FCA assisted IF Channel Construction for Conceptual Data Modelling

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In this paper we explore how IF (Barwise-Seligman's information flow theory, 1997) and FCA (Formal Concept Analysis, Wille 1997) may be used to help conceptual data modelling. A fundamental observation we make is that the process of conceptual data modelling is a distributed system in the sense of Barwise-Seligman's information flow theory, i.e., the Channel theory (Barwise and Seligman ibid), and therefore the process of conceptual data modelling per se, the correctness of it, and thus the usefulness of the resultant database depend solely on the existence of a relevant information channel (hereafter IF channel) that takes the real world domain being modelled and the conceptual data model as components. Based upon this conviction, we explore how such an IF channel may be constructed and how it guides conceptual data modelling. The main findings through this work are as follows:

Using IF and FCA for conceptual data modelling, domain-dependent knowledge is still needed in establishing a set of original correspondences between objects in the real world and those in a conceptual data model. This constitutes the basis for further modelling work;

IF and FCA help the modelling in that all those that are required by the existence of an IF channel guide the process of modelling and eventually determine the correctness of it. This includes:

Helping check the correctness of the domain-dependent knowledge reflected in the original set of correspondences;

Guiding the elicitation of knowledge about the domain from the domain expert throughout the process of modelling.

We use a simple example to illustrate our points.

1 INTRODUCTION

It is easily observable that conceptual data modelling is still conducted largely intuitively, and therefore any formulation of it with sound theoretical underpinnings would seem desirable, and the issue of whether and how this might be done is an interesting research question.

In this paper, we present some thoughts on FCA assisted IF channel construction from the real world context (This is a term of FCA) to some certain conceptual data model context. The thoughts are described in terms of two semiotic levels, i.e., the syntactic and the semantic level. By the 'the syntactic level of the construction of an IF channel for conceptual data modelling', we mean that the syntactic rules for data modelling and for IF channel construction are used for a particular modelling task. This is one hand. On the other hand, 'the semantic level of the construction of an IF channel for conceptual data modelling' is concerned with how the correspondences between objects in the real world domain and those in a data model are established.

An IF channel for conceptual data modelling is built upon the understanding and knowledge about the syntactic rules of conceptual data modelling and IF channel construction of the person (i.e., the modeller) that carries out the modeling. We assume that the modeller has the ability to map the real world objects to a certain set of conceptual objects and data. Therefore, the IF channel is 'conceptual' in that it formulates something in his or her mind, and this process is not unlike the process of 'metaphor'.

How the syntactic rules for data modelling and for the construction of an IF channel are used for a particular modelling task would depend on the establishment of concrete correspondences between real world objects and objects within a data model, which are represented by data types and instances. These correspondences (mappings) constitute the semantic level of the construction of the IF channel. Moreover, semantic correspondences are presented by the formal structure of the IF channel and the conceptual data model, which comply with the syntactic rules for IF channels and data models. Thus the two levels are interrelated with and depend on each other. In the sections that follow, we will use an example to show our points.

2 THE SYNTACTIC LEVEL OF THE IF CHANNEL CONSTRUCTION

On this level, the construction of an IF channel involves representing some objects (together with relations) in one context by using certain set of objects in a different context. Here, we are especially interested in how to establish a channel that connects real world objects in the 'source' context with modeling objects in the 'target' context (Following Barwise-Seligman's IF theory, the term 'source' refers to representations, which in our case is the conceptual data model, and the term 'target' the real world domain being modelled). As aforementioned, the modeling process is unlike the process of using metaphor, which is described as a ‘mapping from one situation to another which is governed by the constraints of structural consistency and one-to-one mapping’ (Gentner & Forbus 1991). Our work on the construction of an IF channel on this level is inspired by the findings of Old and Priss (2001) from their work on an IF based formal model of metaphor. They use concept lattice to describe the relations within one context (the same as ‘classification’ (Barwise and Seligman 1997)) and use infomorphisms to describe the information flow between different contexts. The IF channel conceptually links up the source and target contexts and facilitates information transmission between the target and the source. Infomorphisms that are established at some pint of time in modelling between classifications capture the correspondences between objects that are known at that point, which constitute an IF channel. Such a channel captures information flow between the classifications.

Old and Priss (2001) introduce a definition of ‘relational infomorphisms’, which enables more complex modeling of metaphor and extends Barwise-Seligman’s information flow theory:

> *Relational Infomorphisms: a pair of functions (f, f’) which maps between two classifications, (A1, B1, R1) and (A2, B2, R2), which have further relations R11, R12,… $\subseteq$ A1XB1 and R21, R22,… $\subseteq$ A2XB2, such that for elements b1, b2$\in$B2 and for each pair of corresponding relations (R1i, R2i): b1R2ib2 $\Leftrightarrow$ f’(b1)R1if’(b2).*

Based on this definition, we establish that conceptual data modelling is seen as an IF channel that is constructed with relational infomorphisms that connect relations between two contexts. For example, in an example regarding ‘furniture’ in a room, there is an IF channel shown in the following diagram.

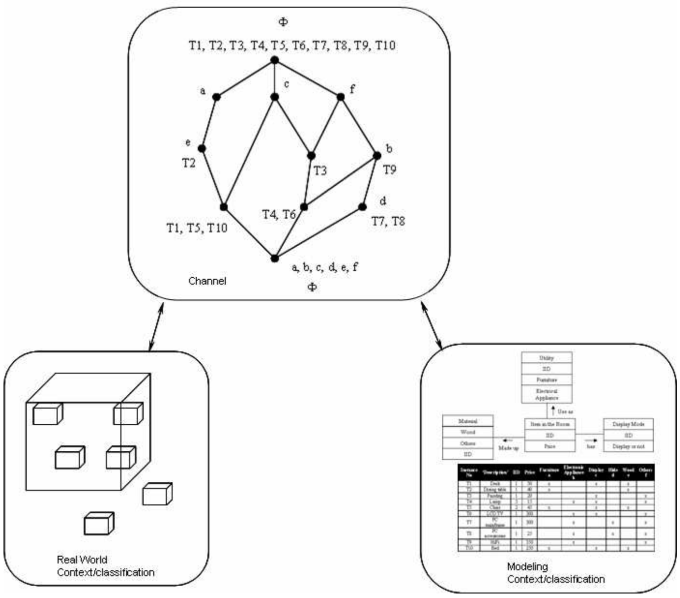

Fig 1 Modeling Procedure Represented by IF channel

In this diagram, a real world context, i.e., the room containing furniture (the room context), and a model context (the DB context), i.e., a DB conceptual structure with a table of data, are connected by an IF channel, which is constructed based upon people’s perceptions about the link between the two. Infomorphisms map each concept from the room context and the DB context to a corresponding concept of the IF channel (more precisely, the core of the IF channel). The core of the IF channel here is represented by a concept lattice, which describes the common abstract conceptual characteristics of both the room context and the DB context.

The infomorphisms are relational infomorphisms because the concept relation hierarchies of both contexts are mapped. The concept relations of the room context are mapped into the concept hierarchy of the IF channel, which is in turn mapped into the DB context. It should be noted that these infomorphisms are not just instantiate functions from the core of the IF channel to each context. Infomorphisms preserve certain information but an IF channel also needs each context to provide additional structural consistency constraints (Gentner & Forbus ibid). Successfully achieving the syntactic level of an IF channel construction means that the source context and the target context are informationally related in a certain way through the understanding of the modeller. However, the syntactic level gives little concern to how these two contexts (or even more contexts) are informationally connected, and yet this relationship plays a central role in the whole process of modeling. This is the reason why we need to know in details how semantically the two contexts are connected by the channel.

3 THE SEMANTIC LEVEL OF THE IF CHANNEL CONSTRUCTION

On this level, we will show how concept lattice assists the finding of mappings for the IF channel. In the example, the room context consists of a set of real world objects including desk, dining table, painting, lamp, chair, LCD TV, PC mainframe, PC accessories, HiFi and bed. A modeller might model them with conceptual objects and relations in a database, i.e., a DB context. The DB context could be one shown below.

Instance No	'Description'	IID	Price	Furniture a	Electronic Appliance b	Display c	Hide d	Wood e	Others f
T1	Desk	1	50	x		x		x	
T2	Dining table	1	40	x				x	
T3	Painting	1	20			x			x
T4	Lamp	3	15		x	x			x
T5	Chair	2	45	x		x		x	
T6	LCD TV	1	300		x	x			x
T7	PC mainframe	1	300		x		x		x
T8	PC accessories	1	25		x		x		x
T9	HiFi	1	350		x				x
T10	Bed	1	250	x		x		x	

Table 1 The DB context Table

Through the analysis on the syntactic level, we know that due to the prior knowledge of modelling of the modeller, he/she might model those identified characteristics of each real world objects as some corresponding attributes of the DB. The mapping is one-to-one. We take attributes 'Furniture', 'Electronic Appliance', 'Display', 'Hide', 'Wood' and 'Others' as an example, and we would have the source and target contexts defined as follows:

Source Context - Room Context A_R(A1, B1, R1):

Tokens A1 – real world objects: desk, dining table, painting, lamp, chair, LCD TV, PC mainframe, PC accessories, HiFi and bed,

Types B1 – characteristics for classifying tokens (in modeller's mind): Furniture, Electronic Appliance, Display, Hide, Wood, and Others,

Relations R1 – Relations between token A1 and B1.

Target Context – DB Context A_{DB}(A2, B2, R2):

Tokens A2 – DB instances: T1, T2, T3, T4, T5, T6, T7, T8, T9, T10,

Types B2 – DB attributes: 'Furniture', 'Electronic Appliance', 'Display', 'Hide', 'Wood' and 'Others',

Relation R2 – 'belongs to' relation in DB.

To find the informational relationship between the objects in the two contexts, following the rules of the IF channels, we need to set up infomorphisms that connect each context with the core of the IF channel. On the type level, the correspondences between some types of the two contexts are established based upon the perception of the modeller that is involved in the modelling process per se or in the use of the modelling.

Although the modeller may carry out the modelling process incrementally, she/he understands and can use the types of the real world domain and the attributes in a database as belonging to a theoretical domain of discourse T. This is mathematically captured by a classification A with T as its type set. For example, a, b, c, d, e, f are types of A, and they are translated (mapped) to types of the source context and the target context respectively. This is part of type level function of their respective infomorphisms.

$g_R{}^{\wedge}$ (a) = Furniture;

$g_{DB\wedge}$ (a) = 'Furniture';

$g_{R\wedge}$ (b) = Electronic Appliance;

$g_{DB}{}^{\wedge}$ (b) = 'Electronic Appliance';

$g_R{}^{\wedge}$ (c) = Display; $g_{DB}{}^{\wedge}$ (c) = 'Display';

$g_R{}^{\wedge}$ (d) = Hide; $g_{DB}{}^{\wedge}$ (d) = 'Hide';

$g_R{}^{\wedge}$ (e) = Wood; $g_{DB}{}^{\wedge}$ (e) = 'Wood';

$g_R{}^{\wedge}$ (f) = Others; $g_{DB}{}^{\wedge}$ (f) = 'Others';

The types are associated with a classification A, which holds the rules in terms of partial alignments, which govern the way of the two contexts being related. Classification A would not add any additional semantic information as it does not comprise any IF theory (namely no constraints showing on it). Therefore, with types defined as a…f, we generate all the possible tokens for the classification of A. Note that as all the possible tokens are generated, there are no embedded constraints available on this classification, that is, no constraints are placed on the possibilities of the existence of the tokens in terms of how they may belong to types.

	a	b	c	d	e	f
n0	0	0	0	0	0	0
n1	0	0	0	0	0	1
…	…	…	…	…	…	…
n9	0	0	1	0	0	1
…	…	…	…	…	…	…
n17	0	1	0	0	0	1
…	…	…	…	…	…	…
n21	0	1	0	1	0	1
…	…	…	…	…	…	…
n25	0	1	1	0	0	1
n34	1	0	0	0	1	0
…	…	…	…	…	…	…
n42	1	0	1	0	1	0
…	…	…	…	…	…	…
n63	1	1	1	1	1	1

Table 2 the IF Channel Classification

With types a…f, the classification A has totally 64 tokens as shown in above table. To satisfy the fundamental property of infomorphisms Barwise and Seligman 1997, P72), the token level functions of the infomorphisms, g_R and g_{DB}, have to be :

g_R $^\vee$ (desk) = n42; g_{DB} $^\vee$ (T1) = n42;

g_R $^\vee$ (^{d}ining table) = n34; g_{DB} $^\vee$ (T2) = n34;

g_R $^\vee$ (painting) = n9; g_{DB} $^\vee$ (T3) = n9;

gR $^\vee$ (lamp) = n25; g_{DB} $^\vee$ (T4) = n25;

g_R $^\vee$ (chair) = n42; g_{DB} $^\vee$ (T5) = n42;

g_R $^\vee$ (LCD TV) = n25; g_{DB} $^\vee$ (T6) = n25;

g_R $\vee$ (PC mainframe) = n21; g_{DB} $^\vee$ (T7) = n21;

g_R $^\vee$ (PC accessories) = n21; g_{DB} $^\vee$ (T8) = n21;

g_R $^\vee$ (HiFi) = n17; g_{DB} $^\vee$ (T9) = n17;

gR $^\vee$ (bed) = n42; g_{DB} $^\vee$ (T10) = n42;

After achieving classification A, we can find the desired IF channel accordingly. This includes constructing the IF channel classification, i.e., the classification that is the core of the channel, and infomorphisms: f_R :VA_R $\rightleftarrows$ C and f_{DB} :VA_{DB} $\rightleftarrows$ C, where VA_R and VA_{DB} are the distinctive power of A_R and A_{DB} respectively. The distributed system is shown as follows.

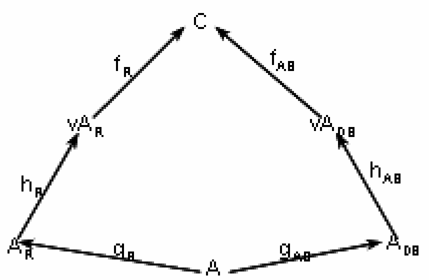

Fig 2 Distributed System

VA_R is defined as disjoint union of classification AR, i.e., the types are disjoint union of A_R while tokens are the same as A_R with corresponding classification relations.

	{'Furniture', 'Electronic Appliance', 'Display', 'Hide', 'Wood', 'Others'}	…	{'Furniture', 'Display', 'Wood'}	…	{'Display', 'Electronic Appliance', 'Others'}	…
T1	1		1			
T2	1					
T3	1					
T4	1				1	
T5	1		1			
T6	1				1	
T7	1					
T8	1					
T9	1					
T10	1		1			

Table 3 The table fragment of VA_R classification

	{Furniture, Electronic Appliance, Display, Hide, Wood, Others}	…	{Furniture Display, Wood}	…	{Display, Electronic Appliance, Others}	…
desk	1		1			
dining table	1					
painting	1					
lamp	1				1	
chair	1		1			
LCD TV	1				1	
PC mainframe	1					
PC accessories	1					
HiFi	1					
bed	1		1			

Table 4 The table fragment of VA_{DB} classification

There are natural infomorphisms hR and h_{AB} which connect A_R and A_{DB} with VA_R and VA_{DB} respectively. The classification C associated with the IF channel is constructed such that the type set of the IF Channel is the disjoint union of types of VA_R and VA_{DB}; the token set is the connections (pair of tokens) that connect a token from VA_R with a token from VA_{DB} only when the two tokens are sent by the infomorphisms g_R and g_{DB} to the tokens of the classification A that are classified as of the same type. For example, the core C will have the token <bed, T10> connecting VA_R's token bed with VA_{DB}'s token T10 because g_R $\vee$ (desk) = n42; g_{DB} $\vee$ (T1) = n42; The following is a fragment of the IF channel classification on the core. The following is a fragment of the IF channel classification on the core.

	{a}	{c}	{f}	{a,e}	{c,f}	{f,b}	{a,c,e}	{c,f,b}	{f,b,d}
<dining table, T2>	1			1					
<desk, T1>	1	1		1			1		
<desk,T5>	1	1		1			1		
<desk,T10>	1	1		1			1		
<chair, T1>	1	1		1			1		
<chair, T5>	1	1		1			1		
<chair, T10>	1	1		1			1		
<bed, T1>	1	1		1			1		
<bed, T5>	1	1		1			1		
<bed,T10>	1	1		1			1		
<painting, T3>		1	1		1				
<lamp, T4>		1	1		1	1		1	
<lamp, T6>		1	1		1	1		1	
<LCD TV, T4>		1	1		1	1		1	
<LCD TV, T6>		1	1		1	1		1	
<HiFi, T9>					1	1			
<PC mainframe, T7>			1			1			1
<PC mainframe, T8>			1			1			1
<PC accessories, T7>			1			1			1
<PC accessories, T8>			1			1			1

Table 5 the table fragment of the IF channel classification on the core

As aforementioned, the modeller models the characteristics of the real world objects as the conceptual attributes. Determined by modeller's knowledge of modelling, this mapping is one-to-one, i.e., each identified feature used to classify the real world's objects is reflected by a corresponding DB attribute. Therefore, in the above table, we do not show the disjoint union type sets as two separate sets of types because they mirror each other. We can produce the concept lattice for the IF channel classification as follows.

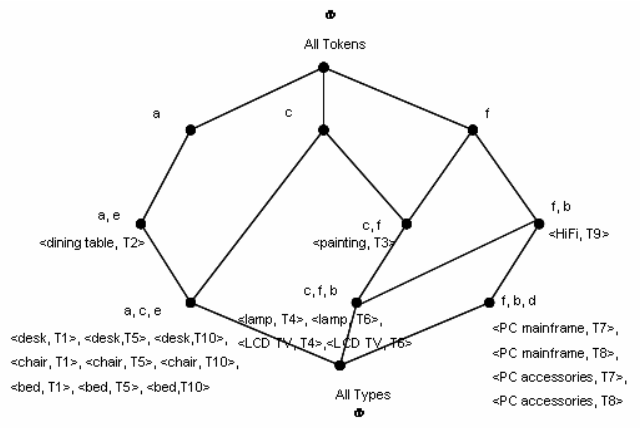

Fig 3 The IF Channel Concept Lattice

It can be seen that the concept hierarchy of this lattice is the same as the one developed in the modeller's mind on syntactic level. Although the tokens become pairwise due to the construction of the IF channel, the concepts and the relations among them are not changed. This reflects the procedure of modeling according to the modeller's prior knowledge. The most important thing is that the structure of the concept lattice is preserved throughout the two levels. It is this lattice that represents what should happen in the modeller's mind. It shows the interrelationship between the two levels of modeling.

Another thing that is worth noting is that according to the modeller's perception at this particular time (Different modeller may hold different perceptions even they share the same knowledge and the same modeller may hold different perceptions at different times. Therefore, here, we emphasise the 'particular time'), some tokens are retained in the same concepts. In other words, they belong to the same set of types. Hence, if we turn to considering some particular instances of relations, for example, the relation 'an object being placed on another object', we would not be able to get this instance using the available concept hierarchy as the instances of a concept are not distinguishable (Feng 2005) from others.

4 INFORMATION FLOW THAT SHOWS THE CORRECTNESS OF THE MODELLING

We have constructed an IF channel as a mathematical model of a conceptual data modelling process. This channel captures the regularities that govern how the real world context is informationally related to the model context. The regularities are reflected in the information flow within the IF channel. That is to say, if there is a right information flow from the real world context to the model context, the modeling process has been conducted correctly. The information flow is captured by the constraints over the sum of the classifications that are mathematical models for the real world context and the model contexts respectively.

In the example, when we set up the infomorphisms between the room and DB context, we stressed that given the correspondences between the types, for the information flow to be ever possible, the tokens have to correspond in a certain way. We have shown, and we re-iterate here in order to make it easier to explain our points, that on the type level, each identified feature used to classify the real world objects is modelled with a corresponding DB attribute, which constitute the type level function of the infomorphisms. The correspondences that constitute this function are as follows:

$g_R{}^\wedge$ (a) = Furniture; $g_{DB}{}^\wedge$ (a) = 'Furniture';

$g_R{}^\wedge$ (b) = Electronic Appliance;

$g_{DB}{}^\wedge$ (b) = 'Electronic Appliance';

$g_R{}^\wedge$ (c) = Display; $g_{DB}\wedge$ (c) = 'Display';

$g_R{}^\wedge$ (d) = Hide; $g_{DB}{}^\wedge$ (d) = 'Hide';

$g_R{}^\wedge$ (e) = Wood; $g_{DB}{}^\wedge$ (e) = 'Wood';

$g_R{}^\wedge$ (f) = Others; $g_{DB}{}^\wedge$ (f) = 'Others';

Now in order to make the information flow ever possible, infomorphisms have to exist between the components of the IF channel, i.e., between the real world context and the core of the IF channel, and the data model context and the core of the IF channel respectively. To this end, the fundamental property of infomorphisms has to be satisfied. Therefore, the correspondences between the tokens have to be defined as follows:

$g_R{}^{\vee}$ (desk) = n42; $g_{DB}{}^{\vee}$ (T1) = n42;

$g_R{}^{\vee}$ (dining table) = n34; $g_{DB}{}^{\vee}$ (T2) = n34;

$g_R{}^{\vee}$ (painting) = n9; $g_{DB}{}^{\vee}$ (T3) = n9;

$g_R{}^{\vee}$ (lamp) = n25; $g_{DB}{}^{\vee}$ (T4) = n25;

$g_R{}^{\vee}$ (chair) = n42; $g_{DB}{}^{\vee}$ (T5) = n42;

$g_R{}^{\vee}$ (LCD TV) = n25; $g_{DB}{}^{\vee}$ (T6) = n25;

$g_R{}^{\vee}$ (PC mainframe) = n21; $g_{DB}{}^{\vee}$ T7) = n21;

$g_R{}^{\vee}$ (PC accessories) = n21; $g_{DB}{}^{\vee}$ (T8) = n21;

$g_R{}^{\vee}$ (HiFi) = n17; $g_{DB}{}^{\vee}$ (T9) = n17;

$g_R{}^{\vee}$ (bed) = n42; $g_{DB}{}^{\vee}$ (T10) = n42.

As the correctness of the modeling lies with the required information flow, none of the above can be violated. This is because any violation of the above specified correspondences would result in the non-existence of the required information flow.

In addition to the functional correspondences shown that are required by the fundamental property of infomorphism, there is another part on the channel, which is significant for the modelling and the correctness of it. This is the constraints of 'regular theory' (Barwise and Seligman 1997, P.117) on the core of the IF channel. For our example, we identify the following constraints that constitute the regular theory on the core of the IF channel by reading the line diagram (this is term of FCA) that represents the core:

$$e \vdash a;\ b \vdash f;\ d \vdash b;\ d \vdash f;$$
$$\vdash a, c, f;\ a, c, f \vdash.$$

These constraints show the entailment relationships between the types of the core, which are represented as 'formal concepts hierarchy' in FCA terms. These constraints clearly show the inheritance hierarchy of concepts.

These constraints make the entailment relationships between each identified types (in terms of concepts) clearly to be seen. They clarify the inheritance hierarchy of concepts on the IF Channel which in deed reflects the modeller's understandings during the modeling process. Like the process of metaphor, these constraints represent the abstraction of common characteristics of both real world and DB context. Constraints capture what information flows. To show the information flow from the real world context to the model context, we translate, by using the Elimination rule (Barwise and Seligman 1997, P.38) of the relational infomorphisms, these constraints are 'moved' to distributed systems (we name them as distributed constraints), that are models of the real world context and the model context:

In the real world context:

Wood ├ Furniture; Electronic Appliance ├ Others;

Hide ├ Electronic Appliance; Hide ├ Others;

├ Furniture, Display, Others; Furniture, Display, Others ├.

In the DB context:

'Wood' ├ 'Furniture'; 'Electronic Appliance' ├ 'Others';

'Hide' ├ 'Electronic Appliance'; 'Hide' ├ 'Others';

├ 'Furniture', 'Display', 'Others'; 'Furniture', 'Display', 'Others' ├.

Following the third principle of information flow put forward by Barwise and Seligman (Barwise and Seligman 1997, P.35), it is the particulars (i.e., tokens) that carry information. In the example, these particulars are in deed the token pairs (shown in figure3) which are determined by the infomorphisms $h_R{}^o f_R$, and $h_{DB}{}^o f_{DB}$ This also means that conforming to the mode of information flow, we would get the induced view of what should be inside the real world and the DB context respectively. In terms of concept lattice, they are shown as follows respectively.

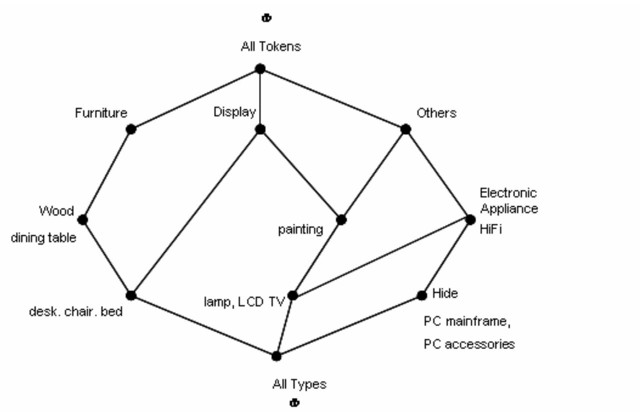

Fig 4 Concept Lattice of Induced Real World Context

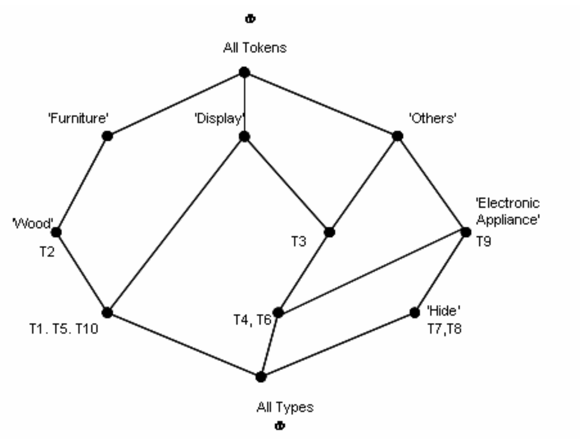

Fig 5 Concept Lattice of Induced DB Context

Therefore, we see that the induced real world and DB contexts are holding the distributed constraints produced earlier. Also, the tokens are corresponding ones in each pairwise token. Now, if we turn to the original real world and DB contexts without considering the IF Channel, we could possibly get the different concept lattices respectively. If differences are recognized, it means that the IF Channel does not reflect the correct or complete informational relations between the two contexts. As a result, the modeling process is neither succeeded nor completed.

For the conditions of incomplete modeling, constraints on the IF Channel are dynamically changeable along with the development of the understanding of the real world domain being modelled. This is what normally happens in the data modelling for a database. Accordingly the IF channel evolves and at the same time the requirements for the existence of the channel continue providing guidance to the modelling process and justifying the correctness of it.

In summary, with our approach, the syntactic level of the IF Channel based on relational infomorphisms are fulfilled by the semantic level of the IF Channel based on detailed infomorphisms i.e., h, f, and g. The semantic level of constraints, if we make them clear, would be:

Furniture $\vdash$ ‘Furniture’; Electronic Appliance $\vdash$ ‘Electronic Appliance’; Display $\vdash$ ‘Display’;

Hide $\vdash$ ‘Hide’; Wood $\vdash$ ‘Wood’; Others $\vdash$ ‘Others’.

They are fostering the distribution of constraints on the syntactic level. The information flow that is captured by the regular theory and token connections by the infomorphisms on the core of the IF channel verifies the correctness of the modelling.

5 SOME GENERAL IMPLICATIONS OF THIS WORK

We believe that qualitative (also called semantic) information theory represented by the work of Dretske (1999), Barwise and Seligman (1997), Devlin (1991), and Barwise and Perry (1983), and information philosophy by Floridi (2004) represent the most advanced knowledge thus far regarding information and information flow. This should provide sound theoretical underpinnings and insights for tackling some tough and elusive problems, such as information creation and information flow in the context of information systems and the correctness and formulation of conceptual data modelling. To this end, there are two questions of a general nature that have been ‘bothering’ us, namely:

How a general theory of information flow might help understand how information creates and information flow takes place within a particular domain, for example, information systems, which in turn help understand the domain.

On the other hand, to construct an IF channel, a layer that might be called ‘domain-dependent foundational layer’ under the IF channel, which enables information flow to take place, would seem needed.

Is this a ‘chicken and egg’ problem? The work reported within this paper represents a step toward finding a convincing answer to this question. Through this work, we find:

That domain knowledge is still needed in establishing an original set of correspondences between objects in the real world and those in a conceptual data model. This constitutes the basis for any further modelling work by using IF and FCA. That is to say, the aforementioned ‘domain-dependent foundational layer’ under the IF channel is necessary, which would determine how a system works, and how a system works does not necessarily require information flow between its components. Information flow, in the sense that we could know something about B by looking at A, does exist, but it is a result of regularities that govern the working of the system.

That IF and FCA do help conceptual data modelling and database design in that all those that are required by the existence of an IF channel guide and eventually determine the process of conceptual data modelling. This is because the construction of database or an information system in general is essentially a job of using a set of ‘representations’, which are external objects that we use to present information about some other objects on the basis of some fixed semantic rules (Shimojima 1996, P29), to represent objects in the modelled real world domain. This, in terms of IF, is a matter of making sure that there exists an IF channel in which information flows from the real world context to the data model and database context. That is to say, conceptual data modelling, database design and information systems construction is, at the heart of the matter, a problem of IF channel construction.

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