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Using quantitative aspects of alignment generation for argumentation on mappings

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Ontology Matching Workshop 2008

Agenda

- Background
- The problem: combining alignments together
- Argumentation frameworks
- Experiments & results
  - Different framework instantiations

Background

- STITCH
  - **S**eman**T**ic **I**nteroperability **T**o access **C**ultural **H**eritage

- Aim: creating alignments between vocabularies from Cultural Heritage

- Semi-formal thesauri
  - As represented in SKOS

Alignment combination problem

- Many alignment techniques and tools available
  - Lexical, structural, etc...
  - #participants in all OAEI campaigns??
- How to select appropriate mappers for a given case?
- Some will perform better than others for this cases
  - Depending on how well the technique fits the vocs. or the application scenario at hand
  - Some perform better for specific parts of the vocabularies to match
- How to combine results of several mappers?
  - Formally distinct but related to selection

Related research

- Recommending mappers
  - Based on profiling (Mochol, 06)
    - Characterizing alignment cases and benchmarking mappers
  - Using sample evaluation/bootstrapping for the case at hand
    - To rank mappers (Tan, 07)
    - To learn composition strategies: weights, thresholds (Ehrig, 05)
  - Problem: all-or-nothing selection

- Filtering individual mappings from alignments
  - Detecting logically inconsistent mappings (Stuckenschmidt, 04)
  - Requires ontologies and mappings with rich formal semantics
  - And we have big vocabularies

What we have still: quantitative aspects of alignment results

- Strength/confidence value
  - The trustfulness of a mapping
  - `(book, publication, exactMatch, 0.7)`
- Consensus
  - The more mappers agree on a given mapping, the more likely it is to be true
  - Cf. OAEI 2007 Food track (van Hage)

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A possible option for combining mappers: argumentation

- Not select mappers: just let them agree on what is good
- Focus on individual mappings and contradictions between mappers about them

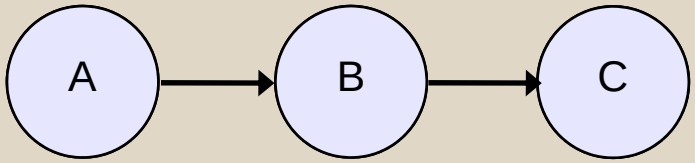
- Already explored for alignment (Laera, 07)
  - With formalized ontologies
- Allows for preferences & strength

- Research question: can we deploy argumentation for cases of informal ontologies, using quantitative aspects of results?

Argumentation framework (Classical)

(Dung, 1995)

- AF = (AR, attacks)
  - *AR*: arguments
  - *attacks*: binary relation over arguments

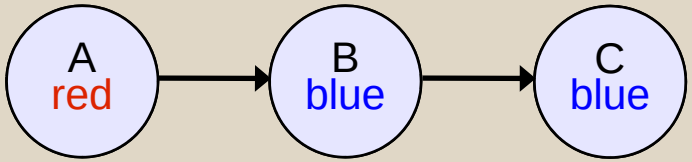


- *Acceptability* of arguments (here, A, C)
  - A is not attacked
  - C is attacked but its attacker is also attacked

Audience-specific AF (VAF)

(Bench-Capon, 2003)

- VAF_{aud}
  - Possible *values*
  - Each argument has a value
  - An audience is associated to a preference order over values



Audience 1: red > blue

Audience 2: blue > red

- *Success* of an attack for an audience
  - A→B is successful for Audience 1
  - B's value is not preferred over A's for Audience 1

Audience-specific strength-based AF

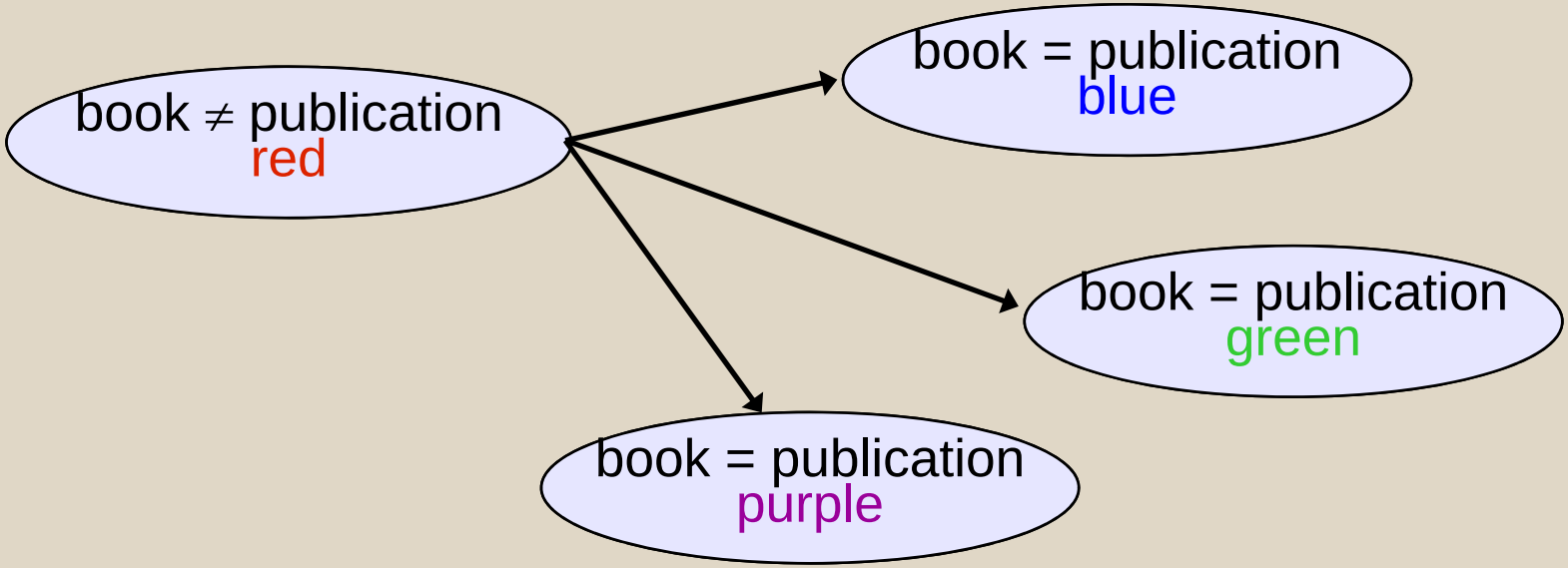
(Trojahn, 2007)

- S-VAF$_{aud}$
  - Each argument has a value and a strength
  - An audience is associated to a preference order over values

- *Success* of an attack (e.g. A→B, B→C)
  - B is stronger than C
  - A is as strong as B but its value is preferred (for Audience 1)

Problem: Consensus?

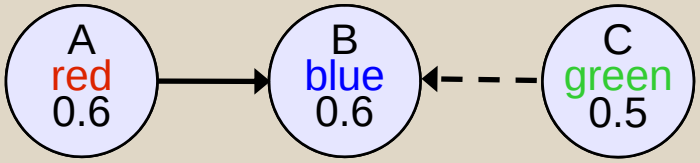
- One single argument can successfully attack any number of arguments
- Even if more of these arguments "support" each other



Introducing voting in argumentation

(us)

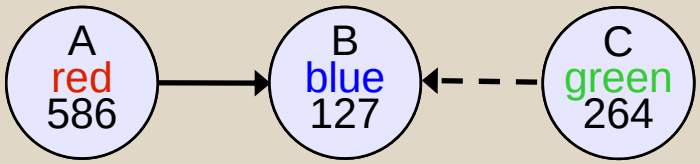
- Sup-VAF$_{aud}$
  - *supports*: (reflexive) binary relation over arguments



- Success of an attack (**plurality voting**)
  - Count supporters of attacker and supporters of attacked
  - Consider preferences when there is a tie
- Raw measure of consensus

Introducing voting in argumentation

- Considering strengths?
  - Problem of scale mismatch
- Comparing "ranks" instead
  - $rank_{map}(A)$= #arguments with strength lower than A's for `map`



- Success of an attack (**borda voting**)
  - Comparing average ranks of attackers and supporters
  - Consider preferences when there is a tie

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Experiments - setting

- Context: OAEI library case
  - 2 thesauri
  - exactMatch, broadMatch, relatedMatch
- Mappers
  - OAEI 2007 mappers (Falcon, Silas, DSSim)
  - Home-grown mappers: Instance-based mapper, Dutch lexical mapper, edit-distance mapper
- Evaluation
  - Using mappings to re-annotate books
  - Automatic: books already annotated by 2 vocs

Instantiating frameworks: arguments

- Argument generation

  `A = (c1, c2, s, r, v, h)`

  - c1, c2: mapped concepts
  - s: strength
  - r: type of relationship (e.g. `exactMatch`)
  - v: value representing a mapper (e.g. `instance-based`)
  - h=+ or – : argument is in *favor* or *against* the mapping
    - Allows to define attack and support

Instantiating frameworks: arguments

- State-of-the-art mappers output “positive” mappings
- It's easy to generate positive arguments

  `(book, publication, exactMatch, 0.6)` by instance-based mapper

  → `(book,publication,exactMatch,0.6,instance-based,+)`
- But how to generate negative ones?
  - Related work has exploited formal disjointness
  - But we are in a non-formalized context!

Instantiating frameworks: counter-arguments

2 approaches for attack:

- Negative argument as failure (NAF)
  - create **(c1, c2, r, 1, map, -)** if no **(c1, c2, r, X)** for **map**

  Assumption: *mappers try to give complete results*

- Attack based on disjoint relations (NARD)
  - If there is **(c1, c2, r, s)** for mapper **map**
  - for all mapping relations **r'** that are not **r**
  - generate **(c1, c2, r', s, map, -)**

  Assumption: *different thesaurus links cannot hold between 2 concepts*

Quite bold assumptions, o*bject of experimentation as well!*

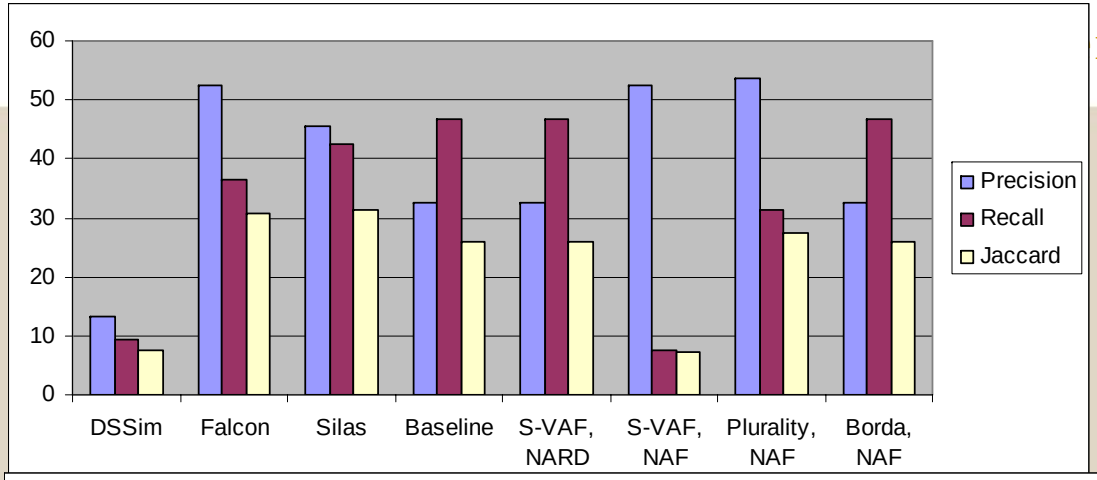
Experiments – combinations and frameworks

- 3 combinations of mappers
  - OAEI, Homegrown mappers, All
- For each combination, different framework tests
  - F2: S-VAF, NARD
  - F1: S-VAF, NAF
  - F3: plurality voting Sup-VAF, NAF
  - F4: Borda voting Sup-VAF, NAF
  - Baseline: simple union of results
- An audience is derived from each mapper

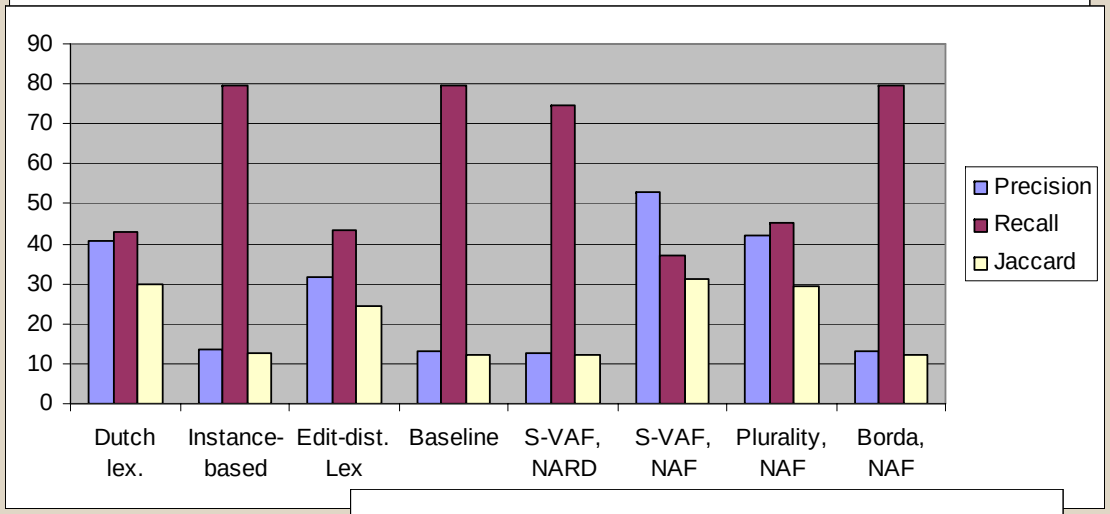
  ≈ Adhoc preference ordering based on individual performances of mappers and self-preference

Results

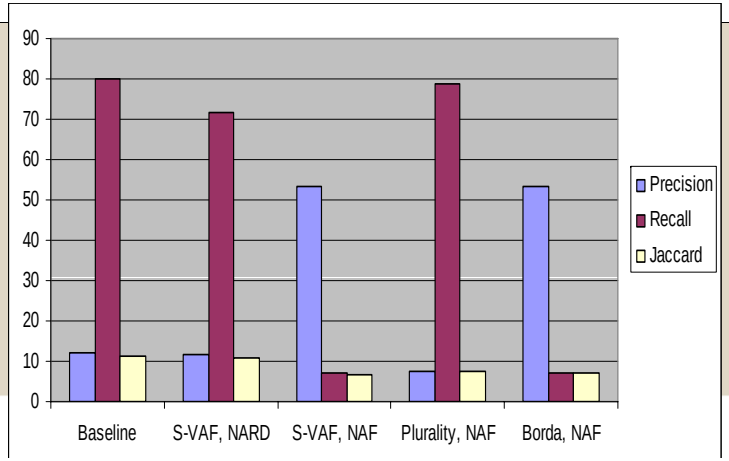
OAEI mappers



Homegrown mappers



All mappers



Discussion

- S-VAF: inconclusive
  - Dependent on negative argument strategy and/or mappers
  - Confirms the problems of comparing strengths across different mappers?
  - NAF amounts most of the time to intersection
    - Due to argumentation setting (objectively acceptable arguments)
- Plurality voting: ≈ OK
- Borda: our implementation does not differ much from S-VAF – NAF

Discussion

- It is possible to enhance on baseline union
  - Gaining on P while not harming too much R
  - Interesting when mappers give lots of imprecise results
- Comparison with best individual: more inconclusive
  - Only F3 consistently enhances P (at the cost of R)
  - Reminder: if we assume that we don't know in advance which one is the best, it is interesting to have comparable results
- Great dependence on mappers involved
  - NARD has not generated lots of attacks (esp. for OAEI)

Future work

- More insight on the process
  - Which proportion of attacked mappings?
  - And successful attacks?
- More « semantic » attack & defense relations
  - Using thesaurus information (hierarchy)
- Experimentation with other aggregation methods
  - But there's already a lot of options available...

Thanks

- Questions?