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Business Rules – Modeling Business Rules

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SBVR - Semantics for Busines Vocabulary and Business Rules

- The Semantics of Business Vocabulary and Business Rules (SBVR) is an adopted standard OMG
- It is intended to be the basis for formal and detailed natural language declarative description of a business.
- The SBVR defines the vocabulary and rules for documenting the semantics of business vocabularies, business facts, and business rules
- SBVR is based on separation between symbols and their meaning, thus allowing multilingual development

Notations for Business Rules

It is obligatory that each driver *of a* rental *is qualified.*

rental *has* driver

driver *is qualified*

Decision table:

Printer troubleshooter

		Rules							
Conditions	Printer does not print	Y	Y	Y	Y	N	N	N	N
	A red light is flashing	Y	Y	N	N	Y	Y	N	N
	Printer is unrecognised	Y	N	Y	N	Y	N	Y	N
Actions	Check the power cable			X					
	Check the printer-computer cable	X		X					
	Ensure printer software is installed	X		X		X		X	
	Check/replace ink	X	X			X	X		
	Check for paper jam		X		X				

Decision tree:

- SBVR is a vocabulary, not a language specification
- Rules can be represented, for example, in
  - SBVR Structured English/Rule Speak
  - Decision Tables
  - Decision Trees
- Terms and Fact Types can be represented in
  - SBVR Structured English
  - Fact Type Models
- The SBVR specification itself uses SBVR Structured English to describe its vocabularies

Levels of Business Rules Expression

- For expressing rules there is a trade-off between acessibility of business meaning and desirable automation
- Rules can be expressed on various levels:

Informal and semi-formal: natural language statements within a limited range of patters or decision tables, e.g.

It is obligatory that a credit account customer is at least 18 years old

Technical: Combining structured data references and operators, e.g.

```
CreditAccout
  self.customer.age >= 18
```

Formal: statements conforming a more closely defined syntax with particular mathematical/logical properties, e.g.

```
{X, Y, (customer X) (creditAccount Y) (holder X,Y)
  ==> (ge (age X) 18)
```

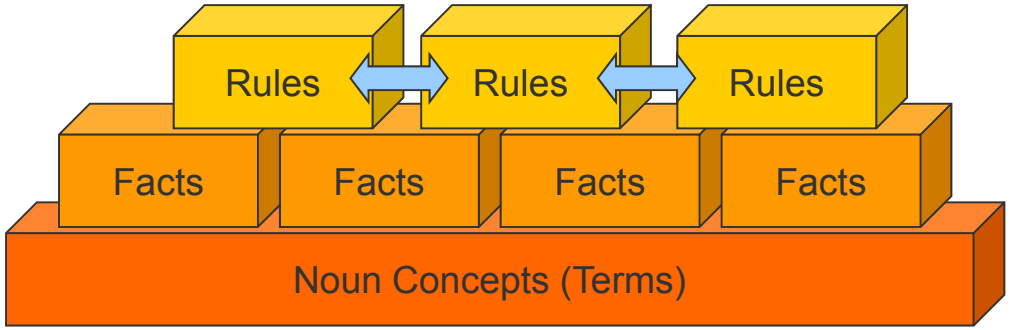
$\forall x \, \forall y \, \text{Customer}(x) \wedge \text{CreditAccount}(y) \wedge \text{Holder}(x,y) \rightarrow \text{age}(x)>18$

(Morgan 2002, p. 63)

All starts with Terms and Facts

„… successful business rule discovery, analysis, modeling, and implementation starts with term and fact identification and term-fact modeling.

- Business terms are words and phrases that have meaning to business people in the context where those terms are used.
- Facts are combinations of business terms that describe what business people know about their business.“



Oscar Chappel: Term–Fact Model

Source: Oscar Chappel: Term–Fact Modeling, the Key to Successful Rule-Based Systems.
URL: http://www.brcommunity.com/b250.php

Rules are built on Facts, Facts are built on Terms

"Rules are built on Facts. Facts are built on Terms."

Base Business Definitions & Rules on Verb Concepts

↑

Associate Concepts to define Fact Types

↑

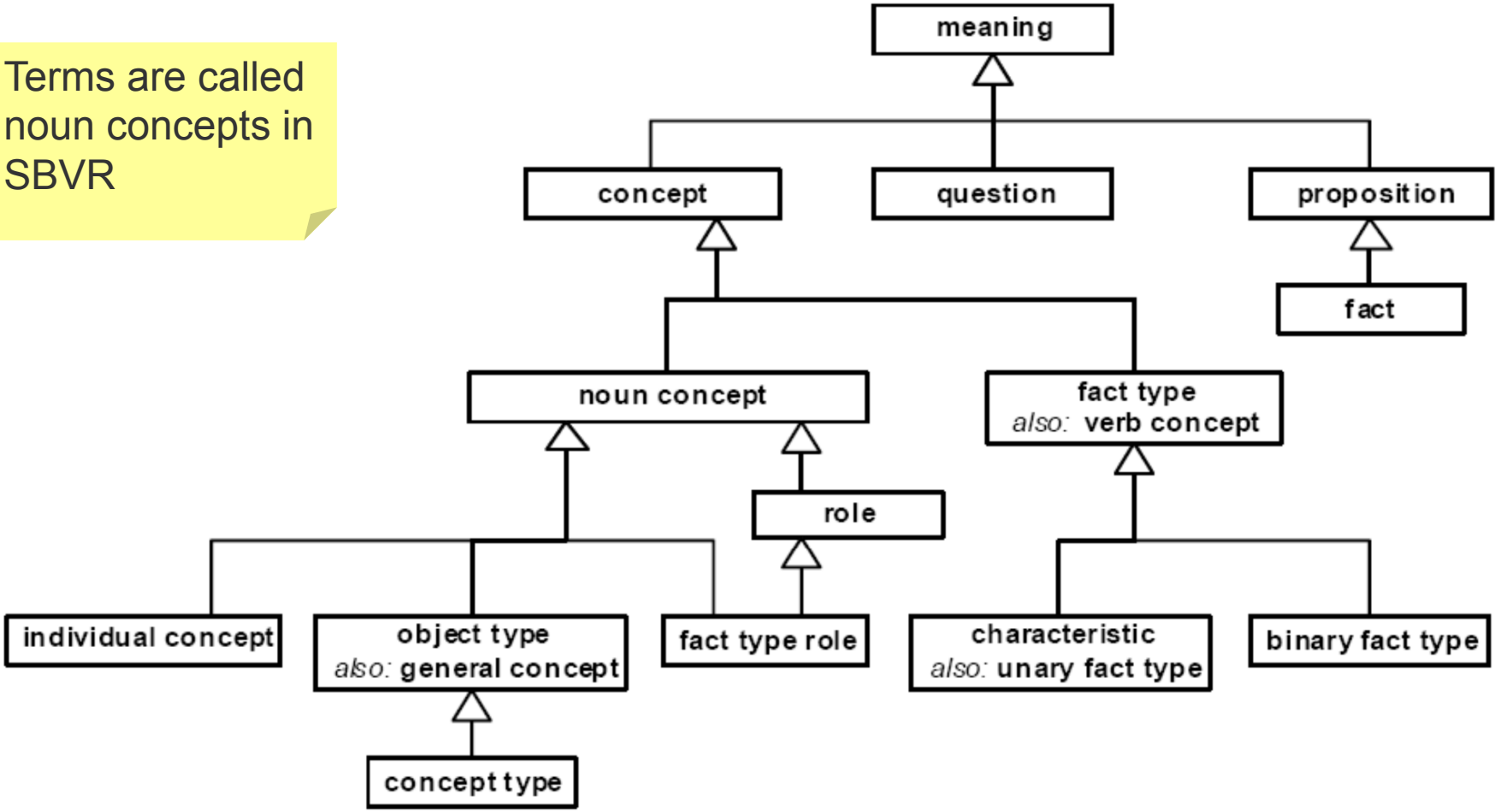
Define Noun Concepts

	Examples
Definitions & Rules	It is obligatory that each payment *employs* at most one credit card
Fact Types (Verb Concepts)	payment *employs* credit card
Terms (Noun Concepts)	payment, credit card

(Chapin et al. 2008)

Terms and Facts According to SBVR

Terms are called noun concepts in SBVR



Terms: Noun Concepts

- A business rule – even if expressed as an English sentence – is more formally stated than most sentences in everyday life.
- Just like any sentence, business rules contain nouns
  - words or word phrases describing persons, places, things, or abstract ideas
- The meaning of a noun is called a *noun concept*
- Every noun concept used in a rule must be defined in a business rule model
  - If a term is a common term, the definition can be taken from a dictionary
  - For specific terms you can create your own definitions

Noun Concepts - Examples

- Definition of a Noun concept

> ***cash payment***
> *Definition:* ***payment*** *that employs* ***cash***

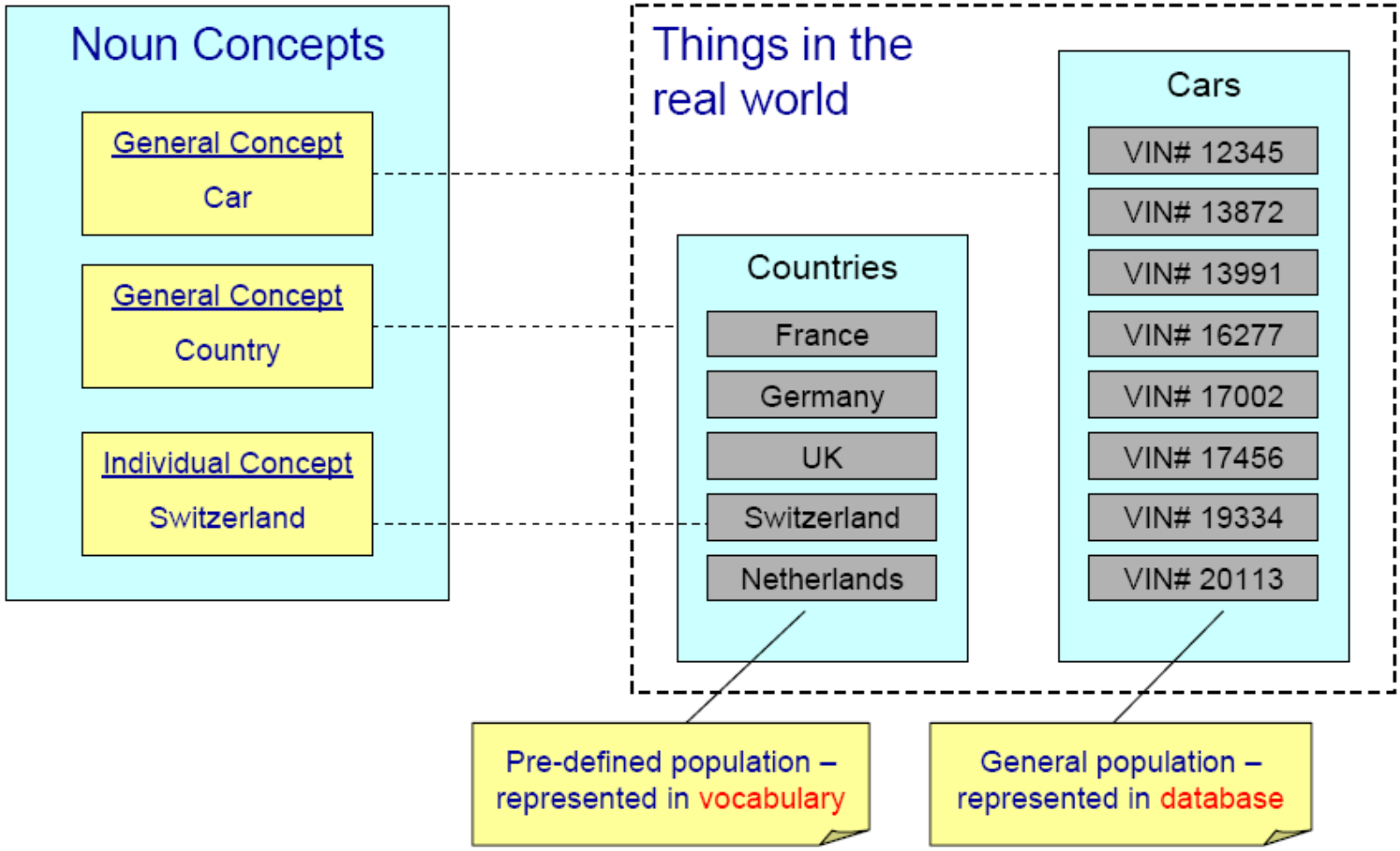
  - ♦ A cash payment is a specialisation; any payment that employs cash is a cash payment

- Two noun concept definition from a dictionary

> ***payment***
> *Definition: an amount paid*
> — American Heritage Dictionary of the English Language, Fourth Edition

> ***cash***
> *Definition: money in the form of bills or coins; currency*
> — American Heritage Dictionary of the English Language, Fourth Edition

Noun Concepts: General and Individual



(Chapin & Hall 2006)

General and Individual Noun Concepts

Examples:

- The '**general concept**' that denotes the set of cities in which Cora Group has restaurants

operating cities
Definition: **cities** in which **Cora Group** has restaurants
Concept Type: **general concept**

- The '**individual concept**' that denotes the city Washington D.C.

Washington D.C.
Concept Type: **individual concept**
Definition: The capital city of the **USA**
General Concept: **city**

General Concept (= Object Type) and Individual Concept as defined in SBVR

object type

Definition:	noun concept that classifies things on the basis of their common properties
Source:	based on ISO 1087-1 (English) (3.2.3) ['general concept']
Synonym:	general concept
Example:	the concept 'rental car' corresponding to cars that are rented
Example:	the concept 'car', the concept 'number', the concept 'person'

individual concept

Source:	ISO 1087-1 (English) (3.2.2) ['individual concept']
Definition:	concept that corresponds to only one object [thing]
Example:	The individual concept 'California' whose one instance is an individual state in the United States of America

Intensional and Extensional Definitions

- In general there are two types of definitions
  - **intensional definition**: a definition which describes the intension of a concept by stating the superordinate concept and the delimination characteristics
  - **extensional definition**: a description of a concept by enumerating all of ist subordinate concepts
- Example: These are an intensional and an extensional definition of the restaurants of Cora Group

Cora restaurant

Definition: restaurant which belongs to Cora Group

Definition: one of restaurants **Nola**, **Portia**, **Viola**, **Zona** and **Adelina**

Epressing Definitions

- One definition form (e.g. intensional) can be expressed in many languages or notations:

  - Expressed in English
    - The sales tax rate for a rental is the sales tax rate at the pick-up branch of the rental on the drop-off date of the rental.
  - Expressed in French
    - Le taux de taxe de vente pour une location de voiture est le taux de taxe de vente à l'agence de départ de la location à la date de retour de la voiture
  - Expressed in SBVR Structured English
    - The sales tax rate *for* a rental *is* the sales tax rate *at* the pick-up branch *of* the rental on the drop-off date *of* the rental.
  - ...

(Chapin & Hall 2006)

Noun Concepts and Structural Rules

- A noun concept can be detailed with a structural rule
- Structural Rules cannot be violated and thus can be used as definitions
- Example: The following rule can be regarded as a definition of the noun concept „separated party“: A separated party must be seated at two or more tables, otherwise it is not a separated party

Parties 1: It is necessary that a separated party is seated at two or more tables

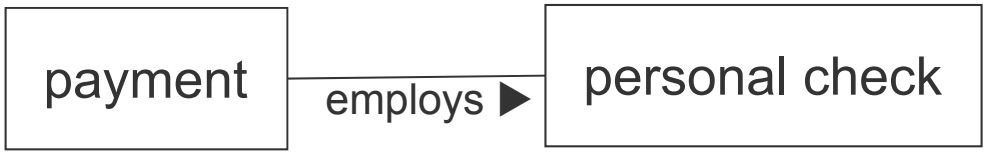
Fact Types

- A Fact Type is the meaning of a verb phrase that involves one or more noun concepts
- Fact types characterize the way noun concepts may be related.
- Example:
  - The following fact type says that any rule that includes the noun concept payment and the noun concept personal check can relate those two noun concepts via the verb employs

    payment *employs* personal check
- Fact types can be visualized as fact-type diagrams

Fact Types and Rules

The same fact type can be used in many rules



Potential Rule	Interpretation
It is obligatory that a payment employ a personal check.	For that odd restaurant that requires all payments be made in personal checks.
It is permitted that a payment employ a personal check only if the personal check is drawn on a local back.	A personal check is acceptable if another condition holds: the check is local.
It is obligatory that a customer be photographed if the customer makes a payment and the payment employs a personal check.	For the careful restaurant that wants to collect forensic evidence from customers who might bounce checks.

Multiple Fact Types

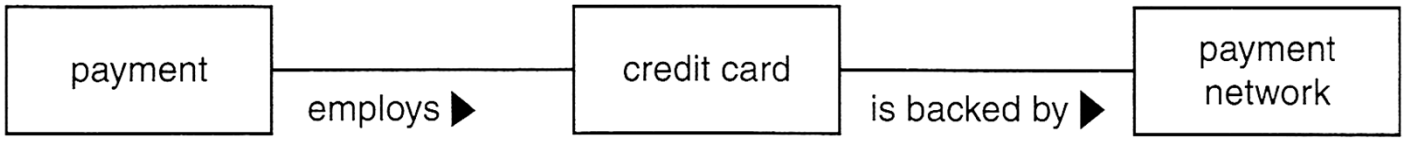
- A business rule can be build on more than one fact type
- Example:
  - The rule VISA Only is build on two fact types

> **VISA Only:** It is permitted that a payment employ a credit card only if the credit card is backed by VISA™.

payment *employs* credit card

credit card *is backed by* payment network

  - Multiple Fact Types can be combined into one diagram



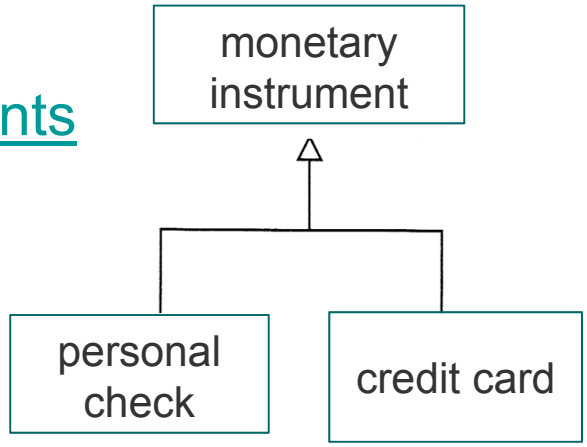
Generalizations and Specialization

- The relation *specializes* is a predefined fact type in SBVR to define a generalisation hierarchy.
- It either relates two general concept which is equivalent to the generalization in UML (meaning subclass of)

  credit card *specializes* monetary instruments

  or it relates an individual and a general concept

  Washington D.C. *specializes* city



- The fact type *generalizes* is the inverse relation

  monetary instruments *generalizes* credit card

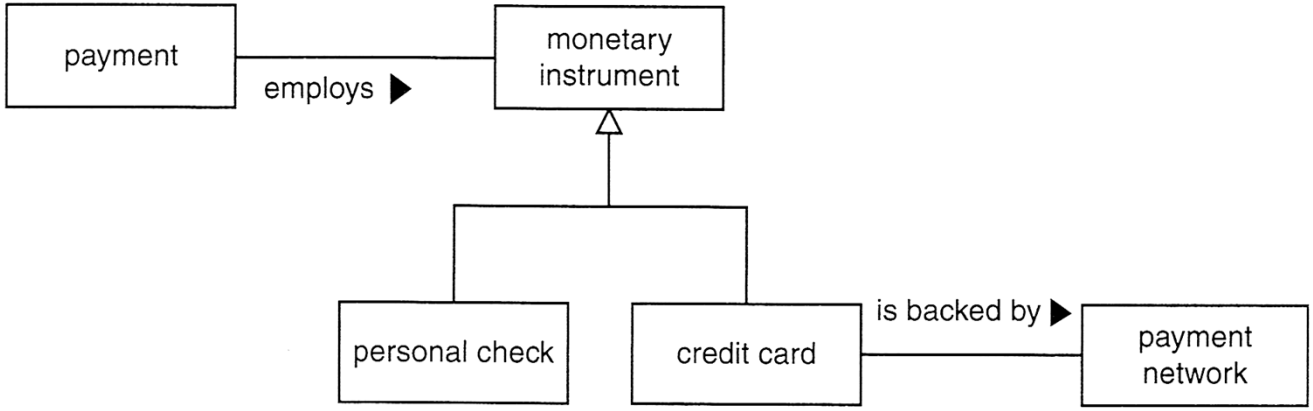
Definition of Specialization in SBVR

concept$_1$ *specializes* concept$_2$ FL

Definition:	the concept$_1$ incorporates each characteristic that is incorporated by the concept$_2$ plus at least one differentiator
Synonymous Form:	concept$_2$ *generalizes* concept$_1$
Example:	The individual concept 'Los Angeles' specializes the concept 'city', the differentiator being that Los Angeles is one particular city in California.

Fact Type Diagrams

- The following fact type diagram contains fact types for several rules
- It consists of noun concepts, verbs and a specialisation



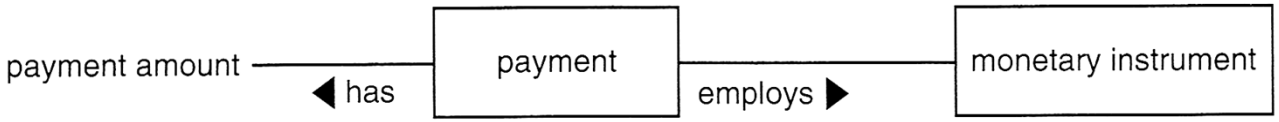
- Note the correspondence of fact type diagrams to UML class diagrams:
  - noun concepts correspond to classes
  - verbs correspond to associations

Fact Type Properties

- Consider the following rule:

> **One Monetary Instrument:** It is prohibited that a payment employ more than one monetary instrument if the amount of the payment is less than $50.

- This rules is build on two fact types
  - payment employs monetary instrument
  - payment has payment amount
- A payment amount is special: it is a property of a payment: Without a payment there is no payment amount.
- It could be a convention, to use a specifc verb „has“ to indicate properties and to distinguish them from other associations.



Characteristics

- Characteristics correspond to unary fact types
  - Unary fact type (characteristic): table *is free*
    - 1 placeholder, filled by 'table'
  - Binary fact type: table *is assigned to* guest
    - two placeholders, filled by 'table' and 'guest'

(Chapin et al 2008)

Fact Type Consistency

- Business rules should be easy to understand and written precisely – avoiding misinterpretation as far as possible.
- Therefore the business rules of an organisation should use a coherent set of fact types
- For example, no two different verbs should be used to name the same association between noun concepts
- Also, fact types can also be defined, too, in a business rules model.

Defining a Business Rule

- Start with a fact type, e.g.

  payment *employs* credit card

- Apply an obligation or necessity to it, e.g.

  it is obligatory that payment *employs* credit card.

- Add qualifications, quantifications and conditions, if necessary, e.g.

  It is obligatory that each payment *employs* at most one credit card

Defining a Business Rule

This procedure is applied also for complex rules with more than one fact type

- Start with the fact types, e.g.

  payment *employs* credit card

  credit card *is backed by* payment network

  VISA *specializes* payment network

- Apply modality keyword, e.g.

  It is permitted that payment *employs* credit card,
  credit card *is backed by* payment network

- Add qualifications, quantifications, conditions, and instantiate, etc.

  It is permitted that a payment *employs* a credit card only if the
  credit card *is backed by* VISA

Graphical Rule Modeling

- Business rules are in practice written as sentences instead of diagrams
- There are some special forms of business rules that can be represented as diagrams
  - Decision Trees
  - Decision Tables
- We will also see some components of business rules, in particular fact type diagrams

Decision Tables

- A decision table is a compact form to represent a whole set of rules
- A decision table can represent condition-action rules and also logical rules
  - Condition-Action rules:

Conditions	Condition alternatives
Actions	Action entries

  - Logical Rules: The effects represent possible decision values

Conditions	Condition alternatives
Effects	Effect entries

- The second column represents a set of rules: one column for each combination of possible values for condition
- All rules (conditions and actions/effects) are formulated with terms and fact types

Decision Table for Printer Diagnosis

each column represents one rule

Printer troubleshooter

		Rules							
Conditions	Printer does not print	Y	Y	Y	Y	N	N	N	N
	A red light is flashing	Y	Y	N	N	Y	Y	N	N
	Printer is unrecognised	Y	N	Y	N	Y	N	Y	N
Actions	Check the power cable			X					
	Check the printer-computer cable	X		X					
	Ensure printer software is installed	X		X		X		X	
	Check/replace ink	X	X			X	X		
	Check for paper jam		X		X				

This decision table represents condition-action-rules

Example: Decision Table for Health Insurance

Reimbursement depends on whether decuctible is already met, whether the patient visited the doctor‘s office (D), a hospital (H) or a lab (L) and whether the Doctor is a Participating Physician

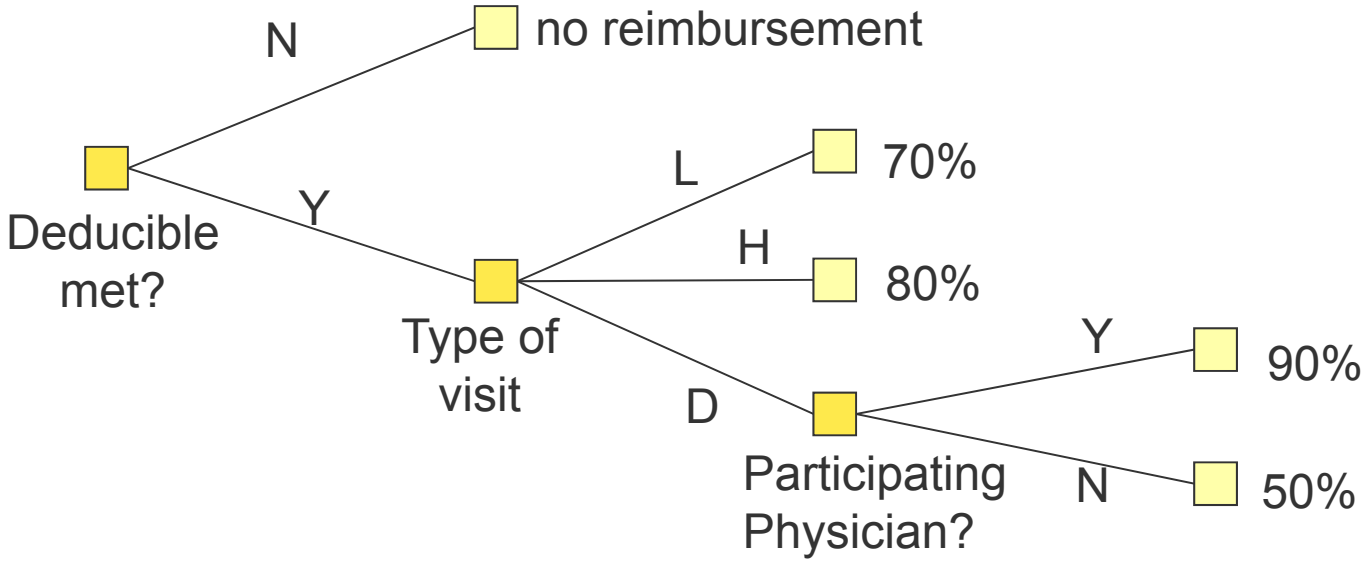
Conditions	1	2	3	4	5	6	7	8	9	10	11	12
1. Deductible met?	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
2. Type of visit	D	D	H	H	L	L	D	D	H	H	L	L
3. Participating Physician?	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Effects												
1. Reimburse 50%		X										
2. Reimburse 70%						X						
3. Reimburse 80%				X								
4. Reimburse 90%	X											
5. No reimbursement							X	X		X		X
6. Impossible or N/A			X		X				X		X	

each column represents one rule

http://web.sxu.edu/rogers/sys/decision_tables.html

Decision Trees

- Decision trees are a graphical representation of rules
  - Each inner node corresponds to a decision
  - Each edge represents an alternative value for the decision
  - The leaf nodes represent actions or effects



Representing a Decision Tree in VisiRule

Table 1. Simple set of rules.

If Full time = yes	and Over4yrs = yes	then answer = Grant Loan
If Full time = yes	and Over4yrs = no	then answer = Unclear
If Full time = no	and Over4yrs = yes	then answer = Unclear
If Full time = no	and Over4yrs = no	then answer = No Loan