INTRO TO THREAT MODELING

Designing for Security

By Avi Douglen

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About… Avi Douglen

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- He / Him

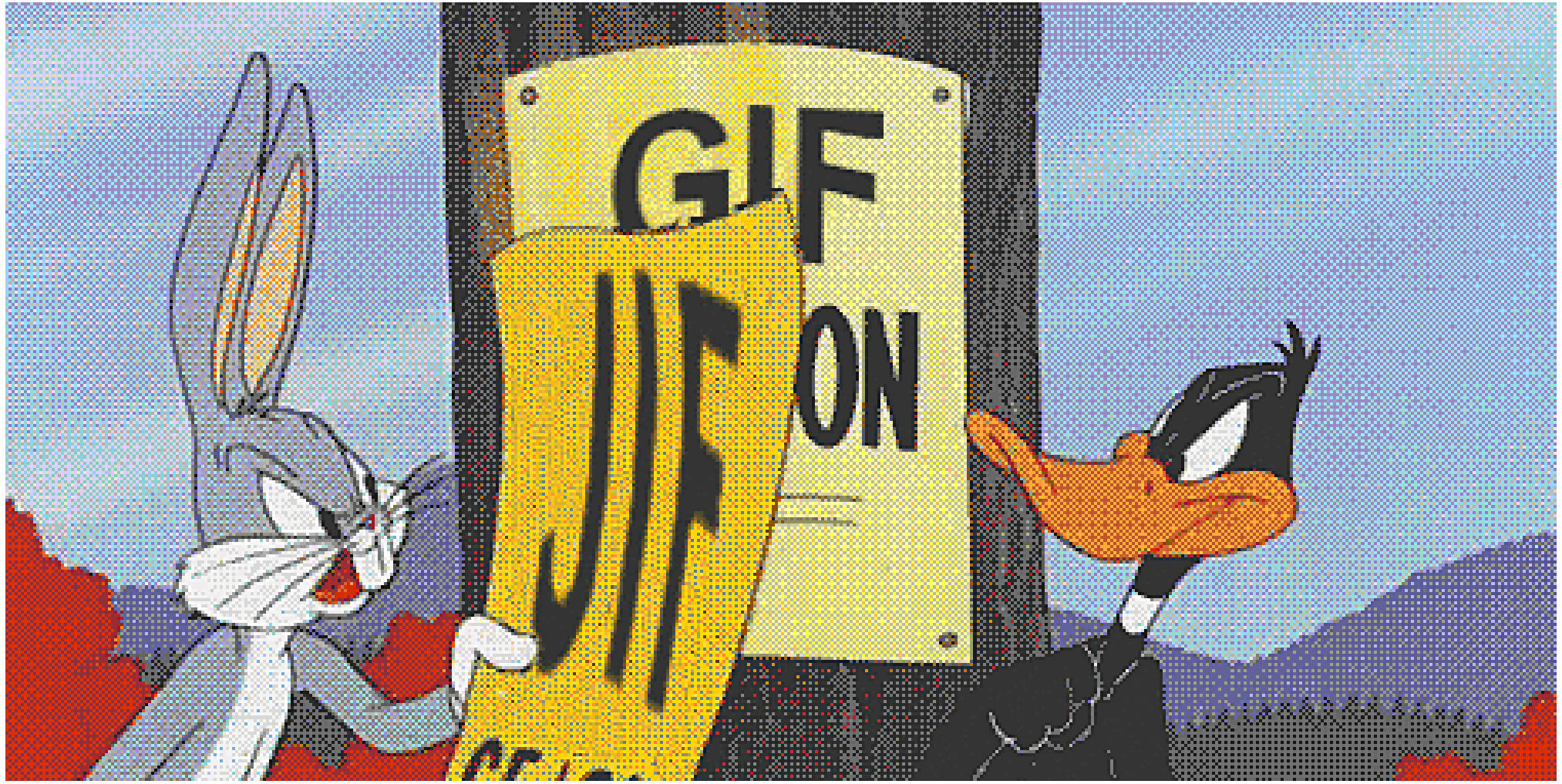
- The important things:
  - *Whisky: smokey*
  - *Beer: stout*
  - *Coffee: black*

- Software Security @ Bounce SECURITY
- Researcher / Developer / Architect
- Advisor at OurCrowd Labs/02
- OWASP Israel Leader
- Threat Model Project Leader
- Moderator Security.StackExchange

Agenda

- Why Threat Modeling
- What Threat Modeling
- How Threat Modeling
- Who Threat Modeling
- When Threat Modeling

The Eternal Conundrum…



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How Secure is Secure *Enough* ??

- How much time / resources to invest in security?
- Spend too much = WASTE
- Spend too little = BREACHED
  - *(or worse, fined)*
- … Or maybe it's both??
- The crutch of generic "Best Practices"

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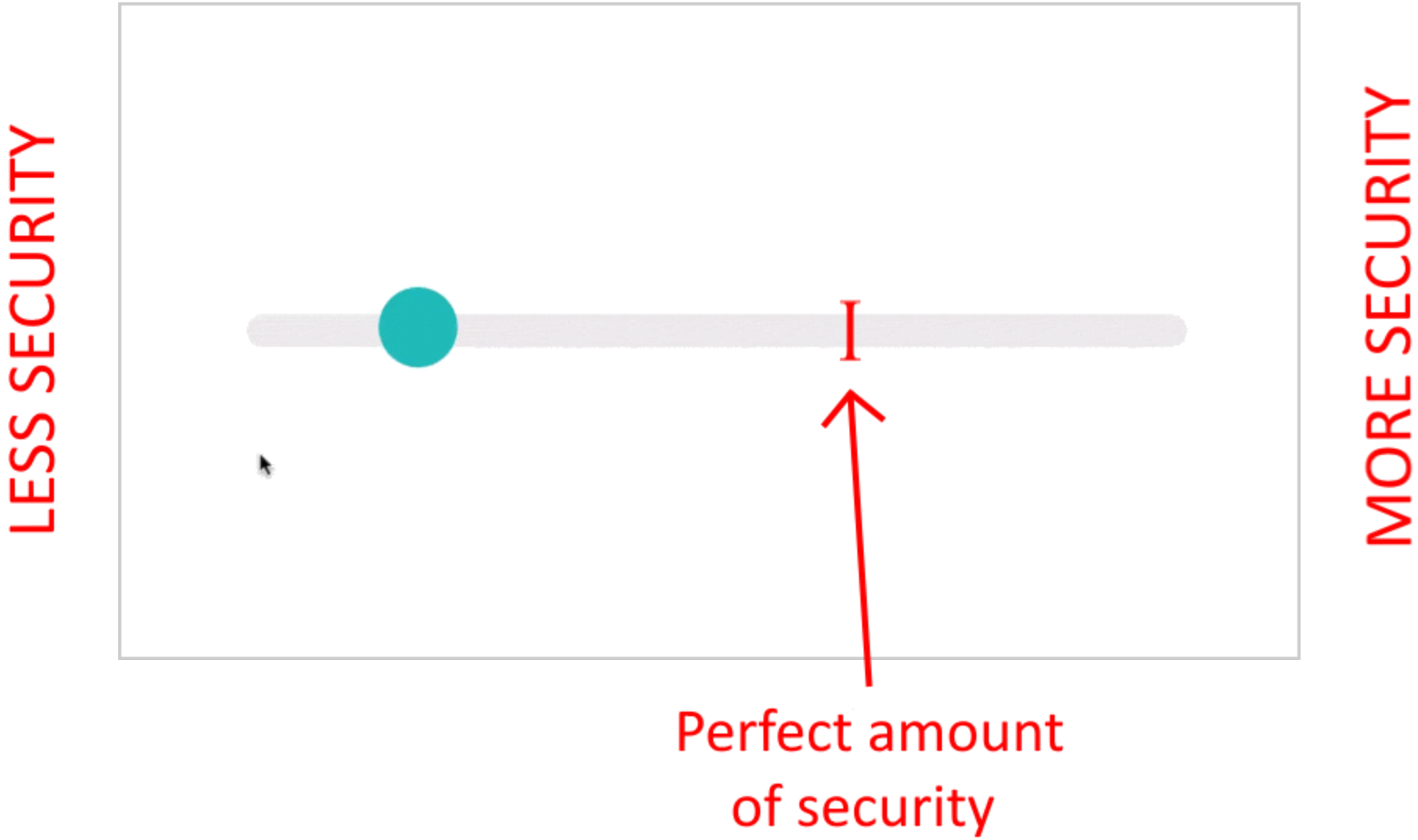

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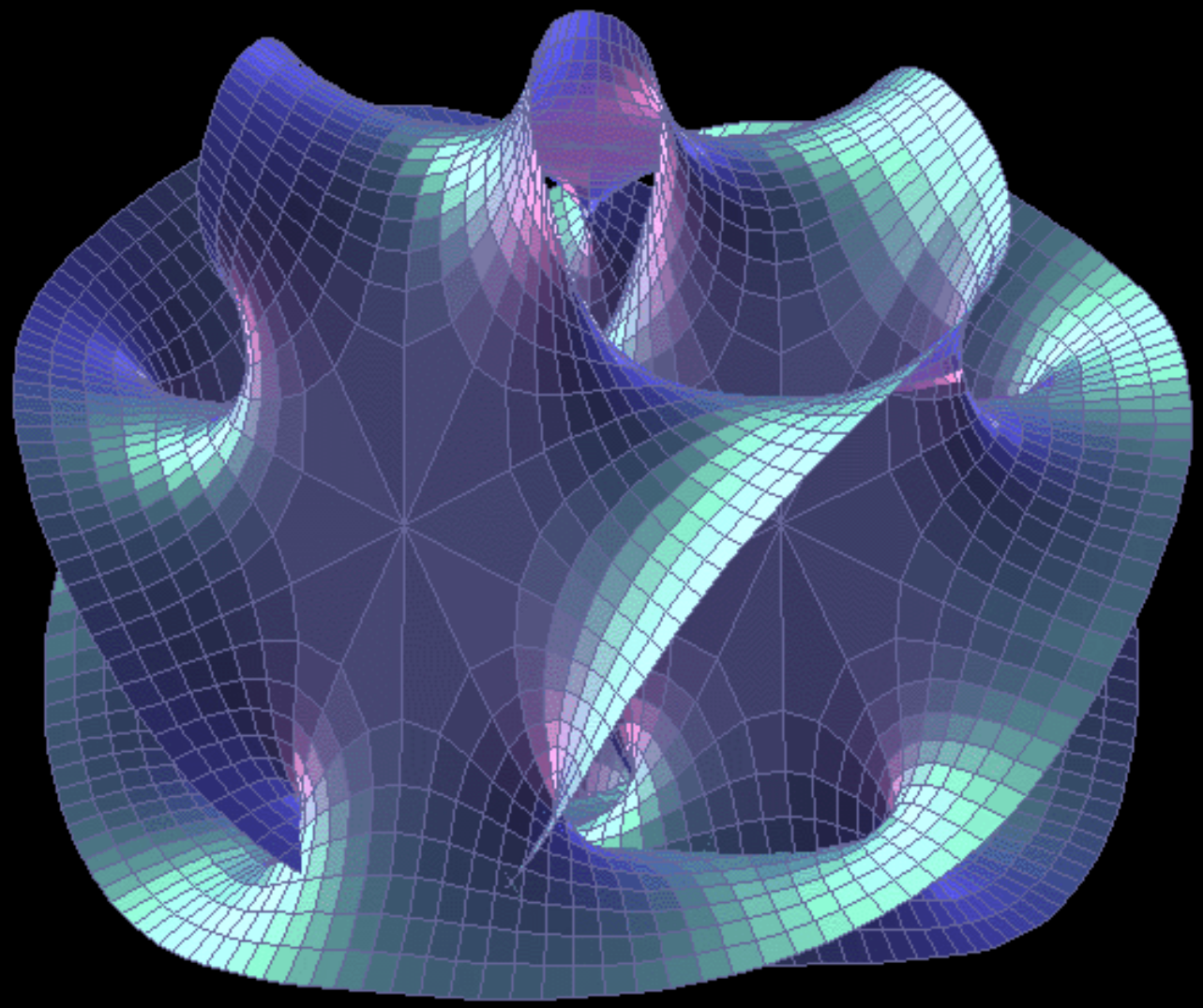

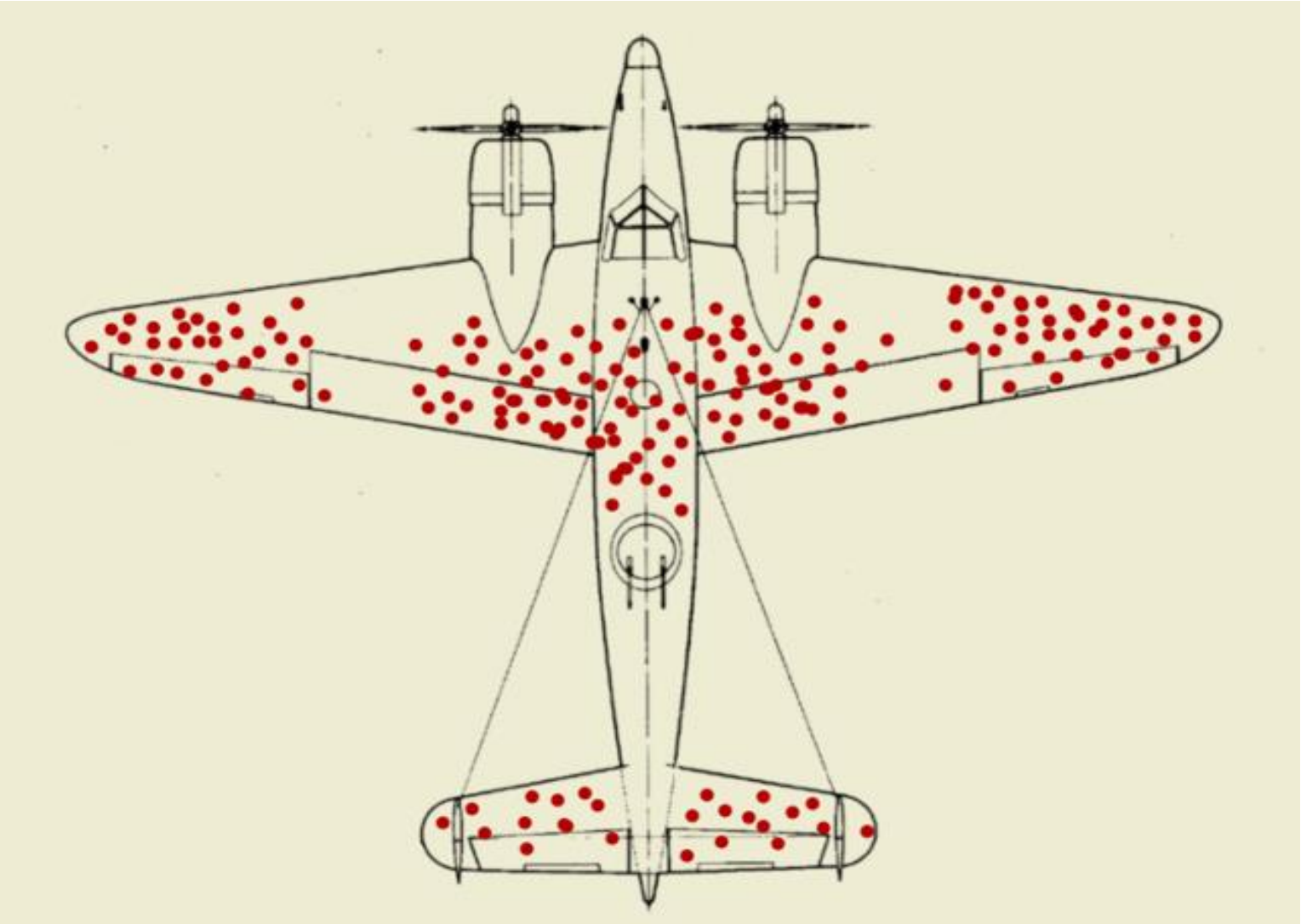

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What does “secure” even mean?

- When you don’t get hacked?
- What are you protecting?
- How are you being attacked?
- Who is attacking you?
- Why are they targeting you?

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Why it is Important

- Most systems have exploitable vulnerabilities
- Customers are demanding secure systems
- Best to build on a secure design
- Find security issues without a line of code
- Shared understanding of system security
- How much time is wasted:
  - *building unneeded security features*
  - *patching critically broken security*

Security is YOUR Responsibility

- Essential non-functional requirements
- Less work now vs. more work later
- Which “security” to work on?
- Own your products security
- Threat modeling helps focus efficient work

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The Threat Modeling Approach

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Enter Threat Modeling

- Structured security-based analysis
- Framework to understand threats
- Review of design elements
- Prioritize mitigations by risk

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Common Approaches

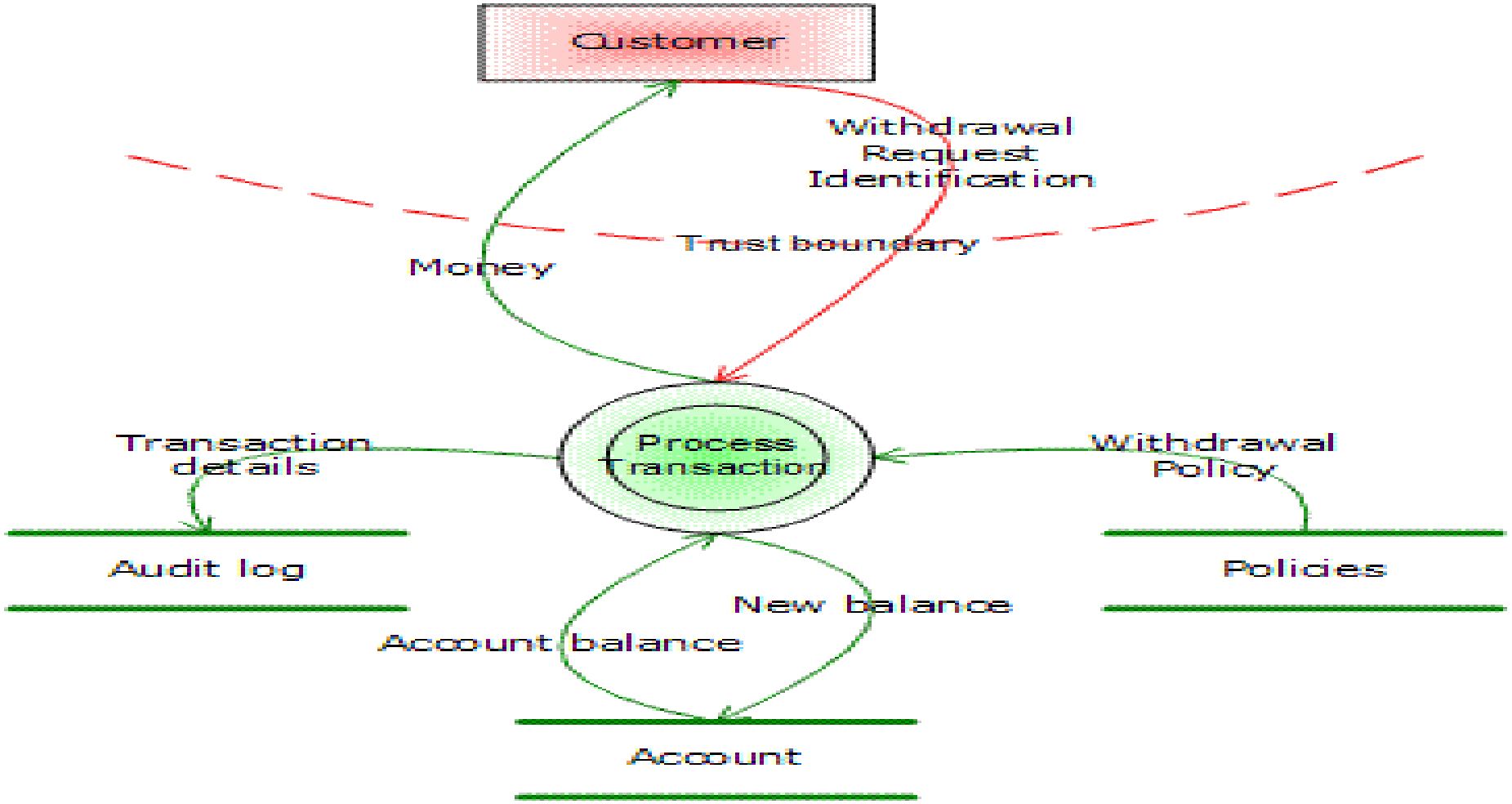
- Software centric
- Asset centric
- Attacker centric
- Risk based
- Value driven

Threat Modeling Framework

- Thanks to Adam Shostack

- What are we building?
- What can go wrong?
- What are we going to do about it?
- Did we do a good job?

Data Flow Diagram



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The Process

Phase #0 – Scope the model

Phase #1 – Decompose the application

Phase #2 – Identify the threats

Phase #3 – Determine countermeasures

Phase #4 – Analyze result

STRIDE Per-Element

Spoofing
Tampering
Repudiation
Information Disclosure
Denial of Service
Elevation of Privileges

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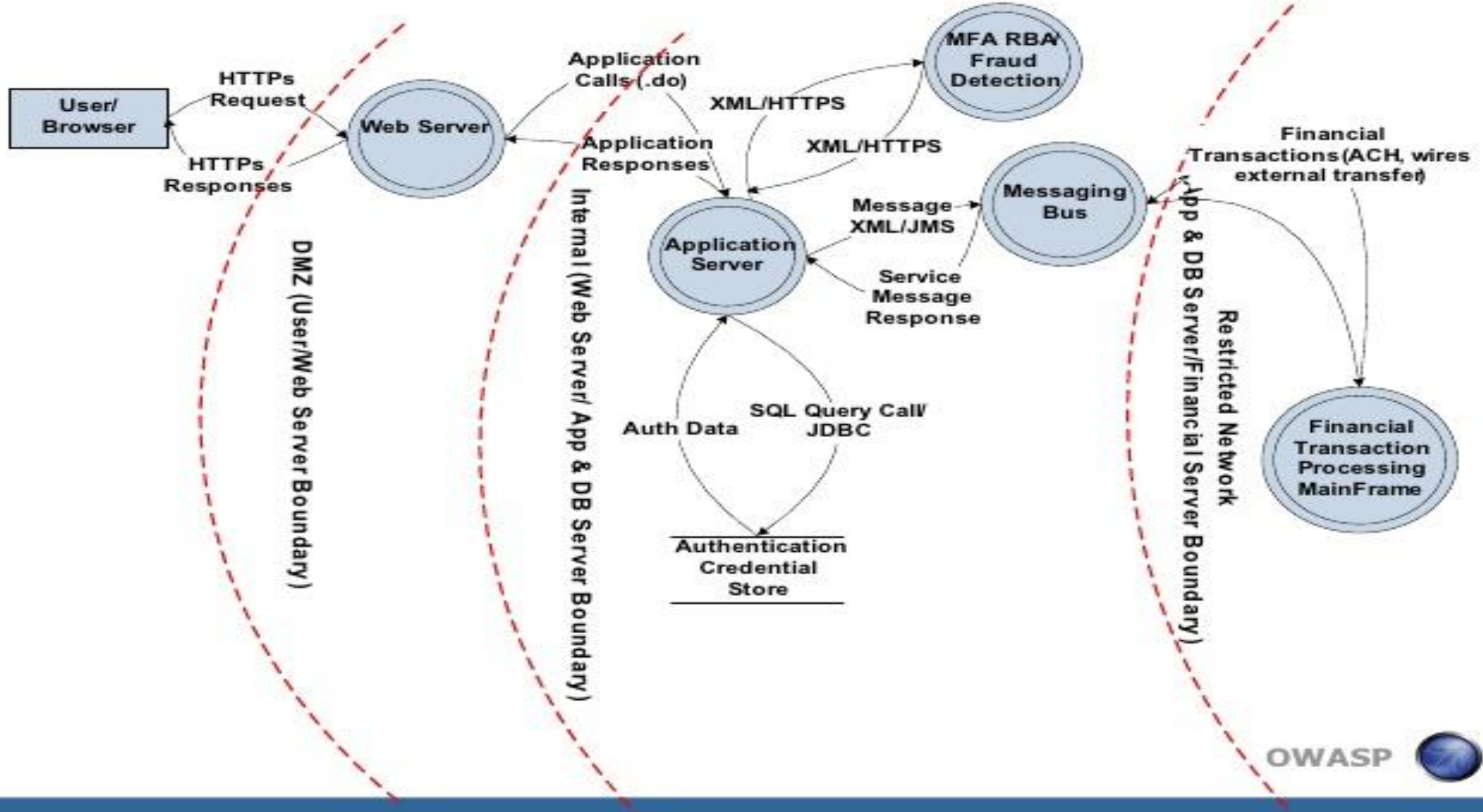
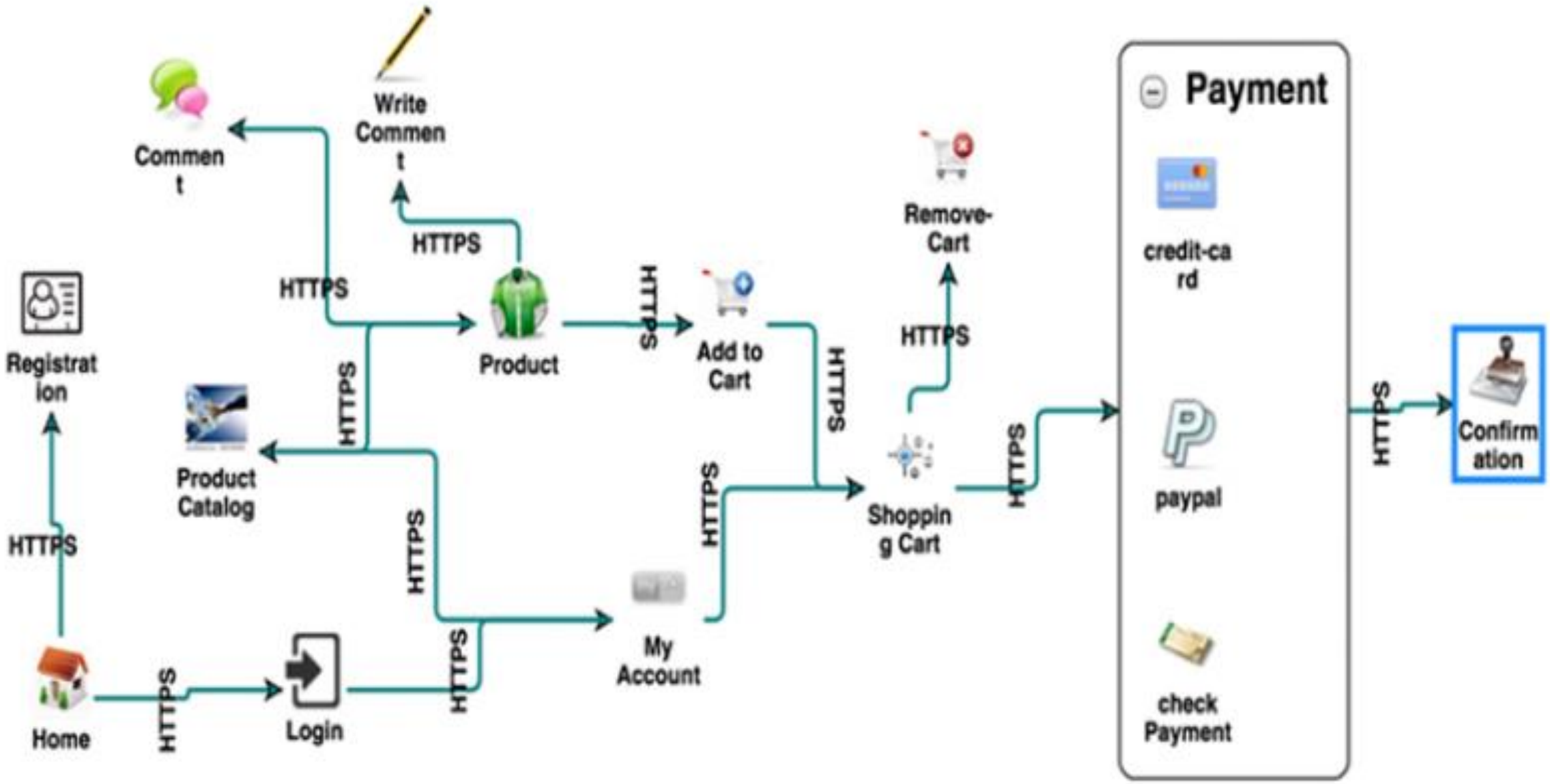
Data flow diagram-Online Banking Application

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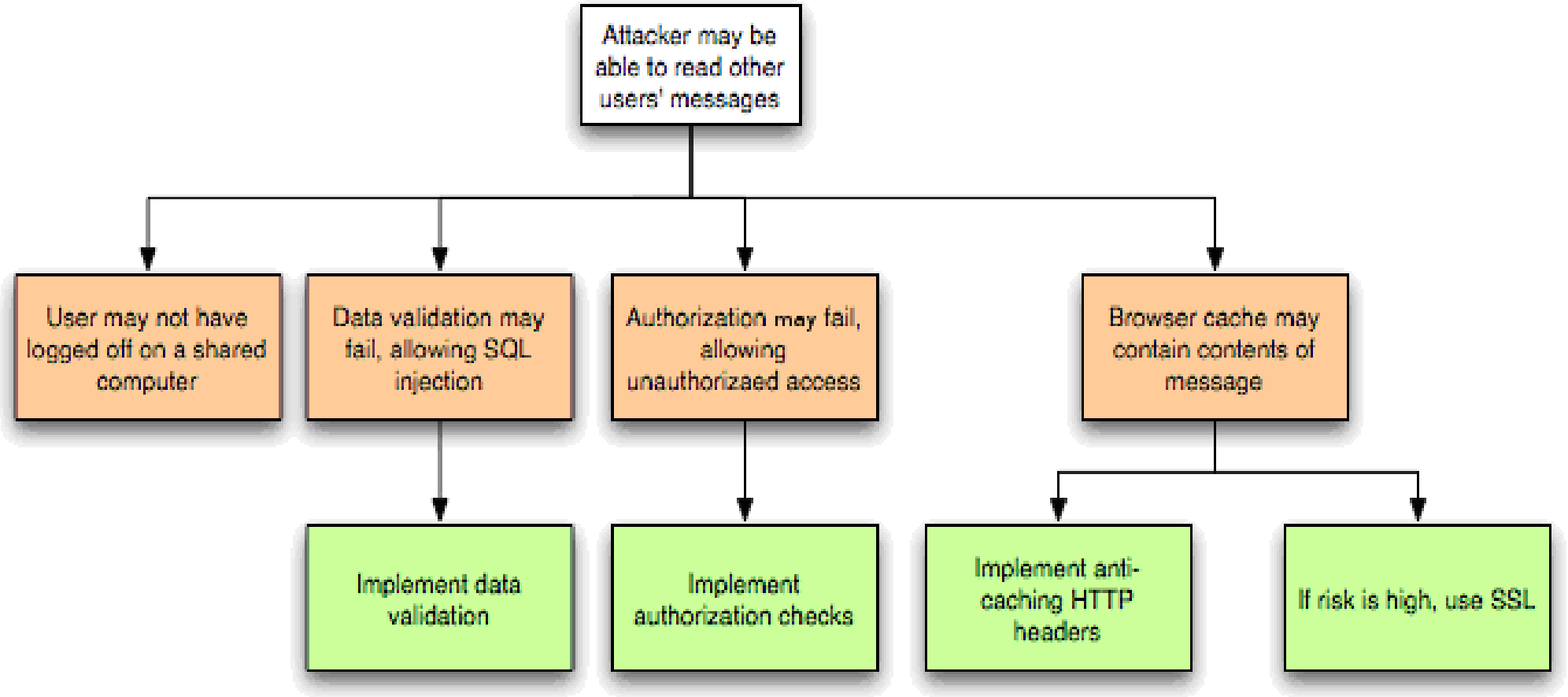
Attack Trees



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P.A.S.T.A

- **P**rocess for **A**ttack **S**imulation and **T**hreat **A**nalysis
- Risk-Based Methodology for higher assurance

- Seven stage process:

1. Define Objectives

- Identify Business Objectives
- Identify Security & Compliance Requirements
- Business Impact Analysis

2. Define Technical Scope

- Capture the boundaries of the technical environment
- Capture Infrastructure | Application | Software Dependencies

3. Application Decomposition

- Identify Use Cases | Define App Entry Points & Trust levels
- Identify Actors | Assets| Services | Roles| Data Sources
- Data Flow Diagramming (DFDs) | Trust Boundaries

4. Threat Analysis

- Probabilistic Attack Scenarios Analysis
- Regression Analysis on Security Events
- Threat Intelligence Correlation & Analytics

5. Vulnerability & Weakness Analysis

- Queries of Existing Vulnerability Reports & Issues Tracking
- Threat to Existing Vulnerability Mapping Using Threat Trees
- Design Flaw Analysis Using Use & Abuse Cases
- Scorings (CVSS/ CWSS) | Enumerations (CWE/CVE)

6. Attack Modeling

- Attack Surface Analysis
- Attack Tree Development | Attack Library Mgt
- Attack to Vulnerability & Exploit Analysis using Attack Trees

7. Risk & Impact Analysis

- Qualify & quantify business impact
- Countermeasure Identification & Residual Risk
- ID risk mitigation strategies

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From a Developer's Perspective

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Takes too much time!

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“Security is everybody’s job”

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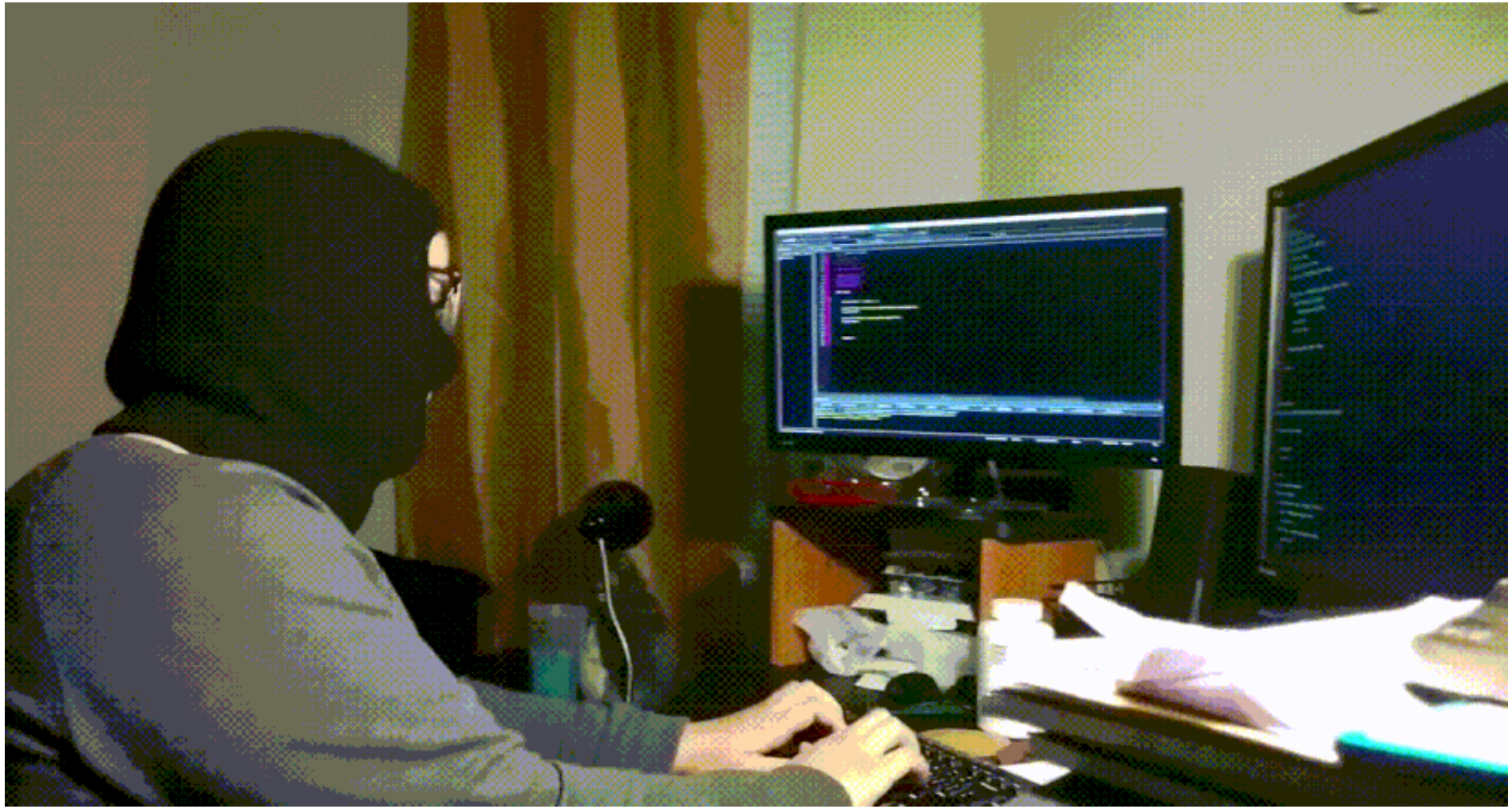

“Think like an attacker”

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Threats are obvious

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Use case approach to user story development

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Big Model Up Front

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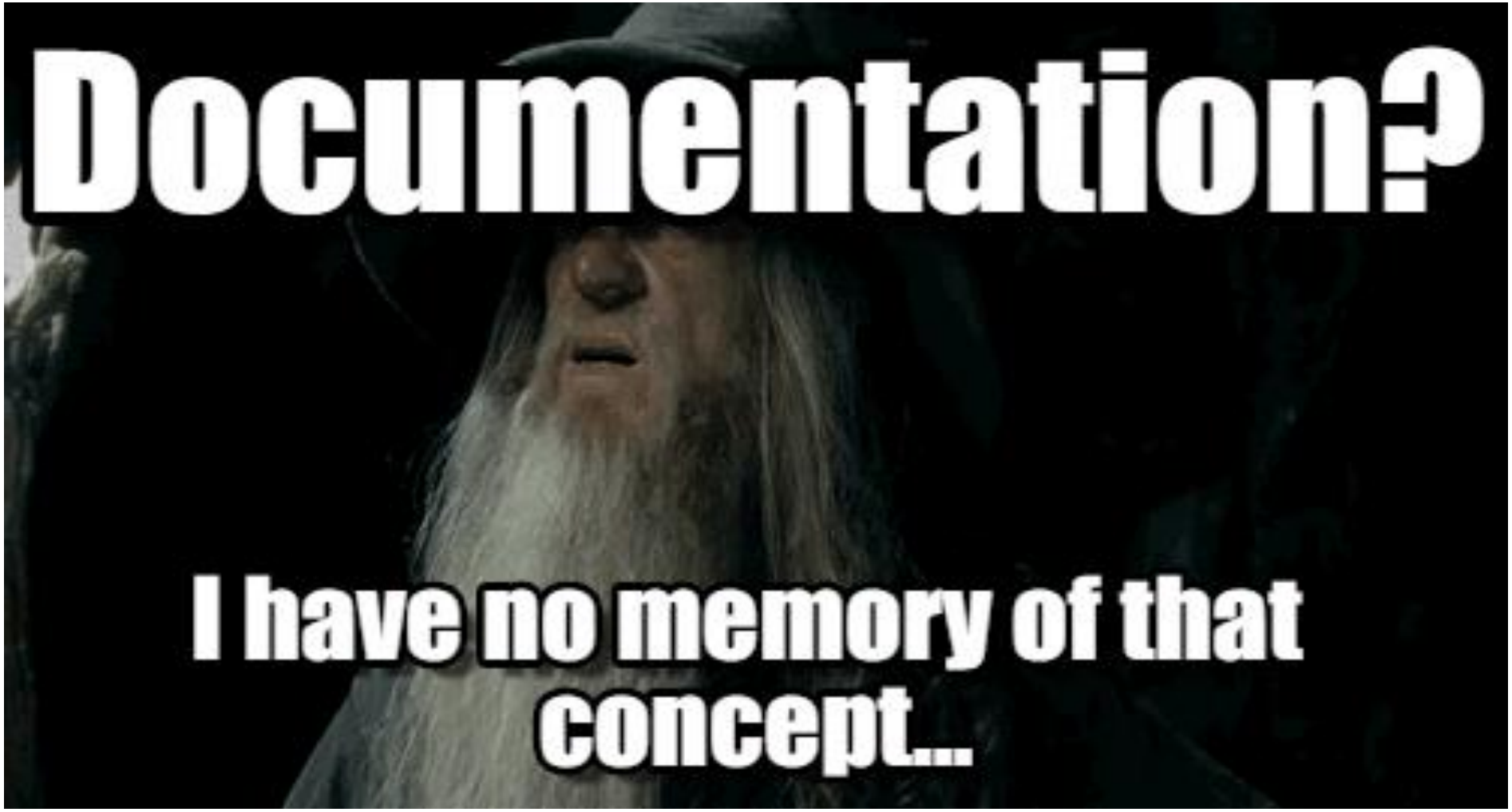

Threat model separate from design

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Usually out of date before completed

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You want me to do WHAT with this?

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Wasted time on unrealistic threats

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Dependent on Security

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Security team drops in and out

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Security team doesn’t scale

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Value Driven Process

Value Driven Approach

"All Threat Models are wrong,
some are useful"

Accept that it's wrong,
focus on the usefulness

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Prioritize by Value Chain

- Why are we building this?
- How do we get the value from this?
- What do we do to ensure that happens?

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Find the Value

Follow the money!

How do people die?

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Lightweight Threat Modeling

- Prioritize by value chain
- Focus on building useful controls
- Goal driven mitigation
- Threat patterns library
- Assumption-less design

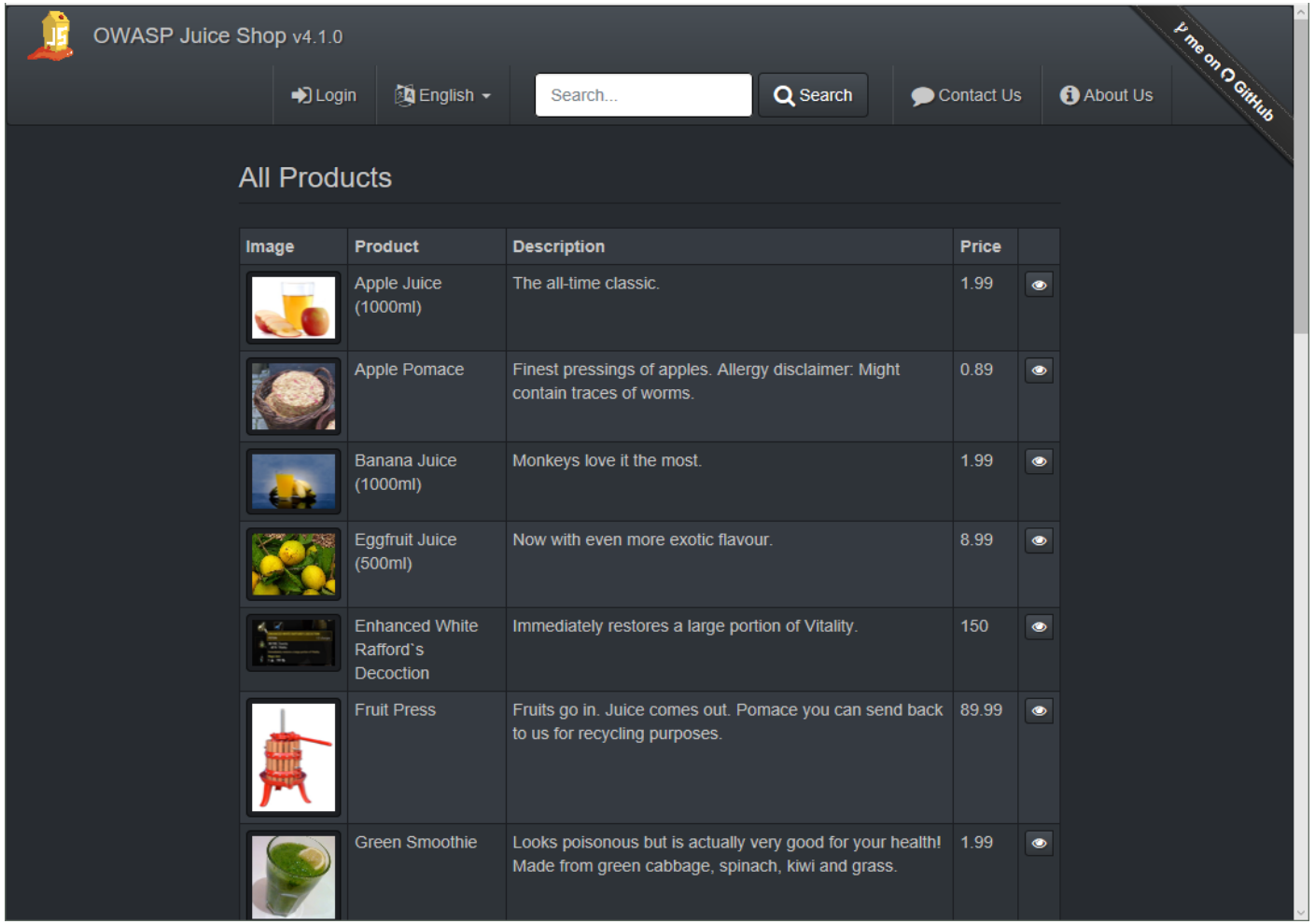
Scope

- For each User Story / Epic / Feature
  - *During “Discovery” or Sprint Planning*
  - *Agile approach of “just enough”*
  - *Threat model goes into the User Story*

Workflow – Stories & Epics

1. State story goals and value chain
2. Describe expected flow and failure states
3. Discover assumptions and conditions
4. Validate assumptions and enforce conditions
5. Explicitly handle failure states

OWASP Juice Shop



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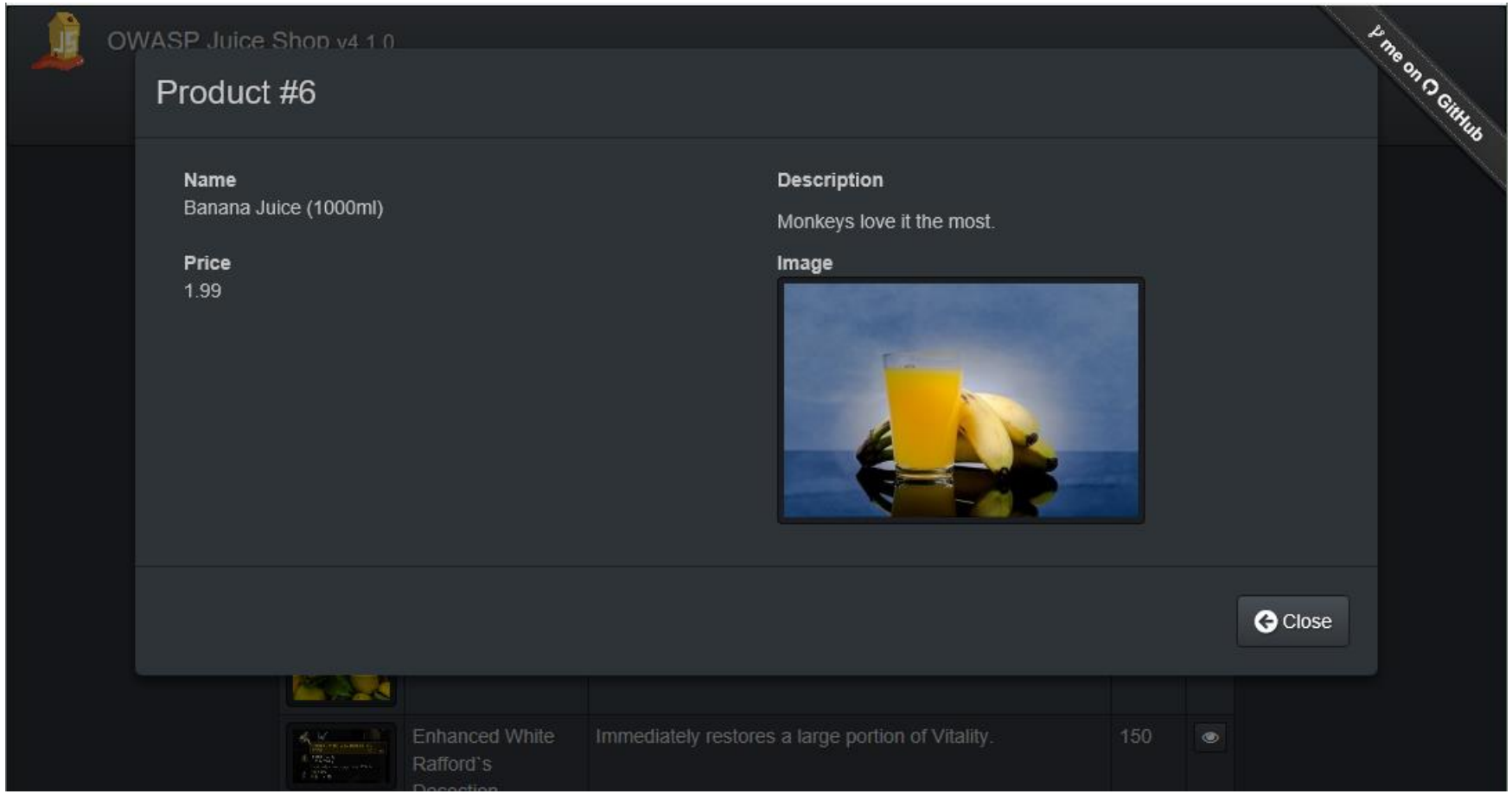
OWASP Juice Shop - Selection



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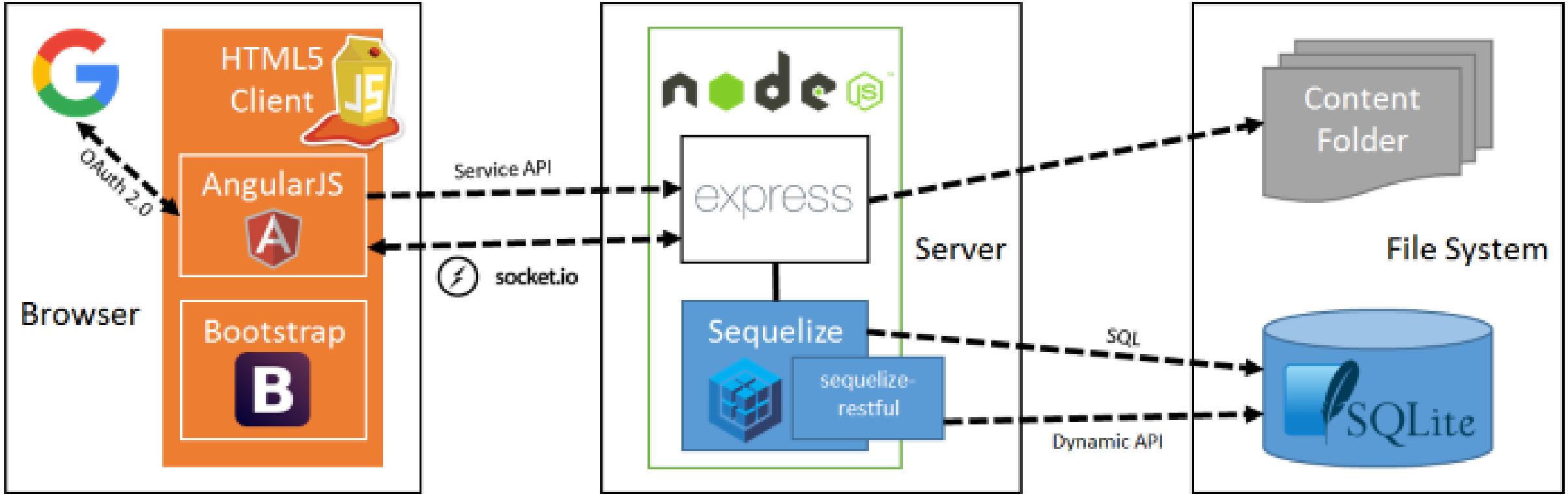
OWASP Juice Shop Architecture



OWASP Juice Shop - Checkout

OWASP Juice Shop v4.1.0

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Your Basket

Product	Description	Price	Quantity	Total Price	
Banana Juice (1000ml)	Monkeys love it the most.	1.99	5	9.95	
Raspberry Juice (1000ml)	Made from blended Raspberry Pi, water and sugar.	4.99	1	4.99	
Woodruff Syrup "Forest Master X-Treme"	Harvested and manufactured in the Black Forest, Germany. Can cause hyperactive behavior in children. Can cause permanent green tongue when consumed undiluted.	6.99	1	6.99	

Checkout

Coupon (Need a coupon code? Follow us on **Twitter** or **Facebook** for monthly coupons and other spam!)

Redeem

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OWASP Juice Shop - Coupon

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Agile Techniques

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Advantages of Agile

Attributes:

- Cross functional teams
- Focus on usable software
- Developer independence

Activities:

- Definition of Done
- Acceptance Criteria
- TDD / Unit tests

Updated User Story Format

“As a … I want … so that … WITHOUT …”

As a customer,
I want to purchase juice
so that my kids let me sleep in
<u>WITHOUT my credit card being stolen</u>

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Acceptance Criteria

When I login with a wrong password,
I should be locked out after X times.

Security Unit Tests

Test that accounts are locked after X attempts

Test locked accounts are unlocked after Y time

Abuser Stories

As an attacker,
I want to impersonate another user
so that I can steal their juicebox

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Sorry Points

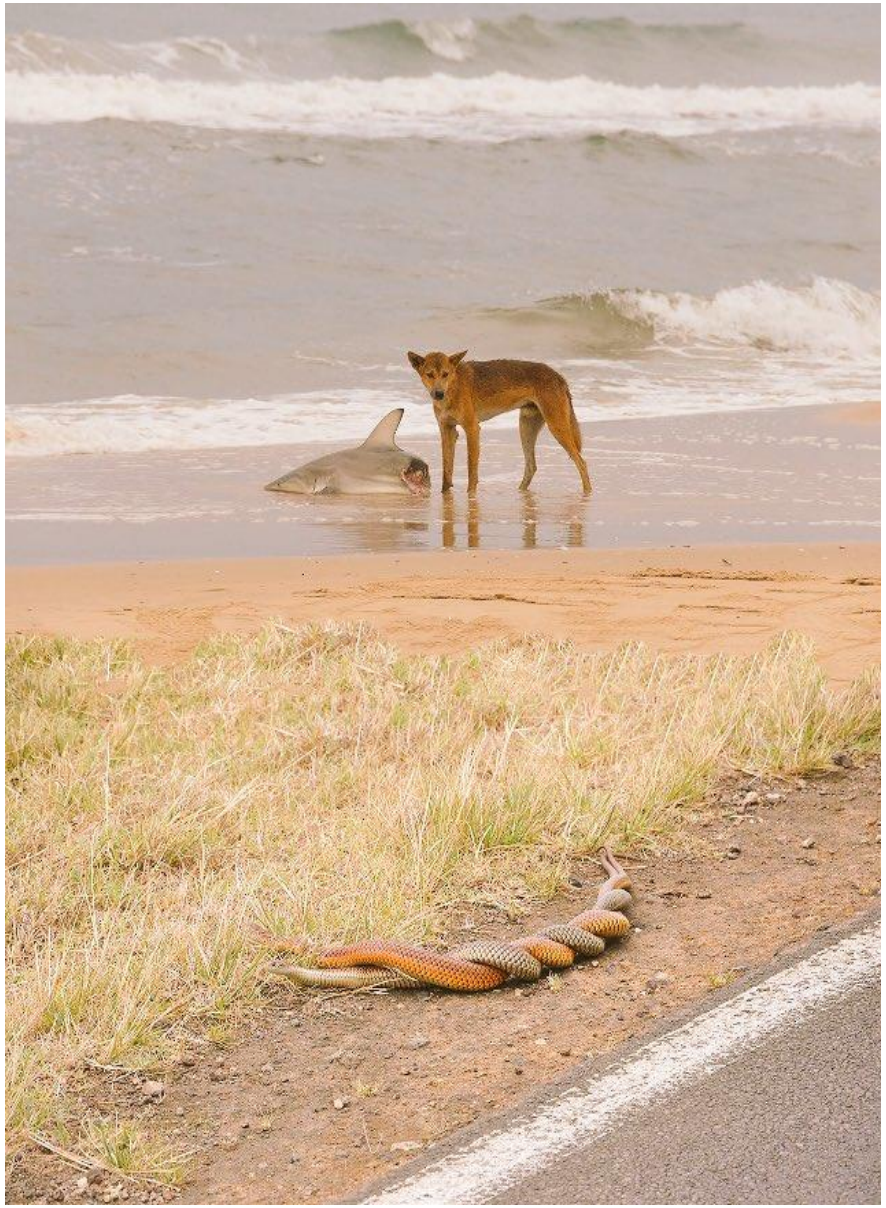
- Similar to Story Points
  - *Rough estimate relative to other stories*
- Measured in the same way
  - *Tshirt sizes, Fibonacci values, etc*
- “How sorry will you be if this breaks?”
  - *Value*
  - *Visibility*
  - *Side effects*

Story Points

Relative estimate of effort

Sorry Points

Relative estimate of impact



"What if it goes horribly wrong?"

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Definition of Done

User stories will include a threat model and security tests.

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Communication

x Cross Site Request Forgery (CSRF)	<->	✓ Unauthenticated Access to Cash Transfer
x Stored XSS	<->	✓ Admin Takeover
x AuthZ Bypass	<->	✓ Change Delivery Address
x Denial of Service	<->	✓ Loss of Revenue/Market

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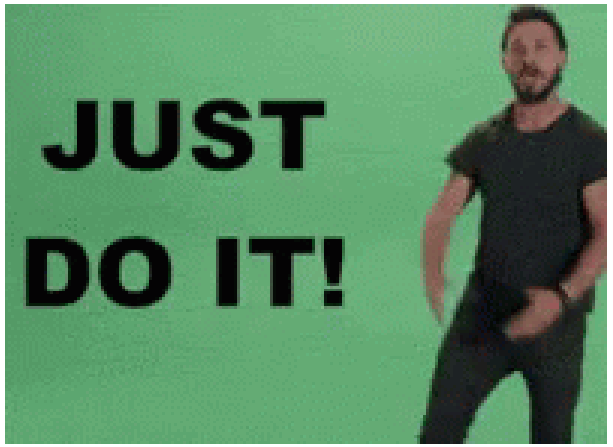
Takeaways

- Design for security by threat modeling
- Everything should be threat modeled
- Everyone should be threat modeling
- Focus on business value
- Prioritize usefulness



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THANKS FOR LISTENING!

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