Modeling Decisions with DMN and The Decision Model

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Decision Logic and Decision Task

(Ross 2011, p. 152f)
There are two well-known modeling notations for Decision Logic

- The Decision Model
  - Based on a book from Barbara von Halle and Larry Goldberg

- Decision Model and Notation DMN
  - A new standard from OMG
Decision Model and Notation (DMN)
Decision Model and Notation (DMN)

- The Decision Model and Notation is a new standard from the OMG
- It is currently published in its Beta version
- Purpose of DMN: provide the constructs that are needed to model decision, so that organizational decision-making can be
  ♦ readily depicted in diagrams
  ♦ accurately defined by business analysts
  ♦ (optionally) automated
Main Concepts of DMN

Business Process

Decision Requirements

Decision Logic

(Coenen 2013)
Main concepts – Decision Requirements Level

- Business concepts only
- Business decisions
- Areas of business knowledge
- Sources of business knowledge

(Coenen 2013)
Elements and Allowed Relationships of the Requirements Graph

Decision 1 is used as input for decision 2

Decision depends on Knowledge Source

Business Knowledge invokes a Decision

Business Knowledge 1 invokes Business Knowledge 2

Input data is used as input for decision

Input data depends on Knowledge Source

Knowledge Source depends on Decision

Knowledge Source depends on Business Knowledge

Knowledge Source 1 depends on Knowledge Source 2

(Coenen 2013)
Main concepts – Decision Logic

- Greater detail
- Business rules
- Calculations
- Automated
- Display

(Coenen 2013)
Languages for Value Expressions

Possible value expression forms:

♦ Literal expression

FEEL = Friendly Enough Expression Language

{  
  Context: { 
    tns$Employee: { tns$salary: 13,000 }, 
    Customer: [ 
      { loyalty_level: "gold", credit_limit: 10000 },
      { loyalty_level: "gold", credit_limit: 20000 },
      { loyalty_level: "silver", credit_limit: 5000 } ]
  }
}

♦ Decision table

<table>
<thead>
<tr>
<th>Applicant Risk Rating</th>
<th>&lt; 25</th>
<th>[25..60]</th>
<th>&gt; 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicant Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical History</td>
<td>good</td>
<td>bad</td>
<td>-</td>
</tr>
<tr>
<td>Low</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High</td>
<td>U</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

(Coenen 2013)
Although other decision logic models can be used

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

The noun concept ‘driver’ is a facet of the noun concept ‘person’.

Supported by DMN

“This will allow the import of many existing decision logic modeling standards (e.g. for business rules and analytic models) into DMN”

(Coenen 2013)
The Decision Model

The Decision Model

- The Decision Model was developed by Barbara von Halle and Larry Goldberg (2010)

- Objective:
  - a rigorous, repeatable, and technology-independent model of business logic that is simple to create, interpret, modify, and automate

- The Decision Model is a template for perceiving, organizing, and managing the business logic behind a business decision.

- It is a declarative representation of decision logic
  - specifies the conditions on which a decision is made
  - does not specify how the conditions are tested, in particular it does not specify the order in which conditions are tested
Decision Model Elements

A Decision Model has two different kinds of diagrams:

Decision Model Diagram

Rule Family Table

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person Student Loans</td>
<td>Person Business Loans</td>
</tr>
<tr>
<td>Is</td>
<td>Yes</td>
</tr>
<tr>
<td>Is</td>
<td>Yes</td>
</tr>
<tr>
<td>Is</td>
<td>Yes</td>
</tr>
<tr>
<td>Is</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Decision Model Diagrams

- The root of a Decision Model diagram (its start) is an octagonal shape that represents the entire business decision:
  - It is this shape that relates to tasks within business process models.

- The other nodes in the Decision Model diagram represent Rule Families.

(von Halle & Goldberg 2010, p. 26f)
The Decision Model Diagram represents Rule Family Tables.

(von Halle & Goldberg 2010, p. 29)
Rule Family: Basic Element of the Decision Model

- Rule Family is a two-dimensional table relating conditions to one—and only one—corresponding conclusion.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person Employment History</td>
<td>Person Likelihood of Defaulting on a Loan</td>
</tr>
<tr>
<td>Person Mortgage Situation</td>
<td></td>
</tr>
<tr>
<td>Person Miscellaneous Loans Assessment</td>
<td></td>
</tr>
</tbody>
</table>

- Column headings: names of facts being tested
- Name of conclusion being reached
- Operator
- Condition
- Value of column heading

(von Halle & Goldberg 2010, p. 18f)
Rule Family Tables are Decision Tables

- A Rule Family table is a kind of decision table
  - In a Rule Family Table each row represents a rule
  - In a decision table each column represents a rule

- A Decision Model is a structured collection of decision tables

- There are some specialties:
  - A Rule Family must only have one conclusion column
  - Inferential relationships between Rule Family are made explicit in a Decision Model diagram

(von Halle & Goldberg 2010, p. 25)
Rule Family: Basic Element of the Decision Model

- A Rule Family node has three parts:
  - The name is the conclusion of the Rule Family
  - Inferred conditions: There are Rule Families with these names
  - Basic conditions: There are no Rules Families with theses names

(von Halle & Goldberg 2010, p. 18f)
This Condition column is part of a logical expression interpreted as “If/when the Policy Renewal Override is Yes”

The conclusion column is part of a logical expression interpreted as “then the Policy Renewal Method is Automatic”

A discrete business logic instance is a single row in the Rule Family table

This condition column is also part of a logical expression interpreted as “If/when the Policy Tier Within Bounds is Yes”

(von Halle & Goldberg 2010, p. 29)
Translating a Rule Family into Natural Language

- It is possible to convert each row in a Rule Family into a sentence that sounds natural to a business audience.

<table>
<thead>
<tr>
<th>Rule Pattern</th>
<th>Person Employment History</th>
<th>Person Mortgage Situation</th>
<th>Person Miscellaneous Loans Assessment</th>
<th>Person Likelihood of Defaulting on a Loan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is</td>
<td>Poor</td>
<td>Is</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

- Possible Conversions
  - If/when Person Employment History is Poor and Person Mortgage Situation is Poor and Person Miscellaneous Loans Assessment is High, then the Person Likelihood of Defaulting on a Loan is High.
  - A Person with Poor Employment History and Poor Mortgage Situation and High Miscellaneous Loans Assessment has a High Likelihood of Defaulting on a Loan.
  - It is obligatory that the Person Likelihood of Defaulting on a Loan is High if the Person Employment History is Poor and the Person Mortgage Situation is Poor and the Person Miscellaneous Loans Assessment is High.

(von Halle & Goldberg 2010, p. 20)
A Rule Family represents all Rules for one Conclusion

The Decision Model has only one Rule Family for each type of conclusion column, i.e. all rules for a conclusion are in one table.

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Manual Policy Override</th>
<th>Policy Tier Within Bounds</th>
<th>Policy Renewal Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>is</td>
<td>Yes</td>
<td>is Manual Renewal Process</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>is</td>
<td>is Manual Renewal Process</td>
</tr>
<tr>
<td>3</td>
<td>is</td>
<td>No</td>
<td>is Automatic Renewal Process</td>
</tr>
</tbody>
</table>

This condition column is also part of a logical expression interpreted as “If/when the Policy Tier Within Bounds is Yes”

This Condition column is part of a logical expression interpreted as “If/when the Policy Renewal Override is Yes”

The conclusion column is part of a logical expression interpreted as “then the Policy Renewal Method is Automatic”

A discrete business logic instance is a single row in the Rule Family table

(von Halle & Goldberg 2010, p. 29)
Rule Pattern

A set of Rule Family rows with a common set of populated condition cells is called a Rule Pattern.

The following Rule Family represents two rule patterns

<table>
<thead>
<tr>
<th>Rule Pattern</th>
<th>Conditions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Person Student Loans</td>
<td>Person Business Loans</td>
</tr>
<tr>
<td>1</td>
<td>Is Yes</td>
<td>Is not</td>
</tr>
<tr>
<td>2</td>
<td>Is Yes</td>
<td>Is not</td>
</tr>
<tr>
<td>1</td>
<td>Is Yes</td>
<td>Is</td>
</tr>
<tr>
<td>2</td>
<td>Is Yes</td>
<td>Is</td>
</tr>
</tbody>
</table>
Two dependend Rule Families

- Conditions of one rule family can depend on another rule family
- Example: Person Employment History in the first rule family depends on
  - Person Years at Current employer &
  - Person Number of Jobs in Past Five Years

<table>
<thead>
<tr>
<th>Rule Pattern</th>
<th>Person Employment History</th>
<th>Person Mortgage Situation</th>
<th>Person Miscellaneous Loans Assessment</th>
<th>Person Outside Credit Rating</th>
<th>Person Likelihood of Defaulting on a Loan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is</td>
<td>Poor</td>
<td>Is</td>
<td>Poor</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rule Pattern</th>
<th>Person Years at Current Employer</th>
<th>Person Number of Jobs in Past Five Years</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Person Employment History</td>
<td></td>
</tr>
</tbody>
</table>
Decision Model Diagram (1/3)

- The Decision Model diagram shows the inferential relationships between Rule Families.
- Solid lines between Rule Family nodes represent inferential nodes:
  - The name of the node at the end with the dot occurs as condition in the other node.
- Leave nodes in a Decision Model diagram to not have inferred conditions.

(von Halle & Goldberg 2010, p. 26f)
The Rule family directly connected to the business decision shape is called the “Decision Rule Family”, its conclusion is the conclusion sought by the entire Decision Model.

The Decision Model diagram begins with an octagonal shape that represents the entire business decision. The other shapes in the Decision Model diagram represent Rule Families. This diagram has 6 Rule Families.

The name of each Rule Family is its conclusion column heading.

Inferring value for the first Condition of the Decision Rule Family

Inferring value for the Second Condition of Decision Rule Family

Conditions based on facts

Policy Discount
- Policy Grade (P1)
- Package Grade (P1)
- Package Discount (P1)
- Location State Category (P1)

Policy Tier Within Bounds
- Policy Discount (P2)
- Policy Tier (P1)(P2)

Policy Renewal Method
- Policy Tier Within Bounds (P2, P3)
- Policy Renewal Override (P1), (P3)

Decision Modeling

(von Halle & Goldberg 2010, p. 28)
The solid line terminated by the **dot** connects Rule Families that have an inferential relationship: The conclusion of one Rule Family is used as a condition in another.

The dotted line: The conditional columns are shown below the solid line and above the dotted line.

Inferred Conditions

Conditions based on facts

(von Halle & Goldberg 2010, p. 28)
Determine Policy Renewal Method

Policy Renewal Method
- Policy Tier
  - Within Bounds (P2, P3)
  - Policy Renewal Override (P1)

Policy Renewal Override
- Insured Major Ownership Change (P2)
- Insured Major Location Change (P1)
- Policy Annual Premium (P3)
- Policy Discontinued Agent (P4)
- Policy Manual Flag (P5)

The Rule Family directly connected to the business decision shape is called the “Decision Rule Family.”

The solid line terminated by the dot connects Rule Families that have an inferential relationship. In this case the condition column “Policy Renewal Override” in the Decision Rule Family has an inferential relationship with the conclusion column of the “Policy Renewal Override” Rule Family.

The labels below the solid line but above the dotted line denote condition column headings that serve as conclusion column headings in another Rule Family. These condition columns will be populated by known fact values (e.g., persistent data).

The labels below the dotted line denote condition columns that do not serve as conclusion columns in another Rule Family.

All labels below the Rule Family name denote condition column headings.

The Name of a Rule Family is the conclusion column heading.

(von Halle & Goldberg 2010, p. 28)
Literatur


