Update Support for Database Views via Cooperation

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- Thus, a view update has many possible *reflections* to the main schema.
- The problem of identifying a suitable reflection is known as the *update translation problem* or *update reflection problem*.
- With a reasonable definition of suitability, it may not be the case that every view update has a suitable translation.
The Constant-Complement Strategy

Main Schema

View Schema
The Constant-Complement Strategy

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**Question**: How can updates which are not supported by constant complement be realized?
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- All users operate within the limits of their vision of the main schema and their access rights.
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and $K_{BC} = (((R[BC], \{B \rightarrow C\}), \{\Pi_B^{R[BC]}\}))$.

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\begin{array}{c}
(R[AB], \{A \rightarrow B\}) \xrightarrow{R[B]} \quad R[B] \xleftarrow{R[B]} \quad (R[BC], \{B \rightarrow C\})
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- This recaptures lossless and dependency-preserving decomposition, but as a 
  *composition* rather than as a decomposition.
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![Diagram showing the propagation of updates through components $C_1$, $V_1$, $C_2$, $V_2$, $V_3$, and $C_3$, $C_4$.]

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![Diagram showing component $C_1$ connected to port $V_1$, which is connected to component $C_2$, and $V_2$ connecting to $C_3$, and $V_3$ connecting to $C_4$.]

- **Key issues:**
  - *Database consistency:* Actual database update must be deferred until the negotiation process is complete.
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- An architecture for the support of such *cooperative updates* is needed.
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- To each view schema $V_i$ is associated a port-status register $\text{PSR}(C_j, V_i)$ for each component $C_j$ which is connected to it.
- These additional registers are part of the control structure, and are in addition to the database itself.
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Example: Travel Request and Authorization

Employee

Travel_Emp
EmpID
ConfID
Amnt
NDays
Notes

travel_EmpSct
EmpID
ConfID
Amnt
NDays

Secretariat

Travel_Sct
EmpID
ConfID
Amnt
NDays
SupID

Travel_SecMgt
EmpID
ConfID
Amnt
NDays
SupID

Travel_SecAct
EmpID
ConfID
Amnt

Management

Apprv_Mgt
EmpID
ConfID
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Accounting

Apprv_Act
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\{\text{Travel}_{\text{Emp}}[\text{Lena}, \text{ADBIS}, e_A, d_A, n] \mid 800 \leq e_A \leq 2000, 5 \leq d_A \leq 10\} \cup \{\text{Travel}_{\text{Emp}}[\text{Lena}, \text{DEXA}, e_D, d_D, n] \mid 1000 \leq e_D \leq 2000, 3 \leq d_D \leq 10\}
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- ADBIS is always preferred to DEXA.
- For a given conference, more money and days are always preferred to fewer.
Example: Evolution of Travel Request and Authorization

- The evolution of a specific update request will now be illustrated.
Example: Evolution of Travel Request and Authorization

- First, the desired ranked update is entered into the pending-update register for Employee. Notation:
  - $+$ = Insert.
  - $\lor$ = Choose one of the alternatives.
Example: Evolution of Travel Request and Authorization

- This update is then projected to the port-status register which connects Employee to Secretariat.
Example: Evolution of Travel Request and Authorization

- The user of the Secretariat component then lifts this update to one on that component. It is placed in the pending-update register for that component.

  - Note that decisions must be made.
  - One of many possible liftings must be selected.
Example: Evolution of Travel Request and Authorization

- The port-status register is then cleared, since this update has been processed.
Example: Evolution of Travel Request and Authorization

- This lifted update is then projected into the appropriate port-status registers which connect Secretariat to Management and Accounting.
- It is not projected back onto the port-status register which is connected to Employee, because the new value would be the same as the old one.
Example: Evolution of Travel Request and Authorization

- First consider lifting the projected update to the Management component.
- Again, there are decisions to be made.
Example: Evolution of Travel Request and Authorization

Manager Steve processes the request, and decides to allow Lena to attend ADBIS for five days.
The value in the port-status register for the Management component is removed, but a new value for the port-status register for Secretariat is inserted.
Example: Evolution of Travel Request and Authorization

- Now consider lifting the projected update to the Management component.
  - The accounting manager decides to award €1000 for the requested travel.
  - The appropriate accounts are also identified.
Example: Evolution of Travel Request and Authorization

- The value in the port-status register for the Accounting component is cleared, but a new value for the port-status register for Secretariat is inserted.
• Now the update negotiation propagates back right to left.
Example: Evolution of Travel Request and Authorization

- The two values in the port-status registers must be lifted to the Secretariat component simultaneously.
- The maximal lifting is selected.
- The Secretariat imposes no additional limitations.
The two port-status registers are now cleared.
The update request is then projected to the appropriate port-status register connecting Secretariat to Employee.
This update request is then lifted to the Employee component.

Again, the maximal lifting is selected.
- The port-status register is cleared.
- Note that all port-status registers are now clear.
• Finally, Lena selects an update from amongst the possibilities.
- This update is propagated to the other components for agreement.
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Note that a decision of which account to use is made by Accounting, but is not propagated since it is local to that component.
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- Finally, these proposed updates may be committed to the database.
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**Theorem** The negotiation process always terminates. Negotiations which proceed indefinitely are not possible. □
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Relationship to workflow:
- There is an apparent close connection between the flow of control which cooperative update mandates and the notion of workflow for complex processes.
- The precise way in which cooperative update defines constraints on the possible workflow patterns for the system warrants further study.