Using Web-based Personalization on Spatial Data Warehouses

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International Workshop on Business intelligence and the WEB
BEWEB’10
March 22, 2010, Lausanne, Switzerland
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**Introduction**

**Spatial Data Warehouses**

A data warehouse is a large database designed to support the decision making needs of an organization.

Spatial data represent geometric characteristics of a real world phenomena. To this aim, it has an absolute and relative position, an associated geometry and some descriptive attributes.

Spatial data warehouses (SDW) rely on extended multidimensional (MD) models in order to provide decision makers with appropriate structures to intuitively analyse spatial data.

Several SDW development approaches provide a conceptual modeling and some guidelines in order to obtain logical schemas. However:

- **Spatial modeling** is still complex for providing each decision maker with their own information needs.

- **Spatial data warehouses** may be potentially large and spatial structures become increasingly complex to be analysed at a glance.
Introduction
Web Engineering & PRML

Similar problems are addressed by Web Engineering (heterogeneous audience, different data sources and increasing amount and complexity of information) by applying personalization.

Due to the similarities, we argue that a similar solution can be applied. This solution is based on:

- A User Model to structure the user data required for personalization.

- A set of personalization rules which are specified using PRML. PRML (Personalization Rules Modeling Language) is a language that we have successfully applied to several Web systems in order to define personalization rules for every particular user and needs.
Introduction
Overview of our proposal

Spatial Instances rules
Spatial Schema rules
MD model
Spatial-aware User model

Schema personalization

Initial GeoMD models

Instance personalization

Personalized GeoMD models
Multidimensional modeling

Our proposal

[Diagram showing class structure and stereotypes]
Spatial-aware User modeling

Our proposal
Spatial PRML

Our proposal
A sales department of a company is initially interested in analysing who bought (Customer), where (Store), what (Product) and when (Time).

Now that the regional sales manager is only interested in sales made near an airport in order to start a specific promotion.
Sample Application
User modeling & Personalization Rules

• Rule: addSpatiality When SessionStart do
  If (SUS.DecisionMaker.dm2role.name='RegionalSalesManager') then
  AddLayer('Airport', POINT)
  BecomeSpatial(MD.Sales.Store.geometry, POINT)
  EndIf
EndWhen

• Rule: IntAirportCity When
  SpatialSelection(GeoMD.Store.City, Distance(GeoMD.Store.City.geometry, 
  GeoMD.Airport.geometry)<20km) do
  SetContent(SUS.DecisionMaker.dm2airportcity.degree, 
  SUS.DecisionMaker.dm2airportcity.degree+1)
EndWhen

• Rule: TrainAirportCity When SessionStart do
  If (SUS.DecisionMaker.dm2airportcity.degree>threshold) then
  AddLayer('Train', LINE)
  Foreach t, c, a in ( GeoMD.Train, GeoMD.Store.City, GeoMD.Airport)
  If(Distance(Intersection(Intersection(t.geometry,c.geometry), 
  a.geometry))<50km) then
  SelectInstance(c)
  endIf
  endForeach
EndWhen
Sample Application
Final Multidimensional model
Conclusions

• To overcome the **SDW development limitations**, we presented a modeling approach for spatial data warehouses **personalization at conceptual level** by providing two new design artifacts together with the multidimensional model:

  - a spatial-aware **user model** which captures all the user-related information
  - a set of spatial **personalization rules** which specify the required personalization actions

• The great **advantage of our approach** is that each decision maker can easily include spatial data according to their own needs at conceptual level, while they can also conceptually get the right spatial schema instance avoiding exploring in a large and complex SDW.
Future work

• Integrate the approach in our model driven approach for spatial data warehouses developing framework.

• Extend this approach considering visualization aspects of the SDW mainly focus on spatial BI tools
Discussion

Using Web-based Personalization on Spatial Data Warehouses

Initial GeoMD models + Spatial-aware User model → Spatial Schema rules → Spatial Instances rules → Schema personalization → MD model + Spatial-aware User model → Personalized GeoMD models

Comparative analysis of PRML with other rule-based languages

Parser implementation