Associations: The Rest

• Associations: The Rest
• Visibility, Navigability, Properties
• Ownership, "Diamonds"
• Multiplicity

Back to the Main Track

OCL in (Class) Diagrams

What makes a class diagram a good class diagram?

Web-Shop Examples

The Elements of UML 2.0 Style

Example: Game Architecture

## Associations: The Rest

### Multiplicities

Recall: Multiplicity is a term of the form $N_1 \ldots N_{2k}$, where

- $N_i \leq N_{i+1}$ for $1 \leq i \leq 2k - 1$
- $N_1, \ldots, N_{2k-1} \in \mathbb{N}$
- $N_{2k} \in \mathbb{N} \cup \{\ast\}$

Define $\mu_{\text{C}}(\text{role}) := \text{context C inv: } \begin{cases} \text{role} \rightarrow \text{size}() \leq N_2 & \text{or} \\ \vdots & \text{or} \\ \text{role} \rightarrow \text{size}() \leq N_{2k} & \text{if } \mu \neq 1 \ldots 1, \mu \neq 1 \ldots 1, \mu \neq 1 \ldots 1 & \text{if } \mu \neq 0 \ldots 1 \end{cases}$

for each $\langle r: \ldots, \langle \text{role}: D, \mu, _, _, _, _ \rangle, \ldots, \langle \text{role}: C, _, _, _, _ \rangle, \ldots \rangle \in V$ or $\langle r: \ldots, \langle \text{role}: C, _, _, _, _ \rangle, \ldots, \langle \text{role}: D, \mu, _, _, _, _ \rangle, \ldots \rangle \in V$, with $\text{role} \neq \text{role}'$, if $\mu \neq 1 \ldots 1$.

Note: in $n$-ary associations with $n > 2$, there is redundancy.

### Multiplicities as Constraints

Example

\[
\mu_{\text{C}}(\text{role}) = \text{context C inv: } \begin{cases} \text{role} \rightarrow \text{size}() \leq N_2 & \text{or} \\ \vdots & \text{or} \\ \text{role} \rightarrow \text{size}() \leq N_{2k} & \text{if } \mu \neq 1 \ldots 1 \end{cases}
\]

CD: $C_v: \text{Int}
\begin{align*}
\text{role}_1 & \quad 0 \ldots 1 \\
\text{role}_2 & \quad 4, 17 \\
\text{role}_3 & \quad 3 \ldots \ast
\end{align*}$

\[
\begin{cases}
\text{context C inv: 4} \leq \text{role}_2 \rightarrow \text{size}() \leq 4 \text{ or } 17 \leq \text{role}_2 \rightarrow \text{size}() \leq 17
\end{cases}
\]

$\cup \{ \text{context C inv: \text{role} \rightarrow \text{size}() = 4 \text{ or } \text{role} \rightarrow \text{size}() = 17} \}$
Recall: on some earlier slides we said, the extension of the signature is only to study associations in "full beauty". For the remainder of the course, we should look for something simpler...

Proposal:

• from now on, we only use associations of the form

\[(i) \quad C_0 \times \cdot \cdot 1 \cdot \quad \text{role} \times \]

\[(ii) \quad C_0 \times \ast \cdot \cdot \quad \text{role} \times \]

(And we may omit the non-navigability and ownership symbols.)

• Form (i) introduces role \(C_0, 1\), and form (ii) introduces role \(C_\ast\) in the set of attributes \(V\).

• In both cases, \(\text{role} \in \operatorname{atr}(C)\).

• We drop \(\lambda\) and go back to our nice \(\sigma\) with \(\sigma(u)(\text{role}) \subseteq D(D)\).

OCL Constraints in (Class) Diagrams

Where Shall We Put OCL Constraints?

Three options:

(o) Separate document.

(i) Notes.

(ii) Particular dedicated places.

Notes:

A UML note is a picture of the form

\[\text{text}\]

\[\text{text}\]

Can principally be everything, in particular comments and constraints.

Sometimes, content is explicitly classified for clarity:

OCL:

\[\text{expr}\]

OCL in Notes: Conventions

(ii) Particular dedicated places in class diagrams: (behavioural features: later)

\[C \xi \{p_1, \ldots, p_n\} \{\text{expr}\} \xi f(v_1:T, \ldots, v_n:T): T\]

\[\{p_1, \ldots, p_n\} \{\text{pre: \text{expr}} 1, \text{post: \text{expr}} 2\}\]

For simplicity, we view the above as an abbreviation for

\[C \xi \{p_1, \ldots, p_n\} \{\text{expr}\} \xi f(v_1:T, \ldots, v_n:T): T\]

\[\{p_1, \ldots, p_n\} \{\text{pre: \text{expr}} 1, \text{post: \text{expr}} 2\}\]
Design Guidelines for (Class) Diagram

Semantics of a Class Diagram

Invariants of a Class Diagram
The more detailed the documentation, the higher the probability for regression
Tell Them What You've Told Them...
