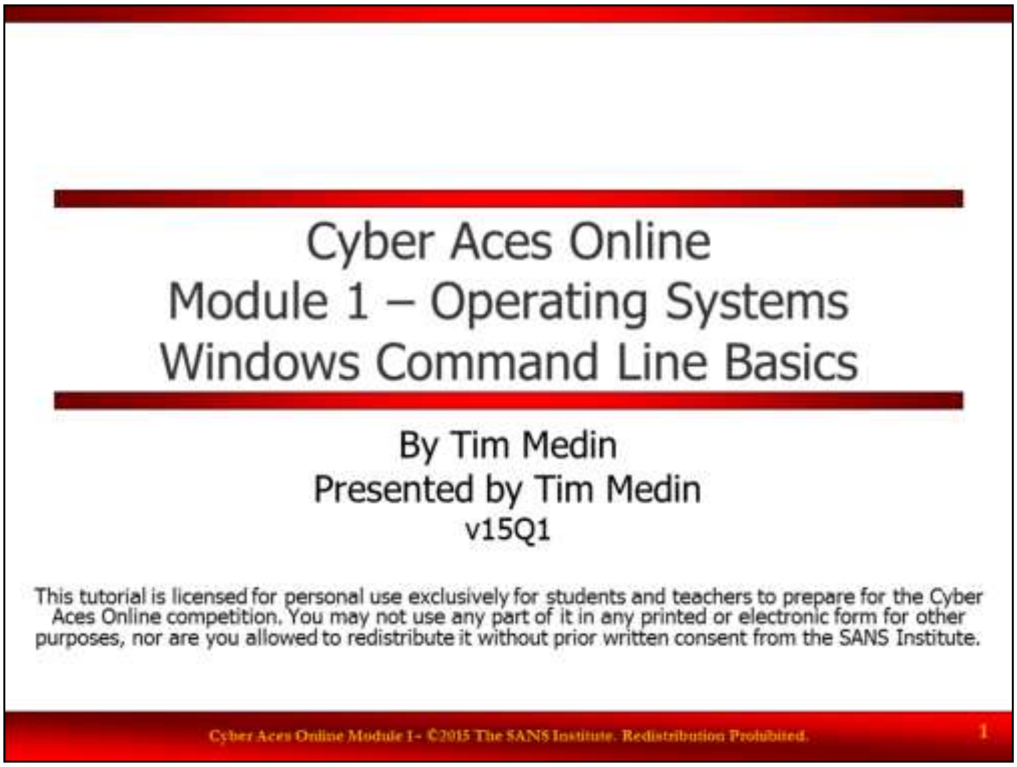

Cyber Aces Online
Module 1 – Operating Systems
Windows Command Line Basics

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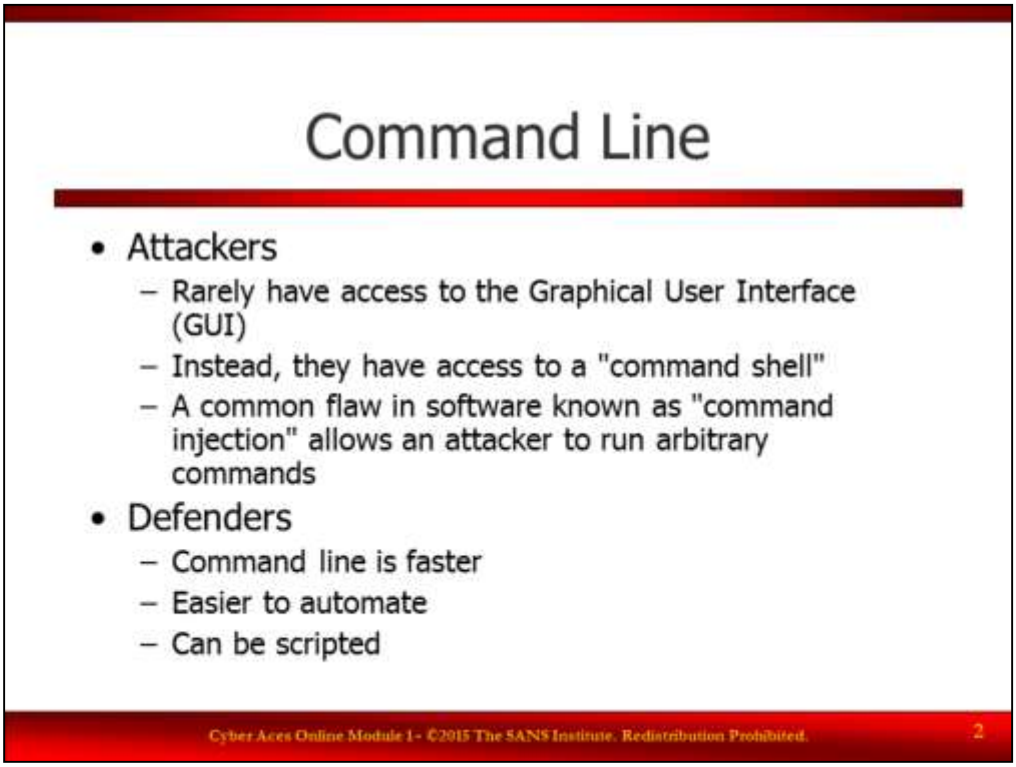
Presented by Tim Medin
v15Q1

Welcome to Cyber Aces Online, Module 1! A firm understanding of operating systems is essential to being able to secure or attack one. This module dives in to the basics of the Windows command line using CMD.EXE.



Command Line

- Attackers
  - Rarely have access to the Graphical User Interface (GUI)
  - Instead, they have access to a "command shell"
  - A common flaw in software known as "command injection" allows an attacker to run arbitrary commands
- Defenders
  - Command line is faster
  - Easier to automate
  - Can be scripted

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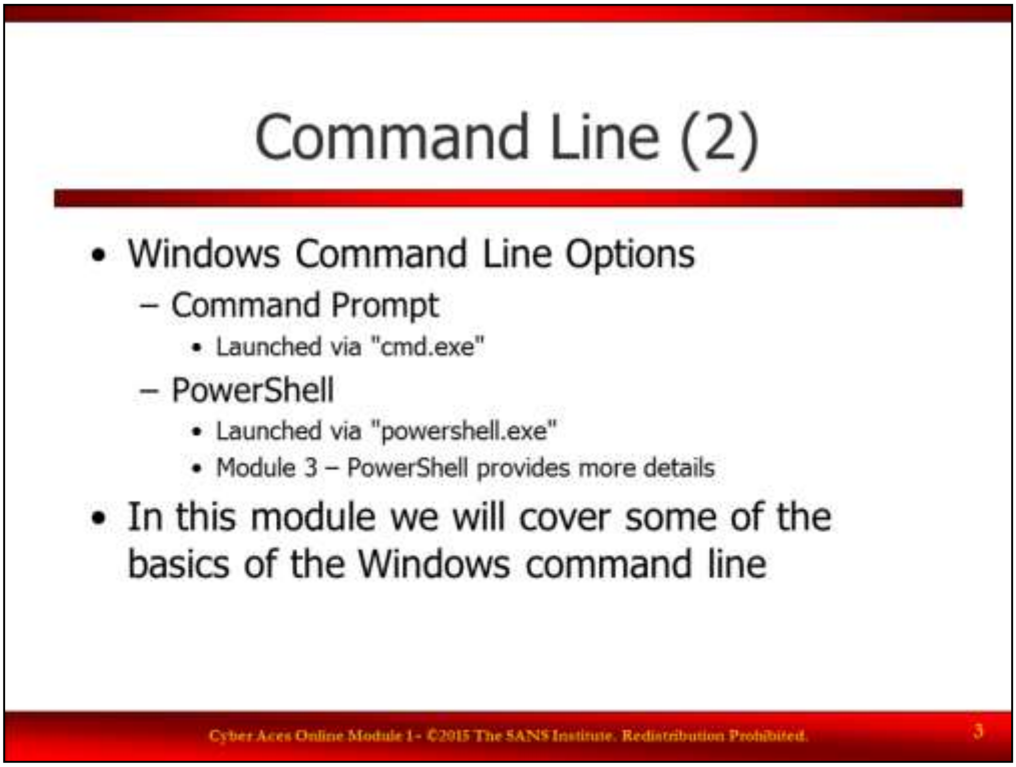
Command Line

Computer attackers often do not have full control of a target system's Graphical User interface or GUI for short. Instead, they usually get a "command shell" (i.e., Command Line Access, Command Line Interface or CLI) that they could use to gain control of the GUI if they choose. Likewise, defenders often have to rely on the command line to defend their system. Defenders need to automate their defenses using scripts that run at the command line or quickly make a series of changes to the system that would be very SLOW to make if you made those changes through the GUI. Therefore, you should be familiar with the use of the command line. Many of the examples and exercises in this course will make use of the command line, so let's start with a basic introduction to navigating the command line on Windows.



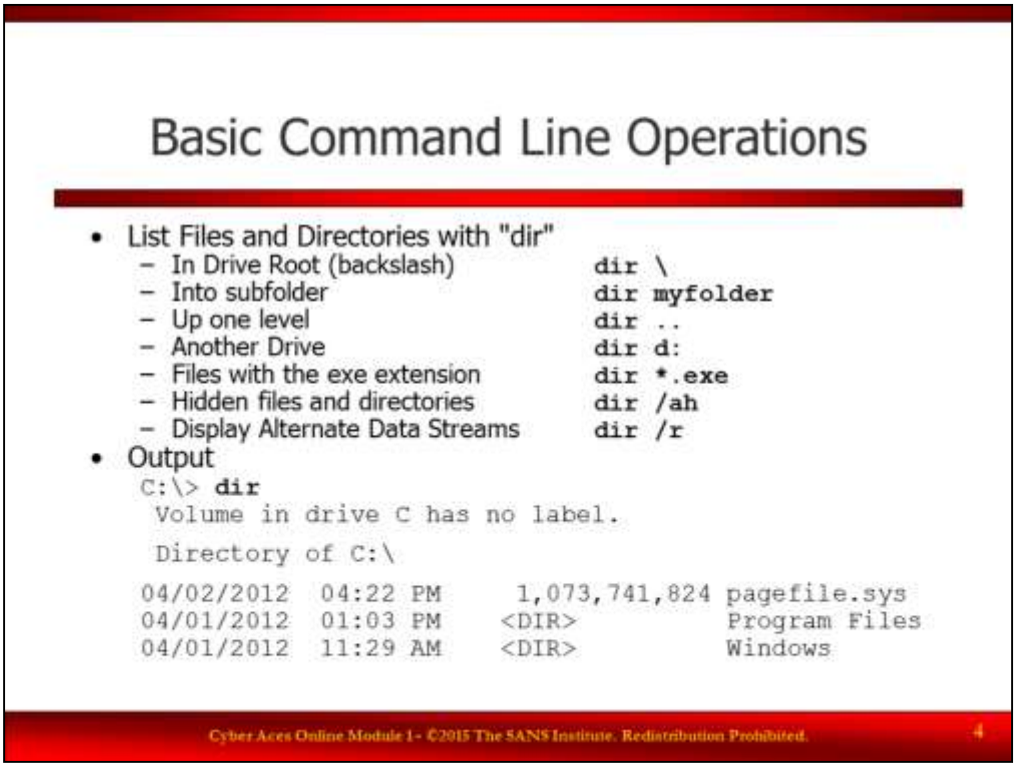
Command Line (2)

- Windows Command Line Options
  - Command Prompt
    - Launched via "cmd.exe"
  - PowerShell
    - Launched via "powershell.exe"
    - Module 3 – PowerShell provides more details
- In this module we will cover some of the basics of the Windows command line

Command Line (2)

In the Windows operating system, the main command-line interpreter is known as Command Prompt. Other interpreters, also known as command shells, are available for Windows but are not as widely-used. For instance, the Windows PowerShell, which provides an avenue for users to perform more advanced administrative tasks within a script-friendly environment, was first introduced in Windows Server 2008R2 and Windows 7, but installations are available for many earlier version of Windows. Windows 8 includes version 3 of PowerShell and Windows 8.1 includes version 4 of PowerShell.

The Command Prompt may be launched by pressing the Windows button (or moving the mouse to the corner), typing "cmd.exe" (without quotes), and then pressing Enter. The web site http://dosprompt.info/ provides a brief introduction to using Command Prompt and familiarizes readers with key administrative commands.



Basic Command Line Operations

- List Files and Directories with "dir"

– In Drive Root (backslash)	**`dir \`**
– Into subfolder	**`dir myfolder`**
– Up one level	**`dir ..`**
– Another Drive	**`dir d:`**
– Files with the exe extension	**`dir *.exe`**
– Hidden files and directories	**`dir /ah`**
– Display Alternate Data Streams	**`dir /r`**

- Output

```
C:\> dir
 Volume in drive C has no label.

 Directory of C:\

04/02/2012  04:22 PM     1,073,741,824 pagefile.sys
04/01/2012  01:03 PM    <DIR>          Program Files
04/01/2012  11:29 AM    <DIR>          Windows
```

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Basic Command Line Operations

The "dir" command is used to list the files and subdirectories in a directory. By default, it looks for files and directories without the hidden attribute set. It displays the last write time, the size of the file or if the item is a directory, and the name.

To view the contents of a specific directory use these commands:

• List the contents of the current directory:	**`dir`**
• List the contents of the root of the current drive:	**`dir \`**
• List the contents of a subdirectory:	**`dir subdir1`**
• List the contents of the root of another current drive:	**`dir d:`** or **`dir d:\`**
• List files with an extension of exe:	**`dir *.exe`**
• List the contents of the parent directory:	**`dir ..`**

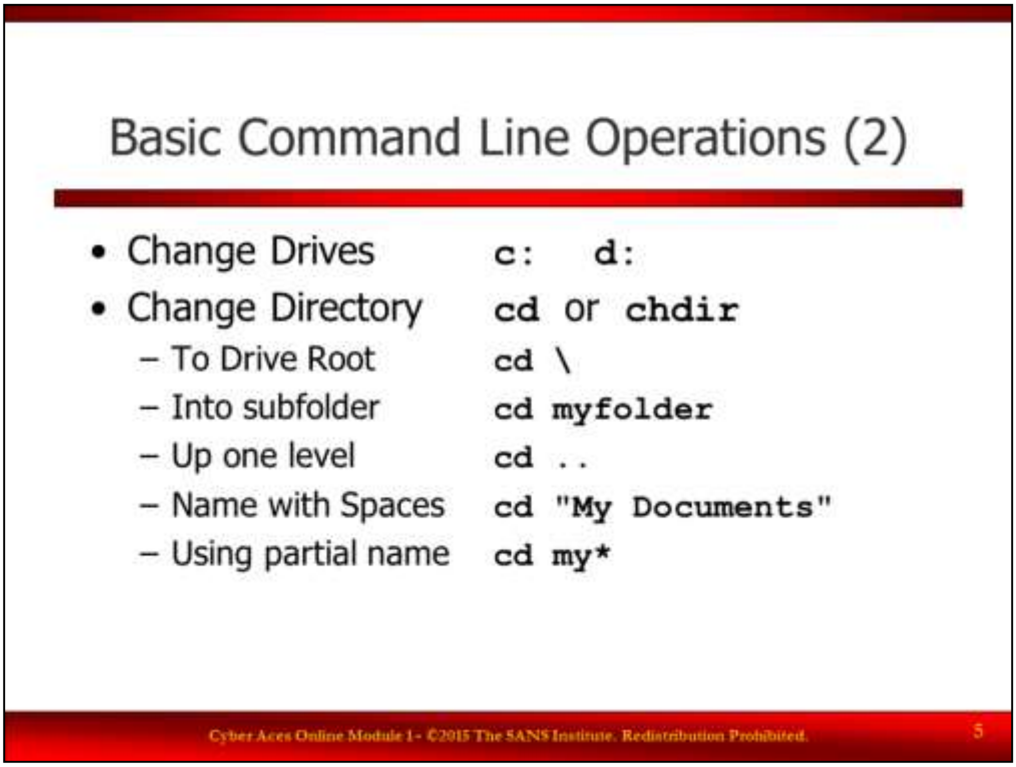
The options can be combined to view the contents of other specific directories:

• List the contents of a sibling directory:	**`dir ..\otherdir`**
• List the contents of a grandchild directory:	**`dir subdir1\subdir2`**
• List the contents of a directory on another drive:	**`dir d:\myfldr\otherdir`**
• List the contents of a sibling folder:	**`dir ..\otherdir`**

To display items with the hidden attribute use: **`dir /ah`**

To display items containing alternate data streams (covered later in this module) use: **`dir /r`**

A full list of options for the "dir" command can be seen by typing: **`dir /?`**



Basic Command Line Operations (2)

- Change Drives **c: d:**
- Change Directory **cd** or **chdir**
  - To Drive Root **cd **
  - Into subfolder **cd myfolder**
  - Up one level **cd ..**
  - Name with Spaces **cd "My Documents"**
  - Using partial name **cd my***

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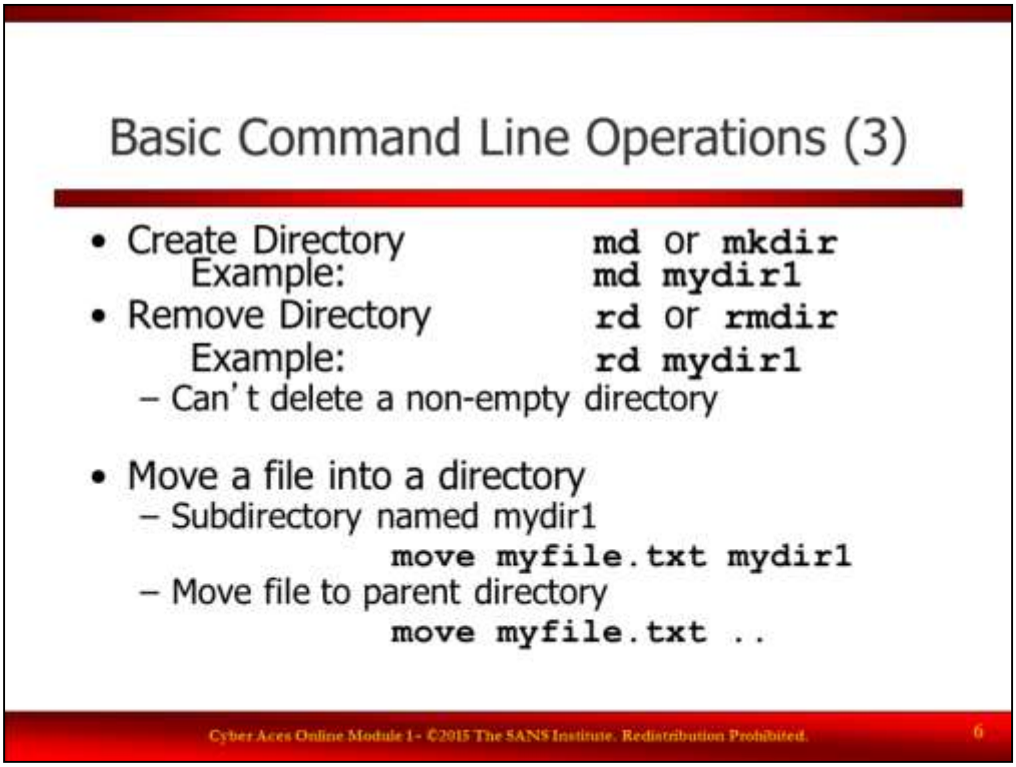
Basic Command Line Operations (2)

To change drives, type the drive letter followed by a colon. For example, to change to the D drive (typically a CD drive) type **d:**

The "cd" and "chdir" commands are used to change the current directory, and is short for "change directory". Running the command without any options will display the current working directory, but the command is most often used to change directories. These commands can be used to change to specific directories:

- The root of the current drive: **cd \**
- A subdirectory in the current working directory: **cd myfolder**
- Move to the parent directory (from C:\dir1\subdir to C:\dir1): **cd ..**
- Move to the directory whose name contains spaces: **cd "My documents"**
- Move to the directory without typing the full name: **cd my***



Basic Command Line Operations (3)

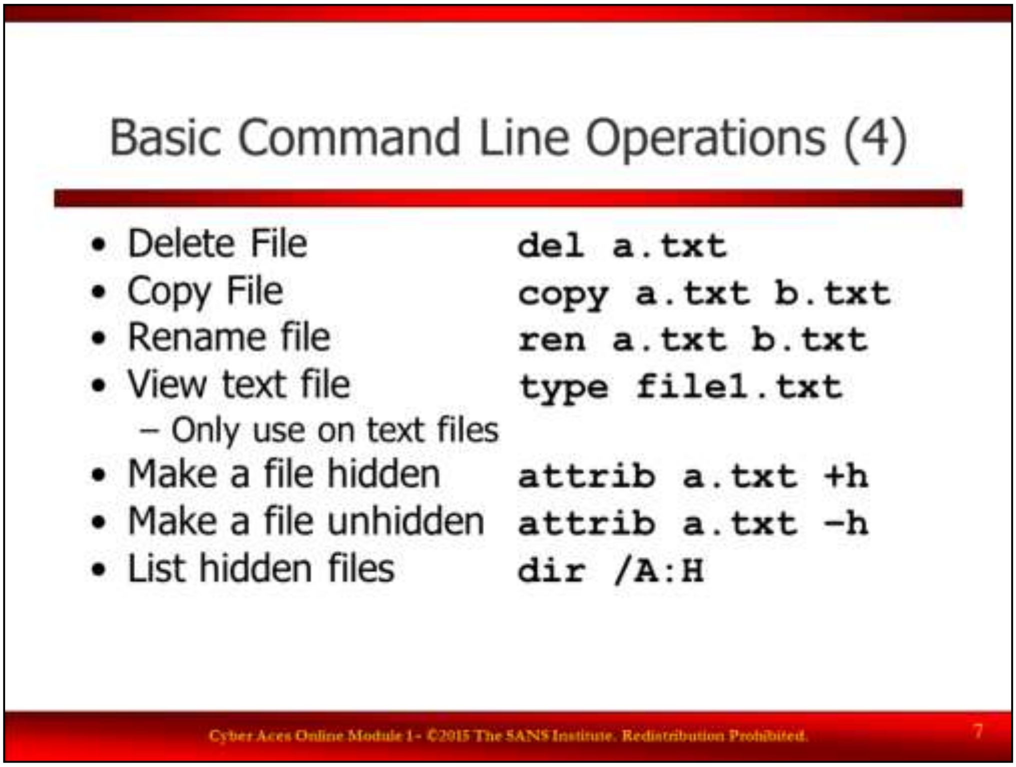
- Create Directory **md** or **mkdir**
  Example: **md mydir1**
- Remove Directory **rd** or **rmdir**
  Example: **rd mydir1**
  - Can't delete a non-empty directory
- Move a file into a directory
  - Subdirectory named mydir1
    move myfile.txt mydir1
  - Move file to parent directory
    move myfile.txt ..

Basic Command Line Operations (3)

To make a directory, you can use the command "md" or "mkdir". Similarly, to remove a directory, you can use the command "rd" or "rmdir". Typically the shorter "md" and "rd" commands are used as they are easier to type.

Files can be moved via the aptly named "move" command. Files can be moved using the similar path qualifiers as used with the "cd" command. Examples:

• Move a file to a subdirectory:	**move myfile.txt mysubdir**
• Move a file to the parent directory:	**move myfile.txt ..**
• Move a file to a sibling directory:	**move myfile.txt ..\otherdir**
• Move a file to the root of the current drive:	**move myfile.txt \**
• Move a file to a directory on another drive:	**move myfile.txt z:\dir1\subdir**



Basic Command Line Operations (4)

- Delete File `del a.txt`
- Copy File `copy a.txt b.txt`
- Rename file `ren a.txt b.txt`
- View text file `type file1.txt`
  - Only use on text files
- Make a file hidden `attrib a.txt +h`
- Make a file unhidden `attrib a.txt -h`
- List hidden files `dir /A:H`

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Basic Command Line Operations (4)

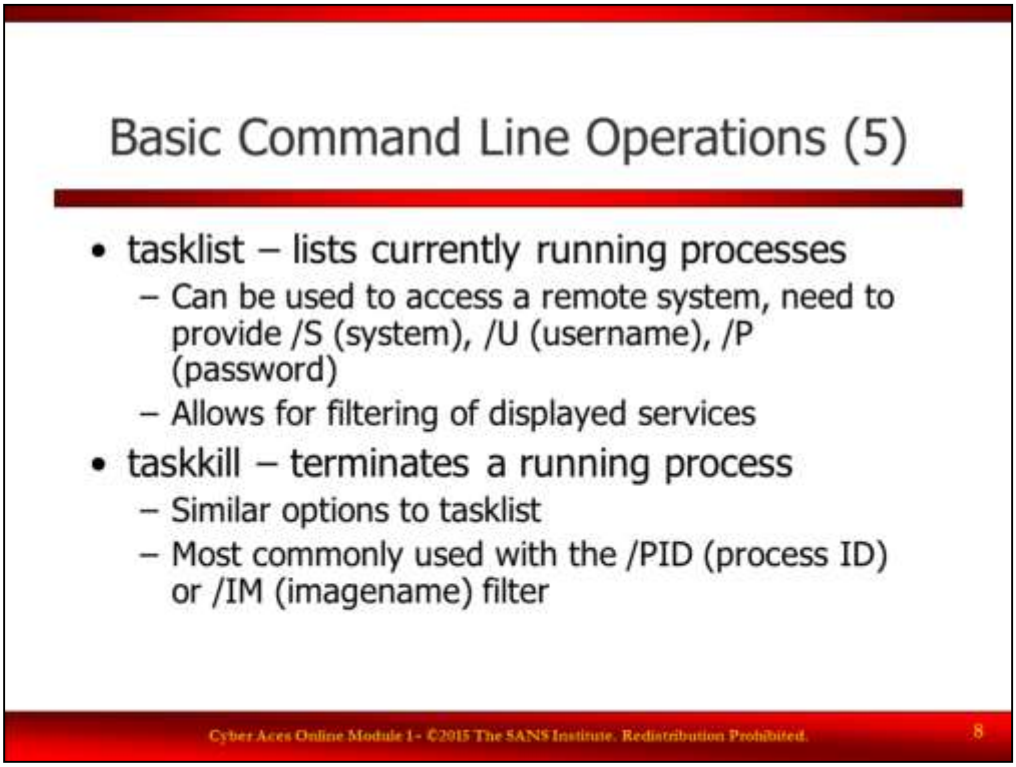
Use the "del" command to delete a file: **`del myfile.txt`**

Use the "copy" command to copy a file

- Create a backup copy: **`copy myfile.txt myfilebackup.txt`**
- Copy the file to another drive and directory: **`copy myfile.txt z:\myfiles\`**
- These command can also use the path qualifiers previously discussed with the "cd" command

Use the "ren" command to rename a file: **`ren roginal.txt original.txt`**

The "attrib" command is used to set attributes on files. Files can be marked as Read-Only (r), Archive (a), System (s), or Hidden (h). The attributes are not exclusive, so more than one attribute can be set. The plus (+) can be used to add an attribute and the minus (-) can be used to remove the attribute. The attrib command can also be used to set the attributes on all files in the directory tree by specifying the directory and using the /S option. (e.g. attrib +h /s mydir). To apply the attribute changes to directories too, use the /D option. The /S and /D options can be used to together to modify the attributes on files and folders.



Basic Command Line Operations (5)

- tasklist – lists currently running processes
  - Can be used to access a remote system, need to provide /S (system), /U (username), /P (password)
  - Allows for filtering of displayed services
- taskkill – terminates a running process
  - Similar options to tasklist
  - Most commonly used with the /PID (process ID) or /IM (imagename) filter

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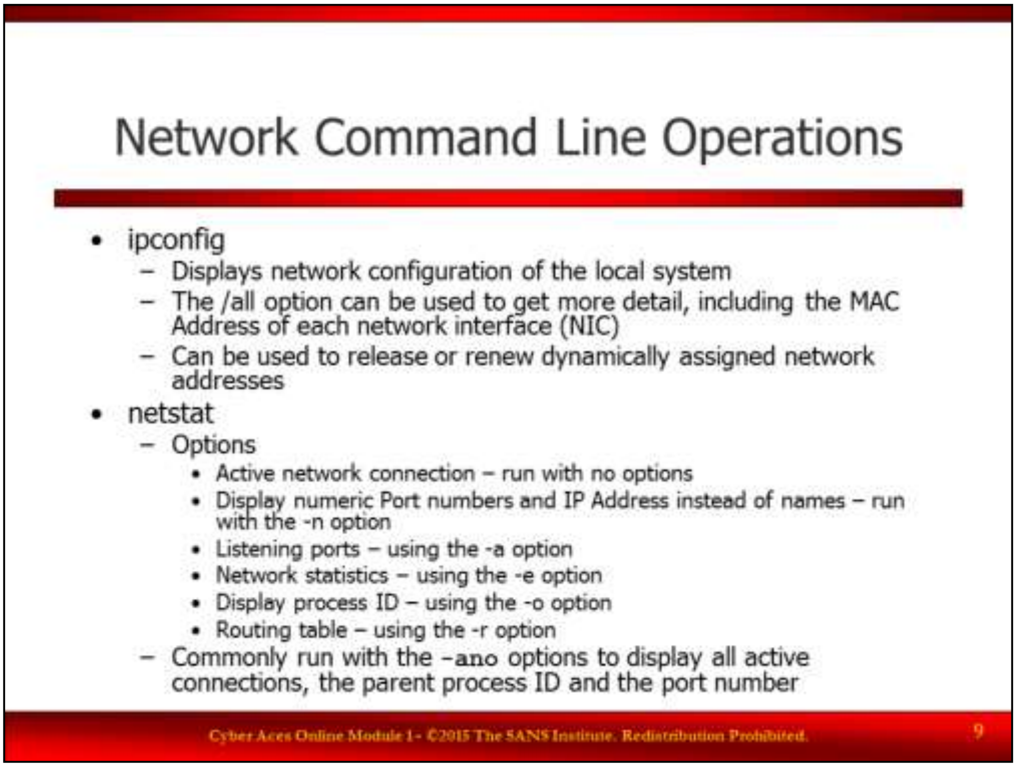
Basic Command Line Operations (5)

The "tasklist" command displays the processes that are currently running on the local or a remote system. To specify a remote system the /S (system), /U (user) and /P (password) options must be used. The list of processes can be filtered using the /fi option and using these filter options:

Filter Name	Valid Operators	Valid Value(s)
STATUS	eq, ne	RUNNING | NOT RESPONDING | UNKNOWN
IMAGENAME	eq, ne	Image name
PID	eq, ne, gt, lt, ge, le	PID value
SESSION	eq, ne, gt, lt, ge, le	Session number
SESSIONNAME	eq, ne	Session name
CPUTIME	eq, ne, gt, lt, ge, le	CPU time in the format of hh:mm:ss. (hh - hours, mm - minutes, ss – seconds)
MEMUSAGE	eq, ne, gt, lt, ge, le	Memory usage in KB
USERNAME	eq, ne	User name in [domain\]user format
SERVICES	eq, ne	Service name
WINDOWTITLE	eq, ne	Window title
MODULES	eq, ne	DLL name

The "taskkill" command uses the same filtering options as tasklist.



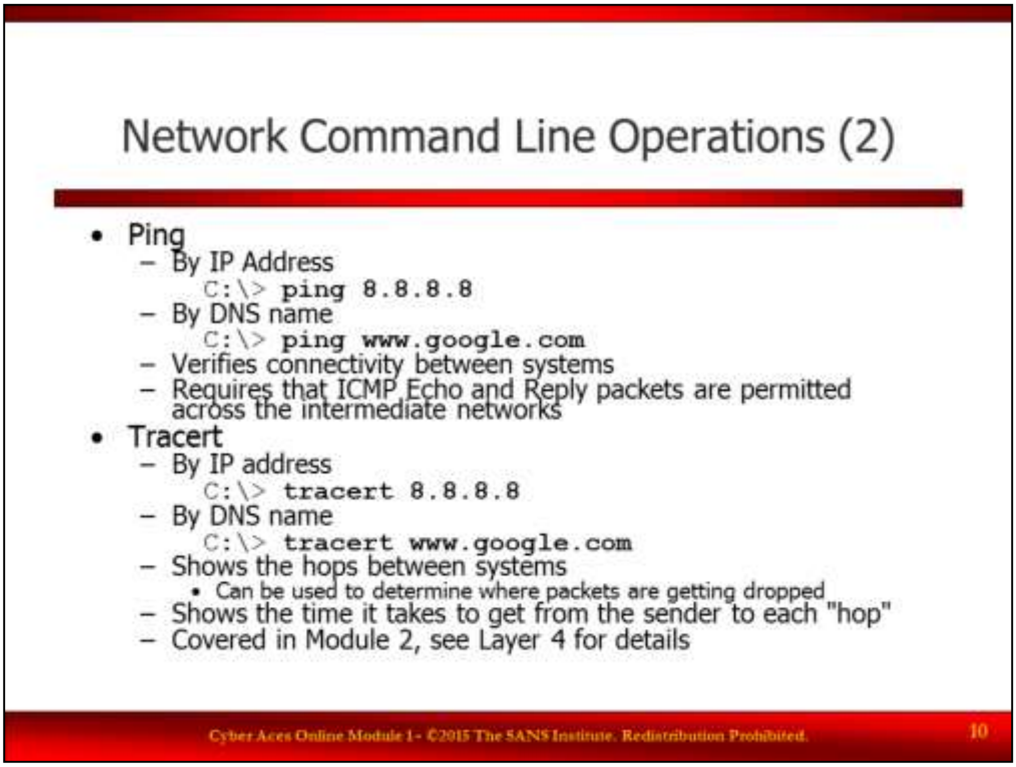
Network Command Line Operations

- ipconfig
  - Displays network configuration of the local system
  - The /all option can be used to get more detail, including the MAC Address of each network interface (NIC)
  - Can be used to release or renew dynamically assigned network addresses
- netstat
  - Options
    - Active network connection – run with no options
    - Display numeric Port numbers and IP Address instead of names – run with the -n option
    - Listening ports – using the -a option
    - Network statistics – using the -e option
    - Display process ID – using the -o option
    - Routing table – using the -r option
  - Commonly run with the `-ano` options to display all active connections, the parent process ID and the port number

Network Command Line Operations

The "ipconfig" command is commonly used to display the network configuration of the local system. More detail, including the MAC address, is displayed when the command is run with the /all option. The /renew and /release options can be used to renew or release (respectively) IP Addresses obtained by a DHCP server.

The netstat command is a very useful command to system administrators and incident handlers as it is used to get information regarding currently open connections or open ports. It can also be used to determine the process ID of the process that opened the connection or port. This is useful to determine which processes are communicating with other systems.



Network Command Line Operations (2)

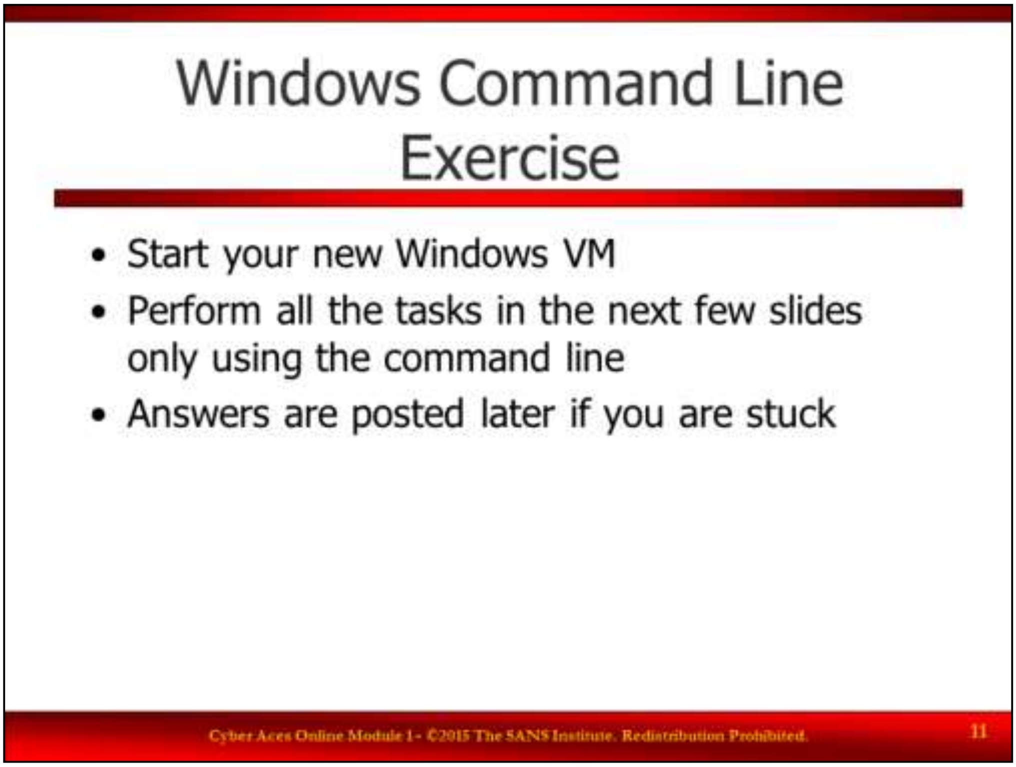
- Ping
  - By IP Address
    ```
    C:\> ping 8.8.8.8
    ```
  - By DNS name
    ```
    C:\> ping www.google.com
    ```
  - Verifies connectivity between systems
  - Requires that ICMP Echo and Reply packets are permitted across the intermediate networks
- Tracert
  - By IP address
    ```
    C:\> tracert 8.8.8.8
    ```
  - By DNS name
    ```
    C:\> tracert www.google.com
    ```
  - Shows the hops between systems
    - Can be used to determine where packets are getting dropped
  - Shows the time it takes to get from the sender to each "hop"
  - Covered in Module 2, see Layer 4 for details

Network Command Line Operations (2)

The "ping" command is used to verify connectivity and check for issues between two systems. The command sends an Echo packet via the ICMP Protocol (Internet Control Message Protocol). The receiving system responds with an ICMP Echo-Reply packet. If there are any network issues in either direction between the two nodes, the system executing the ping will not receive the echo-reply packets. In addition, the sending host times how long it takes between sending the Echo-Request packet and the receipt of the Echo-Reply packet to determine the latency of the links between the hosts.

The proper function of the ping command requires that the ICMP Echo-Request and Echo-Reply packets are permitted across the networks and that the remote system is not blocking ping requests. For example, If you ping www.google.com you will get a reply, but www.sans.org does not send reply packets. The rationale for blocking ping is that it is not essential traffic and it is not necessary for continued operation of the provided web services (web, mail, etc).

The "tracert" (short for Trace Route) command is useful for displaying the path and measuring the latency of packets as they move across the network. The command is quite useful for troubleshooting as it can reveal slow or down links. It does require that the intermediate systems send ICMP Time Exceeded packets and that your host is able to receive such packets. For an explanation as to how tracert works check out the link on Wikipedia: https://en.wikipedia.org/wiki/Traceroute



Windows Command Line Exercise

- Start your new Windows VM
- Perform all the tasks in the next few slides only using the command line
- Answers are posted later if you are stuck

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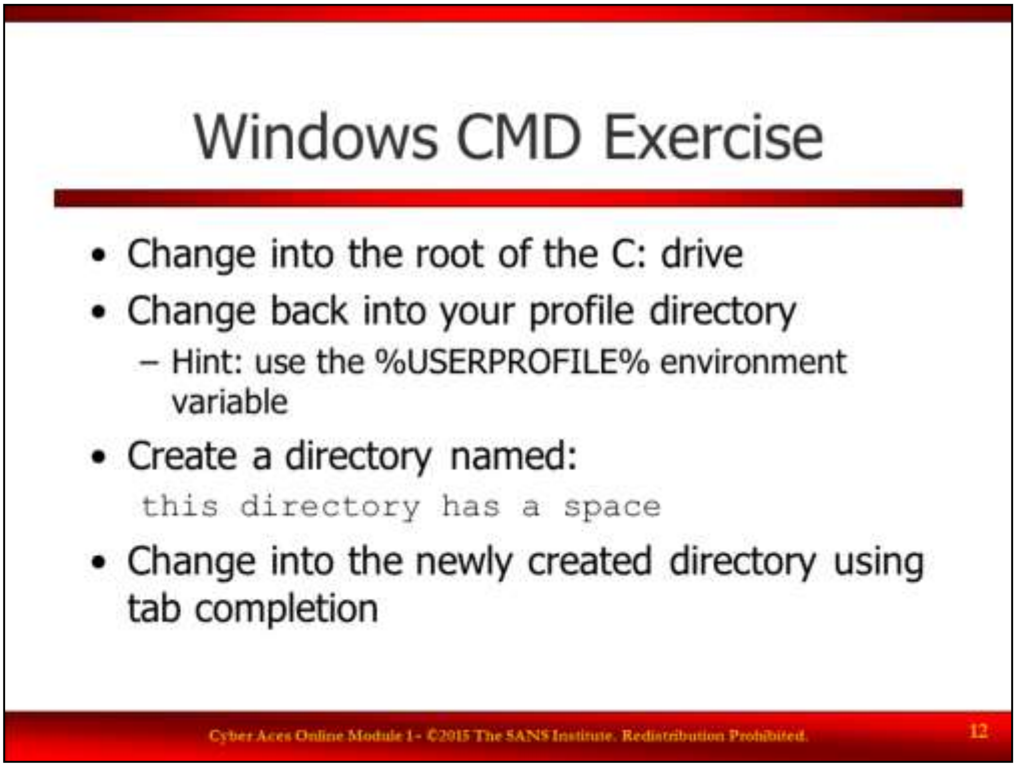
Windows Command Line Exercise

We will practice some of the commands we just learned using the Windows VM built earlier. You will need to start your VM and then perform the tasks presented on the next few pages. If you get stuck, jump ahead for answers.



Windows CMD Exercise

- Change into the root of the C: drive
- Change back into your profile directory
  - Hint: use the %USERPROFILE% environment variable
- Create a directory named:
  `this directory has a space`
- Change into the newly created directory using tab completion

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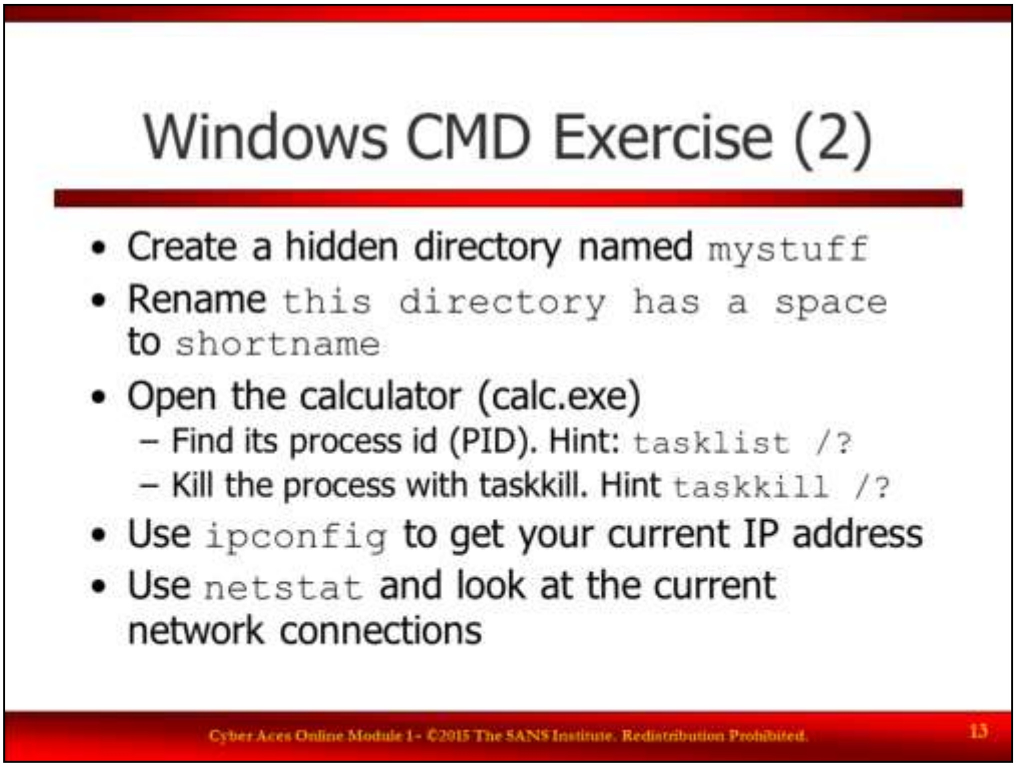
Windows CMD Exercise

Perform these tasks. If you are stuck then skip ahead for the answers.

1. Change into the root of the C: drive
2. Change back to your profile directory
3. Create a directory with the name "this directory has a space"
4. Change into the newly created directory using tab completion



Windows CMD Exercise (2)

- Create a hidden directory named `mystuff`
- Rename `this directory has a space` to `shortname`
- Open the calculator (calc.exe)
  - Find its process id (PID). Hint: `tasklist /?`
  - Kill the process with taskkill. Hint `taskkill /?`
- Use `ipconfig` to get your current IP address
- Use `netstat` and look at the current network connections

Windows CMD Exercise (2)

Continue by attempting to to complete the following tasks:

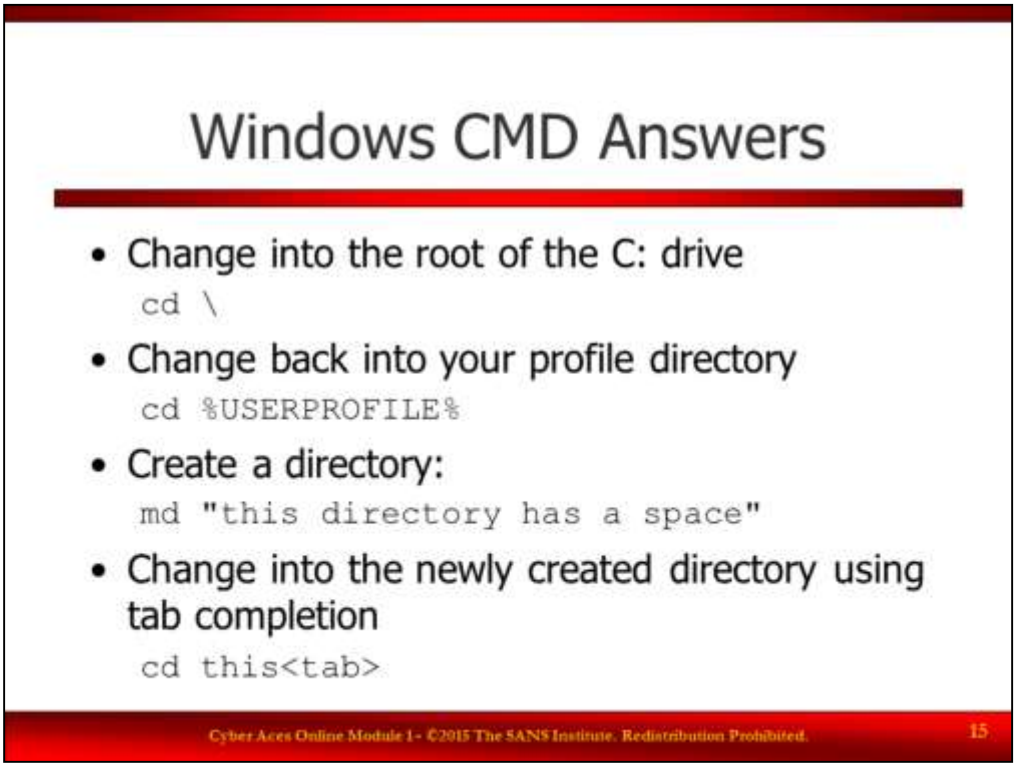
5. Create a hidden directory named "mystuff"
6. Rename "this directory has a space" to "shortname"
7. Open the calculator from the command line (calc.exe)
   a. Find the process ID
   b. Kill the process
8. Use ipconfig to get your current IP address
9. Use netstat and look at the current network connections

STOP!

- Stop here and try the examples on the previous pages
- If you are stuck or want to check your answers look on the following pages

STOP!

The answers are on the following pages. Stop here and use your new knowledge to accomplish the tasks on the previous slides.



Windows CMD Answers

- Change into the root of the C: drive

```
cd \
```

- Change back into your profile directory

```
cd %USERPROFILE%
```

- Create a directory:

```
md "this directory has a space"
```

- Change into the newly created directory using tab completion

```
cd this<tab>
```

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Windows CMD Answers

Here are some examples of commands that can be used to accomplished the tasks outlined earlier:

1. Change into the root of the C: drive:

```
cd \
```

2. Change back to your profile directory:

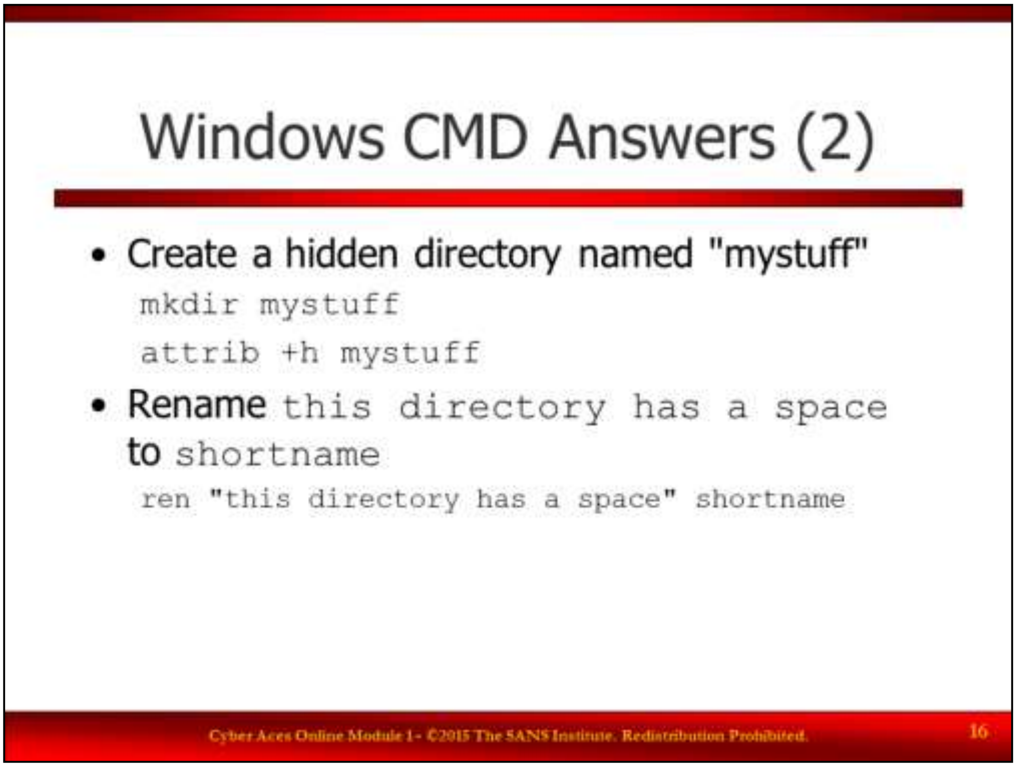
```
cd %USERPROFILE%
```

3. Create a directory with the name "this directory has a space":

```
md "this directory has a space"
```

4. Change into the newly created directory using tab completion:

```
cd this<tab>
```



Windows CMD Answers (2)

- Create a hidden directory named "mystuff"

```
mkdir mystuff
attrib +h mystuff
```

- Rename `this directory has a space` to `shortname`

```
ren "this directory has a space" shortname
```

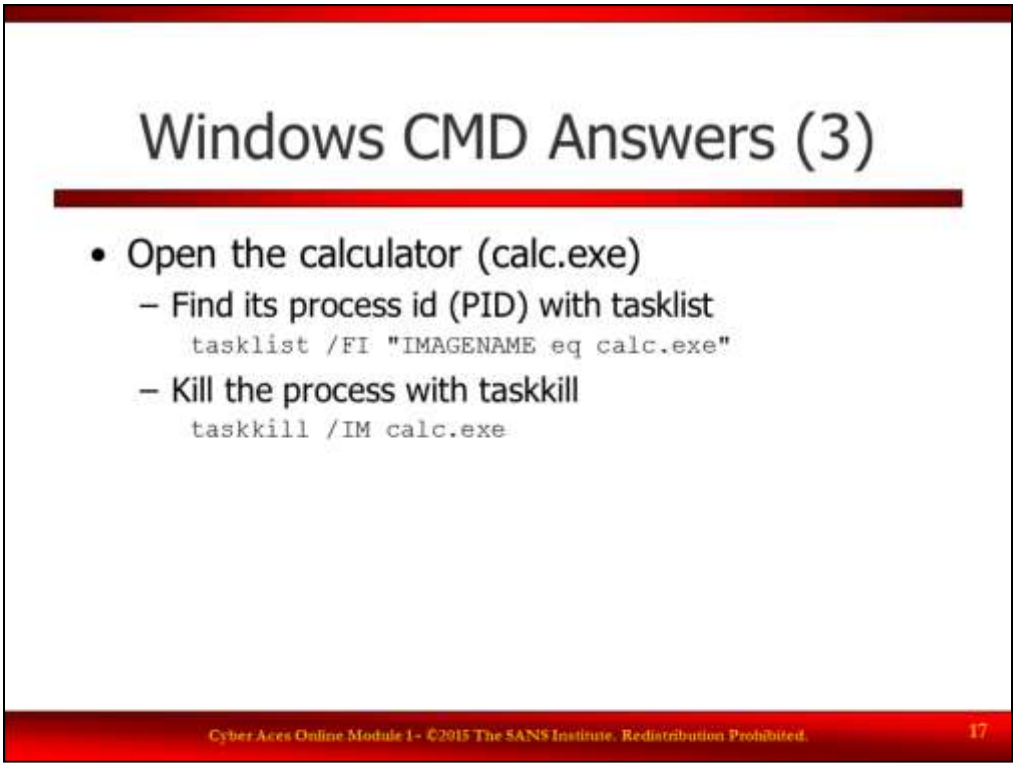
Windows CMD Answers

5. Create a hidden directory named "mystuff"

```
mkdir mystuff
attrib +h mystuff
```

6. Rename "this directory has a space" to "shortname":

```
ren "this directory has a space" shortname
```



Windows CMD Answers (3)

- Open the calculator (calc.exe)
  - Find its process id (PID) with tasklist

    ```
    tasklist /FI "IMAGENAME eq calc.exe"
    ```

  - Kill the process with taskkill

    ```
    taskkill /IM calc.exe
    ```

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Windows CMD Answers (3)

7. Open calc.exe by typing calc.exe in the command line.
   a. Find the process ID using tasklist

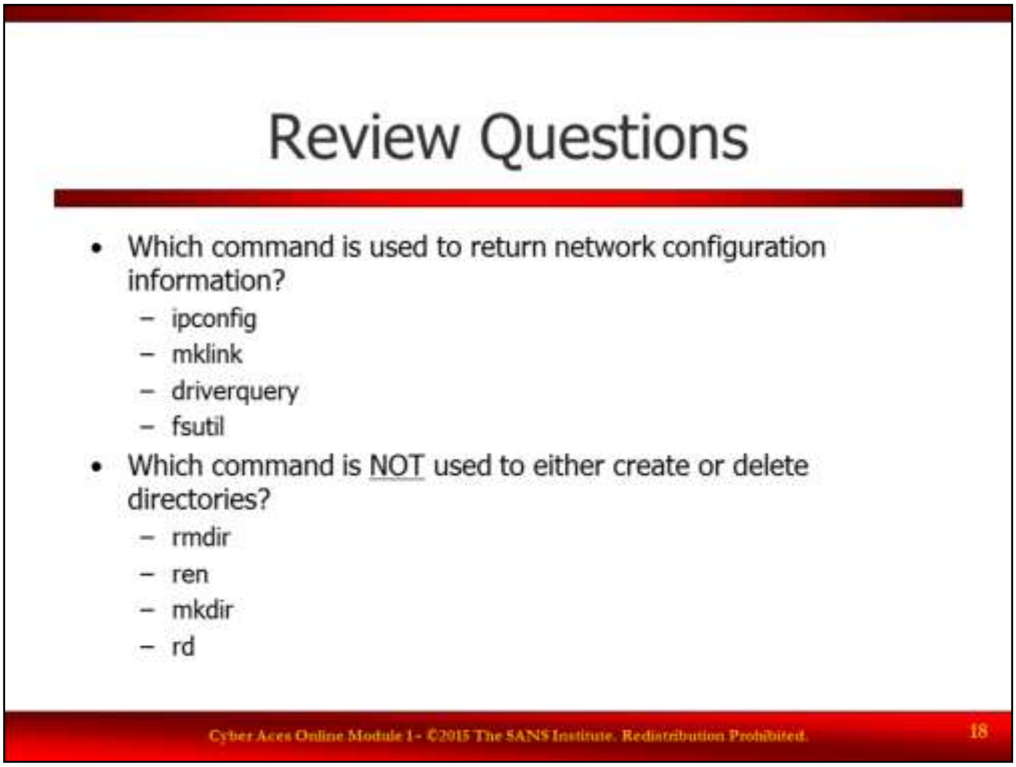
      ```
      tasklist /FI "IMAGENAME eq calc.exe"
      ```

   b. Kill the process with taskkill

      ```
      taskkill /IM calc.exe
      ```

      or

      ```
      taskkill <process ID>
      ```



Review Questions

- Which command is used to return network configuration information?
  - ipconfig
  - mklink
  - driverquery
  - fsutil
- Which command is NOT used to either create or delete directories?
  - rmdir
  - ren
  - mkdir
  - rd

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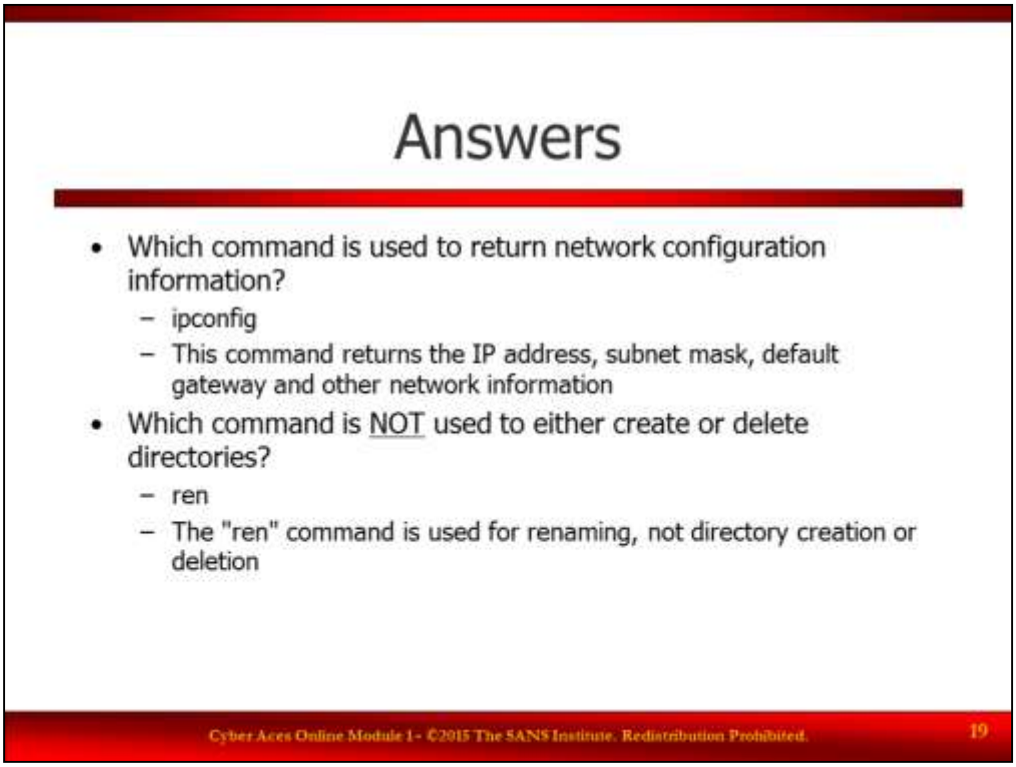
Review Questions

Which command is used to return network configuration information?

- ipconfig
- mklink
- driverquery
- Fsutil

Which command is NOT used to either create or delete directories?

- rmdir
- ren
- mkdir
- rd



Answers

- Which command is used to return network configuration information?
  - ipconfig
  - This command returns the IP address, subnet mask, default gateway and other network information
- Which command is NOT used to either create or delete directories?
  - ren
  - The "ren" command is used for renaming, not directory creation or deletion

Which command is used to return network configuration information?

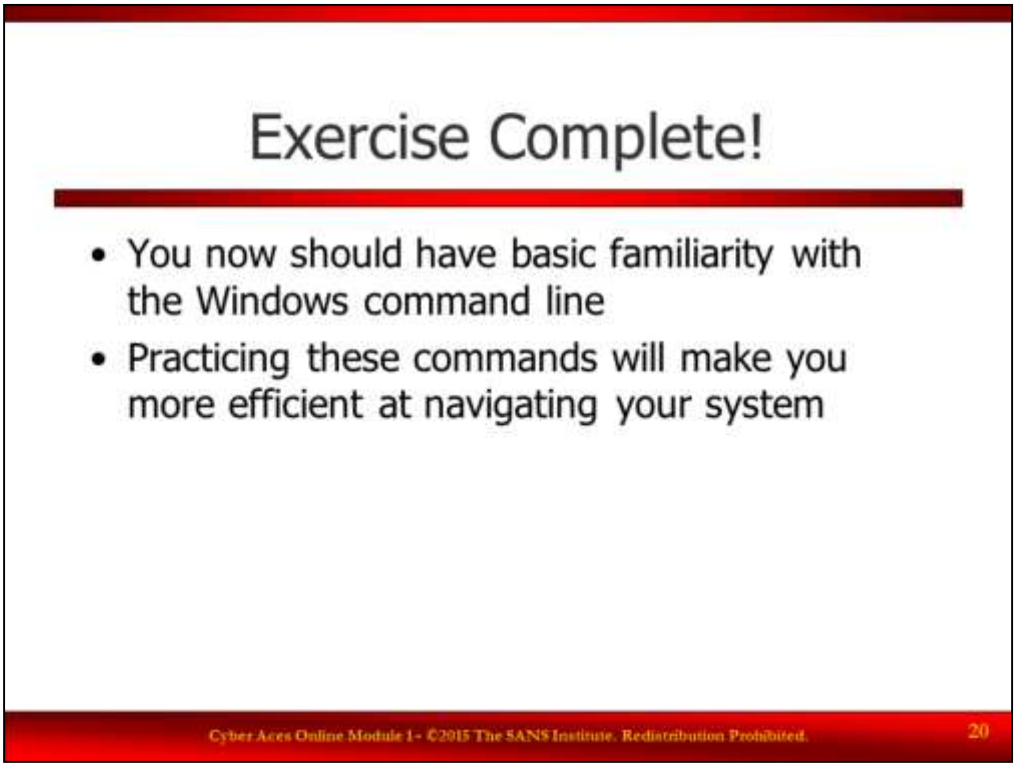
`ipconfig`

This command returns the IP address, subnet mask, default gateway and other network information

Which command is NOT used to either create or delete directories?

`ren`

The "ren" command is use for renaming, not directory creation or deletion



Exercise Complete!

- You now should have basic familiarity with the Windows command line
- Practicing these commands will make you more efficient at navigating your system

Congratulations, you are done with this exercise!