Interface to classification: some objectives and options

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Abstract: This paper explains the basic functions of browsing and searching that need to be supported in relation to analytico-synthetic classifications such as the Universal Decimal Classification (UDC), irrespective of any specific, real-life implementation. UDC is an example of a semi-faceted system that can be used, for instance, for both post-coordinate searching and hierarchical/facet browsing. The advantages of using a classification for IR, however, depend on the strength of the GUI, which should provide a user-friendly interface to classification browsing and searching. The power of this interface is in supporting visualisation that will 'convert' what is potentially a user-unfriendly indexing language based on symbols, to a subject presentation that is easy to understand, search and navigate. A summary of the basic functions of searching and browsing a classification that may be provided on a user-friendly interface is given and examples of classification browsing interfaces are provided.

Keywords*:* interface, information-retrieval, analytico-synthetic classification, faceted classification, Universal Decimal Classification, UDC.

1. Introduction

Presenting library classification as a sequence of incomprehensible notational symbols that users are expected to understand and search has gradually become a thing of the past. We are now fully aware that the use of classification in subject browsing is very important and that it requires an appropriate user-friendly interface that will enable users to '*see'* the relationships between subjects without requiring knowledge of the classification system or its notational representation. Also, we know that 'searching classification' in the context of a user-friendly IR system ought to mean searching words that are linked to the classification's structure, from which users could unknowingly benefit while expanding/limiting/re-directing their searching[1].

In order to implement a classification in information retrieval and eventually enable users to benefit from using the classification, we are expected to have:

- a proper understanding of the roles of classification in IR and how it complements other indexing languages
- the possibility of using a graphical user interface

[1] The benefits of using classifications for collection management and information retrieval (IR) are well documented (Fugmann, 1983, 1990; Markey Drabenstott, 1986, 1990, 1996a; Gödert & Horny, 1990; Soergel, 1999; Svenonius, 2000 etc.). However, we often have to defend and explain the importance of a classification's role in knowledge organization. This kind of justification is usually required because of the higher level of expertise, costly tools and consequently the higher initial expense incurred for classification implementation in IR. These costs and problems are exacerbated for IR systems when machine readable classification data are not available or when the data available do not contain all the elements necessary for its straightforward implementation and use in an IR system. It is, however, cheap and effortless for implementers to provide a classification search through notational codes and often, especially in the past, this was the only way classification was presented to users.

- access to machine readable classification data that will support such an application

Assuming that these three requirements are in place there still remains the consideration of the choice of interface and its functionality. This paper will discuss some of the available options using UDC as an example.

2. Subject browsing and analytico-synthetic (faceted) classifications

Not all information-seeking scenarios can rely on a known, well-defined, specified subject topic. In effect, subject searching is often exploratory and bears similarities to the learning process (Bates, 1989; Belkin, 1998; Marchionini, 1995; Hildreth, 1991). This has influenced a modern information retrieval system design that has moved from being output-orientated to being process-orientated with an emphasis on subject browsing and navigation. Such a trend in IR systems has created more opportunity for the wider use of indexing languages with a hierarchical structure such as classifications.

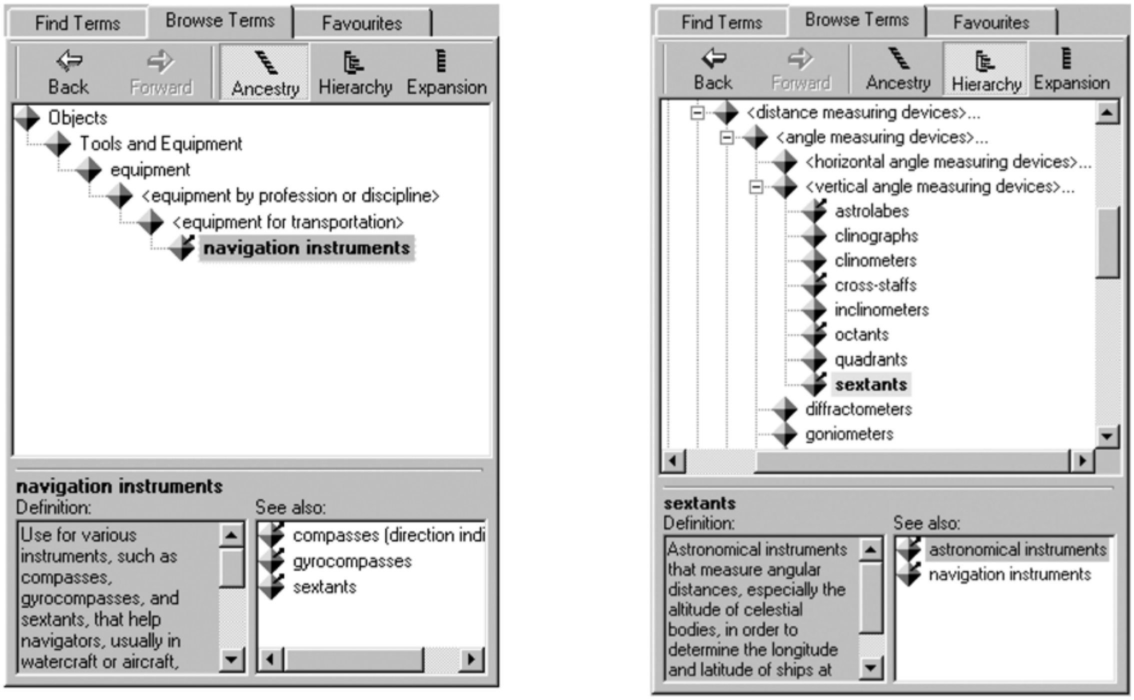
Past studies into user-behaviour when searching library catalogues have provided useful observations about subject browsing based on classification that are still relevant for the contemporary information system. Hancock's study (1987) on subject searching behaviour, for instance, showed that users had a tendency to browse shelves even if the subject was well understood and defined in advance. According to her research, they tended to combine a catalogue search with subject browsing on the shelf, in spite of the fact that they did not fully comprehend the classification structure. Also, she found that users had a tendency to focus on the immediate subject proximity on the shelf, i.e. a few books before and a few books after. Her conclusion on the importance of collocation and aggregation is probably the most important point in creating an interface to classification as it stresses the importance of dense collocation and very localised but intensive linking.

As we know, classification can be used for linear, pre-sequenced and inflexible browsing of classification schedules that display the subject in an extensive chain of classes and subclasses. More importantly, classification can be used for more localised, interlinked, multidirectional and associative subject displays. Thus, it can be useful in improving a user's understanding of a subject and it can be used for the selection of search terms through a subject index, for instructing users on a subject through associative navigation, exploratory browsing, and in displaying search results as a launch pad for a further, more contextualised search. For this to function, classification has to be represented in such a way that its visual qualities are maximised in both a linear and non-linear direction (e.g. facet browsing, hierarchy browsing, navigation through syndetic structure) while its notational representation and complexity ought to be held in the background.

It is a well known fact that classification browsing helps improving recall (e.g. by moving up the hierarchy tree), and the usefulness of this feature for users was confirmed by research into the use of UDC online in the early sixties, and also by user studies on Dewey Decimal Classification (DDC) and Library of Congress Classification (LCC). Some of these studies also emphasised that navigation through a single hierarchy is not likely to improve precision (Hildreth, 1991; Markey Drabenstott, 1990, 1996). Some IR systems built on faceted thesauri, however, show that faceted thesauri with a systematic (classification) display can be adapted for search expansion, enhancing both recall and precision, through exploiting hierarchical and associative relationships, provided that semantic linking in the vocabulary is fully supported by vocabulary data (Binding & Tudhope, 2004; Tudhope et al., 2006). Figure 1 shows an example of how an interface functions in supporting browsing a faceted thesaurus.

It is easy to draw a parallel here and see how this approach in exploiting faceted structures and hierarchical and associative linking for searching and browsing can also be applied to UDC, which is a semi-faceted and fully analytico-synthetic classification. UDC offers the same possibilities as a faceted thesaurus in terms of parallel facet hierarchies and lateral linking and allows for search results to be further specified or broadened, notwithstanding the ability of UDC to express inter- and intra-disciplinary relationships due to its analytico-synthetic nature.

Figure 1. *Representation of relationships between concepts (hierarchy of navigation instruments and sextants)* (Tudhope et al., 2006: 522-523)



The important advantage of the analytico-synthetic classifications, such as UDC, is that the vocabulary is organized into structural components that can be combined in the process of indexing or searching. This property gives to an indexing language two basic advantages:

1) a limited number of indexing terms can be used to denote an unlimited number of subjects thus reducing the size of the scheme e.g.:

The use of Common auxiliary of persons:

-051	Person as a doer
-053.2	Children (facet: Persons by age)
-055.2	Women (facet: Persons by gender)
-058.6	Victims of circumstances (facet: Persons according to social class, civil status)
343.232	Crime
343.232-058.6-053.2	Crime–victims–children
343.232-058.6-055.2	Crime–victims–women
324	Elections
324-051	Elections–voters
324-051-055.2	Elections–voters–women

51	Mathematics
51-051	Mathematicians
51-051(092)	Mathematics–mathematicians–biography
51-051-055.2(092)	Mathematics–mathematicians–women–biography
51-051-055.2(44)(092)	Mathematics–mathematicians–women–France–biography

2) indexing terms can be combined to provide a more detailed description of the subject thus allowing for a single classification scheme to be used for both broad aggregation or for very detailed indexing, as shown in the example above.

On a more specific level, the UDC vocabulary is organized into mutually exclusive facets, each of which contains hierarchies of concepts organized by various principles of division. In the process of indexing, as shown in the example above, concepts from different facets are combined to form what is a complex and structured, multi-concept statement of a document's content (e.g. subject + persons according to different characteristics: age + gender + physical characteristics + social status etc). In the process of searching, the ability of 'tracing' a simple class concept that is a part of a complex UDC number (e.g. -055.2 Women in 51-051**-055.2**, in 343.232-058.6**-055.2** or in 324-051**-055.2**) enables greater flexibility in collocation of subjects and retrieval. Hence, when a collection is indexed by UDC in the described manner of pre-coordinated "indexing terms", it is possible to retrieve not only documents relating to a certain subject but also a certain time, place, ethnic grouping, type of person and so on, which has great importance in both IR and collection organization and presentation. When fully supported by an IR system, access to each simple class number in pre-combined UDC numbers also allows easier mapping of UDC numbers to subject-alphabetical indexing languages such as thesauri and subject-heading systems, and allows easier searching of UDC using words (Riesthuis, 1998; Frâncu, 2003).

But apart from detailed and precise indexing, an analytico-synthetic classification scheme allows a visualisation of hierarchical, coordinated and collateral relationships among concepts and, if an interface reflects the structure of the classification, this can help users expand a search, combine terms and specify complex subject components.

If, however, we have to identify the most important reason for the use of classification in IR, this ought to be subject browsing. This is because systematic subject browsing cannot be fully supported by any other indexing language, which makes classification unique and complementary to an alphabetical indexing language. This is, for instance, why thesauri or subject heading systems, when applied, are often used in combination with systematic i.e. classificatory presentations (e.g. Art and Architecture Thesaurus - AAT or Medical Subject Headings - MeSH). One should note, however, that browsing and navigational paths depend on the interlinking of classification data, as well as linking the classification to document metadata. This is why the 'quality' of a classification scheme is often evaluated and judged based on the existence of machine readable information on hierarchical and associative links, on notation/caption linking, notation/descriptor, notation/subject-heading linking etc. The supplied connectivity on the interface then represents a rudimentary form of hypertext that offers the possibility for users of an IR system to select and follow a desired link and change direction at any single point of browsing.

3. A few points on hypertext, non-linear browsing and classification

Hypertext is now a ubiquitous technology and is considered to be the norm for all IR systems, whether they are isolated or networked. Even library OPACs, which are often criticised for their modest IR functionality and primitive interfaces, are now often reported as making good use of hypertext. Its full exploitation in library systems led to a great improvement of the OPAC GUI and contributed to the creation of so-called *hypercatalogues* (cf. Gödert, 1996). Hypertext also opened up the possibility of new ways of exploiting classificatory indexing languages for subject browsing in library OPACs (Hjerppe, 1990; Gödert, 1995, 1996, 2003; Papy & Chauvin, 2005; Schallier, 2004, 2004a, 2005; Hajdu Barat, 2004, 2006).

Hypertext technology allows data structures to be dynamically re-arranged and represented in a non-linear manner. Hypertext consists of nodes, each node being a basic unit of information, e.g. a standalone chunk of text, page or frame, linked to a network of nodes. This network can be represented using *hypergraphs* that allow for the unlimited inclusion of a pictorial and graphic display, termed *hypermedia*. Most importantly, interactive (live) hypertext is capable of storing (authoring) new relationships. This technology allows information presentation that coordinates, within a single view, navigation between a full document, an abstract, thesaurus or classification and makes it an ideal tool for mounting and displaying bibliographic tools (Garcia Marco & Estaban Navarro, 1996).

Hypermedia represents a platform for the coordination of natural-language retrieval and multi-criteria retrieval using the concrete form of nodes. This is why hypertext is considered to be not only a user-friendly interface but also an alternative and complementary access to information. In such a context, a classification node collocates documents according to their content similarity, and the criterion for this collocation should be obvious from the name of the common concept or from the non-formal textual description explaining the meaning of the class and a list of terms associated with the reference terms.

Aboud et al. (1993) pointed out that the influence between classification and hypertext goes both ways: classification can help hypermedia to be more organized while hypermedia will help classification to become more usable. For instance, classification can be used to restrict the investigation domain. Agosti (1991) emphasised the importance of hypertext in administering the semantic structure of a classification scheme or thesaurus (hyper-concept database), and in storing and handling term structure. It is clear that a hypertext system ought to illustrate and give the transparent appearance of the semantic content of various different documents in a collection, whilst also establishing necessary links between the collection of documents and the term structure, representing the knowledge structure consisting of some kind of classification.

The most obvious weakness of analytico-synthetic classification is that it may be complex to use. Garcia Marco & Estaban Navarro (1996:89:93) suggested that hypertext can constitute a perfect platform for both the automatic management of classification and a user-friendly retrieval interface and, thus, can help:

- to make it easier to access and use pre-coordinate languages through combination of an alphabetical search and relational navigation
- to connect indexing languages with cognitive maps of users (it enables storing of knowledge and learning paths from different points of view)
- to interconnect dynamically documentary languages, and languages with documents
- to design, build and manage links between the graphical and alphabetical presentation of a thesaurus and classifications.

The most obvious weakness of hypertext, on the other hand, is that it is not instructive and can appear 'too multidirectional', which may lead to confusion. With respect to this, Garcia Marco & Estaban Navarro (1996: 89-93) suggest that hypertext may profit from an intermediary system based on the classification type of knowledge which will: *(a)* organize perspectives and access hierarchical nodes (top-down versus direct activation), *(b)* focus attention (pruning of hierarchies), and *(c)* help in learning paths.

4. Classification related interface functions

A search interface, as pointed out by Shneiderman, Byrd & Croft (1997) has to provide for four phases of searching: *(a)* formulating the query, *(b)* submitting the search, *(c)* reviewing the results and *d)* a refinement phase formulating the next step. When applied to classification, this may be 'translated' into the following specific steps:

- positioning at the classification tree to start browsing
  - by launching a word search against the index
  - by top/down hierarchy browsing
- submitting a search against a subject area
- reviewing the classified set of results
- moving to browse a specific classification node in the results hierarchically or laterally, or re-launching a query against a specific class.

Since the UDC may be used for both searching and browsing and can be searched using notations and words, these elements should be considered along with specific techniques that may be used to make the most of the existing data.

Gödert (1996) suggested a 'general functional requirements framework for a subject search interface' and if this is taken as a starting point it is possible to define the requirements for creating a search interface for e.g. UDC[2]. As shown in the Table 1, most of the functions related to searching are expected irrespective of whether searching involves UDC numbers or their word representation. While Boolean operators and truncation are relevant for number and word searching, adjacency and distance-proximity operators are not very relevant for searching notation but may be relevant in searching captions. The same applies for linguistic intermediation.

Table 1. ***Possible functions in searching UDC***

SEARCHING UDC		
FUNCTIONS	**NOTATIONS**	**WORDS**
Boolean logical operators	●	●
Categorization i.e. broadening and narrowing search	●	●
Truncation/exact match/phrase search	●	●
Adjacency, distance- proximity operators		●
Linguistic intermediation -morphological tools -insertion of the dictionary		 ● ●
Free-text search	●	●

According to Hildreth (1991:10) "a user's query should never produce zero results and the display of the result should not be assumed to be the end-point of the search process". He relates this statement to the premise that "humans have a greater facility for recognizing things of interest when they are encountered than describing them in advance". This opinion

2 How many and exactly which elements of the searching and browsing functions may be implemented depend, obviously, on the specific IR system environment, the size of the database(s) being interrogated and whether UDC is the only, or just one of the indexing languages and indexing techniques used.

is shared by Cochrane & Johnson (1996) who pointed out that there is a need for better interaction between vocabulary displays, hypertextual browsing and retrieval functions and they particularly emphasised the need to support the transition from search to browsing (Cochrane & Johnson, 1996).

Table 2, below, shows the interface elements that are important for browsing and for the transition from searching to browsing or browsing to searching functions. A term dictionary can be open for alphabetical and systematic browsing and is usually displayed alphabetically but within each entry it may be possible to insert a hierarchical tree. If the term dictionary offered is in the form of a thesaurus this may be further exploited for browsing.

Table 2. ***Possible functions in browsing and classified display***

FUNCTION	INTERFACE ELEMENTS
browsing	• knowledge map navigation window • class numbers with captions display[3] • number of hits against class • hyperlinks on class numbers, see also references • display of targeted class with a broader class and possible narrower classes • different colouring of facets • display with hierarchical indentation of class captions with highlighted position of the relevant class/term in the hierarchy: • collapsing/expanding function key
transition from search to browse and browse to search	• search box available for term search to be launched against class or facet • term dictionary window • hyperlinks (as pointers or as 'trigger' for the search syntax) - results displayed with class number hyperlinked to the broader class - hyperlink to 'see also' related class numbers for lateral browsing and/or search expansion

The IR functions listed may be relevant for IR systems using UDC, irrespective of whether or not they are isolated or distributed over a network. The difference between the use of classification in a networked environment or in an isolated system is how the classification data are managed, how the UDC files are linked to one or more surrogate/metadata repositories, and how they are built into the system architecture. A poor data structure, however, may impose fundamental limits on the search and interaction options that may be presented at the user interface (Hildreth, 1995). If a database does not contain information on relationships (hyperlinks) between, for example, a UDC number and its broader class or a UDC number and its caption, or UDC notation and verbal expressions, no interface technology will overcome these limitations. This is why it is necessary to pay attention not only to functions that need to be supported, but also to the data necessary for underpinning those functions.

A recent study of 30 Web OPACs using UDC reported on 23 different options in accessing, searching, browsing and displaying UDC found in these catalogues (Slavic, 2006). This seems to be a step forward compared to the situation in the 1990s and shows that libraries using UDC do not entirely neglect this valuable source of subject data. Not a great number of catalogues, however, make a full use of classification in improving subject access. There are

[3] Browsing should be performed on numbers with the caption, or on the caption alone e.g. "595.12 Platyhelminthes. Flatworms" or "Platyhelminthes. Flatworms", and not "595.12". It is worth noting that browsing UDC numbers with no associated verbal explanation is not a desirable option for end-users.

still some catalogues that do not use authority files to properly manage classification data and as a result they are not able to provide full hierarchical or associative linking of subject classes or links of UDC numbers to captions, verbal expressions or to subject-heading systems. Paradoxically, although subject browsing is the most important reason why users need classification, according to this study library OPACs very rarely support hierarchical subject browsing.

Recently, however, there have been several reports of developments in the interface to classification within library OPACs with commendable results as described by Schallier (2004, 2004a, 2005), Hajdu Barat (2006) and Papy & Chauvin (2005). According to Papy & Chauvin (2005), for instance, library users make good use of visual representation of the UDC hierarchy, coupled with links to subject headings. Unlike these successful solutions a recent user study by Ortiz et al. (2006), confirms how a poor and user-unfriendly interface, on the other hand, can act as a deterrent to using UDC in library catalogues. In the example of this particular Web OPAC the only subject access through classification was enabled through searching UDC numbers (*SIC!*) and not surprisingly users did not show much enthusiasm for this function.

5. Evolution of GUI and examples of classification browsing interface

When reading reports from the 1980s and 1990s regarding the hesitation of users to search or browse classification or sometimes even recently, as mentioned at the end of the previous section, we have to be aware of the obstacle a poor interface can represent to the use of classification. We usually make a distinction between three types of user interface: command-driven, menu-driven and GUI. The GUI uses graphics (images, icons) to represent options, functions and tasks, and is the only user interface that provides a satisfactory platform for browsing a classification.

The characteristics of a GUI, as summarised by Hildreth (1995) are the following:

- sizeable, moveable windows
- scroll bars to scan through data and lists
- pull-down menus and pop-up dialogue boxes with preformatted data entry spaces
- hot buttons for activating functions
- point-and-click device-based interaction.

Combined with hypertext/hypermedia this creates a highly dynamic and interactive environment.

Browsing strategies involve advanced interface features: dynamic queries, smooth integration between the formulation, action and refinement phases coupled with different displays (over viewing, zooming, filtering and relating retrieved documents). In addition, a clear screen presentation of the concepts and their position in the semantic network are necessary (Marchionini, 1995: p 101). If we put aside subtle differences in spatial abilities between individual users (cf. Allen, B. L., 1998: p 69), it could be asserted that classification can represent the so-called 'spatial metaphor' which makes it possible to visualise a knowledge space and help orientation or help the user find a familiar reference point from which to move forward. Bates (1989) pointed out that, similar to browsing library shelves, which involves random eye movement, browsing in an online environment should also allow random eye movement that can be reproduced by rapid scanning across a large amount of text.

As mentioned before, a classification contains linear (hierarchical) and non-linear (syndetic and facet-based) structures that may need many anchors and pointers for the purpose of navigation, as 'flipping back and forth' may lead to a loss of orientation if the computer screen continues to change rapidly. This is, precisely, why it was so hard to prove the advantages of classification subject browsing in early command and menu driven interfaces. The solution for browsing a hierarchy was in keeping track of broader classes throughout the screens as shown in Figure 2 (the example of UDC - Common auxiliaries of materials).

Figure 2. ***A model of an early solution of hierarchy browsing through a sequence of screens***

SCREEN 1	
-03	Common auxiliaries of materials
-032	Naturally occurring mineral materials
-033	Manufactured mineral-based materials
-034	Metals
-035	Materials of mainly organic origin
-036	Macromolecular materials
-037	Textiles. Fibres. Yarns. Fabrics. Cloth
-039	Other materials

SCREEN 2	
-03	Common auxiliaries of materials
-032	Naturally occurring mineral materials
-032.1	Air
-032.2	Water (in any of its forms)
-032.3	Carbonaceous and hydrocarbon minerals
-032.4	Ores. Metalliferous minerals
-032.5	Rock. Stone
-032.6	Earths. Nonmetalliferous

SCREEN 3	
-03	Common auxiliaries of materials
-032	Naturally occurring mineral materials
-032.3	Carbonaceous and hydrocarbon minerals
-032.31	Natural gas
-032.32	Mineral oil. Petroleum
-032.34	Peat
-032.35	Coal, including lignite and anthracite

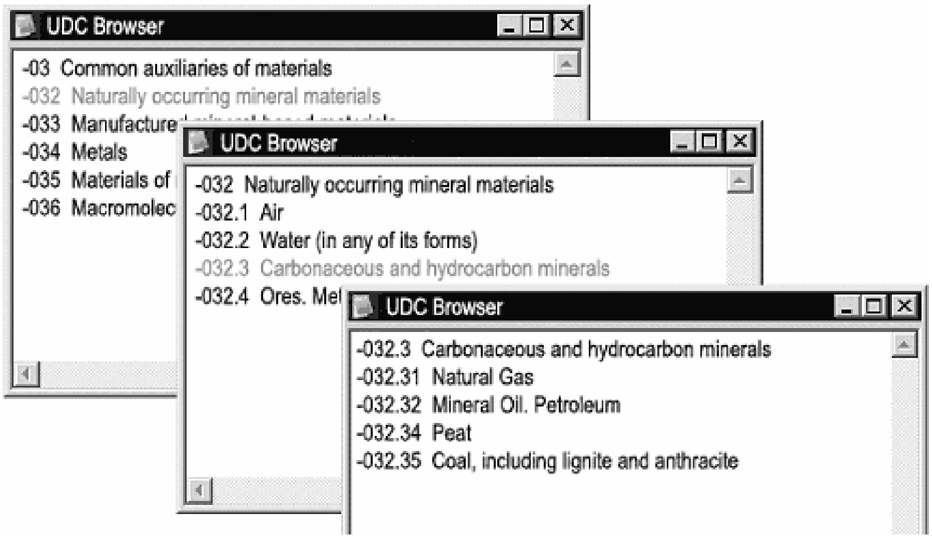
SCREEN 4	
-03	Common auxiliaries of materials
-032	Naturally occurring mineral materials
-032.3	Carbonaceous and hydrocarbon minerals
-032.38	Fossil resins and copals
-032.386	Ozokerite
-032.387	Amber

Furthermore, analytico-synthetic classifications organize hierarchies into mutually exclusive vocabulary facets and sub-facets. Switching from one facet hierarchy to another in this environment involves several command steps and a knowledge of the classification system. Needless to say, GUIs that allow for the opening of multiple windows simultaneously have brought a great change to the classification display (Figure 3) as they allow an overview of the browsing steps by allowing dynamic and interactive exploration, 'drilling' down the hierarchy and simultaneously opening several facet hierarchies.

The multiple views of hierarchies in separate, cascading windows allow the 'starting' hierarchy for browsing to remain present while the link to any subclasses or superclasses is opened as a new view.

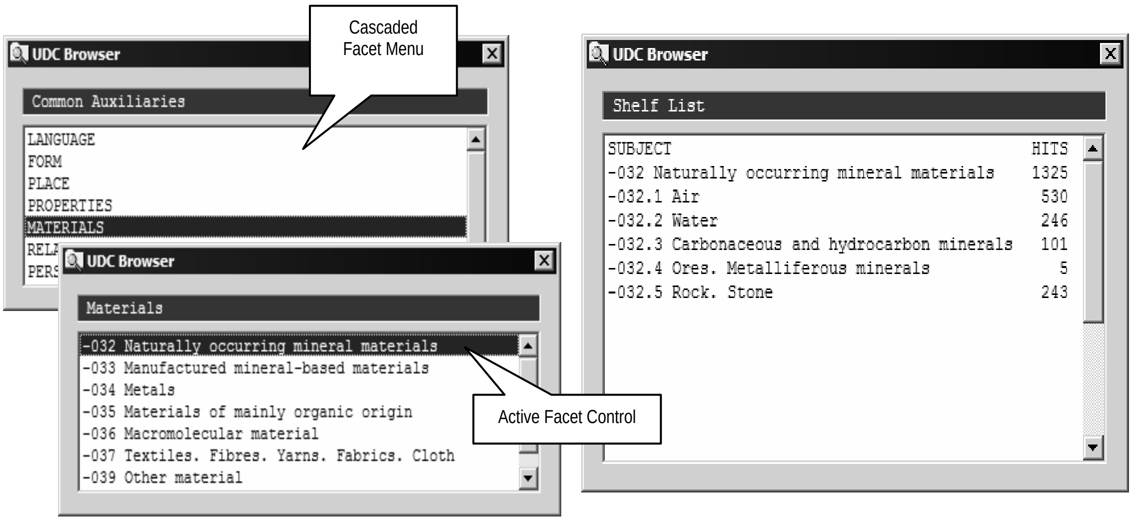
In the case of a cascading windows interface each hierarchy level is opened in a separate window. While this may be suitable for the browsing of a single hierarchy of an enumerative classification its benefit for an analytico-synthetic classification that has to deal with multiple facet browsing is limited.

Figure 3. ***A model of UDC hierarchy browsing in cascading windows***



The next step in interface development that helped to overcome the problems of too many windows is an interface with interactive windows (Figure 4):

Figure 4. ***Model of cascading interactive windows***



Typically, as shown in the model of browsing the UDC represented in Figure 4, interactive window frames would offer the choice of facets ('table of contents') in one window, and a single facet hierarchy in another, while a third window can be used to zoom into the hierarchical nodes within a single facet. Each window can be scrolled vertically and allows viewing of the entire hierarchy while a selection of a hyperlink in one window changes the display in another.

When a faceted classification is applied to a collection of documents, the result is that, in addition to a series of interactive classification hierarchies (cascading facets), there will be a window representing a virtual document shelf as well as a window for term selection (constraints). This means that an additional layer of complex linking is required, especially since the documents are likely to be linked to several facets simultaneously and may be attached to multiple parents (several facet nodes)[4].

When comparing an enumerative and a faceted classification structure, R. B. Allen (1996) concludes that the enumerative is easier to present for browsing than a faceted structure. Although not recommended, he points out that the latter may also be reduced to a simple hierarchy as shown on the example of the GERHARD (German Resource Harvester and Directory)[5] gateway in Figure 5. From the class captions in this example it is obvious that it represents a simple, linear, hierarchical display that shows documents classified as both 'simple class numbers' and 'complex class numbers' with coordinated concepts (linked with +) from several independent hierarchies (facets).

Figure 5. ***Representation of UDC in a simple hierarchy sequence with result display*** **(GERHARD)**

The greatest problem for an interface appears to be the complex interaction between features of the classification itself and between the classification and a collection. Also, when classification is used for term selection and searching in a GUI environment, in spite of the 'ease of presentation', the hierarchy window may contain an extremely long hierarchy, impossible to view quickly or break down, while in effect the user may want to restrict the search to one single hierarchical node.

This brings into focus the problem of interacting and manipulating multiple components of a classification in browsing. R. B. Allen (1995, 1996) suggested that a faceted classification would be best presented with an interface similar to an electronic book or an electronic encyclopaedia. This would enable for classification to be presented as a collection of facet hierarchies rather than a single linear hierarchical sequence. This approach in managing classification made more sense once GUI allowed for collapsing and expanding hierarchy within a single window as shown on the model of such an approach in Figure 6.

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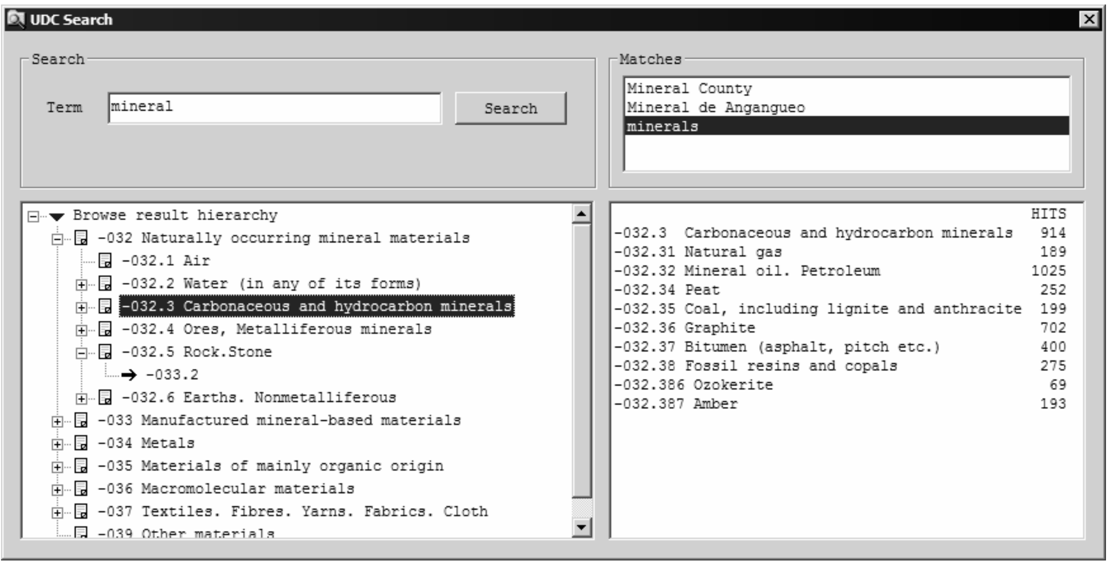
4 R. B. Allen (1996) described a 'facet space interface', which was a variant of an interactive windows interface. A 'facet space interface' is an improvement to a 'cascading-menu interface', achieved through better linking and better control over constraints that prevent facets overflowing and reduce the possibility of exclusion and the intersection of terms. The window of the virtual shelf in this case shows only the documents that match these constraints.

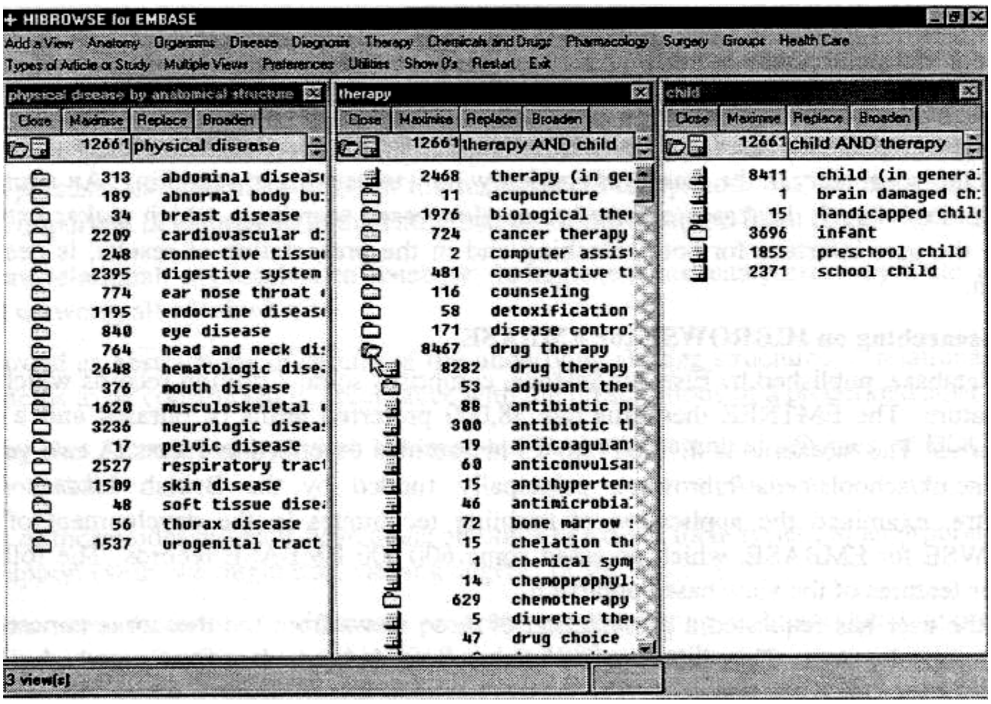
5 GERHARD was a subject gateway based on automatic resource harvesting and automatic classification (according to UDC) that was active from 1997-2006 (see more in Slavic, 2006a).

Figure 6. ***Model of browsing interface with an expandable hierarchical list***



Research into the implementation of classification browsing on an IR interface was encouraged by a general trend in improving the GUI for OPACs in the 1990s (Allen R. B., 1995, 1996; Hildreth, 1995). The application, known as *view-based searching*, was studied and demonstrated on a system called HIBROWSE. This application made use of windowing technologies to provide intuitive and easy to manage browsing, expanding and collapsing of hierarchies (Figure 7). The feature most emphasized in the application was the view of facets used in DDC, i.e. the possibility to view, browse and search standard subdivisions such as a geographic area table (Pollitt, 1997, 1997a, 1998; Pollitt & Tinker, 2000).

Figure 7. ***Facets of disease, therapy and child in HIBROWSE interface***
(Pollitt, 1997: 54)



The interface, with an expanding/collapsing option, allows for the further integration of a faceted and hierarchical display and is particularly suited for large classification systems such as UDC. By collapsing all hierarchies, one gets a display of the basic vocabulary facets (top categories). Continuing further incremental expansion will gradually reveal the content of facets and the full hierarchy within each subfacet. This feature is probably the most useful in instructing users about the knowledge space and its organization. In addition, in order to prevent a window from overflowing, the opening of a hierarchy node in one place may be set to trigger the closing of all other parent/children displays within the same facet. Icons (buttons) at the hierarchy root are often used to control this function.

The choice of facets to be displayed and browsed independently depends of the general purpose of the system i.e. whether it is an IR system or classification tool. Figures 8 and 9 show the selection of facets offered on the Web interface created for the prototype of a faceted classification scheme tool called FATHUM, which has a very similar structure to UDC (http://www.ucl.ac.uk/fatks/php/browse.php).

Figure 8. ***Screenshot of tree expansion/collapsing in Web interface***

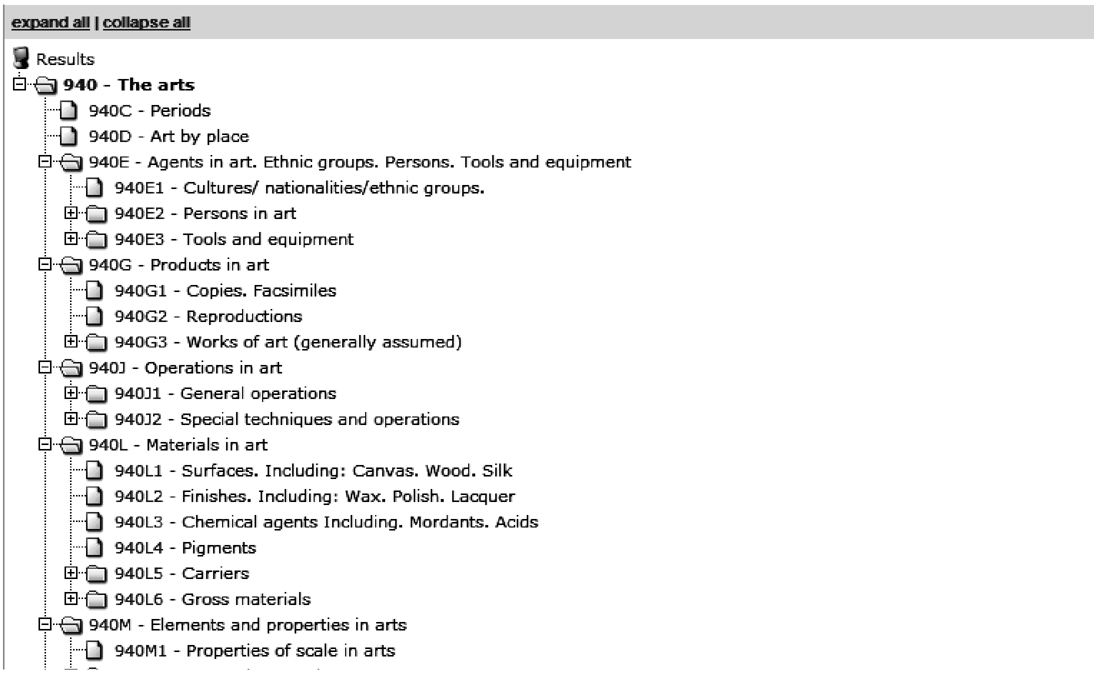


Figure 9. ***Screenshot of facet browsing in a Web interface***

The interface for browsing a faceted and analytico-synthetic classification was recognized as being more demanding and more complex to support as it is highly dependent on the possibility of processing classification data automatically (Gödert, 1991a; Priss, 1998; Pollitt, 1997).

Different authors have pointed out that both a hierarchically inexpressive notation and the lack of facet indicators in the notation may influence classification implementation (Pollitt, 1998; Gödert, 1991a; Allen R. B., 1996)[6]. Faceted classification may be both broad and deep, in which case the display of facets may overfill the screen. A polyhierarchy on the level of both a classification and document collection is not easy to represent, so in addition to hypertext and interactive window technology there is often a need to include graphic aids in the form of icons (widget buttons), text size and colours. As pointed out by R. B. Allen (1996), colours give an extra dimension to the display and are useful in characterizing the state of the interface and in providing rapid visual indication of selected facets or terms. The use of different sizes and colours of text is yet another helpful feature in browsing a faceted classification and is exploited in many applications.

A Web interface to classification

The Web represents a natural environment for the full use of classificatory structures, as every function that requires a windows-based GUI is easy to construct in this environment.

[6] In discussing these specific problems in the implementation of classification, it is useful to make a distinction between problems caused by the lack of machine processable classification data (e.g. lack of machine readable data to manage vocabulary facets), the inconsistency in indexing or the inconsistency in classification structure (see also the summary of mixed problems by R. B. Allen, 1996).

Interactive interfaces on the Web at the moment, however, require customized programming for each website.

The BSI's *UDC-online*, for instance, is a classification tool that is a good example of a Web interface to a classification with a certain amount of facet control using frames where hyperlinks are maximised at every level of browsing, linking frames as well as providing non-linear navigation. To avoid an overwhelming number of windows, colours and graphic aids are used to the fullest extent (http://www.udconline.net). A different example using the UDC is the interface to the previously mentioned GERHARD subject gateway that shows how the UDC can be maximised, preserving simplicity and straightforwardness in a hierarchical display.

Web searching, which is based on the interrogation and accessing of a remote repository may, however, suffer because of the large amount of data that needs to be streamed, rendered and displayed simultaneously by browsers. One consequence is the reduction of speed in browsing and searching. Relationally linked classification data are quite demanding to display and in combination with interactive windows, hyperlinks and a large collection database, this increases the requirements for display resources. Binding & Tudhope (2004) have reported on this problem in relation to a project that explored IR based on the AAT thesaurus. Each expansion of facets and hierarchies on the Web interface occurs through a new independent page request and download. This causes a delay and also, in the search process, the status of the user's query that is linked to the previous page is lost while the current view is being refreshed by new, incoming data. It is not possible to overcome this problem without additional scripting and browser configuration (Binding & Tudhope, 2004).

Marchionini & Brunk (2003) pointed out that there is an increasing need for more standardized tools and services to manage GUI details. One such development is a general class of user interface called a Relation Browser (RB) that allows for the exploration of relationships between different attribute sets. RB manages and controls hypertext, expandable (cascading) hierarchical lists, tabbed views, a zoomable space, magic lenses, mouse-over pop-ups (tooltips), coordinated lists (supermenus) and animations. The greatest advantage of this tool is the display of information by a simple mouse move without the need to click and download data[7].

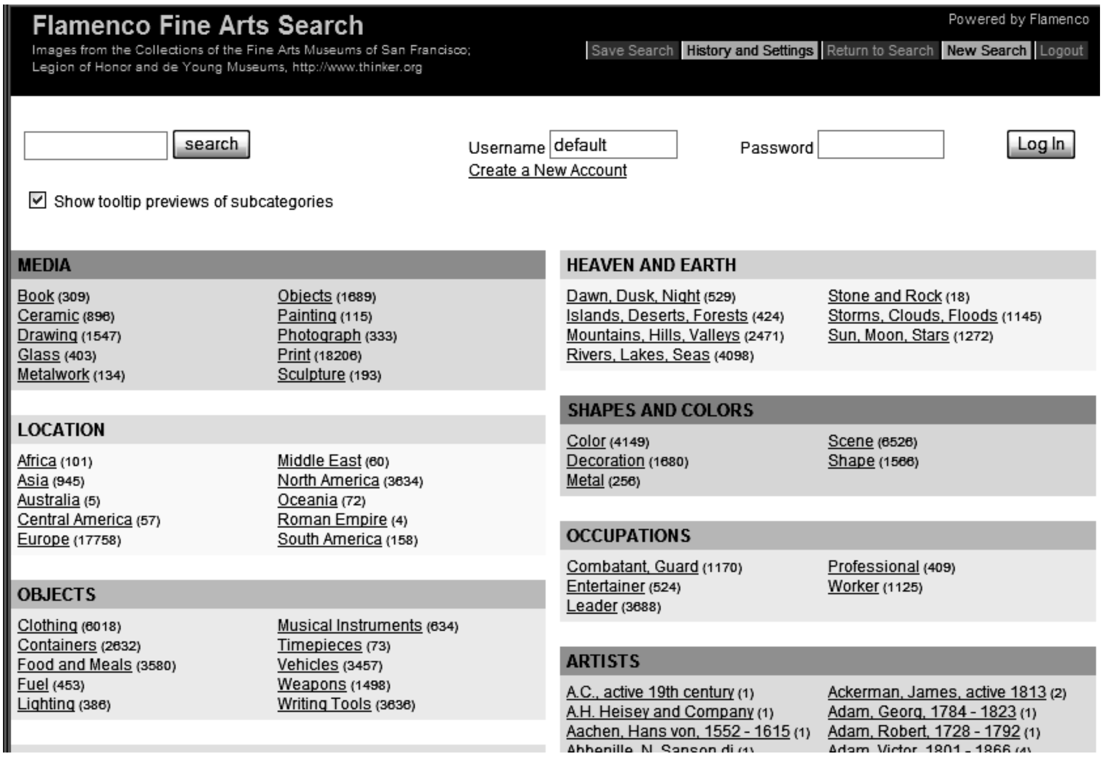
Another development, yet to be tested for accessing and representing classification data on the Web, is 'programmatic interfaces' within the development of Web Services[8]. Based on XML technology this service-orientated architecture leads to a separation between the underlying data resources and interface components. OCLC, for instance, research the possibility of 'terminology services' as a type of a Web service that provides mappings from a term in one vocabulary to one or more terms in another vocabulary. Terminology services can be used in the process of cataloguing or information retrieval (Vizine-Goetz, 2003; Vizine-Goetz et al., 2004, 2004a).

Last but not least, we should mention the creation of the eXchangable Faceted Metadata Language (XFML) format, aimed at the managing and displaying of a faceted vocabulary (Van Dijck, 2003). Its practical applications and tools (e.g. Flamenco search interface framework http://flamenco.berkeley.edu/, Figure 10) ought to be observed as they represent a direction in interface development that is compatible with analytico-synthetic classifications.

7 For further developments and practical applications see Zhang, 2004 and Zhang & Marchionini, 2004.

8 Web Services are m2m software applications best described as "a suite of protocols that define how requests and responses between software applications should be encoded (using XML) and transferred (e.g., over the Web using Hypertext Transfer Protocol - HTTP or e-mail) and how such services should be described and registered for discovery and use" (Tennant, 2002).

Figure 10. ***Faceted interface on Flamenco demo, showing facets of media, location objects etc.***



Ontology orientated vocabulary standards, such as the Simple Knowledge Organisation System (SKOS), seem also to be open to accommodate classification schemes and to some extent analytico-synthetic classifications which eventually may encourage and lead to more applications with faceted subject browsing interfaces based on classification (see Miles et al., 2005; Voss, 2006).

6. Concluding remarks

The ease of use of classification in indexing and its efficiency in retrieval are closely related to how the knowledge structure and its semantic linking are accessed and presented on the interface. Not until the advent of the GUI and hypertext/hypermedia was it possible to consider a more sophisticated interface to classification with dynamic cascading windows and hypertext.

A desirable interface to classification would make use of hypertext and would consist of interactive/dynamic windows that would enable independent browsing of vocabulary facets. It would also allow for hierarchies to be collapsed and expanded, and contain hyperlinks to related classes. Ideally the classification tree would be presented with captions (with or without notation) and appropriate indentation. If the classification interface is created for an IR system, the number of hits should be displayed against each class that is hyperlinked either to the list of surrogates or the list of resources. Classification should be searched using words and a term index may be used to help choose appropriate terms. A transition from search to browse/browse to search should be provided as well as the possibility to scroll back and forward through the hierarchy. Broadening and narrowing of search results should be supported independently of the UDC decimal notation.

The interface functionality is closely dependent not only on the appropriate formalisation and coding of classification data, but also on their enrichment. When classification is managed as a database tool, the functions necessary for classification management and indexing and those necessary for IR retrieval overlap. In this context the same classification data are used to support an interface for both librarians (for indexing) and patrons for searching the collection. A possible future improvement of UDC Master Reference File data will hopefully contribute to easier and better implementation of classification in IR systems. There are now more good classification interface examples available on the Web and this should encourage future development in the area of classification visualisation and use.

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