Towards Anomaly Comprehension
Using Structural Compression
to Navigate Profiling Call-Trees

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Why visualise anomalies?

- Software easier to construct than to understand
  ➔ as climbing up vs. climbing down
- Particularly true for emergent dynamic behaviours
  ➔ e.g. dependability and performance
  ➔ arise from interactions within/ without target system
  ➔ phenomena might span large set of components
  ➔ at different levels of abstraction
- Dynamic observation data difficult to make sense of
  ➔ large size (up to 1,000,000 invocations for a few sec)
  ➔ likely to involves poorly understood parts
Example: Performance

- Piece of grid middleware (Globus ws-core)

impossible to vary level of abstraction (methods)
impossible to abstract locally (methods)
difficult to relate different parts of the data
Visualising Dynamic Data

- Strategies: extract **salient features**
  - collapse recurring patterns (e.g. Jinsight)
  - remove and focus (e.g. CosmOpen)
  - data-mining (e.g. PCA in Xu et. al, SOSP’09)

- Our take in this work
  - use **structural information** in dynamic data
    e.g. `org.apache.axis.utils.ClassUtils.forName()`
  - vary ‘**local abstraction**’ level at which data is shown

- Contributions
  - application of structural compaction to **dynamic data**
  - algorithm for **localised structural compaction**
  - prototype and **explorative user study**
Dynamic Profiling Data

- Toy example: weighted call tree (sample based profiling)
Full compaction

- Only highest level packages visible
Progressive exploration

- Different levels of compaction in different parts of graph
  ➔ including for the same package (here lib3)
Realisation

- Uniform compaction reasonably well-understood
  - e.g. merge all ‘org.globus.xx’ nodes together
  - used by other tools (e.g. Creole for static analysis)

- **Challenges** here:
  - same entity → different compaction in different areas
  - but uniform compaction locally (otherwise confusing)

- **Question**
  - How do we encode these different ‘localised’ levels?
  - Which mechanisms to drive ‘local’ compaction?
Compaction Algorithm

- Local compaction level
- ‘Take over mechanisms’
  - use ‘vicinity’ relation
  - cascading compaction

More details in paper
Demo
Evaluation

- **Design**
  - small scale and **exploratory** (4 users)
  - 2 categories of programs (‘**small**’ and ‘**large**’)
  - two tools: **ProfVis** and **Treetable**
  - each user applied both tools to both categories
  - task: identify performance issues

- **Two quantitative measures**
  - perceived understanding (from test user)
  - assessed understanding (from us)

<table>
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<th>LoC</th>
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</table>
Results

![Diagram showing perceived vs. assessed understanding with different symbols for treetable small, treetable large, profvis small, and profvis large categories.](image-url)
Results (2)

- Users seem
  - to **overestimate** their understanding on large programs with TreeTable on small programs with ProfVis
  - to **underestimate** their understanding on large program with ProfVis

- Possible explanations
  - TreeTable hides full scope while ProfVis does not
  - As a result possible ‘false sense of mastery’
Results (3)

- Usage patterns seem to support this interpretation

  ➔ users go deep w/ TreeTable, tend to hover w/ ProfVis
Results (4)

- Understanding
  - slight advantage for Provis

- But
  - very small study!
  - informally, users preferred TreeTable

- Questions raised
  - acceptability
  - ergonomics
  - design combination
Conclusion

- A novel **localised structural compaction** algorithm
  - applied to performance profiling traces

- Preliminary **evaluation**
  - potential gap btw. user perception and their actual perf.
  - and btw. subjective preference and actual perf.
  - impact of presentation on search strategy

- **Future** work
  - larger study!
  - combine design dimensions (e.g. text + compaction)
  - explore approaches to avoid ‘false sense of mastery’