SIGMA: Systematic Island Grammar forMation Approach Merging Grammars

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Introduction

Motivation—
Research Goal—
Research Question—

Approach

Steps

1. Parse Grammars
2. Trivally Merge Grammars
3. Normalize Grammar
4. Measure Production Similarities
5. Merge Most Similar Productions
6. Repeat Steps 3–5 Until Max Similarity is Below a Threshold
7. Output Grammars

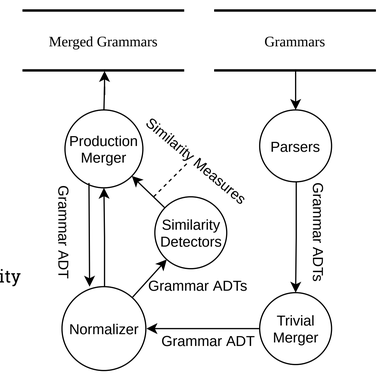

Fig. 1: Merge Process

Data Model

- Object Based
- Right Hand Side of Productions is an Object
- Constructed via Transformation of Grammar's Abstract Syntax Tree
- Converted to Text via Visitor

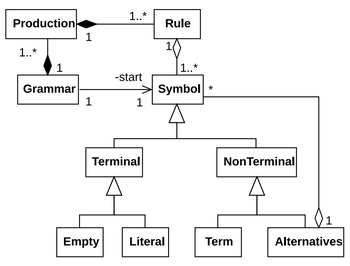

Fig. 2: Data Model

Measuring Production Similarity

Productions P_a, P_b like `A'a'B`

$$\frac{2|LCS(P_a, P_b)|}{|P_a| + |P_b|}$$

Productions P_a, P_b like `A|'a'|B`

$$\frac{2|P_a \cup P_b|}{|P_a| + |P_b|}$$

LCS returns the longest common subsequence.

Normalization

Normalizes grammars so that all rules match one of two forms:

$P_1 \rightarrow$ `A'a'B` or $P_2 \rightarrow$ `A|'a'|B`

Experimental Design

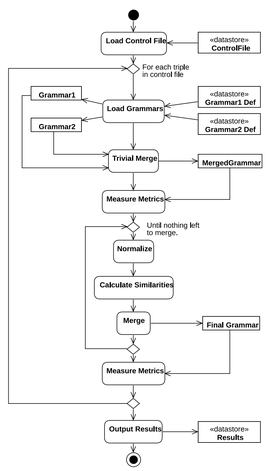

Fig. 3: Data Collection Process

- One Experiment for Each of ΔHAL and ΔMCC.
- 3*5 Factorial Design With 5 Repetitions
- Experimental Units — To select our experimental units, we split grammars from the ANTLR4[a] repository into 3 sizes, selected 12 grammars from each size category, and selected 50 unordered pairs of grammars from each size category.
- Threshold From Step 6 of Approach. We used 5 different levels of our threshold: .01, .25, .5, .75, 1.0. A threshold of 1.0 was our control.
- Experimental Measures. From [1].

PROD Number of Productions. Measure of Size of Grammars.
ΔHAL Amount Halstead Effort Decreased. Measure of the Maintainability of Grammars.
ΔMCC Amount Cylometric Complexity Decreased. Measure of Grammar Complexity.

- Analysis
  - Permutation F-Test
  - Jonchheere-Terpstra Test
  - Steel's Test

[a] https://github.com/antlr/grammars-v4

Results

ΔHAL

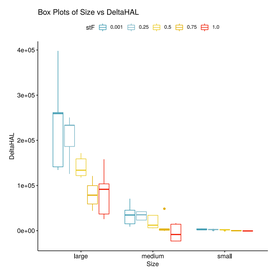

Fig. 4: ΔHAL Box Plot

Interaction

- F — 5.098
- p — 7.31e-05
- Influential primarily at control

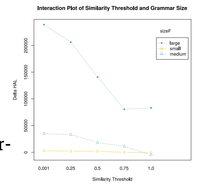

Fig. 5: ΔHAL Interaction Plot

1. Perm. F-Test — F: 9.569, p: 4.73e-06
2. JT Test — Statistic: 767, p: 6e-4
3. Steel Test — p:

ΔMCC

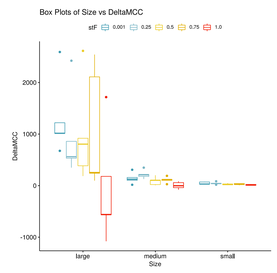

Fig. 6: ΔHAL Box Plot

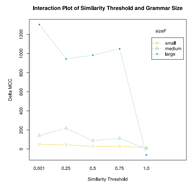

Fig. 7: ΔMCC Interaction Plot

- F —
- p —
- Influential primarily at control

1. Perm F-Test — F: , p:
2. JT Test — Statistic: , p:
3. Steel Test — p:

Discussion

Conclusions

References

[1] J. F. Power and B. A. Malloy, "A metrics suite for grammar-based software," Journal of Software Maintenance and Evolution: Research and Practice, vol. 16, no. 6, pp. 405–426, Nov. 2004.

Acknowledgements

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