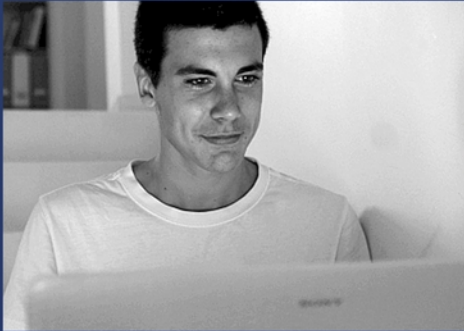


Hacker Highschool

SECURITY AWARENESS FOR TEENS



LESSON 2

ESSENTIAL COMMANDS



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Introduction and Objectives

Whether you've seen "hacking" in the 1995 movie *Hackers* or Trinity hacking into a UNIX system in *The Matrix Reloaded*, when you picture a hacker they're working at the command line. For good reason.

You can do very big, very powerful things in the command line interface (**CLI**). You don't have to be a master at the command line but you should be comfortable working with it.

Once you've mastered the basics of the CLI, you can start using these commands in text files (called **scripts**); it's the easiest programming ever.

We will discuss commands and basic tools for Windows, OSX and Linux operating systems. You'll need to know them for exercises in the following lessons. At the end of this lesson, you should be familiar with:

- General Windows, Linux and OSX commands
- Basic network commands and tools, including

```
ping
tracert/traceroute
netstat
ipconfig/ifconfig
route
```


Requirements and Setup

Requirements

To complete this lesson you will need:

- A PC running Windows
- A PC running Linux
- Optionally a Mac running OSX
- Access to the Internet

Setup



Figure 2.1: General Network Setup

This is the network in which we'll do most of our work. It consists of your PC, the Internet, and the ISECOM Hacker Highschool test network, which you will access through the Internet.

Note that access to the ISECOM test network is restricted. In order to gain access to it, your instructor must contact the system administrator, as detailed on the <http://www.hackerhighschool.org> web site.

However, you can also substitute any test network for these exercises. **NEVER** run tests against computers you don't own! That may be a criminal offense, and can be dangerous in lots of other ways.

If you want to set up your own test network, it can be as easy as testing another computer in your classroom or home. No special set-up is needed! Of course if you want something more robust or something that lets you experience the challenges and flaws of accessing another computer over the Internet, then you'll need an Internet-based test network. This can also be done by making alliances with other schools or homes and letting them access certain computers of yours remotely and you access theirs. But make sure you know what you're doing in setting it up because what you don't want is for those open computers to get hijacked by some random person on the Internet who does damage for which you will be responsible.



Operating System: Windows

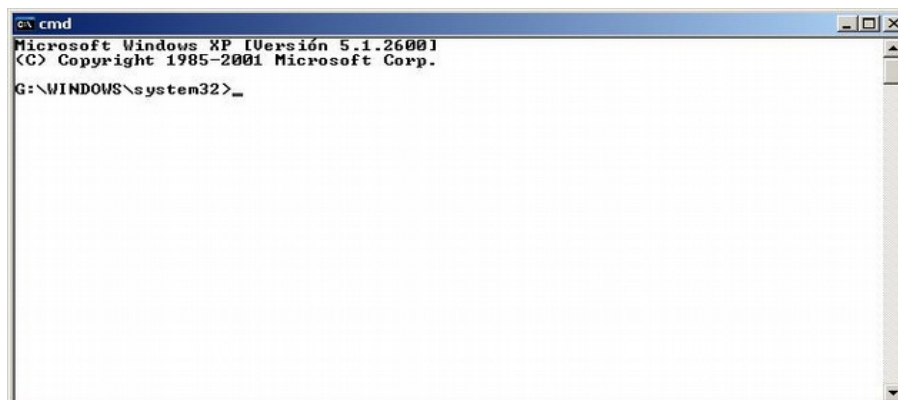
In the days of yore, if we weren't working in UNIX, we all worked in DOS. We didn't need to open a CLI; we lived in one. Then UNIX developed "window" interfaces, an idea that eventually came to the PC with Microsoft Windows.

Once Windows arrived, we opened DOS in a window on our desktop and called that a **command prompt**. Long after Windows had moved beyond being DOS-based, Windows still has a CLI – and many people still call it a **DOS box**. It's not really DOS any more, but for our purposes, it doesn't matter. Here's how you open one.

How to open a CLI window

The procedure is similar for all versions of Windows.

1. Click the START button.
2. Choose the RUN option (skip this in Vista and later).
3. Type **command** if you are using Windows 95/98 or **cmd** for all other versions of Windows and press Enter or click OK.
4. A window similar to the following will appear:



5. Now you can use the commands and tools listed below.

Commands and Tools (Windows/DOS)

Commands provide built-in operating system functions. Tools do more: they probe networks, search for **hosts** (which is, by the way, what we call computers attached to a network), and let you see or set your host's routing information.



Commands

Words in italics are options that you must enter.
 Some commands have both long and short versions.

Command	Purpose
date	Display or set the date
time	Display or set the time
ver	Display the MS-DOS or Windows version
dir	Display the list of subdirectories and files in a directory.
cls	Clear the screen.
mkdir <i>directory</i> or md <i>directory</i>	Make a directory with the name <i>directory</i> : md tools
chdir <i>directory</i> or cd <i>directory</i>	Change the current directory to another directory: cd tools
rmdir <i>directory</i> or rd <i>directory</i>	Delete the directory: rd tools
tree <i>directory</i>	Display the structure of folders and files in text-graphic format: tree c:\tools
chkdsk	Check a disk and show a status report.
mem	Show the amount of memory used and free in the system.
rename <i>source dest</i> or ren <i>source dest</i>	Change the name of files: ren pictures MyPics
copy <i>source dest</i>	Copy one or more files to another location: copy c:\tools\myfile.txt c:\tmp\
move <i>source dest</i>	Move files and change the name of files and directories: move c:\tools c:\tmp
type <i>file</i>	Display the content of one or more text files: type c:\tools\myfile.txt
more <i>file</i>	Display the information screen by screen: more c:\tools\myfile.txt
delete <i>file</i> or del <i>file</i>	Delete one or more files: del c:\tools\myfile.txt



Tools

Words in italics are options that you must enter.

Tool	Purpose
ping <i>host</i>	<p>Verify contact with the machine <i>host</i>.</p> <p>This command sends ICMP (Internet Control Message Protocol) ping packets to another computer to see how long it takes to respond, or if it responds at all. You can use a hostname or an IP address:</p> <pre>ping hackerhighschool.org</pre> <pre>ping 216.92.116.13</pre> <p>Options include:</p> <pre>ping -n 100 hackerhighschool.org</pre> <p>which sends 100 ping packets, and</p> <pre>ping -t 216.92.116.13</pre> <p>which pings the host until stopped with CTRL+C.</p> <p>To see more options:</p> <pre>ping /h</pre>
tracert <i>host</i>	<p>Show the route that packets follow to reach the machine <i>host</i>.</p> <p>The DOS tracert command is an adaptation of the UNIX traceroute. (DOS commands could only be eight characters long, back in the day.) Both allow you to find the route that a packet follows from your host to the destination host, tracert also tracks how long each hop takes and travels, at the most, 30 hops. Often you can see the hostnames of the machines through which the packets travel:</p> <pre>tracert hackerhighschool.org</pre> <pre>tracert 216.92.116.13</pre> <p>Some options are:</p> <pre>tracert -n 25 hackerhighschool.org</pre> <p>to specify N, at the most, jumps, and</p> <pre>tracert -d 216.92.116.13</pre> <p>to hide hostnames.</p> <p>To see more options:</p> <pre>tracert /?</pre>



Tool	Purpose
ipconfig	<p>Used alone, displays information on your host's active network interfaces (ethernet, ppp, etc.). It is similar to Linux ifconfig.</p> <p>Some options are:</p> <pre>ipconfig /all</pre> <p>to show more details</p> <pre>ipconfig /renew</pre> <p>to renew the network connection when automatic configuration with DHCP is used, and</p> <pre>ipconfig /release</pre> <p>to deactivate networking when DHCP is used.</p> <p>More options:</p> <pre>ipconfig /?</pre>
route print	<p>Displays the routing table. route can also be used to set up or erase static routes.</p> <p>Some options:</p> <pre>route print</pre> <p>to show the list of routes,</p> <pre>route delete</pre> <p>to delete a route, and</p> <pre>route add</pre> <p>to add a route.</p> <p>More options:</p> <pre>route/?</pre>



Tool	Purpose
netstat	<p>Displays information on the status of the network and established connections with remote machines.</p> <p>Some options:</p> <p><code>netstat -a</code> to check all the connections and listening ports,</p> <p><code>netstat -n</code> to display addresses and port numbers in numeric form, and</p> <p><code>netstat -e</code> to sample Ethernet statistics.</p> <p>Options can be used together:</p> <p><code>netstat -an</code></p> <p>To see more options:</p> <p><code>netstat/?</code></p>

For additional information on these commands and tools try these options:

```
command /h
```

```
command /?
```

```
help command
```

from a CLI window.

For example, for additional information on the tool **netstat**, you have three possibilities:

```
netstat /h
```

```
netstat /?
```

```
help netstat
```

Exercises

- 2.1 Open a CLI window.
- 2.2 Identify the version of DOS or Windows that you are using.
- 2.3 Identify the date and time of the system. If they are incorrect, correct them.
- 2.4 Identify all the directories and files that are in `c:\`.
- 2.5 Create the directory `c:\hhs\lesson2`. Copy to this directory the files with the extension `.sys` that are in `c:\`. What files have you found?
- 2.6 Identify the IP address of your host.
- 2.7 Trace the route to `www.hackerhighschool.org`. Identify IP addresses of the intermediate routers.



Game On: Taking Command

"Macrosoft Fenestra is neither an operating system nor an interface. It is a graphical system built around Solitaire," announced the technology teacher with bits of food stuck to the corners of his wet mouth. Mr. Tri was satisfied that the students bought that line of trash so he moved on. "Fenestra has a command interface, where you speak to the monitor and the computer does whatever it is that you want it to do. If you want a cup of coffee, just tell the monitor and a nice fresh cup of Joe appears."

Jace was so close to strangling this man, wondering if the police and judge would be sympathetic to her murder plea considering how he was butchering computer technology.

"Wait, hold on Mr. Tri." Jace hadn't let a breath out in the last ten minutes so her face was a funny color. "Sir, Fenestra is a graphical user interface, GUI, like the used gum you keep in that jar." Kids wrinkled their noses and giggled.

She got up and slid around him, getting behind the keyboard like a professional basketball player slipping past the defense. "Click Windows, type CMD, hit Enter. Check out the CLI. See that blinking line? That's where you type. See how it says what folder you're in?" Like a Formula 1 driver she never looked back; she just picked up speed.

"Now you can type CD C: and you're into the system root." Jace buried the throttle. "With a new system, you'll want to know as much as you can about your environment. Start by typing in VER, that's short for version. Now we can tell exactly what version of the operating system is running. See?" Students were staring. Mr. Tri was paralyzed.

Jace felt herself connecting with the computer, typing faster, becoming effortless. She mused out loud, "You can get a computer to spill its guts and tell you everything that's happening inside of it." Her fingers flew across the keyboard, dislodging a key and sending it into the air where it landed in the moldy jar of old gum on the teacher's desk. Three girls in the front swallowed their gum.

Jace took this as her cue to stop. She stood up abruptly, giving the keyboard back to her teacher. His face was white and there was spit on his lips. She pulled a laser pointer from her inside jacket pocket quickly as if she were drawing a gun and shone it on Mr. Tri's forehead. A boy in the back of the class peed himself. Then turning it to the pathetic presentation slide on the screen at the front of the class, she calmly said, "These slides are so wrong they have to go."

"Maybe it's you who should go," the teacher said, handing her a pass to the big man's office, the Vice Principal, aka the Principal of Vice. Her third pass this week. Technology was going to be the end of her, or at least the loss of her free time with another night of detention.

Game Over



Operating System: Linux



Just like in Windows, when you're using Linux, you run commands in a CLI window. You'll see these called **consoles**, **terminals** and **shells**.

Feed Your Head: Console, Terminal or Shell?

Amaze your friends by knowing the difference.

- The **console** was actually the screen and keyboard attached directly to a computer back when the old people today used **dumb terminals** to access the computer remotely.
- You actually have your choice of **shell** in Linux, including **bash**, **tcsh** and **zsh**, among others. Different shells let you do very different things, and which one you like is almost a political issue. In most cases, you'll use bash. When you connect to the Hacker Highschool test network, you'll get an **empty shell**.
- When you open a **console window** what you're technically opening is a **terminal emulator** or **terminal window**, that is, a "fake" dumb terminal running in a window on your desktop.

What can you do at the Linux command line? Everything you could possibly do in any GUI tool, plus vastly more. Race your Windows friends to set your IP address: they will have to drill through all kinds of interfaces to do it. In Linux you could do it with:

```
ifconfig eth0 192.168.1.205
```

Bet you can type that faster than they can click!



How to open a terminal window

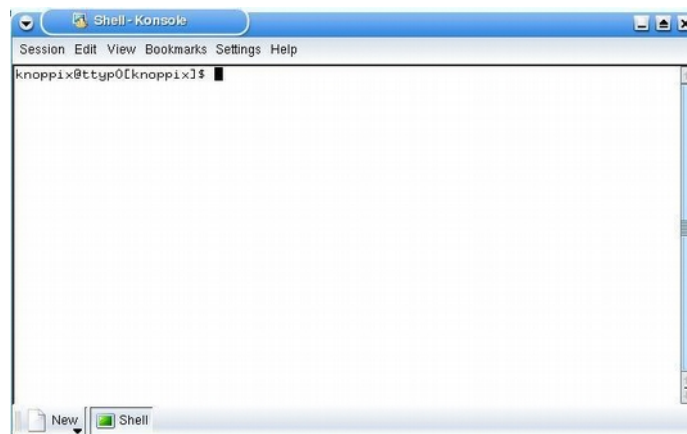
Because there are many versions of Linux, there are several ways to start a console window.

1. Click the Start Application button.
2. If you see a "Run Command" option, click it and enter "konsole", then Return.
3. Or look for Accessories, then choose Terminal.
4. Or on many systems you can press CTL-ALT-T.
5. A window similar to this will appear.
6. Now you can use the commands and tools listed below.

Linux Commands and Tools

Commands

Words in *italics* are options that you must enter.



Command	Purpose
date	Display or set the date.
time	Display or set the time.
fsck	Check a file system and show a status report.
cat <i>file</i>	Display the content of one or more text files: cat /etc/passwd
pwd	Display the name of the current directory.
hostname	Display the name of the computer you are currently using.
finger <i>user</i>	Display information on a user: finger root



Command	Purpose
ls	<p>List the contents of the current directory:</p> <pre>ls -la</pre> <p>List the contents of another directory:</p> <pre>ls -la /etc</pre>
cd <i>directory</i>	<p>Change from current directory to <i>directory</i>. If no directory name is specified it changes to the home directory.</p> <p>For the login name "fred" the command</p> <pre>\$cd</pre> <p>changes the directory to /home/fred, and</p> <pre>\$cd -</pre> <p>changes to the last visited directory (think of "subtracting" one directory), and</p> <pre>\$cd /tmp</pre> <p>changes to the /tmp directory.</p>
cp <i>source dest</i>	<p>Copy the file <i>source</i> to the file <i>dest</i>.</p> <p>Example:</p> <pre>cp /etc/passwd /tmp/bunnies</pre>
rm <i>file</i>	<p>Delete files. Only users with proper access permissions (or root) can delete specific files.</p> <pre>rm letter.txt</pre>
mv <i>source dest</i>	<p>Move or rename files and directories.</p> <p>Example:</p> <pre>mv secrets.zip innocent.zip</pre>
mkdir <i>directory</i>	<p>Make a directory with the name <i>directory</i>.</p> <p>Example:</p> <pre>mkdir tools</pre>
rmdir <i>directory</i>	<p>Delete the directory with the name <i>directory</i> but only if it is empty:</p> <pre>rmdir tools</pre> <p>Bonus question: how do you delete a directory with files in it?</p>
find / -name <i>file</i>	<p>Look for files, starting at /, with the name <i>file</i>:</p> <pre>find / -name myfile</pre>
echo <i>string</i>	<p>Write <i>string</i> to the screen:</p> <pre>echo hello</pre>



Command	Purpose
<i>command > file</i>	Redirect the normal screen output of <i>command</i> to <i>file</i> : <pre>ls > listing.txt</pre> If this file already exist, it will get clobbered , meaning overwritten!
<i>command >> file</i>	Redirect the normal screen output of <i>command</i> to <i>file</i> . If the file already exists, it appends the output to the end of the file. Example: <pre>ls >> listing.txt</pre>
<i>man command</i>	Show the pages of the online manual about <i>command</i> : <pre>man ls</pre>

For additional information on these commands and tools try these options:

```
command -h
command --help
man command
help command
info command
```

For example, for additional information on the *ls* command, type in either of these two possibilities:

```
ls --help
man ls
```



Tools

Words in italics are options that you must enter.

Tool	Purpose
ping <i>host</i>	Verify the contact with the machine <i>host</i> : <code>ping www.google.com</code>
tracert <i>host</i>	Show the route that the packets follow to reach the machine <i>host</i> : <code>tracert www.google.com</code>
ifconfig	Display information on active network interfaces (ethernet, ppp, etc.).
route	Display the routing table.
netstat	Display information on your network connections. <code>netstat -an</code>

Exercises

- 2.8 Identify the owner of the file **passwd**. (Note: first locate where this file is.)
- 2.9 Create the directory **work** in your own home directory (for example, if your login is **fred**, create the directory in /home/fred), and copy the file **passwd** to the directory **work** that you just created. Identify the owner of the **passwd** copy.
- 2.10 Create the directory **.hide** in the **work** directory (notice that the file name begins with a dot). List the contents of this directory. What did you have to do to see the contents of directory **.hide**?
- 2.11 Create the file **test1** with the content, "This is the content of the file test1" in the **work** directory. Create the file **test2** with the content, "This is the content of the file test2" in the **work** directory. Copy into a file with the name **test** the contents of both previous files.



Operating System: OSX

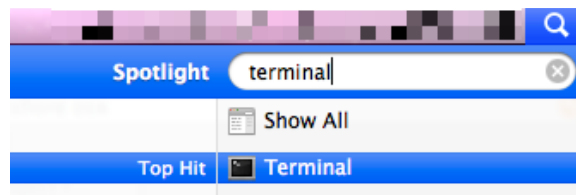
Just like in Linux, when you're using OSX, you run commands in a CLI window. In OSX this application is called **Terminal**.

OSX is based on NetBSD and FreeBSD UNIX, ancestors of Linux. Its GUI and CLI approach is similar to Linux: you can do everything you could possibly do in any GUI tool, plus vastly more.

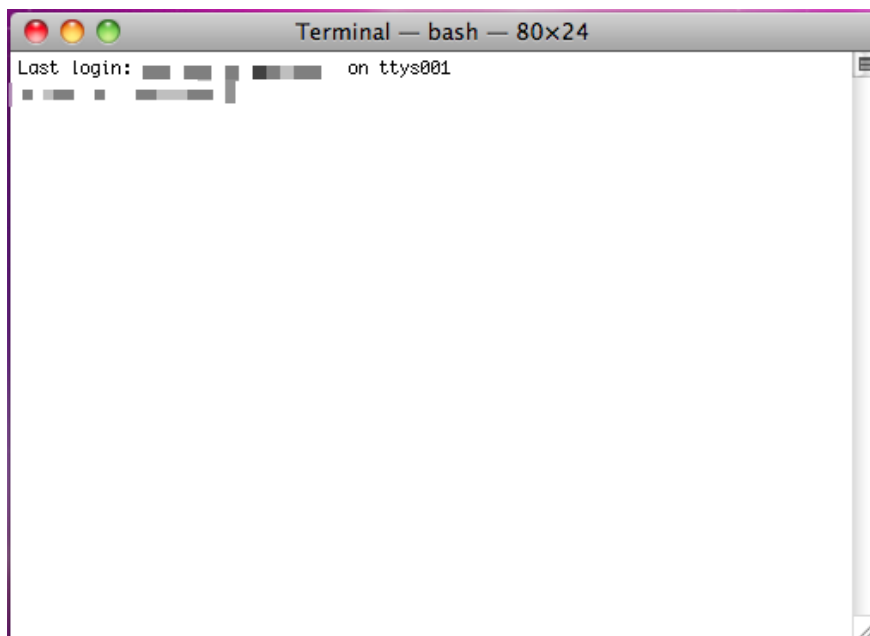
Some people think Windows stole the whole idea of a GUI from Mac. Actually, GUI interfaces and mouse pointers were used in a much older OS. You can know more than practically everybody by finding out which.

How to open a Terminal window

1. Click on the **Spotlight** icon, an icon of a magnifying glass typically located on the top right of your screen, and search for **Terminal**.



2. Then press Enter or click on it. You will see the Terminal window.



Typically Terminal is located under **Applications > Utilities**. Impress your friends by changing the Terminal style depending on your preferences. Press both the Command and comma



keys to get the Preference dialog for Terminal and choose your preferred colors. Usually this keyboard shortcut gives you access to program preferences in OSX.

Commands and Tools (OSX)

Mac ships with a bash shell, so almost all typical Linux commands work on OSX as well.

Commands

Words in italics are options that you must enter.

Command	Purpose
date	Display or set the date.
time <i>command</i>	Display how long it takes for <i>command</i> to execute.
fsck	Check a file system and show a status report. If you use an OSX journaled volume such as Mac OSX 10.3 or later, in which journaling is enabled by default, you probably won't need to run this command.
cat <i>file</i>	Display the content of one or more text files: <code>cat /etc/passwd</code>
pwd	Display the name of the current directory.
hostname	Display the name of the computer you are currently using.
finger <i>user</i>	Display information on a user: <code>finger root</code>
ls	List the contents of the current directory: <code>ls -la</code> List the contents of another directory: <code>ls -la /etc</code>
cd <i>directory</i>	Change from current directory to <i>directory</i> . If no directory name is specified it changes to the user's home directory. For the login name "fred" the command <code>cd</code> changes the directory to /Users/fred, and <code>cd -</code> changes to the last visited directory (think of "subtracting" one directory), and <code>cd /tmp</code> changes to the /tmp directory.
cp <i>source dest</i>	Copy the file <i>source</i> to the file <i>dest</i> . <code>cp /etc/passwd /tmp/bunnies</code>



Command	Purpose
rm file	Delete files. Only users with proper access permissions (or root) can delete certain files. <code>rm letter.txt</code>
mv source dest	Move or rename files and directories. <code>mv secrets.zip innocent.zip</code>
mkdir directory	Make a directory with the name <i>directory</i> . <code>mkdir tools</code>
rmdir directory	Delete the directory with the name <i>directory</i> but only if it is empty: <code>rmdir tools</code> Bonus question: how do you delete a directory with files in it?
find / -name file	Look for files, starting at /, with the name <i>file</i> : <code>find / -name myfile</code>
echo string	Write <i>string</i> to the screen: <code>echo hello</code>
command > file	Redirect the normal screen output of <i>command</i> to <i>file</i> : <code>ls > listing.txt</code> If this file already exist, it will get clobbered , meaning overwritten!
command >> file	Redirect the normal screen output of <i>command</i> to <i>file</i> . If the file already exists, it appends the output to the end of the file. Example: <code>ls >> listing.txt</code>
man command	Show the pages of the online manual about <i>command</i> : <code>man ls</code>

For additional information on these commands and tools try these options:

```
command -h
command --help
man command
help command
info command
```

For example, for additional information on the `ls` command, type in either of these two possibilities:

```
ls --help
man ls
```



Tools

Words in *italics* are options that you must enter.

Tool	Purpose
ping <i>host</i>	<p>Verify contact with the machine <i>host</i>.</p> <p>This command sends ping packets using ICMP (Internet Control Message Protocol) to another computer to see how long it takes to respond, or if it responds at all. You can use a hostname or an IP address:</p> <pre>ping www.hackerhighschool.org ping 216.92.116.13</pre> <p>Options include:</p> <pre>ping -c 100 www.hackerhighschool.org</pre> <p>which sends 100 ping packets, and</p> <pre>ping -t 216.92.116.13</pre> <p>which pings the host until stopped with CTRL+C.</p> <p>More options:</p> <pre>man ping</pre>
tracert tracert <i>host</i>	<p>Show the route that packets follow to reach the machine <i>host</i>.</p> <p>tracert has the same scope as Windows tracert but uses different network protocols: tracert uses UDP (User Datagram Protocol) and tracert uses ICMP (Internet Control Message Protocol). You may obtain different results using tracert and tracert from same network source and destination.</p> <p>Both allow you to find the route that a packet follows from your host to the destination host. Each also tracks how long each hop takes and travels for, at the most, 30 hops. Often you can see the hostnames of the machines through which the packets travel:</p> <pre>tracert www.hackerhighschool.org tracert 216.92.116.13</pre> <p>To specify the maximum (-m) number of hops:</p> <pre>tracert -m 25 www.hackerhighschool.org</pre> <p>To save DNS lookups by showing the IP address rather than a hostname:</p> <pre>tracert -n 216.92.116.13</pre> <p>To see more options:</p> <pre>man tracert</pre>



Tool	Purpose
ifconfig	<p>Used alone, displays information on your host's active network interfaces (ethernet, ppp, etc.). It is similar to Windows ipconfig.</p> <p>To show more details, meaning to be verbose:</p> <pre>ifconfig -v</pre> <p>To show only the <i>en1</i> network interface information:</p> <pre>ipconfig en1</pre> <p>To deactivate the network interface:</p> <pre>ifconfig en1 down</pre> <p>To bring it up:</p> <pre>ifconfig en1 up</pre> <p>Note: you must have permission to use this command, so you may need to put sudo in front of these commands. Then you will have to enter your password. Use sudo carefully!</p> <pre>sudo ifconfig en1 up</pre> <p>More options:</p> <pre>man ifconfig</pre>
netstat	<p>Displays information on the status of the network and established connections with remote machines. On BSD-like systems, netstat is also used to see your routing table.</p> <p>To sample all the connections and listening ports:</p> <pre>netstat -a</pre> <p>To display the routing table:</p> <pre>netstat -r</pre> <p>Used with <i>-n</i> to show addresses numerically:</p> <pre>netstat -nr</pre> <p>To show information for <i>en1</i> network interface.</p> <pre>netstat -r -ii en1</pre> <p>To see more options:</p> <pre>man netstat</pre>



Exercises

- 2.12 Identify the name and the IP address of your machine.
- 2.13 Trace the route to www.hackerhighschool.org. Identify IP addresses of the intermediate routers and find your path.
- 2.14 In Windows use **tracert** to see the path between you and www.hackerhighschool.org as seen by Windows, and send the output on a file named **output.txt** for further analysis.
- 2.15 Then run the equivalent traceroute command on OSX and Linux from the same network, putting the output in files named **output2OSX.txt** and **output2Linux.txt**. Look at the output files carefully.
 1. Are the paths the same or are there differences?
 2. Did you find any lines containing the string:
* * *
What does it mean?
 3. Repeat this test at least an hour later. Are the results always the same?



Basic Command Equivalences for Windows, OSX and Linux

Words in italics are options that you must enter.

Linux	OSX	Windows
command --help	command --help	<i>command /h,</i> <i>command /?</i>
man <i>command</i>	man <i>command</i>	help <i>command</i>
cp	cp	copy
rm	rm	del
mv	mv	move
mv	mv	ren
more, less, cat	more, less, cat	type
lpr	lpr	print
rm -R	rm -R	deltree
ls	ls	dir
cd	cd	cd
mkdir	mkdir	md
rmdir	rmdir	rd
netstat -r	netstat -r	route print
tracert	tracert	tracert
ping	ping	ping
ifconfig	ifconfig	ipconfig

Today's teens are in a world with major communication and productivity channels open to them and they don't have the knowledge to defend themselves against the fraud, identity theft, privacy leaks and other attacks made against them just for using the Internet. This is the reason for Hacker Highschool.

The Hacker Highschool project is the development of security and privacy awareness learning materials for junior high and high school students.

Hacker Highschool is a set of lessons and a practical means of making hackers. Beyond just providing cybersecurity awareness and critical Internet skills, we need to teach the young people of today how to be resourceful, creative, and logical, traits synonymous with hackers. The program contains free security and privacy awareness teaching materials and back-end support for teachers of accredited junior high, high schools, and home schooling. There are multiple workbooks available in multiple languages. These are lessons that challenge teens to be as resourceful as hackers, including safe Internet use, web privacy, researching on the internet, avoiding viruses and Trojans, legalities and ethics, and more.

The HHS program is developed by ISECOM, a non-profit, open-source research group focused on security awareness and professional security development and accreditation.