Provenance Support for Rework

Xiang Zhao[1], Leon J. Osterweil[1], Barbara Staudt Lerner[2], Emery R. Boose[3], Aaron M. Ellison[3]

[1]University of Massachusetts Amherst
[2]Mount Holyoke College
[3]Havard University

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The Problem: How to Support Rework

- Rework is quite common in software development processes
  - Inconsistencies between requirement and design specifications cause reconsideration of both
  - Inconsistencies between code and design too
  - Most software engineering books ignore the topic
- Process provenance support could help
  - People could review earlier decisions to facilitate rework

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  - Splits a method that was both a query and a modifier into two methods
    - Create a query method to return the same value
    - Change the return statement in original method to return the query
    - Add calls to the query before the calls to the original method
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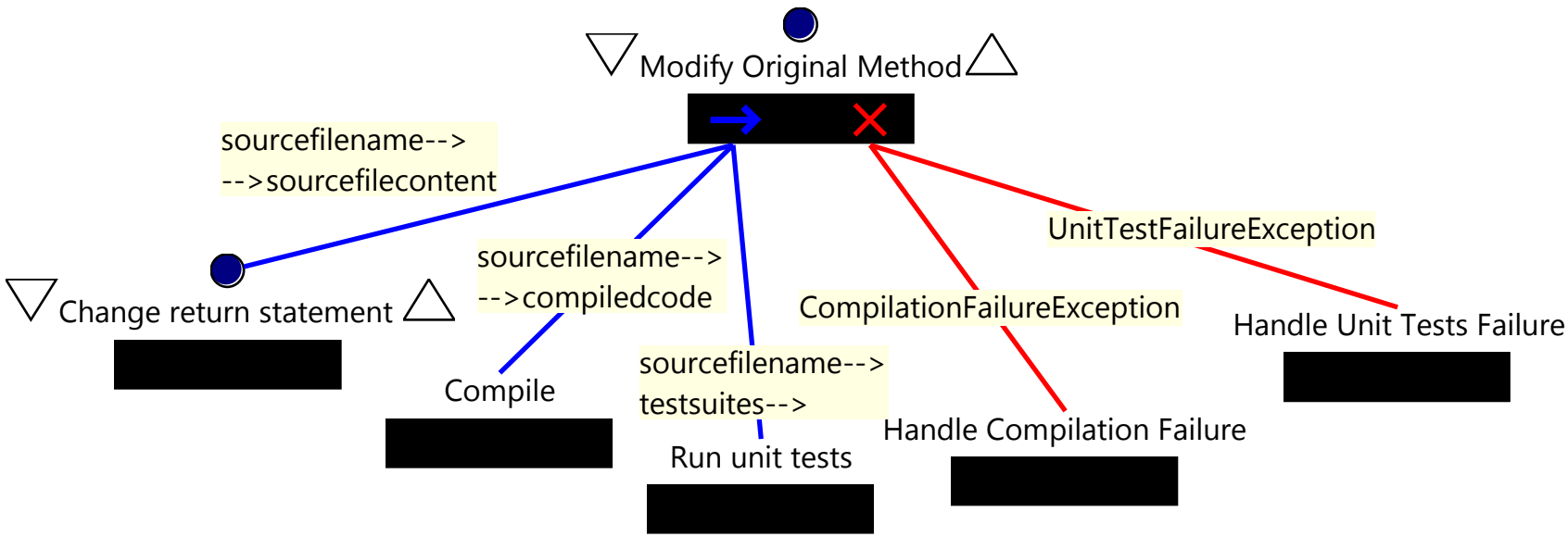
- Executing this rework process can entail carrying out a number of different kinds of rework

Separate Query from Modifier Refactoring as an Example of Rework



- Exception instances are handled differently according to their types.
- Each exception instance triggers rework

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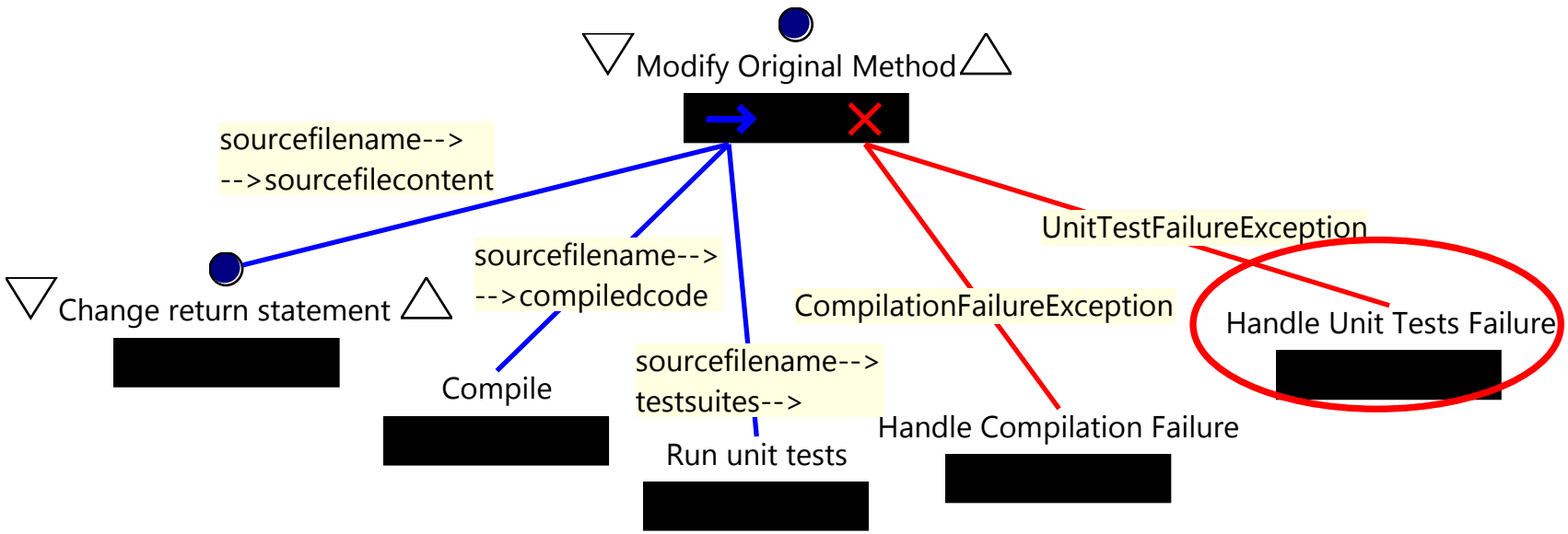

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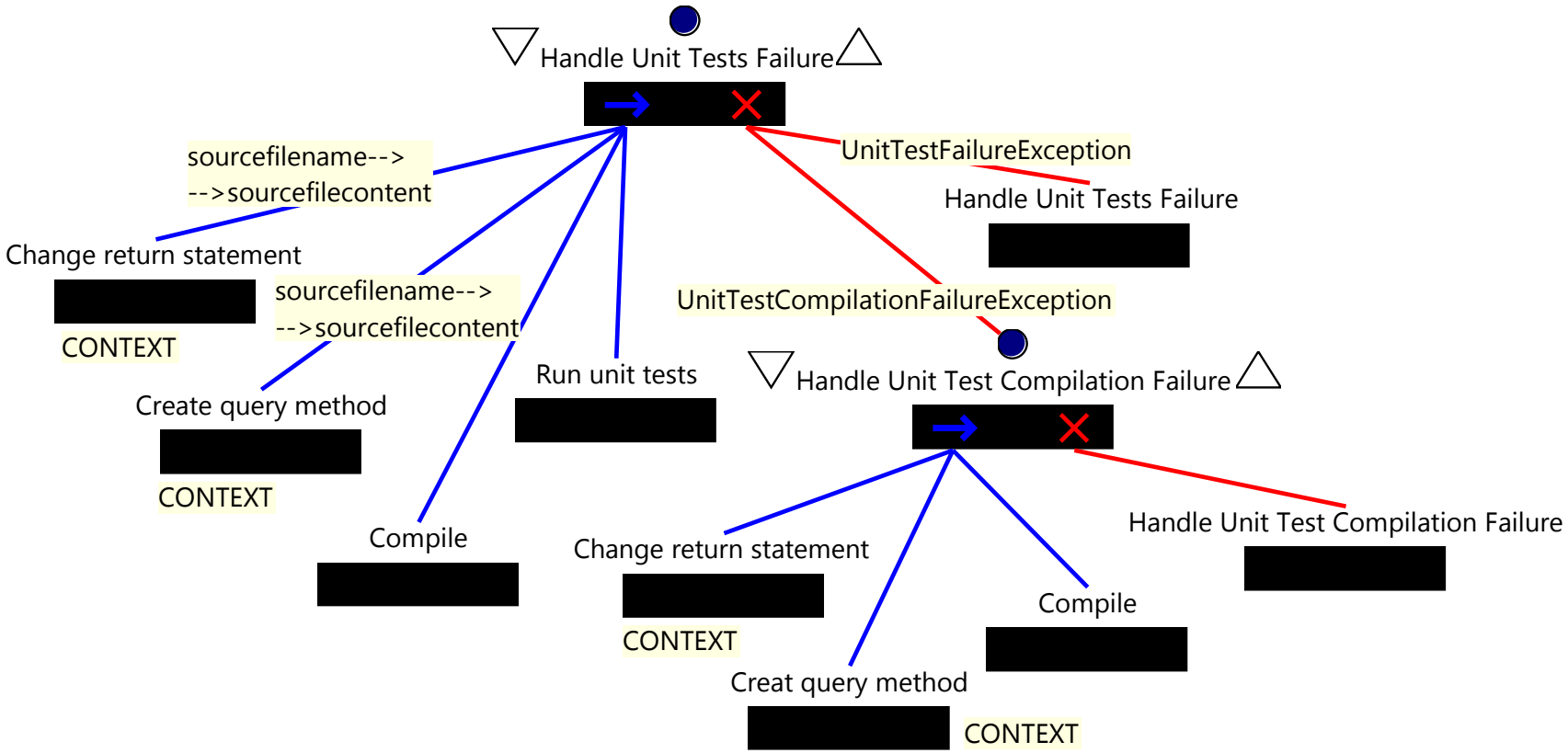
Exception-Triggered Rework Examples



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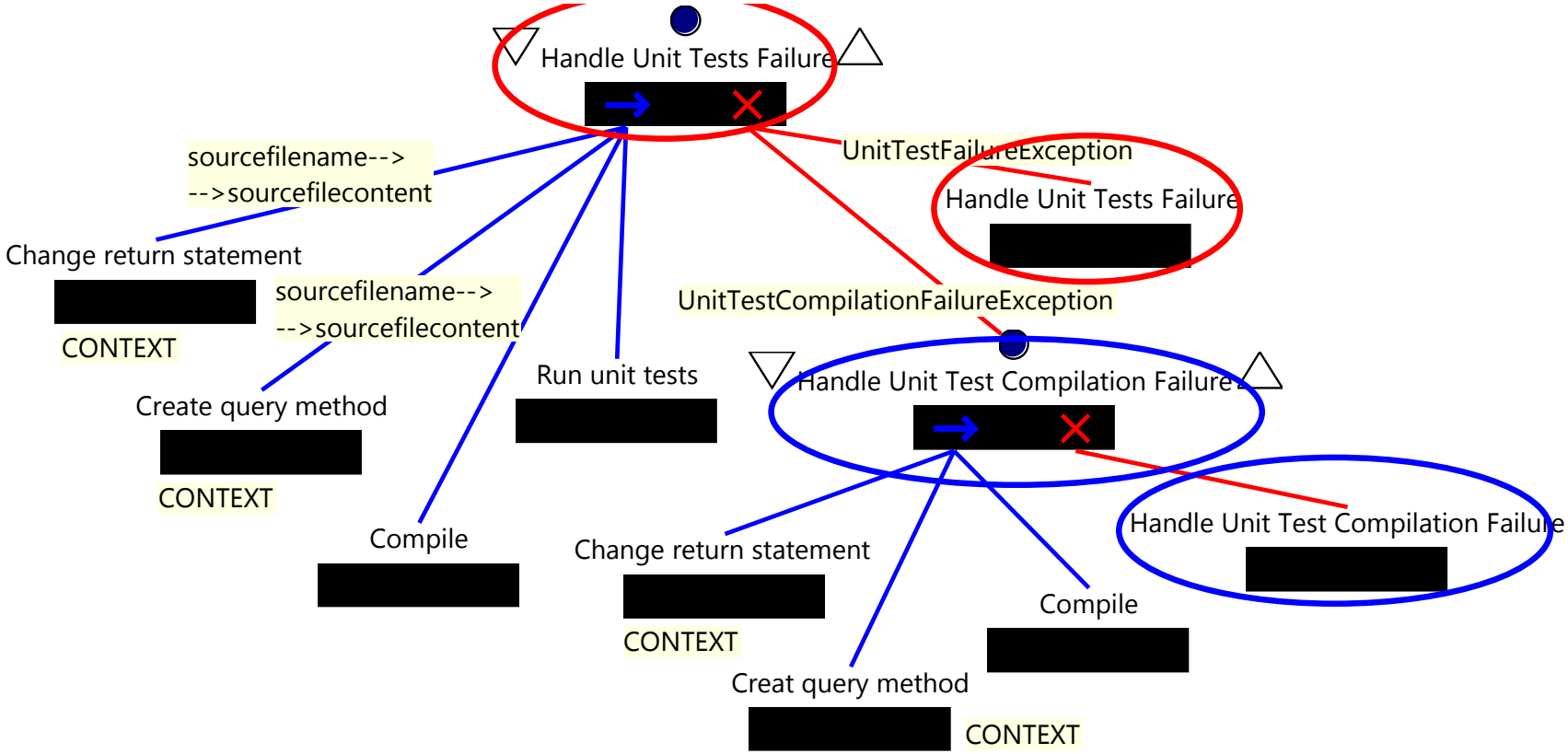

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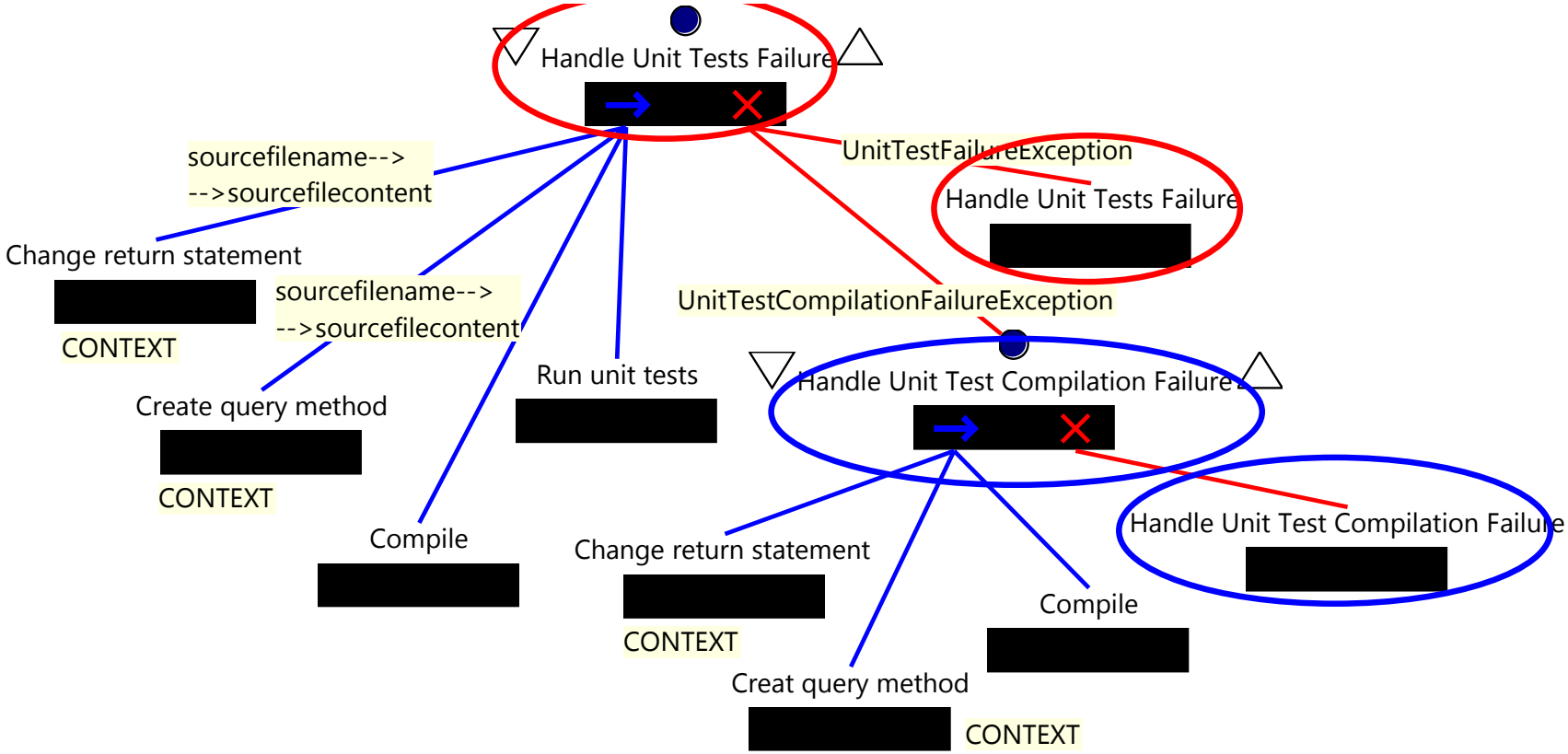

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- Actual rework should be guided by *context* provided by provenance

Typical Questions that Users Want Answers to during Rework

- Where am I?
- What am I doing here?
- How did I get here?
- What have I already tried?
- How did that work out?
- What alternatives do I have now?
- Which are likely to turn out best?

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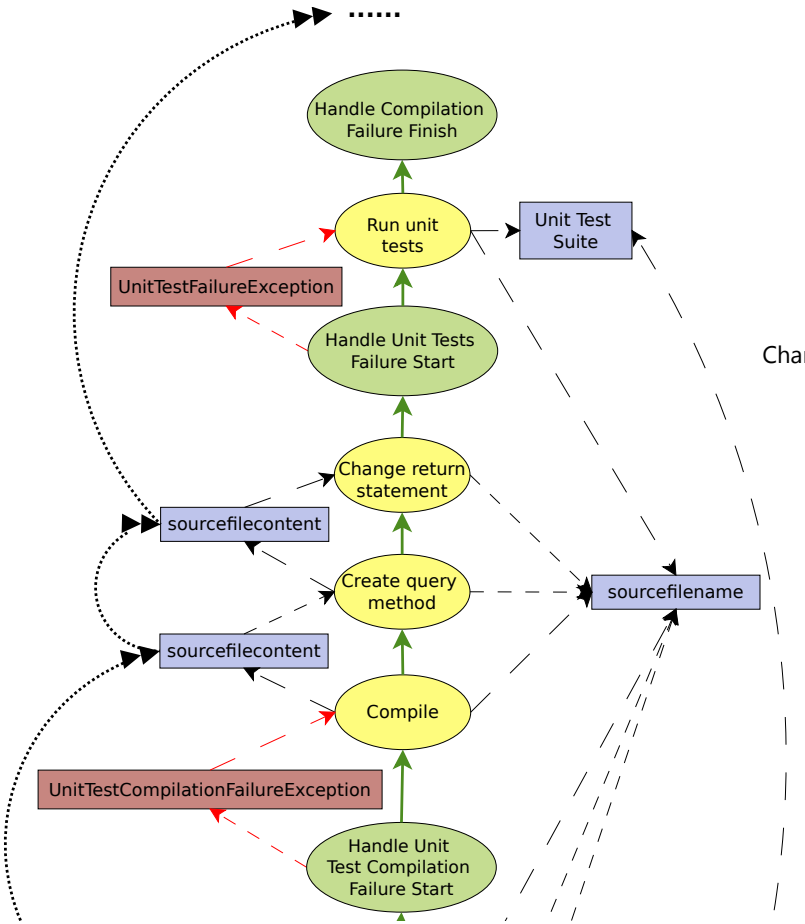
Contextual information provided by provenance could help

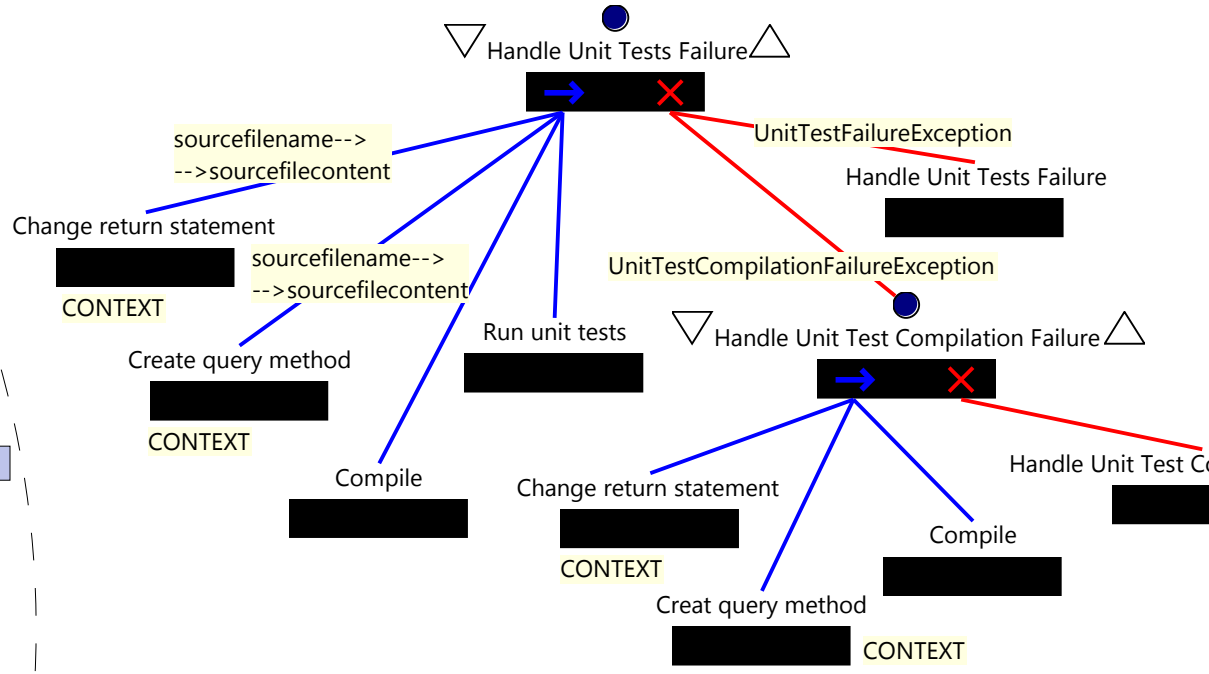
Context Information that could Help

- Present process execution state
  - Current artifact values
  - Pointers to executing steps and their recursions
- A complete process execution history
  - Prior values of artifacts
  - Previous step execution sequences
- Information that could help to form a plan for completing rework successfully

Data Derivation Graph is the key artifact

Data Derivation Graph





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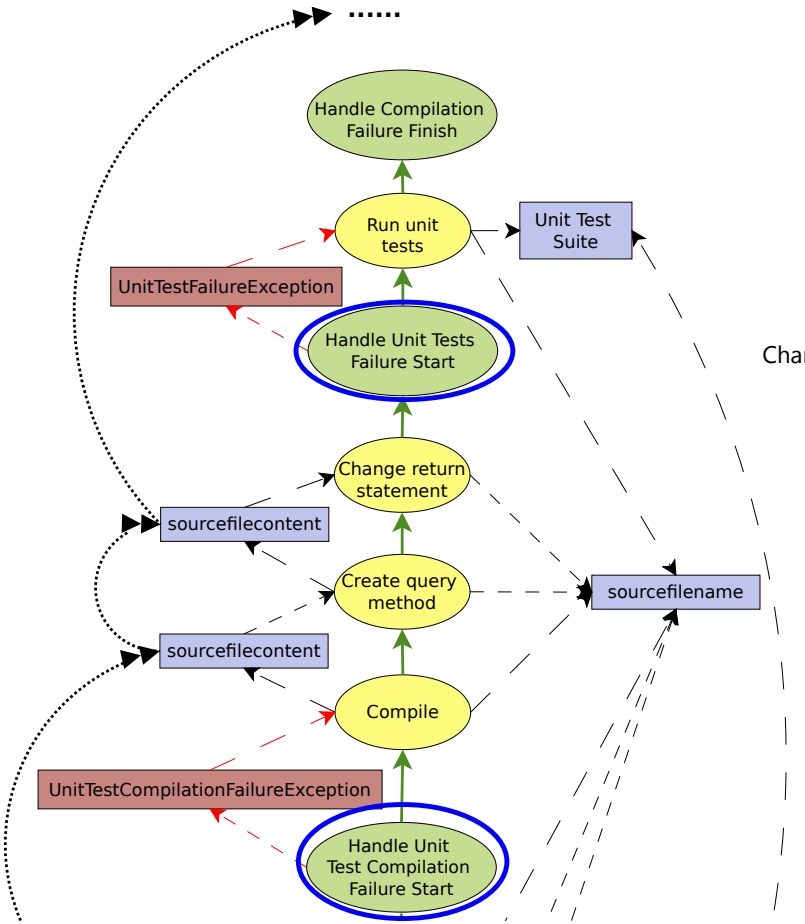

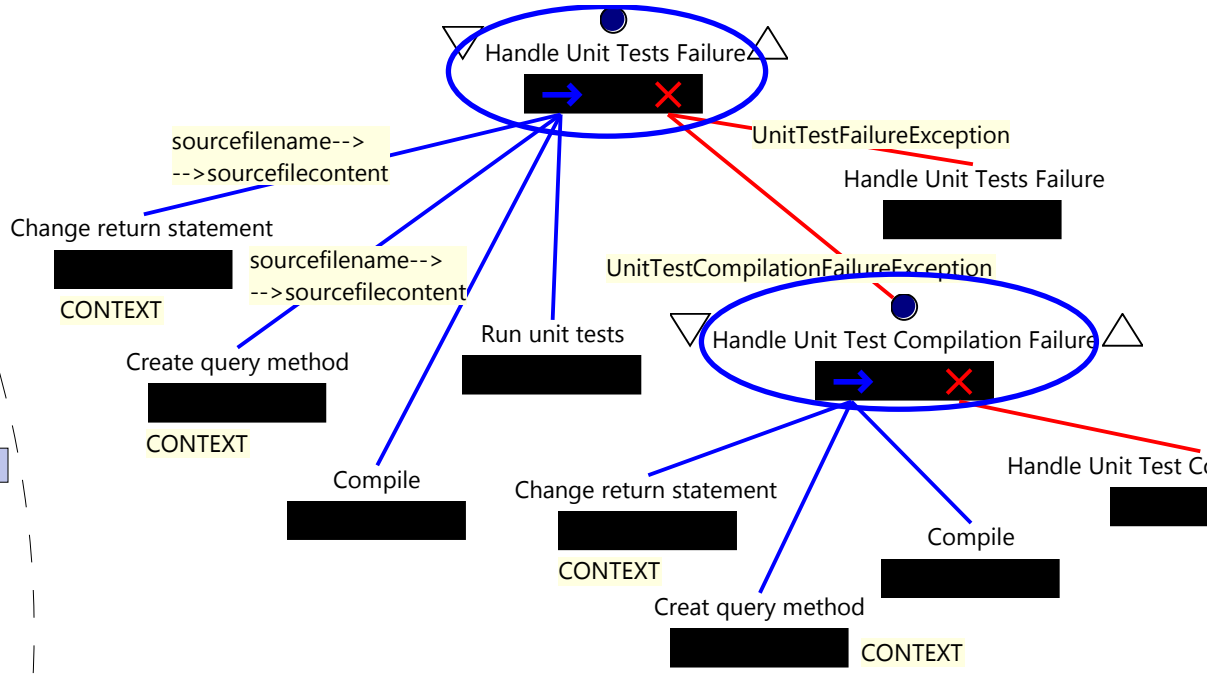

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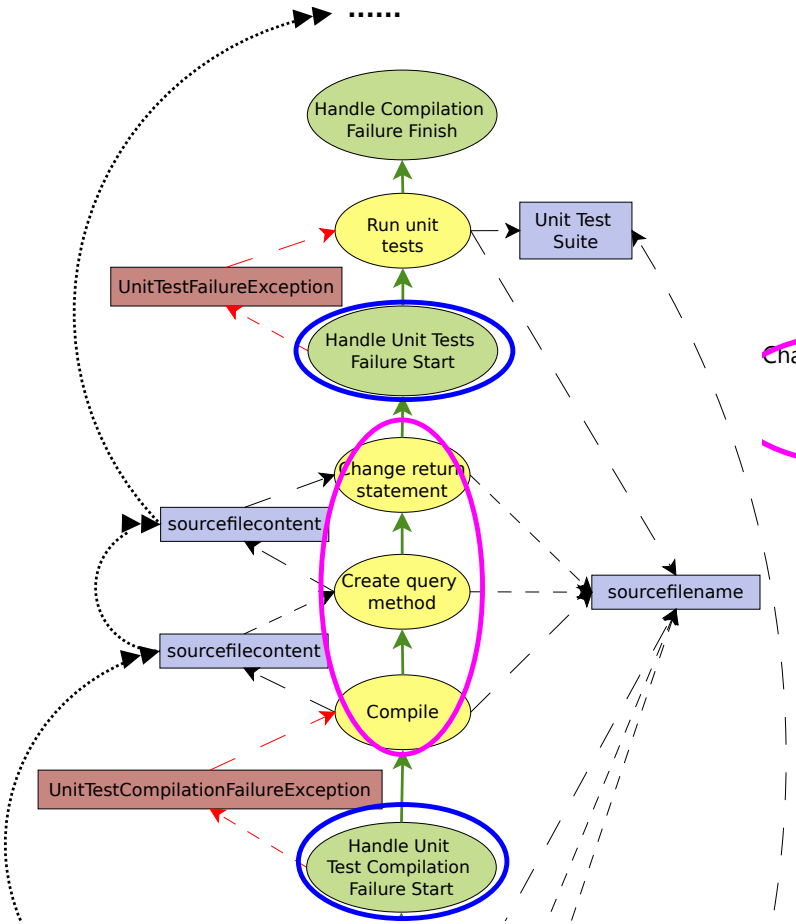

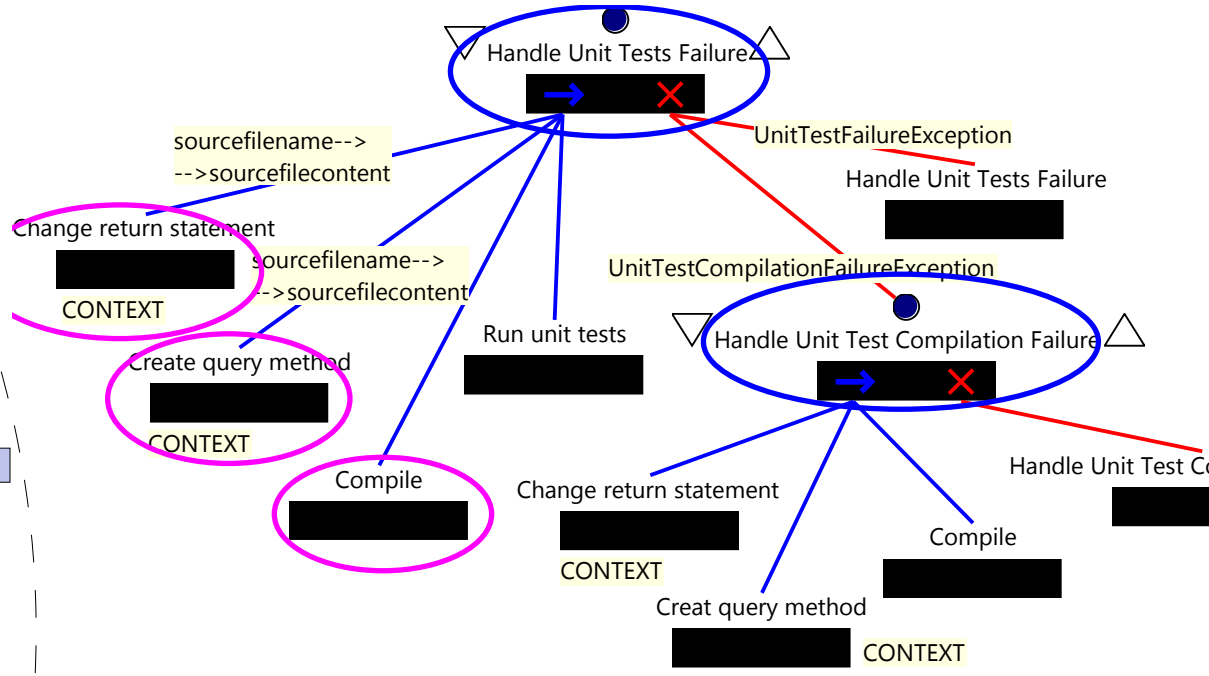

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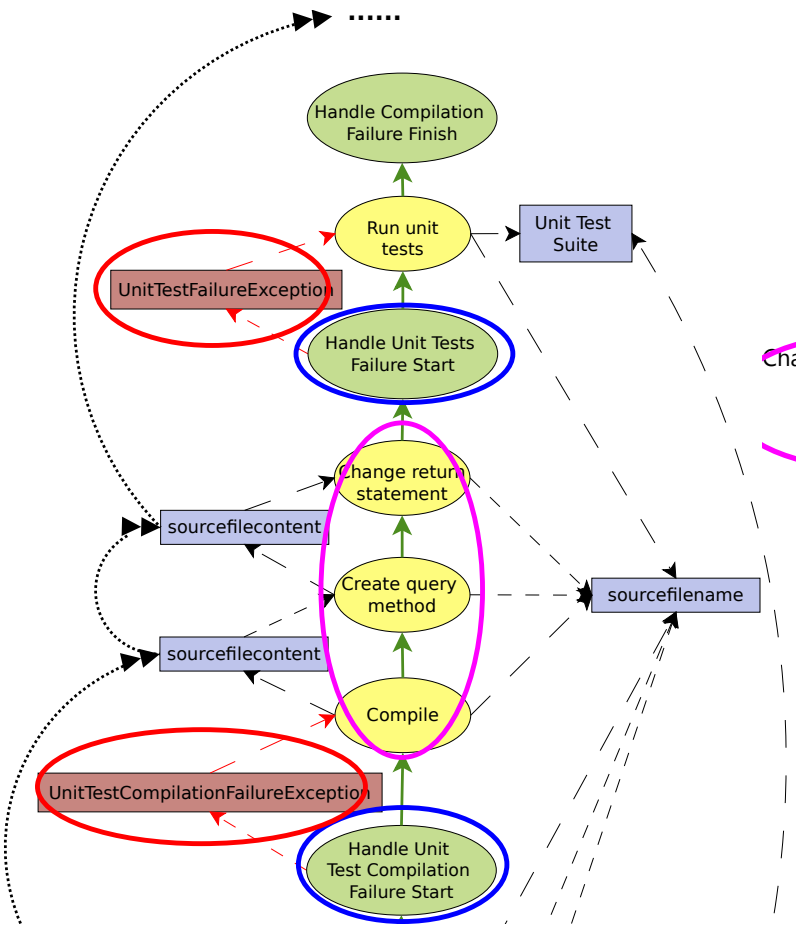

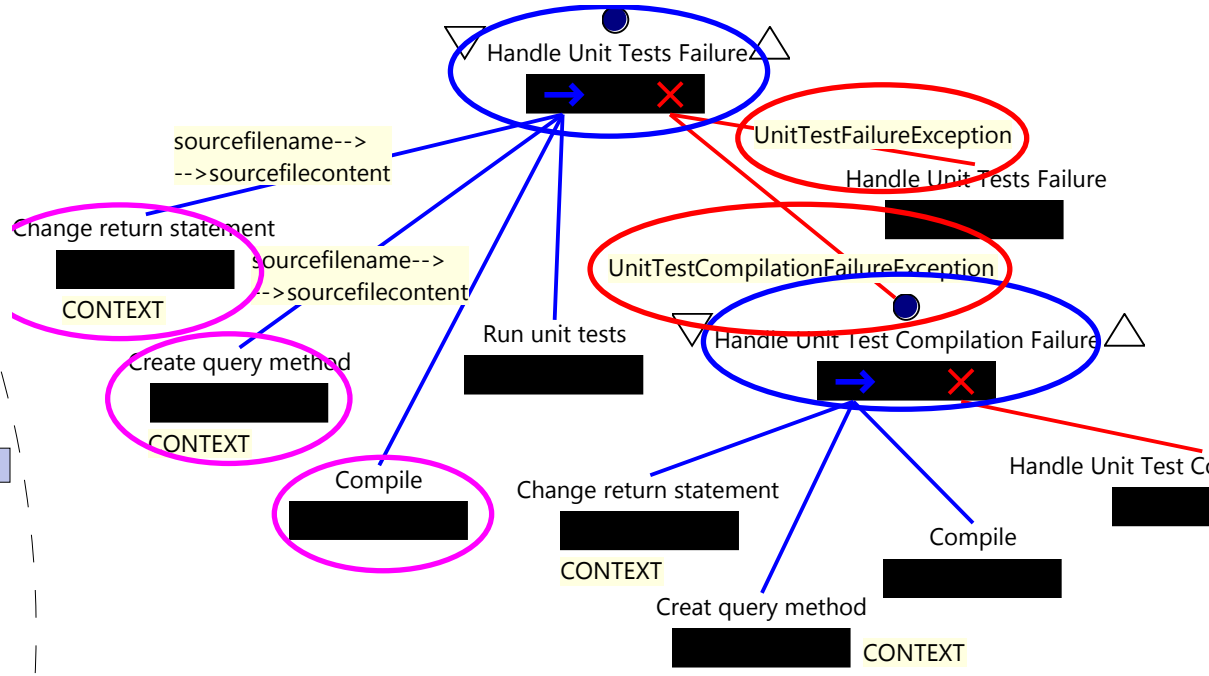

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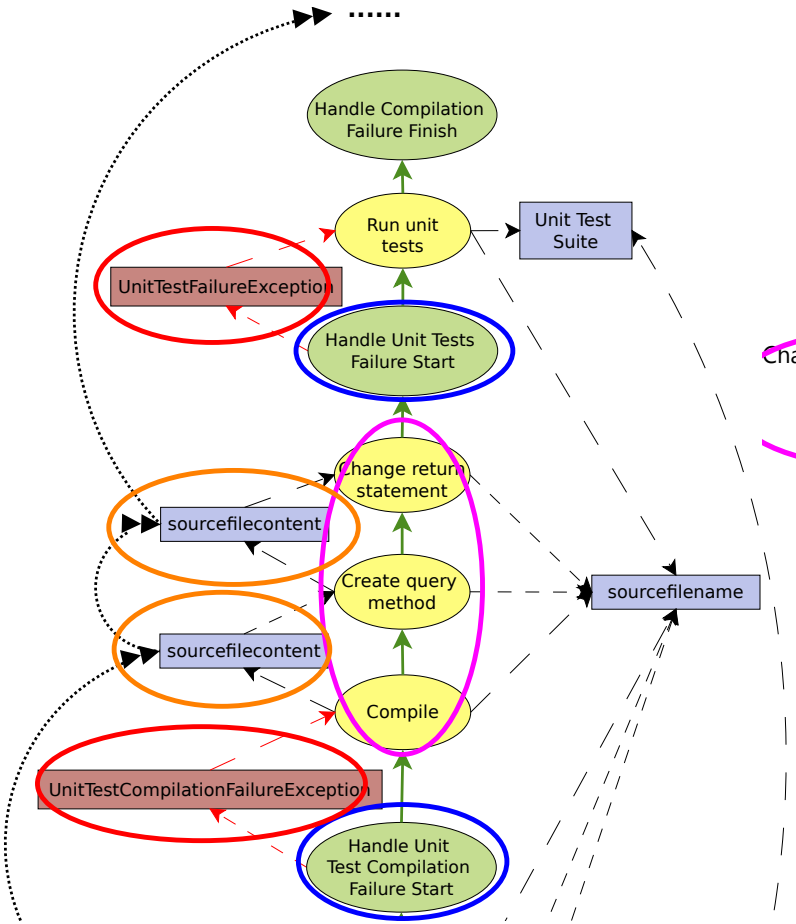

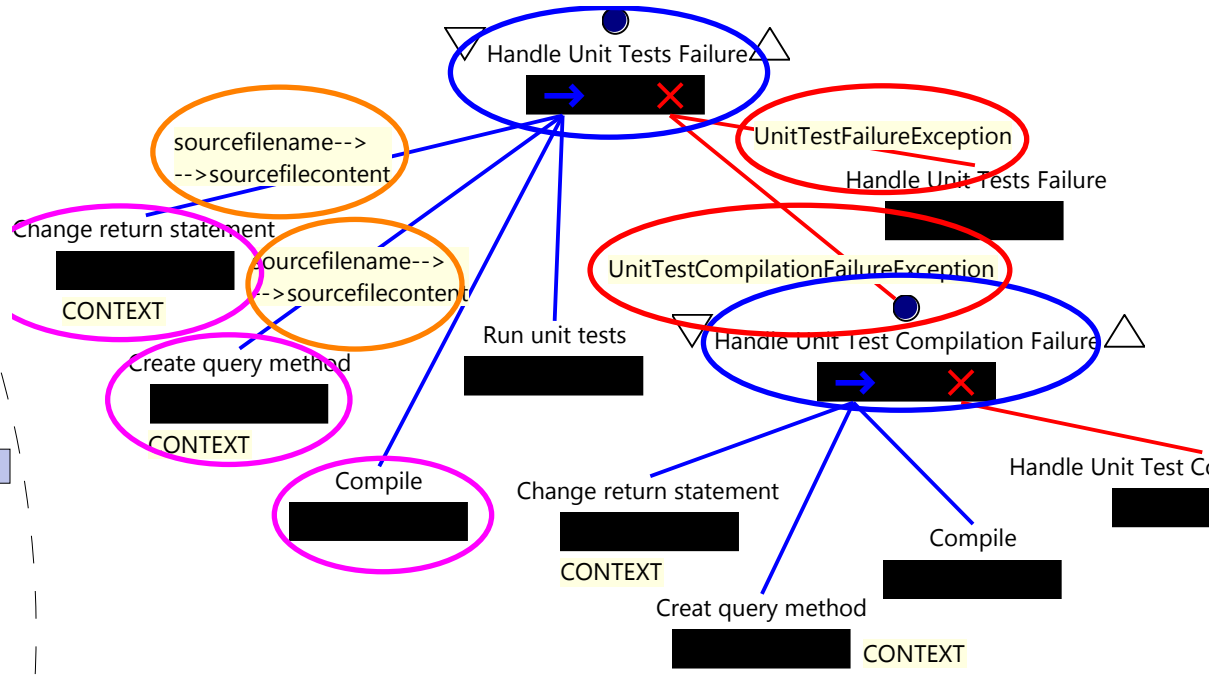

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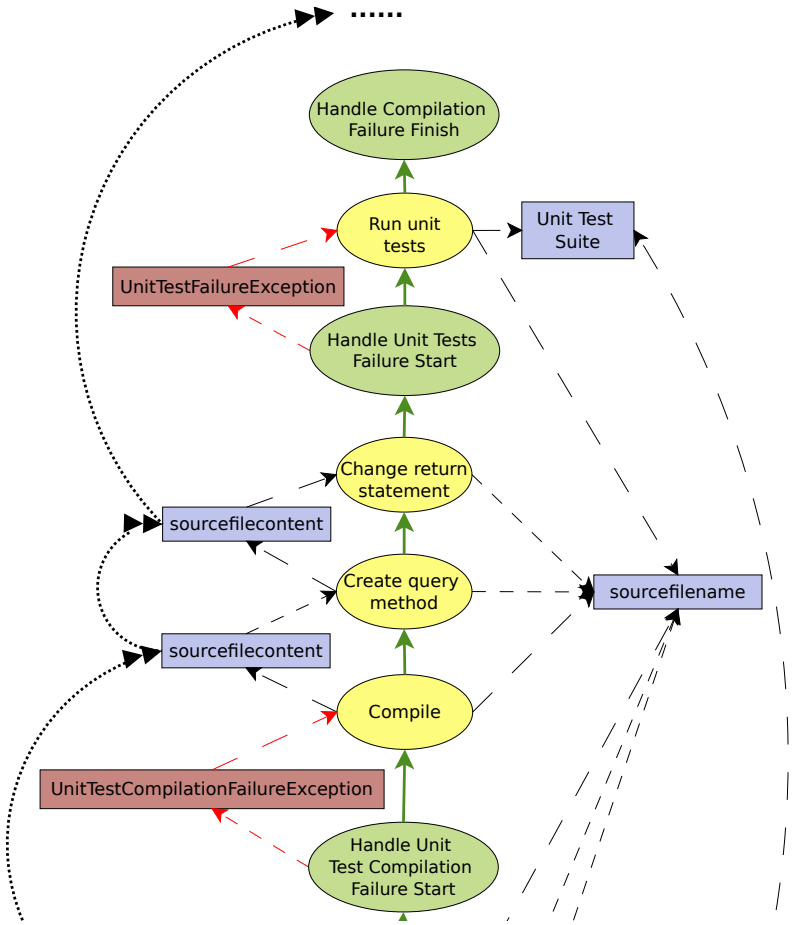

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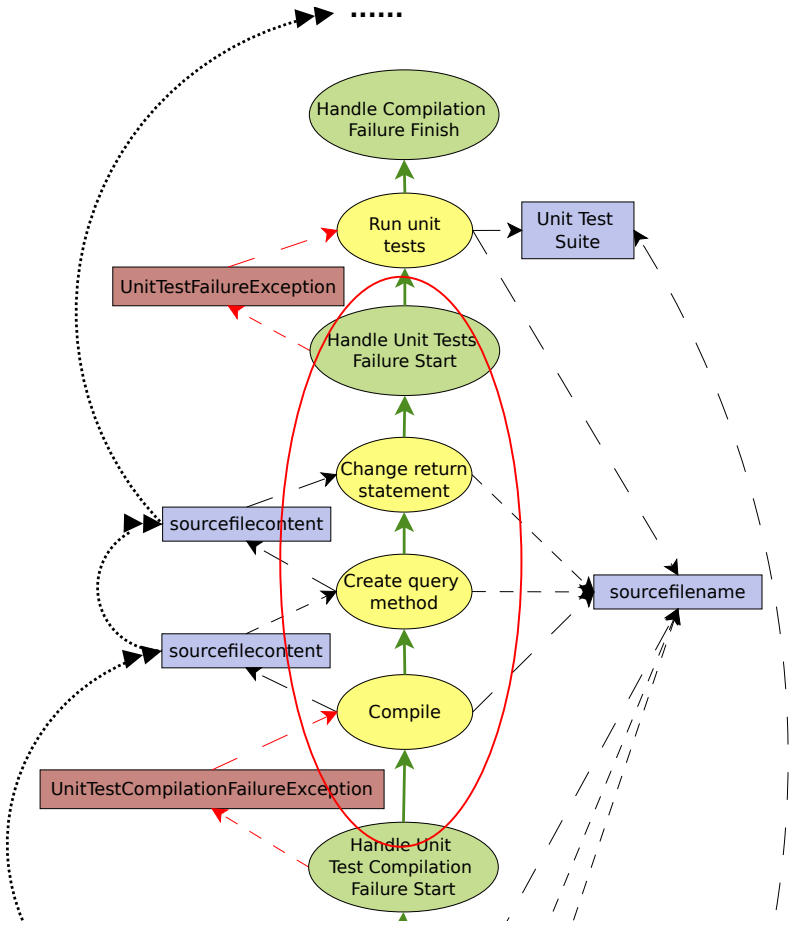

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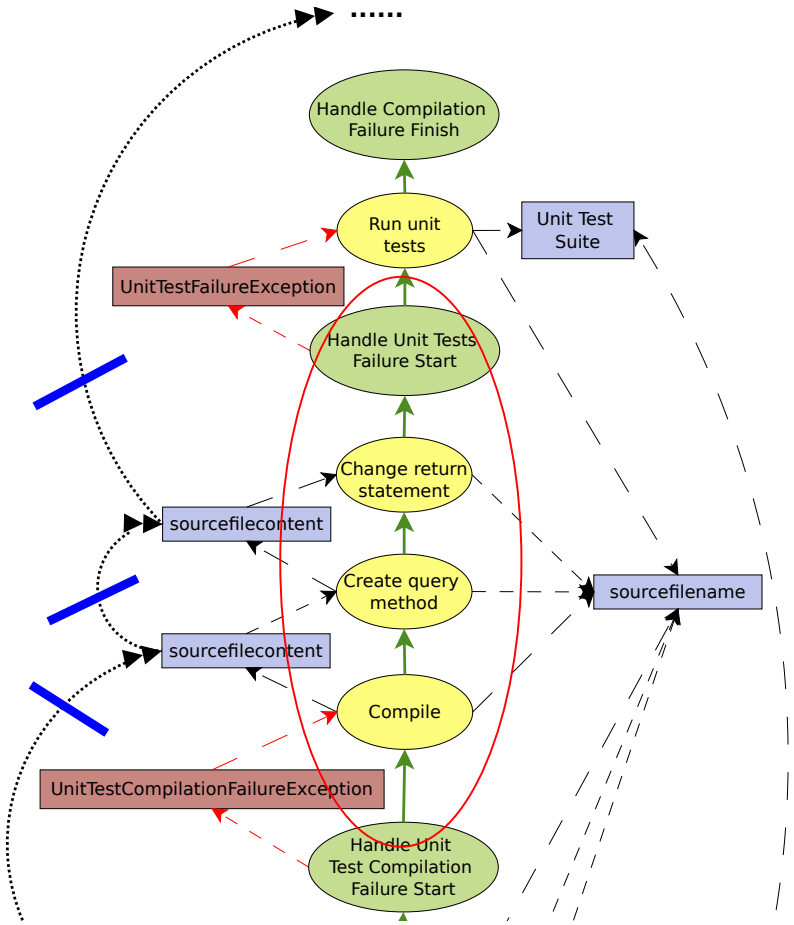

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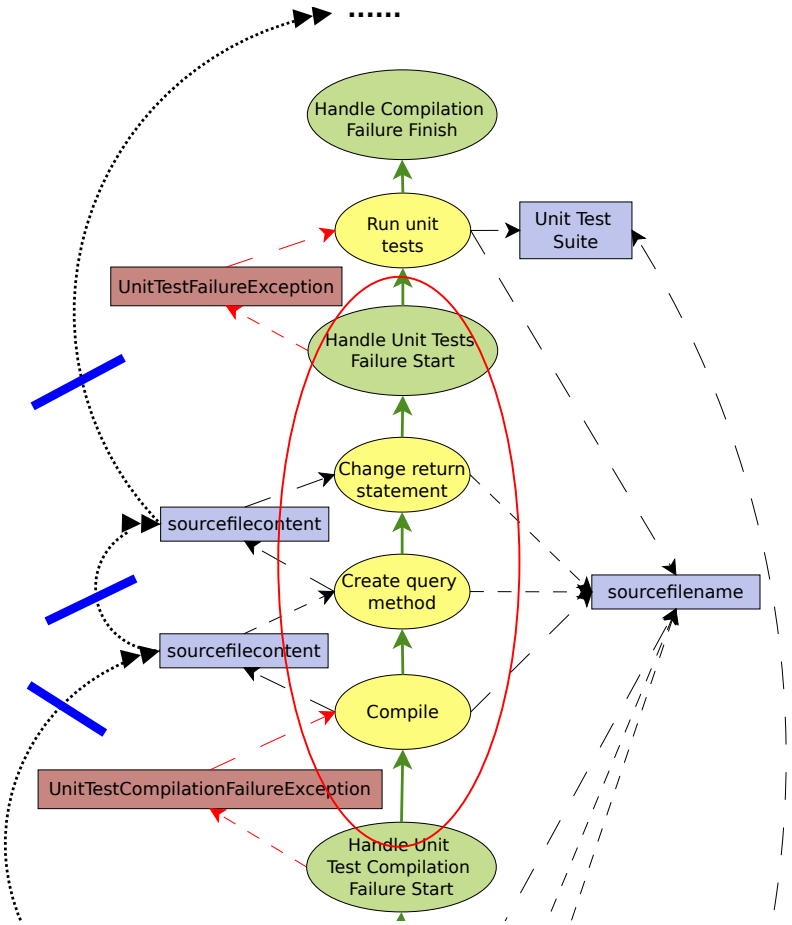

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- Can generate DDGs dynamically while the process is executing

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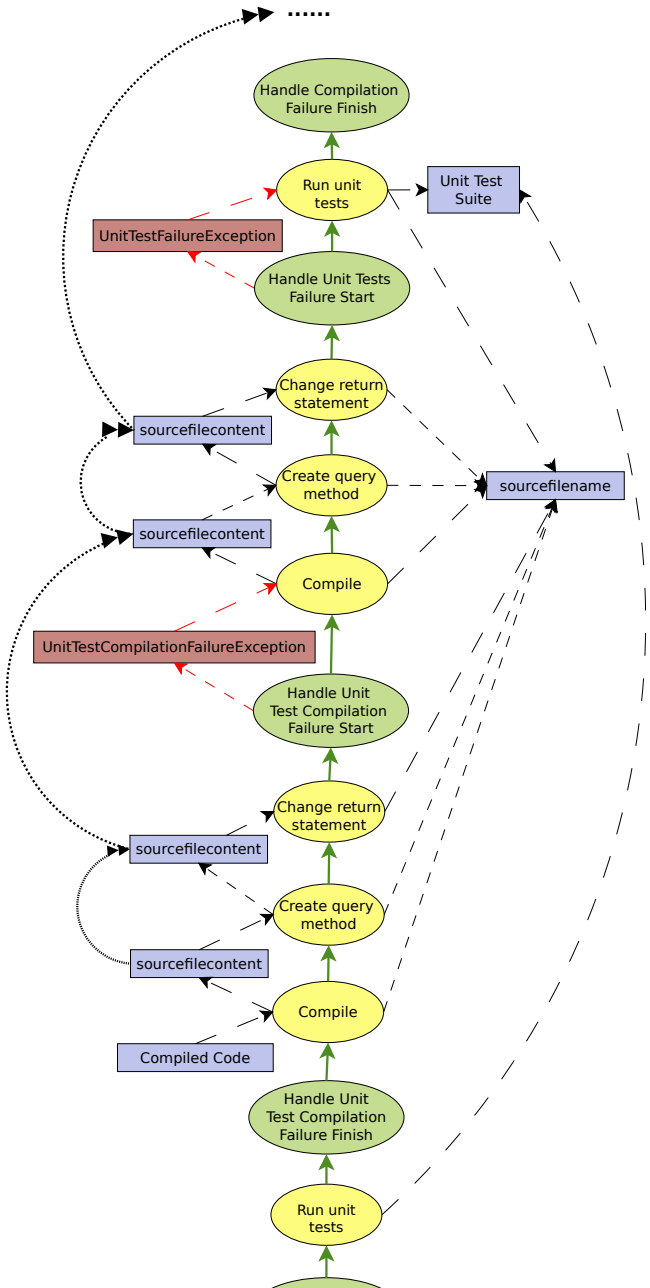

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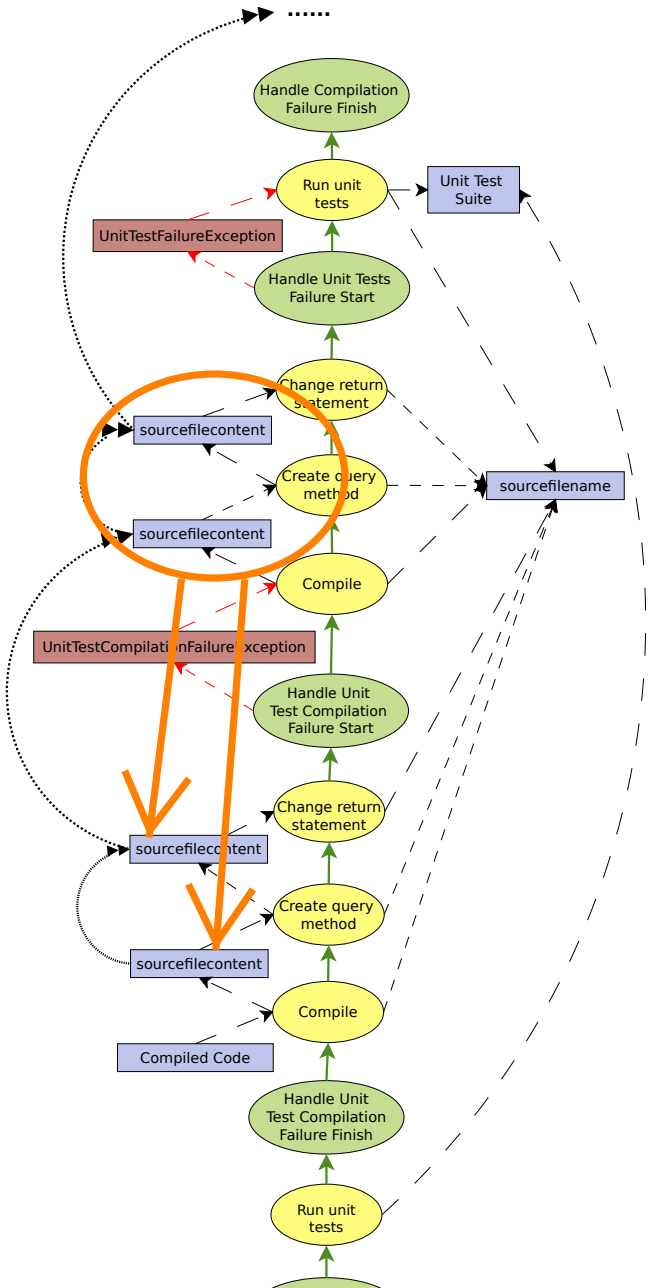

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A: See the DDG

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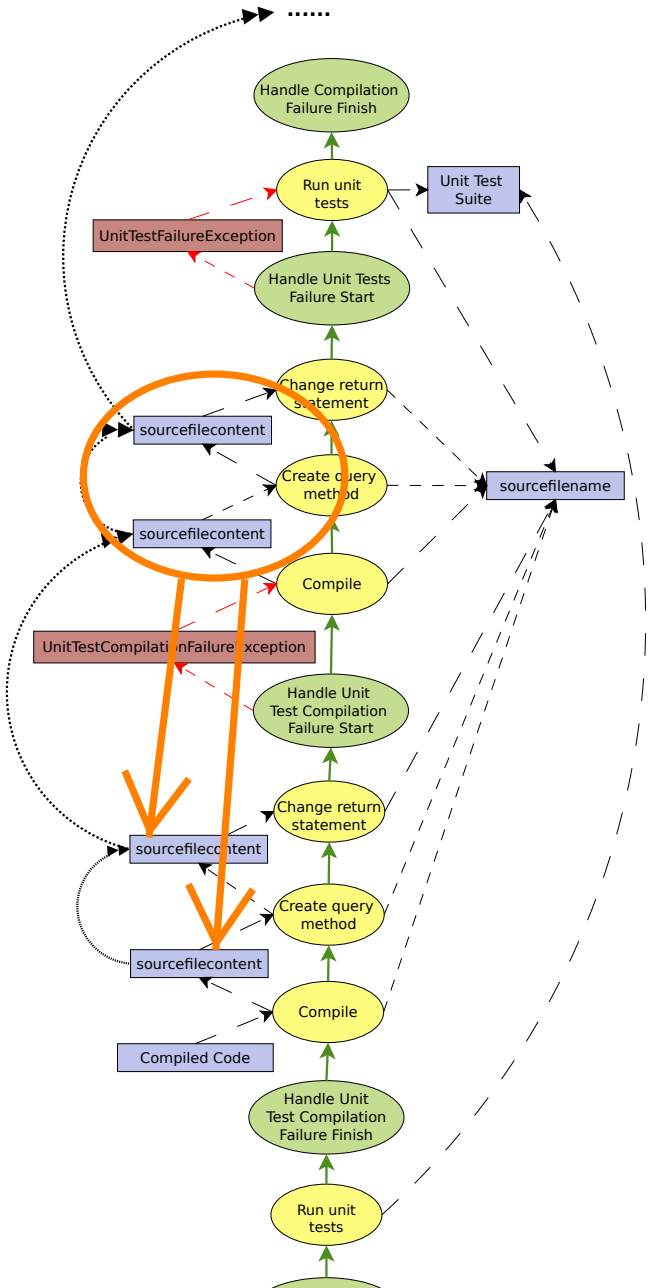

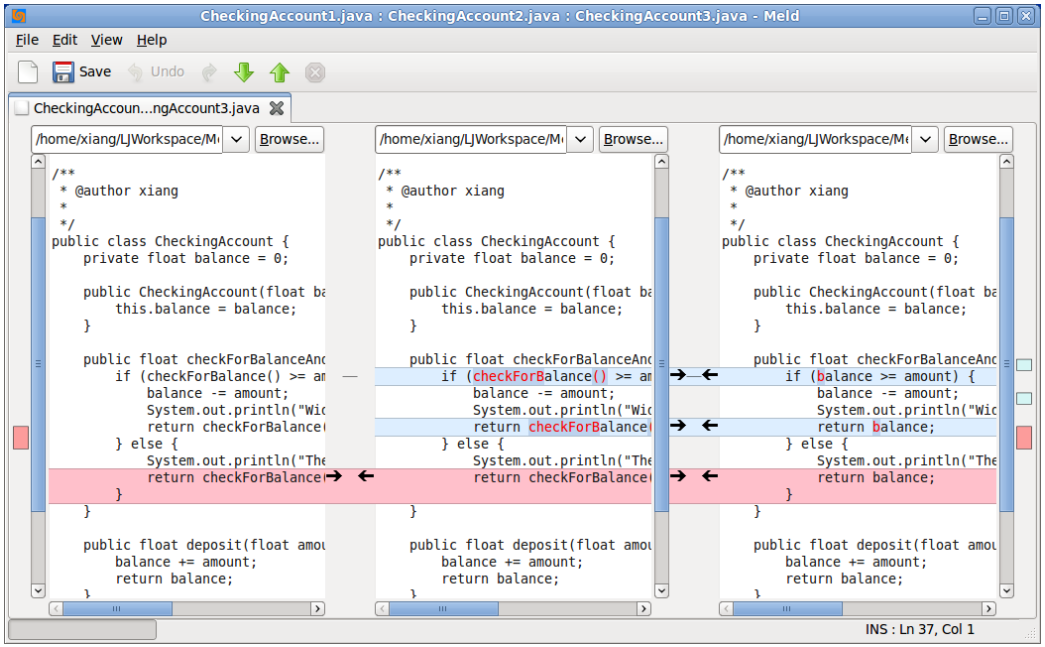

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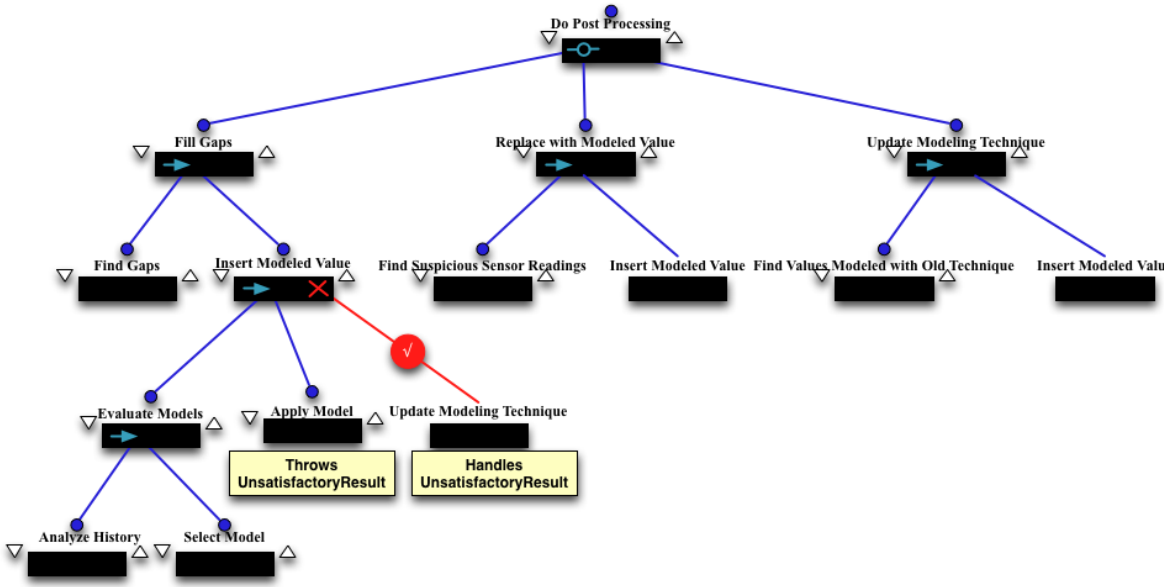
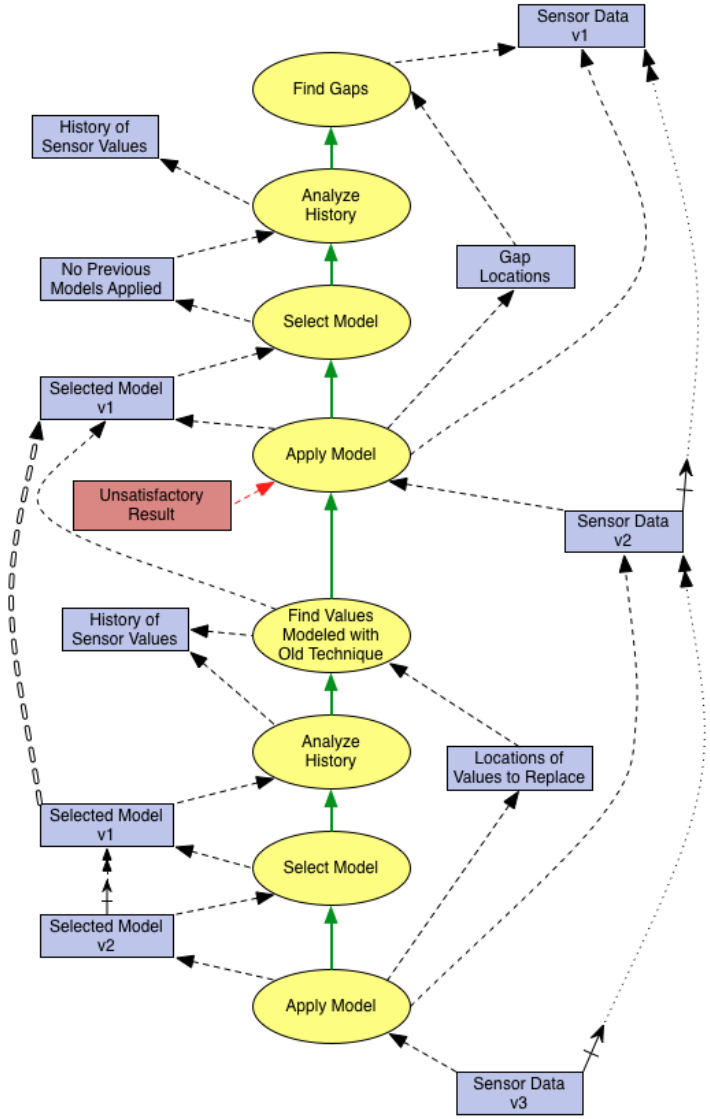
Scientific Data Process





Check our paper and poster for details

Future Work

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- Ripple effects
  - Support for helping users decide the order in which to handle exceptions when many are thrown
    - Probably can use prospection for this
- Study more refactoring patterns

Related Work

- Rework Formalization
  - [Cass et al. EWSPT] proposed initial approaches of formalizing rework
  - A pattern for modeling rework[Cass et al. ICSP '09]
- Context Support
  - [Antunes et al. AITSE '10] proposed a context model in software development with multiple layers and perspectives.
  - Mylyn [12] is a tool integrating task management and task context[Kersten et al. AOSD '05]
- Workflow Provenance: VisTrails[Callahan et al. SIGMOD '06], Kepler[Altintas et al. SSDBM '04], and etc.

Conclusion

- Executable model of rework processes
- Provenance as a first class data
  - Available process wide
  - Directly supports the process where it comes from
- DDG facilitates provenance support
  - Scoping and nesting
  - Version edges and equivalence edges
  - Process introspection and retrospection

Thank You

- Questions?