Detecting Concurrency Errors in Client-side JavaScript Web Applications
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Overall research goal
• We developed an automated web application test generation technique to detects actual concurrency bugs effectively and efficiently

Challenge
• Conventional in-house testing is not effective to detect race bugs due to
  – Difficulty to feed various execution scenarios with diverse combination of network comm. and user interactions
• Bug detectors report many false alarms

Approach
• Define race bug patterns in client-side web app.
• Develop an automated testing framework that controls user interactions, network comm., and timer for testing-purpose
• Develop test case prioritization algorithms to maximize performance in bug detection

Contribution
• Developed an automated testing framework to detect concurrency bugs in web applications
  – More effective & efficient than random testing
  – More accurate than bug detectors (no false pos.)
• Detected 5 new bugs in real-world web apps

Concurrence bug patterns in web application
• Order violation: unintended race condition of two operations that must be executed one order only, but allow to be in the reverse order
• Atomicity violation: unintended race condition that permits an operation to be executed between two operations that should be executed consecutively

Evaluation
• Experiment setup
  – Target 5 real apps (AjaXplorer, Feng Office, Gallery3, TYPO3, WordPress) + 8 benchmark apps
  – Compare with 6 random testing techniques (with 3 random delays and 2 web browsers) and EventRacer
• Results
  – WAVE detects 5 new bugs in real web applications
  – Effectiveness: WAVE detected race bugs in all 13 apps, while the random techniques and EventRacer did in 11 apps
  – Efficiency: WAVE detected race bugs 10x ~ 30x faster than the random techniques on average
  – Ex. New bug detected in WordPress
    – Symptom: failed reaction to user input
    – Bug pattern: order violation

Application in telecomm. & multimedia
• WAVE can detect concurrency bugs of web-based multimedia apps written in JavaScript, HTML5, Flash, Silverlight, etc.
• WAVE’s virtual environment can be extended to control multiple clients to generate systematic workload to test a networked system

Visit http://swtv.kaist.ac.kr/data/webapp-race for more information on this project