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SCIENTIFIC STUDY OF RELIGION IN VEXILLOLOGY

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Abstract

Examining the knowledge discovery of worldly flags, this article explores the vexillological use of realistic and abstract presentations of assorted features observed in flags with its association towards religion of an underlying nation. This study raised questions such as: What is the connection of religion in relation to motley of colours, symbols and styles in the flags of a country. How can we express the connection of these parameters to the major religion of any nation. We obtained flags dataset from UCI machine learning repository and applied machine learning techniques of classification to investigate these question of relationship. While doing so, it was necessary to draw a probabilistic model to optimize data fitting in the model. The model is based on Bayesian Belief Network (BBN) in structure learning. The digging of the dataset comes up with some interesting facts and patterns.

Keywords: flag, probabilistic model, colours, emblems, shape

1. Introduction

A flag is usually an emblem consisting of a rectangular piece of cloth with distinctive design. It is by and large rectangular in shape and depicts a symbol. In literature, a word 'vexillology' is used for the study of flags wherein the word, *vexillum* is derived from the Latin which means flag or banner. The history of flags dates back to military adventures and then later on the use of flag got prevalent in many disciplines of human activities such as signalling and identification in railway, roads, military communication and many more in modern civilization. Country flags are virile symbols in their nature. Flags bear motley connotations encompassing strong loyalty to a faith or belief. Moreover, their application is prevalent in advertising, messaging, or for decorative usage. The national flags interpret some kind of religious intentions tinged with patriotic potent in a kind of veneration and reverence of the flag. There are many significant examples in this regard such as the British Union Jack comprises of

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crosses of three saints which is a sign of its strong ties towards religious implication; roman army keep their religious flags erected; Israeli flag contains many religious symbols; the Buddhists flag represent peace, faith and harmony. The flowerers of almost all of the faith show their pride in their respective flags; even bible has mention flags and banner.

This study is an attempt towards analysis of various parameters found in flags and their connection to religion. We used scientific methods such as data mining or machine learning; as the name suggest, data mining deals in digging out the data for the purpose of extracting useful knowledge or interesting patterns from piles of data. The data mining technique has the potential to turn the machine into an intelligent device. Moving a step ahead, data mining techniques has been grouped into classification, clustering, regression and association rules. Among all of these classification techniques are significantly more popular and has been used extensively in various domain. In the domain of classification, various intelligent heuristics have been proposed.

We obtained in this study dataset of flags from UCI machine learning repository [C. Blake and C. Merz, *UCI repository of machine learning databases*, 1998, http://www.ics.uci.edu/~mlearn/, MLRepository.html, accessed on December 2012] followed by the application of various classification techniques. Among all of the classification techniques, BBN was of great importance due to two reasons. First it give relatively better accuracy as compared to its peer technologies. Secondly its deliverable is a graph (network). The rationale a graphical representation also known in the name of Directed Acyclic Graph (DAG) lies in the fact that this DAG is quite useful to give insight into the cause and effect of various parameters involved in a dataset in a probabilistic term.

2. Literature review

Although history of flags or vexillology is very old; however, the modern era with consideration of sanctity of flags emanate in eighteenth century during French and American revolutions [1]. Since then, every group or specific segment of people with a motive of pursuit of its unique identification devise a flag. The modern flag can be traced back to antediluvian period. The first flag has been discussed in 3000 BC in china. Later on, the use of flag got its popularity in the rest of world [1, p. 48–56; 2].

Sociological significance of the flag is an ‘emotional symbol’. Such symbol evince an emotionally rugged and relatively undifferentiated way by which any system intends to its participants [3]. More to say, functions of the flag in modern society is not only limited to emotional symbolism; yet the flag is exercised to ‘evoke powerful emotions of identification with a group’ [4] in a fashion where flag is termed equivalent to a tribal totem [5]. The flag permits an individual to represent his/her fidelity and commitment to his/her underlying nation or segment of the people with a focus of beefing up the solidarity among its members [1, p. 103; 2, p. 23; 6]. The consecrated and hallowed meaning

affixed to a flag through the exercise of liturgy is akin to carry out a religious ritual [7, 8]. Even in literature the overwhelming importance of flag in the life of a nation has been termed 'cult of flag' [4, p. 351; 9]. It was described that this cult elicits strong emotional reactions and relations heading to the extent of self-sacrifice.

In recent era, it has been observed that some flags have been introduced with a symbolic theoretical boundary. Some instances include UNO, NATO, ASIAN, EU, Arab League and many more. Some of the flags are look like; they include these pair of flags: Niger vs. India; Cote D'Ivoire vs. Ireland; Chad vs. Romania; Western Sahara vs. Palestine; Indonesia vs. Monaco. However, the flags have some minor difference to each other. In some countries, such as USA, Sweden, Austria and Lebanon, a Flag Day is officially celebrated to highlight the sanctuary of the flag in the national ceremonialism exercising a 'ritual display of national unity' [10]. Moreover, numerous nations are mobilized by means of using the flag as a solidarity mechanism. Such activities surely fortify the bond between Shrewd management of public affairs, dominion and public itself.

The subject of vexillology has been addressed in various dimensions. Whyte examines various flags and produce a classification based on parameters like vertical half of the flag near flagpole, base colour, any design element and others [11]. A grouping was introduced like terrestrial map flags, celestial maps flags with further sub classification. They argued about the usage of the maps at different levels of abstraction on flags, documenting examples at supranational, national, and sub-national levels with an understanding of why and when maps are used in flags. They addressed six trenchant and distinguishable reasons why maps are not commonly placed in the maps.

Podeh [12] give an insight into the evolution of modern Arab flags and also give some limited statistical information which were restricted to only Arab world. The study presented by Podeh is a bit relevant but their study was presented in a historical perspective while we deliver a scientific view using a lot of features present in the flags of the nations. We discussed the possible connection between these features of flags where some interesting pattern were presented.

3. Materials and methods

With the advent of modern computational techniques, we are confronted with an avalanche amount of data in every domain of life. Researchers realized that such data contains useful hidden information. This motivation brought the field of data mining and machine learning. Bayesian Belief Network (BBN) is one kind of such technique to extract interesting patterns from the data. Bayesian networks in the literature have been reported as well known graphical representation of probabilistic relationship between random variables [13]. Bayesian network has been recognized as effective and widely used frameworks for inference and induction. Bayesian network modelling has its advantages in

comparison to artificial neural networks, decision-making tree and the density estimation methods. It is useful to recall its prominent characteristics.

(1) Once the Bayesian network is established, new features can be easily joined keeping in view of the current structure.
(2) This network model is well suited for handling incomplete data sets with uncertainty [14].
(3) It is resilient on the loss of input data. Usually the statistical models have the tendency to cause a deviation for the model on the loss of one input data. Bayesian network model cope with this issue by taking sum or integration of all the probability of possible values.
(4) Bayesian networks is not only an expression of probability but also a reasoning model, it holds the ability to better reflect the over-fitting of the model in context of combination of input data and prior knowledge in a probabilistic approach.

Standard classification technique requires preliminary identification of an outcome feature in order to draw inference on any feature in the dataset. A Bayesian network is an appropriate tool and space efficient data structure for working with the uncertainty to encode available information within a dataset in a way which is typical of real life data applications in various domains. A Bayesian network is graphically denoted as a directed acyclic graph (DAG) in which random features from dataset are realized by vertices of the directed graph. Each node is conditionally independent of every member of the descendant subset and conditioned parent of this node are given. The arcs connecting the nodes are considered a representation of the casual representation among nodes, which is why Bayesian network is also known as causal network. Some other alternate naming conventions used in literature for Bayesian Networks are: Bayes Nets, Belief Nets and Probability Nets [15]. However, in machine learning and knowledge discovery, learning Bayesian Network structure from database has been reported as an NP-hard problem [16]. The process of learning the construction of network as directed acyclic graph is considered as critical as well as challenging. Several techniques have been reported for learning Bayesian networks from dataset [17].

4. Experiment

The flag dataset contains 194 cases (records) and 30 attributes (features). The dataset originally was provided with remarks that any feature can be considered as class as per requirement. However the donor of the flag dataset endorsed ‘religion’ as a potential class in application of classification. Among 30 attributes there were 13 numeric and 16 categorical attributes. We decided to choose religion feature as class, Moreover, while preparing dataset, we eliminate three features ‘name of the countries’, ‘area’ and ‘population’ as these features have no direct or indirect relation towards religion of a nation in a sense of cause and its effect in a probabilistic model like BBN. A *religion* is defined as a realization and recognition of what happens to a person after demise of his/her

life where in this idea is part and parcel of a series of instructions and command for how to live life. There were seven distinct religion considered in this experimental dataset. These include Catholic, Non Catholic Christian, Muslim, Buddhist, Hindu, Ethnic, Marxist while all of the other beliefs were considered in 'Others' category.

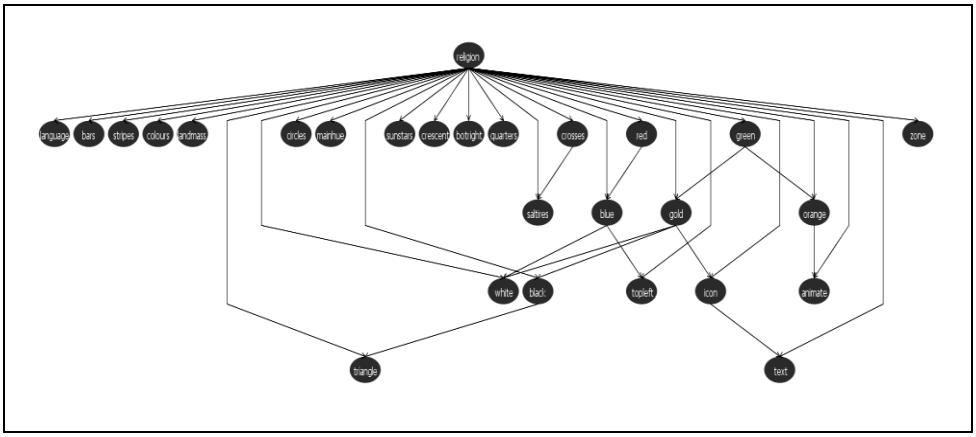

Figure 1. Directed Acyclic Graph using BBN with AIC Scoring Function (Accuracy: 64.43%).

Table 1. Conditional Probability Table for Text, Icon with Religion (class)

Religion	Icon	Text	
		False	True
Catholic	False	0.956	0.044
Catholic	True	0.813	0.188
Non-Catholic	False	0.988	0.012
Non-Catholic	True	0.625	0.375
Muslim	False	0.953	0.047
Muslim	True	0.417	0.583
Buddhist	False	0.900	0.100
Buddhist	True	0.700	0.300
Hindu	False	0.875	0.125
Hindu	True	0.750	0.250
Ethnic	False	0.929	0.071
Ethnic	True	0.938	0.063
Marxist	False	0.955	0.045
Marxist	True	0.750	0.250
Others	False	0.875	0.125
Others	True	0.750	0.250

Before we explain the information obtained in the experimental work in this study, it is useful to give a detail of conditional probability table drawn out of a learnt structure representing the flag dataset. Table 1 illustrates one of the Conditional Probability Table (CPT) which is derived from Figure 1. As a directed acyclic graph (learnt structure) is constructed. Each node in this graph holds a probabilistic detail of its relationship with the assumed class (herein Religion is assumed as class node). The tabular information in Table 1 is CPT for feature 'Text' found in the dataset of the flags. The text feature is a Boolean feature which indicates that it contains only two states: true or false. In other words a flag bears a text on it or not. The same is true for feature 'Icon'. Hence a translation of first record in this CPT shown in table 1 would be such that 95.6% of Catholic belief nations with icon on their flag certainly contain no text at all. Feature which has direct relationship with religion contains a simple two dimensional CPT. Whereas the features which are associates with two or more features contains relatively large CPT albeit the complexity of explanation is still simplistic which is a particular characteristics of this information systems. After this introduction of how the explanation is drawn from this DAG, we shall discuss each of the features in context of its relation with religion.

Number of different colours in the flag: this parameter in flags was in range of 1-8. Three values were of somewhat interesting which include 2-4 number of colours in a flag, as smaller number and higher number of colours are found in less probability in general. The significant probability measure includes 44.7% of Marxist nation flags bear three colours and 44.3% of catholic contains three colours in their flags followed by non-catholic Christians whose 39.8% contains three colours. This can be converged into conclusion that in general, three colours are more popular in nations with Christians beliefs. However, when we talk about two and four colour flags then it was observed that such flags were found more popular in Muslim nation countries where 33.8% of whole of the Muslim nation flags contain two and four number of colours for each. Moreover ethnic flags were mostly found in three and four colours (37.1% for each). The fact can also be deduced from the reporting made in literature where it was described that among 22 Arab states, ten states the same colours (green, white, black and red) in their national flags; of the remaining 12 states most rely on red or green [12]. The importance of colour in flags can not be set aside. Whyte [11] reported that the symbology of flags using colours and shapes has the deep potential to visually convey substantial facets of the peoples or political entities. Colours such as blue inspired from a water channel (river, lake, stream, sea), or the sky; green for Trees, grass, or forests; and last but not least red for the soil of the mountain land are in use unremarkably.

When we draw CPT for number of vertical bars in the flag then it was revealed that it has no specific connection towards the religion of a nation. In all of the religion, it was observed that majority (64.7% to 88.8%) of the flags bear no vertical bar with an exception for catholic religion in which 22.4% of catholic belief nations contain 3 vertical bars. Another important observation in number of vertical bar is that only three vertical bars are relatively popular in catholic,

Muslim, non catholic, ethnic and Marxist to some extent while other number of vertical bars including 1, 2, 5 were quite negligible in trends.

4.1. Number of horizontal stripes in the flags

The general trend in all of the religions indicate that flags with no stripes ranges from 25% (Hindu) to 67.4 (non-Catholic Christian) flags. The horizontal stripes were found in many numbers including 1 to 9, 11, 13 and 14. Among all of these only one figure was noteworthy, which is 16.7% of ethnic nation flags containing three horizontal stripes. Other probability distribution was of no importance in particular.

4.2. Language

45.6% Catholic speaks Spanish language, 56.2% non-Catholic Christians speaks English, 47.6% Muslims speak Arabic followed by 15.9% French language and 18.3% miscellaneous languages. 26.9% Buddhist speak Chinese language. 27.8% Hindu are well aware of English language (either their first or second language probably). Majority (57.8%) of ethnic religion speaks diverse language and not particularly tied up to a specific language. Approximately a quarter (22.5%) Marxist speak Slavic language.

4.3. Landmass

Landmass means North America, South America, Europe, Africa, Asia and Oceania. The BBN graph' conditional probability table gives result that Catholic nations are mostly concentrated in South America, Europe and North America with the probability distribution of 33.7%, 31.4% and 22.1% respectively. Non catholic believers are mostly resident of N. America and Europe (34.1% and 21.4%) followed by Africa (11.9%). Muslim nation were found in Asia (52.6%) and Africa (39.7%). Dominant majority of Buddhist reside in Asia (77.3%) while 88% of ethnic nations live in Africa.

4.4. Number of circles in the flag

Flags contain 1, 2 or 4 circles in figures. Only two patterns were found regarding circles. In first pattern, 25% Buddhist nation flags contain single circle and in second pattern, 25% of Hindu nation flags bear one circle. No other significant pattern was noteworthy.

4.5. Mainhue

It is predominant colour in the flag. In case of tie decision proceeds by considering the topmost hue, if that fails then the most central hue, and in the last, even if that fails in deciding then the leftmost hue is selected as mainhue.

The mainhue includes blue, brown, gold, green, orange, red and white. Here gold and yellow both are taken in same. The interesting patterns observed are such as: 35.2% of Catholic nations flags contain red as mainhue; 35.8% and 25.8% non-Catholic Christian nation flag contain blue and red colour as mainhue respectively. For Muslim nation flags, the dominant mainhue colour includes red (38.8%) followed by green (31.2%). This is also true for ethnic religion where 33.9% and 27.4% ethnic flags contains red and green colour respectively. The prominent mainhue for Buddhist nation flags is red (37.5%). For Hindu nation no particular mainhue observed. Another significant pattern found is for Marxist where 55.3% Marxist flags bear red colour.

4.6. Botright

It is the colour in the bottom-left corner (moving towards left is used to decide tie-breaks). In this parameter like mainhue, the dominant colours are red, blue and green. Red colour was observed in 46.6% of catholic flags, 28.9% of non-catholic flags, 26.2% of Muslim and 45.8% of Hindu nation flags. Blue colour in bottom right was seen for 39.8% of non catholic Christians and 26.1% of catholic flags while green colour was observed in 33.8% of Muslim flags and 43.8% of flags of ethnic belief nations.

4.7. Shapes

Shapes such as stars, crescent, icons in a flag potentially express the constituent component of a polity. It can be expressed that these symbologies brings up a certain degree of abstraction and visual representation. They demand particular information about the polity to construe.

4.7.1. Sunstars

It is number of sun or star symbols found in range of 1-10, 14, 15, 22 and 50. Only single star/sun was observed interesting probabilistically where a percentage of 38.6, 33.8 and 33.7 Marxist, ethnic and Muslim nation flags contain single star on their flags. In fact certain symbols such as eagle or star in a flag shows the uniqueness of that national heritage and proud.

4.7.2. Crescent

Among all flags, only two nations flags were ascertained to carry out a crescent. These include 23% of Muslim and 30% of Hindu nation flags. In case of Christian, ethnic and Marxist there was no trend for bearing crescent on their flags.

4.7.3. Quarters

It denotes number of quartered sections. This feature mostly found in 28.5% of non-Catholic and 36.8% of Buddhist.

4.7.4. Saltires and crosses

In the procedure of learning structure from the dataset, the saltires received inference from circles as well as from the class feature that is religion. It means the probabilistic discussion is required in terms of both of these features. From the learning of structures, interesting patterns are: non catholic with two upright crosses and one diagonal crosses and secondly Buddhist with single upright crosses and a single diagonal cross were probabilistically higher.

4.7.5. Triangle and black colour

Both of these features again were related such that triangle get inference from black colour and its class at the same time. The only pattern found in it was related to Hindu belief nation where 75% probability found with presence of triangle and black colour in flag.

4.7.6. Text with icon

Two interesting information were achieved. First 58.3% and 37.5% of Muslim nation flag and non catholic flags respectively contain icon and text on their flags.

4.7.7. Animate with orange colour

The feature animate indicates an image of living object like eagle, human hand or a tree. This feature also obtains inference from feature orange as shown by Figure 1. Three interesting patterns were observed. 83.3% of ethnic flags, 70.8% of non-Catholic flags and 75% of Marxist nation flags bearing both animate object and orange colour.

4.8. Zone

Geographic quadrant based on Greenwich and the Equator. These include North East (NE), South East (SE), South West (SW) and North West (NW). As a matter of fact, the geographical distribution of various nations is a common knowledge. In this study, we shall discuss it as a test case whether our results are valid or not. Catholic nation mostly concentrated in NW (41.7%), North East (32.1%) and SW (25%). Non catholic flags distribution was NW (44.4%), NE(25%) and SE (20.2%). 77.6% of the Muslim flags belongs to north east

hemisphere. 85% of Buddhist nations reside in north east. 85.3% of Marxist nations also reside in north east zone.

In colours there was one important pattern. The presence of three colours white, gold and blue were mostly ascertained in non catholic flags with a probability distribution of 86.5%.

Apart from these individual parameters learning, some general trends were also retrieved out of this structure. If no crosses and no quarters then no saltires. If no triangle then no crescent. These were some generalized patterns for unavailability of some peculiar characteristics of feature in which first rule was having 99% confidence while the second rule was having 94% confidence.

This was a detailed excerpt from the analysis of each parameters commonly found in flags. We shall now turn our attention to the conclusion.

5. Conclusions

A flag belonging to a certain group of people furnish them with idiosyncratic pride and bring forth a sense of 'we-ness' with a distinctive recognition. It can be articulated that a nation is identified through a triangle of symbols consisting of a flag, an anthem and an emblem; in other words this triangle is a representation of sovereignty of any nation with its deep roots in ideology, culture and history. Albeit there are many nations which have flags resembling to each other; however a flag to every nation has its idiosyncratic impression through a course of hues, design, number of bars, any specific icon or textual slogan placed at a specific position. A flag is of great essence in a nation's history. Numerous studies have been introduced with an analysis of flags in pragmatic factors. However, we noticed that advanced computational techniques can yield interesting patterns in the field of vexillology with a focus on religion. This motivates us to deliver a scientific study in vexillology. According to our information, such study is currently non existent and this study is quite novel and original in its nature. After application of fitting the data into a model, we may conclude that some colours are particularly akin to nations of a specific religion. Red and blue colours are mostly popular among Christian nations. Green and red are popular in Muslim nation. Crescent colour is mostly a symbol particularly attached to Muslims and many more delicate findings were presented in this study. By testing and applying the implications of a powerful probabilistic model, we can achieve understanding about the relationship between various essential features found commonly in the flags to the religion of the worldly nation.

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