Modeling Theory

Objectives

• Allow modeling to be done ontologically (high level of abstraction, real-world modeling, application specific)
• Then, systematically transform the application model into an efficient implementation.
  – Automatically transform the application model into a model-theoretic view of a database
  – Apply efficiency transformations (automatically, if possibly, and synergistically, when full automation is not possible)
  – Automatically generate a database scheme

Assumptions & Example

• Assumptions
  – no recursive relationships (add roles to remove, if necessary)
  – relationship-set names include associated object-set names
  – no templates (transform shorthand into underlying constructs)

• Example
Generated Predicates

Object Sets

Room(x), Room Nr(x), Cost(x), Date(x), Guest(x), Guest Nr(x),
Current Guest(x), Future Guest(x), Guarantee Nr(x)

Relationship Sets

Room(x) has Room Nr(y),
Room(x) has Cost(y),
Guest(x) has reservation for Room(y) on Date(z),
Guest(x) has Guest Nr(y)
Future Guest(x) has Guarantee Nr(y)

Generated Rules

Referential-Integrity Constraints

∀x∀y(Room(x) has Room Nr(y) → Room(x) ∧ Room Nr(y))
...

Generalization/Specialization Constraints

∀x(Current Guest(x) ∨ Future Guest(x) → Guest(x))
∀x(Guest(x) → Current Guest(x) ∨ Future Guest(x))

Participation Constraints

∀x(Room(x) → ∃y(Room(x) has Cost(y))
∀x(Cost(x) → ∃y(Room(y) has Cost(x))
...

Co-occurrence Constraints

∀<x, y>(∃z(Guest(z) has reservation for Room(x) on Date(y)))
→ ∃w(Guest(w) has reservation for Room(x) on Date(y)))
A Valid Interpretation

Object-Set Relations

<table>
<thead>
<tr>
<th>Room</th>
<th>Room Nr</th>
<th>Cost</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>1</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>2</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

Relationship-Set Relations

<table>
<thead>
<tr>
<th>Room has Room Nr</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>1</td>
</tr>
<tr>
<td>R2</td>
<td>2</td>
</tr>
</tbody>
</table>

Constraints

\( \forall x \in \text{Room}(x) \rightarrow \exists y (\text{Room}(x) \text{ has Room Nr}(y)) \)

...