1.ping 另外一台计算机

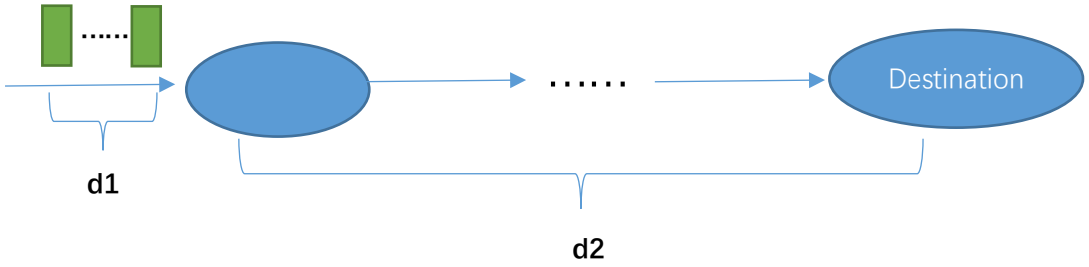
```
$ ping www.csdn.net

Pinging www.csdn.net [47.95.164.112] with 32 bytes of data:
Reply from 47.95.164.112: bytes=32 time=36ms TTL=88
Reply from 47.95.164.112: bytes=32 time=36ms TTL=88
Reply from 47.95.164.112: bytes=32 time=36ms TTL=88
Reply from 47.95.164.112: bytes=32 time=36ms TTL=88

Ping statistics for 47.95.164.112:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 36ms, Maximum = 36ms, Average = 36ms
```

2.tracert 一个服务器

```
$ tracert www.zhihu.com

Tracing route to k7itxdrj.gsadds.com [118.89.204.192]
over a maximum of 30 hops:

  1    <1 ms    <1 ms    <1 ms  192.168.1.1
  2     *        *        *     Request timed out.
  3    <1 ms    <1 ms    <1 ms  172.20.255.250
  4     *        *        *     Request timed out.
  5    <1 ms    <1 ms    <1 ms  172.17.11.214
  6     1 ms     1 ms     1 ms  172.17.11.254
  7     1 ms     1 ms     1 ms  218.197.158.254
  8     2 ms     1 ms     2 ms  wh0.cernet.net [202.112.53.81]
  9     *        1 ms     1 ms  101.4.114.229
 10     8 ms     8 ms     8 ms  101.4.112.62
 11    10 ms    11 ms    10 ms  101.4.117.26
 12    16 ms    16 ms    16 ms  101.4.112.42
 13    17 ms    19 ms    19 ms  101.4.114.250
 14    17 ms    17 ms    17 ms  101.4.118.54
 15    17 ms    17 ms    17 ms  101.4.135.186
 16    31 ms    31 ms    33 ms  219.224.100.70
 17    34 ms    33 ms    33 ms  10.200.6.57
 18    35 ms    34 ms    43 ms  182.254.127.53
 19     *        *       58 ms  10.196.28.150
 20    39 ms    36 ms    36 ms  100.67.119.231
 21    32 ms    32 ms    33 ms  118.89.204.192

Trace complete.
```

P2. Solution:

The delay is the time interval between when the first packet has just started to be transmitted and when the last (P) packet arrives at the destination.



Therefore, $d_{end\text{-}to\text{-}end}$ = d1+d2 = (P - 1) $* \frac{L}{R}$ + N $* \frac{L}{R}$

= (N+P-1)$* \frac{L}{R}$

P8.Solution:

a. N = 3Mbps/150kbps = 20

b. p=0.1

c. P(n users are transmitting) = $C_{120}^{n} * 0.1^{n} * 0.9^{120-n}$

d .P(X>=21) = $\sum_{21}^{120} C_{120}^{n} * 0.1^{n} * 0.9^{120-n}$

= 0.079

```
>> n=120;
>> syms k; c_nk=nchoosek(n, k);
>> s=c_nk*0.1^(k)*0.9^(n-k);
>> sum=symsum(s, k, 21, 120);
>> vpa(sum)

ans =

0.0079411922483969881553161992556852
```

P13.Solution:

a. $d_n = (\mathrm{n}-1) * \frac{L}{R}$

Thus, $d_{avg} = \sum_{n=1}^{N} d_n$

$= \frac{N-1}{2} * \frac{L}{R}$

b. Since N packets can be transmitted in N*L/R seconds, there is no need for the next batch to queue after the prior one.

Thus, $d_{avg} = \frac{N-1}{2} * \frac{L}{R}$.

The reference answer of P8 is incorrect.

d) $1-\sum_{n=0}^{20}\binom{120}{n}p^n(1-p)^{120-n}$.

We use the central limit theorem to approximate this probability. Let X_j be independent random variables such that $P(X_j=1)=p$.

$P(\text{ "21 or more users" })=1-P\left(\sum_{j=1}^{120}X_j \le 21\right)$

$$P\left(\sum_{j=1}^{120}X_j \le 21\right)=P\left(\frac{\sum_{j=1}^{120}X_j-12}{\sqrt{120\cdot 0.1\cdot 0.9}} \le \frac{9}{\sqrt{120\cdot 0.1\cdot 0.9}}\right)$$

$$\approx P\left(Z \le \frac{9}{3.286}\right)=P(Z\le 2.74)$$

$$=0.997$$

when Z is a standard normal r.v. Thus $P(\text{ "21 or more users" }) \approx 0.003$.

P("21 or more users") = 1-P($\sum_{j=1}^{120} X_j \le 20$)

Then, P($\sum_{j=1}^{120} X_j \le 20$) $\approx \mathrm{P}\left(\mathrm{Z} \le \frac{8}{3.286}\right) = \mathrm{P}(\mathrm{Z} \le 2.43) = 0.9925$

P("21 or more users") =0.0075 , which is approximately equal to the answer calculated by series.