraries that adopt the ISAN can take advantage of the centralized metadata structure provided by the ISAN International Agency. The central database provides just enough ISAN metadata to distinguish the audiovisual works and the cross-references to producers and participants are text based. Aside from providing the title and type of audiovisual work, one of the more promising aspects of the ISAN metadata lies in the compositional link. Through this link, you may be able to find useful groupings. For instance, if you are the rights owner to a registered audiovisual work, you may be able to query for all works that include your particular audiovisual work as a part of a larger work. *Figure 1* below is a partial view of the ISAN Metadata Ontology.

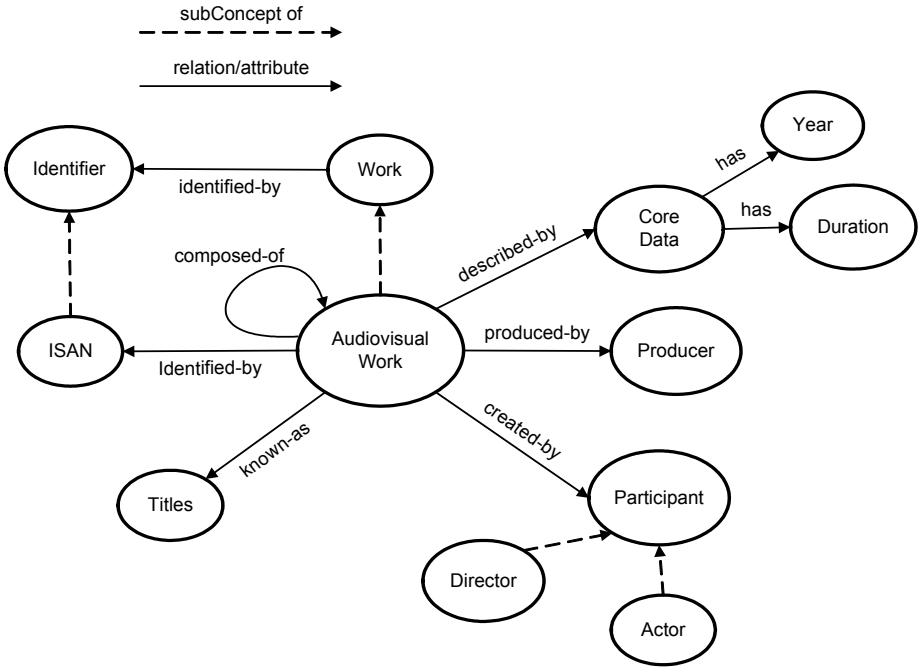

Figure 1 – ISAN Metadata Ontology (partial view)

4.2 Categorization of Audiovisual Works

Each audiovisual work must be classified within their respective film libraries using the *same* Common Metadata Ontology. The issue of categorization and a common ontology is outside the scope of this paper. Further, it is an assumption that the Film Interest Ontology presented in *Figure 2* is congruent to the Common Metadata Ontology. For the sake of simplicity, these ontologies are taken to be one and the same.

Given the following films and their attributes:

A. 1997 Action Comedy Film (20 minutes)
B. 2005 Animated Western Comedy Film (25 minutes)
C. 1993 Romantic Comedy Blockbuster (136 minutes), and
D. 2002 Animated Drama and Action Film (111 minutes)

we can superimpose these instances onto the Film Interest Ontology as shown on the bottom part of *Figure 2*.

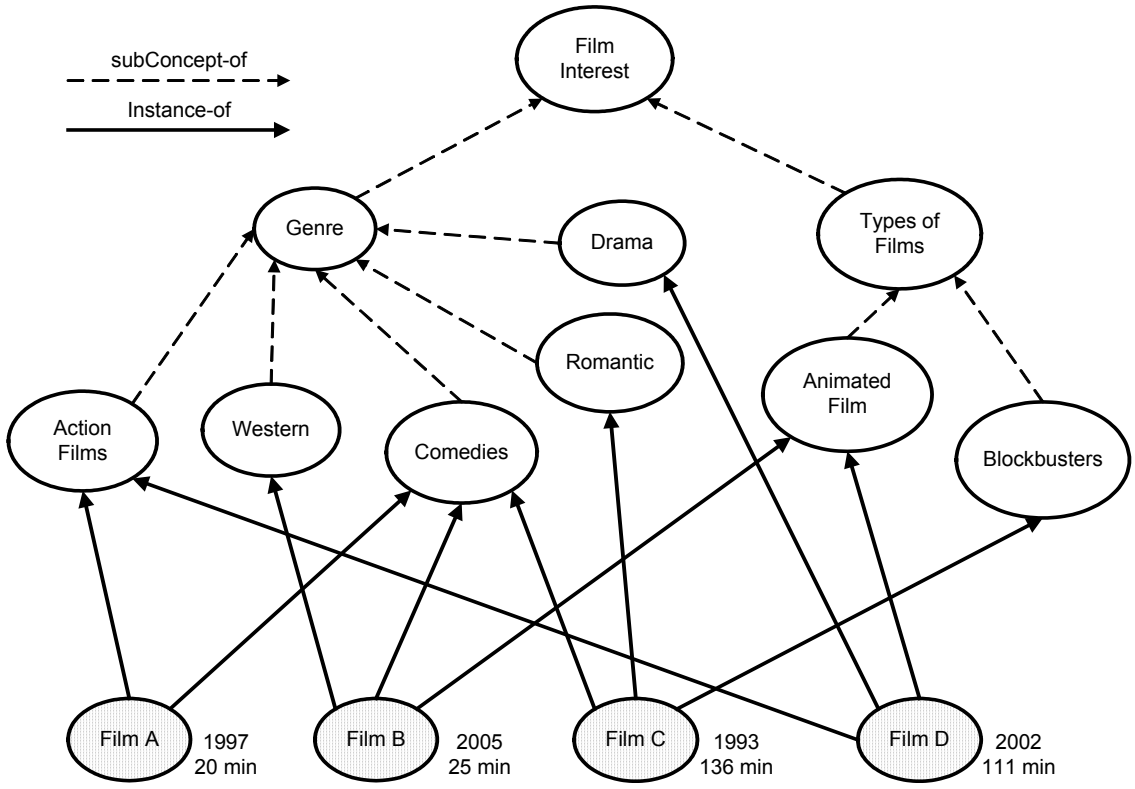

Figure 2 -- Film Interest Ontology / Common Metadata Ontology

4.3 Agent Interaction

In an ideal environment, each agent is paired with every other agent (via a "Metcalfe" operation) to form "named" bidirectional relationships based on measured similarities.

The "named" relationships in *Figure 3* identify eventually the possible groups.

When each agent is paired with another agent for comparison they are measured along three dimensions: Taxonomy Similarity, Relation Similarity, and Attribute Similarity [5]. Afterwards, a weighted average of scores in all three dimensions can be combined to form an Affinity Score [5].

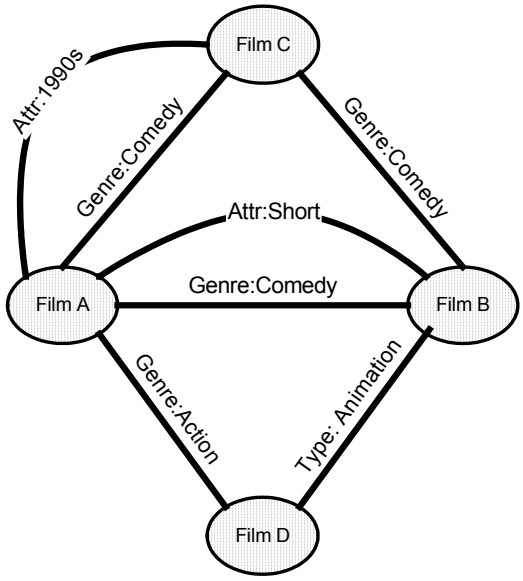

Figure 3 -- Named Relationships based on Paired Comparisons

For the Taxonomy Similarity calculation, the Film Interest Ontology is used. The taxonomy similarity value between two instances is based upon their corresponding concepts and relative positions in the Concept hierarchy [5]. Grouping based on taxonomy similarity creates bundles of audiovisual works that generally belong to the same "subject matter".

For the Relation Similarity calculation, the ISAN Metadata Ontology is used. Relation Similarity assumes that if two instances have the same relation to a third instance, they are more likely similar than two *other* instances that do not exhibit this relation to any third instance [5]. Here is where the ISAN Metadata compositional link comes into play. For example, if two films include the same audiovisual clip, then these two films would have a relation similarity score that would be higher than two films that did not contain any common clips. As another example, if two films are produced by a single person, then these two films would likely have a relation similarity score that would be higher than two other films produced by totally different people. Grouping based on relation similarity creates bundles of audiovisual works that generally involve the same "participants" or "rights holders".

Attribute Similarity focuses on comparing the attributes of the instances. The ISAN Core Metadata is used in this calculation. Film attributes include, among other

metadata, *duration* and the *year* in which the film was produced. Grouping based on attribute similarity creates bundles of audiovisual works that generally share the same characteristics of "expression."

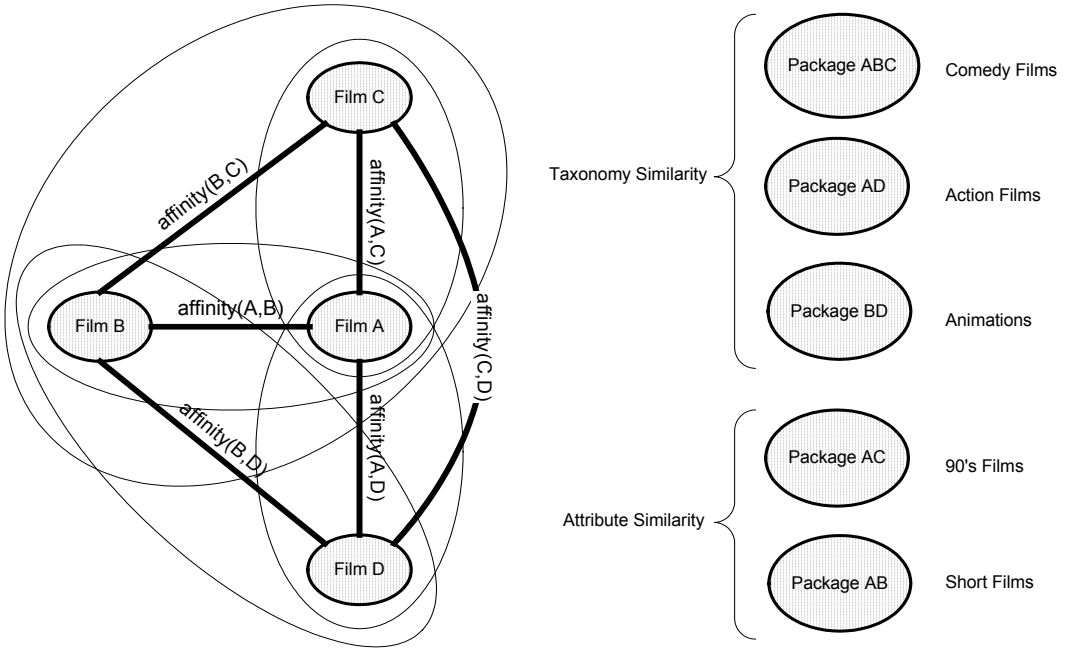

Figure 4 – Forming Groups based on Similarity Measures

Using the taxonomy alone as the organizing principle, the following bundles can be generated: Comedy Film Package (ABC), Action Film Package (AD), and Animated Film Package (BD). Using just the attributes, the following bundles can be generated: 90's Film Package (AC) and Short Films Package (AB).

Based on the given information, unless there is something substantial that ties Film C and Film D together, such as having a common director or simply that someone owns the rights to both films, there is probably no marketing reason to bundle them.

Further, the Affinity Score, calculated for each pair of films, can be used not only to determine general clusters or candidate groups, but also to order the films within a given group. This overall score could then be used to limit group size or further segment a group for market consumption. For example, if the market can only handle bundles of two components due to technical limitations[2], then the Comedy Film Package (ABC) would have to be segmented into Comedy Package 1 (AB), Comedy Package 2 (BC), and Comedy Package 3 (AC).

[2] To illustrate this point, Odeon [6], one of the pioneering record companies, introduced the first double-sided records in 1904 at a time when all records were single-sided. It was through this patented technical breakthrough that gave rise to the idea of bundling for value. Consumers were getting a 2-for-1 deal and previously unknown music artists were given exposure that they would not otherwise receive.

CONCLUSION

Using the ISAN Metadata Ontology in conjunction with a Common Metadata Ontology to organize works in participating networked audiovisual libraries has a value creation effect. Collecting audiovisual works into higher-order groups in order to take advantage of this value creation effect has the *potential* to drive the overall value of the library. The sheer number of possible groupings grows exponentially as the inventory grows linearly. The challenge then is being able to search this space using Group Forming Agents to look for the hidden value. Reed's Law applies just as well to agent-based communities as real communities.

FURTHER WORK

The current value of any consumer product is actually driven by marketing and market forces within a community. Therefore, the value of the products that are grouped by an organizing principle are driven by the groups' appeal to various market segments. This paper has intentionally left out (consumer) agents that represent market segments and instead focuses on group forming (producer) agents. The assumption is that the more groups there are, the higher the market value of such a collection. However, there are factors, such as *market saturation* and *choice overload,* that affect the true market value of organized collections. To model the environment effectively, one must introduce "consumer" agents that track (or even anticipate) market trends and interact with producer agents to determine the optimal product set at a given time.

REFERENCES

[1] The Pullman Group LLC. http://www.pullmanco.com/

[2] Movie Marketing Update
A closer look at the MGM/Sony/Time Warner Triangle (July 2004)
http://www.indiescene.net/archives/Industry-News/A-closer-look-at-the.html

[3] Reed, Weapon of Math Destruction (1999)
Reed's Locus. http://www.reed.com/gfn/

[4] ISAN International Standard Audiovisual Number
User Guide v 2.0 (January 2005) http://www.isan.org/

[5] A. Maedche, V. Zacharias. Clustering Ontology-based Metadata in the Semantic Web (2002)

[6] P. Vernon. Odeon Records (1997)
http://www.mustrad.org.uk/articles/odeon.htm