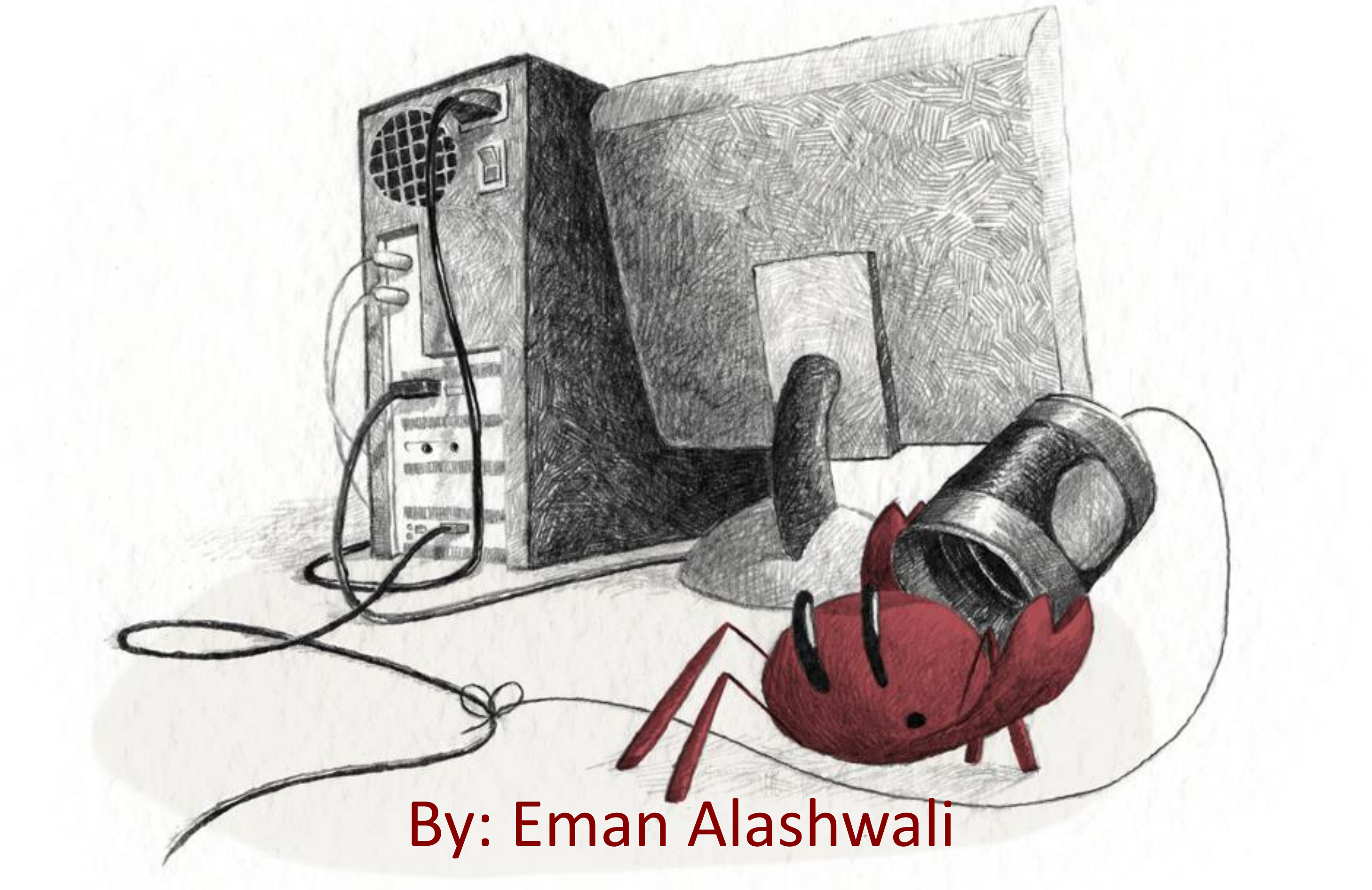
NETWORK SNIFFING

With a focus on the risks of insecure login in Universities Online Systems



By: Eman Alashwali

Image source: http://alsoalso.net/criminal-crab/

OUTLINE

- Sniffing: What? Why? Who? How?
- Sniffing Tools
- Risks
- The Goal
- Illustration Examples
- Real World Example
- Defences
- Conclusion

WHAT IS NETWORK SNIFFING ?

- Network analysis = Packet Analysis = Eavesdropping
- Capturing network traffic and inspecting it closely to determine what is happening on the network

WHY SNIFFING ?

- Troubleshooting problems on the network
- Analysing the performance of a network
- Discovering the origin of virus
- Detect Denial of Service (DoS) attacks
- Educational purposes
- **Malicious purposes**

WHO ?

- System administrators
- Network engineers
- Security engineers
- Researchers and Teachers
- **Attackers**

HOW SNIFFING WORKS?

- Non-switched (shared bus broadcast) networks
  - The message is sent to all machines over the network
  - NIC checks the destination address
  - NIC accepts the packet if it has the machine’s address
  - Otherwise, it discards it

HOW SNIFFING ?

- Put the NIC into “promiscuous mode”
- The NIC does not discard packets not addressed to its machine

OUTLINE

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SNIFFING TOOLS

- Programs used to decode packets that travels across the network layer of the TCP/IP and display them in a readable format

EXAMPLES SNIFFING TOOLS

- **Wireshark**
- **Cain & Abel (Windows)**
- Tcpdump (Unx based systems)
- Windum (Windows version of Tcpdump)
- Dsniff (Different platforms)
- Ettercap (Windows, Linux)
- Packetyzer (Windows)

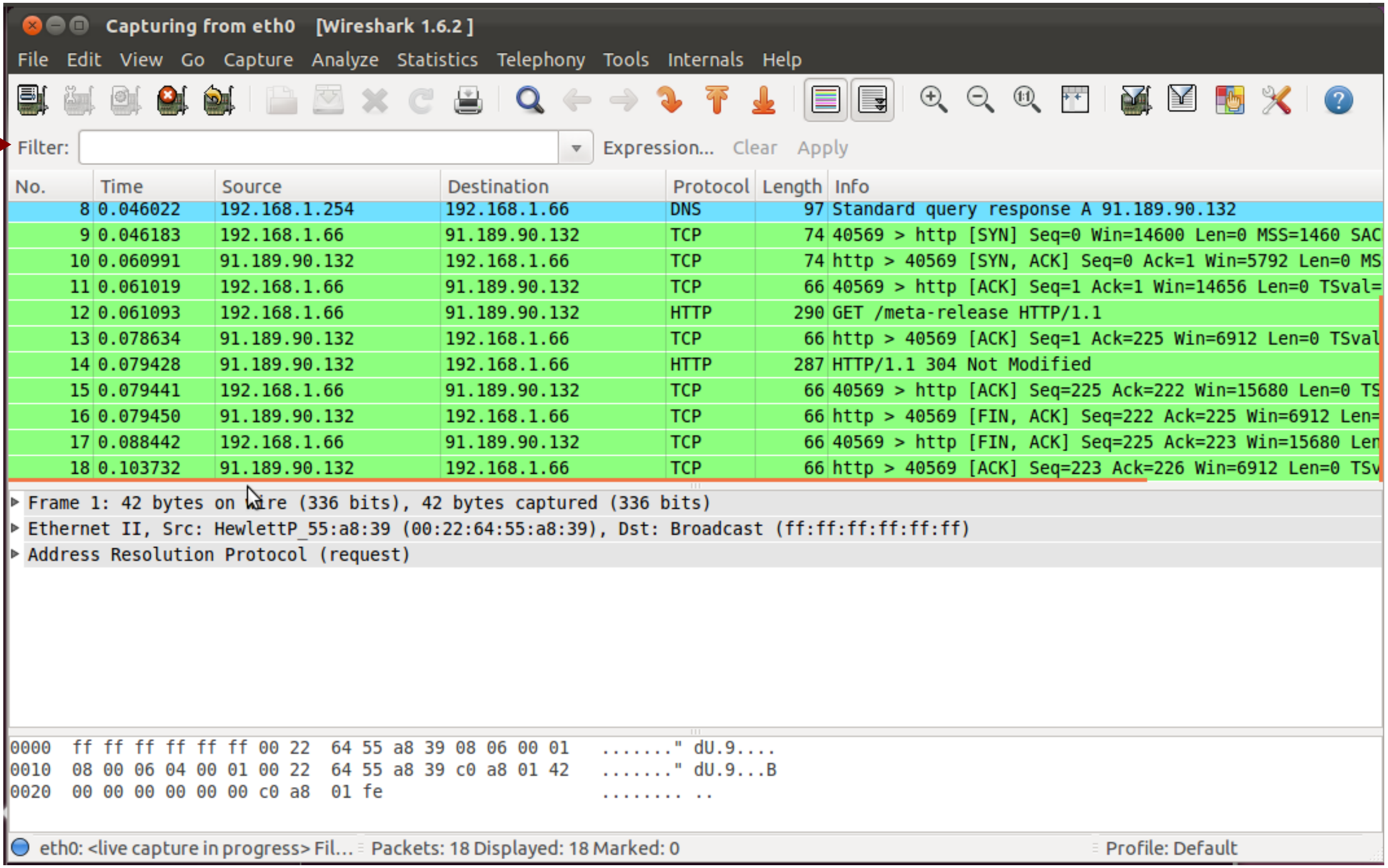
WIRESHARK

Filter

Summary

Protocol Tree Windows

Data View Windows



```
No.  Time      Source         Destination    Protocol Length Info
   8 0.046022  192.168.1.254  192.168.1.66   DNS          97 Standard query response A 91.189.90.132
   9 0.046183  192.168.1.66   91.189.90.132  TCP          74 40569 > http [SYN] Seq=0 Win=14600 Len=0 MSS=1460 SAC
  10 0.060991  91.189.90.132  192.168.1.66   TCP          74 http > 40569 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MS
  11 0.061019  192.168.1.66   91.189.90.132  TCP          66 40569 > http [ACK] Seq=1 Ack=1 Win=14656 Len=0 TSval=
  12 0.061093  192.168.1.66   91.189.90.132  HTTP        290 GET /meta-release HTTP/1.1
  13 0.078634  91.189.90.132  192.168.1.66   TCP          66 http > 40569 [ACK] Seq=1 Ack=225 Win=6912 Len=0 TSval
  14 0.079428  91.189.90.132  192.168.1.66   HTTP        287 HTTP/1.1 304 Not Modified
  15 0.079441  192.168.1.66   91.189.90.132  TCP          66 40569 > http [ACK] Seq=225 Ack=222 Win=15680 Len=0 TS
  16 0.079450  91.189.90.132  192.168.1.66   TCP          66 http > 40569 [FIN, ACK] Seq=222 Ack=225 Win=6912 Len=
  17 0.088442  192.168.1.66   91.189.90.132  TCP          66 40569 > http [FIN, ACK] Seq=225 Ack=223 Win=15680 Len
  18 0.103732  91.189.90.132  192.168.1.66   TCP          66 http > 40569 [ACK] Seq=223 Ack=226 Win=6912 Len=0 TSv
```

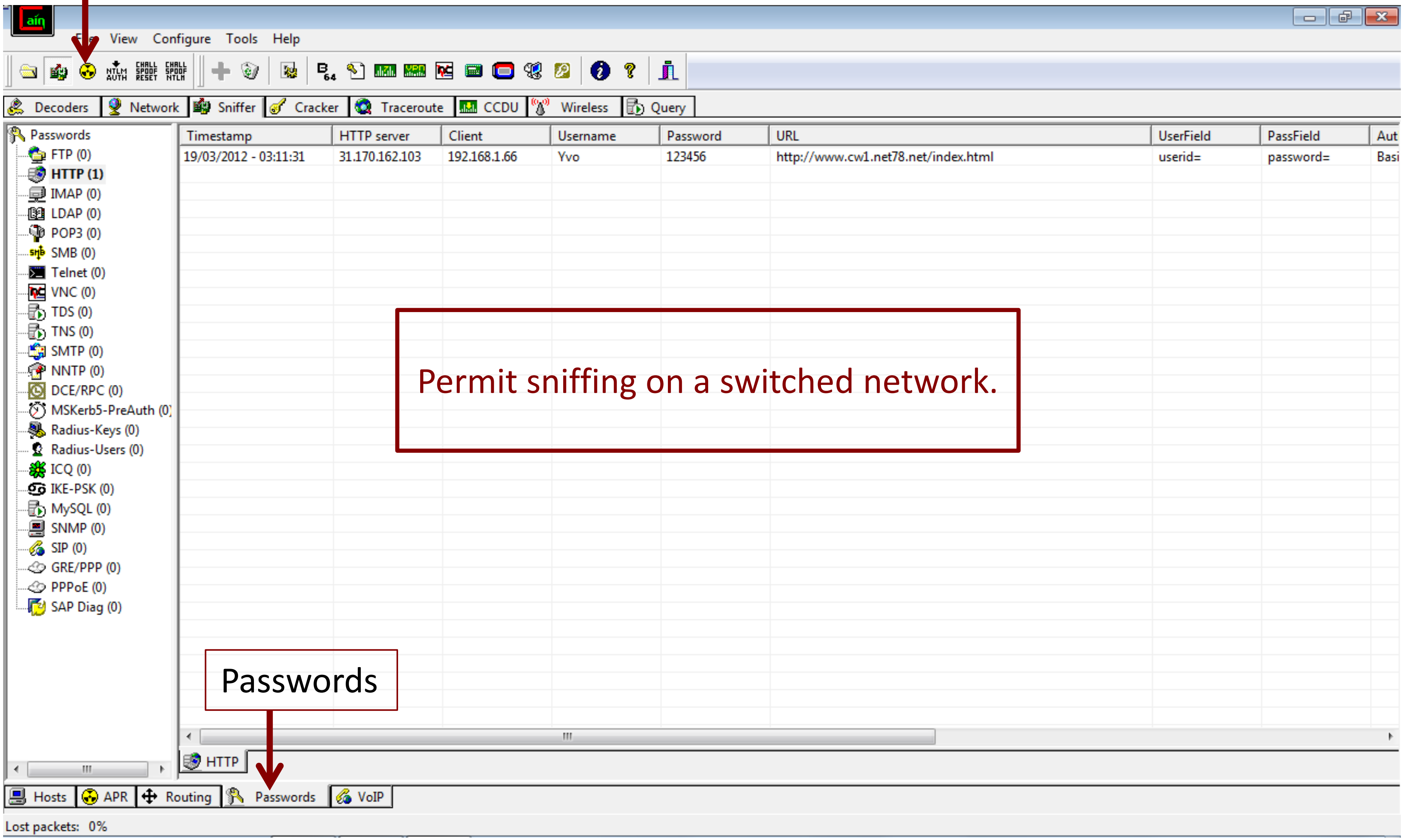
```
▸ Frame 1: 42 bytes on wire (336 bits), 42 bytes captured (336 bits)
▸ Ethernet II, Src: HewlettP_55:a8:39 (00:22:64:55:a8:39), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
▸ Address Resolution Protocol (request)
```

```
0000  ff ff ff ff ff ff 00 22  64 55 a8 39 08 06 00 01   ......." dU.9....
0010  08 00 06 04 00 01 00 22  64 55 a8 39 c0 a8 01 42   ......." dU.9...B
0020  00 00 00 00 00 00 c0 a8  01 fe                     ........ ..
```

eth0: <live capture in progress> Fil... Packets: 18 Displayed: 18 Marked: 0 Profile: Default

Cain & Abel

ARP Poisoning



Timestamp	HTTP server	Client	Username	Password	URL	UserField	PassField	Aut
19/03/2012 - 03:11:31	31.170.162.103	192.168.1.66	Yvo	123456	http://www.cw1.net78.net/index.html	userid=	password=	Basi

Permit sniffing on a switched network.

Passwords

OUTLINE

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RISKS

- Capturing cleartext usernames and passwords
- Compromising proprietary information

OUTLINE

- ~~What? Why? How? Who?~~
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- ~~Risks~~
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OUR GOAL

- Demonstrate the risks of insecure login
- Stress the importance of secure login in educational electronic systems, specially online systems

OUTLINE

- ~~What? Why? How? Who?~~
- ~~Sniffing Tools~~
- ~~Risks~~
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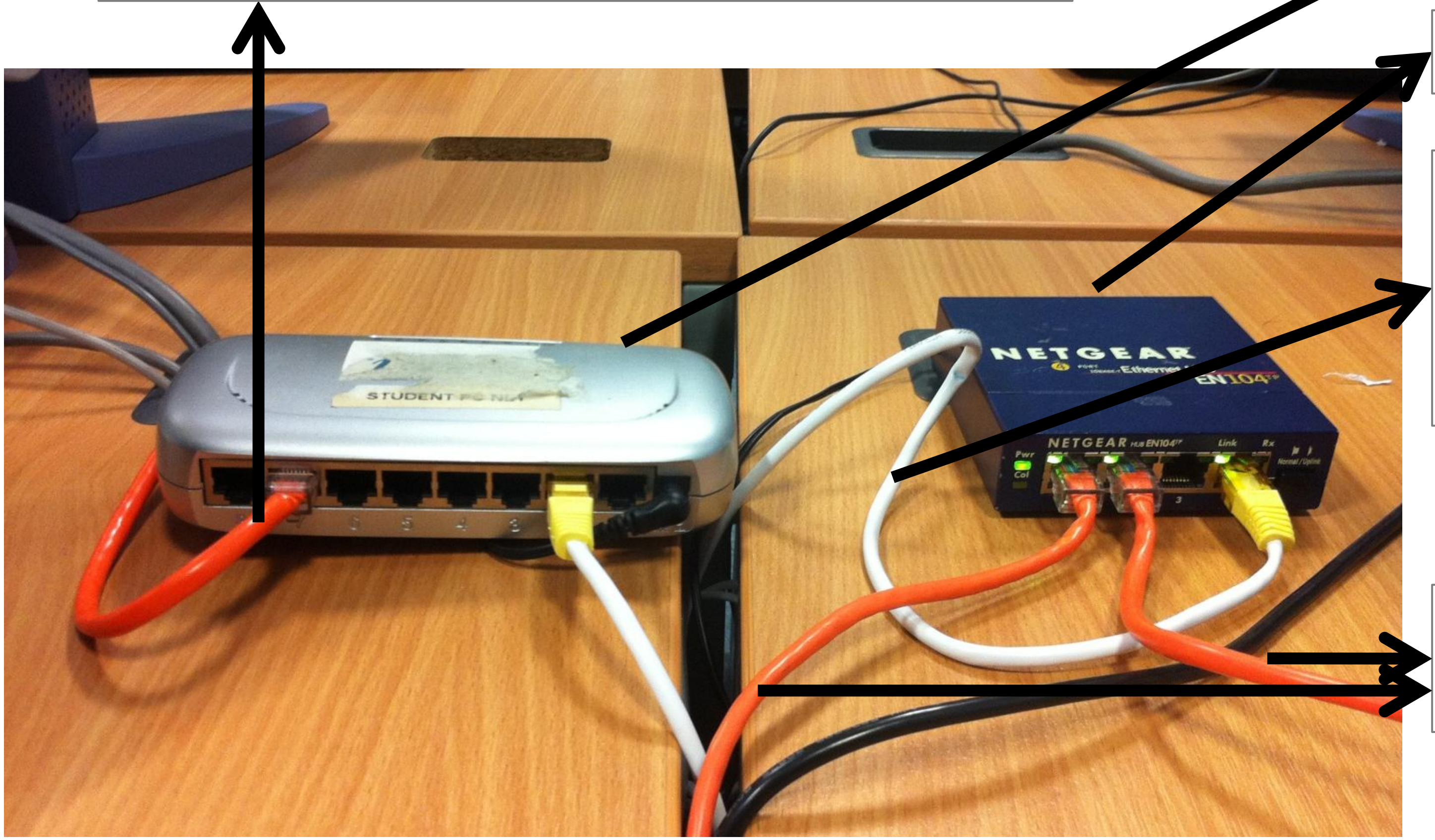
“ ENOUGH TALK .. LET’S GET TO WORK”

TOPOLOGY



Orange Cable: To the Lab actual Switch

Switch

HUB

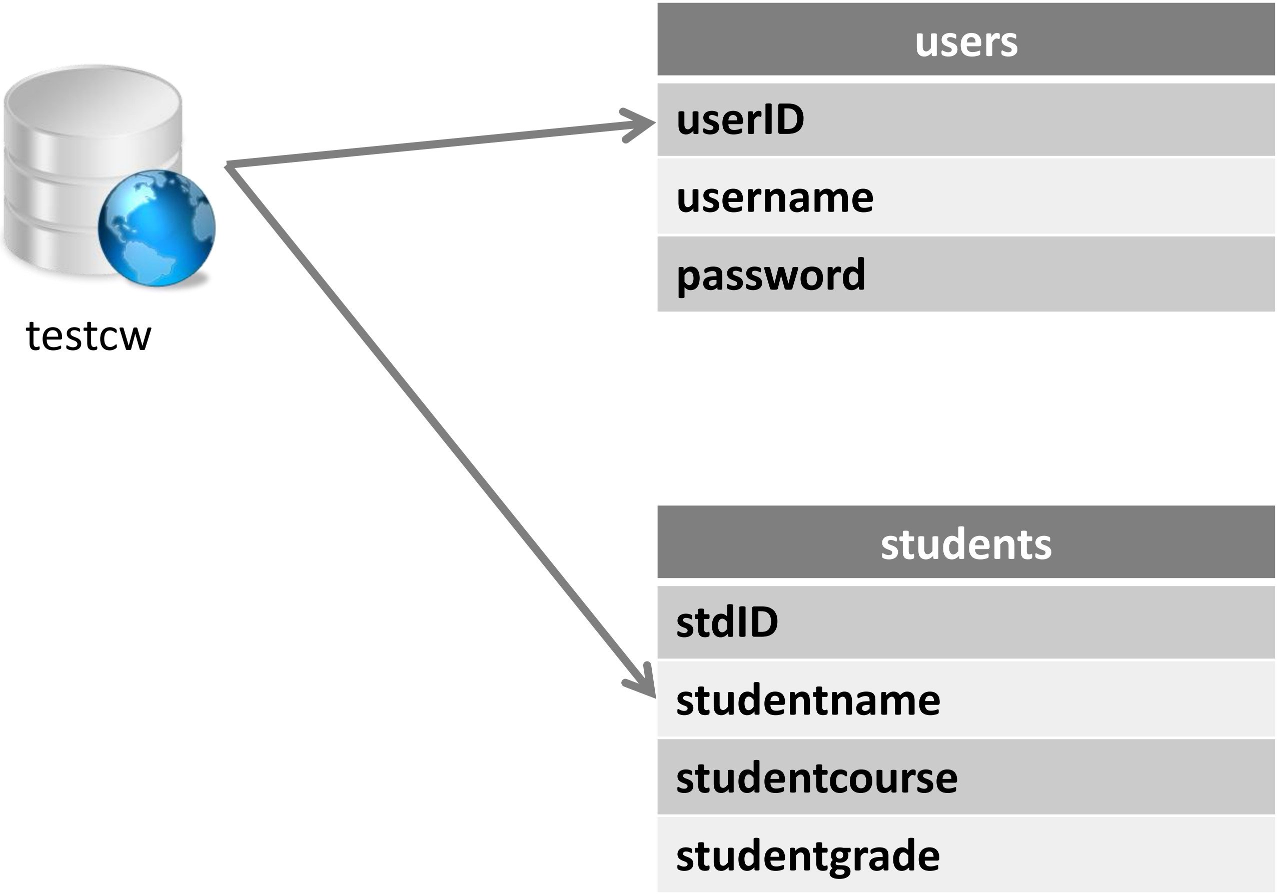
White Cables: Uplink from the Hub to the Switch

Orange Cables: PC1 & PC2

REQUIREMENTS

- **HW:**
  - Switch; Hub; Two Laptops
- **Services:**
  - Internet; Web hosting
- **SW:**
  - Programming with PHP and MySQL
  - Sniffing tools: Wireshark; Cane & Abel
  - Operating Systems: Linux (Ubuntu 11) & Windows 7
- **Simulating educational system (editing grades)**

DATABASE

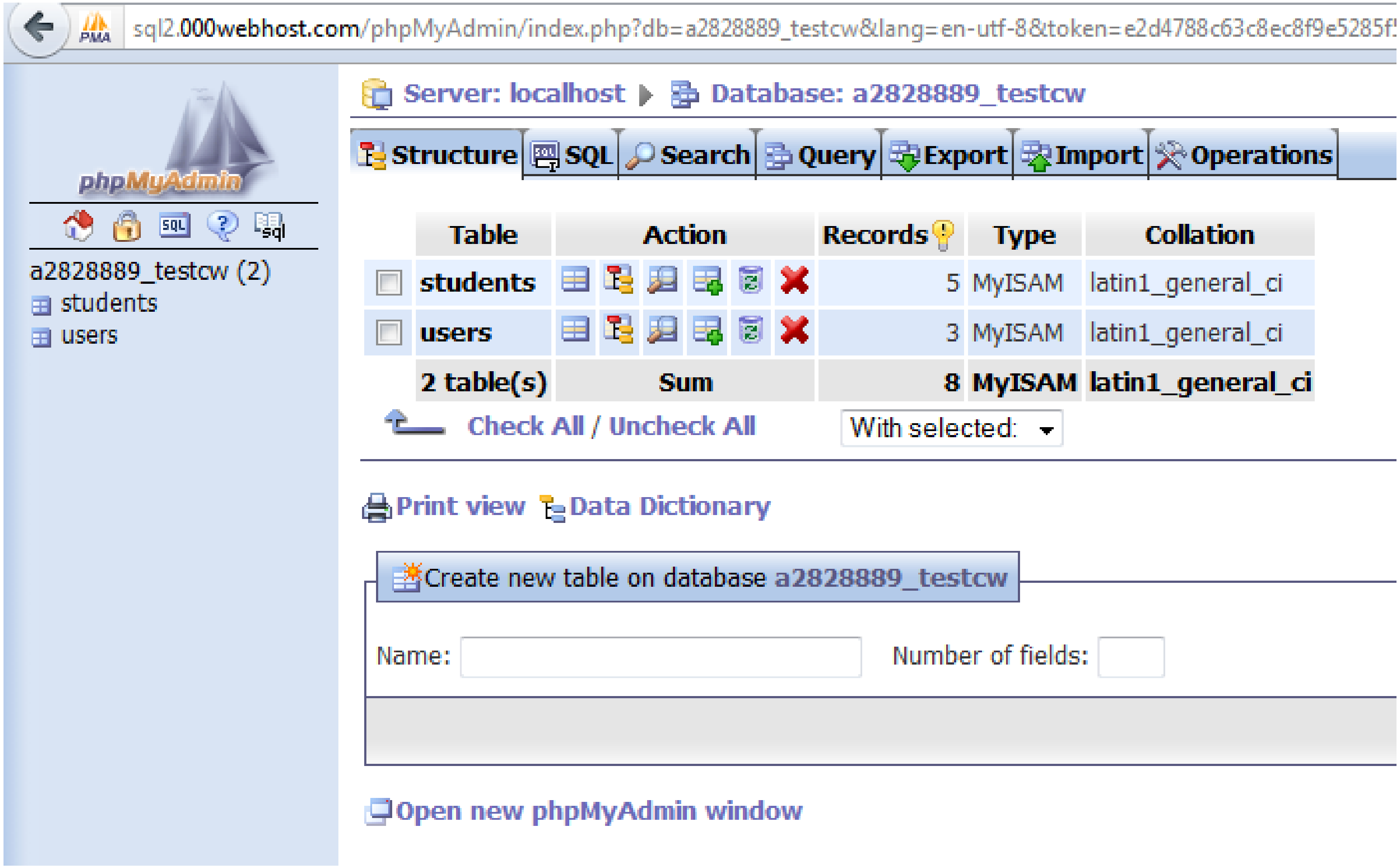


testcw

users
userID
username
password

students
stdID
studentname
studentcourse
studentgrade

DATABASE



sql2.000webhost.com/phpMyAdmin/index.php?db=a2828889_testcw&lang=en-utf-8&token=e2d4788c63c8ec8f9e5285f

Server: localhost ▸ Database: a2828889_testcw

a2828889_testcw (2)
- students
- users

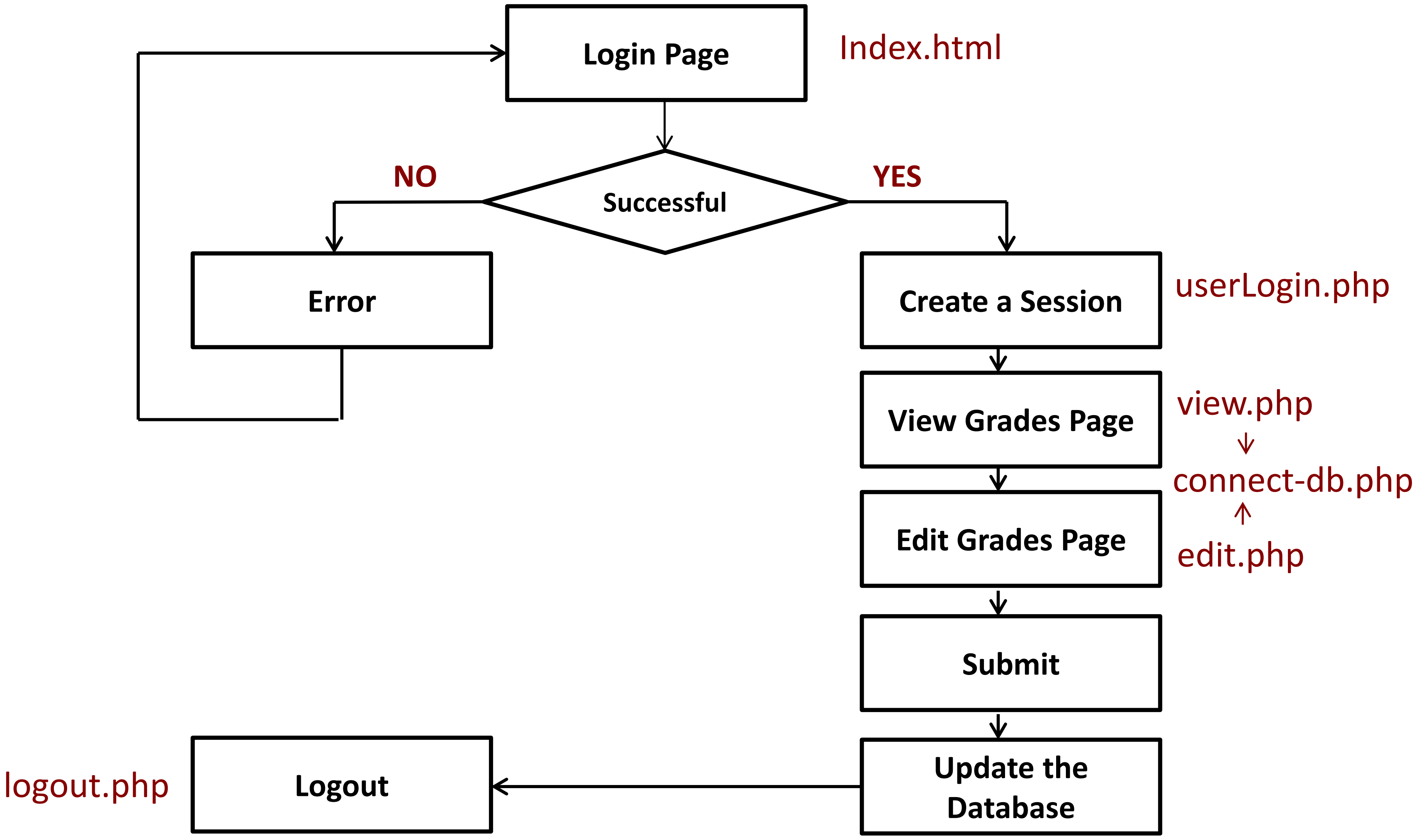
	Table	Action	Records	Type	Collation
□	students	✖	5	MyISAM	latin1_general_ci
□	users	✖	3	MyISAM	latin1_general_ci
	2 table(s)	Sum	8	MyISAM	latin1_general_ci

Create new table on database a2828889_testcw

Name:

Number of fields:

WEB PAGES



Login Page

Index.html

Successful

NO

YES

Error

Create a Session

userLogin.php

View Grades Page

view.php

connect-db.php

Edit Grades Page

edit.php

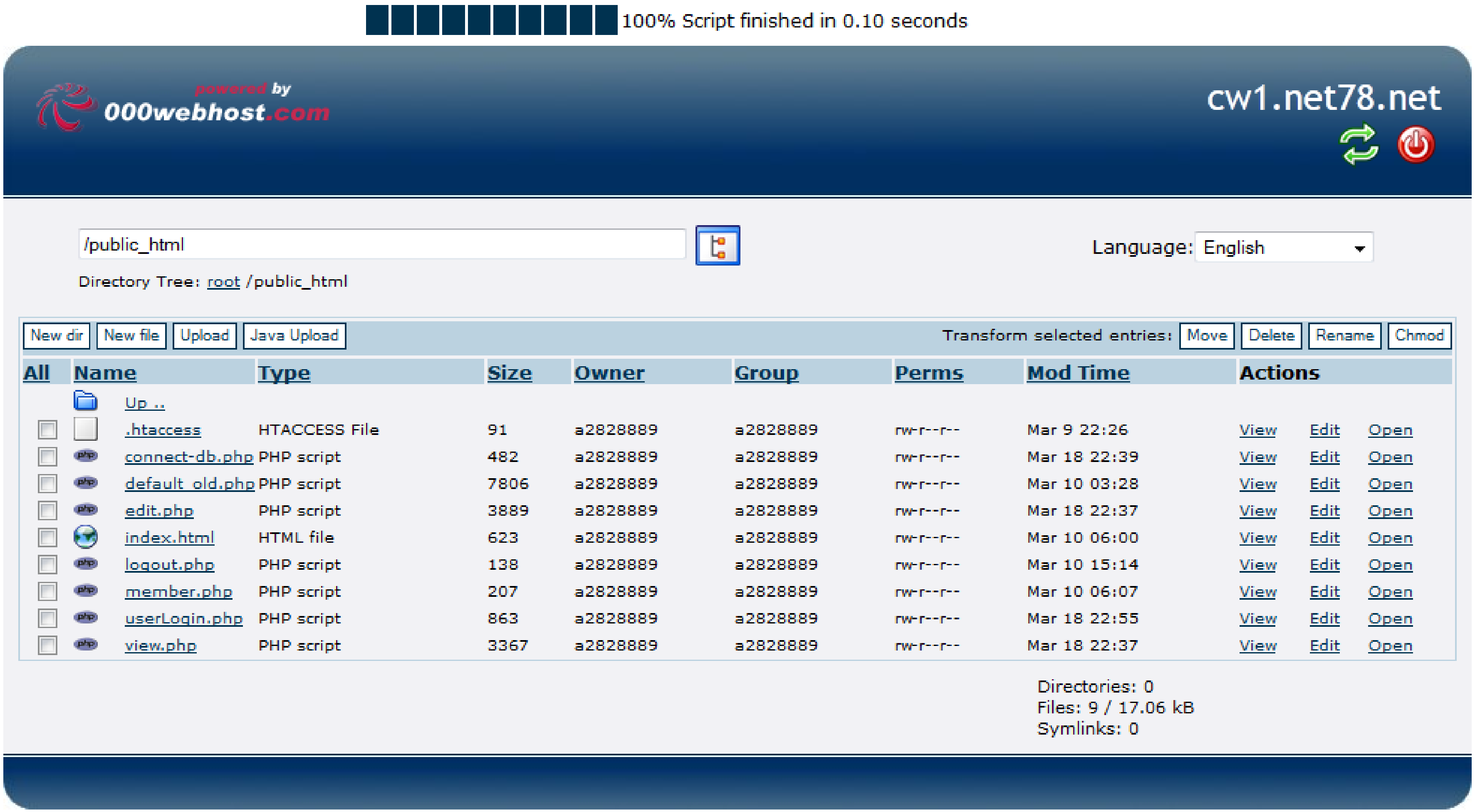
Submit

Update the Database

Logout

logout.php

WEB PAGES



/public_html

Language: English

Directory Tree: root /public_html

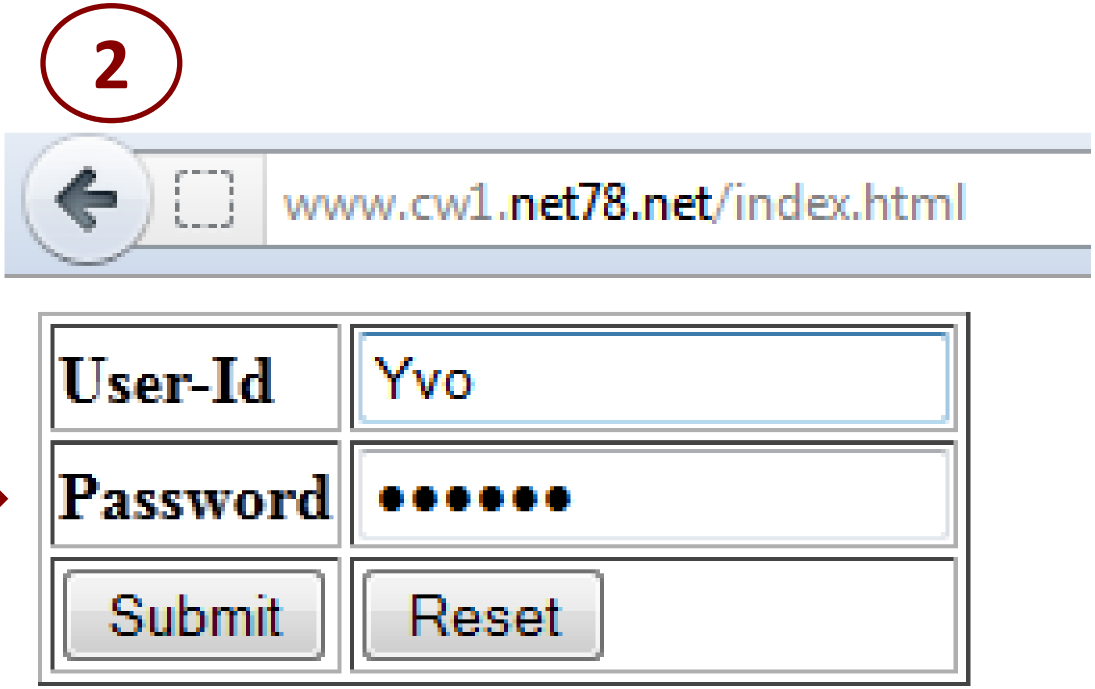
Transform selected entries:

All	Name	Type	Size	Owner	Group	Perms	Mod Time	Actions		
	Up ..									
□	.htaccess	HTACCESS File	91	a2828889	a2828889	rw-r--r--	Mar 9 22:26	View	Edit	Open
□	connect-db.php	PHP script	482	a2828889	a2828889	rw-r--r--	Mar 18 22:39	View	Edit	Open
□	default_old.php	PHP script	7806	a2828889	a2828889	rw-r--r--	Mar 10 03:28	View	Edit	Open
□	edit.php	PHP script	3889	a2828889	a2828889	rw-r--r--	Mar 18 22:37	View	Edit	Open
□	index.html	HTML file	623	a2828889	a2828889	rw-r--r--	Mar 10 06:00	View	Edit	Open
□	logout.php	PHP script	138	a2828889	a2828889	rw-r--r--	Mar 10 15:14	View	Edit	Open
□	member.php	PHP script	207	a2828889	a2828889	rw-r--r--	Mar 10 06:07	View	Edit	Open
□	userLogin.php	PHP script	863	a2828889	a2828889	rw-r--r--	Mar 18 22:55	View	Edit	Open
□	view.php	PHP script	3367	a2828889	a2828889	rw-r--r--	Mar 18 22:37	View	Edit	Open

Directories: 0
Files: 9 / 17.06 kB
Symlinks: 0

1. CLEARTEXT PASSWORD SNIFFING

- **The User's Side**



www.cw1.net78.net/index.html

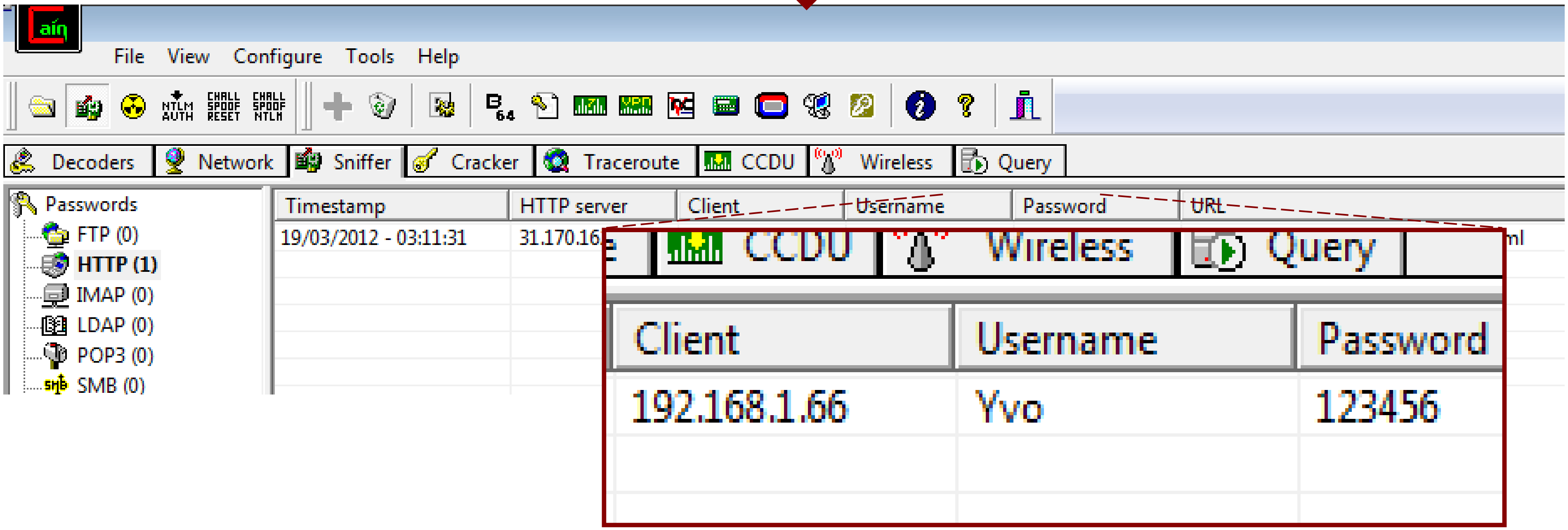
User-Id	Yvo
Password	•••••••
Submit	Reset

Image source: http://alsoalso.net/criminal-crab/

1. CLEARTEXT PASSWORD SNIFFING

- **The attacker’s Side**

Running Cain and Abel sniffing tool



Timestamp	HTTP server	Client	Username	Password	URL
19/03/2012 - 03:11:31	31.170.16				ml

Client	Username	Password
192.168.1.66	Yvo	123456

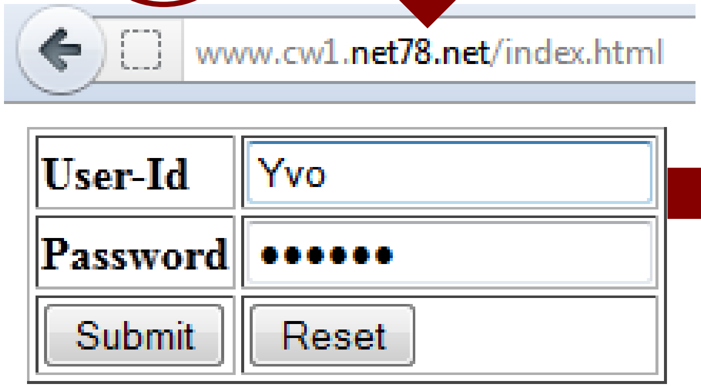
1. CLEARTEXT PASSWORD SNIFFING

- The attacker owns the legitimate user's credentials

Image source: http://alsoalso.net/criminal-crab/

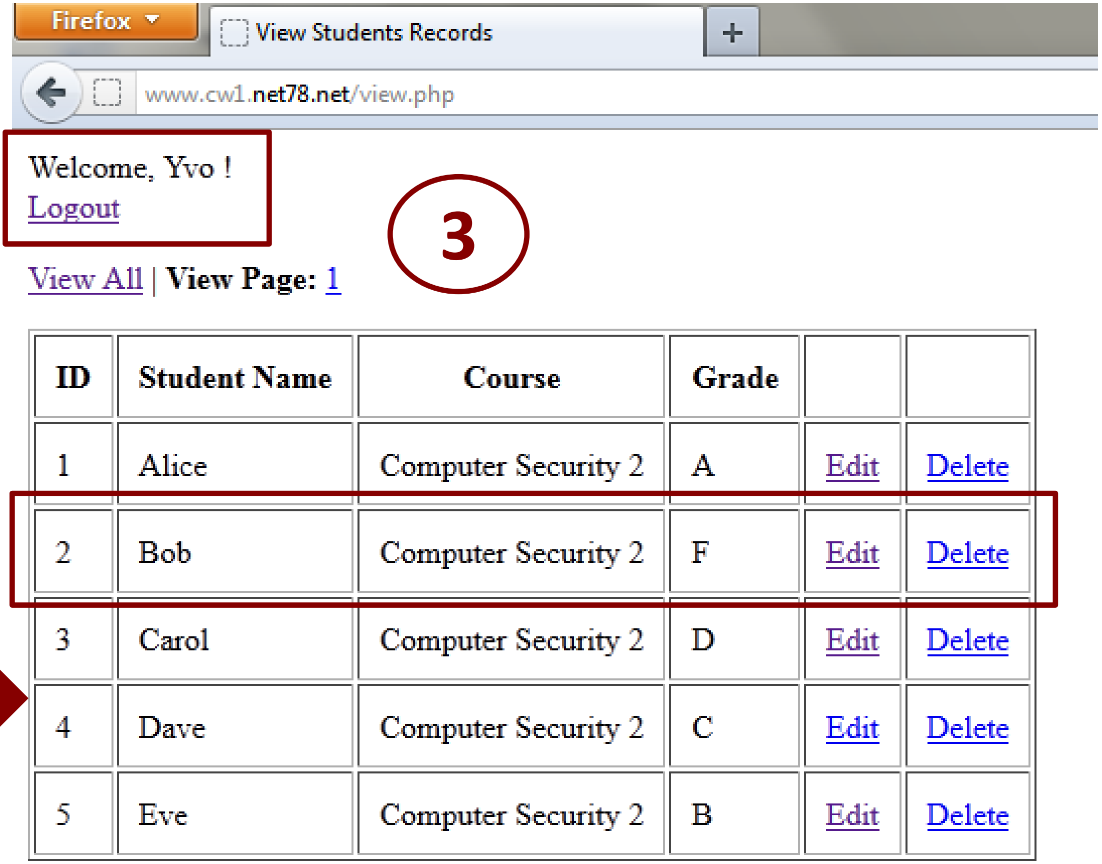
2. SESSION HIJACKING

- **The User's Side**



www.cwl.net78.net/index.html

User-Id	Yvo
Password	•••••••
Submit	Reset



www.cw1.net78.net/view.php

Welcome, Yvo !
Logout

View All | **View Page:** 1

ID	Student Name	Course	Grade		
1	Alice	Computer Security 2	A	Edit	Delete
2	Bob	Computer Security 2	F	Edit	Delete
3	Carol	Computer Security 2	D	Edit	Delete
4	Dave	Computer Security 2	C	Edit	Delete
5	Eve	Computer Security 2	B	Edit	Delete

2. SESSION HIJACKING

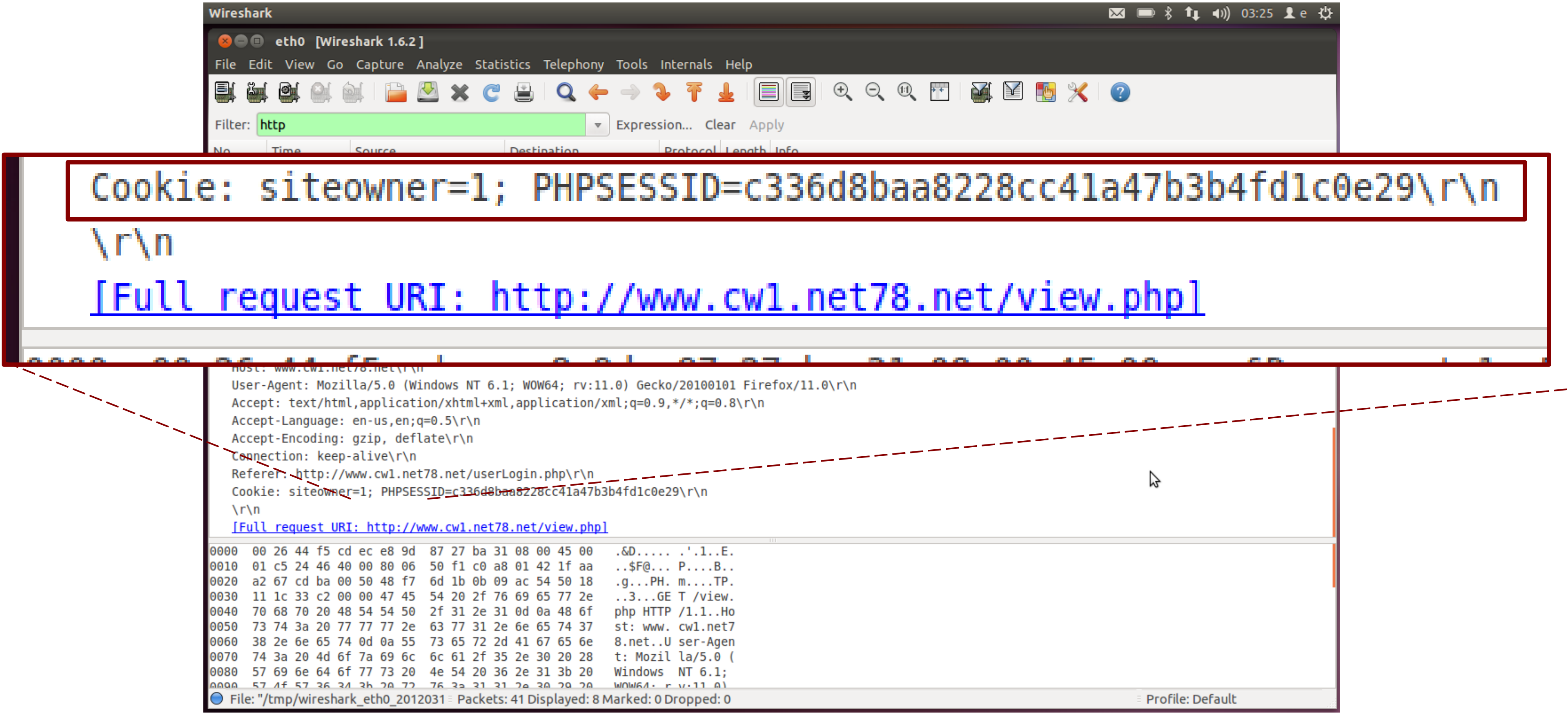
- Bob is not Happy !!

Image source: http://alsoalso.net/criminal-crab/

2. SESSION HIJACKING

- **The Attacker’s Side**
  - Sniff cookies

Running Wireshark


Wireshark
03:25
eth0 [Wireshark 1.6.2]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply
No. Time Source Destination Protocol Length Info
Profile: Default

Filter: http

```
Cookie: siteowner=1; PHPSESSID=c336d8baa8228cc41a47b3b4fd1c0e29\r\n
\r\n
[Full request URI: http://www.cw1.net78.net/view.php]
```

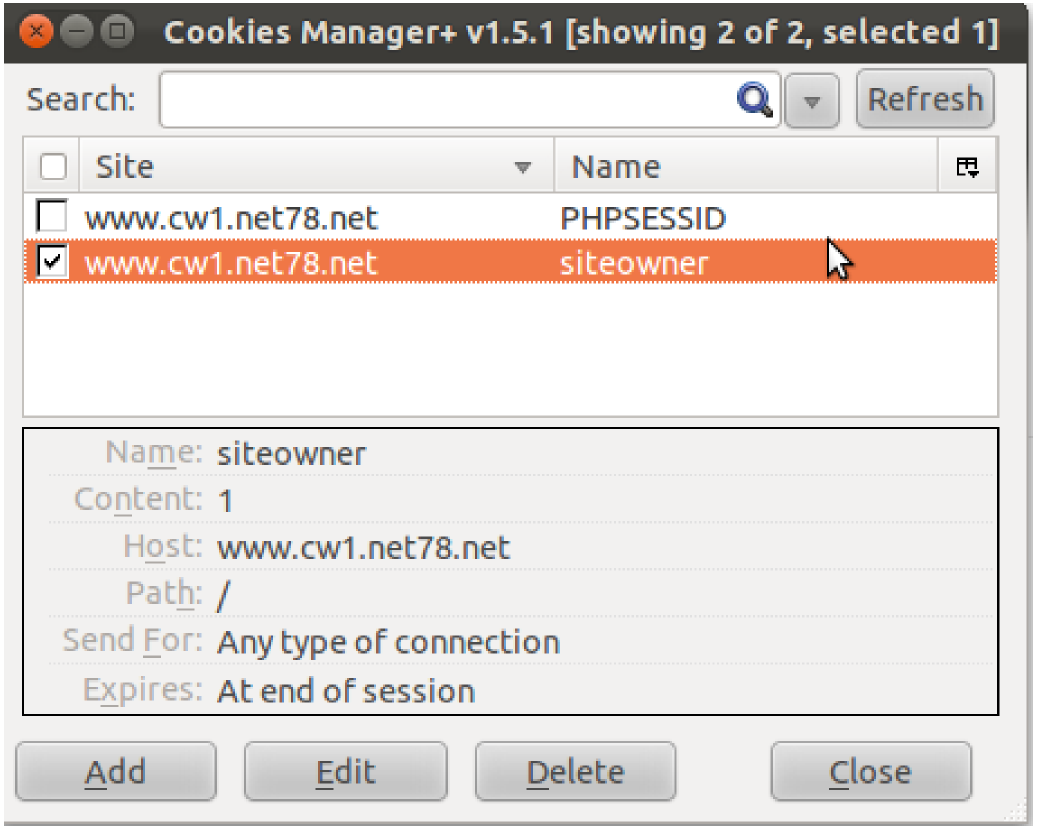
```
Host: www.cw1.net78.net\r\n
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:11.0) Gecko/20100101 Firefox/11.0\r\n
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\r\n
Accept-Language: en-us,en;q=0.5\r\n
Accept-Encoding: gzip, deflate\r\n
Connection: keep-alive\r\n
Referer: http://www.cw1.net78.net/userLogin.php\r\n
Cookie: siteowner=1; PHPSESSID=c336d8baa8228cc41a47b3b4fd1c0e29\r\n
\r\n
[Full request URI: http://www.cw1.net78.net/view.php]
```

```
0000  00 26 44 f5 cd ec e8 9d  87 27 ba 31 08 00 45 00   .&D..... .'.1..E.
0010  01 c5 24 46 40 00 80 06  50 f1 c0 a8 01 42 1f aa   ..$F@... P....B..
0020  a2 67 cd ba 00 50 48 f7  6d 1b 0b 09 ac 54 50 18   .g...PH. m....TP.
0030  11 1c 33 c2 00 00 47 45  54 20 2f 76 69 65 77 2e   ..3...GE T /view.
0040  70 68 70 20 48 54 54 50  2f 31 2e 31 0d 0a 48 6f   php HTTP /1.1..Ho
0050  73 74 3a 20 77 77 77 2e  63 77 31 2e 6e 65 74 37   st: www. cw1.net7
0060  38 2e 6e 65 74 0d 0a 55  73 65 72 2d 41 67 65 6e   8.net..U ser-Agen
0070  74 3a 20 4d 6f 7a 69 6c  6c 61 2f 35 2e 30 20 28   t: Mozil la/5.0 (
0080  57 69 6e 64 6f 77 73 20  4e 54 20 36 2e 31 3b 20   Windows  NT 6.1; 
0090  57 4f 57 36 34 3b 20 72  76 3a 31 31 2e 30 29 20   WOW64; r v:11.0) 
```

File: "/tmp/wireshark_eth0_2012031 Packets: 41 Displayed: 8 Marked: 0 Dropped: 0

2. SESSION HIJACKING

- Inject cookies values in his browser
- Some free tools: Cookies Manager+ for Firefox

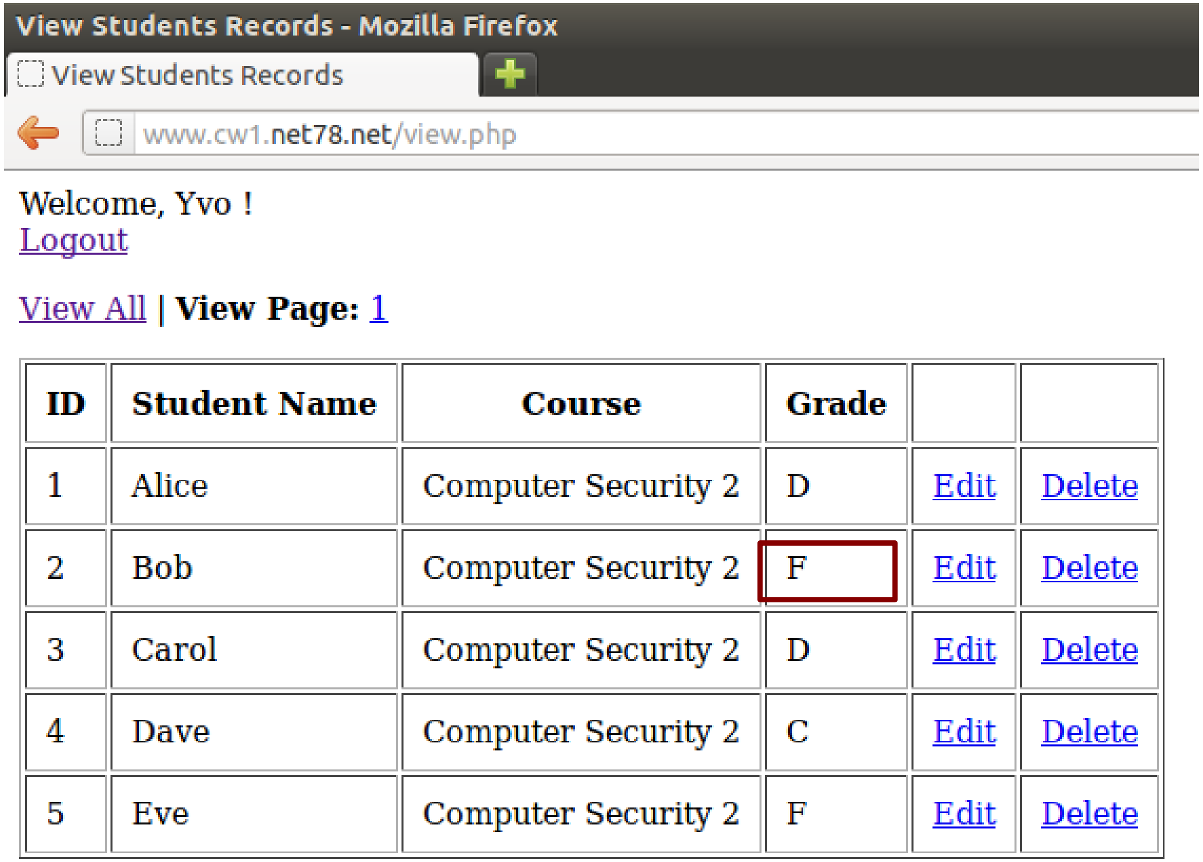


	Site	Name
□	www.cw1.net78.net	PHPSESSID
☑	www.cw1.net78.net	siteowner

Name: siteowner
Content: 1
Host: www.cw1.net78.net
Path: /
Send For: Any type of connection
Expires: At end of session

2. SESSION HIJACKING

- Copy the full request URL and he has the legitimate user's session


View Students Records - Mozilla Firefox
View Students Records
www.cw1.net78.net/view.php

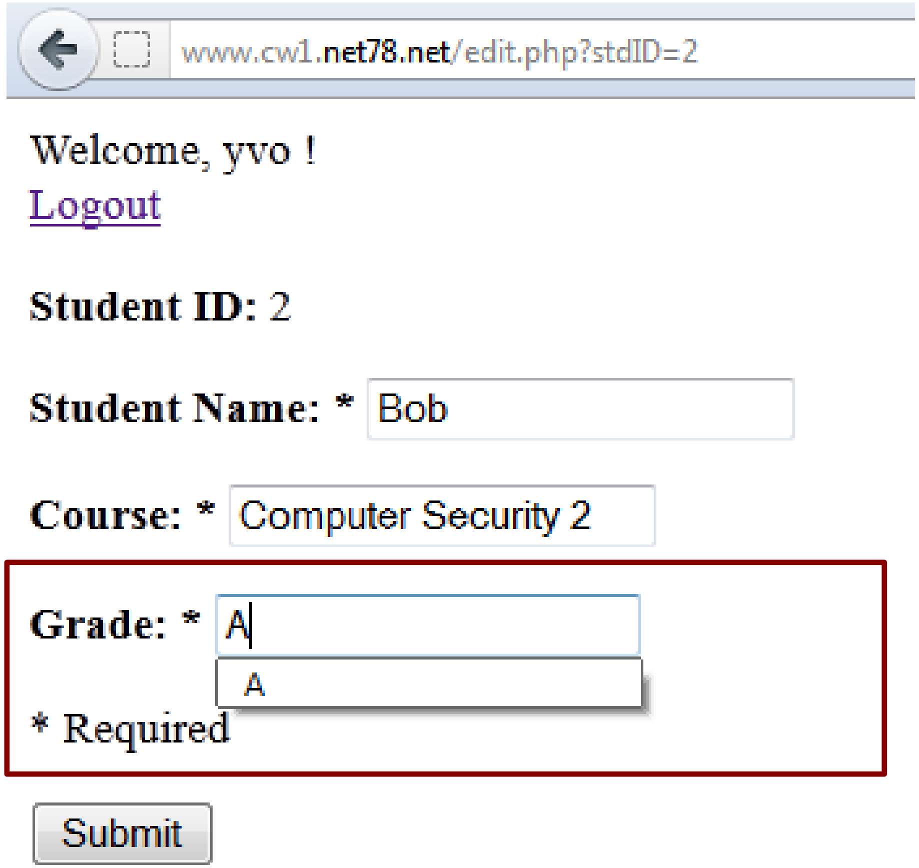
Welcome, Yvo !
Logout

View All | **View Page:** 1

ID	Student Name	Course	Grade		
1	Alice	Computer Security 2	D	Edit	Delete
2	Bob	Computer Security 2	F	Edit	Delete
3	Carol	Computer Security 2	D	Edit	Delete
4	Dave	Computer Security 2	C	Edit	Delete
5	Eve	Computer Security 2	F	Edit	Delete

2. SESSION HIJACKING

- What’s next ??



www.cw1.net78.net/edit.php?stdID=2

Welcome, yvo !

Logout

Student ID: 2

Student Name: * Bob

Course: * Computer Security 2

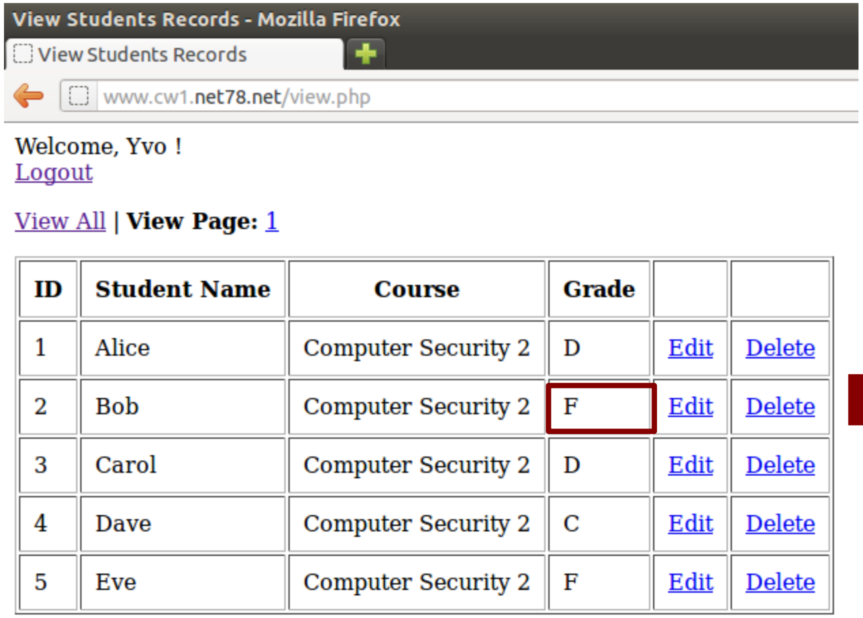
Grade: * A

A

* Required

2. SESSION HIJACKING

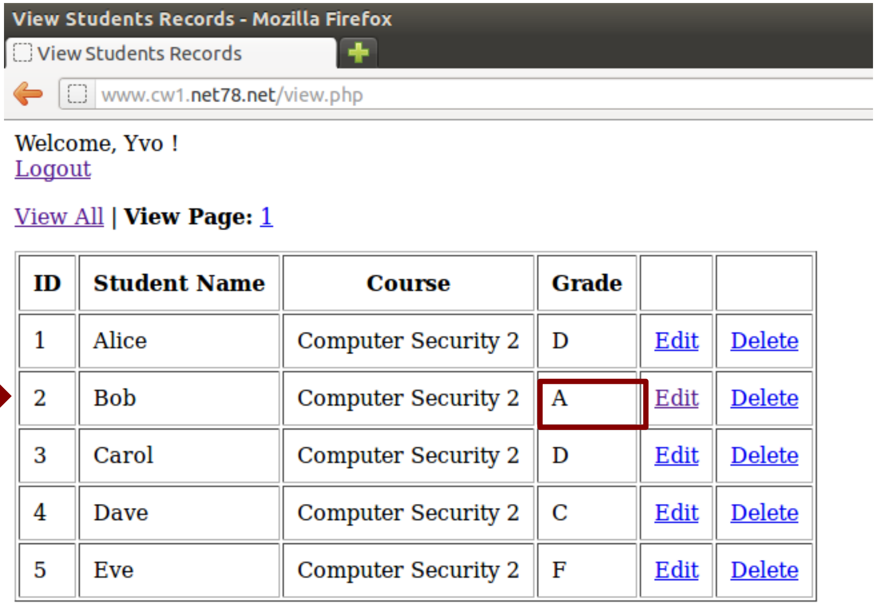
- What’s next ??


View Students Records - Mozilla Firefox
View Students Records
www.cw1.net78.net/view.php

Welcome, Yvo !
Logout

View All | **View Page:** 1

ID	Student Name	Course	Grade		
1	Alice	Computer Security 2	D	Edit	Delete
2	Bob	Computer Security 2	F	Edit	Delete
3	Carol	Computer Security 2	D	Edit	Delete
4	Dave	Computer Security 2	C	Edit	Delete
5	Eve	Computer Security 2	F	Edit	Delete


View Students Records - Mozilla Firefox
View Students Records
www.cw1.net78.net/view.php

Welcome, Yvo !
Logout

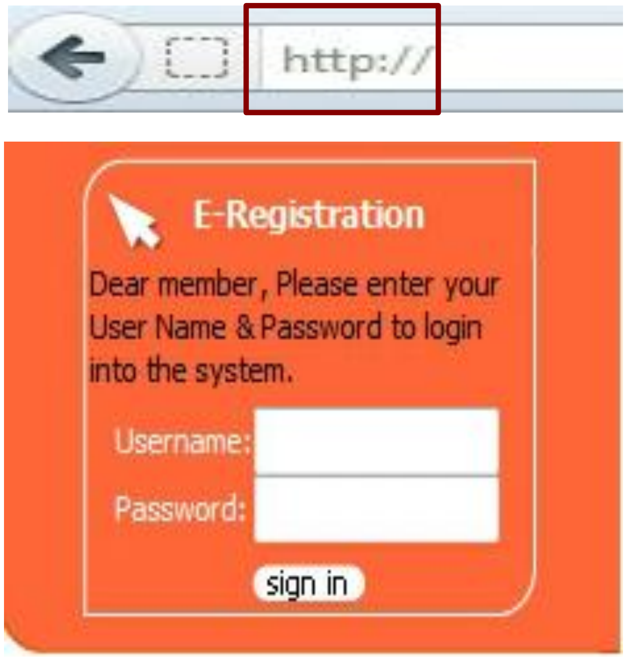
View All | **View Page:** 1

ID	Student Name	Course	Grade		
1	Alice	Computer Security 2	D	Edit	Delete
2	Bob	Computer Security 2	A	Edit	Delete
3	Carol	Computer Security 2	D	Edit	Delete
4	Dave	Computer Security 2	C	Edit	Delete
5	Eve	Computer Security 2	F	Edit	Delete

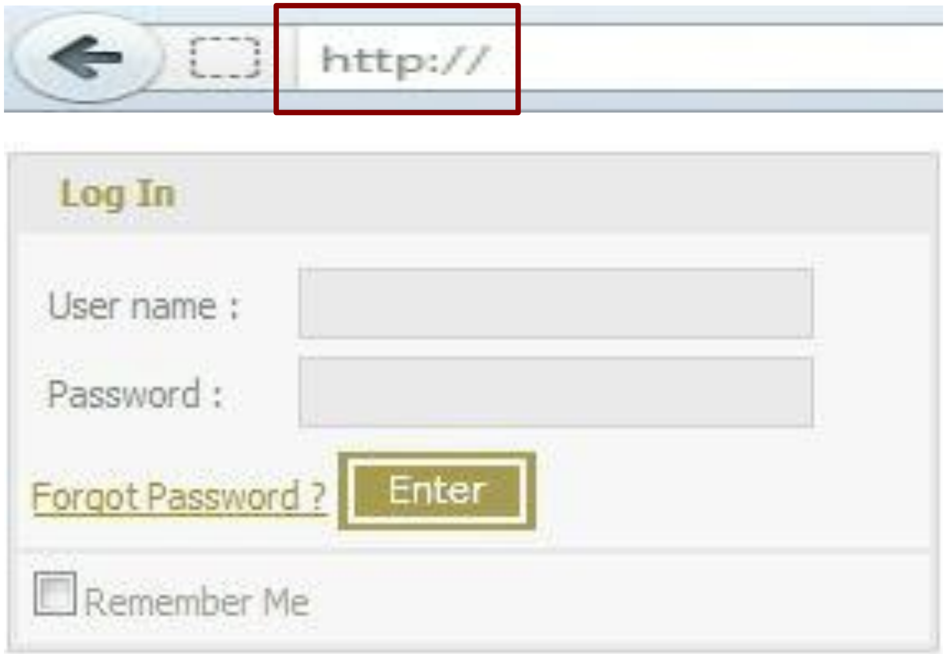
IN REALITY ?

Yes. Many universities websites around the world are vulnerable to such attacks.

IN REALITY ?



Dear member, Please enter your User Name & Password to login into the system.



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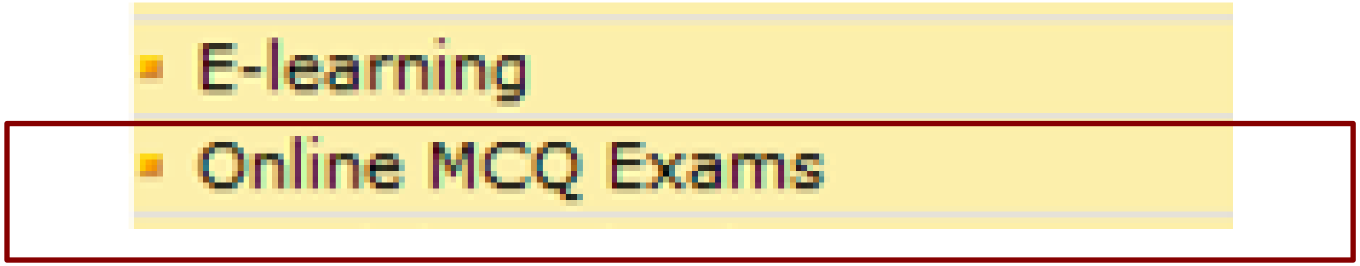
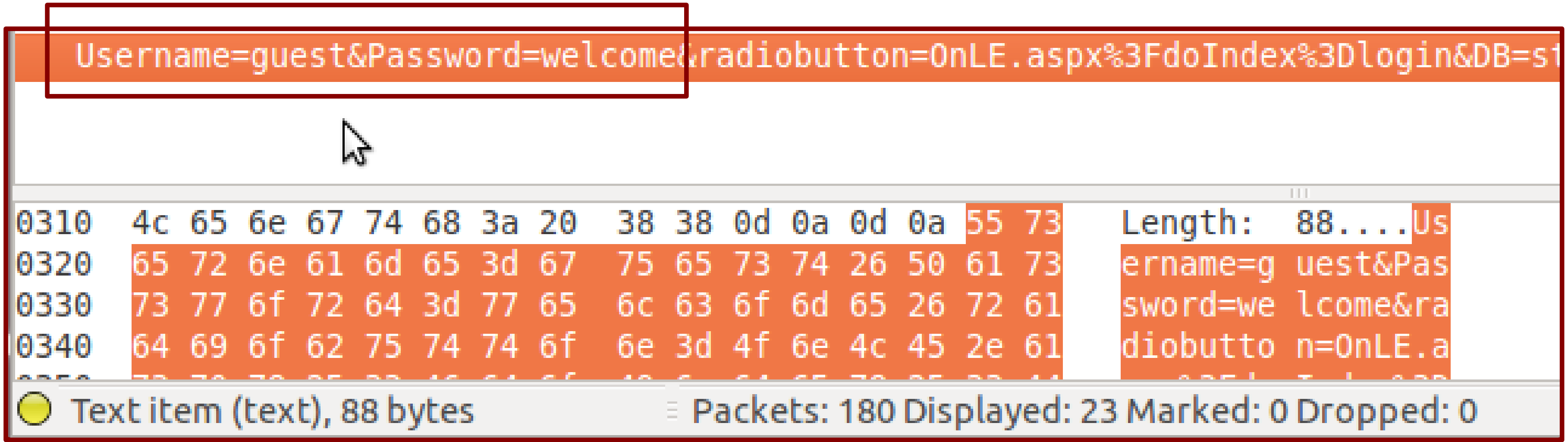
IN REALITY

- ABC University online exam system in Egypt

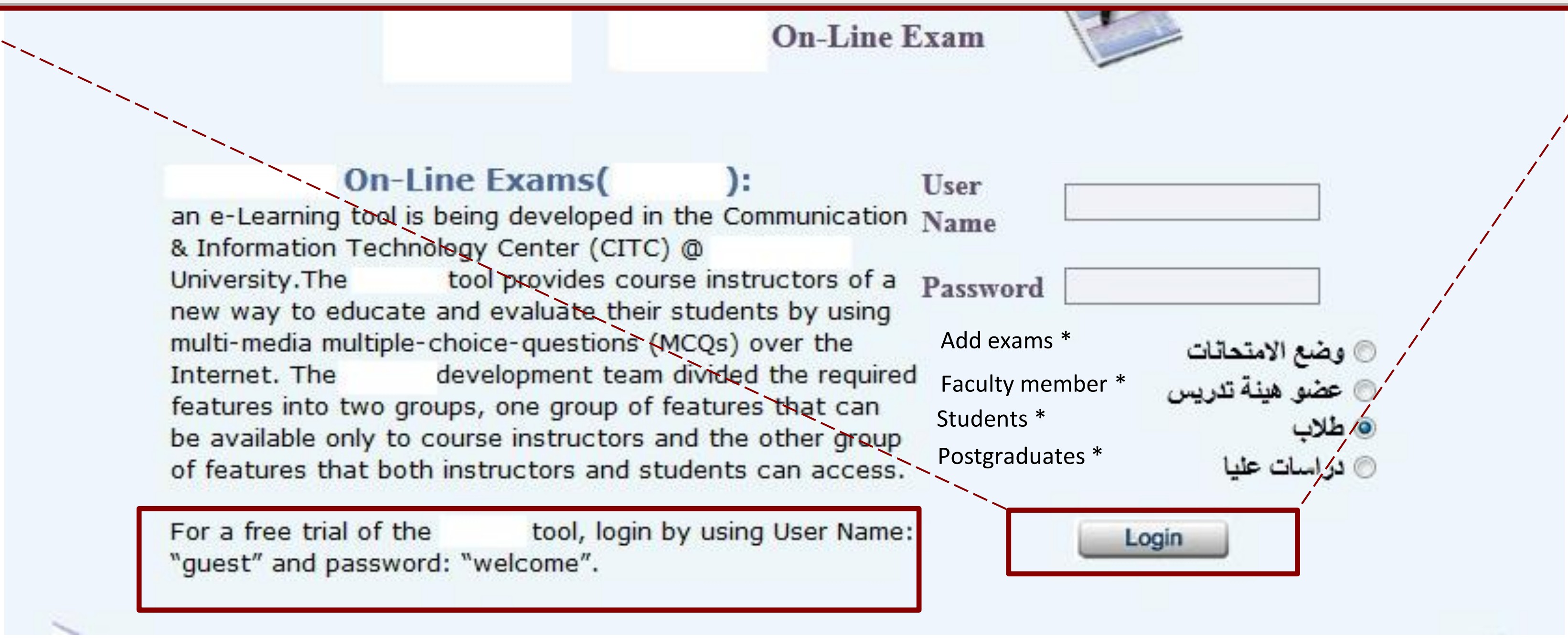




```
Username=guest&Password=welcome&radiobutton=OnLE.aspx%3FdoIndex%3Dlogin&DB=st
```

```
0310  4c 65 6e 67 74 68 3a 20  38 38 0d 0a 0d 0a 55 73   Length:  88....Us
0320  65 72 6e 61 6d 65 3d 67  75 65 73 74 26 50 61 73   ername=g uest&Pas
0330  73 77 6f 72 64 3d 77 65  6c 63 6f 6d 65 26 72 61   sword=we lcome&ra
0340  64 69 6f 62 75 74 74 6f  6e 3d 4f 6e 4c 45 2e 61   diobutto n=OnLE.a
```

Text item (text), 88 bytes   Packets: 180 Displayed: 23 Marked: 0 Dropped: 0



[redacted] [redacted] On-Line Exam

[redacted] On-Line Exams([redacted]):

an e-Learning tool is being developed in the Communication & Information Technology Center (CITC) @ [redacted] University.The [redacted] tool provides course instructors of a new way to educate and evaluate their students by using multi-media multiple-choice-questions (MCQs) over the Internet. The [redacted] development team divided the required features into two groups, one group of features that can be available only to course instructors and the other group of features that both instructors and students can access.

For a free trial of the [redacted] tool, login by using User Name: “guest” and password: “welcome”.

User Name

Password

Add exams * ○ وضع الامتحانات

Faculty member * ○ عضو هيئة تدريس

Students * ● طلاب

Postgraduates * ○ دراسات عليا

Text followed by ‘*’ is translated by me

OUTLINE

- ~~What? Why? How? Who?~~
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DEFENCES

- Switched network
- Encryption
  - Secure Sockets Layer (SSL)/Transport Layer Security (TLS)
  - SSH
- One Time Password (OTP)

OUTLINE

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CONCLUSION

- “ Your data isn’t safe on public networks. You may not even realize the extent to which that statement is true” (Adrian Hannah, 2011)
- Sensitive data must be encrypted
- Universities **must** ensure **Confidentiality**, **Integrity** and **Availability** for their systems users.

FUTURE WORK

- Test Wireless sniffing
  - Preliminary observation: It was not possible to capture http packets in UCL wireless network
  - Need more testing
  - I could not perform it due to lack of time
- Awareness about such risks

THANK YOU

QUESTIONS ?

REFERENCES

- [1] S. Ansari, R. S.G., and C. H.S., “Packet Sniffing: A Brief Introduction,” *Potentials, IEEE*, vol. 21, no. 5, pp. 17-19.
- [2] A. Orebaugh, R. Gilbert, J. Burke, J. Wright, and G. Morris, *Wireshark & Ethereal Network Protocol Analyzer Toolkit*. Rockland, MA: Syngress, 2007, pp. 1-554.
- [3] A. Hannah, “Packet Sniffig Basics,” *Linux Journal*, vol. 2011, no. 210, 2011.
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