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The Cool Future of Source Code Analysis

USING THE WISDOM OF THE CROWD TO ENHANCE APPLICATION SECURITY

By Moshe Lerner

VP Corporate Strategy at Checkmarx



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ABOUT MYSELF



Moshe Lerner

VP Corporate Strategy at Checkmarx

- Led many Israeli software companies
- A technology, vision and business match-maker

moshel@checkmarx.com



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APPLICATION SECURITY ANOMALY

Ratio Developers VS QA experts

2 : 1

Ratio Developers VS Appsec experts

150 : 1

CAN WE TRULY SECURE APPS?



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NEW PARADIGMS

Agile Development

Continuous Deployment

Beta = GA

Hybrid Apps

CAN WE CREATE A TRUE SECURE SDLC?



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ISSUES AT HAND Size | Complexity | Volume

The biggest challenge of current source code analysis solutions is size and agility!

How to deliver:

1. Usable results
2. Automatically
3. Out-of-the-box
4. Accurate

for extra large code bases with thousands+ of results



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AGENDA

1. How to automatically detect issues that the user does not even know how to describe.
 - “Extracting knowledge” from a large code base
(wisdom of the crowd)
2. How to automatically correlate ???
 - Suggest remediation actions for a fraction of the time for extra large code bases



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ZERO DAYS? ZERO CONFIGURATION?

- What happens if you do not even know what question to ask?
- What if you do not have the resources to configure the system?
- We want a “guru” that asks the questions for us.
 - Configures the system for us.
 - Finds the vulnerabilities for us.
 - Guides us how to fix.

Hold on for a few more slides ...



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SOURCE CODE ANALYSIS

HISTORY



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FIRST GENERATION CODE ANALYSIS

- The system came out of the box with the relevant security knowledge wired into the system.
- Little-to-no adaptation capabilities.



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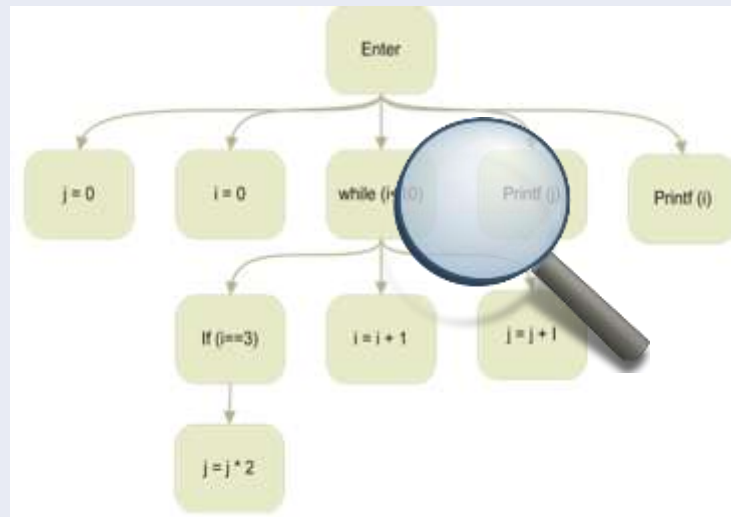
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FIRST GENERATION CODE ANALYSIS

```
void main()
{
    int j = 0;
    int i = 0;

    while (i < 10){
        if (i == 3){
            j=j*2;
        }
        j = j + i;
        i = i + 1;
    }

    printf ("%d\n", j);
    printf ("%d,n", i);
}
```





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NEW GENERATION CODE ANALYSIS

- The system came out of the box with the relevant security knowledge
- Ability to customize existing security knowledge
- Ability to add you own business logic
- EASY!! Virtual Compiler. No need to compile your code.
- EASY!! Incremental scan.
- Detection ranges from SQL Injection to Backdoors



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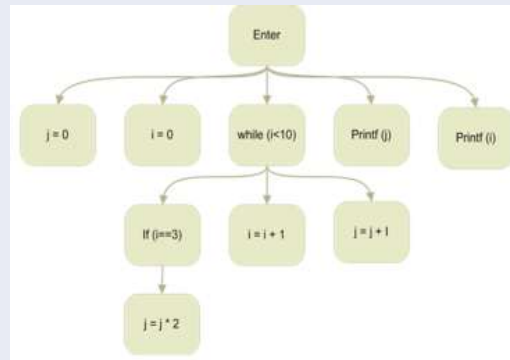
NEW GENERATION CODE ANALYSIS

```
void main()
{
    int j = 0;
    int i = 0;

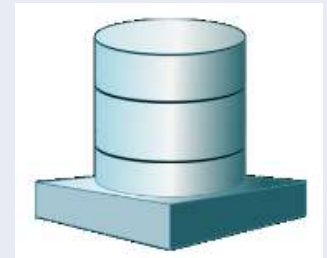
    while (i < 10){
        if (i == 3){
            j=j*2;
        }
        j = j + i;
        i = i + 1;
    }

    printf ("%d\n", j);
    printf ("%d\n", i);
}
```

Abstract



Store



<EXAMPLE/>



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SOQL/SOSL Injection

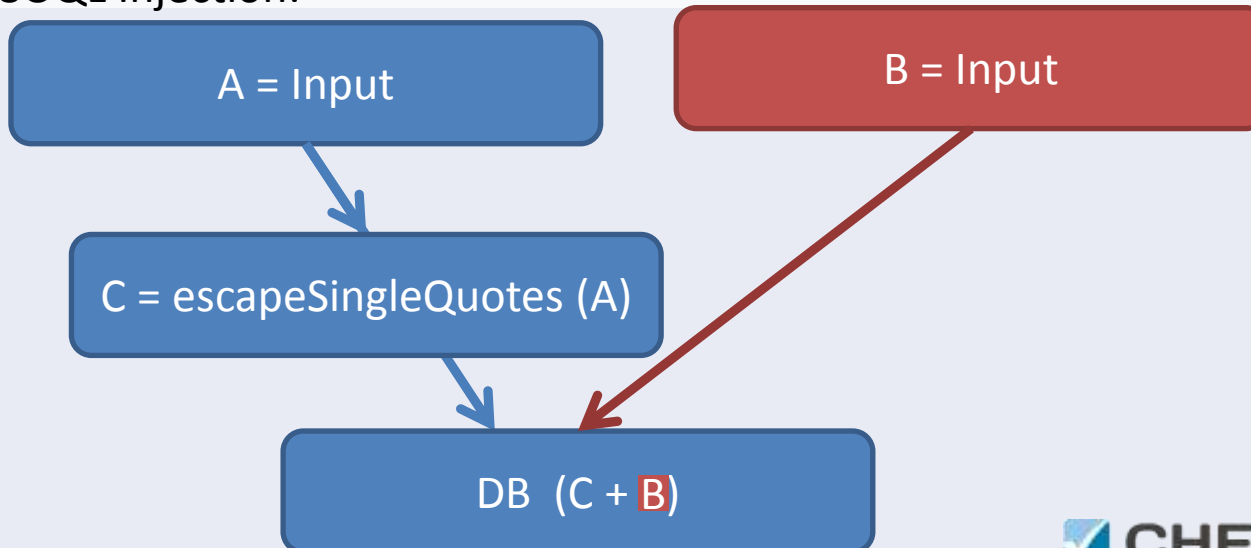
CWE ID 10502

Description

In other programming languages, this flaw is known as SQL injection. Apex does not use SQL, but uses its own database query language, SOQL. SOQL is much simpler and more limited in functionality than for SQL injection, but the SQL/SOQL injection involves taking any input and trick the application into performing unintended commands.

```
CxList db = Find_DB();  
CxList inputs = Find_Interactive_Inputs() ;  
CxList sanitized = Sanitize() ;  
  
result = db.InfluencedByAndNotSanitized(inputs, sanitized);
```

SOQL Injection:



<EXAMPLE/>



```
CxList Input = All.FindByName("input");  
CxList DB = All.FindByName("execute");  
CxList Fix = All.FindByName("fix");  
  
Return DB.InfluencedByAndNotSanitized(input, fix);
```




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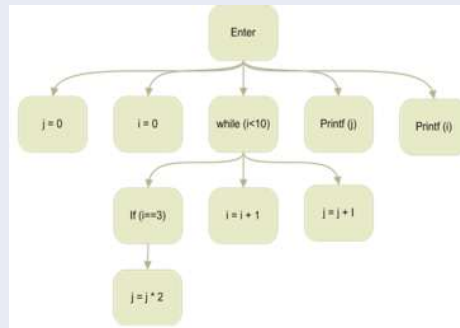
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APPLICATION INTELLIGENCE

```
void main()
{
    int j = 0;
    int i = 0;

    while (i < 10){
        if (i == 3){
            j=j*2;
        }
        j = j + i;
        i = i + 1;
    }

    printf ("%d\n", j);
    printf ("%d,n", i);
}
```





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SCKD

Source Code Knowledge Discovery

“Using Wisdom of the crowd (Big Data) to identify security vulnerabilities via code irregularities”



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THERE IS SUCH A GURU

YOU

YOU

YOU

and... YOU!

All of you – Wisdom of the crowd

Most of the developers write good, standard, quality code, most of the time



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CROWD

We can set a baseline based on code statistics and find deviations thereof





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SCKD

- Source Code Knowledge Discovery – an active research

(Knowledge Discovery in DB - http://en.wikipedia.org/wiki/Knowledge_extraction)

*“Knowledge discovery describes the process of automatically **searching large volumes of** data for patterns that can be considered knowledge about the data. It is often described as **deriving knowledge from the input data.** Knowledge discovery developed out of the Data mining domain, and is closely related to it both in terms of methodology and terminology.”*





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TECHNIQUE

- Building reference data
- Finding common sequences
- Finding violations



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BUILDING REFERENCE DATA

```
E = input();  
If (isValid(E))  
{  
    ...  
    response.write(E) ;  
    ...  
}
```

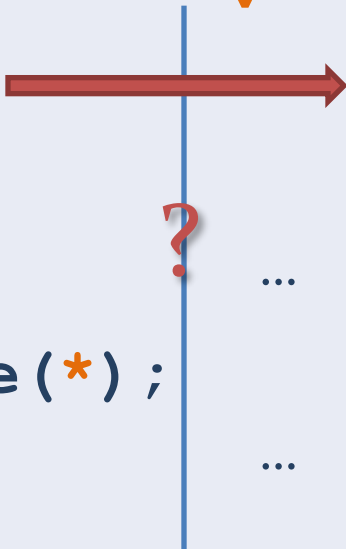
```
A = input();  
If (isValid(A))  
{  
    ...  
    response.write(A) ;  
    ...  
}
```



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FINDING DEVIATIONS

<pre>* = input(); If (isValid(*)) { ... response.write(*); ... }</pre>		<pre>v = input(); X ... response.write(v); ... </pre>
--	---	---



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BACKDOOR

if my name is Moshe, login

```
if (isAuthenticated(user)) || user.name == "Moshe")  
{  
    .....  
}
```




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EXAMPLE: LEVERAGING CLOUD OF APPS?

Find similarities between different applications in order to set an intra-corporate standard.

With Zero-Definition!

It's enough that some apps were fixed.

They'll allow us to find the apps that are not yet fixed.

VAT = 1.05

...

VAT = 1.08

...

VAT = 1.08

...

VAT = 1.08



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WORKS WELL FOR:

- General:
 - We can find the hidden knowledge of the crowd, give it a name and find breaches of it.
- Security:
 - Make sure the user is authenticated at each page
 - Auto-recognize sanitization routines
 - Backdoors (`"if (isValid(user) or user=="Moshe")..."`)
 - Business logic (`"if (qty > 0) {charge (qty*amnt)}"`)
- Quality
 - Always release a specific resource
 - Best coding practices (auto recognize conventions)
 - Initialize a variable

ALSO

- Wisdom of the crowd
- Works better for larger enterprises and code bases



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GRAPH VISUALIZATION

Optimize call for action

“Using smart graph methods to identify
Vulnerability junctions and best fix locations ”



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ISSUE

- Findings thousands accurate results, does not make us happy ...
- Webgoat, for example, has ~220 XXS+SQL Injection
- Assuming 30 minutes to fix each one + 30 minutes to validate will take 220 hours - ~ 1 month of work
- We'll narrow this down to 16 places
- ~1/14 of the time
- So we have some time to play golf ;)



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CURRENT SITUATION

Each results has a data flow, presented independently from other findings.



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SINGLE DATA FLOW PATH- XSS

```
String s = Request.QueryString["param1"];
```

...

```
Response.Write(s);
```

```
Request.QueryString["param1"];
```



s



```
Response.Write(s);
```



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ONE IS EASY ... AND 14?!

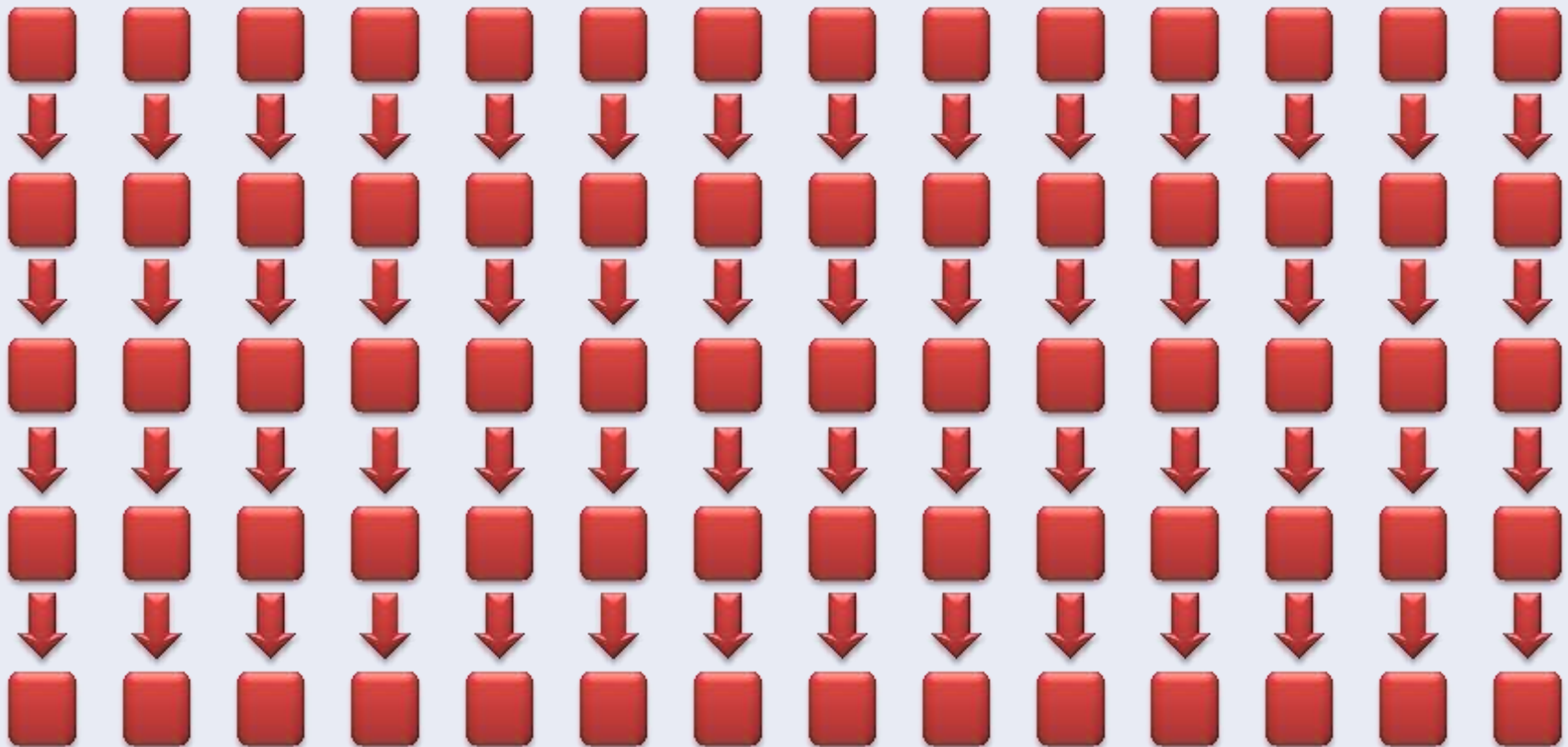




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Many Single-Path – XSS – a lot of work





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BUT...

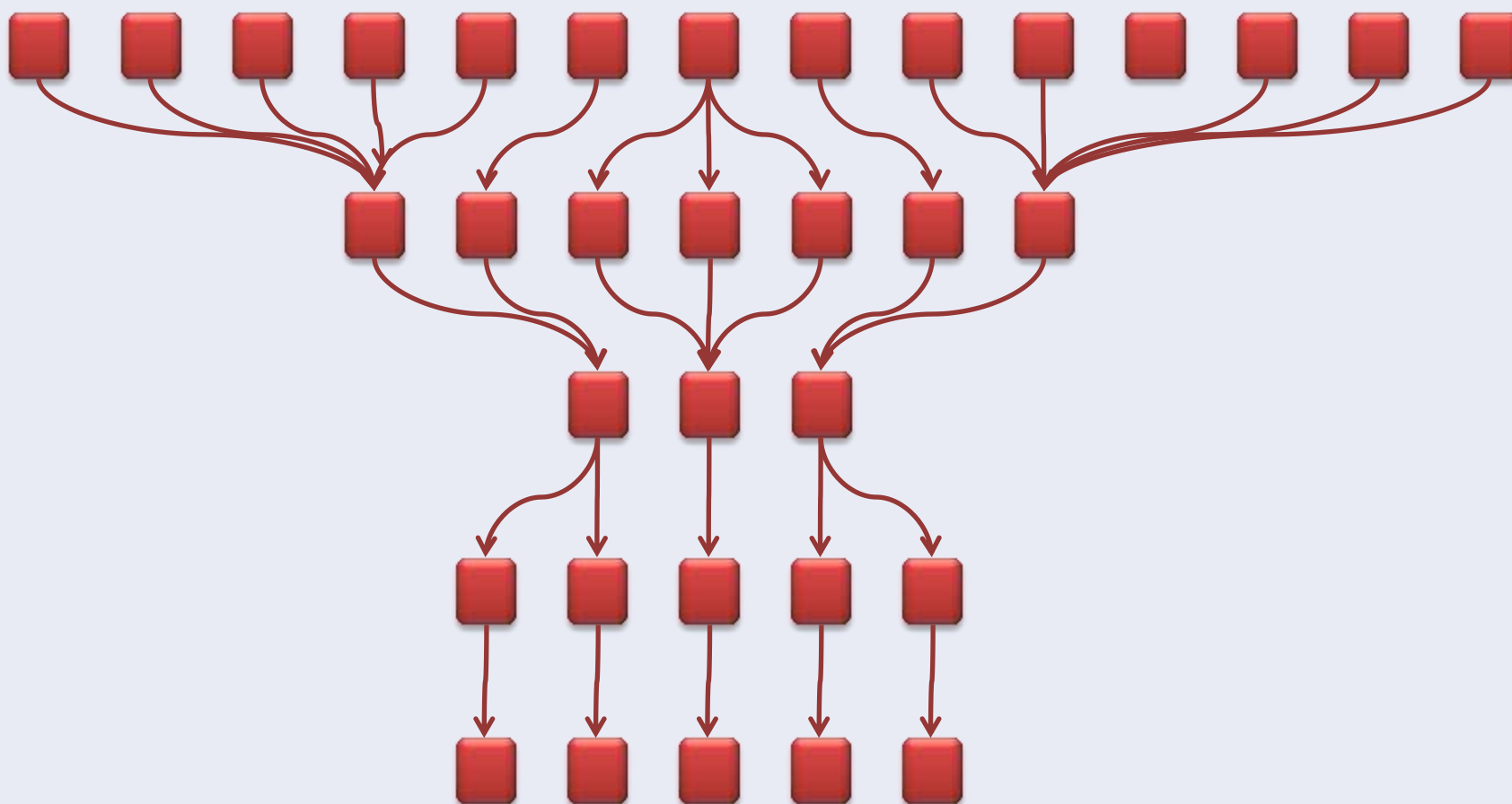
What do they have in common?



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Combined paths



CAN WE:

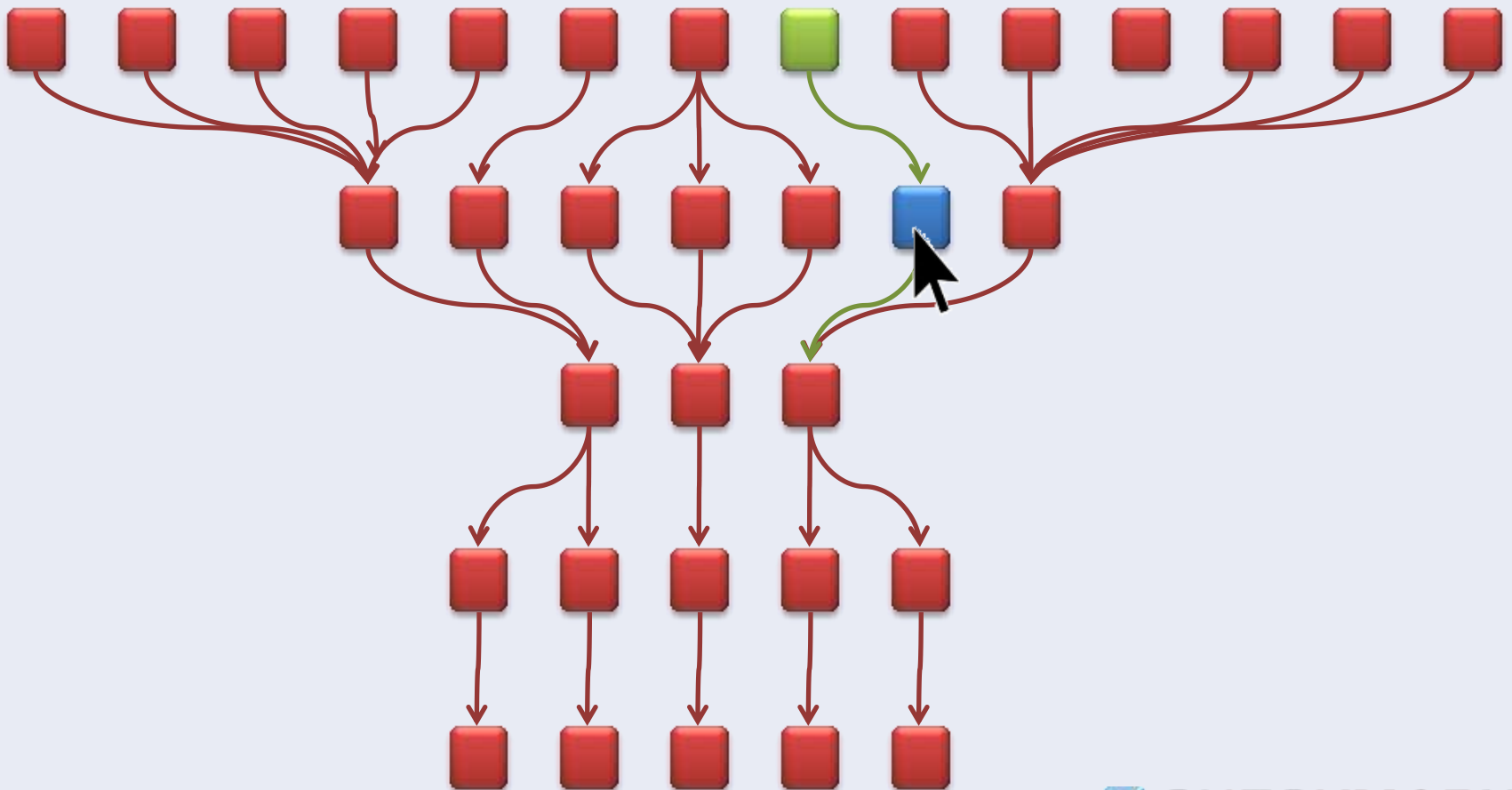
- Point, click and check without even READING the source code?
- “What if I fix here? Or here?”



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What-If I fix here?

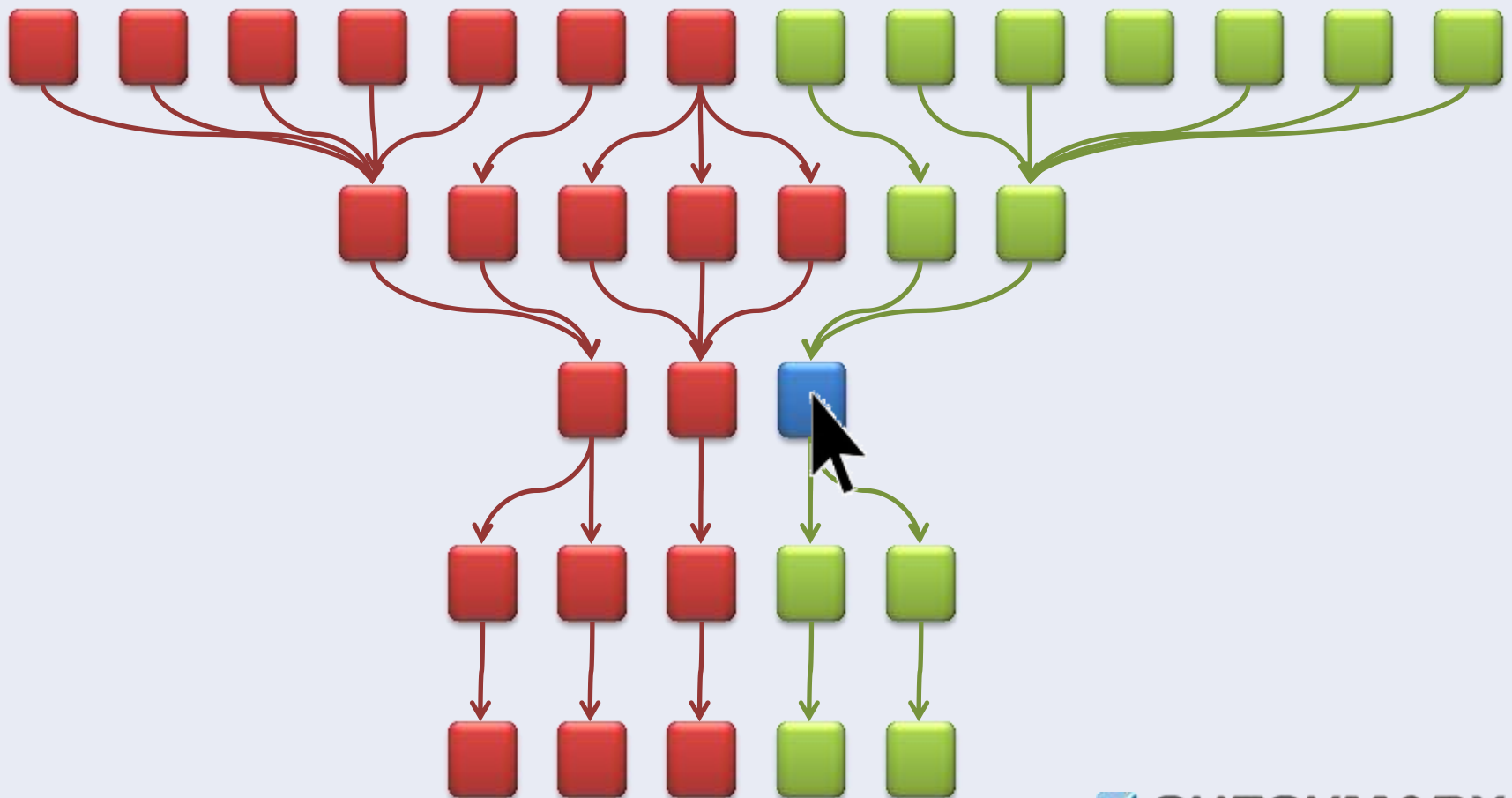




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Here it is more effective

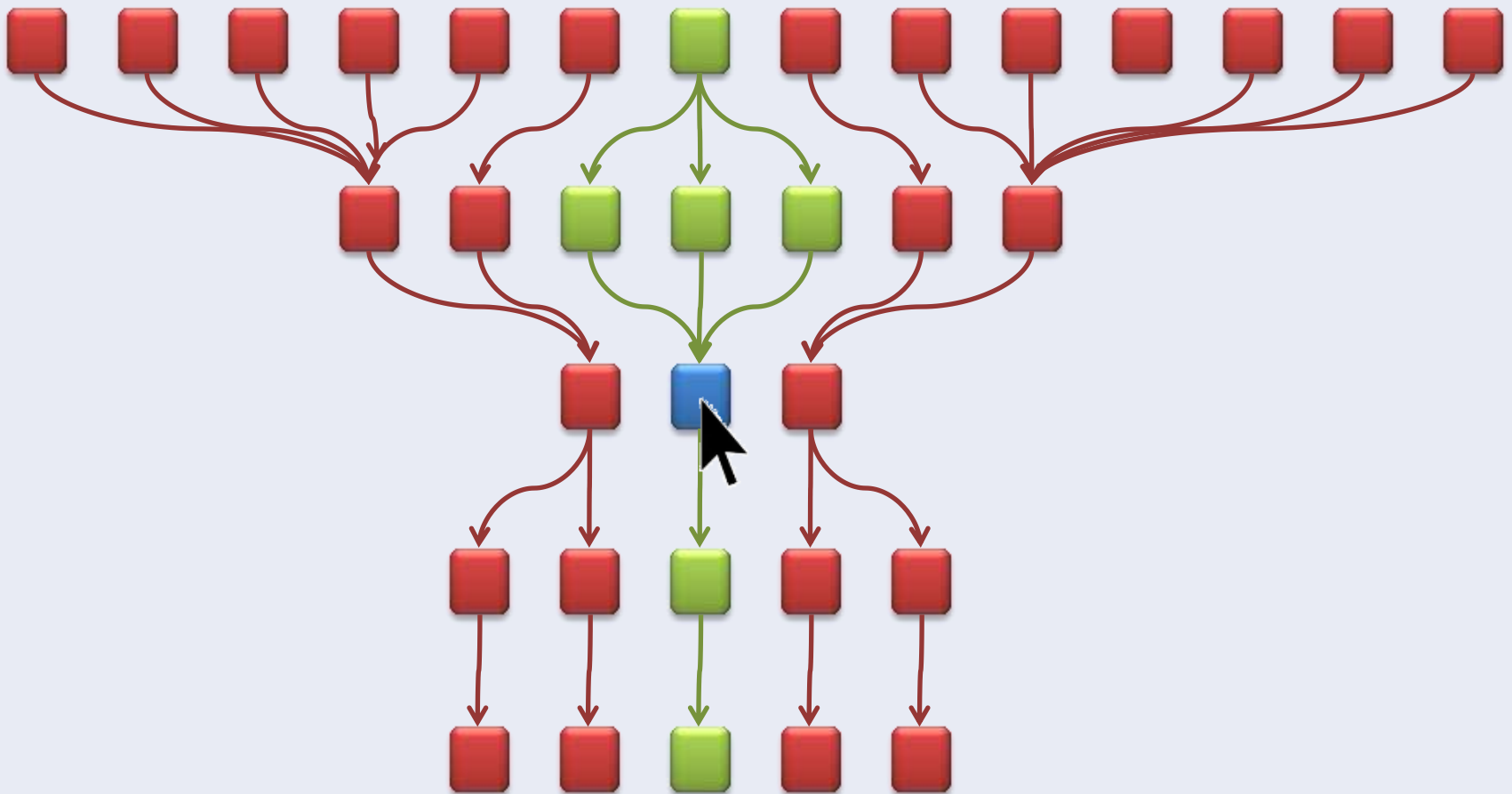




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And here?

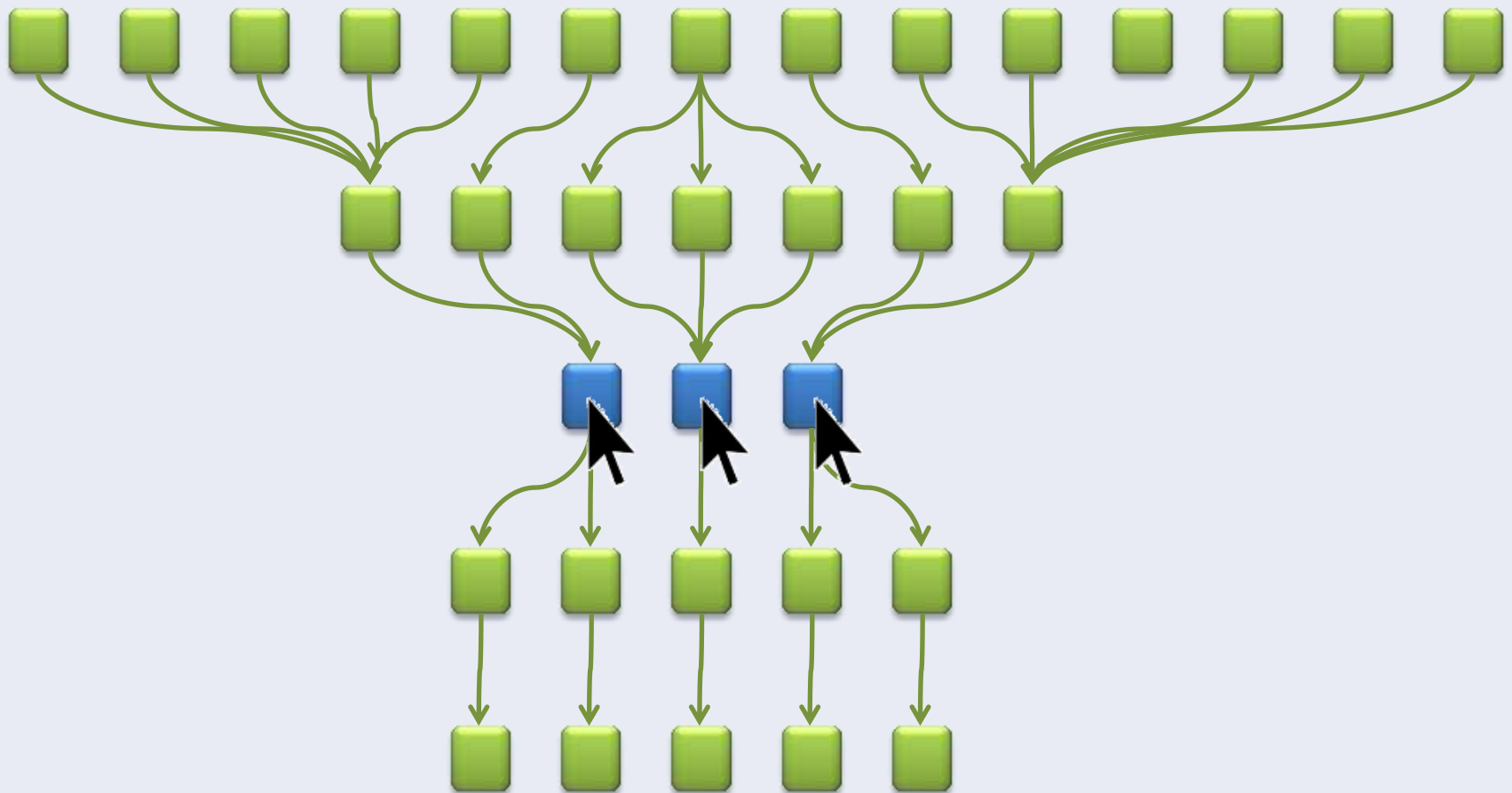




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Automatic “What-if” => Best Fix Location

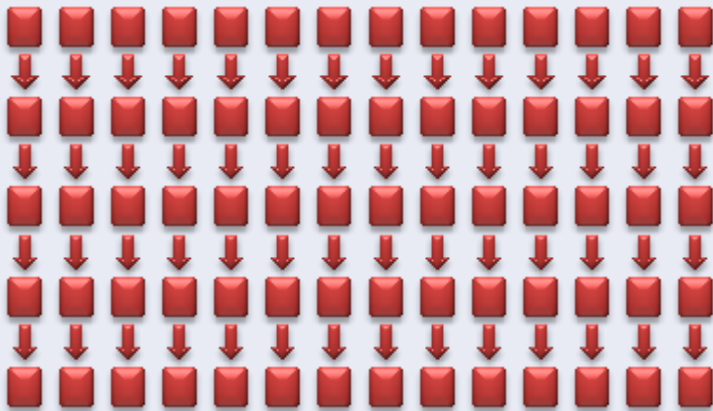




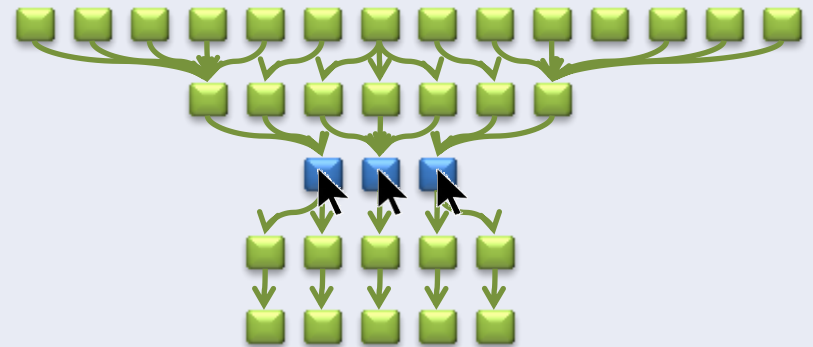
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Compare the two:



Vs.





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BENEFITS

- Gives you the correlation between findings of the same type (e.g. SQLi) and different types.
- You are not dealing with individual findings – but with a complete system
- Use your time better



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FIX LOCATIONS

- At the point of a click we narrow down 220 places into 16.
- The more results, the more effective this solution is



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RECAP

The biggest challenge of current source code analysis solutions is size!

How to deliver:

1. Actionable results
2. Automatically
3. Out-of-the-box
4. Accurate

for extra large code bases with thousands+ of results



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QUESTIONS?



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Thank you

Moshe Lerner

Moshel@checkmarx.com