Multi-layer provenance framework for job distributed system

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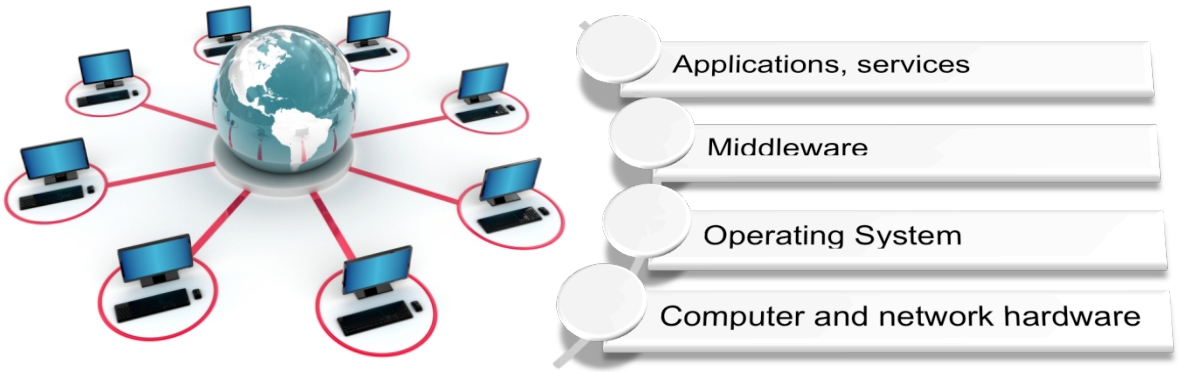
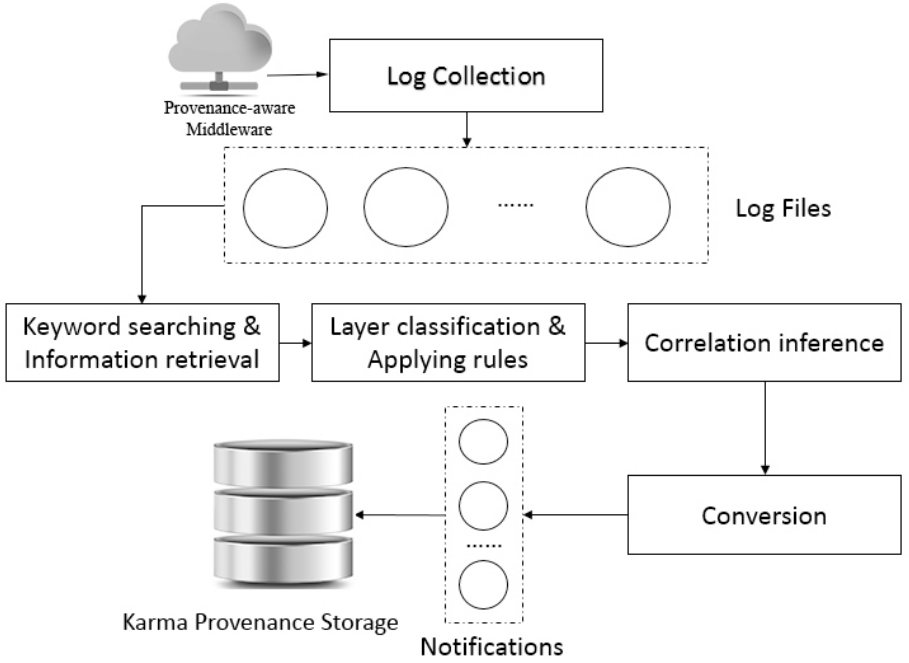
Motivation

- Global information is expensive in distributed environment
  - Multi-layer software stacks and distributed knowledge
  - Massive overhead to infer correlation between events or activities in varied layers
- Enable provenance-based failure tracing and data lineage tracking
  - Data management requirements in data driven scientific workflows
  - Failure tracing and diagnose requirements in highly distributed system
- Examine the quality and usefulness of provenance that can be collected by middleware and platform provenance only



Methodology

- Provenance-aware middleware
  - Middleware wrapper script
- Provenance adaptor
  - Log collection
  - Keyword searching
  - Information retrieval
- Correlation inference engine
  - Timestamp similarity
  - Data flow similarity
- Provenance storage
  - Raw data to provenance conversion
  - Karma Provenance Repository



Application Cases

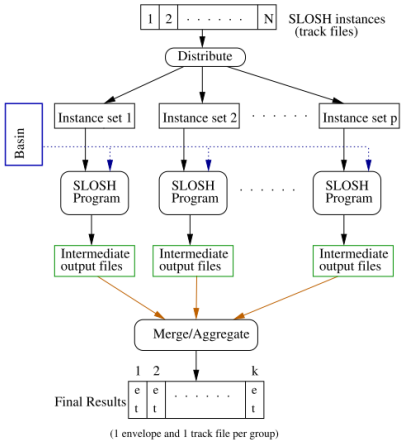


Fig. 1 the Sea, Lake and Overland Surge from Hurricanes (SLOSH) model By NOAA

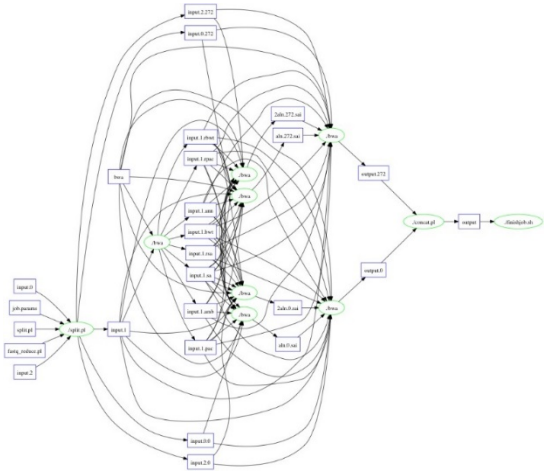


Fig. 2 BWA workflow (Input size: 6.5 GB; Used workers: 10)

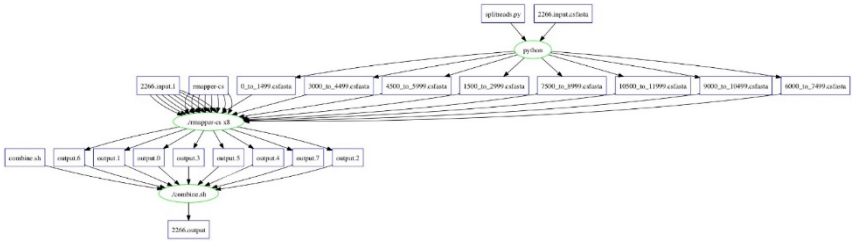


Fig. 3 BLAST workflow (Input size: 8.4 GB; Used workers: 10)

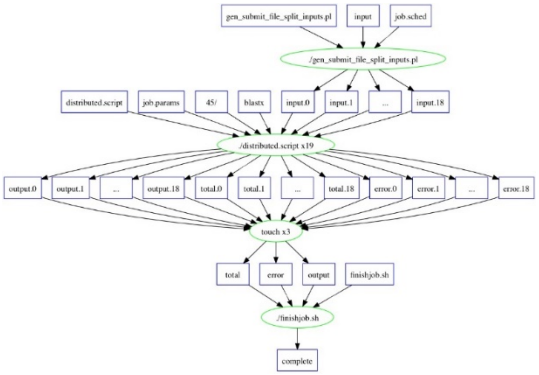
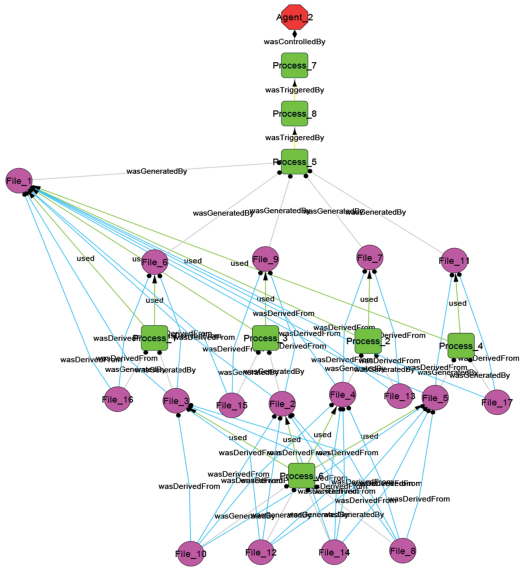


Fig. 4 Shrimp workflow (Input size:675 MB; Used workers: 10)

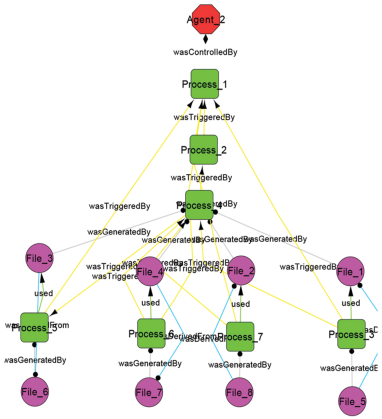
Evaluation

- Multi-layer provenance events correlation inference

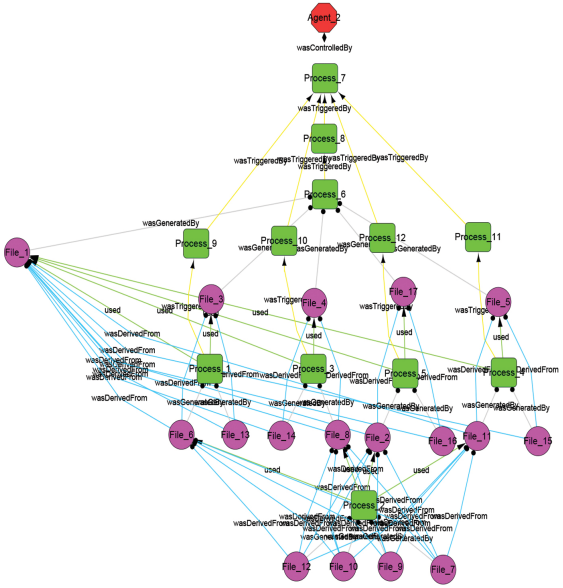
Application

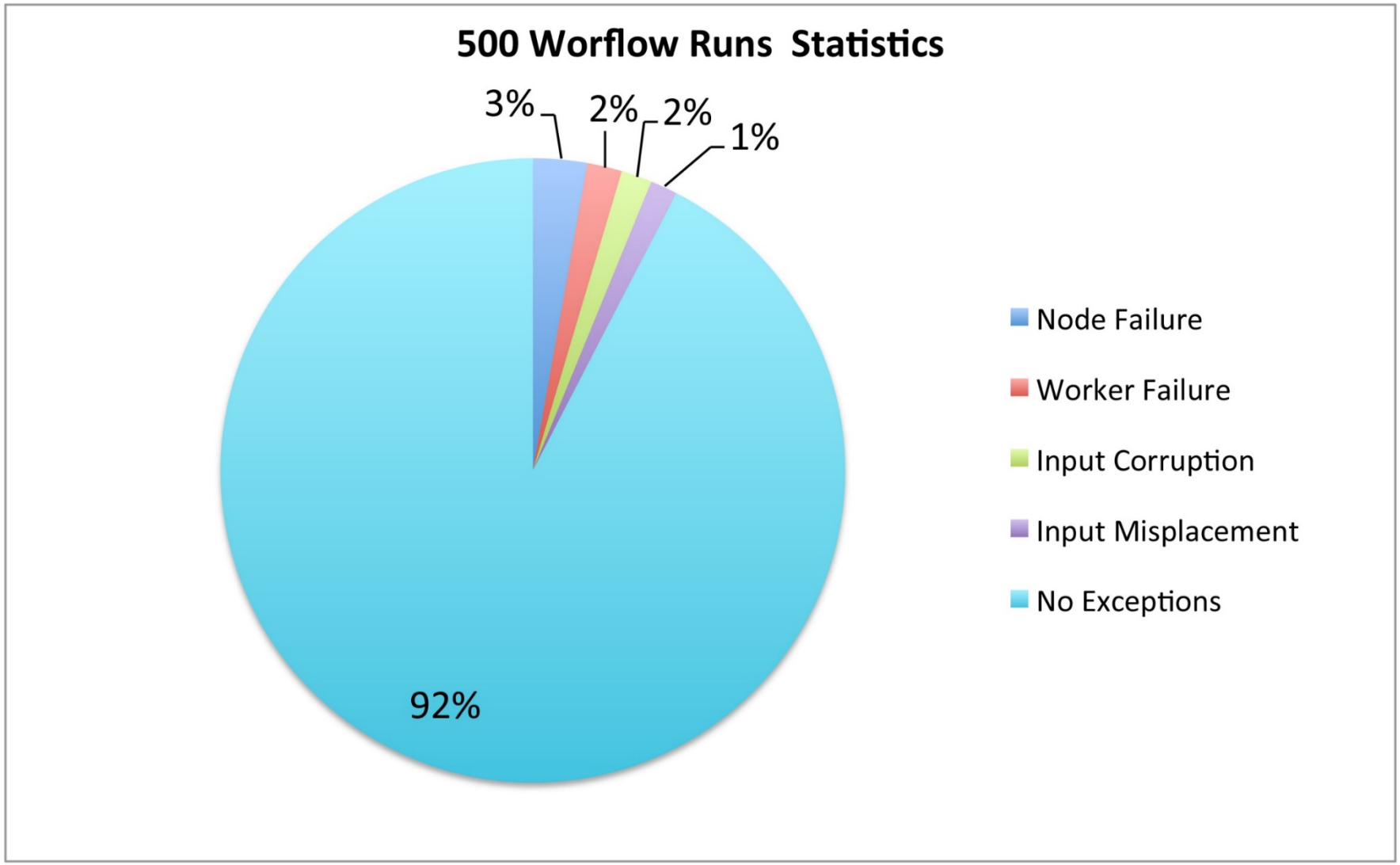


Middleware



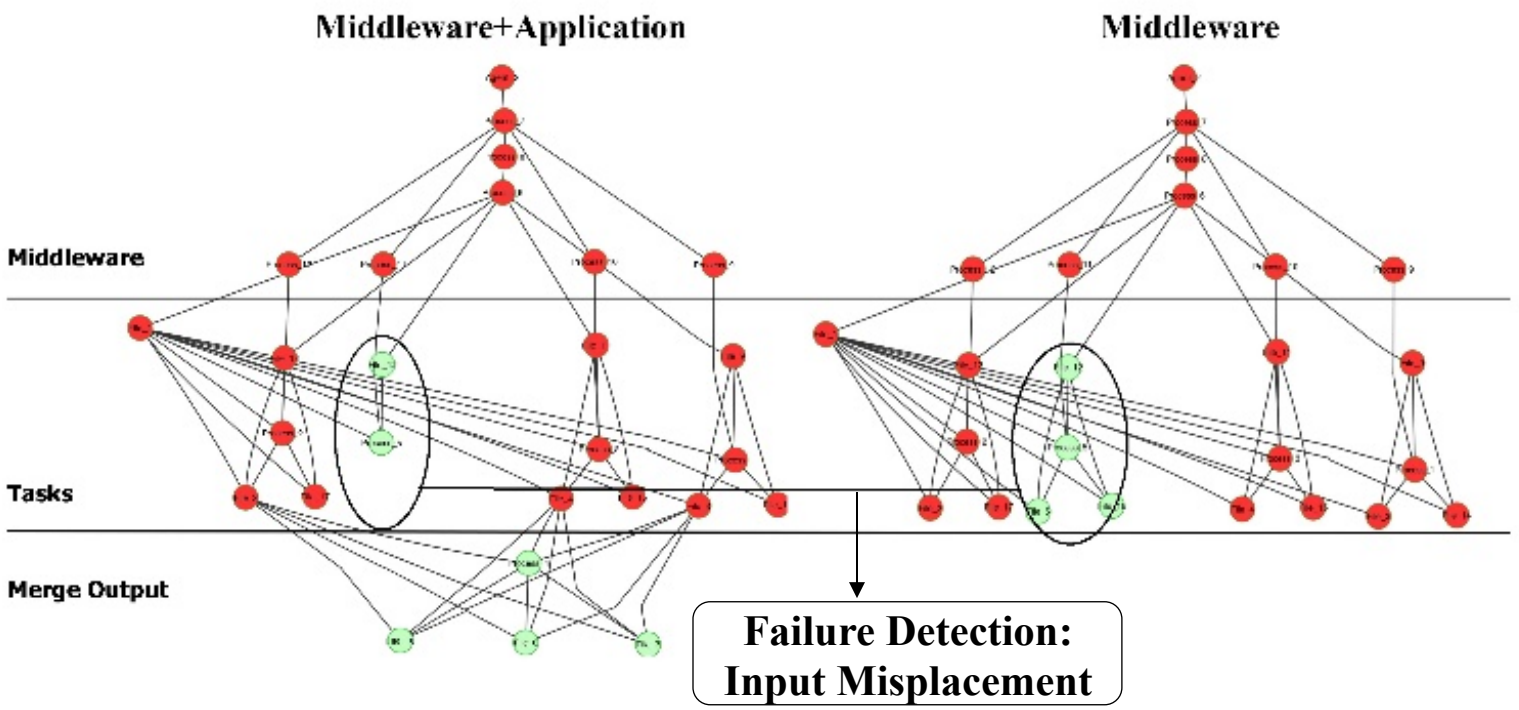
Middleware+Application




500 Worflow Runs Statistics
3%
2%
2%
1%
92%
Node Failure
Worker Failure
Input Corruption
Input Misplacement
No Exceptions

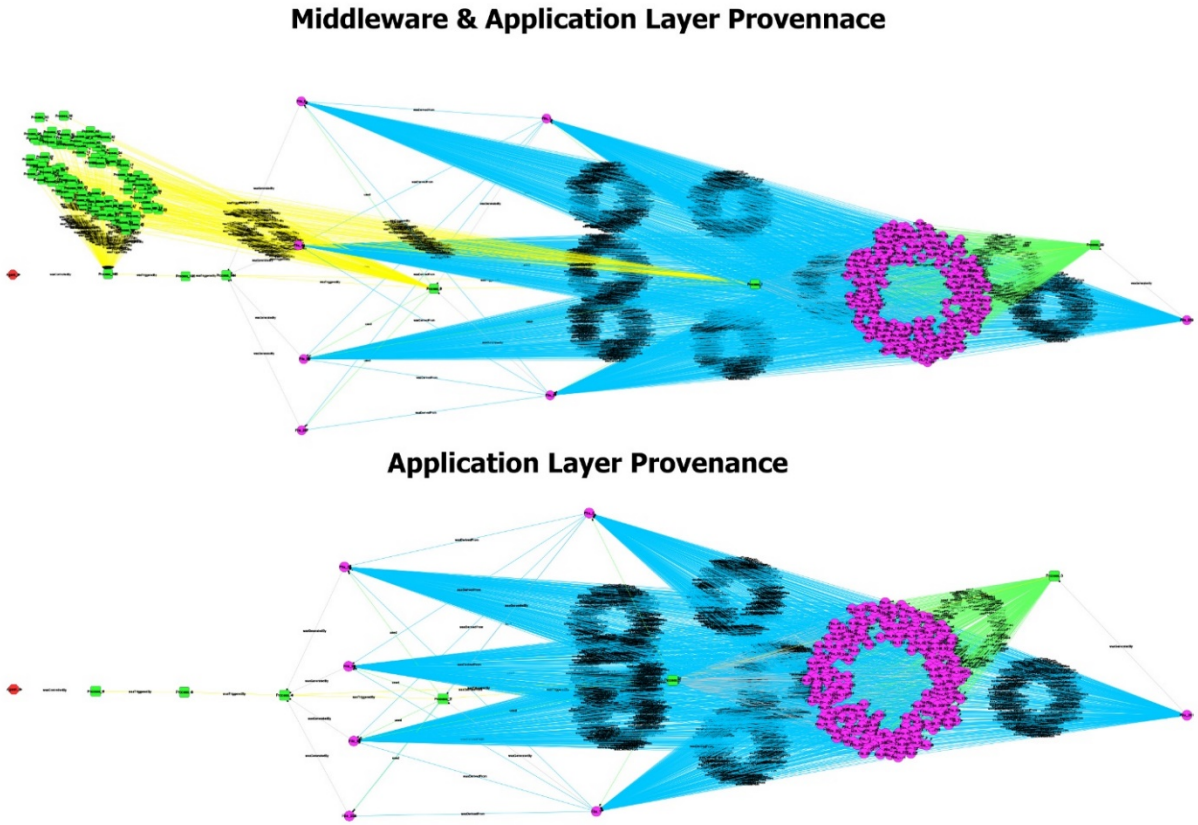
Evaluation

- Provenance-based failure tracing and data lineage tracking



Evaluation

- Generalizing multi-layer provenance framework



Ongoing and Future Work to handle BigData in distributed environment

- Quality metrics for provenance data quality assessment
- Adding more configurability and portability for provenance identification and collection mechanism
- Seeking more application cases for generalization

Acknowledgements

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