Anatomy of a Logic Flaw

Presented by:

Charles Henderson
Director, Application Security Services
chenderson@trustwave.com

David Byrne
Managing Consultant
dbyrne@trustwave.com

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Vulnerabilities

- **"Traditional" Vulnerabilities**
  - Standardized definitions
  - Security requirements common to all applications
- **"Logic" Flaws**
  - Violations of business rules; may be rules unique to a company or industry
- **All vulnerabilities are violations of security rules**

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SQL Injection

- **Requirement:**

  Do not allow users to execute arbitrary SQL commands

- **Vulnerability:**

  Users can execute arbitrary SQL commands

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Authentication Bypass

- **Requirement:**

  Verify a user's identity before allowing access to the application

- **Vulnerability:**

  Access can be obtained without proving identity

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Cross-Site Scripting

- **Requirement:**

  Do not allow users to define browser-side scripts

- **Vulnerability:**

  Users can define browser-side scripts

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Vulnerabilities

- **"Traditional" Vulnerabilities**
  - Standardized definitions
  - Security requirements common to all applications
- **"Logic" Flaws**
  - Violations of business rule
  - Rules are often unique to a company, industry, or type of application
- **All vulnerabilities are violations of security rules**

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Payment Bypass

- **Requirement:**

  Customers must pay for goods & services

- **Vulnerability:**

  Customers are not required to pay for goods & services

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Client-Side Price Fixing

- **Requirement:**

  Only the business can set the price of goods

- **Vulnerability:**

  Customers can set the price of goods

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Root Causes of Logic Flaws

- **Failure to anticipate threats**
- **Insufficient documentation of business rules**
- **Poor design practices (no SDLC)**
- **Poor understanding of underlying technologies**
- **Bad production management**

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Examples

- **All real world examples**
- **Most are from real Trustwave tests, but client identity is well protected**
- **These are not rare flaws; we find them on a regular basis**

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Complex Price Manipulation

```
eyDigJ1pdGVtIjogeyAidGl0bGUiOiDigJ1IYWNraW5nIGZvciBE
   dW1taWVzIiwg4oCdQXV0aG9yIjogeyAidGl0bGUiOiAiUyIsIO
   KAnUNodWNrIEhlbmRlcnNvbiI6IHsgIkdsb3NzRW50cnkiOiB7
   ICJJRCI6ICJTR01MIiwgIlNvcnRBcyI6ICJTR01MIiwgIkFjcm
   9ueW0iOiAiU0dNTCIsIOKAnVByaWNlIjog4oCdMTU4NeKAnX0g
   fSB9IH0gIAoK
```

```
{ "item": { "title": "Hacking for Dummies",
   "Author": { "name": "S", ”Tom Brennan":
   { "GlossEntry": { "ID": "SGML", "SortAs": "SGML",
   "Acronym": "SGML", "Price": "1585"} } } }
```


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Complex Price Manipulation

Root cause:

- **Poor understanding of underlying technologies**

History

- **This was an otherwise secure application**
- **The application framework obscured what data was sent to the client**

Prevention

- **Avoid niche application frameworks**
- **Popular frameworks have better documentation**
- **If a niche product is needed, dig into its internals**

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Private Performances

- **Online theater seat reservation system**
- **Put seats into a cart,**
  then checkout later
- **Once seats are in a cart, they are held so that seats are not overbooked**
- **Using multiple browsers**
  1. Put the seats you want into a cart
  2. Put the remaining open seats into a the second cart
  3. Complete the checkout of the first cart
  4. Never complete the checkout of the second cart.

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Private Performances

Root causes:

- **Failure to anticipate threats**
- **Poorly documented business rules**
- **Poor design practices**

History

- **Likely similar to the earlier examples of programmers experienced with private applications**

Prevention

- **A lot**

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Eat for (almost) Free

- **Online system to place restaurant orders for delivery**

- **Standard online order process**
  1. You select your meal
  2. Enter your address
  3. Pay your bill
  4. Food arrives

- **A third party handled the credit card transaction**
  - Redirected to a third party to handle the credit card purchase
  - Redirected back to the primary site after approval

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Eat for (almost) Free

Minha Bandeja

Valor do pedido:	3.50
Taxa de entrega:	6.00
Total do pedido:	9.50

QTD. PROD VLR

My Tray

Order value:	3.50
Delivery Rate:	6.00
Total Order:	9.50

QTD. PROD VLR

NÃO É DOCUMENTO FISCAL
COMPROVANTE CRÉDITO OU DÉBITO
CARTAO CREDITO
1ª VIA

COO do documento vinculado: 102642
Valor da compra R$ 9,50
Valor do pagamento R$ 9,50

REDECARD 51[redacted]******[redacted] A:064254
CREDITO VALOR: 0,50
969501020274297 DOC:004527237 (SiTef)

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Eat for (almost) Free

Root causes:

- **Insufficient documentation of business rules: The restaurant's novice developers assumed that the processor was providing a secure service.**
- **Failure to anticipate threats: User tampering should always be prevented**

History

- **The payment processor did not provide a way to detect user tampering**

Prevention

- **Clearly define security responsibilities when integrating with a third party.**
- **Detect user tampering with cryptographic signing**

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Static Entropy

- **Effective random number generation relies on a strong entropy source**

```
using System;
public class RandomGenerator
{
        Random random = new Random(3212351);
        public int getNext()
        {
                return random.Next();
        }
}
```


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Static Entropy

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Static Entropy

Root causes:

- **Poor understanding of underlying technologies**

History

- **The developers didn't understand how random number generators worked**

Prevention

- **Educate developers**

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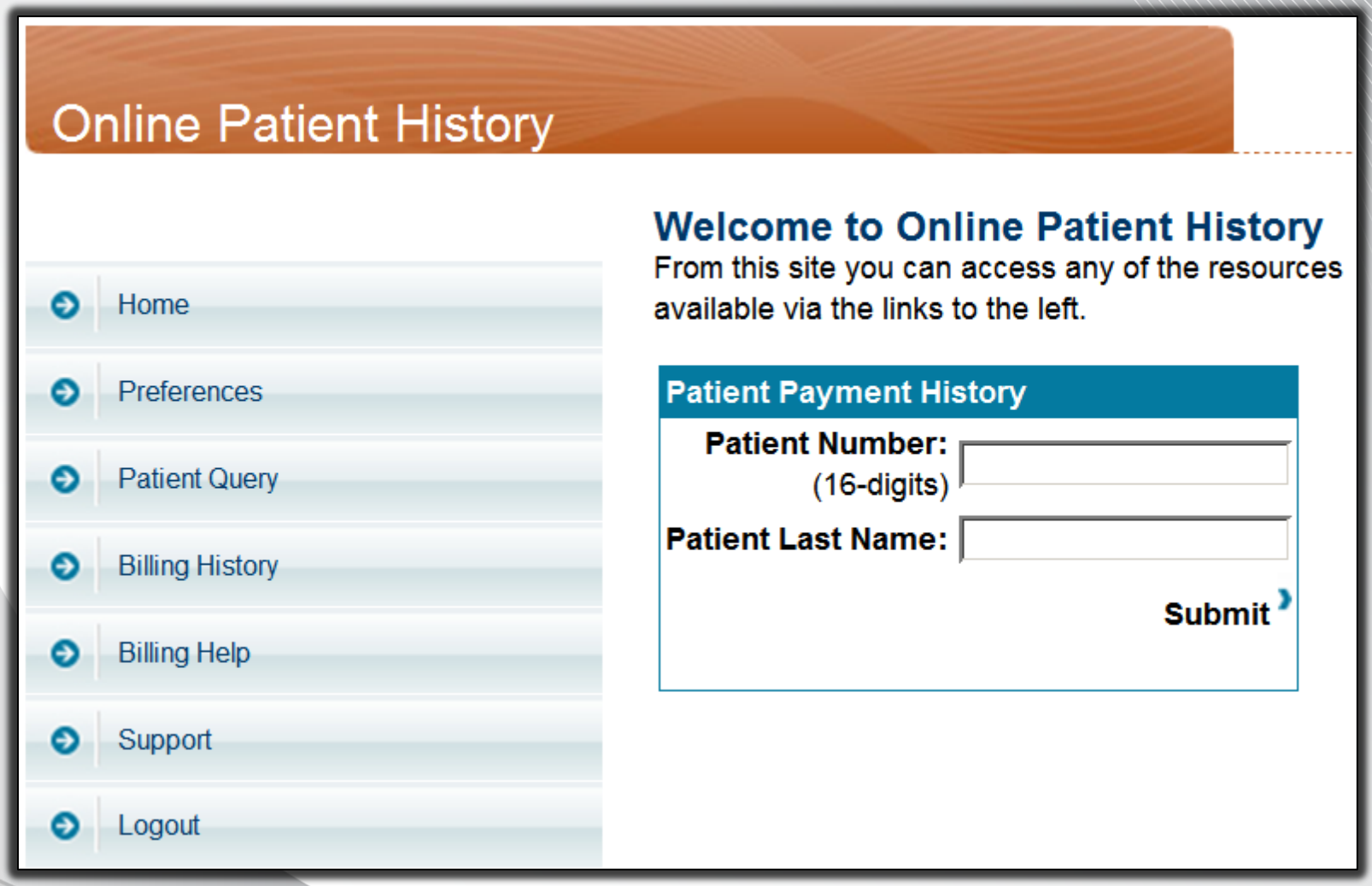
When Queries Collide



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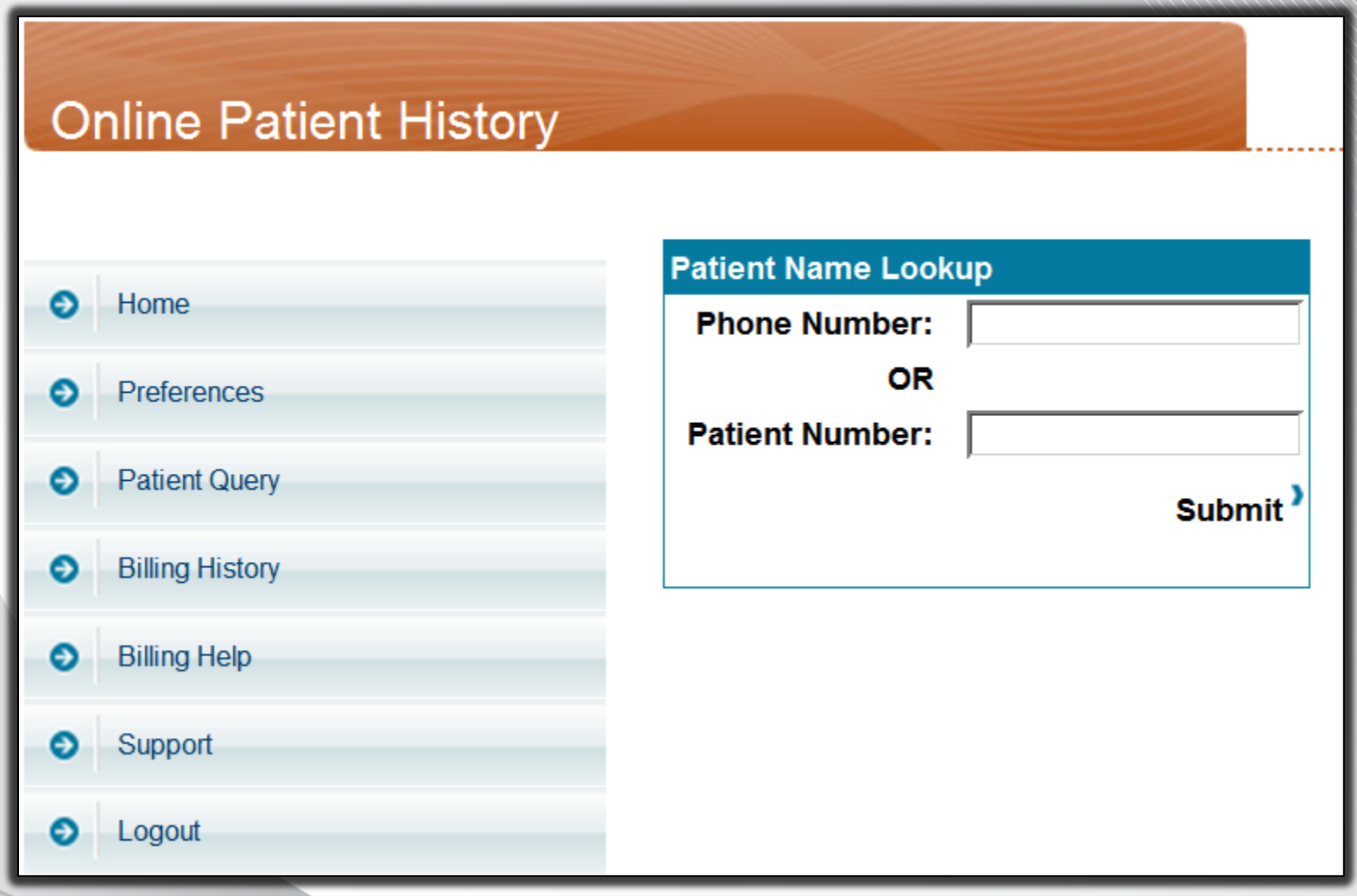
When Queries Collide



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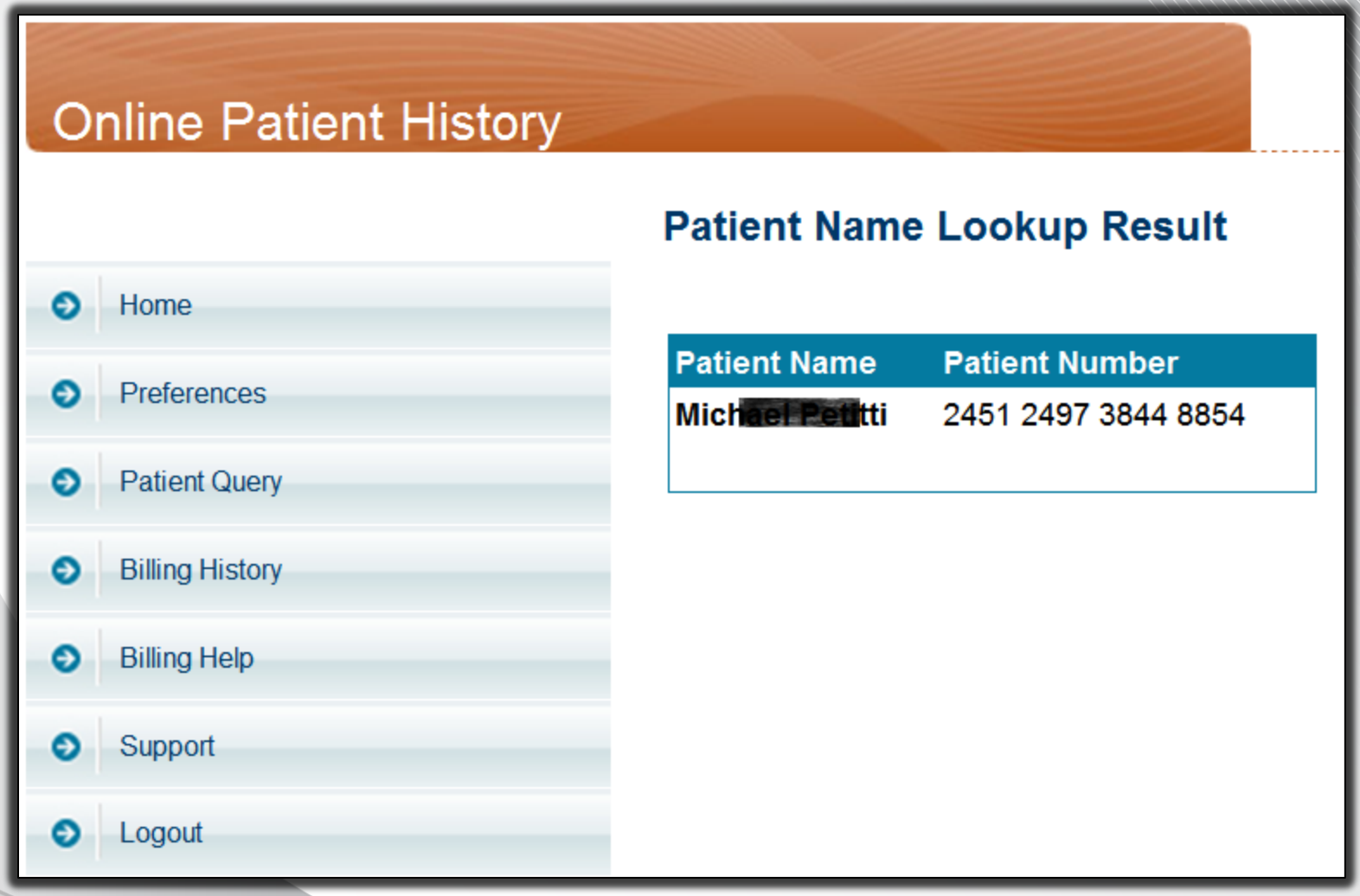
When Queries Collide



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When Queries Collide

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When Queries Collide

Patient Payment History

Michael Peritti
SSN: 893-2
DOB: 8/30/1951

Billing Address:
70. W. Madison Street
Suite 1050
Chicago, IL 60602
312-873-7291

Date	Charge	Credit	Description
1/12/2009	$125.00		ER Visit - Hand sanitizer over-exposure
1/18/2009	$78.50		Very embarrassing lab tests
1/24/2009	$125.00		ER Visit - Hand sanitizer over-exposure
2/03/2009	$125.00		ER Visit - Hand sanitizer ingestion

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When Queries Collide

Root causes:

- **Poor documentation of business rules**

History:

- **Changes to legacy applications were made without considering business implications**

Prevention

- **Document business rules & processes**
- **Maintain documentation**
- **Consult documentation when changing legacy applications**

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Salami Slicing Variant

- Traditional Salami Slicing has been well known since at least the 1970's
- Office Space, Superman III…
- Stealing small amounts of money repeatedly can add up
- From June 2007 to May 2008, Michael Largent obtained at least $60,000 from E-trade, Schwab.com, Google

- Brokerages will commonly deposit a few cents to confirm new bank accounts
- Largent programmatically opened thousands of accounts
- The transfers were legal, the phony checking accounts were not
- 11,385 Schwab accounts were opened as "Speed Apex" from only five AT&T IP addresses

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Salami Slicing Variant

Root causes:

- **Poor application design: Insufficient steps to detect automated account creation**

History:

- **Apparently, a lack of account confirmation functionality**

Prevention

- **CAPTCHAs probably aren't enough**
- **Where human identity is important, more sophisticated data correlation is required**

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Unsolvable: Poker Collusion

- **Some logic flaws are impossible to solve**
- **It can be made difficult:**
  - Analyze player win patterns
  - Correlate table-mate frequency
  - Attempt to validate human identity
  - Ask the software client for computer description

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Preparing to Test for Logic Flaws

- **Obtain or create thorough documentation of:**
  - Business rules
  - Business processes
  - Domain data
- **Identify hypothetical violations of business rules**
  - Where are the rules enforced
  - How can the relevant data be accessed and changed
- **Understand the technology used to exchange data between the client & server**

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Verifying Logic Enforcement

- **Stand-alone transactions:**
  - What business rules apply to this transaction?
  - What is the mechanism of enforcement?
  - What is the purpose of each piece of data sent to the server from the client?
  - Are any data fields in the transaction relevant to business rules?
  - What business domain information is returned by the server?

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Verifying Logic Enforcement

- **Multi-step**
  - How is each step defined? (Different URL, query parameter, server-side state, etc)
  - Can a future step be requested before prerequisites are satisfied?
  - Can data from past steps be modified after the initial business logic has been applied?

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Verifying Logic Enforcement

- **Combining Processes**
  - Logic flaws can span applications
  - All applications accessed by a user should be considered
  - Publicly-available information should also be a factor

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Summary

- **Poor design & poor planning lead to logic flaws**
- **Logic flaws are one-off, custom creations**
- **Logic flaws are generally driven by underlying programming weakness**
  - Unique instances of vulnerabilities
  - Combination of vulnerabilities to create a flaw
  - Requires manual testing to find
- **Adherence to secure coding techniques will go far to remove logic flaws but code generally cannot fix design issues.**

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Logic Flaw Poster Child: SocGen

- **Société Générale is a major European bank: over $1 trillion in managed assets, and 160,000 employees**

- **A leading industry analyst said they were "considered one of the best risk managers in the world." …until January 2008**
- **In one year, Jerome Kerviel made $73 billion in unauthorized trades, losing $7 billion**
- **A junior trader; used to work in the bank's compliance department.**

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Logic Flaw Poster Child: SocGen

- **Without using any "advanced" hacking skills, he evaded all of the bank's approval systems**
- **The CEO described Jerome's knowledge of the bank's controls as "intimate and perverse".**
- **Internal audit findings:**
  - Many controls were batch run, and could be evaded within a limited window
  - Some controls were based on the net value of a group of holdings and could be evaded by creating a fictitious opposite entry
  - Some management approvals were email-based and were easily spoofed

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- **SpiderLabs Website & Wiki – Papers, Tools, Service Information**
  - http://www.trustwave.com/spiderlabs
  - https://wiki.trustwave.com/display/sl/SpiderLabs+Team+Site
- **Twitter – Security News, Event Information, etc.**
  - http://www.twitter.com/spiderlabs
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  - http://www.linkedin.com/groups?home=&gid=90640

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Questions?

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Survey

https://www.surveymonkey.com/s/Research12_AnatomyofaLogicFlaw_CharlesHenderson

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