A Goal-Question-Metrics Model for Configuration Knowledge Bases

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Outline

- Introduction
- GQM-model
  - Goals
  - Questions
  - Metrics
- Interpretation
- Summary
Introduction

- Constraint-based configuration knowledge bases are changing over time
- Maintenance is time consuming and error prone
  - Detect anomalies
  - Understand the knowledge base
  - Optimize the knowledge base
- Different techniques to reduce the maintenance effort
  - Recommendation
  - Anomaly management
  - Simulation
  - KB evaluation
Introducing GQM

- Depicted from software engineering
  - Measure metrics
  - Aggregate metrics to answer questions
  - Aggregate questions to achieve goals
GQM: goals

- A configuration knowledge base must be **maintainable**, such that it is easy to change the semantics of the knowledge base in a desired manner.

- A configuration knowledge base must be **understandable**, such that the effort for a maintainability task for a knowledge engineer can be evaluated.

- A configuration knowledge base must be **functional**, such that it represents a part of the real world (e.g. a bike configuration knowledge base).
GQM: questions

- Q1: Is the configuration knowledge base complete?
- Q2: Does the configuration knowledge base contain anomalies?
- Q3: Does the configuration knowledge base have an admissible performance?
- Q4: Is the configuration knowledge base modifiable?
- Q5: Is the configuration knowledge base understandable?
GQM: metrics (selected)

• Restriction rate: how many constraints are in the knowledge base?
  \[ RR_2 = \frac{|C|}{|V|} \sum_{c_i \in C} \frac{\# \text{vars}(c_i)}{|V|} \]

• Coverage: how many variants are consistent?
  \[ \text{coverage}(C) = \frac{\text{number of consistent variants}}{\text{number of all possible variants}} \]

• Variable Inheritance Factor: how important is a variable?
  \[ VIF(v_i) = \frac{\sum_{c_i \in C} \begin{cases} 1 & v_i \in c_i \\ 0 & \text{otherwise} \end{cases}}{|C|} \]
GQM with the metric redundancies
Evaluating completeness

- KB life cycle
  - initial tasks

![Graph showing the evolution of |C| with KB versions v2 to v9.](image)
Evaluating completeness

- KB life cycle:
  - initial tasks
  - maintenance tasks
Evaluating completeness

- KB life cycle:
  - KB development
  - initial tasks
  - maintenance tasks
Interpretation of metrics

- Explaining the values based on the history of the knowledge base
Conclusion

- GQM helps to measure the knowledge base
- Aggregation of metrics into questions and goals
- Compare the results with previous versions
- Getting tendencies of goals / questions / metrics
- Further research
  - Weighting the relationships
  - Empirical studies
References

### Link between goals and questions

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<th>Usability</th>
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## Link between questions and metrics

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