Software Security Touchpoint: Architectural Risk Analysis

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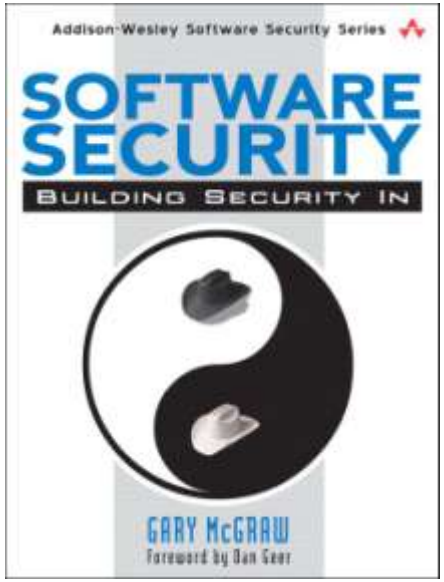
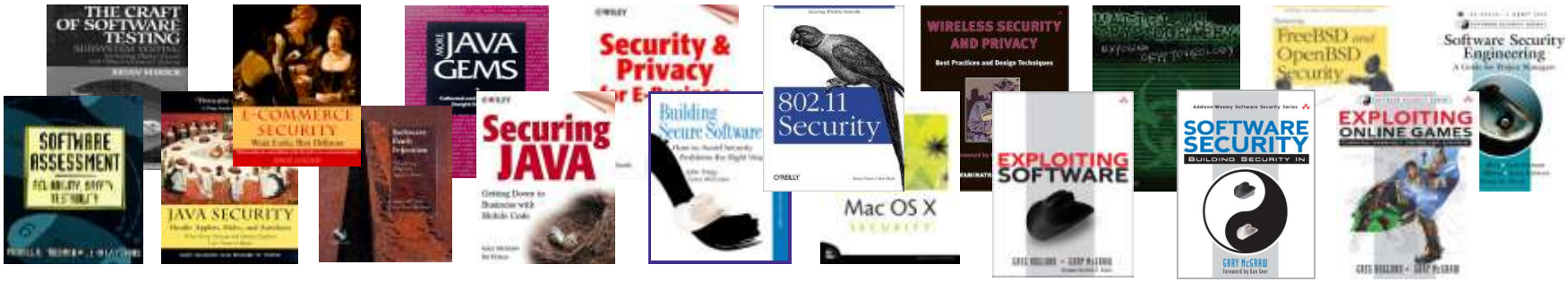


Cigital

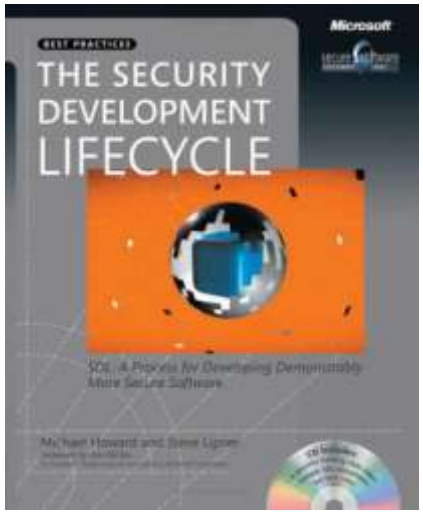
- Founded in 1992 to provide software security and software quality professional services
- Recognized experts in software security and software quality
  - Widely published in books, white papers, and articles
  - Industry thought leaders



ARA in Context:
State of the Practice

A shift from philosophy to HOW TO

- Integrating best practices into large organizations
  - Microsoft's SDL
  - Cigital's touchpoints
  - OWASP adopts CLASP



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What works: BSIMM

- Building Security In Maturity Model
- Real data from real initiatives

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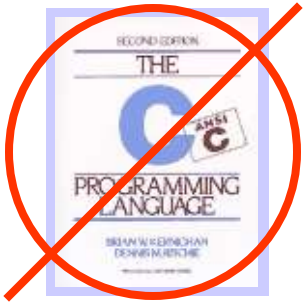
FORTIFY

Two kinds of security defects

IMPLEMENTATION BUGS

50%

- Buffer overflow
  - String format
  - One-stage attacks
- Race conditions
  - TOCTOU (time of check to time of use)
- Unsafe environment variables
- Unsafe system calls
- Cross-site scripting
- SQL injection



ARCHITECTURAL FLAWS

50%

- Misuse of cryptography
- Compartmentalization problems in design
- Privileged block protection failure (DoPrivilege())
- Catastrophic security failure (fragility)
- Type safety confusion error
- Insecure auditing
- Broken or illogical access control (RBAC over tiers)
- Method over-riding problems (subclass issues)
- Signing too much code

The bugs/flaws continuum

`gets()`

`attacker in the middle`

BUGS — FLAWS

- Architectural risk analysis
- Customized static rules (Fidelity)
- Commercial SCA tools: Fortify, Ounce Labs, Coverity
- Open source tools: ITS4, RATS, grep()

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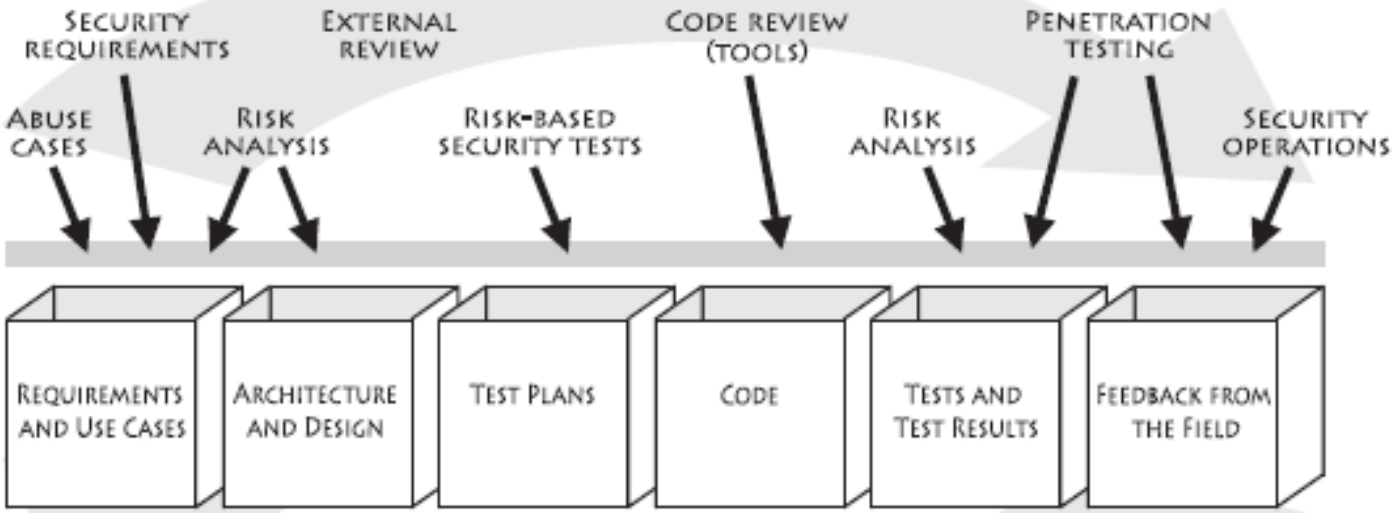
Software security touchpoints



Architectural Risk Analysis

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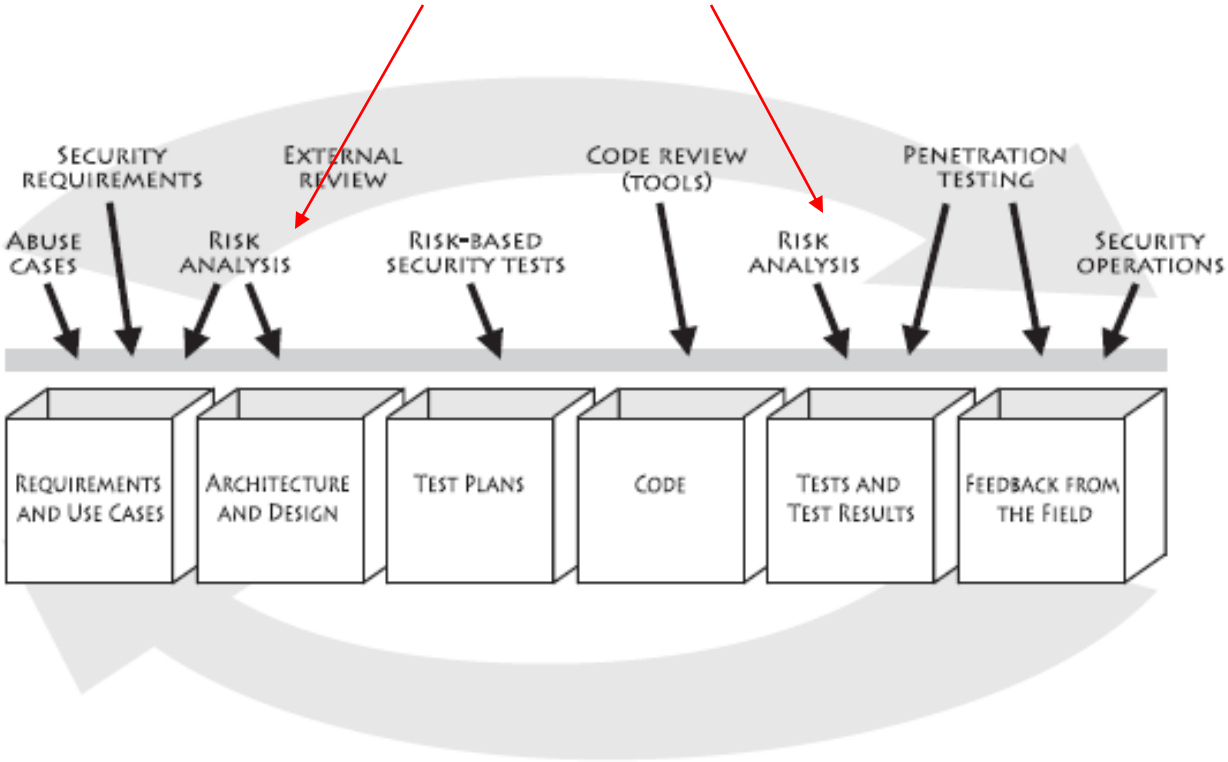
BSIMM: Ten surprising things

1. Bad metrics hurt
2. Secure-by default frameworks
3. Nobody uses WAFs
4. QA can't do software security
5. Evangelize over audit
6. ARA is hard
7. Practitioners don't talk attacks
8. Training is advanced
9. Pen testing is diminishing
10. Fuzz testing

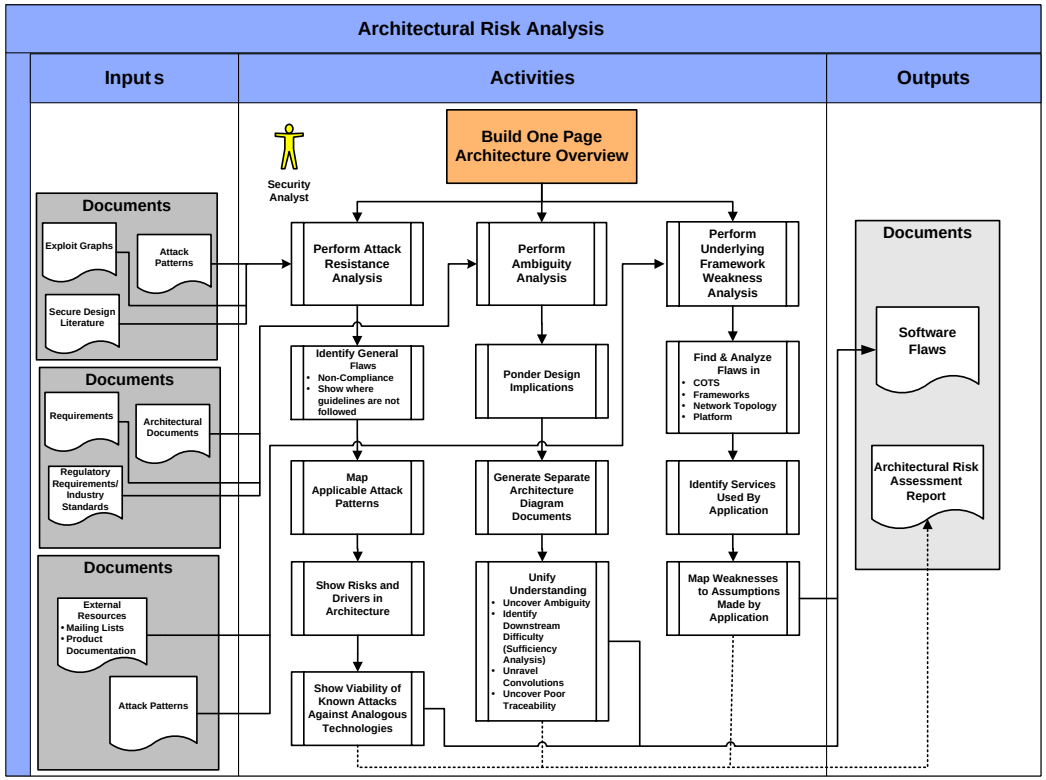
- http://www.informit.com/articles/article.aspx?p=1315431

Architectural Risk Analysis



For more information, see
http://www.cigital.com/services/security/

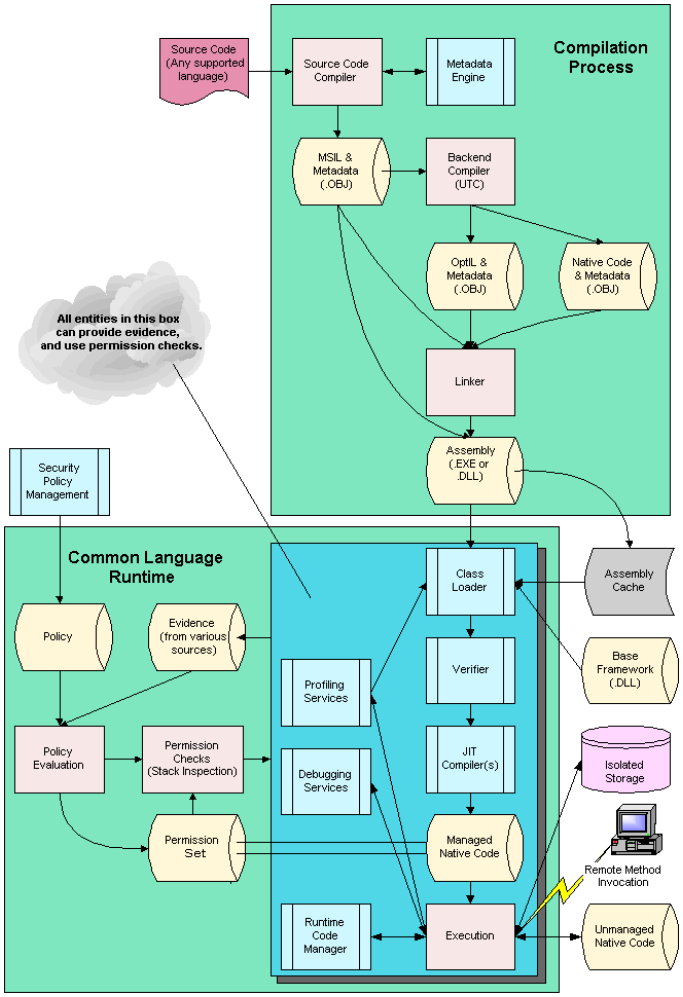
Touchpoint: Architectural risk analysis



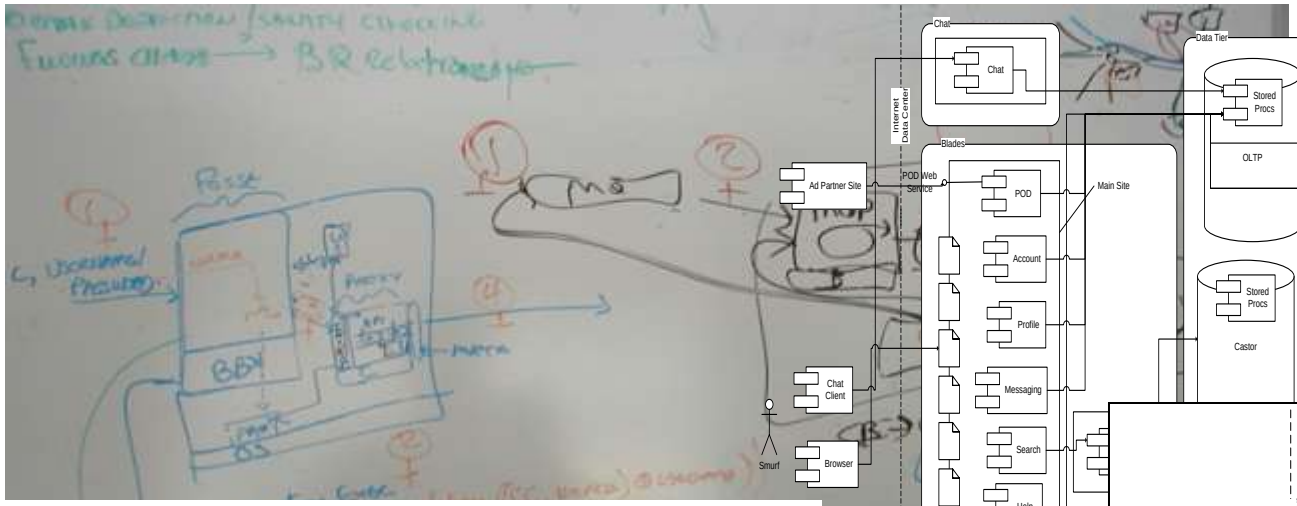
- Start by building a one-page overview of your system
- Then apply the three-step process
  - Attack resistance
  - Ambiguity analysis
  - Weakness analysis

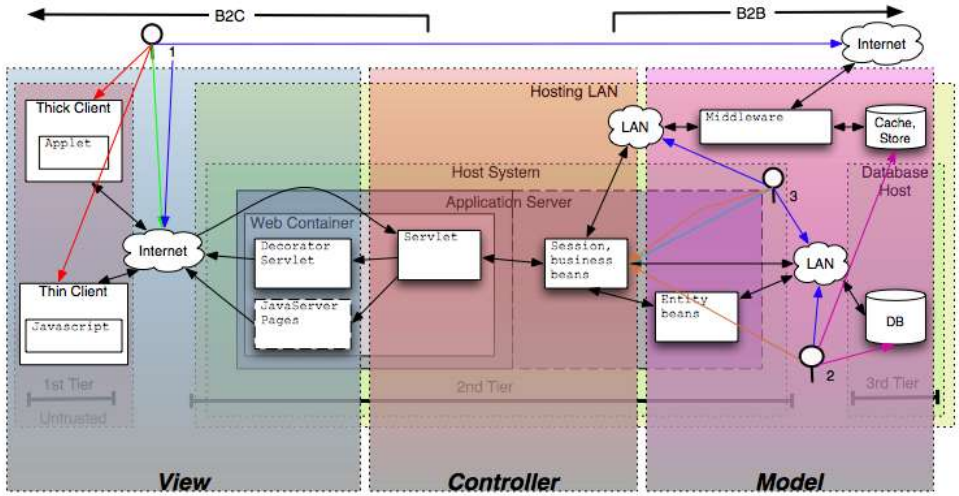
Touchpoint: Architectural risk analysis

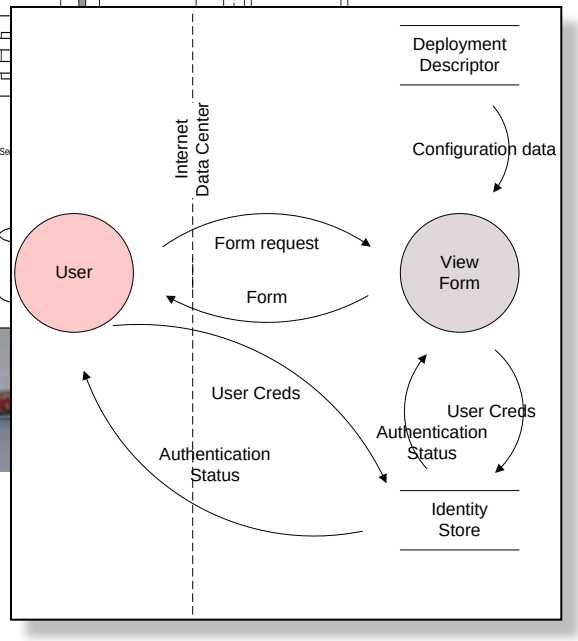
- Step one: get an architecture
- Forrest level view
  - Up out of the code
- Widespread use of common components helps (but also has security impact!)
  - Spring
  - Hibernate
  - Log4J
  - OpenSSL
- Design patterns also help



Design diagrams need security too

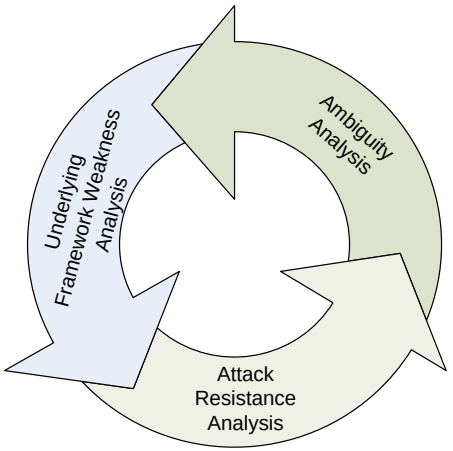






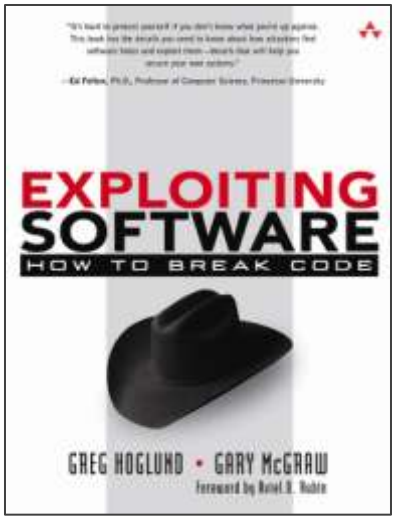
Three steps to ARA

- Attack Resistance (use a CHECKLIST)
  - Apply a list of known attacks (like STRIDE)
  - Calculate risk-based impact
- Ambiguity Analysis (multiple PERSPECTIVES)
  - Find attacks based on how the system works
  - Expose invalid assumptions
- Weakness Analysis (DEPENDENCIES)
  - Think through dependencies: toolkits and frameworks
  - In, Over, Under, Outside



Attack resistance: build an attack checklist

- Understand known attacks
  - Designers – what controls are needed to prevent common attacks?
  - Attackers – what to try again
- Example: Microsoft SDL's STRIDE model
  - Spoofing, tampering, repudiation, info disclosure, denial of service, elevation of privilege
- Start with common taxonomies
  - 7 Pernicious Kingdoms; McGraw
  - 19 Deadly Sins; Howard, LeBlanc, Viega
  - 48 Attack Patterns; McGraw/Hoglund
  - Common Weakness Enumeration
    - http://cve.mitre.org/cwe

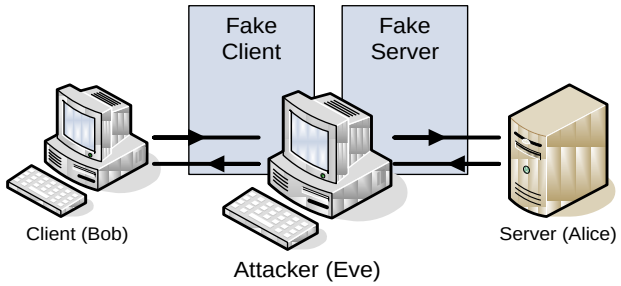


Attack resistance: common design elements

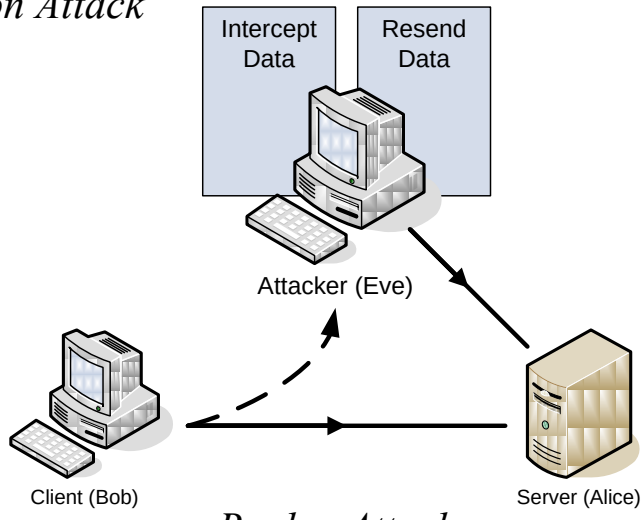
- Flag design elements that are historically vulnerable to attack
- Enterprise applications share many of the same design elements
  - Distributed architecture
  - Dynamic code generation and interpretation
  - APIs across stateless protocols
  - Rich Internet Applications
  - Service-oriented Architecture

Example: distributed architecture risks

- Distributed systems are susceptible to network-based attacks
  - Eavesdropping
  - Tampering
  - Spoofing
  - Hijacking
  - Observing
- Relevant Attack Patterns
  - Interposition attacks
  - Network sniffing
  - Replay attacks



Interposition Attack

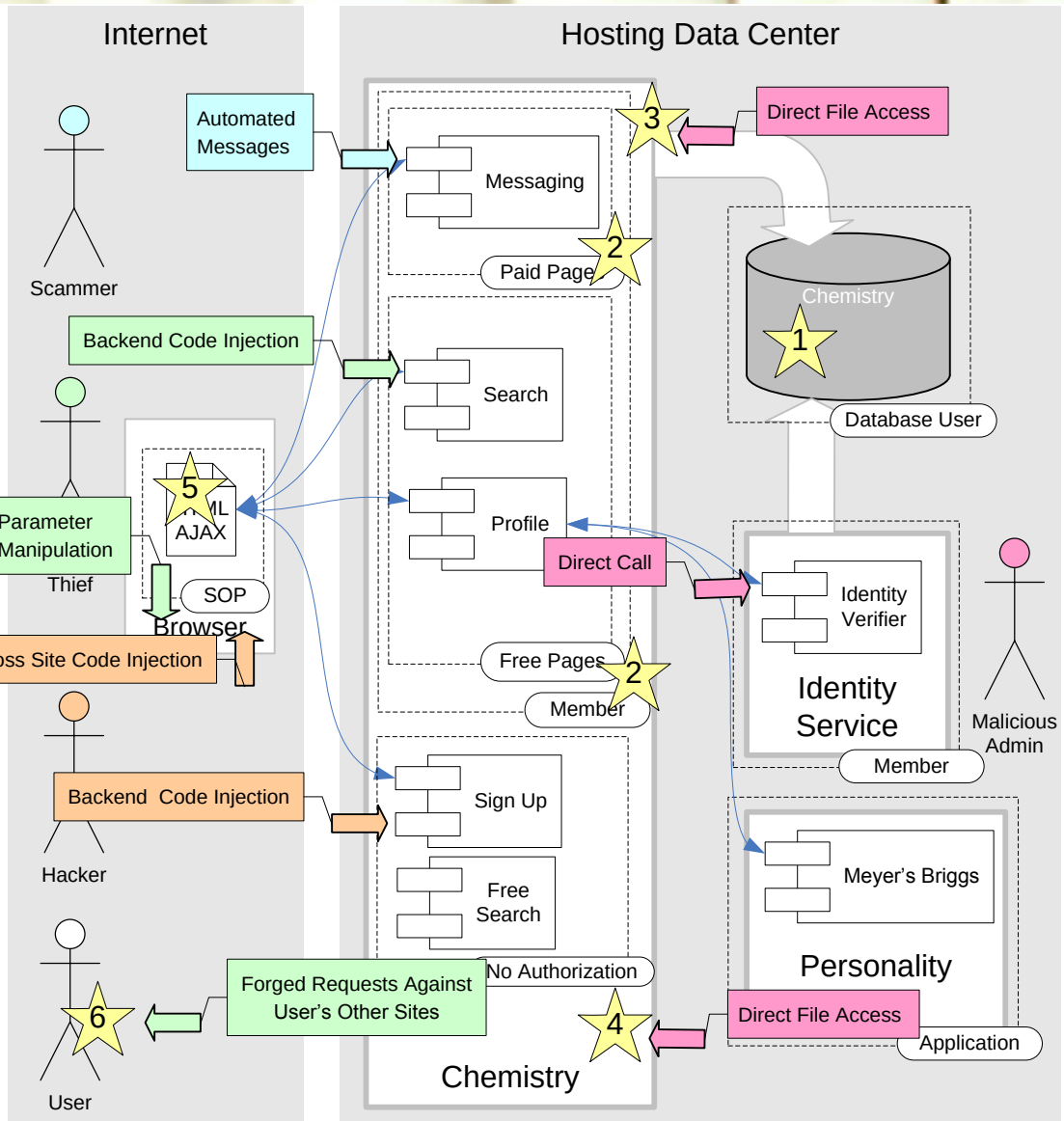


Replay Attack

Ambiguity analysis: model your stuff

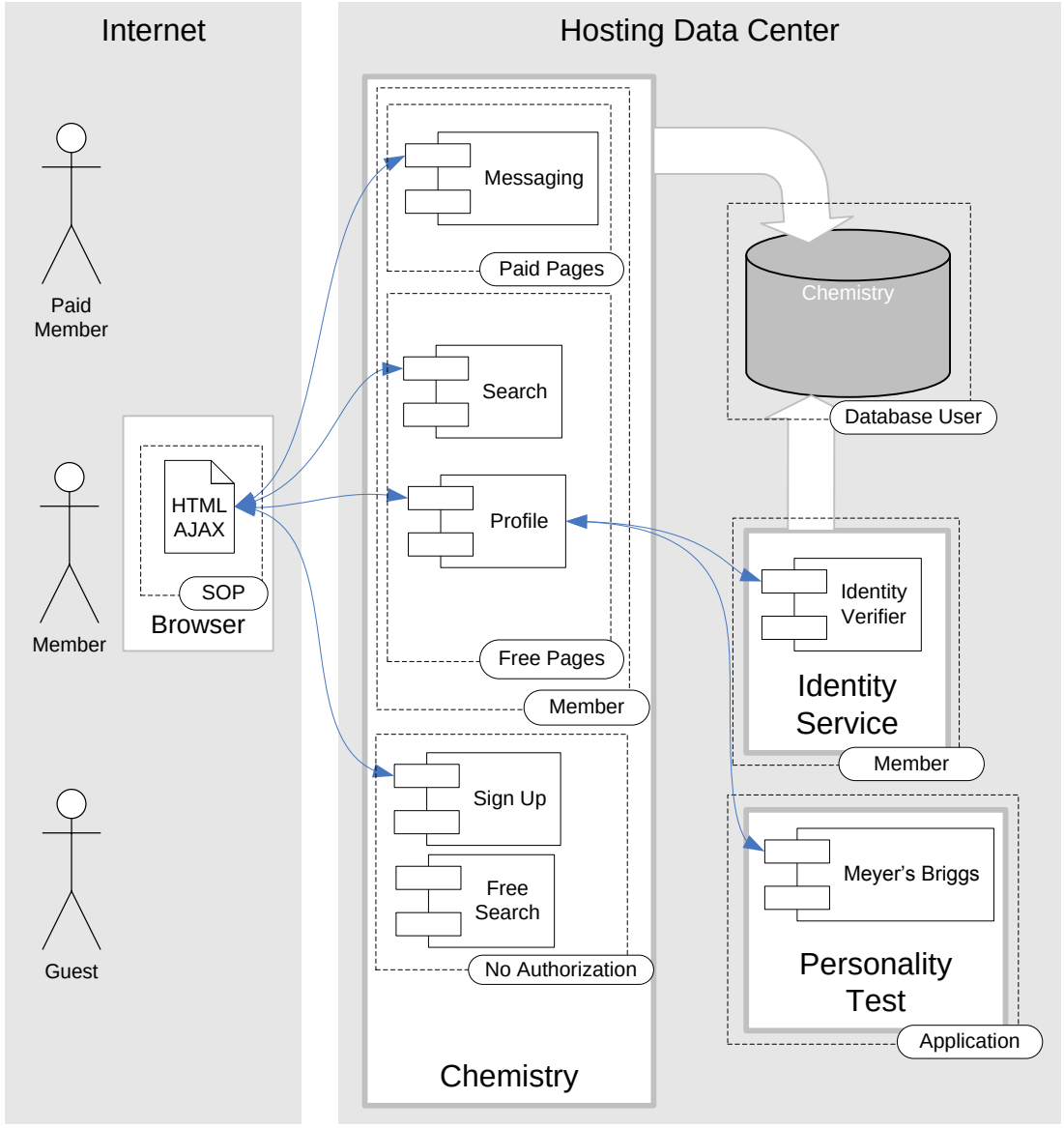
- Modeling techniques help expose an application's area of potential vulnerability
- Multiple points of view (and sets of experience) help

- **Trust Modeling** identifies the boundaries for security policy for function and data
- **Data Sensitivity Modeling** indentifies privacy and trust issues for application data
- **Threat Modeling** identifies the attacker's perspective and areas of weakness



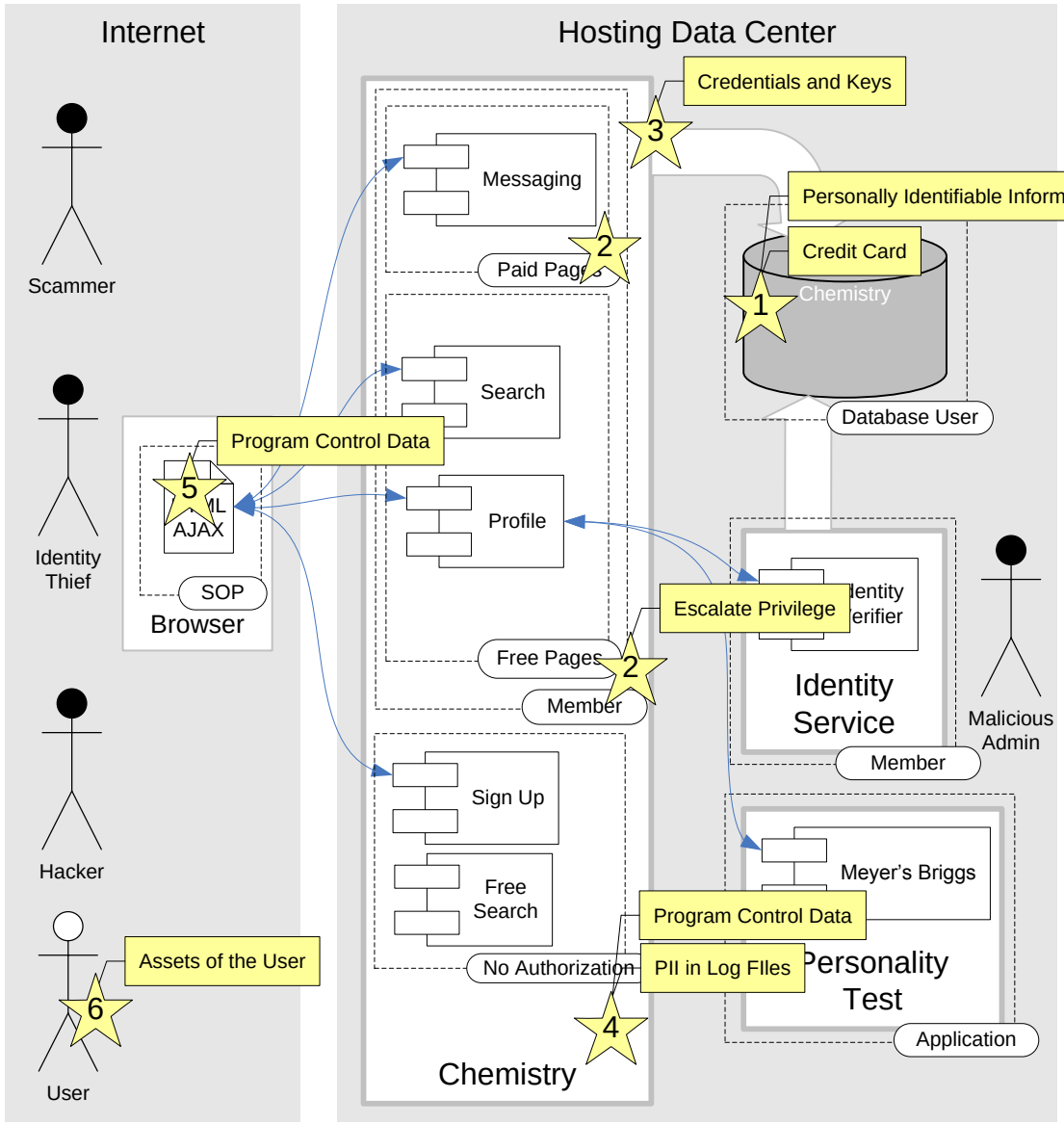
Ex: Threat modeling

- Threat: agents of malicious intent
- Asset: function and data the threat desires
- Point of Attack: Design element requiring hardening and/or the method of attack



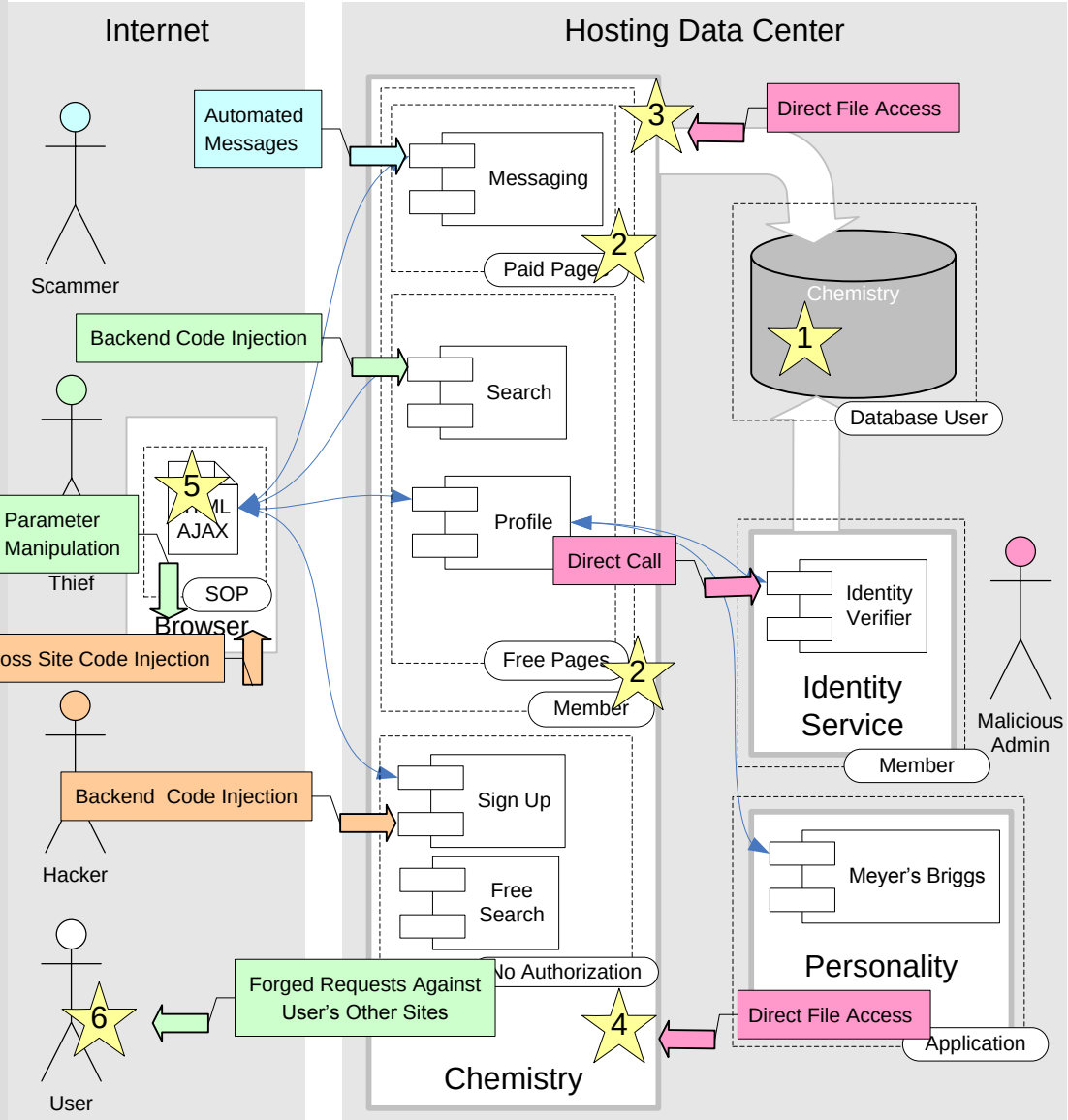
Ex: modeling users

- Threats = malicious users
- Like users, they have capabilities within the system
- Threats have a goal that usually involves subverting a security control or finding a "loophole" in the system



Ex: assets

- Application's functions
- Sensitive data
- Data controlling the application's state
- Users and the assets of the other systems the users access

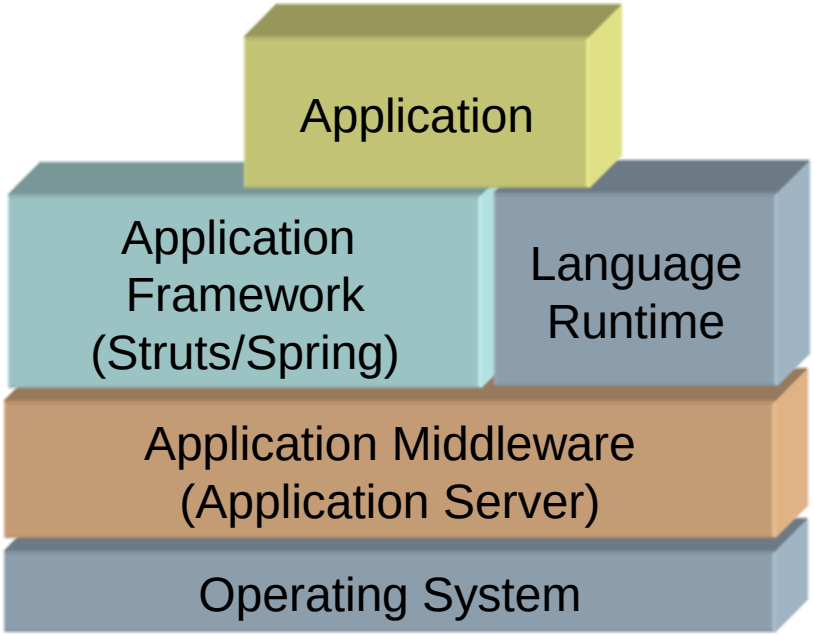


Ex: points of attack

- Associate threat and assets (determine what the attacker can do)
- Ponder nearest, easiest targets first
- Designers: place controls around assets
- Attackers: start with direct attacks and graduate to multi-step

Framework analysis

Software is built upon layers of other software



What kind of flaws exist?

- Known vulnerabilities in open-source or product versions
- Weak security controls provided with the framework
- Framework features that must be disabled or configured to their secure form

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Framework analysis: interfaces & contracts

- Place components or application relative to dependencies
  - It is important to see the relationship of an application or component with other callers of shared code and data
- Identify libraries and secure library versions
- Show runtime in diagram where there are security implications:
  - Framework controls
  - VM or other security sandboxes
  - Client-side runtime

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Framework security controls

- The application environment provides controls. What are the limitations?
  - Cryptography
    - Example: JCA
  - Authentication and Authorization
    - Example: JAAS
  - Input Validation and Output Encoding
    - .NET validateRequest
  - Sandboxing
    - JavaScript Same Origin Policy

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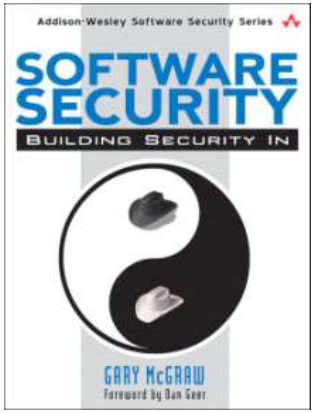
Combine risks and rank

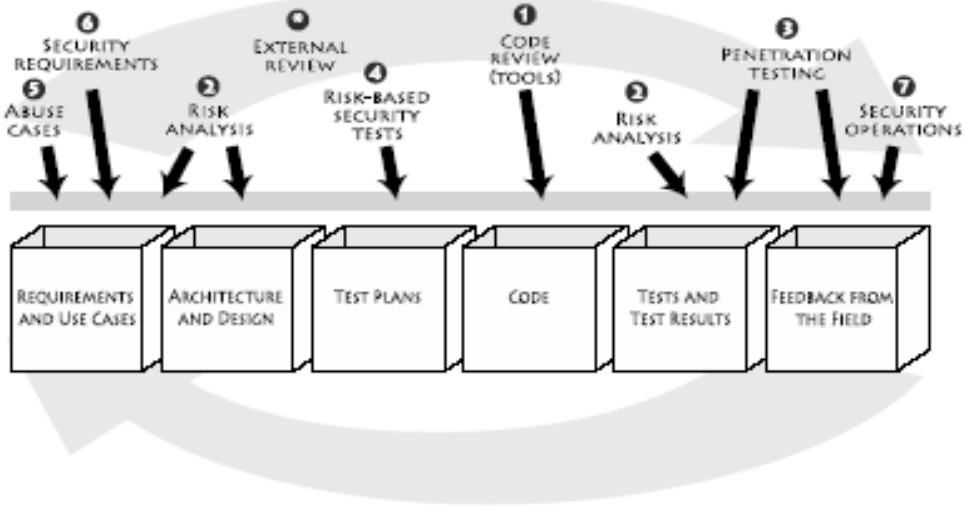
- Take all of your findings and consider business impact
- Rank the findings
- Come up with solutions

- See chapter 5 of “Software Security”
- http://www.informit.com/articles/article.asp?p=446451



Touchpoints adoption

- Code review
  - Widespread
  - Customized tools
  - Training
- ARA
  - Components help
  - Apprenticeship
  - Training
- Pen testing
  - No longer solo
- Security testing
  - Training
- Abuse cases and security requirements
  - Training



Where to Learn More

informIT & Justice League

- www.informIT.com
- No-nonsense monthly security column by Gary McGraw

- www.cigital.com/justiceleague
- In-depth thought leadership blog from the Cigital Principals
  - Scott Matsumoto
  - Gary McGraw
  - Sammy Migues
  - Craig Miller
  - John Steven

IEEE Security & Privacy Magazine + 2 Podcasts

- Building Security In
- Software Security Best Practices column edited by John Steven
- www.computer.org/security/bsisub/

The Silver Bullet Security Podcast
with Gary McGraw

- www.cigital.com/silverbullet
- www.cigital.com/realitycheck

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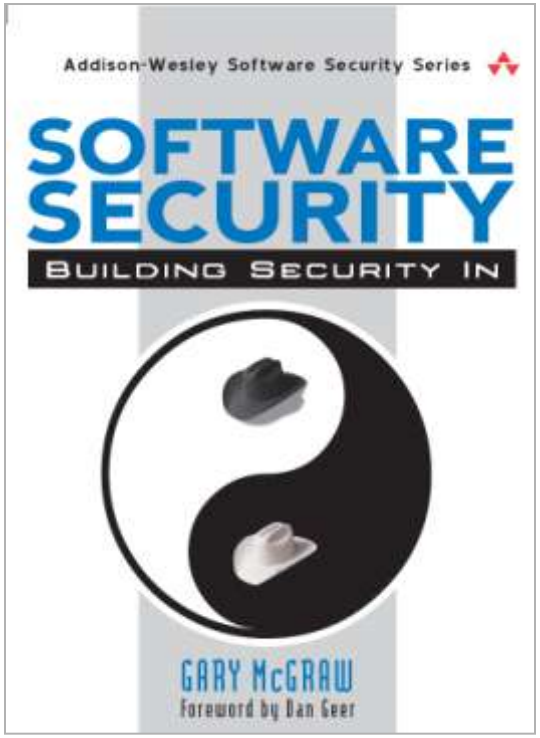
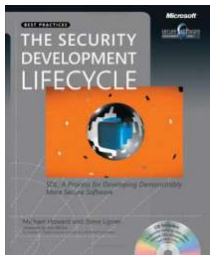
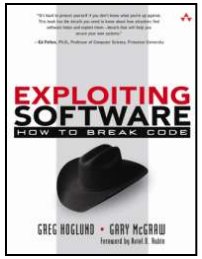


Software Security: the book

- How to DO software security
  - Best practices
  - Tools
  - Knowledge
- Cornerstone of the Addison-Wesley Software Security Series
- www.swsec.com





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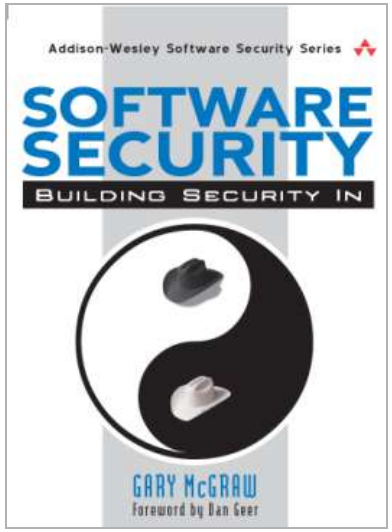
- Cigital's Software Security Group invents and delivers Software Quality Management
- WE NEED GREAT PEOPLE
- See the Addison-Wesley Software Security series
- Send e-mail: gem@cigital.com



For more

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"*So now, when we face a choice between adding features and resolving security issues, we need to choose security.*"

-Bill Gates