DaWaK '09

Visual Modelling of Data Warehousing Flows with UML Profiles

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Introduction

- Data warehousing ≡ data transformations
  - Complexity
- "Model-driven development" ≈ Visualisation
  - Perception & cognition

Outline

- UML-based Visual Language for F^w
  - Formalisation
  - UML Mapping
  - Diagrams
    - data cubes + data flows

Definition

Let C be the set of all data cubes,

and X be the set of the data types
that are not data cubes,

A data-warehousing flow is
a function f^w: {C,X}→{C,X}

F^w is the set of all f^w's

F^W Characterisation

Subject	Class	Definition
OLAP	F^C	$C \rightarrow C$
ETL	F^{+C}	$X \rightarrow C$
Mining	F^{-C}	$C \rightarrow X$
Object	$F^{\varnothing}$	$X \rightarrow X$

F^W Characterisation

The archetypical data warehousing $f^W \in F^W$ holds

$$f^W = k^{\varnothing} \bullet j^{-c} \bullet i^{c} \bullet h^{+c} \bullet g^{\varnothing}$$

where

$k^{\varnothing}, g^{\varnothing} \in F^{\varnothing}$

$h^{+c}, i^{c}, j^{-c} \in F^{+c}, F^{c}, F^{-c}$

Visualisation Requirements

(i) supported by multidimensional diagrams

(ii) understandable

(iii) formal

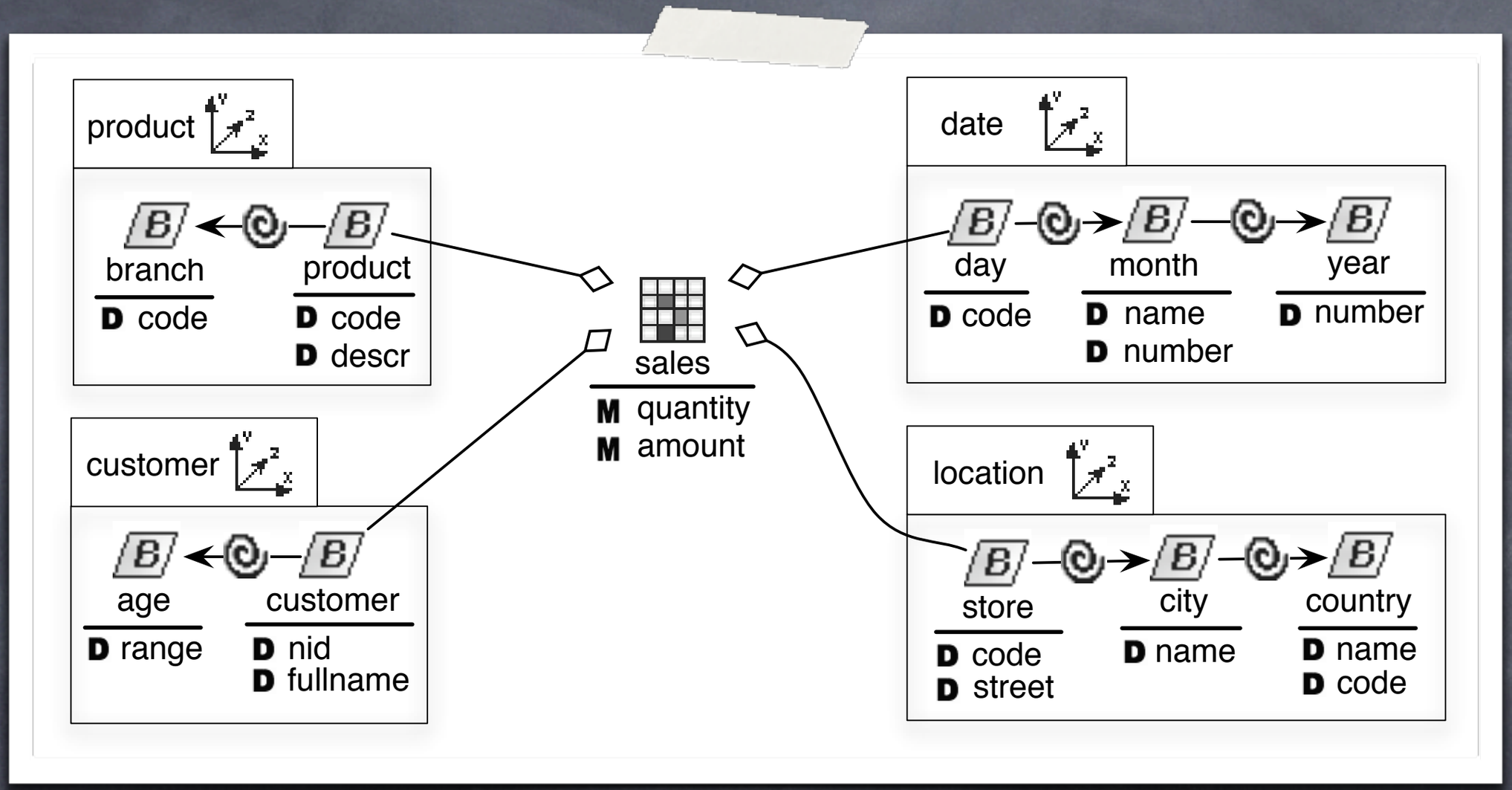
(iv) standard

Concerns

(i) Data Cubes
  @ Multidimensional Diagrams
  @ UML Class Diagrams

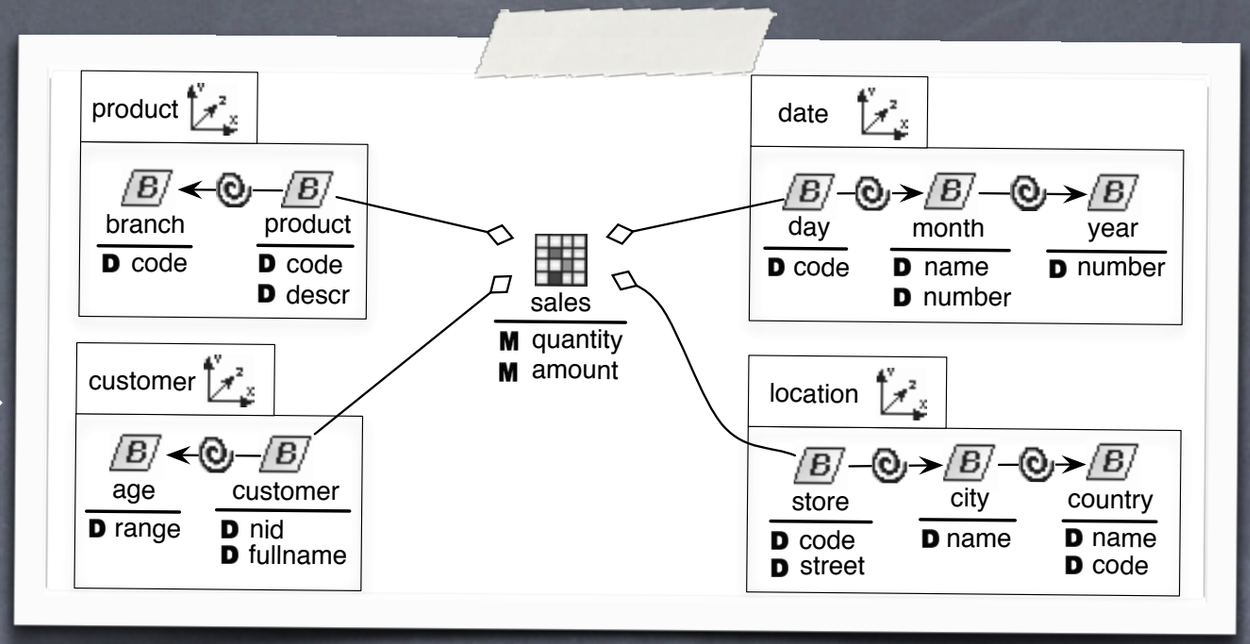
(ii) Data-warehousing Flows
  @ UML Activity Diagrams

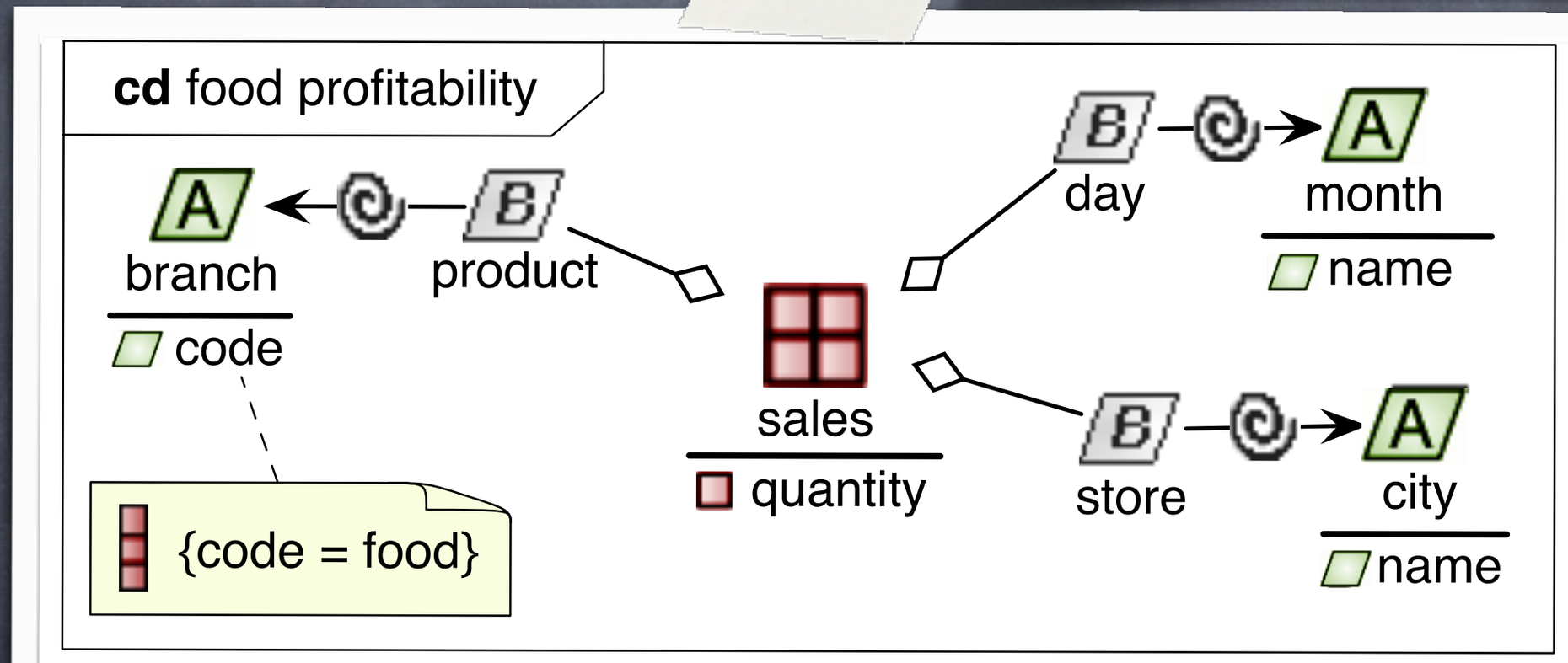
Visual Modelling of F^w with UML Profiles



Multidimensional Diagram

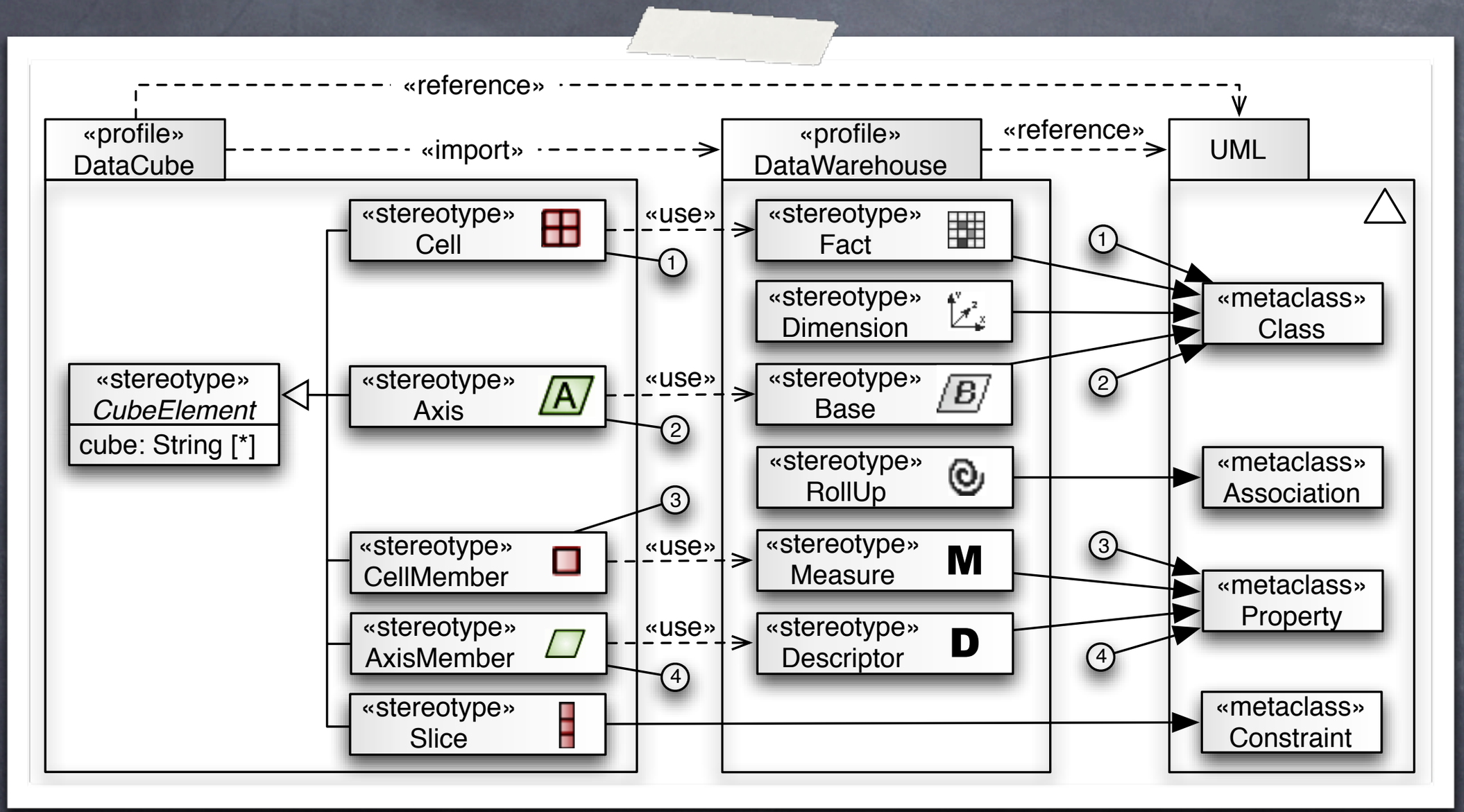
Visual Modelling of F^w with UML Profiles





Data Cube Diagram

Visual Modelling of F^w with UML Profiles



UML Profile for Data Cubes

Specification Levels

Space	Membership
<cell> @ <fact> <axis> @ <base>	<cellmember> @ <measure> <axismember> @ <descriptor>

Space Interpretation:

(a) all measures & descriptors retrieved
(b) measures & descriptors unknown

Diagramming Data Cubes

1. Copy the multidimensional diagram
2. Rename it as a data cube diagram
3. Specify data CubeElement's
   1. Stereotype multidimensional elements
   2. Tag them with the current cube
4. Hide undesired multidimensional elements

Fw Visual Library

- A UML Profile for Fw Library
  - naming patterns
  - iconography
- A Fw Library
  - Catalogues:
    ETL, OLAP, Mining, What-if, OLAM, etc.

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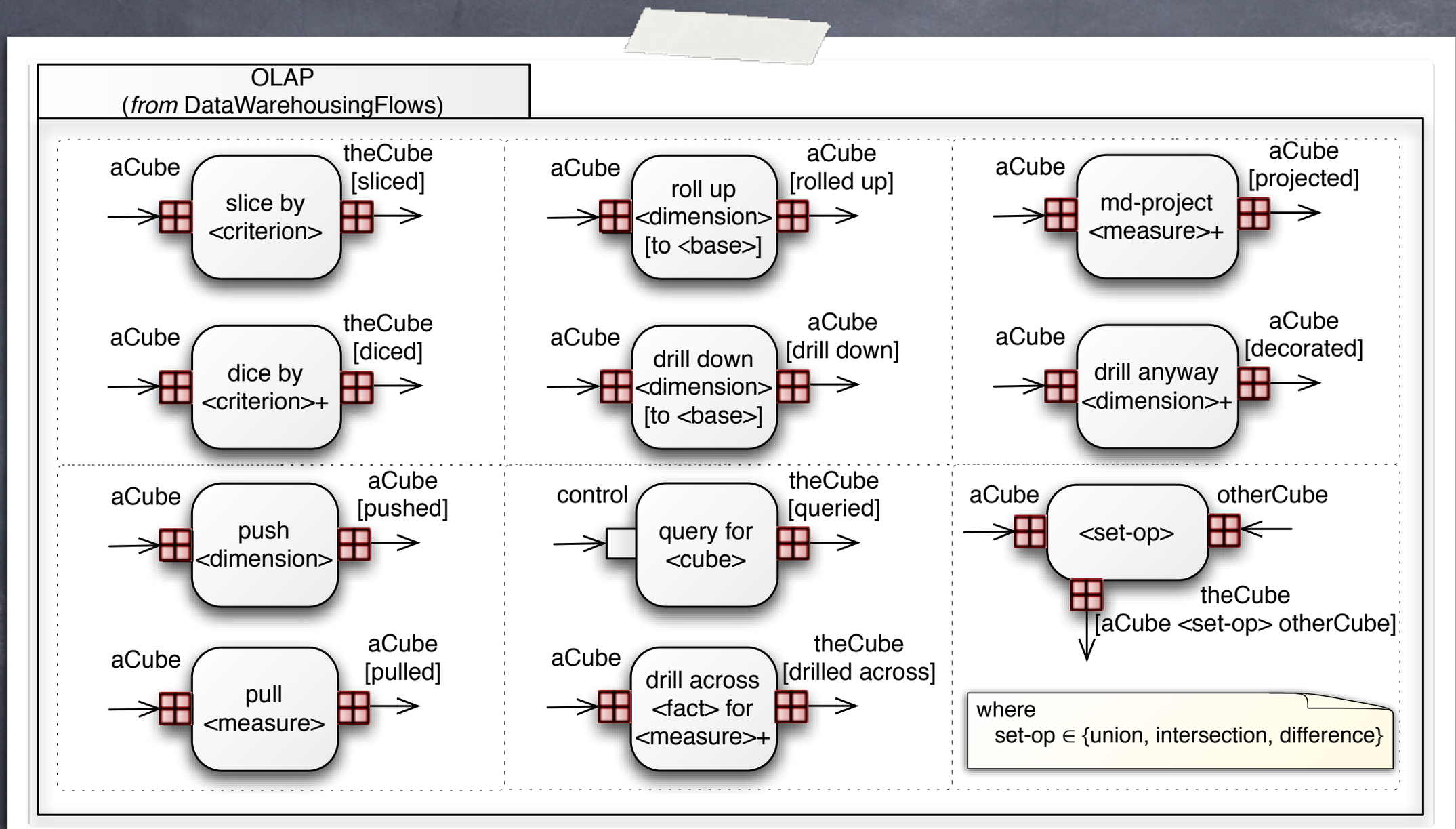
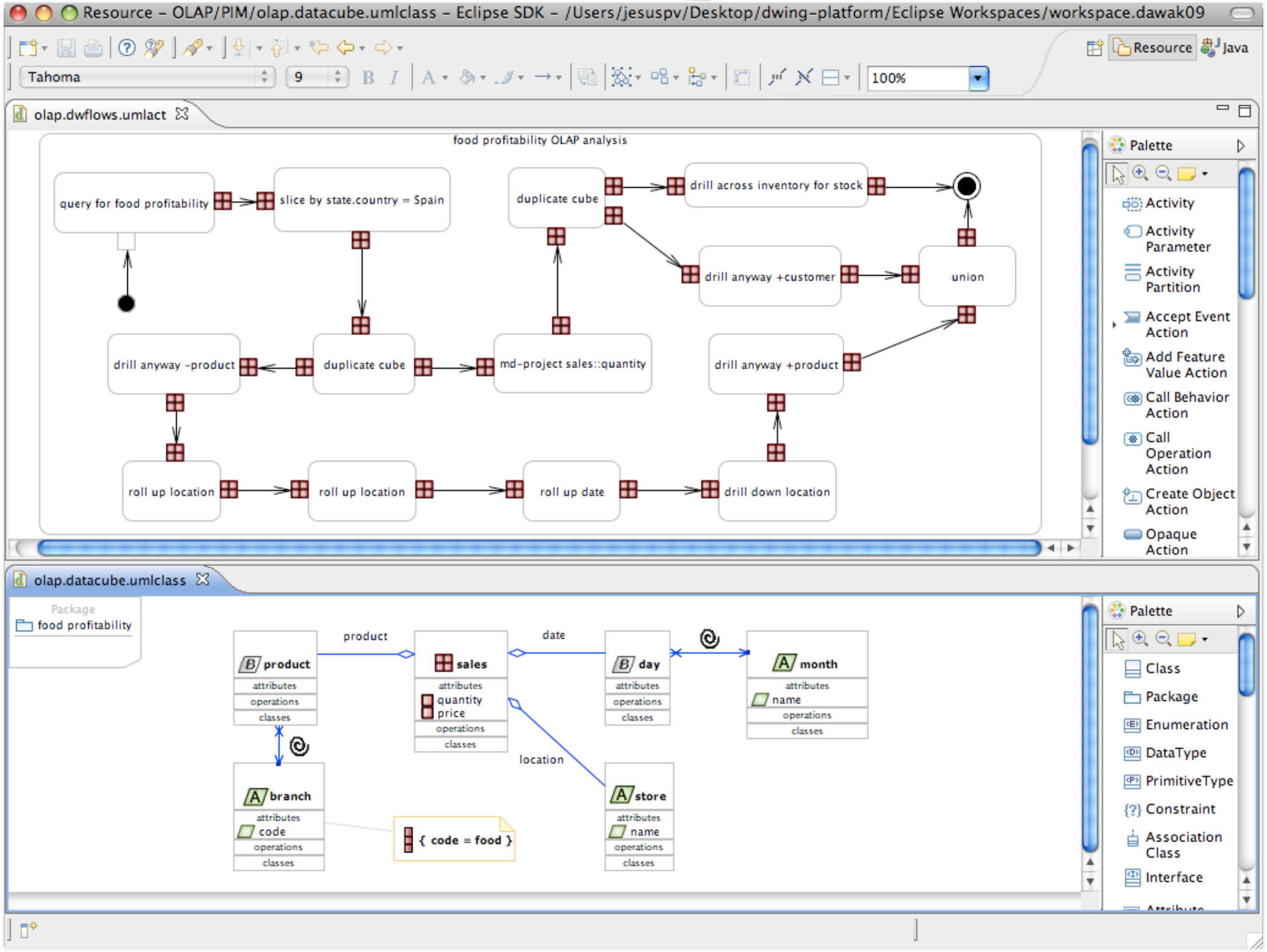


F^C Catalogue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food profitability OLAP analysis
query for food profitability
slice by state.country = Spain
duplicate cube
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drill anyway +customer
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drill anyway -product
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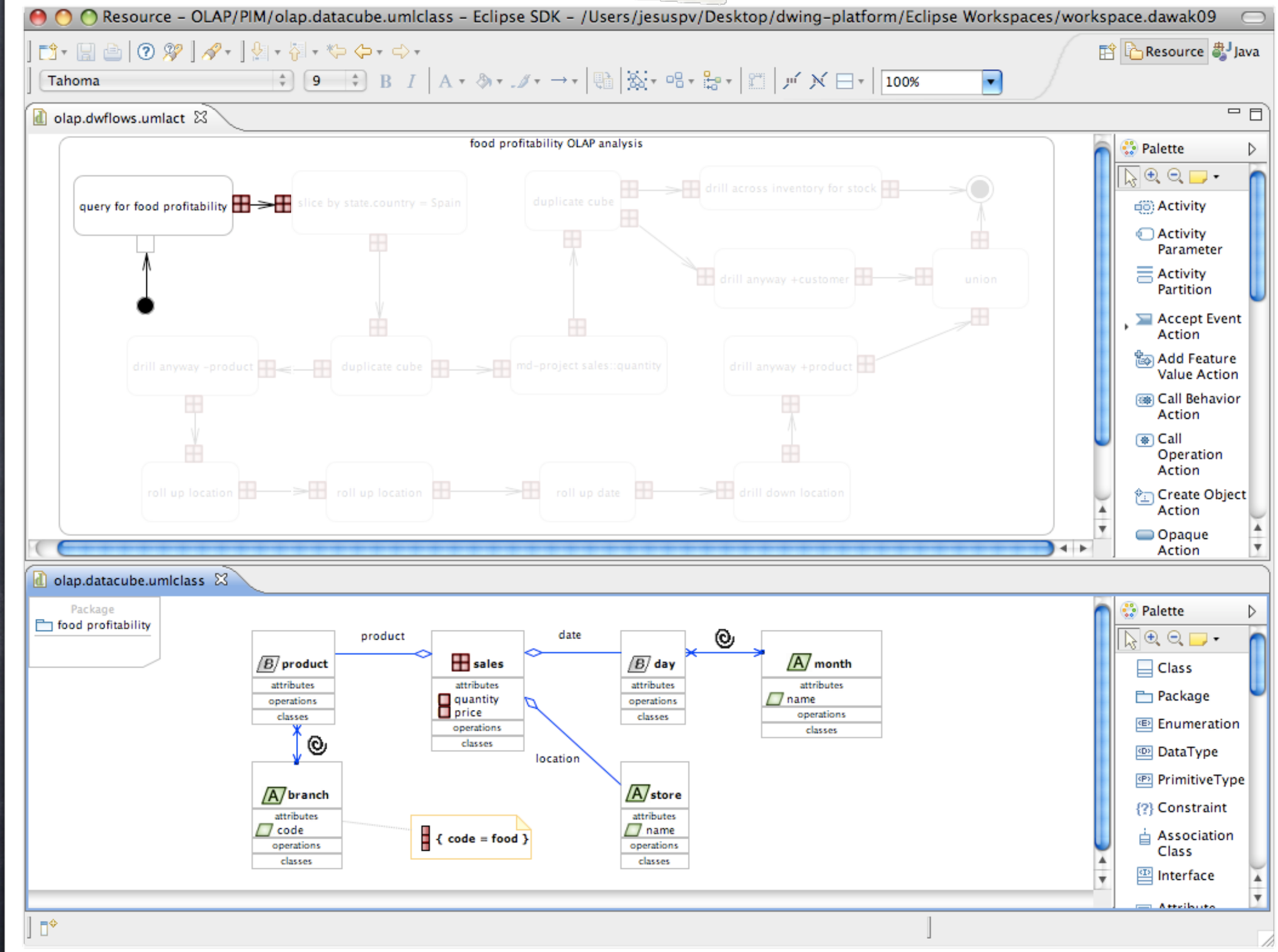
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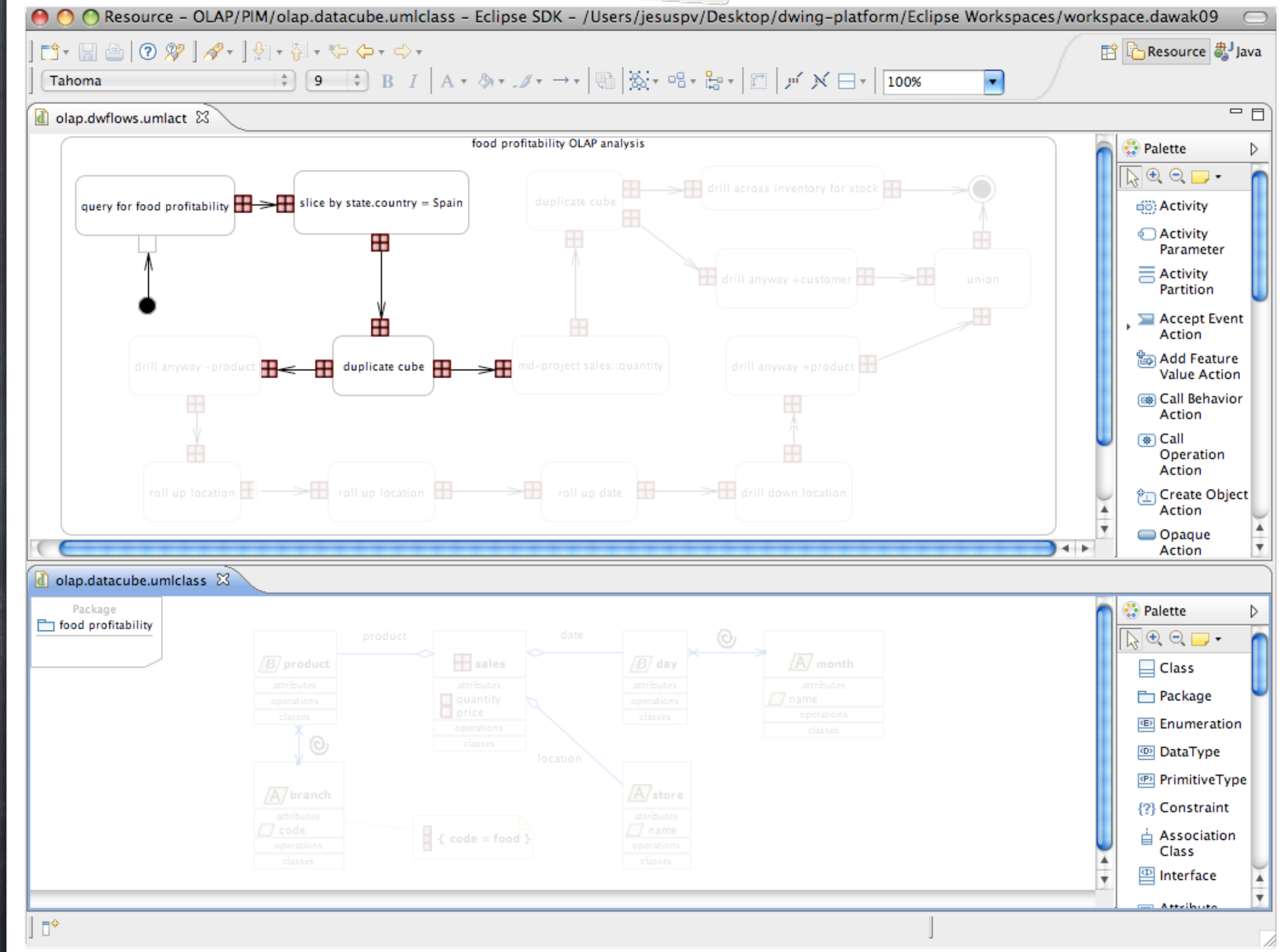
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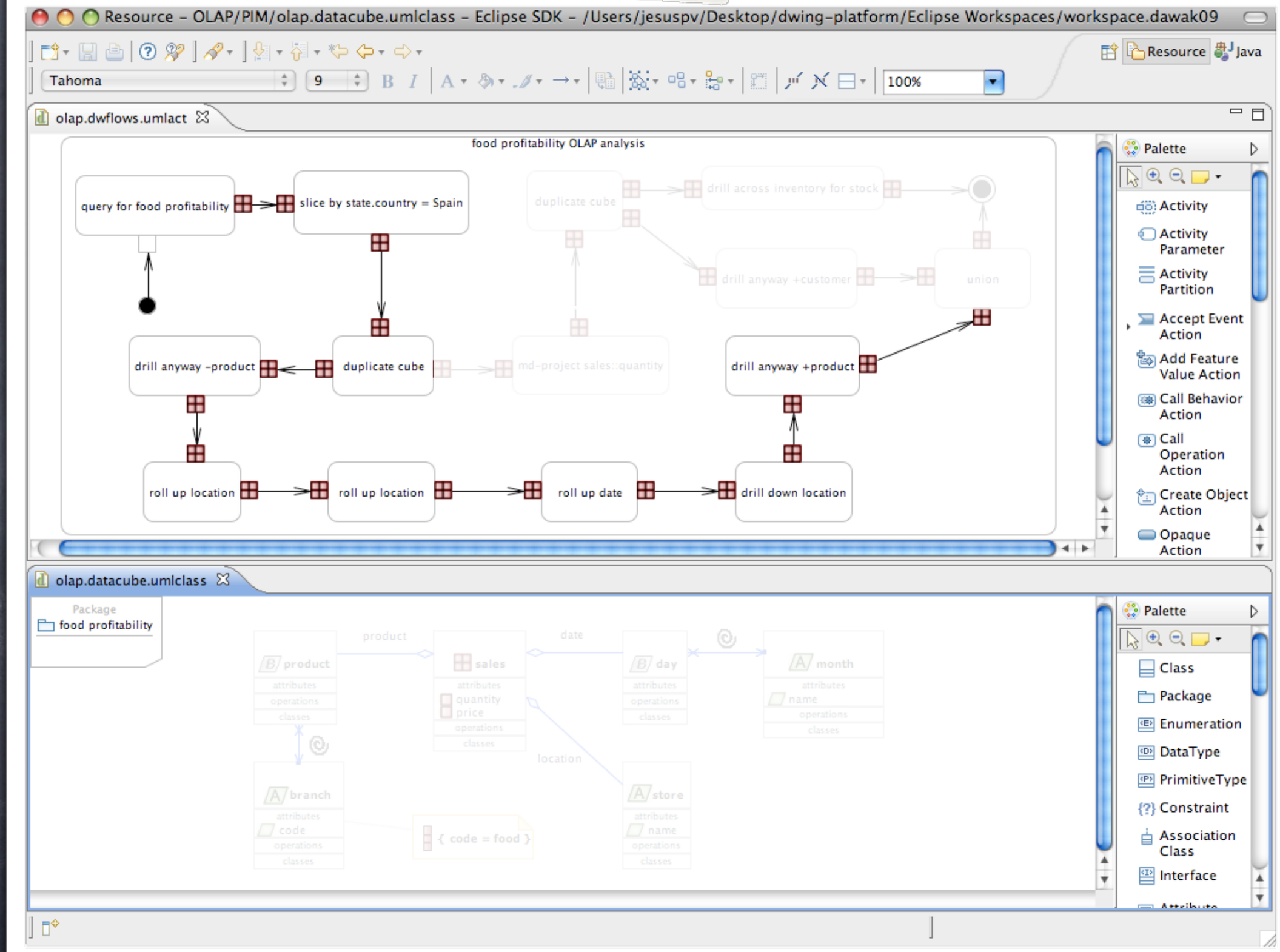
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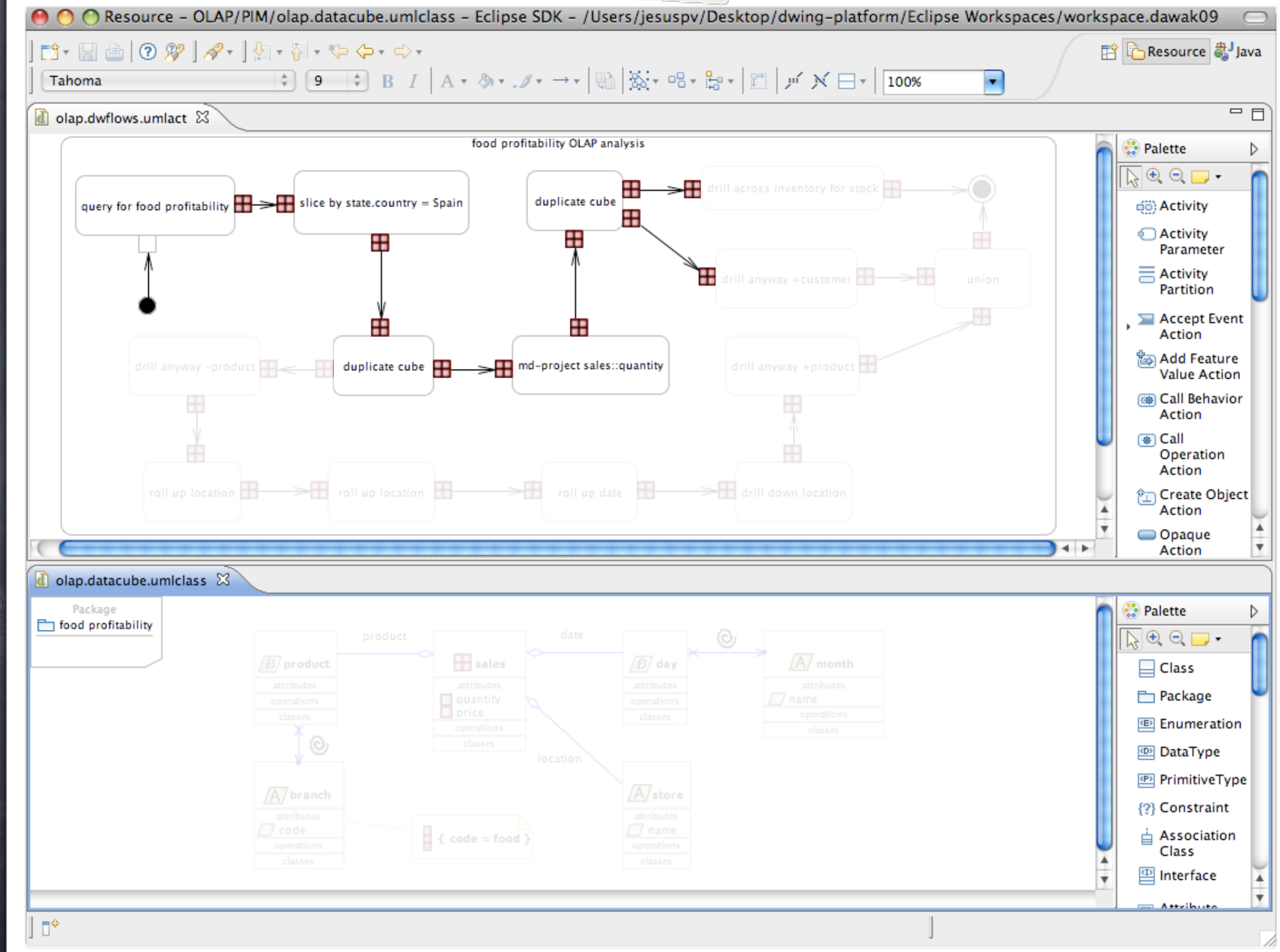
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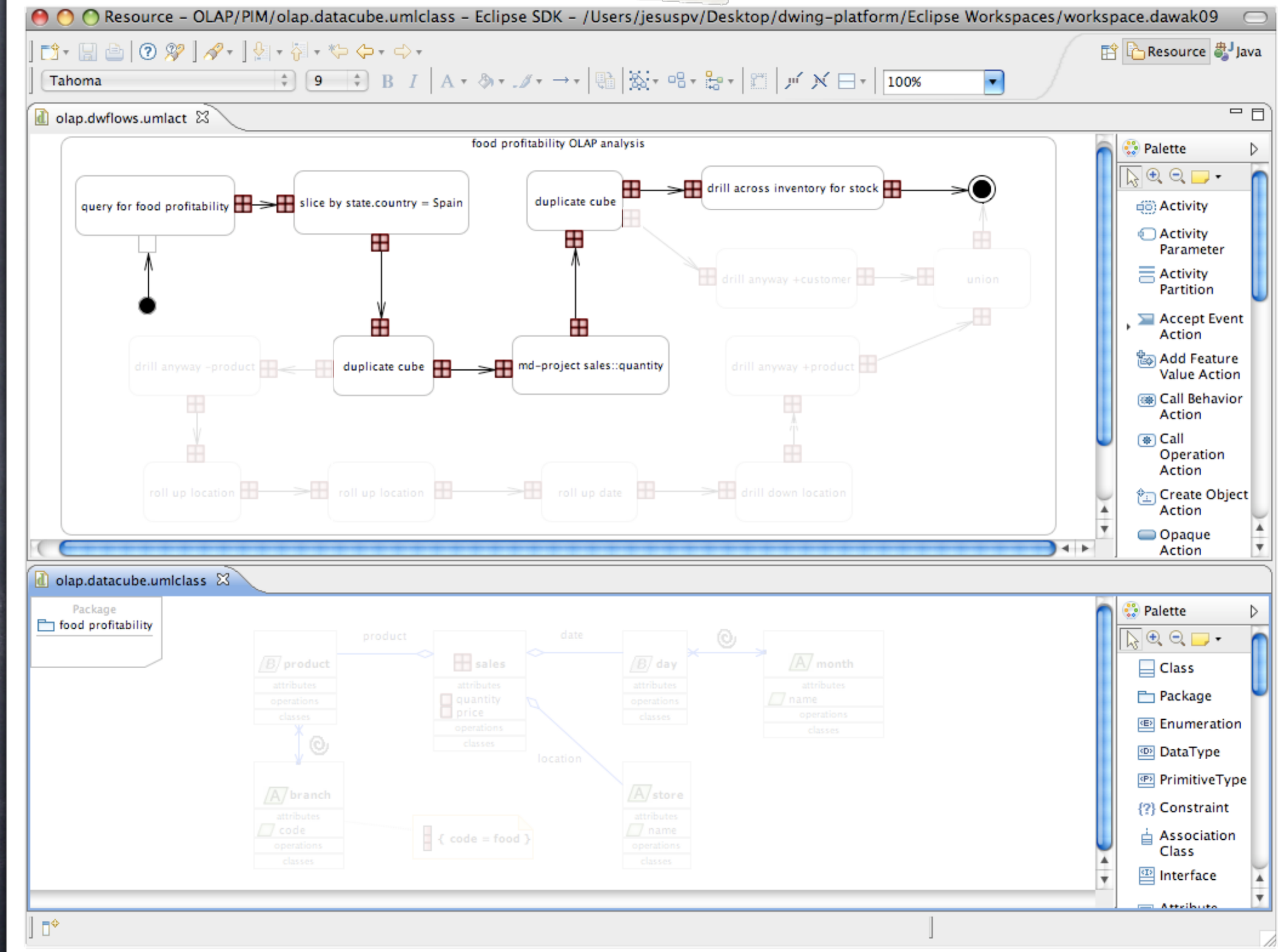
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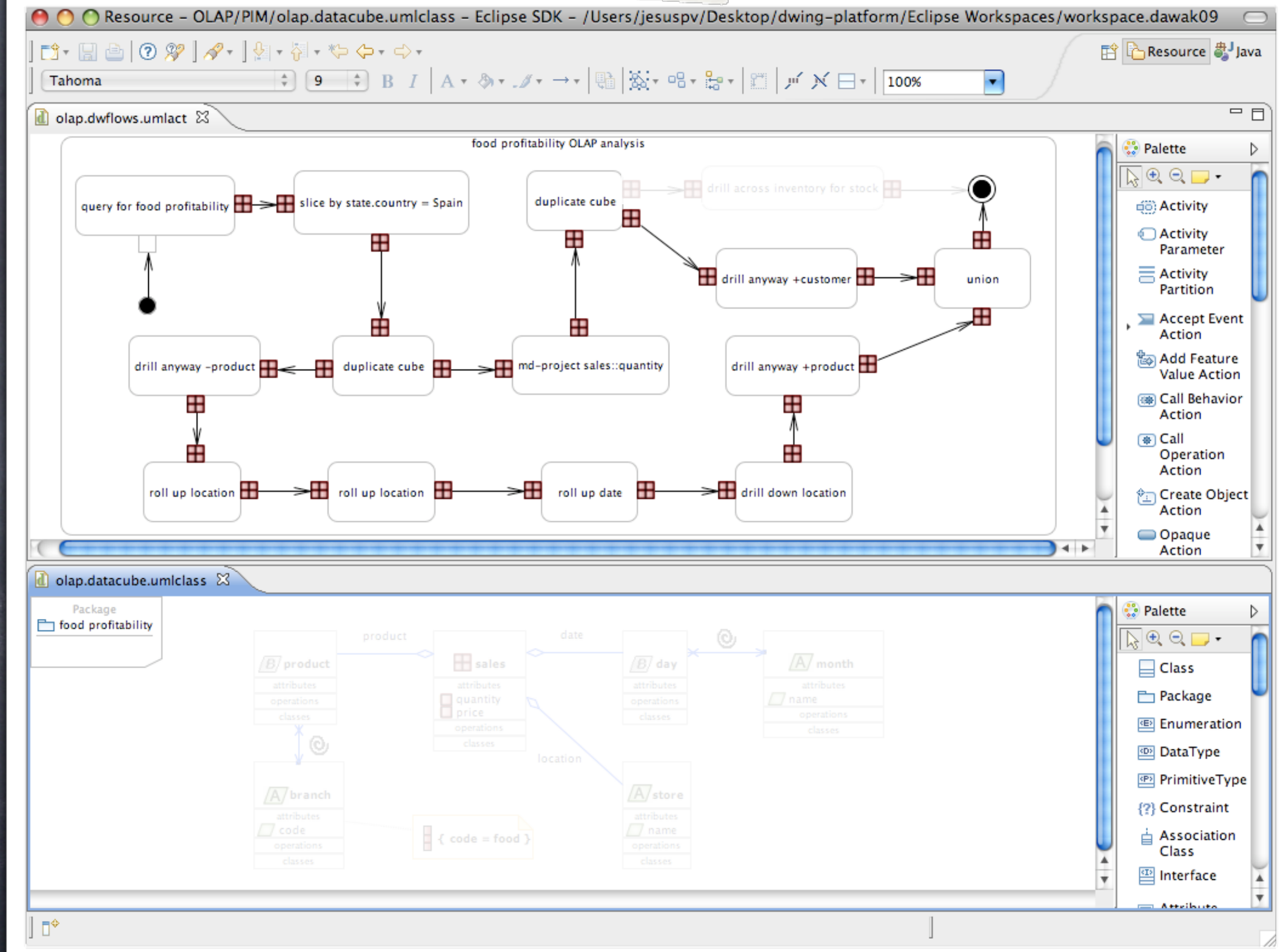
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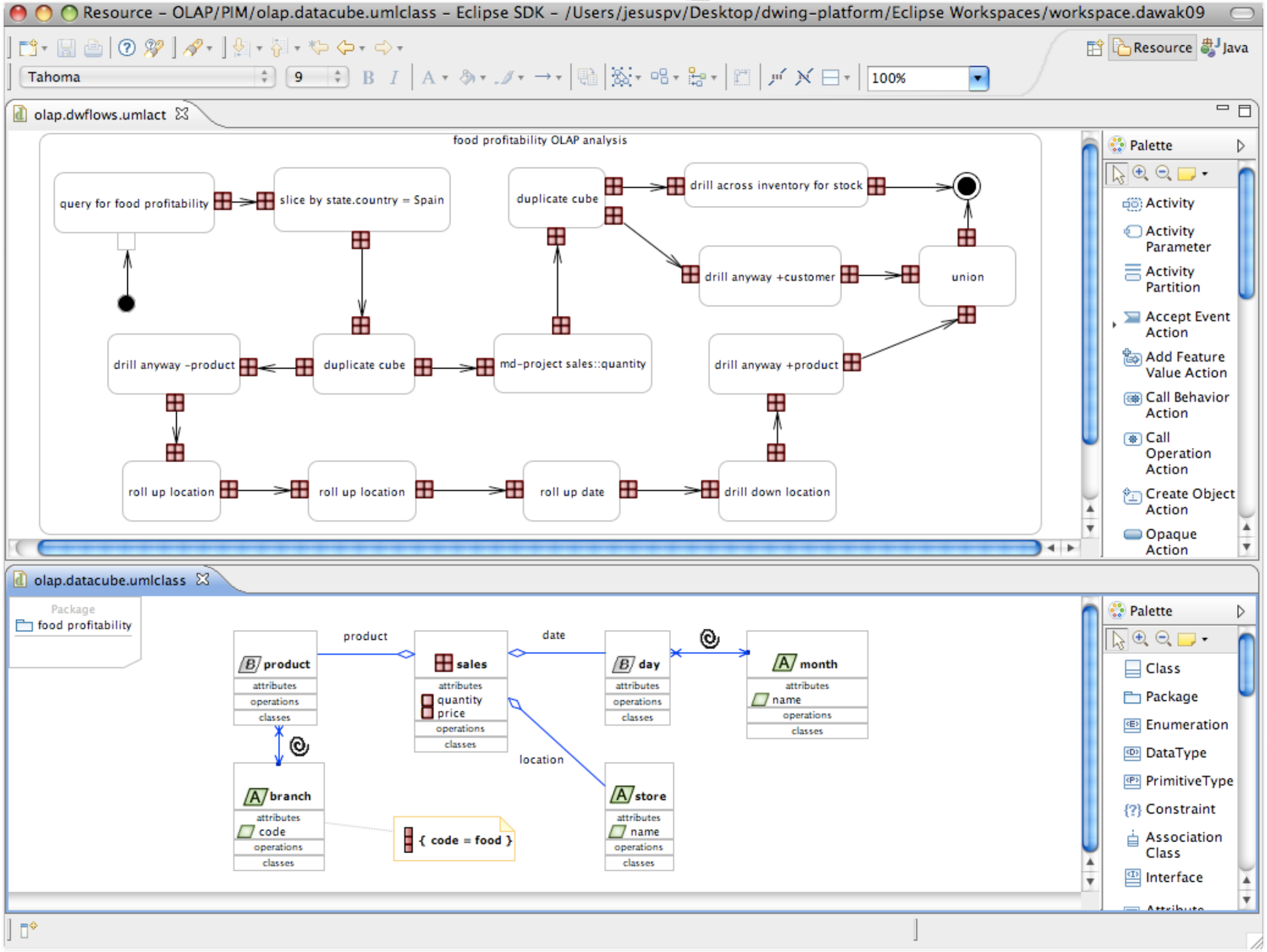
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Conclusion

- Wide range of visualisation techniques for F^W
  - Heterogeneous diagrams
  - Isolated frameworks
- Challenges
  - Handle data cubes (complex types)
  - Unify modelling requirements
  - Drive perception & cognition
- Contribution
  - Characterisation of F^W
  - UML Diagrams for F^W + C
  - Prototype on the Eclipse platform

Open Questions

- Systematic Review of Literature
- Study of the Cognitive Aids
  - Theoretical foundation
  - Empirical validation
- Make Diagrams Executable

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