

东 北 大 学 考 试 试 卷

2017 —2018 学 年 第 一 学 期

课程名称：Computer Networks (Test 2)

总分	一	二	三	四	五	六	七	八

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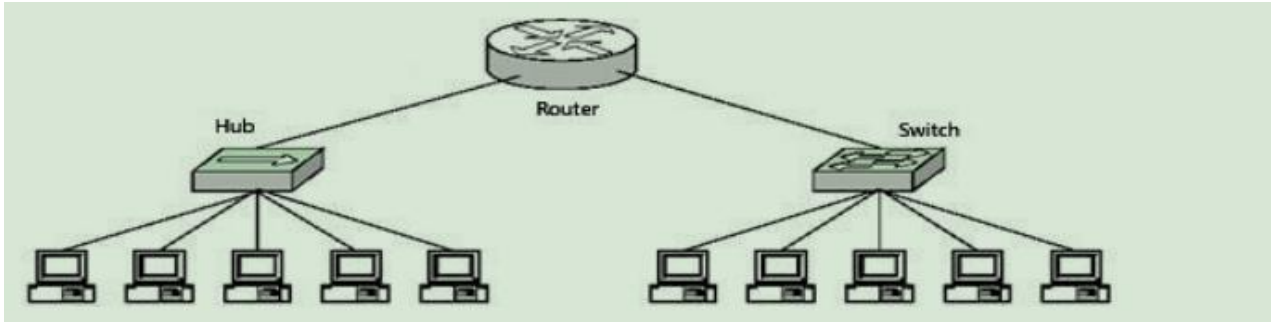
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I. Multiple Choices (20 points, 1 for each)

- ( C ) 1. What is the mask for a smallest subnet usable in practice?  
A. 255.255.255.0                      B. 255.255.255.254  
C. 255.255.255.252                    D. 255.255.255.255
- ( D ) 2. Which of the following IP address CANNOT be assigned to a host?  
A. 141.107.255.80/16                  B. 201.255.0.11/24  
C. 116.1.0.255/16                      D. 198.121.254.255/24
- ( A ) 3. If a package is to be broadcasted to the local network, then the destination IP address of the package should be:  
A. 255.255.255.255                      B. 0.0.0.0  
C. the lowest address of the subnet      D. the highest address of the subnet
- ( C ) 4. The core of the Internet protocols is:  
A. IPX/SPX    B. PPP    C. TCP/IP    D. SLIP
- ( A ) 5. The lower layer of RIP protocol uses:  
A. UDP    B. TCP    C. ARP    D. IP
- ( C ) 6. Which of the following is true of the IP address 198.0.0.10 using default mask?  
A. The netid is 198.                                      B. The hostid is 0.10.  
C. The network address is 198.0.0.0                  D. The hostid is 0.0.10
- ( D ) 7. Which of the following is true about IP routing?  
A. The destination IP address changes at each hop.  
B. The source IP address changes at each hop.  
C. The frame does not change at each hop.  
D. The frame changes at each hop.
- ( A ) 8. Which of the following ranges is considered as well-known port number?  
A. 1~1023                  B. 1024 and above                  C. 1~256                  D. 1~65534
- ( A ) 9. When we assign an IP address to a host, which of the following can be used?  
A. 129.12.1.112                  B. 127.0.1.1  
C. 192.168.1.255                  D. 220.1.25.0
- ( D ) 10. Concerning the following statements about Internet Control Message Protocol(ICMP), which is wrong?  
A. ICMP data is encapsulated in the data part of IP datagrams  
B. The transportation of ICMP messages is reliable  
C. ICMP is a necessary part of IP protocol  
D. ICMP can be used for congestion control

- ( C ) 11. The similarity of TCP and UDP is that both of them are:  
A. connection-oriented protocols                  B. connectionless protocols  
C. transportation-layer protocols                  D. none of above
- ( A ) 12. When a router receives an IP datagram, and the destination network is not recorded in the routing table, what action should the router take?  
A. Discard the datagram  
B. Broadcast the datagram to all ports of the router  
C. Return the datagram to the upper level device  
D. Request routing information to a particular router
- ( D ) 13. What is used at the Transportation layer to stop a receiving host' s buffer from overflowing?  
A. Segmentation                  B. Packets                  C. Acknowledgement                  D. Flow Control
- ( C ) 14. Which is the correct description that TCP sender needs to buffer?  
A. Only last packet sent, since it may need to be retransmitted  
B. Only first packet sent, since it may need to be retransmitted  
C. All packet sent, since any of them may need to be retransmitted  
D. No packet at all
- ( A ) 15. Which IP address range is allowable given an IP address of 172.37.2.56 and 28-bits of subnetting?  
A. 172.37.2.48 to 172.37.2.63                      B. 172.37.2.48 to 172.37.2.62  
C. 172.37.2.49 to 172.37.2.62                      D. 172.37.2.49 to 172.37.2.63
- ( A ) 16. The sequence number in TCP segment refers to:  
A. the first byte of data part                      B. the last byte of data part  
C. the first byte of the segment                  D. the last byte of the segment
- ( C ) 17. How many collision domains are there in the following network configuration?



- A. 2                  B. 5                  C. 6                  D. 10

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- ( B ) 18. What type of service does IP protocol provide?  
A. Connection-oriented datagram service      B. Connectionless datagram service  
C. Connection-oriented virtual circuit service      D. Connectionless virtual circuit service
- ( D ) 19. Concerning IPv4 addresses, which of the following statements is incorrect?  
A. An IP address is always 32-bit-long.  
B. Each IP address consists of network address and host address.  
C. A class C address owns 8-bit host addresses, which can be assigned to 254 hosts.  
D. A class A address owns the largest number of networks.
- ( B ) 20. Which of the following host addresses belongs to the same network as 10.110.12.29 with mask 255.255.255.224?  
A. 10.110.12.0      B. 10.110.12.30      C. 10.110.12.31      D. 10.110.12.32

II. Fill in the Blanks (10 points, 1 for each blank)

1. ping 172.0.0.1 command will test the internal loopback of a computer.  
(Fill the complete command with parameters)
2. 254 (how many) usable subnets are created by applying the subnet mask 255.255.255.0 to a Class B network.
3. In Internet, we use ip 地址和端口号 (套接字) as the identification of a process.
4. The MTU of Ethernet is 1500 of length bytes.
5. The total digit number of IPv6 addresses is 4 times of the total digit number of IPv4 addresses.
6. The IP address 11011011.00001101.00000101.11101110 can be written as 219.13.5.238 with dotted decimal notation.
7. In Go-Back-N protocol, the sender has sent frames 0~7. When the timer expires, the sender only got acknowledgements to frames 0, 2, and 3. Then the amount of frames the sender need to retransmit is 4.
8. In Selective Repeat protocol, if the sequence number is 4-bit long, and the sizes of receive window and send window are the same, then the maximum size of the send window is 2 / 8.
9. Interior Gateway Protocols (IGP) are routing protocols used within an autonomous system. Now mostly used such protocols includes RIP and OSPF (开放最短路径优先).
10. The four congestion control algorithms include slow start (慢开始/慢启动), congestion avoidance, fast retransmission and fast recovery.

III. True or False (10 points, 1 for each)

- ( T ) 1. Network Address Translation technology is a solution to expand the number of IP addresses available for public use.  
( T ) 2. Latency through the store-and-forward switch varies with frame length.  
( F ) 3. Security is one of the advantages of using static routes over dynamic routes.  
( F ) 4. OSPF is an inter-AS routing protocol, while BGP is an intra-AS routing protocol.  
( T ) 5. Encryption and decryption are functions of the presentation layer.  
( F ) 6. Network layer is the key point of network interconnection. But network layer doesn't provide reliability guarantee, so TCP/IP networks don't have reliability mechanism.  
( T ) 7. Router uses routed protocol to determine the best path for data transmission.  
( F ) 8. Threshold window is smaller than congestion window.  
( T ) 9. When calculating UDP segment checksum, a pseudo-header should be added.  
( T ) 10. An autonomous system is an internet, and its most important feature is that the autonomous system can determine its internal routing protocols autonomously.

IV. Terminology (10 points, 2 for each)

1. Socket  
套接字
2. Sliding Window Protocol  
滑动窗口
3. CIDR  
无类别域间路由 (Classless Inter-Domain Routing)
4. BGP  
边界网管协议 (Border Gateway Protocol)
5. ARQ  
自动重传请求 (Automatic Repeat-reQuest)

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V. Comprehensive Questions (20 points)

1. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 144. Suppose that Host A then sends two segments to Host B back-to-back. The first and second segments contain 20 and 40 bytes of data, respectively. In the first segment, the sequence number is 145, source port number is 303, and the destination port number is 80. Host B sends an acknowledgement whenever it receives a segment from Host A.

a. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?

The first and second segments contain 20 and 40 bytes of data, respectively. In the second segment sent from A to B, the sequence number is 165, the source port number is 303, and the destination port number is 80.

b. If the first segment arrives before the second segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?

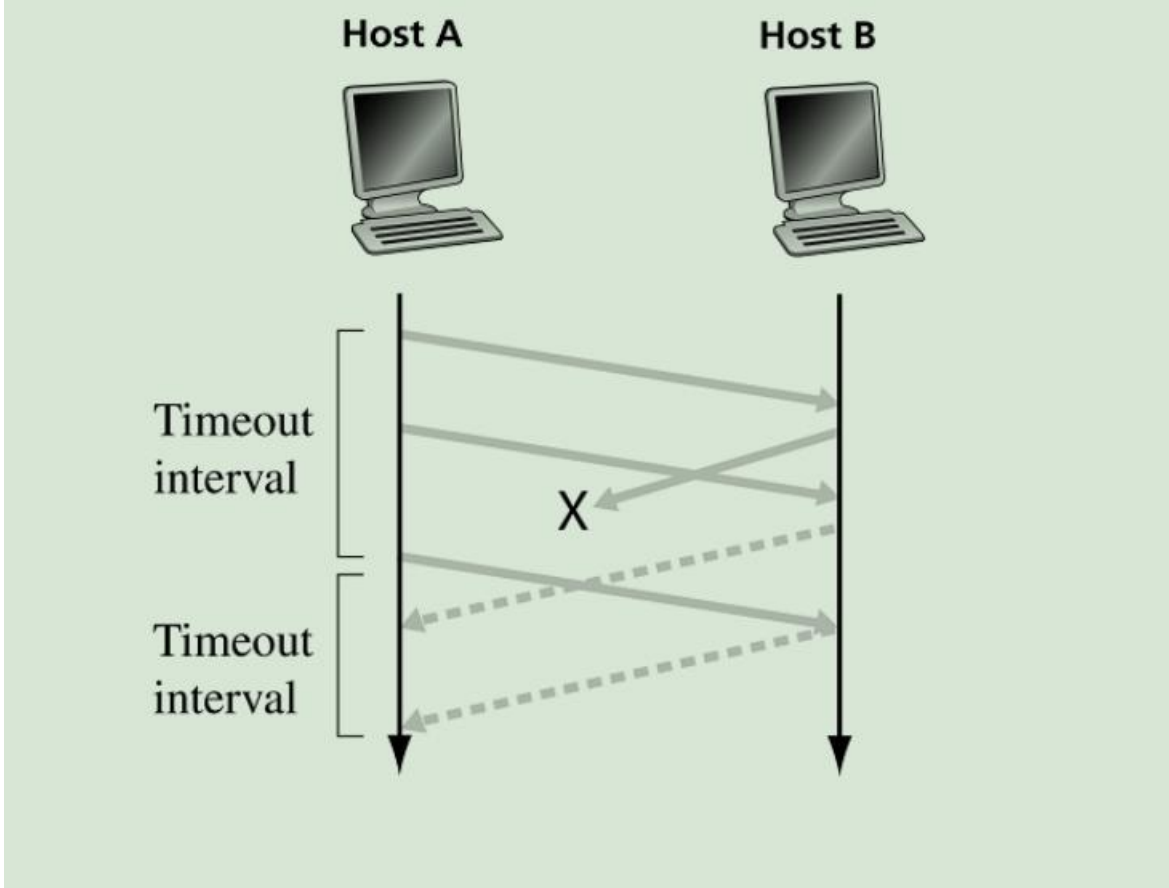
The first acknowledgment has acknowledgment number 165, source port 80, and destination port 303.

c. If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number?

The acknowledgment number will be 145, indicating that it is still waiting for bytes 145 and onward.

d. Suppose the two segments sent by A arrive in order at B. The first acknowledgement is lost and the second segment arrives after the first timeout interval, as shown in the figure below. Complete the diagram, showing all other segments and acknowledgements sent. (Assume there is no additional packet loss.) For each segment you add to the diagram, provide the sequence number and number of bytes of data;for each acknowledgement that you add,provide the acknowledgement number.

The sequence number of the retransmission is 145 and it carries 20 bytes of data. The acknowledgment number of the additional acknowledgment is 205.



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2. TCP Potpourri.

a. Consider two TCP connections, one between Hosts A (sender) and B (receiver), and another between Hosts C (sender) and D (receiver). The RTT between A and B is half that of the RTT between C and D. Suppose that the senders’ (A’ s and C’ s) congestion window sizes are identical. Is their throughput (number of segments transmitted per second) the same? Explain.

No. The two sessions will transmit the same number of segments per RTT. But since the RTT of the A-B connection is half that of the other session, its throughput will be twice as large.

b. Now suppose that the average RTT between A and B, and C and D are identical. The RTT between A and B is constant (never varies), but the RTT between C and D varies considerably. Will the TCP timer values of the two connections differ, and if so, how are they different, and why are they different?

The TCP timer takes the estimate of the RTT and adds on a factor to account for the variation in RTTs. Therefore, the C-D connection timeout value will be larger.

c. Give one reason why TCP uses a three-way (SYN, SYNACK, ACK) handshake rather than a two-way handshake to initiate a connection.

Suppose a client transmits multiple SYN messages that take a long time to be received at the server, so the client terminates (thinking the server is dead). The server then accepts these SYN connections (with only a two-way handshake, the server needs to commit as soon as the SYN is received). However, the client side is no longer present, so the server now has multiple connections opened with no client on the other side.

d. It is said that a TCP connection “probes” the network path it uses for available bandwidth. What does this mean?

TCP’ s sawtooth behavior results from TCP continuing to increase its transmission rate until it congests some link in the network (that is, until there is no unused bandwidth on that link) at which point a loss occurs. TCP then backs off and continues to increase its bandwidth again.

e. What does it mean when we say that TCP uses “cumulative acknowledgement” ? Give two reasons why cumulative acknowledgment is advantageous over selective acknowledgment.

An acknowledgement of X in TCP tells the sender that all data up to X has been correctly received. Cumulative ACKs can decrease the amount of ACK overhead. For example, a TCP receiver will wait a short time before ACKing in the hope that the next in-sequence packet will arrive, and then will just generate a single ACK (for the second packet), which will acknowledge both packets. Also even if the receiver separately ACKs packets X and if the ACK of X is lost but the ACK of is received, the sender will know that X was received by the receiver.

VI. Analysis and Design (30 points)

1. A company is assigned a Class B IP address with the net-id 129.250.0.0. The company has 4000 computers, distributed in 16 different locations averagely. If we choose 255.255.255.0 as the subnet mask, please assign a network (subnet) id for each location, and give the range of host IP addresses for each location.

4000/16=250，平均每个地点 250 台机器。

子网掩码为 255.255.255.0，则每个网络所连主机数=2<sup>8</sup>-2=254>250，能够满足需求。

具体分配如下：

地点	子网号（subnet-id）	子网网络号	主机 IP 的最小值和最大值
1:	00000001	129.250.1.0	129.250.1.1----129.250.1.254
2:	00000010	129.250.2.0	129.250.2.1----129.250.2.254
3:	00000011	129.250.3.0	129.250.3.1----129.250.3.254
4:	00000100	129.250.4.0	129.250.4.1----129.250.4.254
5:	00000101	129.250.5.0	129.250.5.1----129.250.5.254
6:	00000110	129.250.6.0	129.250.6.1----129.250.6.254
7:	00000111	129.250.7.0	129.250.7.1----129.250.7.254
8:	00001000	129.250.8.0	129.250.8.1----129.250.8.254
9:	00001001	129.250.9.0	129.250.9.1----129.250.9.254
10:	00001010	129.250.10.0	129.250.10.1----129.250.10.254
11:	00001011	129.250.11.0	129.250.11.1----129.250.11.254
12:	00001100	129.250.12.0	129.250.12.1----129.250.12.254
13:	00001101	129.250.13.0	129.250.13.1----129.250.13.254
14:	00001110	129.250.14.0	129.250.14.1----129.250.14.254
15:	00001111	129.250.15.0	129.250.15.1----129.250.15.254
16:	00010000	129.250.16.0	129.250.16.1----129.250.16.254

2. In a subnet, there are six routers named A, B, C, D, and E. Router C is connected to Routers B, D, E, and F. Distance Vector Algorithm is used for routing. At some time, Router C got the following distance vectors (with the sequence of A, B, C, D, E, F):

from Router B: (5, 0, 8, 12, 6, 2)

from Router D: (16, 12, 6, 0, 9, 10)

from Router E: (7, 6, 3, 9, 0, 4)

The direct costs from C to B, D, and E are 6, 3 and 5 respectively.

Please give out the renewed routing table of Router C, including the output links and corresponding costs.

dc(A)=min{c(C,B)+dB(A), c(C,D)+dD(A), c(C,E)+dE(A)}=min{6+5, 3+16, 5+7}=11;  
dc(B)=min{c(C,B)+dB(B), c(C,D)+dD(B), c(C,E)+dE(B)}=min{6+0, 3+12, 5+6}=6;  
dc(C)=0;  
dc(D)=min{c(C,B)+dB(D), c(C,D)+dD(D), c(C,E)+dE(D)}=min{6+12, 3+0, 5+9}=3;  
dc(E)=min{c(C,B)+dB(E), c(C,D)+dD(E), c(C,E)+dE(E)}=min{6+9, 3+9, 5+0}=5;  
dc(F)=min{c(C,B)+dB(F), c(C,D)+dD(F), c(C,E)+dE(F)}=min{6+2, 3+10, 5+4}=8;

所以 C 更新后的路由表为 (11, 6, 0, 3, 5, 8);



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3. Host H connects to Internet via Fast Ethernet with the IP address of 192.168.0.8. The IP address of server S is 211.68.71.80. When H communicates with S via TCP, five IP packets captured on H are shown as follows:

Table 1. The first 40 bytes of IP packets. (in Hexadecimal)				
No.	The first 40 bytes of IP packets. (in Hexadecimal)			
1	45 00 00 30 0b d9 13 88	01 9b 40 00 84 6b 41 c5	80 06 1d e8 00 00 00 00	c0 a8 00 08 70 02 43 80
2	45 00 00 30 13 88 0b d9	00 00 40 00 e0 59 9f ef	31 06 6e 83 84 6b 41 c6	d3 44 47 50 70 12 16 d0
3	45 00 00 28 0b d9 13 88	01 9c 40 00 84 6b 41 c6	80 06 1d ef e0 59 9f f0	c0 a8 00 08 50 f0 43 80
4	45 00 00 38 0b d9 13 88	01 9d 40 00 84 6b 41 c6	80 06 1d de e0 59 9f f0	c0 a8 00 08 50 18 43 80
5	45 00 00 28 13 88 0b d9	68 11 40 00 e0 59 9f f0	31 06 06 7a 84 6b 41 d6	d3 44 47 50 50 10 16 d0

Please answer the following questions and give corresponding analysis and explanations.

(1) Concerning the five IP packets in Table 1, which is/are sent by H? Which complete the process of TCP connection setup? And which need(s) to be filled up for fast Ethernet transmission?

从图 1 可以看出，IP 源地址是在 IP 分组头结构的 13-16 字节，对照表可以得出，1、3、4 号分组的源 IP 地址都为 192.168.0.8（c0 a8 00 08），所以 1、3、4 号分组是由 H 发送的。

从表 1 中可以看出，1 号分组封装的 TCP 段的 SYN=1，ACK=0，seq=84 6b 41 c5H；2 号分组封装的 TCP 段的 SYN=1,ACK=1；seq= e0 59 9f f0H，恰好模仿了 TCP 的三步建立连接的过程。

由于快速以太网的最短帧长度为 64 字节，去除首部的 18 字节，即数据部分最短 46 字节。从表 1 中可以看出，第 3 号和第 5 号分组的总长度为 40（28H）字节，小于 46 字节，其他分组总长度均大于 46 字节，所以 3 号和 5 号分组在通过快速以太网传输时需要填充。

(2) According to the IP packets in Table 1, analyze how many bytes of application layer data has S received?

由于到第 3 个报文位置，TCP 连接已经建立好。从第 3 号分组封装的 TCP 段可知，发送应用层数据初始序号为 84 6b 41 c6H，由 5 号分组封装的 TCP 段可知，ack 为 84 6b 41 d6H，所以 S 已经收到应用层数据字节数为 84 6b 41 d6H-84 6b 41 c6H=10H=16 字节。

(3) For some IP packet in Table 1, if the first 40 bytes of it are as follows when it is sent by S, then how many routers has the packet passed?

Table 2. Header of IP Packet sent by S				
45 00 00 28 13 88 a1 08	68 11 40 00 e0 59 9f f0	40 06 ec ad 86 6b 41 d6	d3 44 47 50 50 10 16 d0	ca 76 01 06 b7 d6 00 00

由于 S 发出的 IP 分组的标识=6811H，而表 1 中的 5 号分组的标识也为 6811H，所以该分组所对应的是表 1 中的 5 号分组。S 发出的 IP 分组的 TTL=40H=64，5 号分组的 TTL=31H=49，64-49=15，所以 IP 分组到达 H 时经过了 15 个路由器。

Notes: The header structures of IP packets and TCP segments are as follows:

### Figure 1. IPv4 Packet Header Format

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Version				IHL				DSCP				ECN				Total Length															
Identification																Flags				Fragment Offset											
Time To Live								Protocol								Header Checksum															
Source IP Address																															
Destination IP Address																															

### Figure 2. TCP Segment Header Format

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Source port																Destination port															
Sequence number																															
Acknowledgment number (if ACK set)																															
Data offset				Reserved 0 0 0 0 0 0				U	A	P	R	S	F	Window Size																	
								R	C	S	S	Y	I																		
								G	K	H	T	N	N																		
Checksum																Urgent pointer (if URG set)															