APEX security scanning – what have we learned

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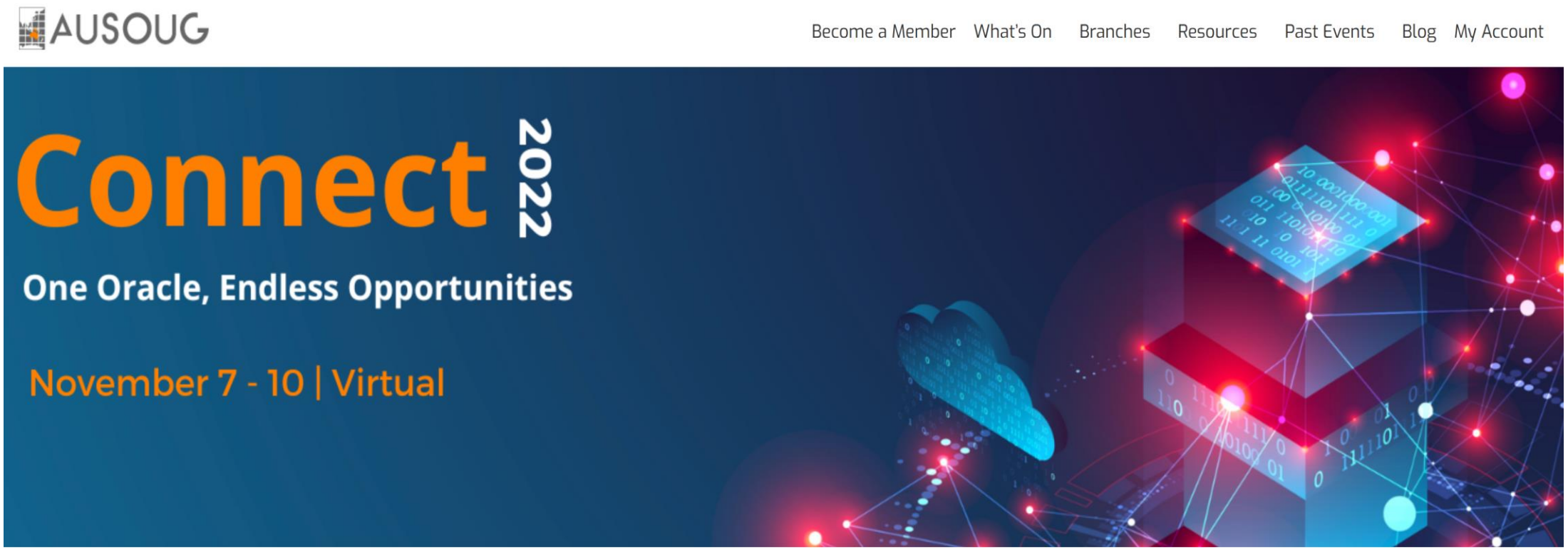
AUSOUG APEX News



www.ausoug.org.au/connect-2022/

Mentor and Speaker Hub

- Our goal is to *connect* speakers with mentors to assist in *preparing* technical sessions and *improving* presentation skills

Interested? Read more and get in touch

https://mashprogram.wordpress.com

My story

AUSOUG

fabē
reduce • rescue • reconnect

AOP

APEX R&D
research & development

- AUSOUG APEX webinars
- NZ APEX meetup organizer
- APEX World Member of the Month
- Conference speaker
- Blogger

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Oracle ACE Pro

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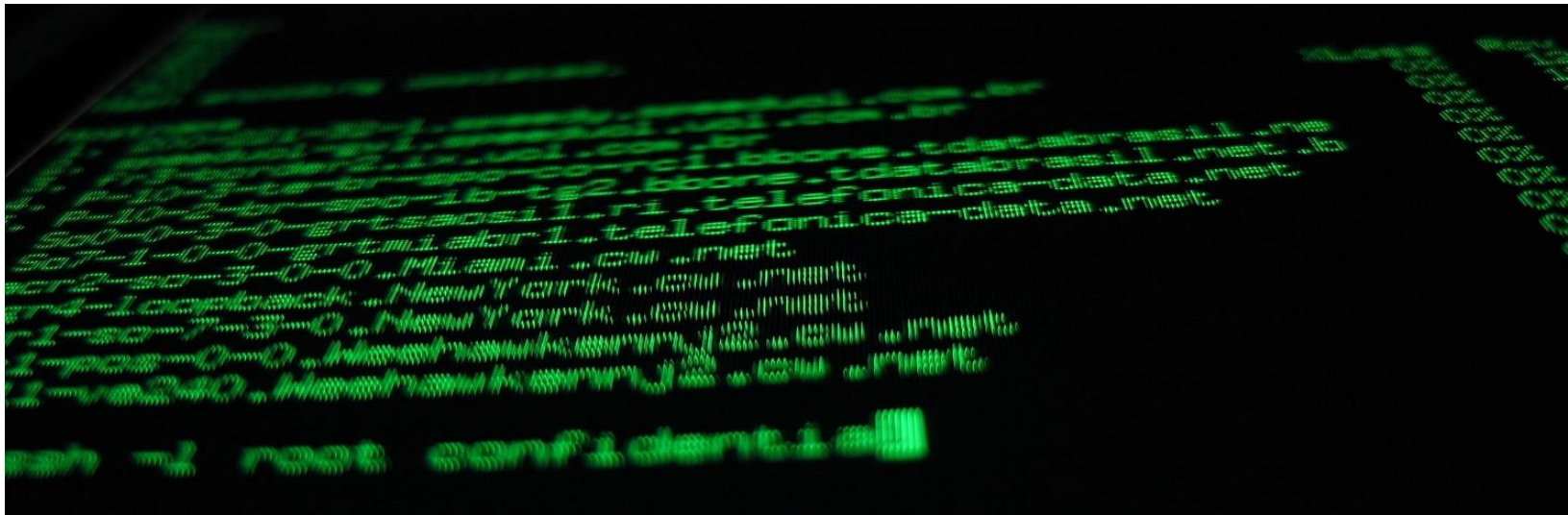
Intro

- There is a hacker attack each 39 seconds
- On average 180 days to detect a breach
- 95% of breaches are due to human error
- 53% of successful are not even detected



Technology

Google Chrome's latest update has a security fix you should install ASAP

Luckily updating Chrome is usually as simple as restarting

By Justine Calma | @justcalma | Sep 5, 2022, 9:51am EDT

SHARE

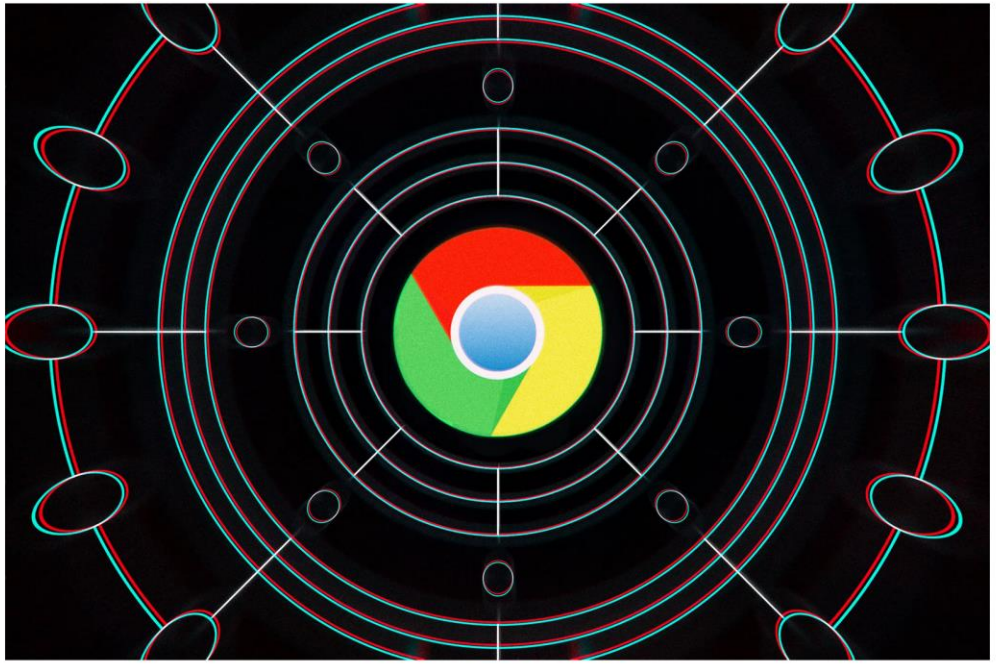


Illustration by Alex Castro / The Verge

Urgent update from Optus about your personal information

Inbox ×

Optus <noreply@e.optus.com.au>
to me

OPTUS

Dear Lino,

Tue, Sep 27, 4:53 PM (15 days ago)

It is with great disappointment I'm writing to let you know that Optus has been a victim of a cyberattack. As a former Optus customer this has resulted in the disclosure of some of your personal information.

No financial information or passwords have been accessed. The information which has been exposed is a combination of your name, date of birth, email, phone number and/or address associated with your former account. **No ID document numbers or details**

Intro

- It works best if it is applied in layers
- Poor or no security practices/standards
- Staying ahead of the game is hard
- We developers are first line of defence

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(#orclapex)

is

SAFE

APEX features

Out of the box features

- Features we have available:
  - APEX URL
  - Authentication/Authorisation
  - Security settings
  - Session handling
  - Session state protection
  - Encoding APIs
  - Advisor tools
  - External tools

APEX provides mechanisms to secure your apps!

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Typical examples

- URL tempering
- Access control inconsistency
- Hidden or Display only items
- JavaScript submit page
- Unprotected application processes or items

XSS examples

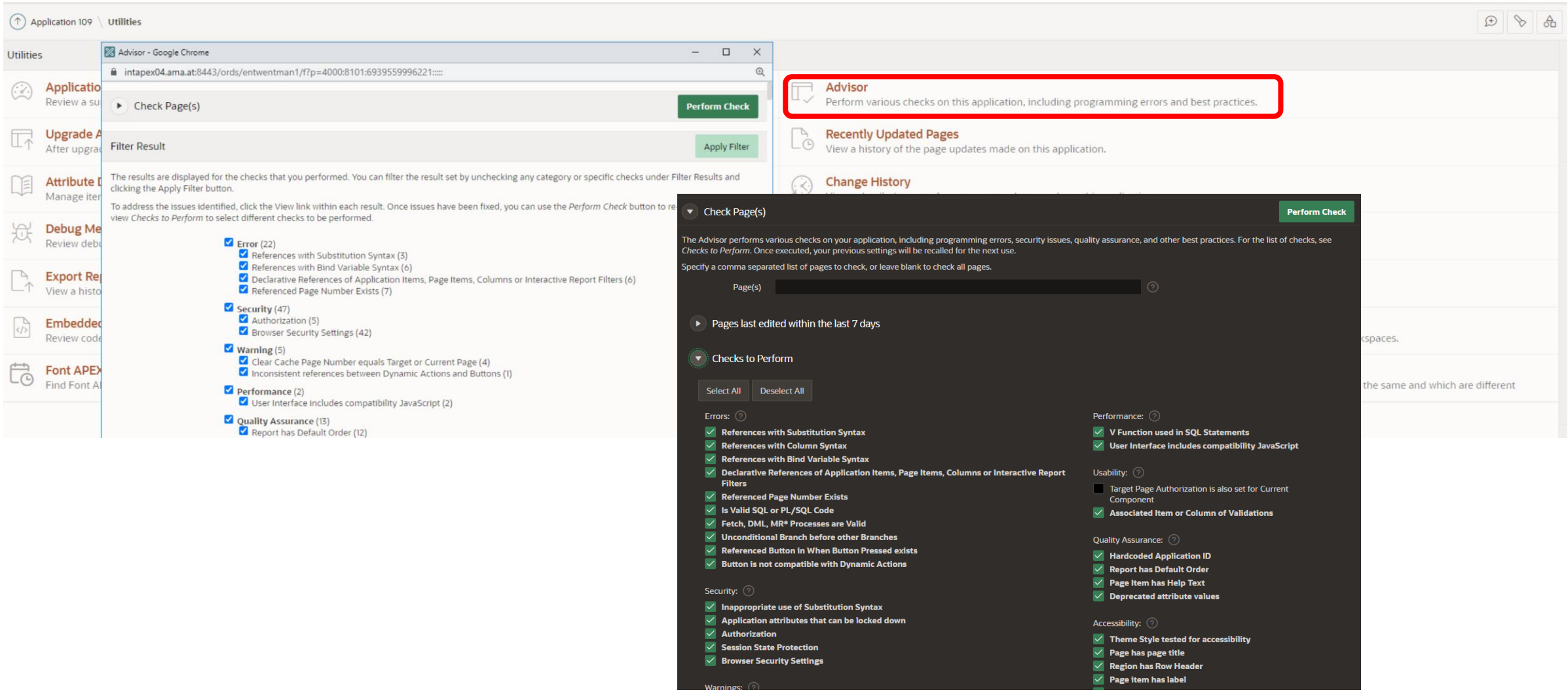
- Reports Column Display Type
- Disabling Escape special characters
- Report Column Formatting - HTML Expressions
- Report Column Formatting - Column Link
- Report Column - List of Values
- HTP.p

SQL injection examples

- Input changes the expected results
- Function returning Query
- Most things with Substitution variables
- Htp.p
- DYNAMIC SQL
  - Cursors
  - EXECUTE IMMEDIATE
  - APEX API

We need Security tools

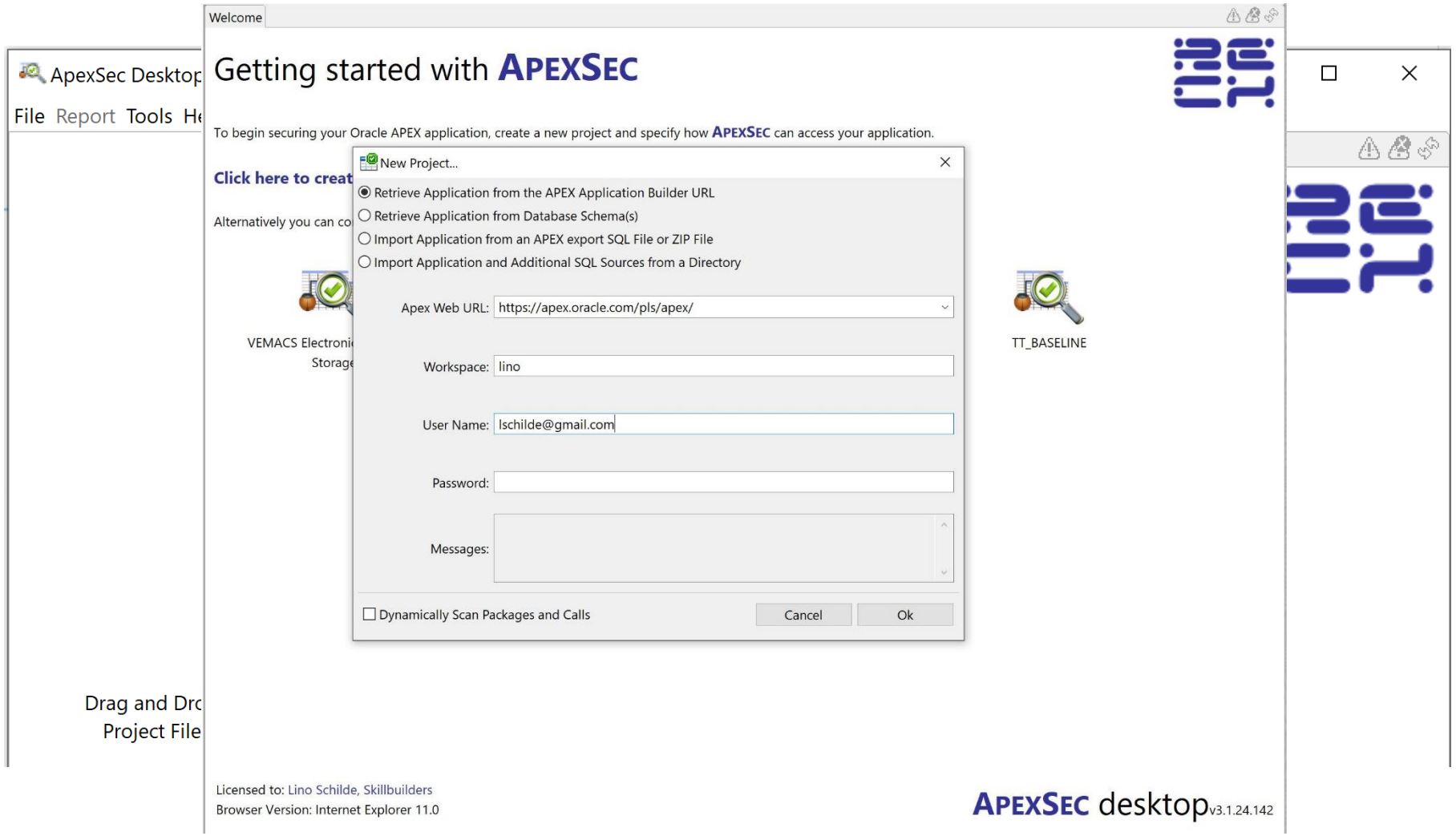
APEX Advisor



Security tools - APEX Advisor

- Takes time getting used to
- It is not a professional tool
- **App Builder -> Application X -> Utilities**
- It checks for errors, security issues, usability and quality assurance

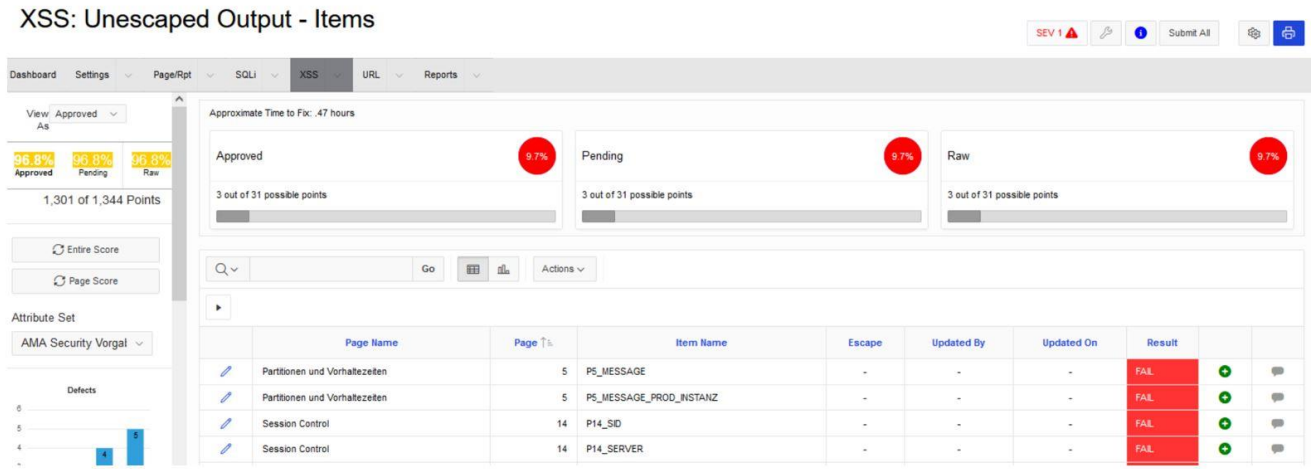
APEXSec


ApexSec Desktop
File Report Tools He
Welcome
Getting started with APEXSEC
To begin securing your Oracle APEX application, create a new project and specify how APEXSEC can access your application.
Click here to creat
Alternatively you can co
New Project...
Retrieve Application from the APEX Application Builder URL
Retrieve Application from Database Schema(s)
Import Application from an APEX export SQL File or ZIP File
Import Application and Additional SQL Sources from a Directory
Apex Web URL: https://apex.oracle.com/pls/apex/
Workspace: lino
User Name: lschilde@gmail.com
Password:
Messages:
Dynamically Scan Packages and Calls
Cancel
Ok
VEMACS Electroni
Storage
TT_BASELINE
Drag and Dro
Project File
Licensed to: Lino Schilde, Skillbuilders
Browser Version: Internet Explorer 11.0
APEXSEC desktop v3.1.24.142

Security tools - APEXSec

- Licensing cost
- Ability to scan from live apps vs uploaded files
- Tests your PLSQL code too
- Available as desktop version
- Fairly simple to run
- With detailed instruction how to sanitize security flaws found

APEX SERT



https://github.com/OraOpenSource/apex-sert

Security tools - APEX SERT

- No licencing cost
- Ability to scan only ‘live’
- Will not tests your PLSQL code
- Community edition available?
- OpenSource tool needed on the market

Demo - Security tools

What does it look for?

Security scans

- Various settings
- Page and Item SSP
- Potential XSS and SQL Injections
- Button and page processes
- Authentications and authorizations

It is all about inconsistency

TIP #1
Keep your data clean

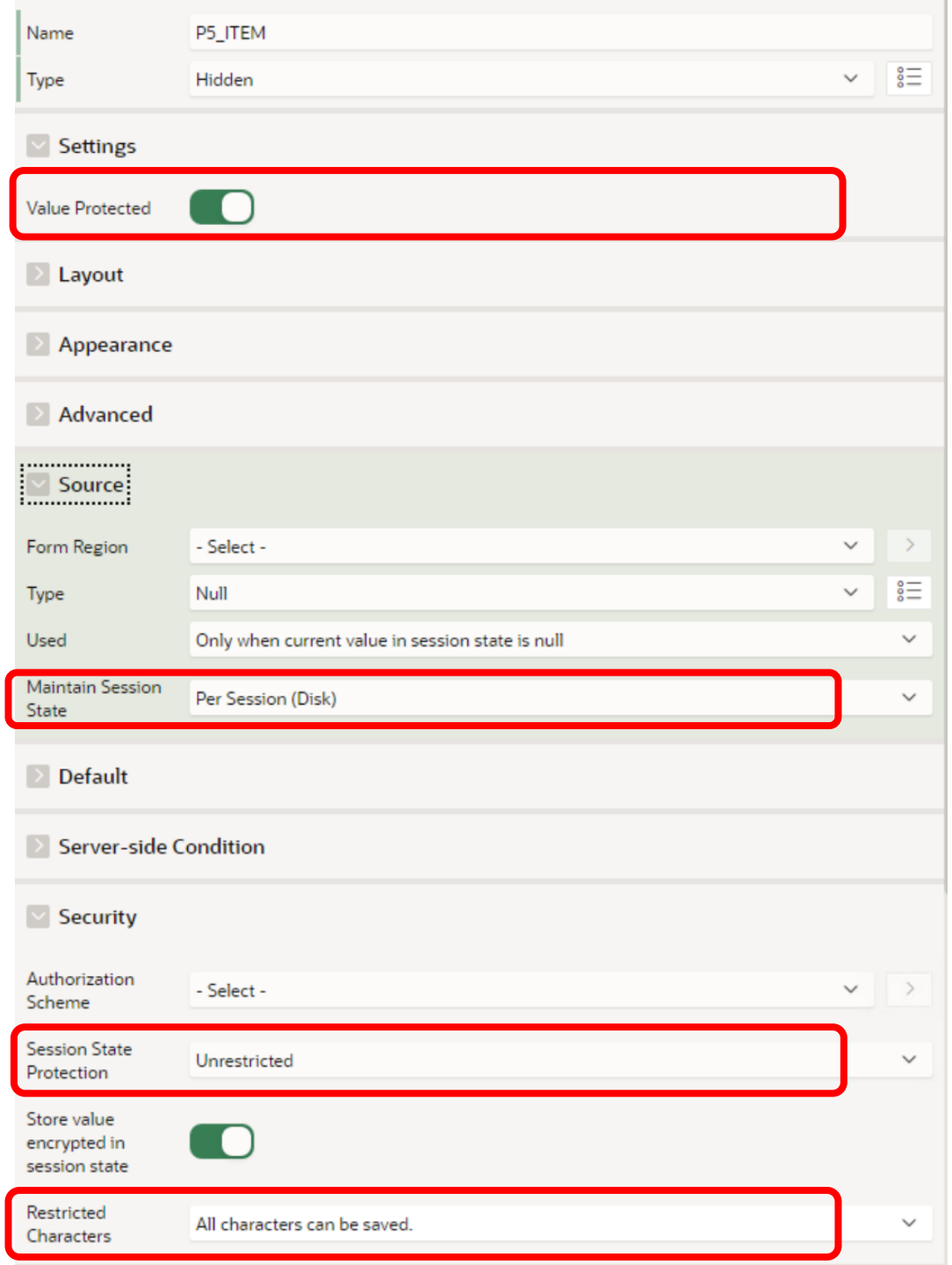
User inputs checks

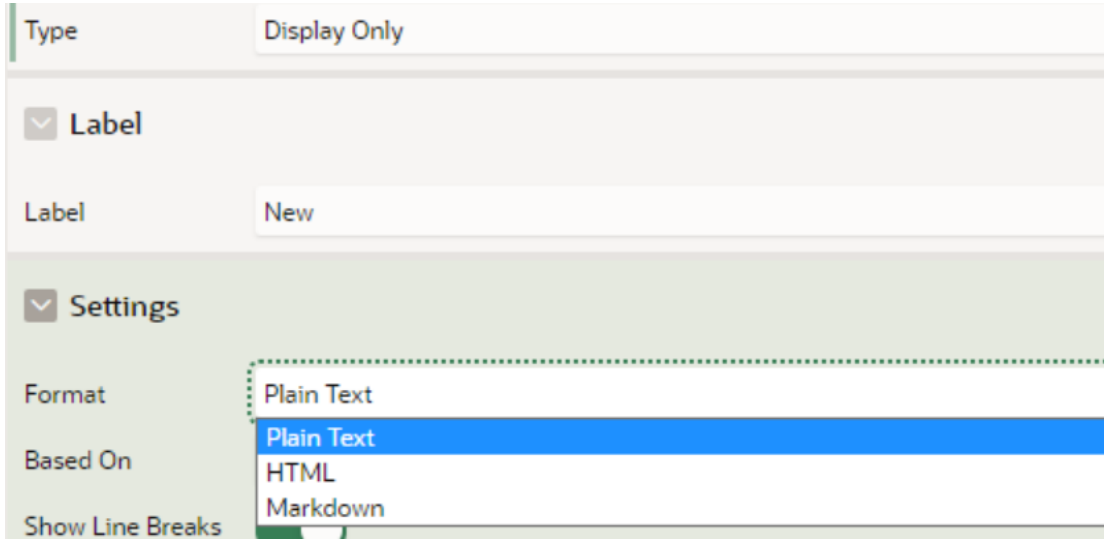
- Sanitize and validate it
- Do not trust it
- 50% of security risk
- Normally never done and ignored

TIP #2
Know your items

Items tips

- Not all items are the same
- Use SSP appropriately
- Store encrypted in session state
- Maintain Session State
- Use
  - Value protected vs escape special character or (Format Settings)
- Restricted characters


Name
P5_ITEM
Type
Hidden
Settings
Value Protected
Layout
Appearance
Advanced
Source
Form Region
- Select -
Type
Null
Used
Only when current value in session state is null
Maintain Session State
Per Session (Disk)
Default
Server-side Condition
Security
Authorization Scheme
- Select -
Session State Protection
Unrestricted
Store value encrypted in session state
Restricted Characters
All characters can be saved.


Type
Display Only
Label
Label
New
Settings
Format
Plain Text
Based On
Show Line Breaks
Plain Text
HTML
Markdown

Items

Application items

- Used for Server-side logic items
- Set SSP to Restricted
- Very often forgotten and left exposed

User editable items

- Page - Set SSP to Checksum
- Validate and sanitize before submitting it to DB
- Do not trust user inputs

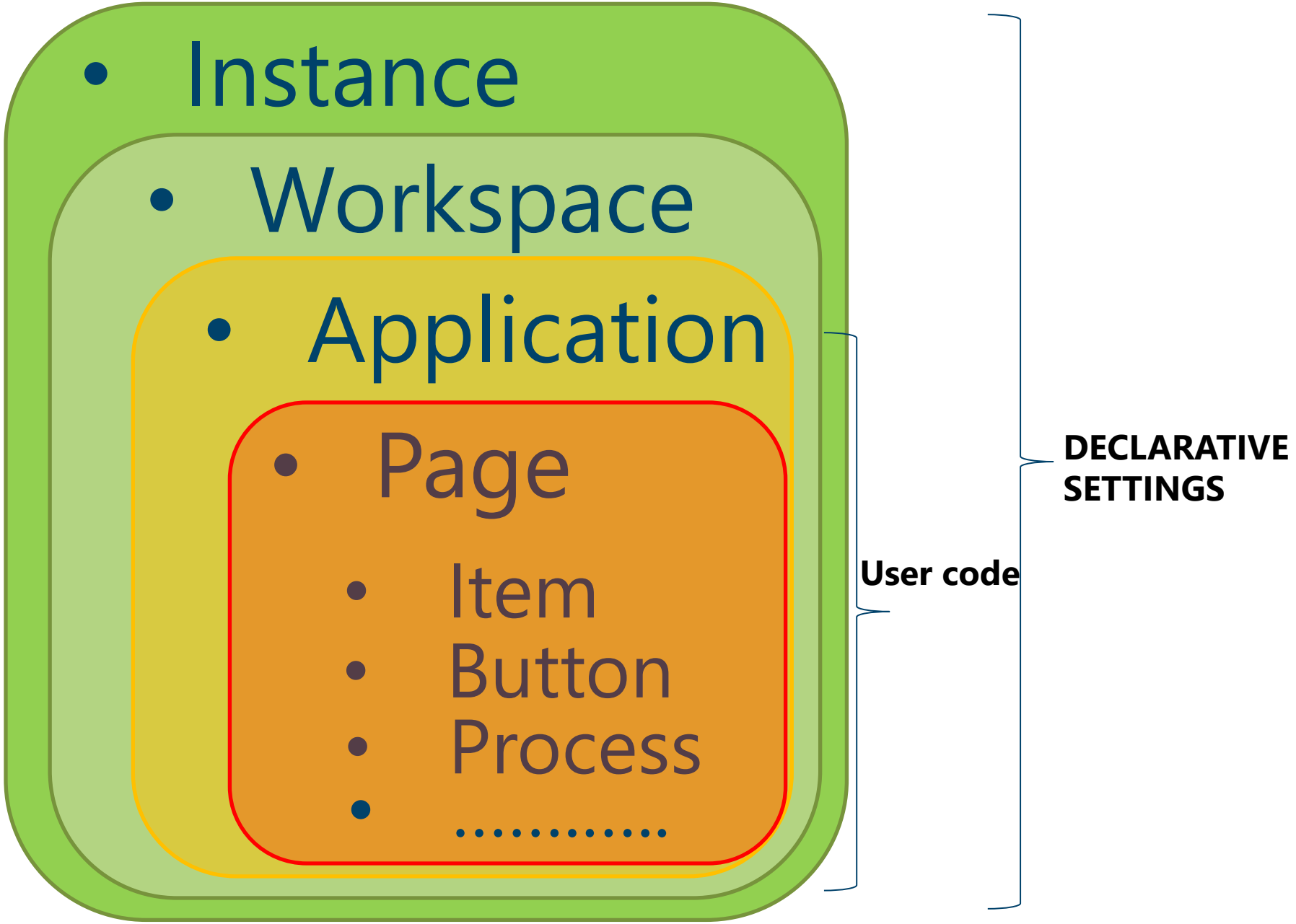
Hidden items

- Not displayed but rendered in an HTML
- Hidden item can be modified
- If JavaScript modifies the value then it cannot be fully protected
- For Items passed as data between pages:
  - Set Page SSP to Checksum
  - Set PAP of receiving page to Checksum
  - Set Value Protected to Yes

Display items

- Non-enterable text item
- Values can still be changed
- Restricted - May not be set from browser
- Use escape special character or Format Settings like plain/HTML/markdown
- Make sure to check:
  - if it can be set by end users or if it used in JS as substitution string

TIP #3
Important settings


Instance
Workspace
Application
Page
Item
Button
Process
.....
User code
DECLARATIVE SETTINGS

Settings – Application Definition

- 150+ APEX settings in total
- Rejoin session & Deep Linking
- Session Timeout & Session idle in seconds
- Error handling function
- Session State Protection (SSP)
- Authorization & Authentication

Settings – Page Security

- Authorization Scheme
- Authentication
- Rejoin Sessions
- Deep Linking

- Page Access Protection (PAP)
  - PAP does not provide any security but is required when SSP is enabled
  - Unrestricted
  - Arguments Must Have Checksum
  - No Arguments Supported
  - No URL Access
- Form Auto Complete & Double submission

Error handling function

- We can easily define one
- Minimize amount of information we give back to the users
- Use it to improve user experience

TIP #4
Where (should) we use HTML?
like substitution variables

APEX and built in HTML

- Everywhere where APEX lets us?
- Watch out for Substitution variables!

OK

- Page title, region title and process success message

NOT OK

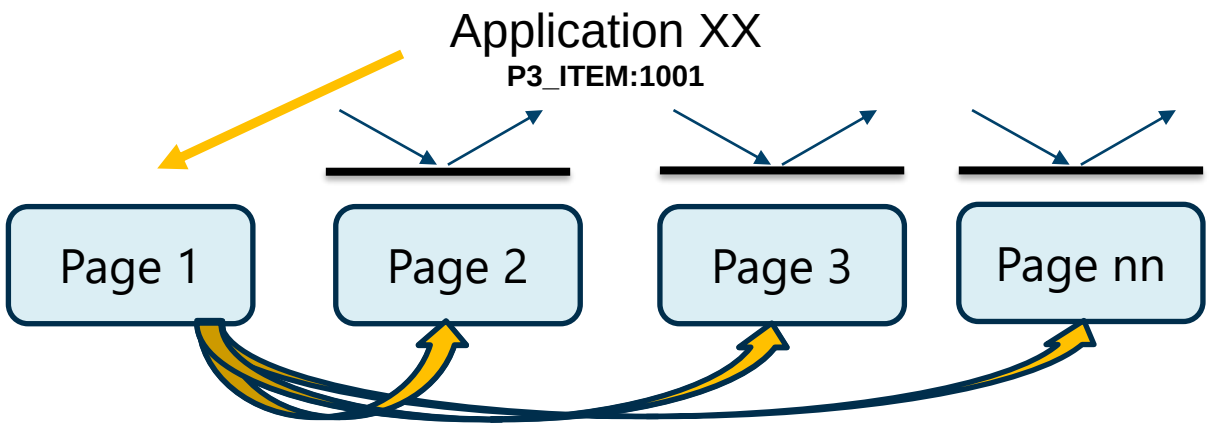
- Substitution variable in JavaScript
- Report columns title
- Breadcrumbs entries

TIP #5 APEX URL

Remember

f?p=App:Page:Session:Request:Debug:ClearCache:itemNames:itemValues

- Tampering is the first way
- Changing URL parameters or changing the values using JavaScript



URL is powerful

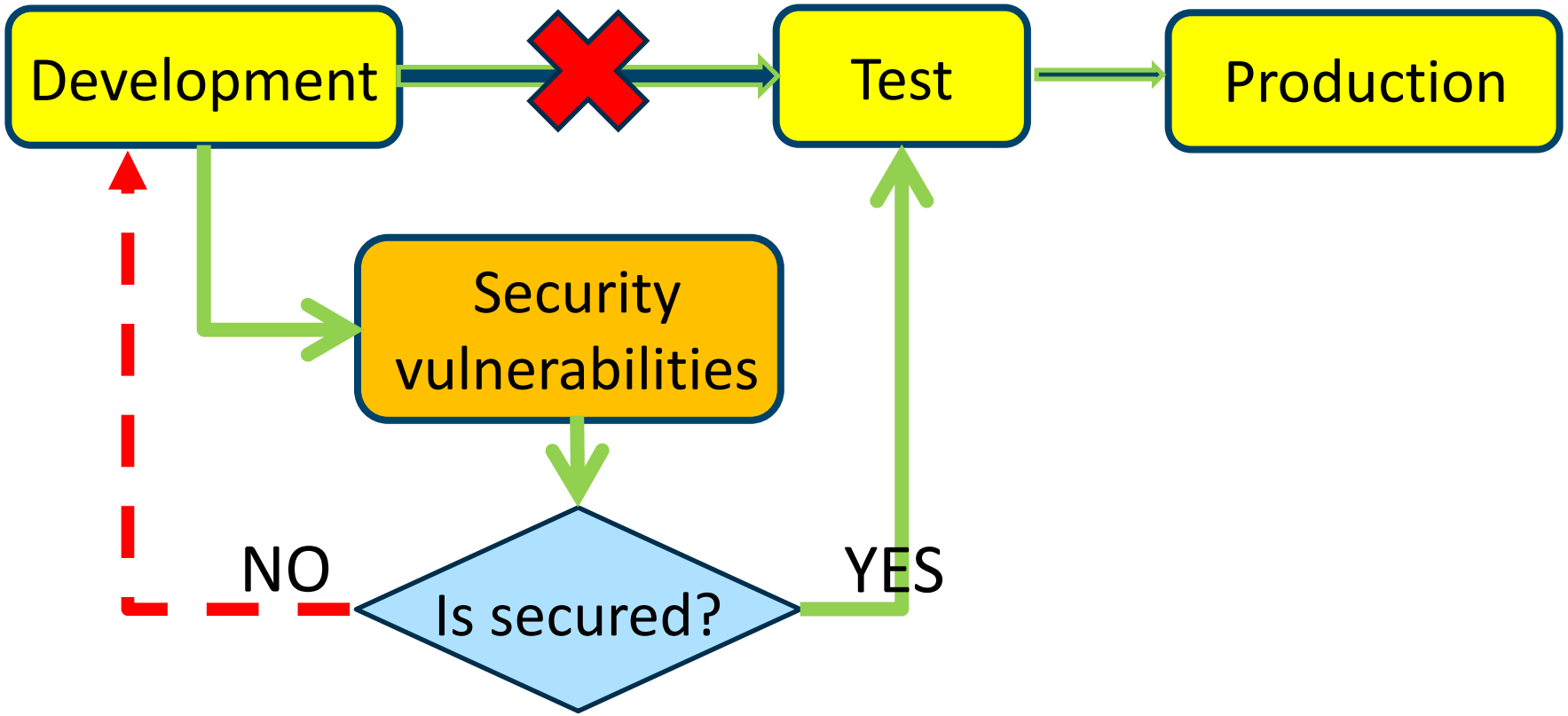
- It can run your processes too
  - Application process

There is Application process - On Demand.
what happens if I do now

f?p=96792:9999:106983718520082:APPLICATION_PROCESS=DUMMYPROCESS:::

Improvements

Idea?


Development
Test
Production
Security vulnerabilities
Is secured?
NO
YES

DIY – part 2

Monitor and logging

- All invalid authentication are logged

```
select * from apex_workspace_access_log
```

OR

```
select * from apex_workspace_activity_log
```

- Attackers will try to break into the system
- Logs are kept for 2 weeks so consider backing them up

Application x / Utilities / Embedded Code

Search

Total Row Count 52

Search... Go

Language

- PL/SQL (22)
- SQL (16)
- JavaScript (14)

Scope

- Shared Component (2)
- Page 4 - Access-control vulnerability (1)
- Page 7 - Error handling function (1)
- Page 11 - XSS Cross Site Scripting (3)
- Page 12 - SQL Injection (1)
- Page 15 - Display and hidden Items (13)
- Page 16 - Report, toggle, card (12)
- Page 17 - Line charts (15)
- Page 9999 - Login Page (4)

Component Type

- Region (16)
- Action (15)
- Process (10)

Search Results

Shared Component
Application Process: DUMMYPROCESS

```
Begin
        htp.p('Hello there!!');
        End;
```

Shared Component
Authorization: ADMINISTRATION RIGHTS

```
if :APP_USER != 'LSCHILDE@GMAIL.COM' then return true; else return false; end if;
```

Page 15 - Display and hidden Items
Page: DISPLAY AND HIDDEN ITEMS

```
function myFunction(p1) {
  alert (p1);
}
```

Page 11 - XSS Cross Site Scripting
Region: REPORT COLUMN HTML EXPRESSION LINK

```
select "ID",
        "USERNAME",
        "FIRSTNAME",
        "SURNAME"
    , apex_escape.js_literal('Full name is ' || firstname || ' ' || surname)
      as jsfullname
        from "APEX_210200"."DEMO_USERS_XSS"
```

APEX Views - Information

- We can do lots using APEX views:
  - **apex_applications**
  - apex_application_static_files
  - apex_application_processes
  - apex_application_pages
  - **apex_application_page_regions**
  - **apex_application_page_proc**
  - apex_application_page_items
  - apex_application_page_buttons

…is in meta data

- apex_application_page_reg_cols
- **apex_application_page_rpt_cols**
- apex_appl_page_igs
- **apex_appl_page_ig_columns**
- apex_application_page_ir
- **apex_application_page_ir_col**
- apex_application_page_da_acts
- apex_application_list_entries
- apex_application_lists
- apex_application_lovs
- apex_application_page_map_layers

APEX Views - We can find

- **Application settings**
- Application processes with no authorizations
- Application processes for Dynamic SQL
- Application computations for Dynamic SQL
- **Page settings**
- Page regions with no authorizations
- Page processes with no authorizations
- Page regions with Dynamic SQL
- Page regions with substitution variables
- Buttons with no authorizations

...and check

- Reports with JS links
- Reports with non escaped items
- Global and on page JS
- **Region sources for SQL injection**
- **Dynamic PLSQL region**
- Deprecated APIs
- Deprecated APEX features (**tabular forms**, date pickers)

...and address

- List items with no authorizations
- Items with invalid settings (hidden or display)
- Items default values (source) checks for Dynamic SQL
- **Editable IGs with no authorizations**
- Page Computations
- Page Validations
- **Dynamic actions with substitution variables**
- **Page JS with substitution variable**

DEV Processes

- Export apps
  - With No debug and as Run Application Only
- Run your APEX Advisors/testing tools
- Have internally built tool to monitor common settings

DEV Apps

Details	Current		Should be
Application	1111 - SB demo		
Embeded in Frames	Allow from same origin		
Application version	1.5.0.2		
Compatibility	19.2		
Default Theme	Universal Theme		
Theme Subscribed From	99999. Style		
Theme Style	SB Style		
Global Page Regions Without Server Side Condition	2	Details	
Global Page Dynamic Actions Without Server Side Condition	2	Details	
Authentication Scheme	SB Authentication		
Button Region Position "Top and Bottom"	3	Details	DEPRECATED (ab APEX 21.2)
Interactive Grids	13	Details	
JavaScript other	6	Details	
Error Handling Functionn			apex_exc_error_handling.apex_error_handling

Automated testing

WHY Automated testing?!

- **Improves software quality**
- Much faster than manual - Longer test cycles
- Saves Time and Money
- **Faster APEX Upgrading**
- Return on investment is high

WHY Automated testing?!

- Reduces manual errors
- Improves Standards
- Faster time to market
- Faster Feedback
- Improved Productivity
- Faster Debugging

Testing tools

- Help with APEX upgrades
- Help with APEX security
- Still someone needs to maintain them
- Several tools available

Testing tools

- Selenium
- Cypress
- Ghost Inspector
- Playwright?!!!!
- utPLSQL

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Quick test

- Item conditions are safe?
- APEX JS alert example
- Commented out code?
- APEX API can not be abused?
- APEX built-in substitution variable?

Code Editor - Code

```
1   alert("Entered value &P10_ITEM.");
2
3   alert("Entered value &P10_ITEM!JS.");
4
5   alert("Entered value " + $v('P10_ITEM'));
6
7   alert("Entered value " + apex.item("P10_ITEM").getValue());
8
9   alert("Entered value " + apex.items.P10_ITEM.value );
10
```

Demo 7 - Condition injection demo

Display Only

Showing

Submit

Server-side Condition

Type: Expression

Language: PL/SQL

PL/SQL Expression

```
length('&P9_MSG.')> 8
```

```
1   DECLARE
2   l_text CLOB;
3   l_email VARCHAR2(50);
4   l_name VARCHAR2(50);
5   BEGIN
6     SELECT 'dummy@demo.com' email, ' there.!!!!!!' name into l_email, l_name
7     from dual;
8
9     --l_text := 'LAST MESSAGE: &P9_COMMENT..' || utl_tcp.crlf;
10    l_text := 'LAST MESSAGE: ' || :P9_COMMENT || utl_tcp.crlf;
11
12    l_text := l_text || ' Changed by &APP_USER.'|| utl_tcp.crlf;
13    l_text := l_text ||' Hello ' || l_name || utl_tcp.crlf;
14
15    htp.p(l_text);
16  END;
```

```
8     l_text := 'LAST MESSAGE: ' || apex_escape.html(:P9_COMMENT) || utl_tcp.crlf;
```

Source

Form Region: - Select -

Type: Expression

Language: PL/SQL

PL/SQL Expression

```
apex_util.prepare_url('f?p=&APP_ID.:&APP_PAGE_ID.:&APP_SESSION.::::P9_MSG:&P9_MSG.')
```

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SAFE

Summary

- Do not trust user inputs
  - Sanitize & validate
  - Make sure it gets escaped when used
- Protect your items
  - We can not change values using URL or JavaScript
  - Use SSP, restricted characters and value protected
- Be careful with using &PX_ITEM. syntax
  - Region, error & success messages are safe places
- Use security & auto-testing tools
- Build your own checks based on APEX views

Summary

- Minimum is to utilize authentication and authorization policies as minimum
- Authentication - “best practices”
- Error handling function
- Inconsistencies can lead to vulnerabilities
- Keep APEX up-to date

Summary SQL Injection

- Do use bind variables with care:
  - ! If used in Dynamic SQL bind variable needs to embedded in the string
- If you are forced to use &ITEM. syntax:
  - Check where data is coming from
  - Use appropriate escaping methods available
- DBMS_ASSERT and APEX_ESCAPE
- Reduce the impact surface

Summary SQL Injection

- APEX_COLLECTION
  - CREATE_COLLECTION_FROM_QUERY
  - CREATE_COLLECTION_FROM_QUERY2
  - CREATE_COLLECTION_FROM_QUERY_B
  - CREATE_COLLECTION_FROM_QUERY_B2
  - MERGE_MEMBERS
- APEX_ITEM
  - POPUP_FROM_QUERY
  - POPUPKEY_FROM_QUERY
  - SELECT_LIST_FROM_QUERY
  - SELECT_LIST_FROM_QUERY_XL
  - TEXT_FROM_LOV_QUERY
- DBMS_SQL.PARSE

Summary XSS

- Restrict, sanitize, validate and escape user inputs per context
- APEX_ESCAPE
- APEX_JAVASCRIPT.ESCAPE
- APEX_UTIL.URL_ENCODE
- HTF.ESCAPE_SC
- apex.util
  - escapeCSS, escapeHTML, escapeHTMLAttr

Summary XSS

- &PX_ITEM!HTML.
- &PX_ITEM!JS.
- &PX_ITEM!ATTR.
- &PX_ITEM!RAW.
- &PX_ITEM!STRIPHTML.

How much can we do ourself?

Yes we can do most!

Q&A

Thank you for attending