## **Entity Relationship Model**

Consensus

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## **Fundamentals**

## **Entity Relationship Model**

- An entity relationship model, also called an entity-relationship (ER) diagram, is a graphical representation of entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems.<sup>1</sup>
- To bridge the gap between users and systems, we need a representation of entities and their relationships as they are in regards to the organization of information in the human mind, and which can be applied to the organization of data (= digital information) within databases or information systems.
- To allow communication between existing users and systems, the model must be both the smallest common multiple and the greatest common denominator of such models among all existing information and thought systems.
- Finally it must allow to represent not only entities and their relationships but also the changes affecting them, and how change propagates within and between users and systems, that is: how their changes relate to each other.

1. from Wikipedia: entity relationship model

## Nodes, Links and Relationship Instances

- Most representations consider entities as nodes and relationships as links within a network or graph of such inter-related... "things"
- Obviously this falls short of considering the links themselves as connectable entities. This shortcoming typically leads to the later introduction of e.g. types, attributes, primary keys, etc. which defeats the model
- In Consensus we consider both *nodes* and *links* as entities which can be associated to, from and via each other as per the following representation (see next slide)
- Finally, to complete the model, we need also to consider the *association* of such entities as an entity in its own rights, which in Consensus we call a *Relationship Instance*

## **Consensus Entities**

Representation		Description			
Α	В	A and B are Nodes			
		${\mathscr R}$ is a Relationship			
		Relationship Instance			
	Exa	imple			
A ——	$R$ $\rightarrow$ B	A $\mathscr{R}$ B in this = $\bigcirc$ Relationship Instance <sup>1</sup>			

1. Higher-order associations can be easily created from such ones, as will be made clear later in this presentation

## Consensus Data Model

Represe	entation	Description				
<i>®</i> A —	<b>→</b> B	A $\mathscr{R}$ B in this = $\bigcirc$ Relationship Instance				
	Data Model <sup>1</sup>					
INSTANCE	SOURCE	MEDIUM TARGET				
А		( A )				
$\mathscr{R}$		$(\mathscr{R})$				
В		(B)				
0	А	${\mathscr R}$	В			

Note: A,  $\mathcal{R}$ , B and this are the unique row entry identifiers in this table, whereas (A), ( $\mathcal{R}$ ) and (B) may refer to a separate symbol table. The distinction is made depending on whether the SOURCE and TARGET coordinates are empty or not.

## **Consensus Key Associations**

## About this section: Update 2017-01-27

- The purpose of this section was to show that the proposed Entity Relationship Model answered indeed all the requirements stated in the previous section.
- Having played with the model for some time, I realized that the "is" and "has" associations were fundamental building blocks, and that a pattern emerged (as shown on the next slide) which allowed to get rid of these words altogether.
- This relied on a convention whereby a relationship instance may represent different types of relationship depending on whether the SOURCE, MEDIUM and TARGET coordinates of a relationship instance are informed or not.
- Although this research has value in showing the completeness of the model, the
  fact is that I was still looking for an *intrinsic* value to be associated with an entity,
  as opposed to my later realization that any such value or function is given
  contextually by the position of the entity within the overall network, according to
  genetic evolution.
- Bottom line is: we keep the "is" and "has" and other keywords, which makes the model much more readable:)

# is of Relationship Instance

Representation	Description
$A \xrightarrow{\mathcal{R}} B$	A $\mathscr{R}$ B = A relates <u>to</u> B via $\mathscr{R}$ = the relationship instance of A to B via $\mathscr{R}$
milou dog has tintin	milou is dog tintin has dog milou is dog of tintin
dog milou — tintin	= milou <i>is</i> dog of tintin Relationship Instance

## has and is Relationships

Representation	Description
A — C	A is C  = A as C
C D	Dhas C $O = D S C$
$\begin{array}{c} B \\ \longrightarrow C \\ A \end{array}$	Chas B $O = C \stackrel{'}{s} B$ $A \stackrel{'}{c} s \stackrel{'}{c} s \stackrel{'}{b} B$ $O = A \stackrel{'}{a} s \stackrel{'}{c} s \stackrel{'}{b} B$

## **Example Database Representation**

Representation	Description			
dog tintin milou	tintin has dog  = tintin s dog  milou is tintin s dog  = milou as tintin s dog			

#### **Database Representation**

INSTANCE	SOURCE	MEDIUM	TARGET
milou as dog	milou	dog	
tintin's dog		dog	tintin
milou as tintin's dog	milou	tintin's dog	

## Consensus Key Associations

Consensus interpretes the specific following associations in the Data Model as

INSTANCE	SOURCE	MEDIUM	TARGET	interpretation
E		(E)		E = declaration
id	A	В		A is B id = A as B
id		В	С	C has B id = C's B
id	Е			E is deactivated id = E's deactivation
id			E	E is activated id = E's activation

 This, coupled with appropriate expressions<sup>1</sup>, allows Consensus to translate user descriptions into their related Database Representations, and vice-versa

## Update 2017-01-27

 The following table aimed to show each association translates into natural language, using an SQL-type representation where

In *red* we have the SQL statement

select SOURCE / MEDIUM / TARGET / INSTANCE where { SOURCE / MEDIUM / TARGET / INSTANCE is informed or not }

In black we have the corresponding statement in natural language

For instance<sup>1</sup>

select INSTANCE where SOURCE in A and MEDIUM in B

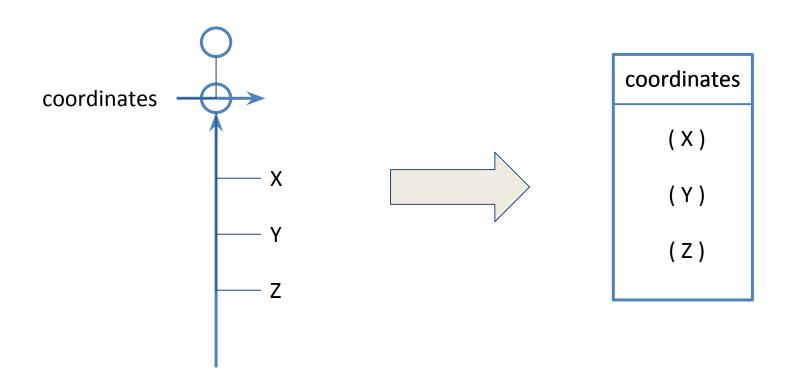
translates as « A as B » (e.g. Dog as Animal)

• In today's representation (which uses "is" and "has") we simply say that the relationship instance [A-is->B] represents "A as B" or more litterally "that per which A is B".

	se	lect			wh	ere	
SOURCE	MEDIUM	TARGET	INSTANCE	. s _	M.	Ţ	
select source where source in X X which = source	select medium where source in X That which identifies X		select instance where source in X <sup>1</sup> Pat X as something	rick Bo	oucha	iud 20	)16
select source where medium in X	select medium where medium in X	select target where medium in X	select instance where medium in X	,			
That which is X	X which = medium	That which has X	something's X or something as X		{ X }		
	select medium where target in X	select target where target in X	select instance where target in X		. ,		
	That which composes X	X which = target	X's something			{ X }	
select source where instance in X	select medium where instance in X	select target where instance in X	select instance where instance in X				
That which, as something, = X	That which either identifies something which, as something, = X or composes something whose something = X	That whose something = X	X which = instance				{ X }
select source where source in A and medium in B	select medium where source in A and medium in B		select instance where source in A and medium in B				
A which is B	B which identifies A		A as B	{ A }	{ B }		
. Carrier 13 B	5 William Identifies A			{A}	l n l	{ B }	
select source where source in A and instance in B A which, as something, = B	select medium where source in A and instance in B That which identifies ( A which, as something, = B )		select instance where source in A and instance in B B which = A as something	{A}		(2)	{ B }
	select medium where medium in A and target in B	select target where medium in A and target in B	select instance where medium in A and target in B				
	A which composes B	B which has A	B's A		{ A }	{ B }	
select source where medium in A and instance in B That which, as A, = B	select medium where medium in A and instance in B A which either identifies something which, as A, = B or composes something whose A = B	select target where medium in A and instance in B That whose A = B	select target where medium in A and instance in B B which = either something as A or something's A		{ A }		{ B }
	select medium where target in A and instance in B That which composes ( A whose something = B )	select target where target in A and instance in B A whose something = B	select instance where target in A and instance in B B which = A's something			{ A }	{ B }
				{ A }	{ B }	{ C }	
select source where source in A and medium in B and instance in C A which, as B, = C	select medium where source in A and medium in B and instance in C B which identifies ( A which, as B, = C )		select instance where source in A and medium in B and instance in C C which = A as B	{A}	{ B }		{C}
				{ A }		{ B }	{ C }
	select medium where medium in A and target in B and instance in C	select target where medium in A and target in B and instance in C	select instance where medium in A and target in B and instance in C				
	A which composes ( B whose $A = C$ )	B whose A = C	C which = B's A		{ A }	{ B }	{ C }
				{ A }	{ B }	{ C }	{ D }

## **Higher Order Associations**

 Higher level interpretations can be built upon Consensus key associations and upon each other, such as



## Change Propagation

Consensus Change Propagation Model builds upon the following associations

Database Representation					
INSTANCE	SOURCE	CE MED		TARGET	
deactivation	state A				
activation				state C	
change	Either - activation - deactivation - change	state B		Either - activation - deactivation - change	
Representation			Description		
state B state A state C			<ul><li>on State A is deactivated</li><li>in state B</li><li>do state C is activated</li></ul>		

## Thank You!