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Department of Computer Science

On Agile Performance Requirements Specification and Testing

Chih-Wei Ho Michael J Johnson
Laurie Williams E. Michael Maximilien

Real Research Group
Software Engineering @ NCSU

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Does It Sound Familiar?

- It's not in the requirements!
- Why? I've already tested it!
- I don't think that's the right way to test the performance!
- When Victoria's Secret meets the Super Bowl…

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Agenda

- Agile Requirements
- Software Performance
- Performance Refinement and Evolution Model
  - Structure
  - Detailed Description
  - Application
- IBM Experience
- Conclusion

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Agile Requirements

- Requirements serve as a media to promote interaction with customer.
- Requirements evolution is a good thing.
- Requirements are testable.

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Performance

- Knuth: “Premature optimization is the root of all evil in programming.”
- Auer and Beck: Lazy Optimization patterns:
  - Performance assessment: early software estimation
  - Tune performance when the functionality is running correctly
  - Stop tuning when performance criteria are met.
  - Use profiler to find “hot spots.”
- “The other camp”: Performance is mostly determined during the architecture stages.

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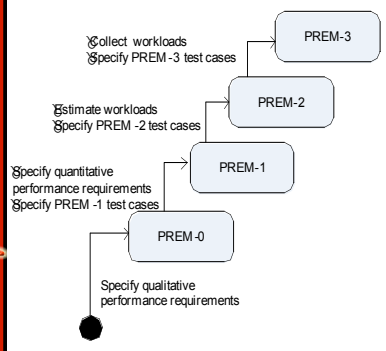
Performance Refinement and Evolution Model (PREM)



- PREM is a four-level model.
- PREM is requirements-centralized.
  - PREM-0: qualitative requirements
  - PREM-1: quantitative requirements
  - PREM-2: estimated workloads
  - PREM-3: collected workloads.
- PREM provides requirements guidelines for requirements specification, performance testing, and performance techniques

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PREM-0

- Starting criteria: Functional requirements are specified.
- Goal criteria: Qualitative performance requirements are specified.
- Activities: Identify and prioritize performance requirements.
- Example: *The system shall provide quick feedback when the user views the medical records .*
- Testing: Qualitative evaluation.

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PREM-1

- Starting criteria: Qualitative performance requirements are defined.
- Goal criteria: Quantitative performance requirements are specified.
- Activities:
  - Specify performance scenarios.
  - Choose appropriate performance metrics.
  - Specify quantitative requirements.
- Example: *When a medical worker clicks on the View Records button, the result page shall be returned within 1.5 seconds*.
- Testing: Run the scenario once and take performance measurement.

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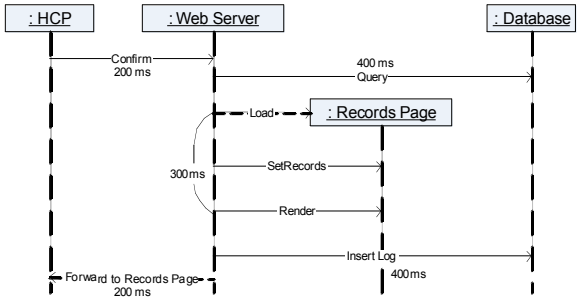
PREM-1 Technique



- Estimate the performance of each smaller step, then calculate the performance of the whole scenario.
- Test cases can be developed based on the small steps to identify performance "hot spots".

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PREM-2

- Starting criteria: Quantitative requirements are specified.
- Goal criteria: Estimated average or peak workloads are specified with the requirements.
- Activity:
  - Estimate workloads.
- Example: *On average, the system receives 0.17 View Records requests every one minute. When a medical worker clicks on the View Records button, the result page shall be returned within 1.5 seconds.*
- Testing: Generate the specified workloads and take performance measurement.

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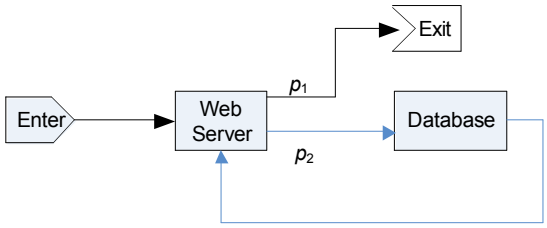
PREM-2 Technique



- Use a closed queueing network model if waiting time is taken into consideration. Otherwise, use an open queueing network model.
- The parameters can be derived from PREM-1 models.
- Automatic tools are available, so let's not get into too much mathematical details.

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PREM-3

- Starting criteria: Quantitative requirements are specified.
- Goal criteria: Peak or average workloads are collected and specified.
- Activity:
  - Collect workloads.
- Example: *During the peak hours, 200 mobile shopping tablets are in use. 8% of the shoppers are either being served at the five checkout stations or are waiting in lines. For the rest of the customers, the promotional message shall display on the mobile tablet within 1 second after a customer enters a lane where the promotional items are located.*
- Testing: Generate the specified workloads and take performance measurement.
- Workload data collection may start as soon as early version of software or prototype is available. Research shows that data collection time ranges from two to twelve months.

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PREM-3 Data Sources

- The operational profiles from a previous release or similar application.
- Intermediate releases, such as alpha or beta releases.
- Things to be considered:
  - Data collection time frame.
  - Data to be collected: At least time and types of operations. Other data may be relevant depending on the project.
- Data collection does not add much overhead but brings much benefit!

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IBM Experience – Overview

- The project was to redevelop device drivers in the retail industry on a new platform in Java.
- TDD was adopted: about 2390 JUnit test cases were written, including over 100 performance test cases.
- Post-release defect was reduced by 40%

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IBM Experience – Requirements Specification

- The performance requirements were collected from three primary sources:
  - Direct customer feedback by marketing representatives: Inexact PREM-0 requirements highlighting most desired performance improvements.
  - Domain expert: Specify quantitative PREM-1 performance-critical requirements and non-performance-critical soft goals.
  - Limiting factors beyond which performance improvement was of little relevance.

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IBM Experience – Test-Driven Performance

- Performance test cases were developed when the code was written. The test cases utilized sample usage patterns specified by a domain expert.
- Unit tests were routinely run prior to check-in of new function.
- A final phase performance test was a separate multi-threaded test case that activated multiple devices simultaneously.
- Result: We observed monotonic improvement of performance!

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Conclusion and Future Work

- We present PREM as a framework for
  - Requirements specification
  - Performance analysis
  - Performance testing
- The IBM experience shows encouraging results form test-driven performance.
- Which level to stop??
- Will this approach help to team deal with software performance development??
- Pattern-based requirements specification.
  - *event*, **the time for** *operation* **shall be less than** *e timeUnits*.
  - Automatic test case generation.

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That's All Folks!

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