A Reachability-based Navigation Paradigm for Triadic Concepts

Diana Troancă

Babeş-Bolyai University of Cluj-Napoca
dianat@cs.ubbcluj.ro

August 30, 2016

Reachability-based Navigation

Problem:

- navigation and exploration in large triadic contexts

Solution:

- a navigation with a local character

Reachability-based Navigation

Main Idea:

- based on appropriately defined dyadic projections
- choose a set of elements with particular properties to project on
- visualize and navigate in the concept lattice of the dyadic projection

Reachability Relation

Definition (Direct Reachability)

Triconcepts $(A_1, A_2, A_3), (B_1, B_2, B_3)$

- $(A_1, A_2, A_3) \prec_1 (B_1, B_2, B_3)$ *if and only if* $(B_2, B_3) \in \mathfrak{B}(\mathbb{K}^{(23)}_{A_1})$
- *Analogously for* $\prec_2$, $\prec_3$

- $\mathbb{K}^{(ij)}_{A_k} := (K_i, K_j, Y^{(ij)}_{A_k})$, where $(a_i, a_j) \in Y^{(ij)}_{A_k}$ if and only if $(a_i, a_j, a_k) \in Y$ for all $a_k \in A_k$

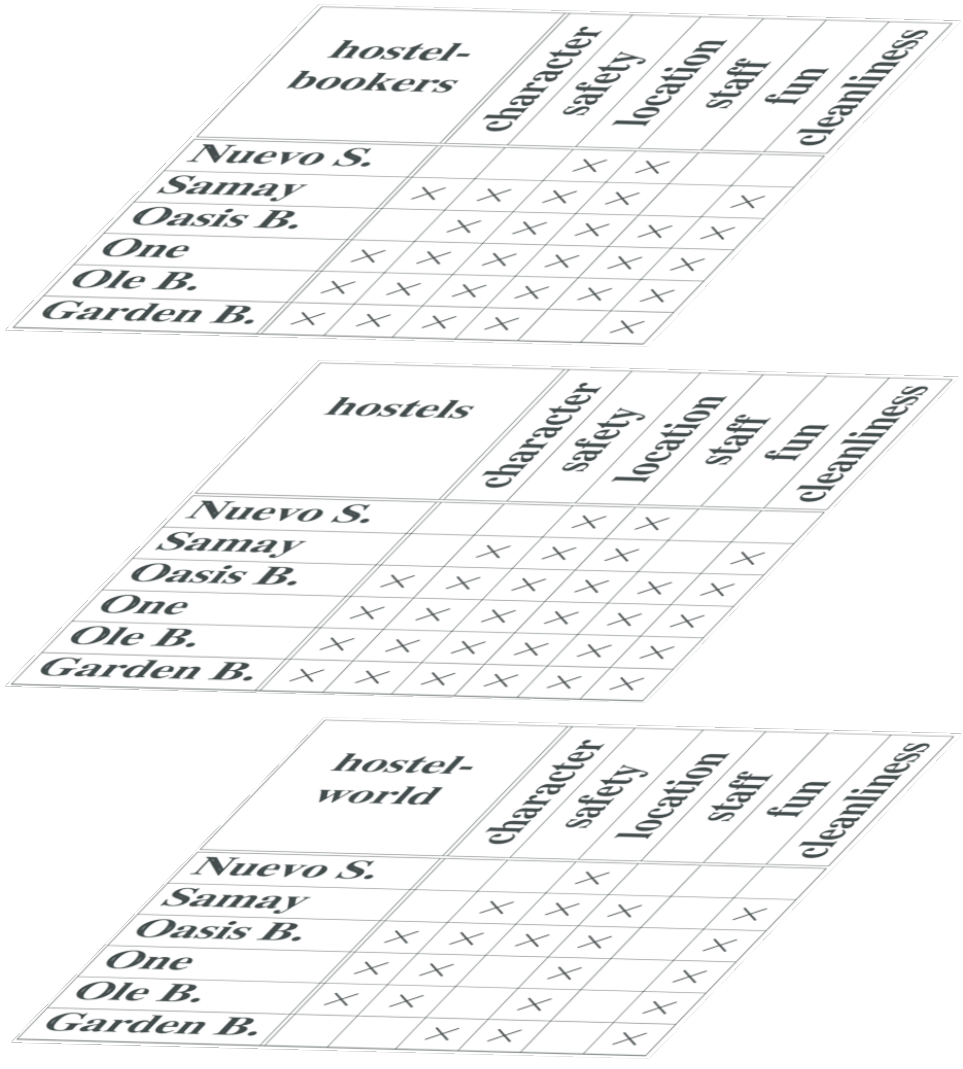
Definition (Reachability)

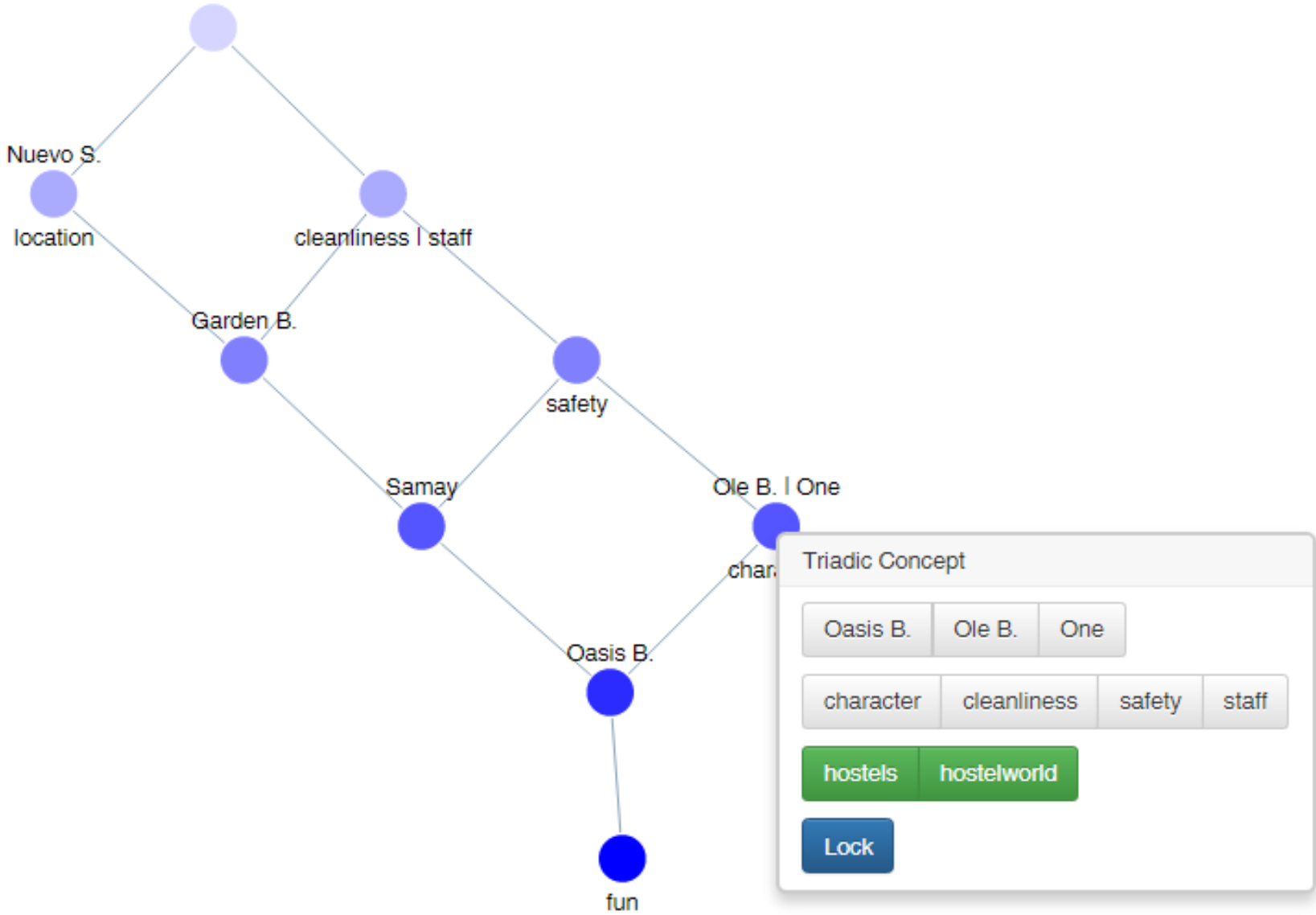
Reachability relation $\lhd$ *is the transitive closure of the direct reachability relation* $\prec$.

Hostel Tricontext

Hostel Tricontext
(defined by Glodeanu)

- hostels as objects
- hostel services as attributes
- websites with hostel ratings as conditions

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location
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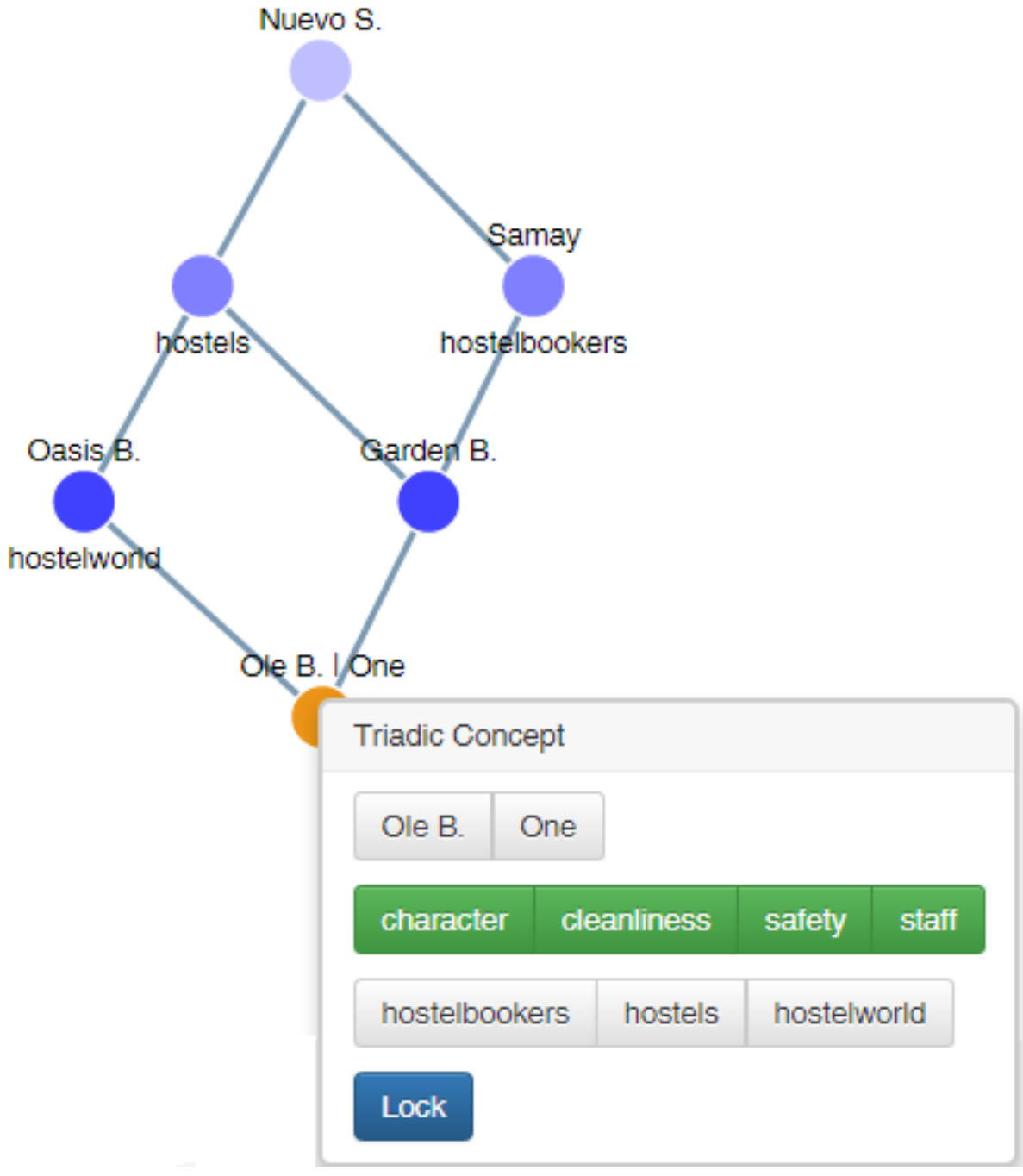
Lock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Lock

Choosing a starting point

Solution 1:

- generate all triconcepts
- pick one triconcept
- choose one of the components to project on

Solution 2:

- find one triconcept using a different method: Concept Finder (ASP Navigation Tool)
- choose one of the components to project on

Is any triconcept reachable?

Disadvantage:

- not all triconcepts can be reached

Proposed solution:

- overall view of the navigation structure (clusters)
- Cluster = maximal group of mutually reachable concepts

Dyadic context of reachability

Steps:

- compute direct reachability relation between triconcepts
- compute the transitive closure (reachability relation)
- represent the dyadic context of reachability
  $\mathbb{K}_{\triangleleft} = (\mathfrak{T}(\mathbb{K}), \mathfrak{T}(\mathbb{K}), \triangleleft)$
- represent the concept lattice of clusters

Multiple Clusters

b1	m1	m2	m3
g1	×		
g2			
g3			

b2	m1	m2	m3
g1			
g2			
g3		×	

b3	m1	m2	m3
g1	×	×	
g2			
g3			

Triconcepts:

- $T_1 = (\{g_3\}, \{m_2\}, \{b_2\})$
- $T_2 = (\{g_1\}, \{m_1\}, \{b_1.b_3\})$
- $T_3 = (\{g_1\}, \{m_1.m_2\}, \{b_3\})$
- $T_4 = (\{g_1, g_2, g_3\}, \{m_1, m_2, m_3\}, \emptyset)$
- $T_5 = (\{g_1, g_2, g_3\}, \emptyset, \{b_1, b_2, b_3\})$
- $T_6 = (\emptyset, \{m_1, m_2, m_3\}, \{b_1, b_2, b_3\})$

Dyadic context of reachability $\mathbb{K}_{\triangleleft}$

$\mathbb{K}_{\triangleleft}$	T_1	T_2	T_3	T_4	T_5	T_6
T_1	$\times$	$\times$	$\times$	$\times$	$\times$	$\times$
T_2		$\times$	$\times$	$\times$	$\times$	$\times$
T_3		$\times$	$\times$	$\times$	$\times$	$\times$
T_4				$\times$	$\times$	$\times$
T_5				$\times$	$\times$	$\times$
T_6				$\times$	$\times$	$\times$

Conclusions

Advantages of the reachability-based navigation

- a navigation paradigm for triadic datasets
- has a local character $\rightarrow$ viable for larger datasets
- uses dyadic concept lattices for visualization
- can integrate different methods for choosing a starting point

Acknowledgements

- **DAAD** - German Academic Exchange Program
- **EurAi** - European Association for Artificial Intelligence

Direct Reachability Algorithm

If $A_1 = B_1$ **or** $A_2 = B_2$ **or** $A_3 = B_3$ **then**
  Return true

If $A_1 \subset B_1$ **then**
  $P_e = \mathbb{K}^{(23)}_{A_1}$
  If $(B_2)'_{P_e} = B_3$ **and** $(B_3)'_{P_e} = B_2$ **then**
    Return true

If $A_2 \subset B_2$ **then**
  $P_i = \mathbb{K}^{(13)}_{A_2}$
  If $(B_1)'_{P_e} = B_3$ **and** $(B_3)'_{P_e} = B_1$ **then**
    Return true

If $A_3 \subset B_3$ **then**
  $P_m = \mathbb{K}^{(12)}_{A_3}$
  If $(B_1)'_{P_e} = B_2$ **and** $(B_2)'_{P_e} = B_1$ **then**
    Return true