Build it, Break it, Fix it
A new security contest

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Contests are cool

DEFCON CTF
Collegiate Cyber defense challenge (CCDC)
Pwn to Own
• Rewards those who can reverse engineer vulnerabilities in real or custom systems
• But what about the opposite? I.e., reward those who can build more secure systems
  – Fallacy: if you know what/how to find the vulnerabilities you can build systems without them
Build it, Break it, Fix it

Round 1: Build-it team
Contestants build software to specification

Round 2: Break-it team
Contestants report bugs in submissions

Round 3: Build-it team
Fixes bugs found by break-it teams

Must satisfy basic correctness and performance requirements

72 hours

Doing so may wipe out many bug reports in one go: all count as the same bug

Bug reports are (failing) executable test cases, including exploits

Then: Judges tally final results
Scoring

• Build-it team
  – Gains points for good performance
  – Loses points for (unique) bugs found by breakers

• Break-it team
  – Gains points for unique bugs found (scaled by how many other teams found the same bug)

• Winners for both categories at end of round 3
Goals

• Encourage defense, not just offense
  – Tie together security with reliability: Bugs are bad, whether they are exploitable or not
  – Elevate real concerns: performance and maintainability

• Provide direct feedback
  – A lack of security is penalized: “feel” the mistake!

• Empirically assess what actually works
  – Correlate features of submission with score
    • Programming language, framework, library, ...
    • Developer experience, S/W process, ...
    • Using static analysis, fuzz testing, etc. ...
Requirements: Making it work

• Scalability – hundreds of submissions
  – Requires (mostly) automated testing, scoring

• Handle adversarial participants
  – DOS the scoring system
  – Report the same bug multiple times in slightly different ways
  – Collusion

• Get data from which we can draw interesting conclusions
Platform

• Submissions run in a VM that we provide
  – We unpack their submission in a defined directory and then run tests etc. within the VM

• Several benefits
  – VM is isolated from other software, limiting its negative effects on ours and others’ software
  – Run-time environment is clearly defined (in advance), yet affords plenty of flexibility
Data

• Teams must use our git repository
  – So we can see their process and intermediate checkins

• Teams must answer (brief) popup surveys during each phase
  – What are you working on? What problems are you dealing with? Who is doing what?

• And, of course, tests and final submissions available
Challenge I

• How to automatically judge whether a bug claim (submitted as a test) is valid?
  – Use Bayesian network to judge the likelihood test is valid based on outcome for all submissions
  – Seed network with results of true tests
  – Builder teams can, during the fix-it phase, argue that any bugs that slip through are not bugs
    • Human judges arbitrate
Challenge II

• How to automatically judge whether two submitted tests are morally the same?
  – Incentive for builders: find bugs that are the same in fix-it phase
  – Incentive for breakers: only allowed 10 test cases per submission (want to avoid duplicates)
  – (Best effort) automation:
    • Idea: test case minimization (e.g., delta debugging)
    • Idea: “footprint” across all submissions
Challenge III

• How to determine scores?
  – More points for an exploit vs. a correctness bug
  – Want to encourage coverage – don’t want to crown winner only because no one looked at code
    • Limit 10 bugs per submission
  – Want to encourage finding deep/challenging bugs
    • Bugs are worth more (to break-it teams) if fewer teams find them
Challenge IV

• How to avoid collusion or behavior not in the spirit of the competition?
  – Disallow direct obfuscation (judges will check)
    • Indirect uses (spaghetti code that looks human-written) might hurt performance, or might actually be relevant
  – Disallow cooperation among build-it teams
    • Goal would be to obtain more than one prize position
    • Run similarity detection tools on submissions
What are the right tasks?

- Must be interesting
- Must be able to complete in 72 hours
- Must have a reasonable attack surface

- Examples: parsers/interpreters/game engines
  - Pilot: SDXF parser (arcane file format)

- Ideas?
Let’s go write some secure code!