Back-in-Time Debugging in Heterogenous Software Stacks

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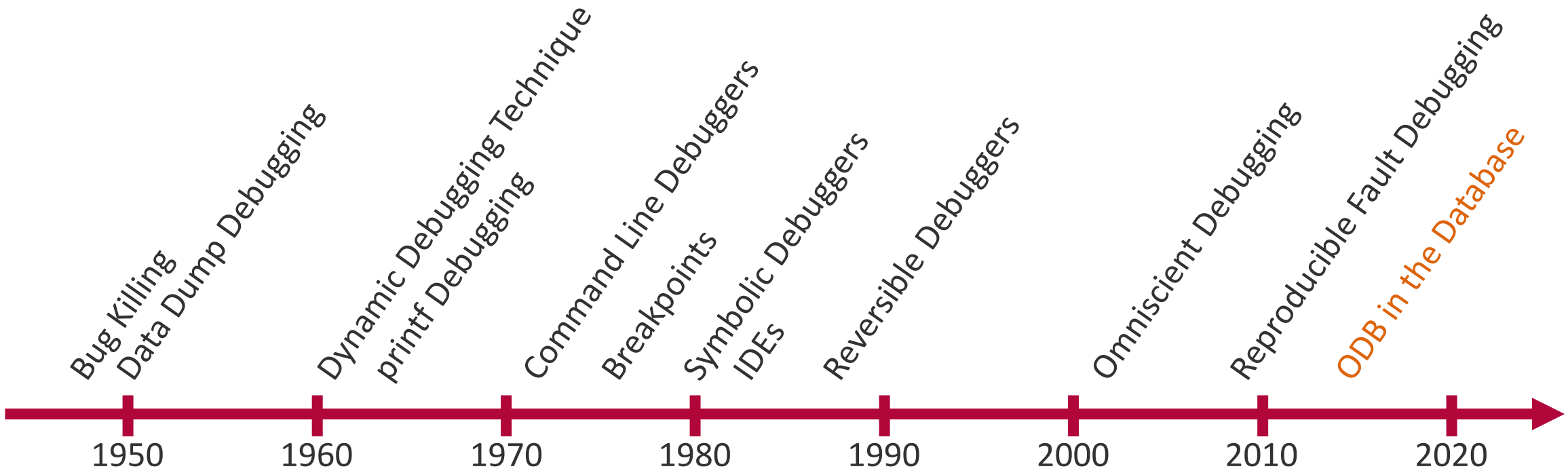
A Brief History of Program Debugging



Debugging Enterprise Applications

- Concurrent users on one instance
- Distributed physical systems
- Often with central server
- Independent components
  - Different environments, languages

Outline

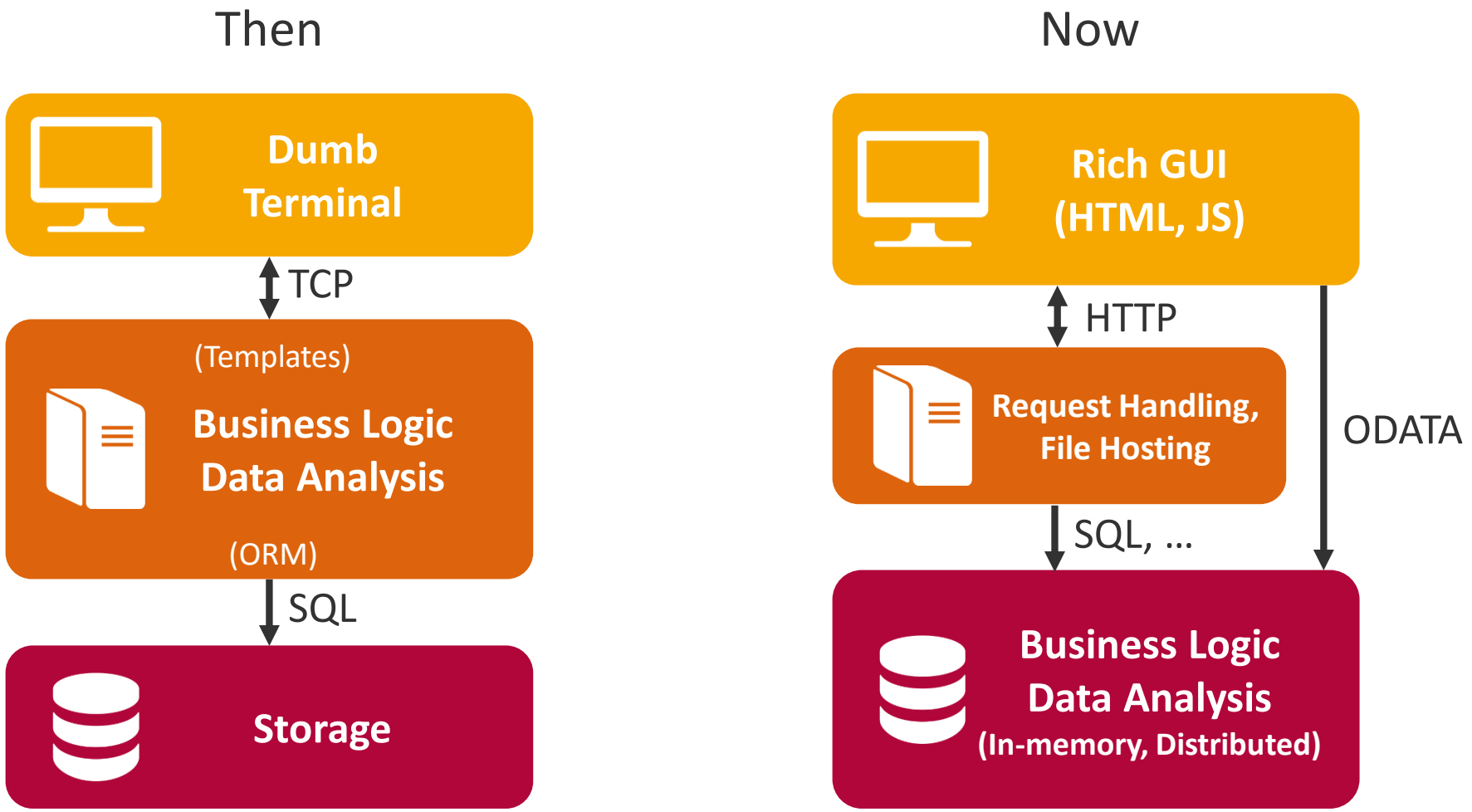
1. Motivation
2. **Developers Needs**
3. Prototype Implementation
4. Conclusion

Developer Interviews

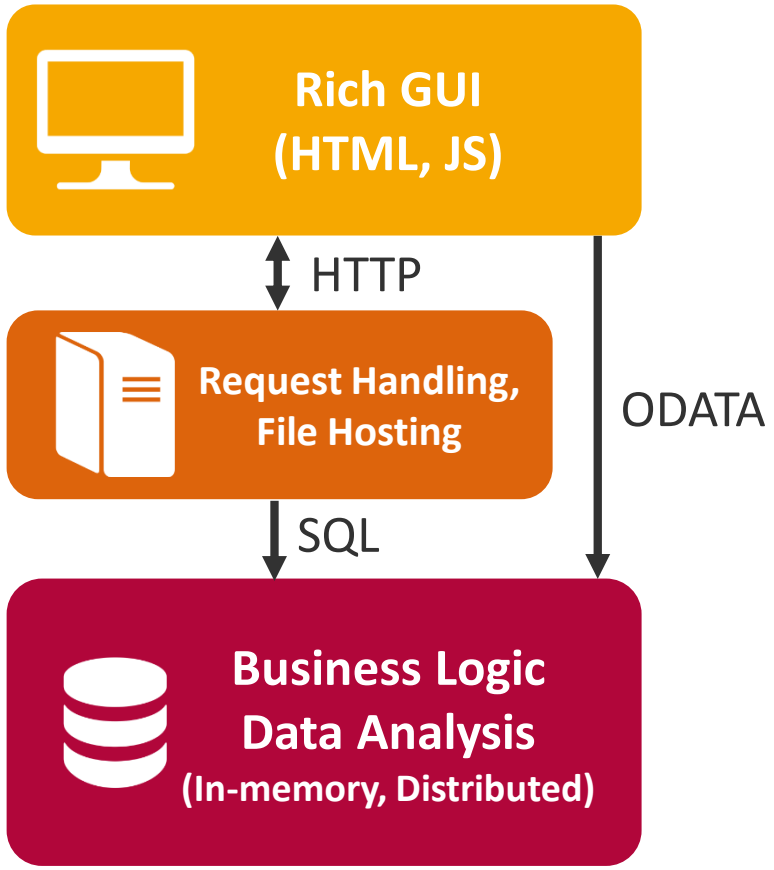
5 SAP Developers, 4 Software Projects

- Liquidity risk management
- Customer analytics
- Predictive analytics for sales
- Point-of-sales explorer KPI dashboard

3-Tier Applications



Real-world Examples



	Project 1	Project 2 (estimated)
Rich GUI (HTML, JS)	55%	90%
Request Handling, File Hosting	18%	5%
Business Logic Data Analysis (In-memory, Distributed)	27%	5%

Debugging 3-Tier Applications

- Agile processes
  - No UI/database team
  - Debugging full stack
- Top-Down approach preferred
  - Find errors in request patterns, parameters, or responses
  - Then debug responsible sub-system
  - Switching between sub-systems is very time consuming

Prototype Debugger

Collection Executions

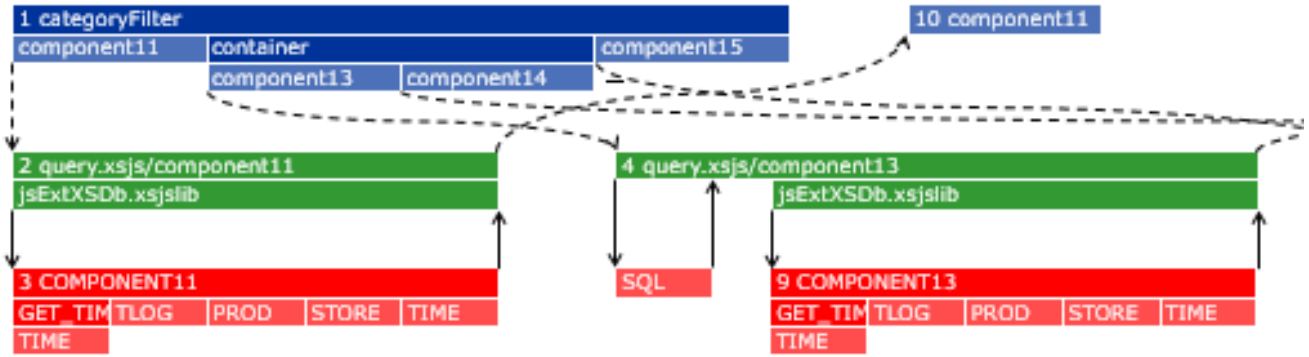
- Assumption:
  - Omniscient debugging available for each sub-system
- “Execution”
  - Function call triggered by external event
  - Independent from other executions
- “Full execution history”
  - Set of all execution transitively caused by root event

Identifying Sub-System Interactions

- Restore request/response relations
- Challenge: uniquely identify each execution
  - URL parameters, query string
  - Add unique argument
- Challenge: find request submissions
  - Well-known method calls
  - Some code-analysis required
- Challenge: find asynchronous response handlers
- No generalizable solutions (?)

High-level Visualizations

- Support top-down approach



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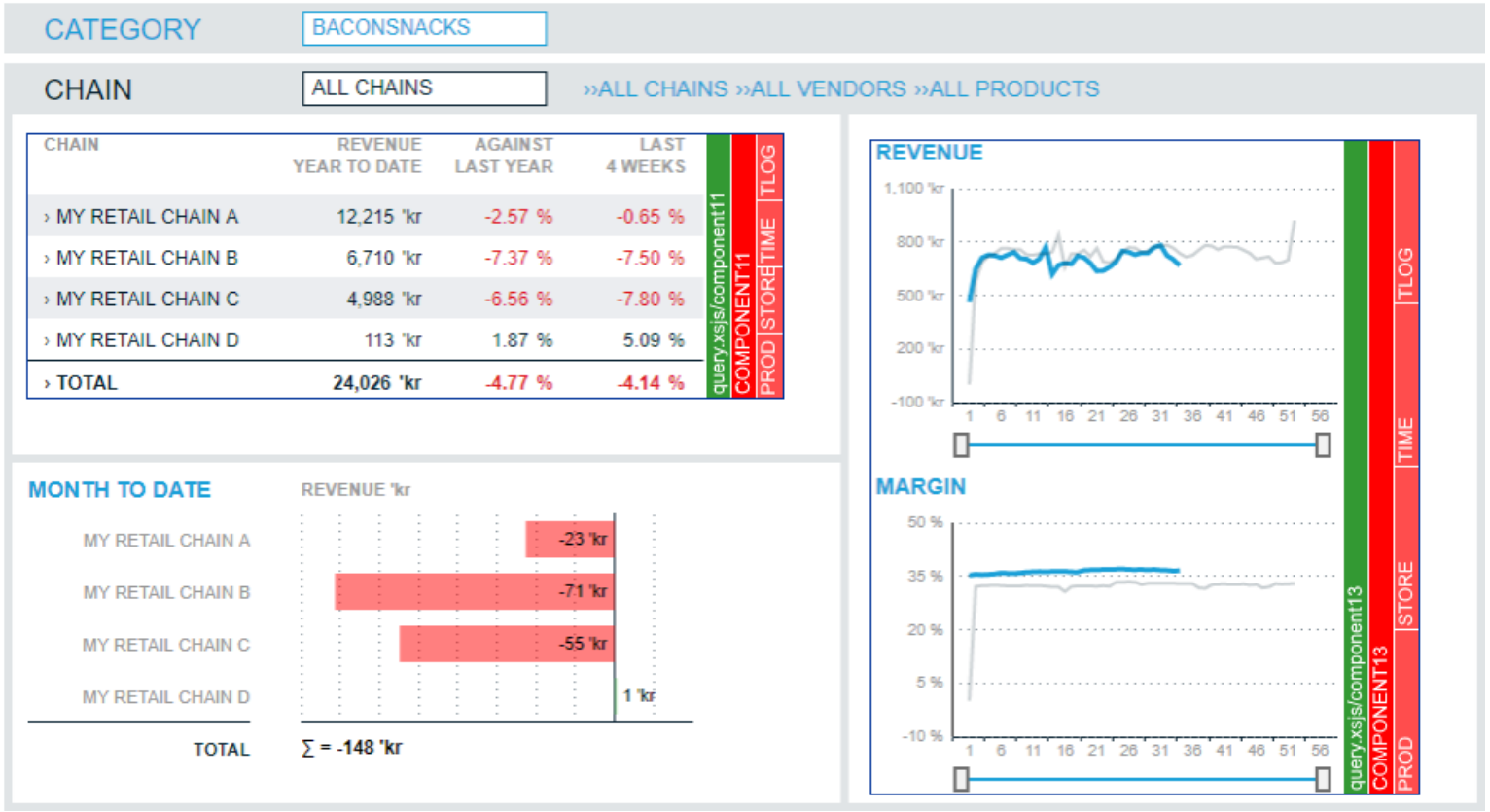

Developer Feedback

- Visualizations
  - help to understand structure
  - Simplify switching between components
- Timing might be relevant
- Restarting executions is much easier now

➢ All three can be achieved without full tracing

Future Work

- Effective dynamic analysis across system boundaries
- Example:
  - Object → JSON String → HTTP Response → … → Object
- Abstraction levels to avoid analyzing parsing code

Summary

1. Motivation
   - ODB for many systems
   - What about complex applications
2. Developers Needs
   - 3-tier application changes
   - Top-down debugging
3. Prototype Implementation
   - Request/response matching
   - Visualizations
   - Generalization
4. Conclusion
   - Low-hanging fruits
   - Future Work