

CS 305 Lab1 Tutorial

Commands for network detection and diagnosis

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LAB information

- Lab website
 - Blackboard: Computer Networks Fall 2023
 - QQ group: 897669773
- Grading criteria
 - Attendance & practice(s) on each lab class
 - Lab programming assignments
 - Project
- regulations on plagiarism
 - The first time the score of the assignment will be 0
 - The second time the score of the course will be 0

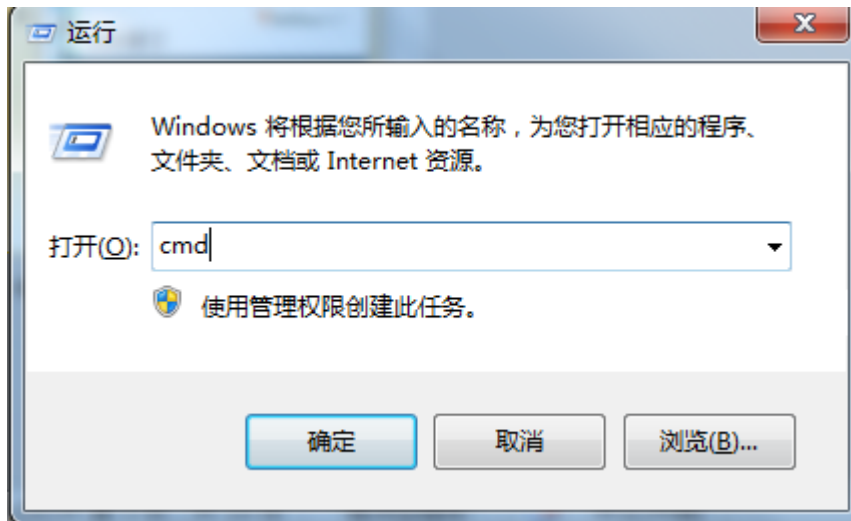
Topics

- Learn the usage of network commands. Learn how to use them to conduct network testing, troubleshooting and event detection.
 - **ipconfig**
 - **arp**
 - **nslookup**
 - **ping**
 - **tracert**
 - **netstat**

TIPS: some commands may vary across different operating systems
- Understand their working principle and underlying network protocols.

Experimental environment

- DOS terminal on Windows 10
 - Click 'start' on desktop -> choose 'run' -> input 'cmd' to invoke the DOS terminal on windows
 - Or Windows + R



1. ipconfig (1)

- “**ipconfig**” is usually used to show the configuration on network adapter.
 - “**ipconfig**” can display the IP address, gateway, network mask of network adapter .
 - Followed by different parameters can display different information.
 - “**ipconfig /all**” or “**ipconfig -all**” can display more information.
 - “**ipconfig /?**” or “**ipconfig -?**” can display its help information.

```
C:\Users\wq>ipconfig /?
```

```
用法:
```

```
ipconfig [/allcompartments] [/? | /all |  
/renew [adapter] | /release [adapter] |  
/renew6 [adapter] | /release6 [adapter] |  
/flushdns | /displaydns | /registerdns |  
/showclassid adapter |  
/setclassid adapter [classid] |  
/showclassid6 adapter |  
/setclassid6 adapter [classid] ]
```

Domai n name

MAC地址：网卡在出厂时已经固定好了 14-5A-FC-10-C4-ED 48个bit 表示成16进制

Practice 1.1

IP地址和子网掩码 按位与操作

10.25.3.144

10.26.15.233

255.252.0.0

10.27.255.254

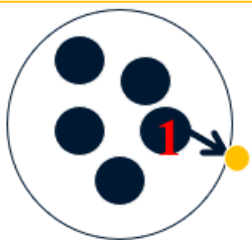
- Practise on “*ipconfig*” with option “*/all*”, what info will be shown by running this command? 显示所有适配器的完整 TCP/IP 配置
- Are the **IP address**, **subnet mask** and **default gateway** of your PC same as those of your classmates? What are **the same**, What are **different**? Are your PCs **in the same subnet**? ip不样子网掩码一样 默认网关不相同
- In the following pictures, PC1 and PC2 are in two different subnets, if PC1 needs to communicate with PC2, what's the usage of default gateway?

PC1

IP address: 192.168.1.104

Subnet mask: **255.255.255.0**

Default Gateway: 192.168.1.1

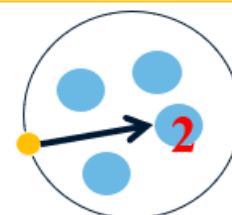


PC2

IP address: 192.168.2.104

Subnet mask: **255.255.255.0**

Default Gateway: 192.168.2.1



默认网关：第一个出入口

2. arp (1)

对本机的arp缓存表进行访问

- “arp” is usually used to display or modify the address translation table (ARP cache, with the IP and MAC address pairs in it) which is used by ARP protocol.
- “arp /?” or “arp -?” can display its help information.

```
C:\Users\Administrator>arp /?
```

```
Displays and modifies the IP-to-Physical address translation tables used by address resolution protocol (ARP).
```

```
ARP -s inet_addr eth_addr [if_addr]
```

```
ARP -d inet_addr [if_addr]
```

```
ARP -a [inet_addr] [-N if_addr] [-v]
```

```
-a          Displays current ARP entries by interrogating the current protocol data. If inet_addr is specified, the IP and Physical addresses for only the specified computer are displayed. If more than one network interface uses ARP, entries for each ARP table are displayed.
```

```
-g          Same as -a.
```

```
-v          Displays current ARP entries in verbose mode. All invalid entries and entries on the loop-back interface will be shown.
```

```
inet_addr  Specifies an internet address.
```

```
-N if_addr  Displays the ARP entries for the network interface specified by if_addr.
```

```
-d          Deletes the host specified by inet_addr. inet_addr may be wildcarded with * to delete all hosts.
```

```
-s          Adds the host and associates the Internet address inet_addr with the Physical address eth_addr. The Physical address is given as 6 hexadecimal bytes separated by hyphens. The entry is permanent.
```

```
eth_addr   Specifies a physical address.
```

```
if_addr     If present, this specifies the Internet address of the interface whose address translation table should be modified. If not present, the first applicable interface will be used.
```

```
Example:
```

```
> arp -s 157.55.85.212 00-aa-00-62-c6-09 .... Adds a static entry.
```

```
> arp -a .... Displays the arp table.
```


2. arp (2)

- **arp -a**
 - **Display** all ARP information, that is, the corresponding relationship between all activated IP addresses and physical addresses
- **arp -d**
 - **Delete** all ARP cache contents.
 - If the IP address is specified in the command, only the ARP cache information of the IP address is deleted.
- **arp -s**
 - **Adding** the corresponding relationship between IP address and physical address to ARP cache

Practice 1.2

- Run the “**arp -a**” command to display all the corresponding relationships in the "IP address to physical address" address translation table (ARP cache).
- You can try to solve the problem of IP address embezzlement in LAN by using “**arp -s**” command according to the format, and bundle the static IP address with the physical address of the network card. For example, “**arp -s 172.16.0.19 00-10-5C-BE-11-CC**”.
- Run the command “**arp -s 192.168.2.222 00-11-22-33-44-YY**”, could this mapping between two address be added to ARP cache? Why?
- In the following picture, “192.168.2.104” is the IP address of a wirelesscard, “192.168.2.1” is its default gateway, could this arp item related to “192.168.2.1” be deleted or changed from ARP cache?

```
C:\Users\Administrator>arp -a -N 192.168.2.104

Interface: 192.168.2.104 --- 0x15
Internet Address      Physical Address      Type
192.168.2.1           00-1a-5a-00-ad-00    dynamic
224.0.0.22            01-00-5e-00-00-1c    static
239.255.255.250       01-00-5e-00-00-ff    static
```

3. nslookup

- “**nslookup**” is usually used to find the corresponding IP through the host name, or find the corresponding host by specifying the IP. The former involves DNS services, while the latter involves reverse DNS (rDNS) services. Generally speaking, DNS services are available, but some websites may not support rDNS services.

```
C:\Users\Administrator>nslookup www.baidu.com
Server:   tw.net-east.com
Address:  116.77.76.254

Non-authoritative answer:
Name:     www.a.shifen.com
Addresses: 163.177.151.109
          163.177.151.110
Aliases:  www.baidu.com

C:\Users\Administrator>nslookup 140.207.198.6
Server:   tw.net-east.com
Address:  116.77.76.254

Name:     publ.sdns.360.cn
Address:  140.207.198.6
```

4. ping 测网络上两个节点的连通性

- “ping” is usually used to check the network connectivity.
- Options
 - ping -t
 - ping -i
 - ping -n
 -

```
C:\Users\Administrator>ping /?

Usage: ping [-t] [-a] [-n count] [-l size] [-f] [-i TTL] [-v TOS]
           [-r count] [-s count] [[-j host-list] | [-k host-list]]
           [-w timeout] [-R] [-S srcaddr] [-c compartment] [-p]
           [-4] [-6] target_name

Options:
  -t           Ping the specified host until stopped.
               To see statistics and continue - type Control-Break;
               To stop - type Control-C.
  -a           Resolve addresses to hostnames.
  -n count     Number of echo requests to send.
  -l size      Send buffer size.
  -f           Set Don't Fragment flag in packet (IPv4-only).
  -i TTL       Time To Live.
  -v TOS       Type Of Service (IPv4-only. This setting has been deprecated
               and has no effect on the type of service field in the IP
               Header).
  -r count     Record route for count hops (IPv4-only).
  -s count     Timestamp for count hops (IPv4-only).
  -j host-list Loose source route along host-list (IPv4-only).
  -k host-list Strict source route along host-list (IPv4-only).
  -w timeout   Timeout in milliseconds to wait for each reply.
  -R           Use routing header to test reverse route also (IPv6-only).
               Per RFC 5095 the use of this routing header has been
               deprecated. Some systems may drop echo requests if
               this header is used.
  -S srcaddr   Source address to use.
  -c compartment Routing compartment identifier.
  -p           Ping a Hyper-V Network Virtualization provider address.
  -4           Force using IPv4.
  -6           Force using IPv6.
```

Practice 1.3

- Here using “ping” to test if the website “www.sustech.edu.cn” is reachable, and the information show, there is no packets lost, the website is reachable.
实际传输跟ttl没关系，网络拥塞情况、路由器的处理速度、数据包大小
- What does “time=9ms” mean? 发出数据包到接收到数据包用了9ms
- What does TTL mean? Why all the “TTL”s based on reply keep same while the “time”s are different from each other? 是 IP 协议包中的一个值，它告诉网络路由器包在网络中的时间是否太长而应被丢弃
- Using your PC to run this command, is the testing result same with the picture below? Check the value of IP address, TTL and time, explain why they are not all the same.

```
C:\Users\Administrator>ping www.sustech.edu.cn

Pinging www.sustech.edu.cn [103.78.127.222] with 32 bytes of data:
8 Reply from 103.78.127.222: bytes=32 time=9ms TTL=56
Reply from 103.78.127.222: bytes=32 time=10ms TTL=56
Reply from 103.78.127.222: bytes=32 time=8ms TTL=56
Reply from 103.78.127.222: bytes=32 time=12ms TTL=56

Ping statistics for 103.78.127.222:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 8ms, Maximum = 12ms, Average = 9ms
```

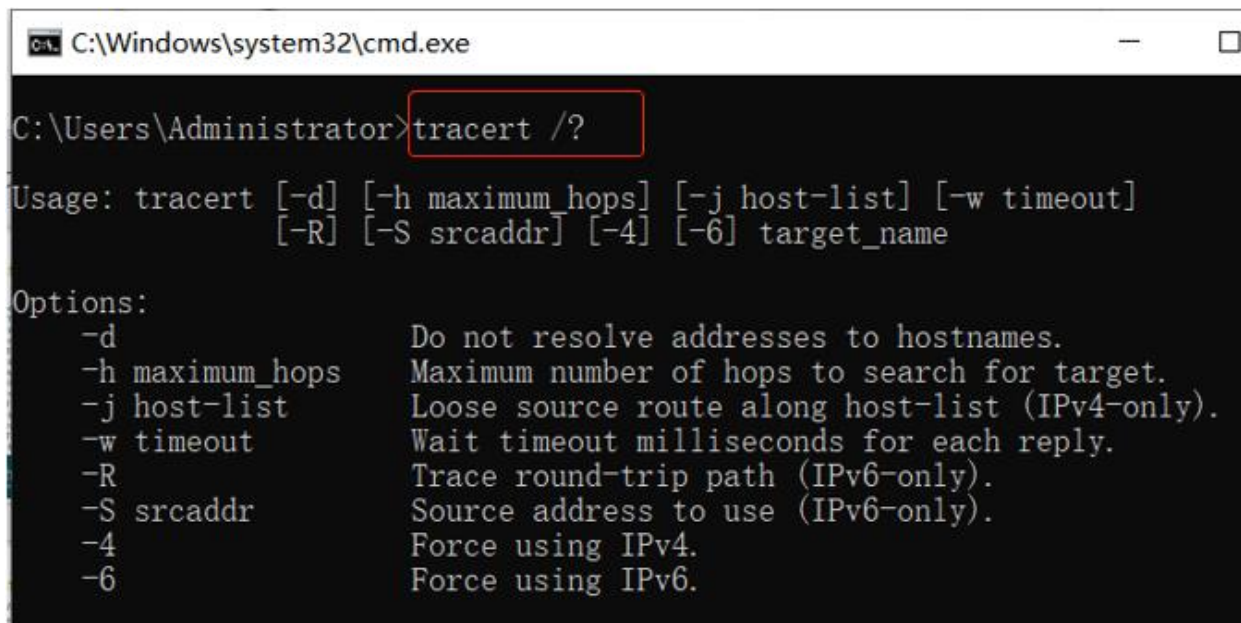
ip不一样，ttl不一样
time也不一样

- Use “ping www.sustech.edu.cn -4” and “ping www.sustech.edu.cn -6” respectively, is there any difference?

在ipv6里面没有TTL字段

5. tracer (1)

- On the Internet, routing directly impact the network performance, it is necessary to track the routing to check the connectivity of the network.



```
C:\Windows\system32\cmd.exe

C:\Users\Administrator>tracert /?

Usage: tracert [-d] [-h maximum_hops] [-j host-list] [-w timeout]
              [-R] [-S srcaddr] [-4] [-6] target_name

Options:
    -d          Do not resolve addresses to hostnames.
    -h maximum_hops  Maximum number of hops to search for target.
    -j host-list  Loose source route along host-list (IPv4-only).
    -w timeout    Wait timeout milliseconds for each reply.
    -R          Trace round-trip path (IPv6-only).
    -S srcaddr    Source address to use (IPv6-only).
    -4          Force using IPv4.
    -6          Force using IPv6.
```

5. tracer (2)

- The five parameters detected are represented from left to right respectively.
 - "Lifetime" (1 node per route)
 - "Return time of ICMP packets sent three times" (3 items in milliseconds)
 - "IP address through router" (IP address, if there is a host name, it will be included either).

```
C:\Windows\system32\cmd.exe
C:\Users\Administrator>tracert www.sustech.edu.cn

Tracing route to www.sustech.edu.cn.w.cdngslb.com [103.78.127.226]
over a maximum of 30 hops:

  1    1 ms    1 ms    <1 ms  192.168.2.1
  2   10 ms   14 ms   10 ms  10.245.100.1
  3   21 ms   16 ms   10 ms  10.21.238.254
  4   11 ms    8 ms    9 ms  10.254.77.85
  5    *     41 ms    9 ms  10.254.86.90
  6    *      *      *      Request timed out.
  7    *      *      *      Request timed out.
  8    *      *      *      Request timed out.
  9   10 ms    8 ms   10 ms  103.78.127.226

Trace complete.

C:\Users\Administrator>tracert www.baidu.com

Tracing route to www.a.shifen.com [163.177.151.110]
over a maximum of 30 hops:

  1    1 ms    2 ms    2 ms  192.168.2.1
  2   33 ms   46 ms   17 ms  10.245.100.1
  3   11 ms   11 ms    9 ms  10.21.238.254
  4   11 ms    8 ms    9 ms  10.254.77.85
  5    9 ms   10 ms    9 ms  10.254.86.86
  6    *      *      *      Request timed out.
  7    *      *      *      Request timed out.
  8    *      *      *      Request timed out.
  9    *      *      *      Request timed out.
 10    *      *      *      Request timed out.
 11    *      *      *      Request timed out.
 12    *      *      *      Request timed out.
 13    *      *      *      Request timed out.
 14    *      *      *      Request timed out.
 15    *      *      *      Request timed out.
 16    *      *      *      Request timed out.
 17    *      *      *      Request timed out.
 18   22 ms   18 ms   84 ms  163.177.151.110

Trace complete.
```


Practice 1.4

- Use “tracert www.baidu.com” command to check the information of each hop between your PC and Baidu server.
 - How many hops are there?
 - What does each column mean of each row?
 - What does * mean in some row?
- Run “tracert www.baidu.com” command again on your PC.
 - Does the result the same with the former? Which hops are same? And which hops are different? Try to speculate possible reasons to these results.
 - Are the first hops the same in these two results?
 - Are the destination hops the same in these two results?

6. netstat (1) 去查看TCP/IP连接状态

- “**netstat**” is usually used to display protocol statistics on current TCP/IP network connections.
- Options:
 - netstat -n
 - List IP addresses in dot decimal format, rather than symbolic hostnames and network names
 - netstat -e
 - Display statistics about Ethernet
 - netstat -s
 - The statistical data are displayed separately according to each protocol. In this way, we can see which connections exist in the current computer network, as well as the details of data packet sending and receiving, and so on.
- Tips: use ‘?’ or ‘help’ arguments to get its help information.

```
C:\Users\Administrator>netstat -e
Interface Statistics
```

	Received	Sent
Bytes	2406827424	183987242
Unicast packets	1584048	1071760
Non-unicast packets	13234544	42138
Discards	0	0
Errors	0	0
Unknown protocols	0	

6. netstat (2)

- State of TCP connection
 - LISTEN**: Listening for connection requests from remote TCP ports
 - SYN-SENT**: Waiting for a matching connection request after sending a connection request
 - ESTABLISHED**: Represents an open connection
 - FIN-WAIT-1**: Waiting for confirmation of remote TCP connection interrupt request or previous connection interrupt request
- A connection can be uniquely determined by the protocol used by both sides of the communication, as well as the IP address and port number.
 - “127.0.0.1:20860”, “127.0.0.1” is an IP address, “20860” is the port number .
- “PID” is the ID number of the process.

```
C:\Users\Administrator>netstat -pno tcp
```

```
Active Connections
```

Proto	Local Address	Foreign Address	State	PID
TCP	127.0.0.1:20860	127.0.0.1:61495	ESTABLISHED	10900
TCP	127.0.0.1:30031	127.0.0.1:62612	TIME_WAIT	0
TCP	127.0.0.1:30031	127.0.0.1:62613	TIME_WAIT	0
TCP	127.0.0.1:30031	127.0.0.1:62614	TIME_WAIT	0
TCP	127.0.0.1:30031	127.0.0.1:62615	TIME_WAIT	0
TCP	127.0.0.1:50051	127.0.0.1:50593	ESTABLISHED	14984
TCP	127.0.0.1:50051	127.0.0.1:54832	ESTABLISHED	14984
TCP	127.0.0.1:50051	127.0.0.1:62385	ESTABLISHED	14984
TCP	127.0.0.1:50593	127.0.0.1:50051	ESTABLISHED	21736
TCP	127.0.0.1:54832	127.0.0.1:50051	ESTABLISHED	16220
TCP	127.0.0.1:61495	127.0.0.1:20860	ESTABLISHED	21692
TCP	127.0.0.1:62385	127.0.0.1:50051	ESTABLISHED	4004
TCP	192.168.2.104:49197	180.163.151.166:443	ESTABLISHED	8836
TCP	192.168.2.104:49542	142.251.42.234:443	SYN_SENT	8836
TCP	192.168.2.104:49543	163.177.151.110:443	FIN_WAIT_1	14436
TCP	192.168.2.104:49558	103.78.126.107:443	ESTABLISHED	8836
TCP	192.168.2.104:49685	140.206.78.14:80	ESTABLISHED	11684