Security Testing

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Confessions of a pen tester

Typical scenario looks like this

- Customer calls and asks for a test
- 2-3 weeks prior to product going “live”
- Security test required by auditors
- Want to ensure “hackers can’t get in”
- How secure are we?

What problems do you see here?

The problem

Too many organizations have either:

- Neglected *security* testing entirely
- Assumed (incorrectly) their QA testing will catch security issues
- Adopted a late-cycle penetration test process as their sole security test

When you ask the wrong questions, you won't get the answers you need!

Security testing is different

- Security focus should primarily be on non-functional aspects of the software
  - Not just focused on what the software can or should do
  - Active deception of software intent
  - Need to test every aspect of app

QA team often has a tough time "thinking like an attacker"

Uninformed “black box” testing

Advantages

- Unencumbered by prejudices of how things “should” behave
- Accurately emulates what an outsider might find
- Can be inexpensive and quick

Disadvantages

- Coverage is abysmal (10-20% LOC not abnormal)
- No notion of risk prioritization

Informed testing

- Advantages
  - Effort can be allocated by risk priority
  - Can ensure high coverage through careful test design
  - Emulate an insider attack
- Disadvantages
  - Functional “blinders” might miss things

Case study: format strings

You are the engineering team leader of an embedded sw open source project

The chaos computer club just posted a paper detailing a newly discovered format string vulnerability ‘sploit

Your boss sends you a memo and asks, “are we ok?”

Your src includes:

```
if (mystate==FOO) {
    printf(userstr);}
```

Testing methods

Common practices include

- Fuzzing
- Penetration testing
- Dynamic validation
- Risk-based testing

Fuzzing

- Basic principle
  - Hit software with random/ garbage
  - Look for unanticipated failure states
  - Observe and record
- Any good?
  - MS estimates 20-25% of bugs found this way
  - Watch for adequate coverage

Fuzzing techniques

- Smart fuzzing and dumb fuzzing
  - “Dumb” refers to using random, unchosen data
  - “Smart” implies using chosen garbage
  - Example - fuzzing a graphic renderer
    - Dumb approach is to throw it randomness
    - Smart approach is to study its expected file formats and to construct garbage that “looks” like what it expects, but isn’t quite right

What to fuzz

Fuzz targets

- File fuzzing
- Network fuzzing
- Other I/O interfaces

Constructing "dumb" scenarios for each is easy, so let's look at some smart approaches

File fuzzing

Smart scenarios

- *Really* study the expected file format(s)
- Look for things like parameters in data
- Construct nonsensical input data parameters
  - Negative or huge bitrate values for audio/video
  - Graphic dimensions

Network fuzzing

Smart scenarios

- *Really* study the software-level network interfaces
  - Coverage here must include *state*
- Look for things like flags, ignoring state
- Construct nonsensical input data parameters
  - “Insane” packet sizes
  - Data overflows and underflows

Interface fuzzing

Smart scenarios for all other “surfaces”

- *Really* study the data interfaces
  - APIs, registry, environment, user inputs, etc.
- Construct nonsensical input data parameters
  - Overflows and underflows
  - Device names when file names are expected

Automation is your friend

…and your enemy

- Lots of fuzz products are appearing
- How can one size possibly fit all?
- Best fuzzing tools are in fact frameworks

Examples

- OWASP’s JBroFuzz, PEACH, SPI Fuzzer

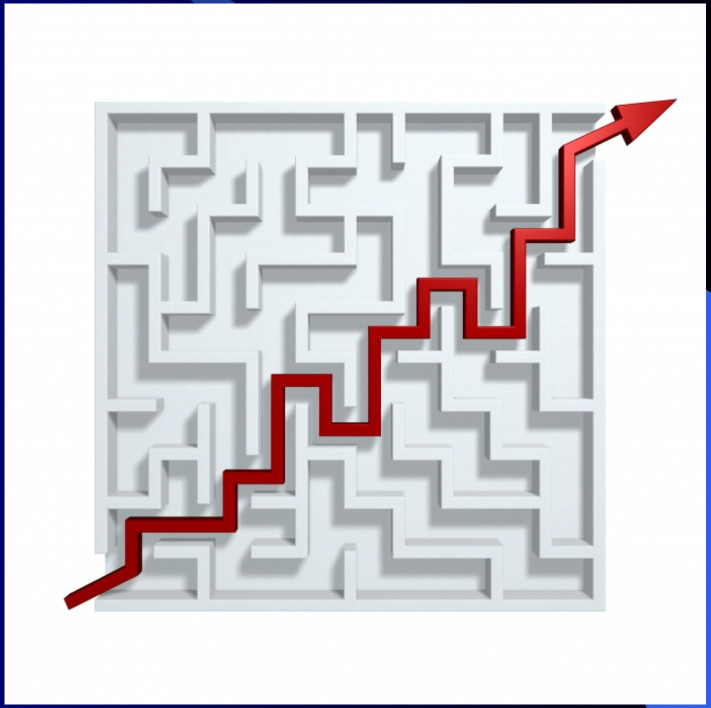
Finding value in pen testing

Enough with what's wrong

- Consider informed testing
- Quick form of attack resistance analysis
- Risk-based prioritization
- Nightmare scenarios from architectural risk analysis
- Abuse case stories
- Start with vendor tools, but then roll your sleeves up and do it yourself
  - Scripting tools can help tremendously

Pen testing strategies

Inside => out approach is most likely to yield meaningful results
  - It doesn’t hurt to also do an outside => in test
  - One very small part of overall testing
  - Adversarial approach
  - Surprises happen



Basic pen testing methods

- Target scan
  - Take inventory of target space
- Vulnerability scan
  - What potential preliminary weaknesses are present?
- Vulnerability exploit
  - Attempt entry
- Host-based discovery
  - What interesting “stuff” is on each breached system?
- Recursive branching
  - Repeat until finished

Pen test results

- Results need to be actions for *dev team*
  - Traditional pen test teams report to IT
  - Need to adapt to different audience
  - Map findings to modules and code

Automation is *really* your friend

- Pen test tool market is (arguably) one of the strongest in the security business
  - Choices abound in commercial and open source
  - Many are quite mature
  - Almost a commodity market
- Examples include
  - Nmap, nessus, Metasploit, ISS, Core Impact, Retina

Dynamic validation

Time to verify all those security requirements and functional specs

- QA will have easiest time building test cases with these
- Fault injection often used
- Helps if requirements verbiage is actionable

Automation, what’s that?

Dearth of available tools

- Some process monitors are available and helpful
- Test cases are easiest to define

Risk-based testing

Time to animate those “nightmare scenarios” you uncovered in the architectural risk analysis

- Start with abuse cases, weakness scenarios
- Describe and script them
- Try them one step at a time

Begin at the beginning and go on till you come to the end; then stop. – Lewis Carroll

Automation, what’s that?

Dearth of available tools

- It’s rare that these scenarios lend themselves to general purpose automation
- Test cases are really tough to define

Additional considerations

There's plenty other things to think about

- Threat modeling
- Results tracking
- Five stages of grief
- Knowledge sharing
- Improvement and optimization

Threat analysis can help

- Who would attack us?
- What are their goals?
- What resources do they have?
- How will they apply technology?
- How much time do they have?

Answers can help in understanding feasibility of attacks

Results tracking

Lots of good reasons to track results

- Use again during regression testing
- Ensure closure
- Knowledge transfer of lessons learned
- Justify time spent

Tools can help

- Test Director

Five stages of grief

- Security testers are often the bearers of bad news
  - Learn from the Kübler-Ross model
    - Denial, anger, bargaining, depression, acceptance
    - Watch out for *denial* and *anger!*
  - Understand and anticipate
  - Diplomacy and tact will optimize likelihood of *acceptance*

Knowledge sharing

- Show the dev team how their code broke
  - Best way to learn
  - Public humiliation is a powerful motivator

If a picture tells a thousand words, a live demonstration shows a thousand pictures

Improvement and optimization

Immediate goal is to find defects in today's software, but preventing future defects is also a worthy goal

- Formalize lessons learned process
- Consider papers, blog entries, etc., to share new findings (once fixed) with others
- Learn from medical community model

Getting started

Some general tips and guidelines

- Interface inventory
- Let risk be your navigator
- Get the right tools for the job
- Scripting skills can be very valuable

Interface inventory

Start by enumerating every interface, API, input, output, etc.

- This should be done per module as well as per application
- List everything
- Some call this the “attack surface”
- This list should become a target list as you plan your tests
- Flow/architecture charts are useful

Risk navigation

The target list is probably too big to do a thorough job

- Prioritize focus in descending risk order
- Follow the most sensitive data first
- Those flow charts will set you free

Understand now why rigorous testing should be "white box"?

Test scenario sources –1

Develop test scenarios throughout SDLC

- Start at requirements, such as
  - US regs: GLBA, SOX, HIPPA
  - ISO 17799 / BS 7799
  - PCI
  - OWASP's WASS
- Warning, they're often fuzzy (no pun…)
  - SOX says, "Various internal controls must be in place to curtail fraud and abuse."

Test scenario sources –2

Also look elsewhere in SDLC for test cases

- Abuse cases
  - Many cases translate directly to test cases
- Architectural risk analysis
  - Seek the doomsday scenarios
- Code
  - Compliance with coding standards

Deployment testing

Rigorous testing of environment

- Network services
- File access controls
- Secure build configurations
- Event logging
- Patch management
- Test for all of this
  - Not your job? Who is doing it? The pen testers?

References

Some useful additional reading

- "Adapting Penetration Testing for Software Development Purposes", Ken van Wyk, http://BuildSecurityIn.us-cert.gov
- "The Security Development Lifecycle", Michael Howard and Steve Lipner
- Fuzz testing tools and techniques http://www.hacksafe.com.au/blog/2006/08/

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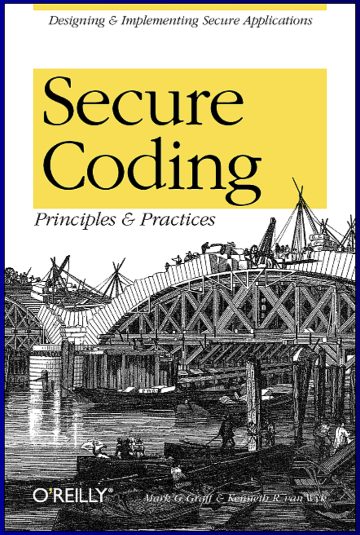
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