vmware

codechix

Secure Coding

By: Security Ninjas

- Bhakti Bohara — Arizona State University
- Deepanjana Gupta — Carnegie Mellon University
- Deepika Peringanji — Stony Brook University
- Shivani Sharma — North Carolina State University

Motivation

- Developers NEED to code securely
- Security mishaps have lead to huge losses
- Better be safe than sorry

ARIANE 5 FAILURE

- BACKGROUND:-
- European space agency's re-useable launch vehicle.
- Ariane-4 was a major success
- Ariane -5 was developed for the larger payloads

- LAUNCHED:-on June 4 1996
- MISSION was to delivered $500 million payloads to the orbit
- THE MAIDEN FLIGHT OF THE ARIANE 5 ENDED IN A FAILURE.
- ONLY AFTER 40 SECONDS THE FLIGHT VEERED OFF ITS PATH AND BROKE UP AND EXPLODED
- CAUSE: Unhandled floating point exception in code
- ENGINEERS FROM THE ARIANE PROJECT STARTED TO INVESTIGATE THE CAUSES OF LAUNCH FAILURE.

Source: Google Images

Brief Description of Curriculum

- The curriculum teaches about common vulnerabilities and helps in adapting to best security measures for applications

- Hands On
  - ➔ Discuss security threat
  - ➔ Ask student to attack given code snippet
  - ➔ Ask student to secure it

Prerequisites

Mac / Linux - or virtual box for terminal access

Basic working knowledge of SQL, C/C++ , Javascript or any other scripting language

Takeaways

- Coding anti-patterns in backend and frontend code leading to these vulnerabilities
- Security vulnerabilities arising from these bad practices
- Solutions and tips on how to avoid these practices

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Memory Management

Specific to stack smashing. Will touch upon buffer overflow and integer overflow.

Will contain hands on exercises on finding vulnerabilities in C code and fixing them.

Duration : 60 minutes

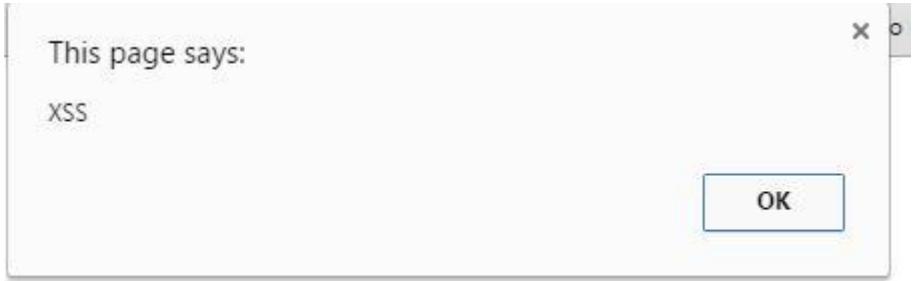
```
Enter the string to be stored : aasdjaskvlsajvblashvb;asgvjad
*** stack smashing detected ***: ./memAttack terminated
Aborted (core dumped)
```

```
Enter a string whose length is less than 128: aaaaaaaaaahhhhhhhhhhhhhhhhhhyyyyyyyyyyyyyyyyyyyyyyyyffffffffffffffffffffffffffffffffffffffffffffffffrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn
nnnnnnnnnnnnnnnn

Enter a string whose length is less than 128: aaaaaaaaaahhhhhhhhhhhhhhhhhhyyyyyyyyyyyyyyyyyyyyyyyyffffffffffffffffffffffffffffffffffffffffffffffffrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn
nnnnnnnnnnnnnnnn

Enter the lengths of the 2 strings whose sum should be less than 256 (in hex): 0xfffffffa 0x106
Segmentation fault (core dumped)
```

Input Validation

The front end should have a centralized input validation routine for untrusted data sources which rejects the input if any validation check fails.

- Specifying character set and canonicalize input before validation
- Check for hazardous characters, dot-dot-slash, null bytes
- Duration : 15 minutes



Database Security

SQL scripts interfacing with the database should be protected from SQL injection attacks.

Hands-on exercise will include a SQL script with queries susceptible to SQL injection and stacked queries which must be identified and fixed (convert simple query to parameterized query) to make it safe.

Duration : 30 minutes

```
Enter your username:ccAdmin
Enter your password:pwdAdmin
Hello 101 ccAdmin
Enter your account type (SAVING/CHECKING):SAVING
Your balance is 20000
```

```
Enter your username:ccAdmin' UNION SELECT uid,username FROM users --
Enter your password:any password
Hello 101 ccAdmin 201 ccMod 301 ccStudent
Enter your account type (SAVING/CHECKING)::SAVING' UNION SELECT balance FROM balances WHERE uid = 201 OR uid = 301 --
Your balance is 4000 5000
```

Cryptographic Practices

Two hands-on problems

- Identifying the correct order/way to use the crypto libraries to get intended effect
- Emphasize on random number generation/ key size
- Duration : 15 minutes

```
def encrypt(plain_text, key):
    iv = "DeadBeef"
    des = DES.new(key, DES.MODE_CFB, iv)
    cipher_text = des.encrypt(plain_text)
    return cipher_text

def decrypt(cipher_text, key):
    iv = "DeadBeef"
    des = DES.new(key, DES.MODE_CFB, iv)
    decrypted_text = des.decrypt(cipher_text)
    return decrypted_text

if __name__ == "__main__":
    plain_text = "This is a secret message"
    key = "Good key"
    cipher_text = encrypt(plain_text, key)
    decrypted_text = decrypt(cipher_text, key)
```

```
def encrypt(plain_text, key):
    iv = Random.get_random_bytes(8)
    des = DES.new(key, DES.MODE_CFB, iv)
    cipher_text = des.encrypt(plain_text)
    return cipher_text

def decrypt(cipher_text, key):
    iv = Random.get_random_bytes(8)
    des = DES.new(key, DES.MODE_CFB, iv)
    decrypted_text = des.decrypt(cipher_text)
    return decrypted_text

if __name__ == "__main__":
    plain_text = "This is a secret message"
    key = "Good key"
    cipher_text = encrypt(plain_text, key)
    decrypted_text = decrypt(cipher_text, key)
```

Error Handling

Error handling is often neglected! Handling errors gracefully and leaving the system consistent is important

Never reveal sensitive information about the underlying application, system, server etc.,

Hands-on exercises - Releasing memory, cleaning up practices during erroneous exit
Duration : 10 minutes

```
HEAP SUMMARY:
    in use at exit: 40 bytes in 1 blocks
  total heap usage: 1 allocs, 0 frees, 40 bytes allocated

Searching for pointers to 1 not-freed blocks
Checked 77,256 bytes

40 bytes in 1 blocks are definitely lost in loss record 1 of 1
   at 0x4C2AB80: malloc (in /usr/lib/valgrind/vgpreload_memcheck-amd64-linux.so)
   by 0x4005AB: main (in /home/deepika/codehouse/secureCoding/error_handling/error)

LEAK SUMMARY:
   definitely lost: 40 bytes in 1 blocks
   indirectly lost: 0 bytes in 0 blocks
     possibly lost: 0 bytes in 0 blocks
   still reachable: 0 bytes in 0 blocks
        suppressed: 0 bytes in 0 blocks
```

```
filp = fopen(argv[1], "ab+");
if (!filp) {
    return -1;
}

if (b != 0) {
    fprintf (filp,"%d divided by %d is %d",a,b,a/b);
    return 0;
}
else {
    printf ("Divide by zero. Exiting");
    return -1;
}
```

Session Management

Managing Cookies, Sessions.

Hands-on:Simple script to add cookie via javascript.

Tasks :

- Restrict cookie through Path, Domain and Max Age
- Use URL encoding to eliminate whitespaces
- Use HTTPOnly.
- Set session id as cookie and send it from server
- Invalidate the session on logout

Duration : 60 minutes

```
<script>
    function setcookie(){

    var d = new Date();
    d.setTime(d.getTime() + (24*60*60*1000));
    var expires = "expires=" + d.toGMTString();
    document.cookie = document.getElementById('form').name.
        value + "=" + document.getElementById('form').pwd.
        value +"; " + expires;
    alert(document.cookie);
}

    function getcookie(){
        var x = document.cookie;
        alert(x);
    }
</script>
```

Other Topics …

Output Encoding

Password Management and Authentication

Access Control

Data Protection

Duration : 40 minutes

Future Scope

- More hands on exercises
- References to external exercises
- Vulnerabilities in other stacks e.g MEAN stack

Demo Time!

References

1. https://www.owasp.org/images/0/08/OWASP_SCP_Quick_Reference_Guide_v2.pdf
2. http://www.w3schools.com/
3. http://www.opinionatedgeek.com/Errors/Unknown.aspx?aspxerrorpath=/dotnet/tools/htmlencode/encode.aspx

Thank You!