Computing minimal mappings

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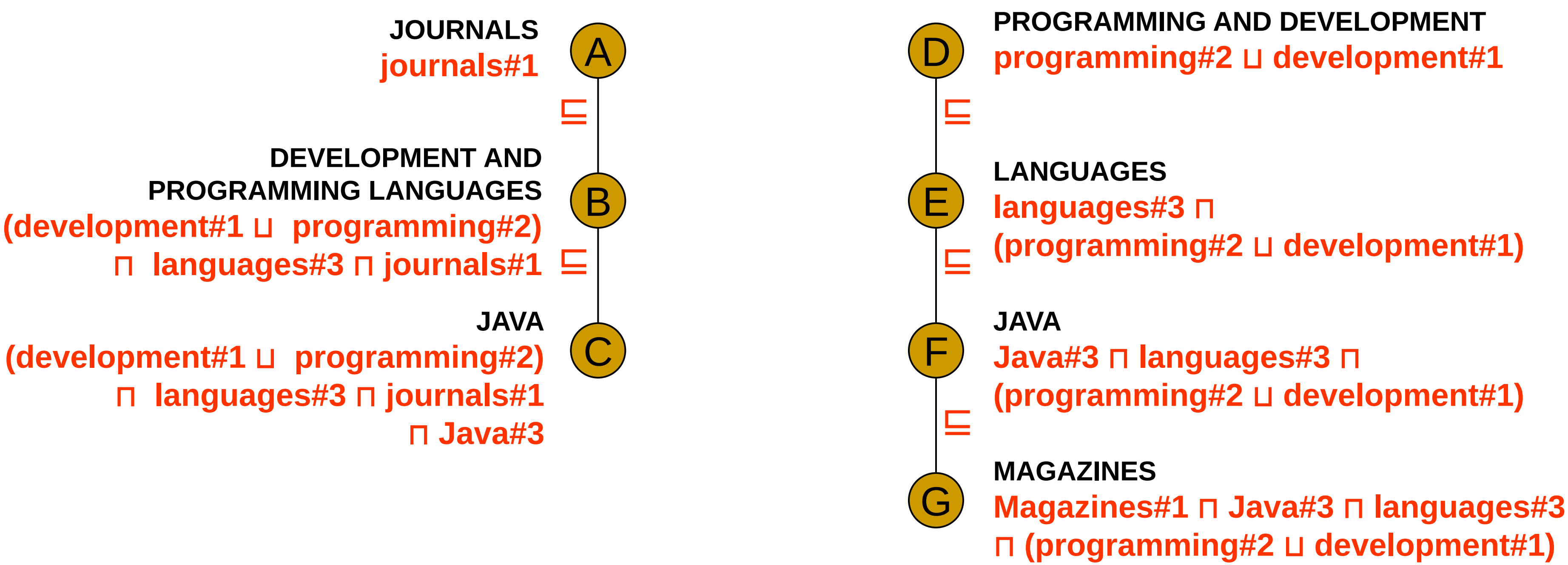
Roadmap

- Lightweight ontologies
- Mapping and minimal mapping
  - Computing a mapping: SMatch
  - Computing the minimal mapping: MinSMatch
- Evaluation
- Conclusions

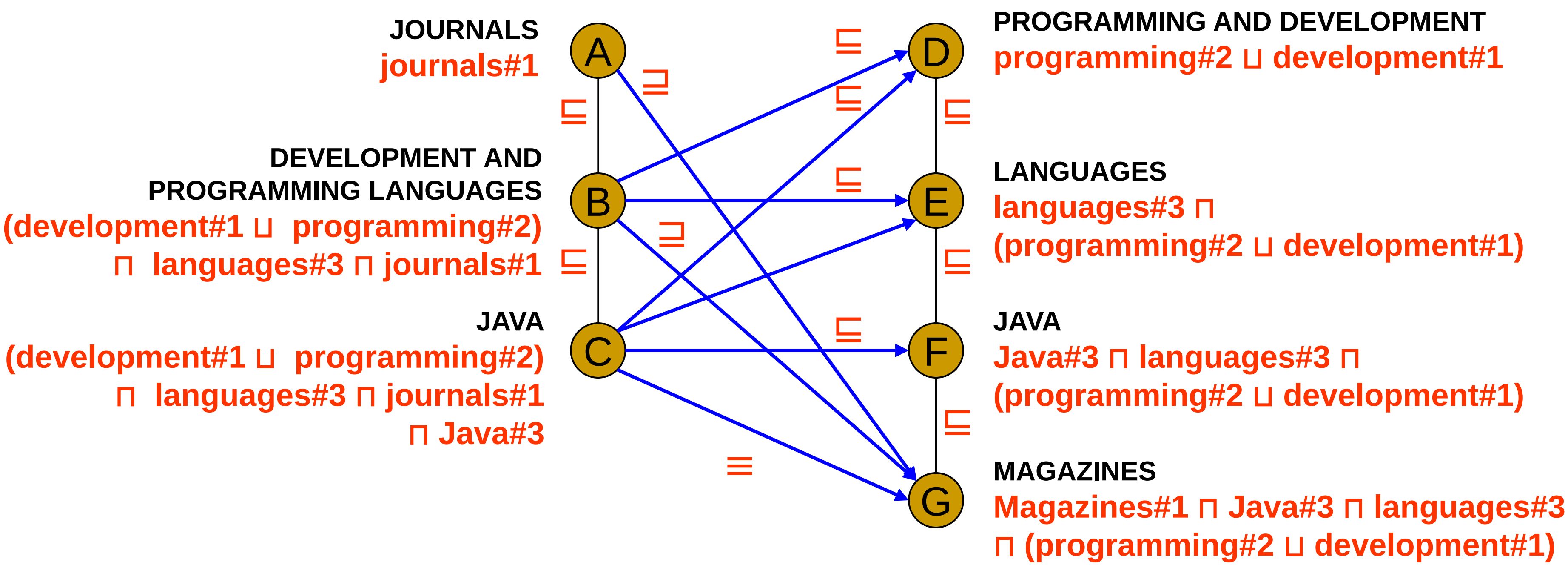
Lightweight ontologies (formal classifications)

- We translate the graphs in input into lightweight ontologies
  - Node labels are formulas in propositional Description Logic (DL)
  - Concepts are taken from WordNet senses
  - Tree structures: each node formula is subsumed by parent node formula



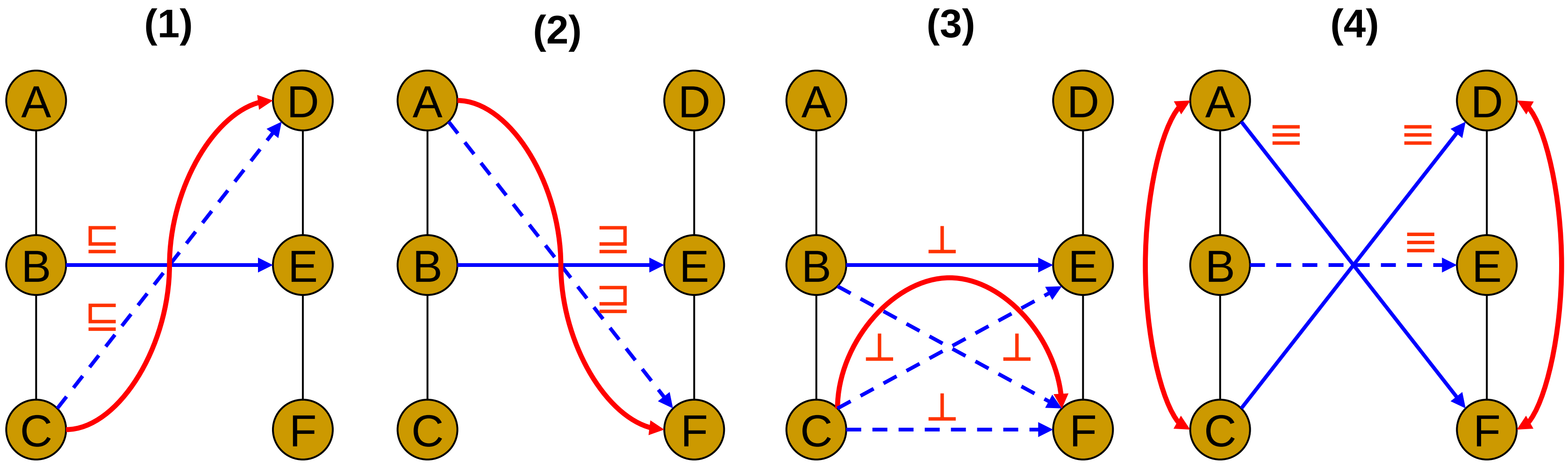
Computing a mapping using SMatch

- A Mapping is a set of mapping elements <source, target, R>
  - R ∈ { '⊥', '≡', '⊑', '⊒'} partially ordered
  - For each pair of nodes a call to a SAT solver verifies if a given semantic relation holds between the two, given the available <u>background knowledge</u>
  - Visualization and usability problems (e.g. validation and maintenance)



Redundancy patterns

- We provide:
  - A definition of **redundant mapping element** (dashed arrows) based on the redundancy patterns below (redundancy w.r.t. another element).
  - A demonstration of soundness and completeness
- Dependencies across-symbols: equivalence is the combination of more and less specific
  - Pattern 4 can be seen as the combination of patterns 1 and 2
  - Patterns 1 and 2 are still valid in case of equivalence between B-E

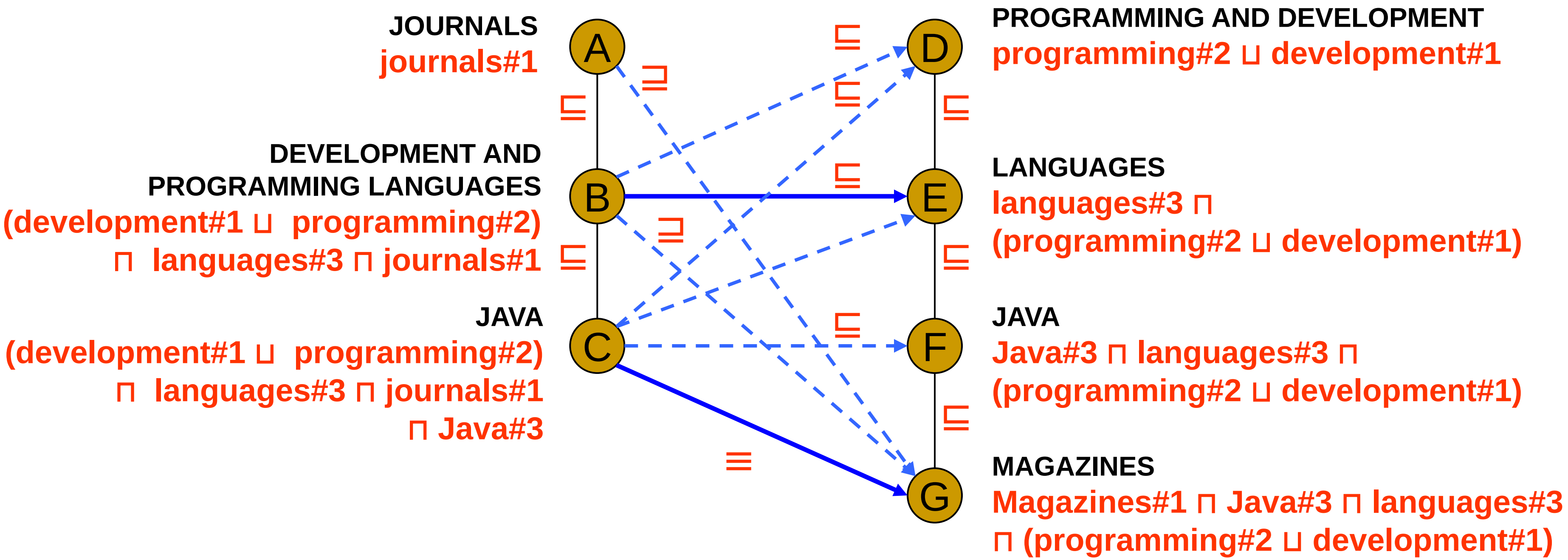


Minimal and redundant mappings

- We compute the Minimal Mapping
  - The subset of mapping elements of maximum size among those without redundant elements
- A Redundant Mapping
  - is a set containing redundant mapping elements
- The Mapping of maximum size
  - is the set containing the maximum number of mapping elements
  - It can be obtained from the propagation of the elements in the minimal set.

MinSMatch: computing the minimal mapping

- The minimal mapping always exists and it is unique
- Advantages in visualization, validation and maintenance



MinSMatch: the algorithm

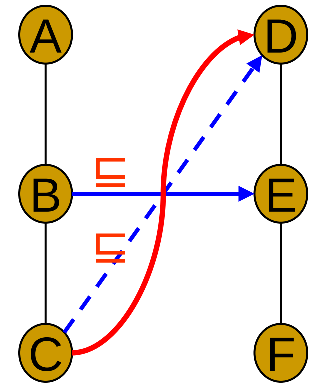
<u>Computing the minimal mapping M</u>:

```
function TreeMatch(tree T1, tree T2) {
        TreeDisjoint(root(T1),root(T2));   (3)
        direction := true;
        TreeSubsumedBy(root(T1),root(T2));  (1)
        direction := false;
        TreeSubsumedBy(root(T2),root(T1));  (2)
        TreeEquiv();  (4) from (1) and (2)
};
```

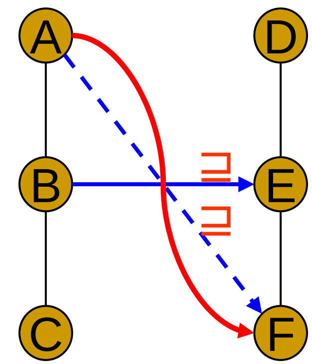
<u>Computing the set of maximum size</u>:

```
function Propagate(M)
```

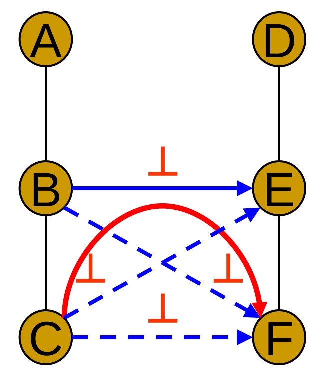
(1)



(2)



(3)



MinSMatch: evaluation w.r.t. SMatch

- We evaluated it on 4 datasets of different dimensions:
  - 34 x 39 (University courses)
  - 542 x 999 (Art domain)
  - 2857 x 6628 (Web directories)
  - 3358 x 5239 (Business directories)

- SAT calls: 43-66% less
- Runtime: 16-59% less
- Size of the minimal mapping: 68-96% less
- Recall: up to 0.6% elements more (*)

(*) We minimize the problem of lack of background knowledge; the deeper the classifications the better.

The result of the propagation of the minimal set computed by MinSMatch is equivalent to the result of SMatch modulo inconsistencies.

Conclusions

- The minimal mapping:
  - always exists and it is unique
  - offers usability advantages in visualization, validation and maintenance
- The MinSMatch algorithm:
  - significantly faster w.r.t. SMatch
  - efficiently computes the mapping of maximum size (by propagation)
  - increased recall (the deeper the classifications the better)
- Next steps:
  - Experimenting MinSmatch on large scale knowledge organization systems (>400k nodes)
  - Avoid SAT
  - User interaction issues (navigation and validation tasks)

Questions

Search on google and Wikipedia: Minimal mappings

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