Learning How to Correct a Knowledge Base Wikidata from the Edit History

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Wikidata is kind of messy

Constraints violations (July 2018)
There are patterns for fixing constraint violations

gender-oneOf-violation(?s, wd:woman) → - { ?s wdt:gender wd:woman } +{ ?s wdt:gender wd:female }
There are patterns for fixing constraint violations

There is a constraint violation for the place of birth of Matsuo Bashō.

```
placeOfBirth-valueType-violation(?s, ?p) . ?p wdt:country ?c
→ +{ ?p wdt:type wd:geoObject }
```
Why rules?

➢ Explainable

➢ Works well with new entities
The edit history provides past corrections

Before:

Revision:

After:
Extracting past corrections

➢ Solving a violation, two options:

➢ We look for such edits and check if they correct a violation
The history SPARQL endpoint

```
PREFIX hist: <http://wikiba.se/history/ontology#>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>

SELECT ?addedGender ?deletedGender (COUNT(?revision) AS ?count) WHERE {
  GRAPH ?additionsGraph {
  }
  GRAPH ?deletionsGraph {
    ?s wdt:P21 ?deletedGender .
  }
  ?revision hist:additions ?additionsGraph ;
  hist:deletions ?deletionsGraph .
} GROUP BY ?addedGender ?deletedGender ORDER BY DESC(?count) LIMIT 10
```

700M revisions, 390k triples  - https://wdhqs.wmflabs.org
Result

rev 1223445: `placeOfBirth-valueType-violation(wd:MatsuoBashō, wd:Iga-Ueno)` → +{ `wd:Iga-Ueno wdt:type wd:geoObject` }

Mining correction rules

Goal: generalize from:

rev 1223445: `placeOfBirth-valueType-violation(wd:MatsuoBashō, wd:Iga-Ueno) → +{ wd:Iga-Ueno wdt:type wd:geoObject }`
rev 3344552: `placeOfBirth-valueType-violation(wd:JohnDoe, wd:SomeWhere) → +{ wd:SomeWhere wdt:type wd:geoObject }`
rev 3456544: `placeOfBirth-valueType-violation(wd:JeanDupond, wd:QuelquePart) → - { wd:JeanDupond, wd:placeOfBirth, wd:QuelquePart }`

to:

`placeOfBirth-valueType-violation(?s, ?p) . ?p wdt:country ?c 
→ +{ ?p wdt:type wd:geoObject }`
Generate candidate rules

- Generalization:
  \[
  \text{placeOfBirth-valueType-violation(wd:MatsuoBashō, wd:Iga-Ueno)} \rightarrow \{ \text{wd:Iga-Ueno wdt:type wd:geoObject} \}
  \]
  become (e.g.):
  \[
  \text{placeOfBirth-valueType-violation(}?s, ?p) \rightarrow \{ ?p \text{ wdt:type wd:geoObject} \}
  \]
  → replace constants by variables

- Expansion from global state:
  add facts about variables:
  \[
  \text{placeOfBirth-valueType-violation(}?s, ?p) . ?p \text{ wdt:country }?c \rightarrow \{?p \text{ wdt:type wd:geoObject}\}
  \]
Vocabulary

rule body

placeOfBirth-valueType-violation(?s, ?p) . ?p wdt:country ?c

→ +{ ?p wdt:type wd:geoObject }

rule head

support(query) = number of times the query matches
Rules ranking

“A rule is good if it predicts the correct change”

\[
\text{confidence}(\text{body} \rightarrow \text{head}) = \frac{\text{support(\text{body . head})}}{\text{support(\text{body})}}
\]
Confidence example

\[ r = \text{gender-oneOf-violation}(?s, \text{wd:woman}) \]
\[ \rightarrow - \{ ?s \text{wd:gender wd:woman} \} +\{ ?s \text{wd:gender wd:female} \} \]

rev 2334569: \text{gender-oneOf-violation}(\text{wd:Nefertiti, wd:woman})
\[ \rightarrow - \{ \text{wd:Nefertiti wdt:gender wd:woman} \} +\{ \text{wd:Nefertiti wdt:gender wd:female} \} \]

rev 4556544: \text{gender-oneOf-violation}(\text{wd:Hatchepsout, wd:woman})
\[ \rightarrow - \{ \text{wd:Hatchepsout wdt:gender wd:woman} \} +\{ \text{wd:Hatchepsout wdt:gender wd:female} \} \]

rev 8994432: \text{gender-oneOf-violation}(\text{wd:RamsesII, wd:woman})
\[ \rightarrow - \{ \text{wd:RamsesII wdt:gender wd:woman} \} +\{ \text{wd:RamsesII wdt:gender wd:female} \} \]

\[ \text{confidence}(r) = \frac{2}{3} \]
Full mining algorithm

1. **Generalize** past corrections
2. **Filter** if body support too low (do not apply in a lot of cases)
3. **Expand** by adding one “context” triple
4. **Filter** if
   a. body support too low (do not apply in a lot of cases)
   b. too small increase in confidence (not useful expansion)
5. **Repeat**...
6. **Filter** out rules with too low confidence
Mining results

178k rules mined on 80% of the past corrections

Some top rules:

Single Value:
```
gender-singleValue-violation(?s, wd:maleOrganism) . ?s wdt:sportsTeam ?t
  → - { ?s wdt:gender wd:maleOrganism }
```

One-of:
```
mannerOfDeath-oneOf-violation(?s wd:trafficAccident)
  → - { ?s wdt:mannerOfDeath wd:trafficAccident } + { ?s wdt:causeOfDeath wd:trafficAccident }
```
Evaluation on the past corrections

➢ Apply the rules on the other 20% known corrections
➢ Compute
  ○ recall (we find a correction)
  ○ precision (it is correct)
➢ Baselines
  ○ Remove the violation
  ○ Add the missing triple (if possible)
Some results

Micro averages

\[ F_1 = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}} \]
Wikidata Game

- Experiment on three months
- 47 participants
- 50k suggested corrections

Francesco Belinzeri [Q57082102]

Violation
An entity should not have a statement for country of citizenship if it also has a statement for sex or gender with value male non-human organism.

Possible correction
Edit statement (Q57082102, sex or gender, male non-human organism). Setting value to: male
**Wikidata Game**

- **Inverse/Symmetric**: 22k actions, 92% approval
- **Value requires statement** and **Conflicts with**: 1k actions each, 80% approval
- **Others**: between 30 et 700 actions, approval between 20% and 50%

Biased by what has been done (or not) by bots

- Some huge easy completions
- Mostly hard stuffs remains
Conclusion

➢ Rule mining:
  ○ Better than baselines
  ○ Understandable

➢ Easy stuffs are already “done”
Future

➢ Interesting problems
  ○ *There are two birth places*
  ○ *A birth date is missing*

➢ Applications
  ○ Suggest edits
  ○ Fight vandalism
Thank you!


Game: https://tools.wmflabs.org/wikidata-game/distributed/#game=43

Dataset: https://doi.org/10.6084/m9.figshare.7712720

Code: https://github.com/Tpt/corhist

History SPARQL endpoint: https://wdhqs.wmflabs.org