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Online Classification Notation: Proposal for a Flexible Faceted Notation System (FFNS)

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After a review of the development of notation for manual library classification systems and a discussion of qualities deemed necessary for such a notation, this paper suggests qualities appropriate to a notation for online classifications. Then a notation system called the Flexible Faceted Notation System (FFNS) is proposed, and the means by which it achieves those suggested qualities for an online notation are described. It is argued that the FFNS can be used to facilitate both the creation and the use of an online classification. (Author)

1. Introduction

Classification notation mainly serves to represent subjects and denote the order in which these subjects are arranged in a classification schedule. Sayers stated that "As it [classification notation] is merely a symbol for terms, it cannot be more important than the terms themselves; it is a piece of apparatus added to the classification"(1). Vickery also advised that "Notation is only a tool; it must always be subservient to the indexing order it is designed to preserve and display; it must never be allowed to dictate that order"(2). It seems generally agreed that notation should by no means determine the structure and arrangement of a classification; it should be assigned to terms only after the classification schedule has been worked out.

Nevertheless, notation should not be underestimated, as it is essential to the practicability of a classification. Without a classification schedule, a notation would be meaningless, but without a notation, it would be very difficult, if not impossible, to apply a classification to documents. H. E. Bliss gave a very precise statement about the limitations and importance of a notation, "The classification is the main thing, and the notation, however real its service, does not make a classification, tho it may mar it"(3).

Since the appearance of the Decimal Classification in 1876, much has been written on notations used for ordering books onshelves. Today as library catalogs are being automated, research is being addressed to the use of existing classification system in online environments (4,5,6). Not much, however, has been published on how to design an online classification and, in particular, how to design a notation for such a classification. In this regard, several questions can be raised:

- *Are existing notations created for shelving books in the stacksappropriate for an online catalog?*
- *Are the qualities necessary for a shelf-ordering notation still needed for a notation in an online environment, or are new qualities required?*
- *Can a different notation be developed that is more appropriate for the online environment?*
- *Can such a notation be generated and manipulated effectively by the computer?*

This paper will attempt to answer these questions after a review of the literature on notation. It will also propose a notation designed for an online environment, which is intended to demonstrate one of many possibilities for a notation to be used online.

2. The Development of Notation

Writers have agreed that a good notation should have the following qualities:

Hospitality, i.e., allows interpolations of new subjects at any point.
Expressivity, i.e., conveys hierarchical structure.
Brevity.
Mnemonics, i.e., uses the same notation to denote a given subject wherever in the schedule the subject occurs.

The following discussion provides an overview of how notations have been developed to meet these requirements.

A series of ordinal numbers applied to subjects enumerated in a list was the earliest and simplest form of notation. Its sole purpose was to give each document an address and make the filing and finding of documents easy. It is obvious that such a notation was not hospitable to new subjects. To allow for future growth, the notation had to reserve gaps between numbers. Early in this century, a British scheme, James Duff Brown's Adjustable Classification, was designed based on the gap device (7).

Providing interpolation of new subjects began in a very simple manner. Melvil Dewey was not satisfied with the gap device, because no more new subjects could be accommodated when all the gaps were filled. He found a better way of allowing interpolation of new subjects, namely by the use of a decimal notation from which his

scheme took its name. In decimal notation, interpolation is infinite, that is, a series of numbers

1, 2, 3 ... 8, 9

can be extended successively in the following manner:

1, 2, 21, 22, 23 ... 3 ... 8, 9, 91, 92 ...

For instance, when a new subject appears as a subdivision of the class 3, any of the digits 31...39 could be assigned to it.

Another significant feature of the Dewey Decimal notation is that it reflects hierarchical structure, as illustrated in the following example:

796.3 Ball games
796.33 Football
796.333 Rugby
796.334 Soccer
796.34 Racket games
796.342 Tennis

As compared with purely ordinal notation, Decimal notation is often said to be expressive, because it reflects the hierarchical structure of the classification scheme. A notation which reflects faceted structure may also be called expressive. To differentiate the expressiveness of hierarchical structure and faceted structure, this paper uses expressive for the former and synthetic for the latter. One of the advantages of an expressive notation is that it makes systematic browsing easier, and helps the user to broaden and narrow searches more easily.

Suppose someone is looking for information on "Football" and finds nothing at 796.33. He could then broaden or narrower his search just by dropping or adding digits. Because this kind of capability appears so attractive, expressivity has been regarded by some authors as a very important quality in a notation (8). But, expressivity is in conflict with hospitality, and often a choice between these two qualities has to be made, as will be discussed more below.

Although the Decimal notation allows infinite interpolation of new concepts, its growth can take place only hierarchically, or in chain. New subjects, however, can develop in two dimensions: hierarchically and collaterally, that is, some being subdivisions of existing subjects, and some being coordinate with existing ones. In Ranganathan's words, a good notation must provide both hospitality in chain and hospitality in array. In the Decimal Classification, hospitality in array is usually achieved only at the expense of expressivity. For example, to insert "Basketball" between "Football" 796.33 and "Racket games" 796.34 can be done by placing it at, say, 796.339. "Basketball" 796.339, however, does not appear to be coordinate with "Football" 796.33 and "Racket games" 796.34, but rather with "Rugby" 796.333 and "Soccer" 796.334, which are subdivisions of "Football". The conflict between expressivity and hospitality can be clearly seen here. Another difficulty with an expressive notation is that it tends to be longer than a non-expressive one. Coates provides a very good discussion of this point (9).

Ranganathan realized the Decimal notation's inability to provide hospitality in array, and sought to solve the problem by means of the 'octave device' in his Colon Classification (10), This is a method of extending a series of digits infinitely by reserving the last of the series as a repeater. Thus by reserving the number 9 as a repeater, the series of digits

1, 2, 3, 4,...

can be extended beyond eight by

91, 92, 93...991, 992...,

all of which are then considered as co-ordinate with

1, 2, 3...8.

The device works well when new subjects are added to the end of an array, but fails when a new subject needs to be inserted between two consecutive coordinate subjects, for instance, between 3 and 4.

Years later, Ranganathan postulated the emptying digit device to provide interpolation between two consecutive ordinal numbers (11). An emptying digit is a digit that deprives a preceding digit in a digit group of its semantic value, but retains its ordinal value. For example, to introduce a new subject between subject P and Q, 'X' can be used as an 'emptying digit', and the digit-pair 'PX' can be used to represent the new subject. In PX, X removes the semantic value of P, but retains its ordinal value so that the digit-pair PX is coordinate with the digits P and Q. With an emptying digit, the Colon Classification can permit infinite insertion of new subjects anywhere in an array, but the expressivity of the notation has been attenuated: PX or PY1 do not appear to be co-ordinate with P and Q. Clearly, even with the octave device and the emptying digit device, full expressivity cannot be achieved. It should be noted that using the emptying digit device to provide interpolation between co-ordinated subjects is really not much different from the approach used by the Decimal notation, which is often called decimal fraction. Ranganathan, however, systematized the idea and gave it a precise name.

Ranganathan developed his Colon Classification using an analytic-synthetic approach, and provided it with a completely synthetic notational structure. The notation of the Colon Classification not only reflects hierarchical structure, but also synthetic structure. From a typical Colon notation, we can tell what the main class of the subject represented is, which facets of the main class appear in the subject, and how the main class stands within the hierarchy of each facet. Since the advent of the Colon Classification, synthetic structure has been regarded as another quality a good notation should have.

To try to meet all requirements mentioned above, especially expressivity, notations have become hopelessly complicated, and are not yet successful, because the conflicts between hospitality and expressivity, and between expressivity and brevity are too difficult to be reconciled. Having realized this, a few authors began to question the necessity of having an expressive notation. In his lecture on notation, Palmer argued that expressivity should be abandoned so that a notation could provide infinite hospitality at any point (see (7)p.42-43).

Because an expressive notation thwarts hospitality and is often very long, a non-expressive hospitable notation, which is shorter and simpler may very well be a better alternative. In 1957 Coates proposed a non-expressive notation (see (9)), which could achieve all qualities of a good notation, except expressivity. His no-

tation was very brief and short, and permitted infinite interpolation of new subjects and facets at any point. He applied the notation to the British National Bibliography (BNB) Classification for Music, a modern faceted classification. In 1965 at the Second International Study Conference on Classification, Dobrowolski proposed a Notational System with Short Symbols (SS) (12). While his notation does not show hierarchical structure, it is a very brief and short. Dobrowolski believed that "the brevity of the codings has a beneficial effect on the structure of the classification table, because the maker of the classification need not fear that his diagram will develop too much in breadth and that the coding will become excessively lengthened" (see (12) p.149). Present day notations, especially those used in modern special classification schemes, have tended to be non-expressive, faceted, and brief.

Having seen how notation has developed, its structure, and its current state, we will now discuss qualities appropriate to a notation for classification in an online environment.

3. Qualities of Notation for an Online Classification System

In her paper "An Ideal Classification for An Online Catalog" (13), Svenonius asked if the canons of hospitality, expressivity, and mnemonics are still needed for the design of notation for a classification system meant for an online environment. She even asked if a human-readable notation is needed, "since the ordering and linking of terms can be accomplished internally by pointers" (13). This paper will not attempt to answer the second question, but does discuss what qualities a notation for a classification system in an online environment should possess.

First, let us list all qualities that have been commonly considered necessary for notation, then discuss which qualities are needed for the design of notation in an online environment, and what new qualities, if any, should be added. Generally, a good notation should be:

Hospitable
Expressive
Short and brief
Mnemonic
Synthetic

Hospitality is a quality which any notation should have so that new subjects can be easily and properly accommodated. A notation which is not hospitable is hardly of any use. However, as we have already seen above, to achieve hospitality in both chain and array, full expressivity cannot be maintained. Some authors regard an expressive notation as useful for broadening and narrowing searches, especially in an online environment (see (8) p.45-46). While expressivity may aid broadening and narrowing searches, such operations are possible without it. Actually, there are many ways in which the computer can easily accomplish these operations in a consistent and reliable manner. So far, there has been no system that has achieved complete expressivity; as Coates puts it, "compromises and exceptions are made at all levels" (see (9) p.57). Because of these compromises and exceptions, broadening and narrowing searches are not always as simple as dropping and adding digits, and sometimes can be very complicated and cumbersome (14). In an online system, hierarchical structure can actually be better displayed by means other than notation, for instance by an indented hierarchical display on the screen (see (6) p.184). These are reasons then for removing expressivity from the list of qualities needed for notation in an online environment.

Shortness, or brevity, is another quality which it is deemed any notation should possess. If a notation is to be used by the user, it must be easy to write and remember. The acceptability of a notation depends very largely on its ease of use. Although direct use of notation by the user might be much less in an online system, as opposed to a manual one, a notation should still be as short and simple as possible.

Mnemonics are often said to be useful in assisting the memory of the user of a classification. Actually, mnemonics probably aids librarians more than library users (15). There are generally two kinds of mnemonics. One, systematic mnemonics, refers to the consistent use of elements of a notation, such as common form or geographical divisions. The other, literal mnemonics, refers to the use of letters in a notation in such a way that the symbol for a class is the initial letter of the name of the class. For example, in LC, Technology is class T. It can be argued that mnemonics is a subsidiary quality of a good notation, and should be striven for only when not conflicting with any other qualities. Bliss, for instance, stated that literal mnemonics "should be casual; they should just fall into the system, fit there, and belong there; they should not be forced into place" (see (3) p.70). It might be noted that while mnemonics is not considered a necessary quality, a good synthetic notation will automatically possess this property.

Mills, in his book, *A Modern Outline of Library Classification*, argued "a notation should use the syntheticprinciple" (15). He maintained that true hospitality can be achieved only when notation has a synthetic structure. A faceted notation offers a special advantage, when it is used online. The computer can make use of the synthetic structure of faceted notation to decompose a class number for a compound, a class which contains two or more topics, and rearrange its components in many desirable ways. For example, the computer can rotate a compound under each component if it is so desired. Further, this compound can be accessed by each of its components or facets. This will be discussed further below. Because synthetic structure offers these advantages and does not seem to affect hospitality and brevity, synthesis is considered a desirable quality.

In addition to these qualities so far mentioned, three more seem appropriate for a good online notation. First, the notation should be easily generated and manipulated by the computer. This quality is desirable because assigning notation to classes manually can be very time-consuming and error-prone. Secondly, the notation should be capable of being used to generate a hierarchical display, and to broaden and narrow searches. Lastly, the notation should be flexible, that is, it should allow for alter-

nate arrangements of a compound or synthetic number so that a multitopical book can be classified and accessed in more than one place. The need for alternative locations and treatments has been advocated by many authors, but has not been widely implemented by manual systems, at least not in the United States. Such a need, however, should be met by the notation used in an online classified catalog. In summary, a good notation for an online classification should be:

Hospitable
Synthetic
Short or brief
Generated and manipulated easily by the computer
Capable of generating hierarchical displays
Capable of broadening and narrowing searches
Flexible

The following section will propose a notational system designed for a classification meant for an online environment and believed to possess all these qualities, at least to a great degree. It is called the *Flexible Faceted Notation System* (FFNS), and is close to completion.

4. Flexible Faceted Notation System

The proposed FFNS is an ordinal faceted system which uses the principle of inversion to create compounds. The principle of inversion states that the filing order of collateral facets in a schedule must be the reverse of their citation order in the facet formula (see (15) p.45-46). Ordinarily in schedules using the inversion principle, the most significant or most concrete facet is placed last. The following example from Buchanan's book (see (16) p.74) illustrates the principle:

Schedule:
- Linguistics
  - Grammar – The Problem facet of Linguistics
  - Etymology
  - etc.
  - English – The Language facet of Linguistics
    - Grammar
    - Etymology
    - etc.
  - French
    - Grammar
    - Etymology
    - etc.

Facet Formula:
- Linguistics – Language – Problem

The language facet in the above example is considered more significant than the problem facet and therefore is placed before the problem facet in the facet formula, but filed after the problem facet in the schedule. The Zoology scheme in Figure 1 will be used as an example to illustrate the FFNS (the Zoology scheme is taken from Buchanan's *Theory of Library Classification*, 1979).

Figure 1. Hierarchy Display with Notations Automatically Assigned.

Zoology	8
(Form of presentation facet)	C
Essays	Ce
Periodicals	Cp
(Operations facet)	F
Collection	Fc
Experiments	Fe
Field experiments	Ff
Laboratory experiments	Ffl
Identification	Fi
Classification/Taxonomy	Fic
Naming/Nomenclature	Fn
General processes facet)	H
Adaptation	Hb
Development/Maturation	Hd
(Activities facet)	K
Activities/Behavior	Kb
Hibernation	Kh
Migration	Km
Social behavior	Kt
Play	Ktr
(Attributes facet)	N
Aggression	Nb
Intelligence	Ni
(Physiological processes and parts facet)	P
Anatomy	Pb
Physiology	Pp
Locomotion	Ppl
Flying	Pplf
Running	Ppls
Nervous system	Ppn
Brain	Ppnb
Senses	Ppt
Respiration/Breathing	Ps
Skin	Pt
(Animals facet)	T
Animals	Tb
(by effect on man subfacet)	Te
Beneficial animals	Teb
Harmful animals	Teh
Venomous	Tev
(by habit subfacet)	Th
Hibernating animals	Ti
Migratory animals	Tim
(by habitat subfacet)	Tm
(by land form subfcet)	Tn
Coastal animals	Tnc
Littoral	Tncl
Lowland animals	Tnl
Upland animals	Tuu
Hill animals	Tnuh
Mountain animals	Tnum
(by ground cover facet)	Tp
Desert animals	Tpd
Grassland animals	Tpg
Scrubland animals	Tpt
Woodland/Forest animals	Tpw
Jungle animals	Tpwj
(by latitude subfacet)	Tr
Polar animals	Trr
Temperate zone animals	Tru
Tropical animals	Trv
Equatorial animals	Trvc
(by element subfacet)	Ts
Aquatic/Water animals	Tsb
Fresh water animals	Tsf
Lake animals	Tsfl
River animals	Tsfs
Marine/Sea/Salt water animals	Tsm
(by zoologists' taxonomy subfacet)	Tt
Invertebrates	Tti
Arachnids	Ttib
Spiders	Ttit
Insects	Ttj
Hymenoptera	Ttjh
Bees	Ttjhb
Honeybees	Ttji
Lepidoptera	Ttl
Butterflies	Ttlb
Moths	Ttm
Leaf Moths	Ttml
Vertebrates	Tv
Amphibians	Tvb
Frogs	Tvbf
Toads	Tvbu
Birds	Tvc
Raptors/Birds of prey	Tvcs

Eagles	Tve
Golden eagles	Tveg
Fish	Tvf
Mammals	Tvm
Bears	Tvmb
Pandas	Tvmr
Primates	Tvp
Man	Tvpg
Monkeys	Tvpm
Colobus monkeys	Tvpmc
Procyonidae	Tvq
Rodents	Tvr
Rats	Tvrs
Reptiles	Tvs
Lizards	Tvsl
Snakes	Tvt
Tortoises	Tvu

5. The Base of Notation

It has been stated that a notation should be based on numerals or letters, because they are the only sets of symbols with a generally accepted and known order (see (9) p.52-53 and (16) p.74). Schneider, however, suggested that only numerals be used, because numbers are easier to remember than letters (see (8) p.46). It is difficult to see how there can be much difference between letters and numerals in terms of ease of use; moreover, alphabetical letters represent a better choice when a larger base is required. In the proposed system, letters or numbers or a combination of the two may be used.

The proposed system allows the designer of the notation, i.e. the classifier, to choose the notation base as well as symbols for main classes and facets. For example, if the collection to be classified is very specific and does not require many main classes, numerals (0-9) may be used. Otherwise, capital letters (A-Z) or two digit numerals (00-99) can be used. Note that if two digits numerals, instead of letters, are used for denoting 20 main classes, then brevity is sacrificed somewhat as the notation will be one digit longer. Suppose Zoology is one of five main classes and the classifier assigns 8 to it. Any other symbol could be used except lower case letters (a-z). In the system being described, letter b-z are reserved to denote enumerated classes and divisions within facets. The letter 'a' is not used so that interpolation is possible at the beginning of an array. It is not difficult to see why this is needed. If the first element is b, we could insert 'ad' or 'at' before it. However, nothing can be inserted before 'a'.

6. Allocation of Notation

Citation orders or facet formulas are also user-definable. The classifier can define different citation orders for different main classes, as is done in the Colon Classification. In the Zoology schedule above, there are seven facets arranged in the following order:

Form of presentation (C),
Operations (F),
General processes (H),
Activities (K),
Attributes (N),
Physiological processes (P), and
Animals (T)

According the principle of inversion, the citation order is:

Animals – Physiological processes – Attributes – Activities – General processes – Operations – Form of presentation

As classes are added to a hierarchy as subdivisions, the system will automatically generate notation and assign it to each class. All notational marks in Figure 1 were generated by the prototype system. For instance, suppose "Essays" is added as a subclass under the "Form of presentation" facet; the system then will automatically assign the notation Ce to it. The process of generating notation works as follows:

1) obtain the mark for the facet, in this case, C (notation for all classes in a facet should start with the mark for the facet)
2) obtain the position for the new class in the hierarchy, in this case, after "Form of presentation facet" (C) and before "Periodicals" (Cp)
3) generate a number (Ce) which could file in that position by means of a Distribution Dictionary.

A Distribution Dictionary is a predefined structured code list for each character based on frequency of occurrence; its purpose is to make notation short and evenly distributed. Figure 1 shows the "Zoology" hierarchy with notational marks automatically assigned by the system. It should be noted that in a schedule of which Zoology is only a main class, the notation for Zoology (8) should be added to the beginning of all notations in Figure 1 to make all notations unique across main classes.
For example, the notation Tb for animals would become 8Tb.

7. Evaluation

7.1 Hospitality

Suppose we want to insert a new form of presentation "Folklore" between "Essays" (Ce) and "Periodicals" (Cp). Following the three steps described above, the system will assign the notation Cf to it. Suppose now we want to insert another form of presentation between "Essays" (Ce) and "Folklore" (Cf). There seems a problem here because there is no room between Ce and Cf. Because expressivity is not a concern, however, the system could easily generate a notation which can be filed between Ce and Cf through the use of the emptying-digit device. The notation for the new class will be Cex, where x can be any letter between b and z, depending on the first letter of the new class.

Obviously, through using the emptying-digit device the interpolation of elemental classes can be easily accommodated. Next, let us see how the interpolation of compounds can be accommodated. Consider a compound "Essays on Animals." Following the principle of inversion, the system appends the notation for "Essays" (Ce) (which is in a earlier facet) to the notation for "Animals" (Tb) (which is in a later facet), obtaining the notation TbCe, which is filed correctly before Te and after Tb. Consider another compound, say, "physiology of animals." Because the "Physiological processes" facet is before the "Animals" facet, the system will append the notation for "Physiology" (Pp) to the notation for "Animals"

(Tb), deriving the notation TbPp, which is filed correctly before Te and after TbCe.

New facets and intermediate subjects can be added in the same fashion. Suppose we want to insert an intermediate class between "Physiology" (Pp) and "Locomotion" (Ppl), which should be a sudivision of "Physiology" and a broader subject of "Locomotion." As the notation is not intended to be expressive, all the system needs to do is to generate a notation which can be filed between Pp and Ppl, say, Ppg. It can be clearly seen that when expressivity is of no concern, hospitality is really not difficult to achieve.

The FFNS system provides a facet formula for the classifier so that he need not remember the citation order when creating compounds. All he needs to do is to enter terms into the appropriate facets in the formula. As soon as he enters all terms, a class number, guaranteed to be consistent and correct, will be automatically generated. This approach has three advantages. The first advantage is that any entry can be easily validated and thus the integrity of the classification is ensured. For instance, if a term designating a form of presentation is entered into the Animal facet, the system can easily detect it and inform the classifier of the mistake. The second advantage is that, by being presented with a facet formula, the classifier is reminded and encouraged to consider all the viewpoints of the document. The third advantage is that the classifier does not have to search through all over the classification schedule to create a class number for a given document; therefore he could concentrate on the intellectual content of the document.

7.2 Synthesis

We have already seen how the proposed notation can show a faceted structure. Looking at the notation TbCe, we can tell that the compound is composed of elemental classes from two facets, T (Animals) and C (Form of presentation), and the notation for "Animals" is Tb and the notation for "Essays" Ce. We have also seen the ability of the FFNS to synthesize a notation for a compound class. As mentioned above, a synthesized notation can be easily created by adding numbers from one part of the schedule to numbers in another part. In addition, the synthetic structure of the FFNS facilitates certain kinds of searches and retrievals, as will be discussed below.

7.3 Shortness and Brevity

The length of the longest notation in the Zoology hierarchy is five, and there are only two terms that long. Both terms are at deep hierarchical levels, one at level seven and the other at level eight. As shown in Figure 1, most terms are represented by a two- or three-digit notation; i.e. generally the notation is brief. Bliss once said that a six-character classmark can be assumed to be a tolerable maximum in any context, because it is no longer than numerous widely-used codes, such as car registration numbers and telephone numbers. It is possible that, with a better Distribution Dictionary, a notation could be developed which is even shorter and more evenly distributed.

7.4 Automatic Generation and Manipulation

As we have seen, the FFNS notation can be easily generated by the computer. Because the computer performs this task by following instructions, the notation is always consistent. Further, it can also be easily and effectively manipulated by the computer, because it is generated by the computer and thus has a structure that can be easily recognized by the computer. More about manipulation will be discussed below.

7.5 Operation of Various Hierarchical Displays and Retrievals

The FFNS notation can be used to generate hierarchical displays. To display the whole hierarchy of "Zoology," the system needs only to follow the order of notation, starting from 8, the notational mark for Zoology. To display only the hierarchy for "Animals," all the system needs to do is to isolate all classes beginning with the notation T, because notations for all classes in a facet start with the notational mark for that facet.

One might now ask how the operations of broadening and narrowing searches can be done without an expressive notation. The answer to this question is not difficult. For any online classification system, links between classes and divisions (parents and children) can be maintained by the computer and used to retrieve broader or narrower subjects for any given subject quickly and easily. For example, for each class an identifier
for its broader subject, which may a node number, an ID, or a class number, can be recorded. Identifiers then can be used to display broader or narrower subjects. They can be used as well to display arrays of coordinate subjects and to distinquish homonyms. Suppose one searches "Football" and finds nothing. If he decides to broaden his search, he can do this simply by using the identifier for the broader class which is stored in the record for "Football". If he chooses to narrow his search, then the identifier for "Football" itself can be used to retrieve all narrower subjects because these all contain the identifier for "Football". If browsing arrays of coordinate subjects is desired, the identifier for the broader class of "Football" can be used to retrieve all its narrower subjects, which are coordinate with the "Football". This method of broadening and narrowing searches is simpler and, as noted earlier, more reliable than dropping or adding digits (14). Actually, this approach has been used by many computer systems to retrieve hierarchical data. Cochrane and Markey propose a similar approach (4).

7.6 Flexibility

The need in classified catalogs for alternative locations and treatments can be met by FFNS. In the FFNS system alternative locations are maintained logically rather than physically. Let us take "physiology of animals" (TbPp) as an example. To the user it appears that the compound is physically filed under "Animals" (Tb). Actually, it is filed under neither "Animals" (Tb) nor "physiology" (Pp), but contains a link to each of them (Tb and Pp). Given the two links Tb and Pp, the compound can thus be accessed from both "Animals" and "physiology". For a compound, the system automatically gener-

ates access points to each of its facets so that the user can find it under any facet involved. This is possible because of the synthetic structure of the FFNS, which allows the computer to decompose and rearrange the notation dynamically and place a compound subject in each of its alternative locations.

8. Summary

It is believed that a new type of notation needs to be developed for a classification in an online environment in order to better serve users' needs and to take advantage of computer capabilities. The proposed notation system FFNS is an attempt to design such a notation. The FFNS has the potential for becoming an effective and efficient notational system in online environments. In sum, the FFNS has the following desirable features:

Generating Class Numbers Automatically. The FFNS can generate class notation automatically. It should be noted that the FFNS can not only generate notations for classificationists when they create classifications, but can also construct class numbers for classifiers when they classify documents. These capabilities promise savings in both time and cost.

Providing complete Hospitality. Because the FFNS doesn't try to achieve expressivity, it allows new concepts to be inserted at any point in the schedule. Complete hospitality is perhaps the most important feature in any notational system.

Short and Brief. Again, because the FFNS doesn't try to produce an expressive notation, the notation it generates is short and brief. Although shortness may not be as important in online environments as in manual environments, it still has some advantages. Firstly, it takes less storage. Secondly, the shorter the notation, the faster it is to search. In those situations where the user uses the notation directly, short numbers are definitely preferable to long ones for their memorability.

Facilitating the Creation of a Classification. With FFNS, classificationists can develop an online faceted classification without worrying about the hospitality, stability, and brevity of the notation. As a result, they can focus on the intellectual content of the scheme, rather than the design and allocation of its notation.

Facilitating the Construction of Class Numbers. Once the scheme is developed, the classifier can classify documents without worrying about finding or constructing correct class numbers; he need only analyze the content of each document and the system will construct the correct class numbers for him.

Facilitating Retrieval. It has always been a problem to decide which facet in a classification is most important when determining citation order, because only the first facet in the citation order can bring together related materials. Suppose the example in Figure 1 (see above) is taken from a traditional faceted classification system. Because Animals is the first facet in the citation order, one can find all materials on Animals together. However, if one is interested in Form of presentation, say, Essays, one has to look in several different places. It has been assumed that no system can please all the people all the time; all that a system can do is to bring together related materials that fall into the first facet, the one deemed most important by classificationists and, hopefully, also by most users. It seems that the FFNS can please all the people all the time in this regard. Because of the unique synthetic structure of the FFNS notation, the FFNS can decompose and rearrange the notation dynamically and place a compound subject in each of its facets. Let us look at the compound "physiology of animals" (TbPp). Although it has a notation TbPp which normally should be placed under "Animals" (Tb), it is actually not filed there physically. Instead, it contains a link to each of the two facets "Animals" (Tb) and "physiology" (Pp) and the notation can be rearranged into PpTb. With the two links Tb and Pp, the user can access the compound through either "Animals" or "physiology" as he desires. Actually, the FFNS can be set up in such way that the user at a terminal can access all related materials on a particular facet by moving a cursor or mouse to it and then pressing a predefined key. Thus, with the FFNS, classificationists no longer have the problem of having to decide which facet is most significant.

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