

# Merging and Repairing Ontologies

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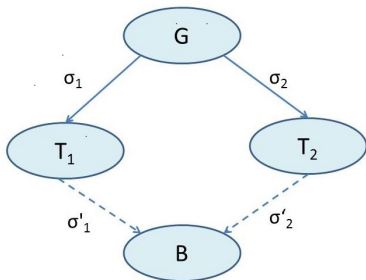


# Outline

- 1 Merging Ontologies via Analogical Blending
- 2 Repairing Faulty Ontologies using Reformation



# Analogical Blends



- $T_1$  and  $T_2$  are the parent theories, and  $B$  is the blend constructed from them.
- Alignments between concepts in each of the two parents are given by the morphisms  $\sigma_1$  and  $\sigma_2$  between the general theory,  $G$ , and the two parent theories,  $T_1$  and  $T_2$ .
- The colimit algorithm then constructs the morphisms  $\sigma'_1$  and  $\sigma'_2$ , which together define  $B$ .



# Merging Two Ontologies

 $T_1$ 

$Own(Cust_a, Prod_a), \quad Part\_Num(Prod_a) = 123$   
 $Own(Cust_b, Prod_b), \quad Part\_Num(Prod_b) = 123$   
 $Prod_a \neq Prod_b$

 $T_2$ 

$Sold\_To(Cust_c, Prod_c), \quad Ser\_Num(Prod_c) = 234$   
 $Ser\_Num(x) = Ser\_Num(y) \implies x = y$

## Morphisms

$\sigma_1 = \{p \mapsto Own, f \mapsto Part\_Num\}$   
 $\sigma_2 = \{p \mapsto Sold\_To, f \mapsto Ser\_Num\}$

where  $G$  consists of just binary predicate  $p$  and unary function  $f$ .



# The Merged Ontology as a Blend

 $B$ 

$Sold\_To(Cust_a, Prod_a), \quad Ser\_Num(Prod_a) = 123$

$Sold\_To(Cust_b, Prod_b), \quad Ser\_Num(Prod_b) = 123$

$Sold\_To(Cust_c, Prod_c), \quad Ser\_Num(Prod_c) = 234$

$Ser\_Num(x) = Ser\_Num(y) \implies x = y$

$Prod_a \neq Prod_b$

- Unfortunately,  $B$  is inconsistent.
- The error was to align  $Part\_Num$  from  $T_1$  with  $Ser\_Num$  from  $T_2$ .



## Proof of Inconsistency

Proof of  $\perp$  (= false)

$$\begin{array}{r}
 \text{Ser\_Num}(x) = \text{Ser\_Num}(y) \implies x = y \\
 \hline
 \text{Ser\_Num}(\text{Prod}_a) \neq \text{Ser\_Num}(\text{Prod}_b) \quad \text{Prod}_a \neq \text{Prod}_b \\
 \hline
 \text{Ser\_Num}(\text{Prod}_a) \neq 123 \quad \text{Ser\_Num}(\text{Prod}_b) = 123 \\
 \hline
 123 \neq 123 \quad \text{Ser\_Num}(\text{Prod}_a) = 123 \\
 \hline
 \perp \quad z = z
 \end{array}$$

- Matching colours show formulae that are unified.
- Apply reformation to block the red unification.
- Suggested repair: rename apart the two occurrences of *Ser\_Num*.
- Implemented by dropping  $f$  from  $G$  and, hence, from morphisms  $\sigma_1$  &  $\sigma_2$ .



## Repaired Merged Ontology

 $\nu(B)$ 

$Sold\_To(Cust_a, Prod_a),$   $Part\_Num(Prod_a) = 123$

$Sold\_To(Cust_b, Prod_b),$   $Part\_Num(Prod_b) = 123$

$Sold\_To(Cust_c, Prod_c),$   $Ser\_Num(Prod_c) = 234$

$Ser\_Num(x) = Ser\_Num(y) \implies x = y$

$Prod_a \neq Prod_b$

where the green formulae are the repaired ones.



## Conclusion

- Ontologies can be merged by analogical blending.
- But some blends may be faulty.
- Faults can be revealed by reasoning failures.
- Reformation uses such failures to diagnose and repair faulty ontologies.

