

Assignment 1

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Q1: ping another computer

A1:

```
C:\Windows\system32\cmd.exe
本地链接 IPv6 地址 . . . . . : fe80::90cb:9ae2:e3dc:719f%16
IPv4 地址 . . . . . : 192.168.140.1
子网掩码 . . . . . : 255.255.255.0
默认网关 . . . . . :

无线局域网适配器 WLAN:

连接特定的 DNS 后缀 . . . . . :
本地链接 IPv6 地址 . . . . . : fe80::287e:fbc8:ddbd:5c75%12
IPv4 地址 . . . . . : 192.168.1.106
子网掩码 . . . . . : 255.255.255.0
默认网关 . . . . . : 192.168.1.1

C:\Users\voywe>ping 192.168.1.102

正在 Ping 192.168.1.102 具有 32 字节的数据:
来自 192.168.1.102 的回复: 字节=32 时间=299ms TTL=64
来自 192.168.1.102 的回复: 字节=32 时间=5ms TTL=64
来自 192.168.1.102 的回复: 字节=32 时间=15ms TTL=64
来自 192.168.1.102 的回复: 字节=32 时间=136ms TTL=64

192.168.1.102 的 Ping 统计信息:
    数据包: 已发送 = 4, 已接收 = 4, 丢失 = 0 (0% 丢失),
    往返行程的估计时间 (以毫秒为单位):
        最短 = 5ms, 最长 = 299ms, 平均 = 113ms

C:\Users\voywe>
```

Figure 1: default

Q2: traceroute a server

A2:

```
GuideMacBook-Pro:~ gggwx$ traceroute github.com
traceroute: Warning: github.com has multiple addresses; using 52.74.223.119
traceroute to github.com (52.74.223.119): 64 hops max, 52 byte packets
 1 192.168.1.1 (192.168.1.1)  1.756 ms  1.606 ms  1.267 ms
 2 10.132.127.254 (10.132.127.254)  2.441 ms  2.485 ms  1.919 ms
 3 172.20.255.250 (172.20.255.250)  105.374 ms  2.632 ms  4.449 ms
 4 172.20.255.254 (172.20.255.254)  2.631 ms  4.564 ms  7.637 ms
 5 172.17.11.214 (172.17.11.214)  1.965 ms  3.262 ms  3.663 ms
 6 172.17.11.254 (172.17.11.254)  1.839 ms  3.903 ms  3.257 ms
 7 218.197.158.254 (218.197.158.254)  2.130 ms  3.267 ms  11.001 ms
 8 wh0.cernet.net (202.112.53.81)  3.728 ms  11.403 ms  *
 9 101.4.114.228 (101.4.114.228)  59.107 ms  3.738 ms  16.036 ms
10 101.4.117.38 (101.4.117.38)  17.126 ms  10.723 ms  18.255 ms
11 101.4.112.1 (101.4.112.1)  20.383 ms  21.746 ms  21.545 ms
12 101.4.113.109 (101.4.113.109)  25.346 ms  22.175 ms  20.367 ms
13 101.4.114.222 (101.4.114.222)  22.265 ms
14 101.4.114.194 (101.4.114.194)  25.565 ms
15 101.4.114.174 (101.4.114.174)  25.345 ms
16 101.4.114.57 (101.4.114.57)  27.803 ms  21.564 ms  54.250 ms
17 101.4.118.122 (101.4.118.122)  32.008 ms  31.859 ms  30.278 ms
18 101.4.117.250 (101.4.117.250)  59.130 ms  58.177 ms  70.423 ms
19 ix-xe-1-2-0-0 (core1.hkz-hong-kong.as6453.net (180.87.112.109)  331.021 ms
402.122 ms  223.652 ms
AC
```

Figure 2: default

1 Problem7

In this problem, we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64kbps bit stream on the fly. Host A then groups the bits into 56-byte packets. There is one link between Hosts A and B; its transmission rate is 2Mbps and its propagation delay is 10ms. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet's bits to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

Solution: time elapses = $56 * 8 \text{bits} / 64 * 10^3 + 56 * 8 / 2 * 10^3 + 10 = 17.224 \text{ ms}$

2 Problem8

Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time.

1. When circuit switching is used, how many users can be supported?
2. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.
3. suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously.
4. Find the probability that there are 21 or more users transmitting simultaneously.

Solution:

1. $3 \text{ Mbps} / 150 \text{ kbps} = 20$ users can be supported.
2. $p = 0.1$
3. $p = \binom{120}{n} p^n (1-p)^{120-n}$
4. $p = 1 - \sum_{n=0}^{20} \binom{120}{n} p^n (1-p)^{120-n}$

3 Problem9

Consider the discussion in Section 1.3 of packet switching versus circuit switching in which an example is provided with a 1 Mbps link. Users are generating data at a rate of 100 kbps when busy, but are busy generating data only with probability $p = 0.1$. Suppose that the 1 Mbps link is replaced by a 1 Gbps link.

1. What is N , the maximum number of users that can be supported simultaneously under circuit switching?
2. Now consider packet switching and a user population of M users. Give a formula (in terms of p , M , N) for the probability that more than N users are sending data.

Solution:

1. $N = 1Gbps/100kbps = 10000$
2. $p = \sum_{n=N+1}^M \binom{M}{n} p^n (1-p)^{M-n}$