香港公開大學
THE OPEN UNIVERSITY OF HONG KONG

CT212
Marker No.:
Total Mark:

Middle Level Course Examination February 2003 (Sample Paper)

NETWORK PROGRAMMING AND DESIGN (Apr 2002)

9 February 2003 Time Allowed: 3 hours 1830-2130

Examination Number								
Student Number								

Admissible / Inadmissible materials in this examination:	Stationery provided to candidates (standard items)	Stationery provided to candidates (upon request)
1. Dictionaries are NOT allowed. **2. Calculators are NOT allowed.** Violation of the above may lead to disqualification from the examination.	**1. 1 Examination paper** **2. 1 Loose Flap** **3. 1 Treasury tag**	**1. Answer book**

This examination paper is in **TWO** (2) parts. You should attempt **ALL** sections and answer the number of questions indicated in each part.

Part A (55 marks)
Attempt **ALL FIVE** (5) questions. The marks allocated to each part of the question are given in bracket alongside each part. We suggest you spend 1 hour and 30 minutes on this part.

Part B (45 marks)
Attempt any THREE **(3) of the four questions. Each question is worth 15 marks. We suggest you spend 25 minutes on each of your three Part B questions, leaving 15 minutes for checking.**

Instructions:
1. **This examination paper should be answered in ENGLISH.**
2. **Write** ALL **your answers in the spaces provided inside this examination paper. Answers not recorded in this examination paper will not be marked.**
3. **Rough work must be written in the examination paper only and crossed through afterwards. Rough work being crossed through will not be marked.**
4. **You should write clearly. Marks may be deducted where the writing is very difficult to read.**
5. **After the examination has started, write your examination number and student number on the cover of this examination paper and each answer book used. Also write the course code and complete the examination number and student number column on the loose flap.** Failure to do so will mean that your work cannot be identified.
6. **At the end of the examination, fasten together your loose flap, examination paper and answer book(s) with the treasury tag provided. The examination paper and answer book(s) must be handed in to the invigilator together and must not be removed from the examination room.**
7. Do NOT open this examination paper until you are told to do so, otherwise you may be disqualified.

PART A (55 marks)

You should attempt all FIVE questions in this part.

Write all your answers in the answer book provided.

We suggest you spend about 1 hour and 30 minutes on this part.

Question 1 [11 marks]

(i) Computer networks use a variety of transmission media. What data transmission medium can be used for a network connection that passes near a power electric motor (e.g., near an air conditioner)?

[4 marks]

Answer:

- Electric motors can generate electro-magnetic fields that can generate interferences in some physical media such as copper-based cables.
- Optical fibres are immune to this form of interference.

(ii) What is a category 5 UTP Cable?

[3 marks]

- Electronic Industries Association/Telecommunications Industries Association (or EIA/TIA) wiring standard.
- Consists of four twisted pairs and is capable of transmitting data at speeds up to 100 Mbps (Fast Ethernet)

(iii) Describe **TWO** potential causes of collisions in Ethernet networks. [4 marks]

Answer:

– Propagation delay which is the time takes a signal from a source PC to reach a destination PC is one cause of collisions
– Two PCs both sensing a free line and accessing the media at the same instant is the other cause of collisions.

Question 2 [11 marks]

(i) Differentiate the User Mode and the Kernel Mode in Windows 2000 Server. [4 marks]

- Kernel mode is a highly privileged processor mode, with direct access to all hardware and memory.
- User mode is a less privileged mode, with no direct access to hardware and restricted access to memory.

(ii) Distinguish the domains, the trees and the forests in the Active Directory. [3 marks]

Active Directory organizes multiple domains hierarchically in a domain tree (or simply, tree). At the base of the Active Directory tree is the root domain. From the root domain, child domains branch out to separate objects with the same policies.

A collection of one or more domain trees is known as a forest. All trees in a forest share a common schema. Domains within a forest can communicate, but only domains within the same tree share a common Active Directory database.

(iii) FTP uses port 21 for control connections. If you use telnet to connect to port 21, can you list the contents of a directory or perform a file transfer? Why or why not? [4 marks]

Answer:

Simply connecting to port 21 does not allowing listing of files or file transfers, because the data is sent through a separate connection using a different port.

Question 3 (11 marks)

(i) Describe the file permission level of the following executable file:

```
-rwxr-x--x 1 s1234567 ct212          3 Mar  2 13:42 hello
```

[2 marks]

Answer:

This tells us that hello is a file; the owner is s1234567, the owner has read, write and execute permission; the group has read and execute permission; others just have execute permission.

(ii) How does the "make" utility in UNIX help the C program compilation?

[4 marks]

Answer:

When users develop multi-module programs and make changes, they must compile the program repeatedly. However, with multi-module source files, they only need to compile those source files in which they made changes. The linker then links the newly generated object-code files with previously complied object-code, thereby creating a new executable file. However, keeping track of what needs to be recompiled and what does not can become an overwhelming task when the program involves dozens of source-code files. This is where the make utility helps. The **make utility** tracks what needs to be recompiled by using the time stamp filed, which is stored in all the source files.

(iii)Write a shell script which excutes an executable program every 10seconds.

[5 marks]

```
#!/bin/sh
#This is an exercise devised by students of CT212 (PLUG)
#getpage is an excuteable program written by students
#Input parameters:  IP/host name + document name
#This script gets the webpage document every 10 seconds and stores
#it in a file known as plugfile.
while [ 1 ]
do
./getpage plbpc011.ouhk.edu.hk index.html > plugfile
sleep 10
done
```

Question 4 (11 marks)

(i) Describe the steps needed to compile the following C program. The executable program should be named *myq4.*

(3 marks)

```
1     <include stdio>
2     main()
3     {
4     int A;
5     printf("\t Number \t\t Square of Number\n\n");
6     for (i=0; i<=25;++i)
7     printf("\t %d \t\t\t %d \n",i,i*i);
8     }
```

myq4.c (program listing)

gcc –o myq4 myq4.c	

(ii) Modify the program so that it takes input from the keyboard and print the results on the screen. The range of the input should be from 1 to 5 only. Ask the user to re-enter the number if the number is outside the range.

(8 marks)

Correct use of scanf structure and looping such as 'while' loop
Check boundary conditions
Overall clear logic

Sample working program(without comment though):

```
#include <stdio.h>

main()

{
    int input_no;

    while (1) {

    printf("Please input a number : ");
    scanf("%d",&input_no);
    while (input_no < 1 || input_no > 5) {
          printf("Please re-enter a number between 1 and 5 : ");
          scanf("%d",&input_no);
    }
```

```
    printf("\n\t Number \t\t Square of Number\n\n");
    printf("\t %d \t\t\t %d \n\n",input_no,input_no*input_no);

    }
 }
```

Question 5

(i) How does the CGI program on the server receive the necessary data from the client for processing? Suggest **TWO** methods. [2 marks]

The two methods are: GET and POST

A program that uses the GET method gets the data from a pre-defined environment variable.
A program that uses the POST method gets the data from the standard input device.

(ii) Suppose the following site http://plug.ouhk.edu.hk, has been relocated to http://plug.com.hk. Write a complete HTML Web Page that will redirect the user from plug.ouhk.edu.hk to plug.com.hk automatically. [4 marks]

Answer:
The highlighted parts are important for this question.

```
<html>
  <head>
    <meta HTTP-EQUIV="REFRESH" CONTENT="3; URL=http://plug.com.hk/">
    <title>Homepage of PLUG moved....</title>
  </head>
  <body>
    <p> </p>
    <h2><font color="green" size="-1"><br>
      <i>   Website moved to <a
href="http://plug.ouhk.edu.hk">plug.ouhk.edu.hk</A></i><br>
      <i>   Redirecting to the homepage of PLUG, please
wait, .  .   .</i>
    </font></h2>
  </body>
</html>
```

(iii) Write a JavaScript program with a function so that when the user clicks on a form button, it prompts the user to enter two strings, concatenate the two strings and display the result in an alert window. Example of user input screens are shown in Figures 5-1 & 5-2. The example of result is shown in Figure 5-3. [5 marks]

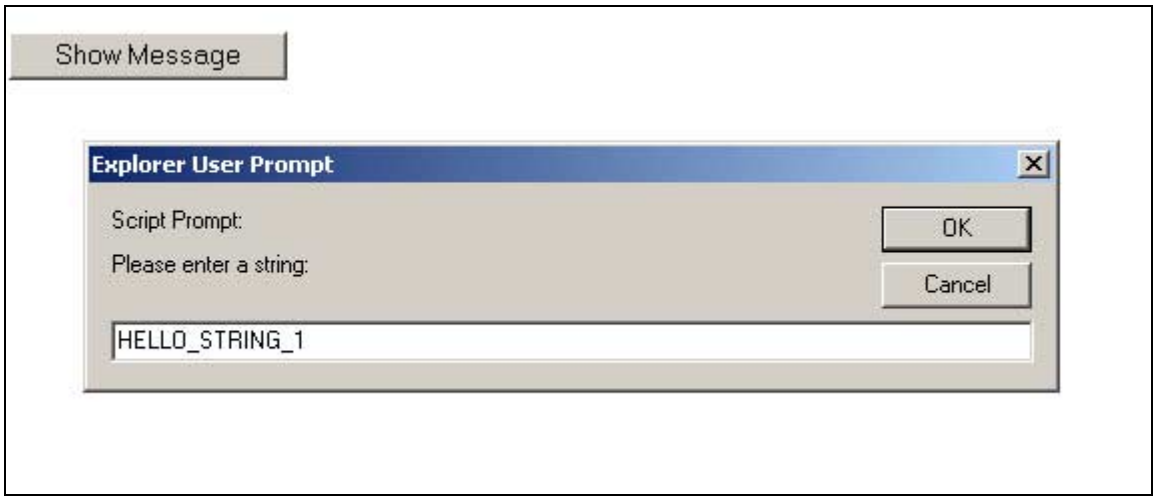

Figure 5-1

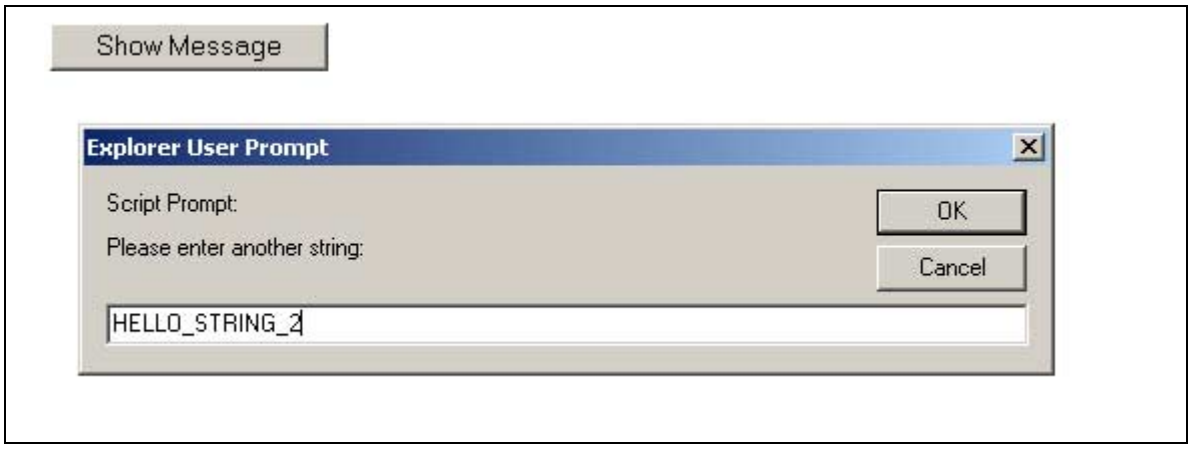

Figure 5-2

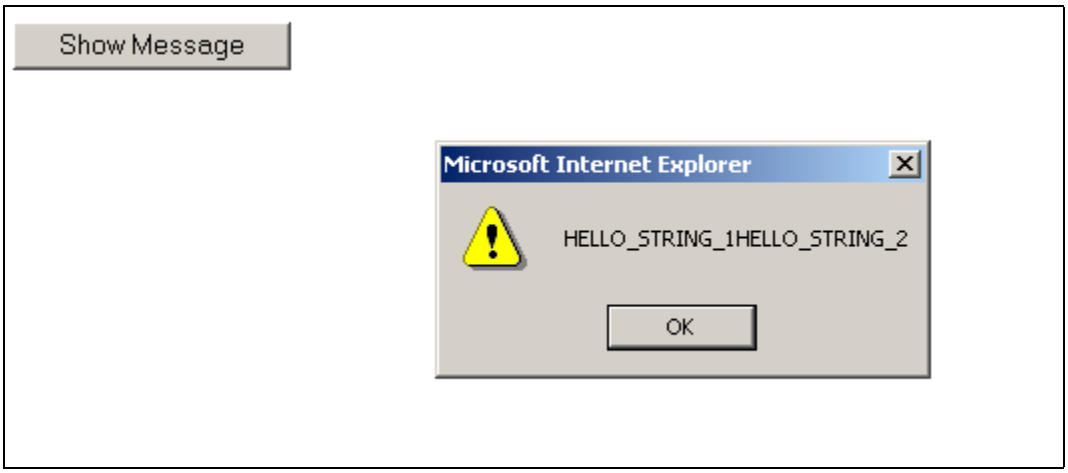

Figure 5-3 Result

Answer:

```
<HTML>
<HEAD>
<SCRIPT language="JavaScript">
<!--hide the script from old browser

function show_message(){
  var str1 = prompt("Please enter a string: ", "default");
  var str2 = prompt("Please enter another string: ",
"default");
  var res_str = str1 + str2;
  alert(res_str);
}

// close the hiding-->
</SCRIPT>
</HEAD>

<BODY>
<FORM>
<INPUT TYPE="button" VALUE="Show Message"
OnClick="show_message()">
</FORM>
</BODY>
</HTML>
```

Part B (45 marks)

You should attempt any THREE of the four questions in this part. Each question is worth 15 marks.

Write your answers in the answer book provided.
You are advised to spend about 25 minutes on each of the three questions in this part.

Question 6 (15 marks)

(i) What is a 'process'? What is a zombie process? (4 marks)

A process is an instance of a program that is being executed by the operating system.
Processes that have exited but have not had their exit status reported to their parents are left inactive. The process is this status is called the Zombie process.

(ii) What is the process ID of the inetd command in the following log file (Figure 6-1):

(2 marks)

```
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1  0.0  0.0   1104    72 ?        S    Sep14   0:04 init
bin        304  0.0  0.0   1204   384 ?        S    Sep14   0:00 portmap
root       357  0.0  0.0   1156   324 ?        S    Sep14   0:02 syslogd -m 0
root       368  0.0  0.0   1376     0 ?        SW   Sep14   0:00 [klogd]
root       404  0.0  0.0   1304   296 ?        S    Sep14   0:00 crond
root       420  0.0  0.0   1128    68 ?        S    Sep14   0:00 inetd
root       436  0.0  0.0   1140   292 ?        S    Sep14   0:00 routed
```

Figure 6-1 sample output of executing 'ps -aux | more'

420

(iii) What will happen to the PPID of a child process if its parent process terminates without waiting for its child process to terminate?

(4marks)

In this case it is taken under the wing of init,
for which FreeBSD reserves the PID 1.
init takes control of any orphaned children,
and upon completion of their work, issues the wait() on behalf of the parent.

(iv) Illustrate with explanation a time line of a typical scenario that takes place for a connection-oriented transfer – first the server is started, then sometime later a client is started that connects to the server. (Hints: think in turns of a series of system calls such as socket () ……. Write () …)

(5 marks)

Answer

	Description of Socket ()
	Description of bind()
	Description of listen()
	Description of accept()
	Description of read() and write()

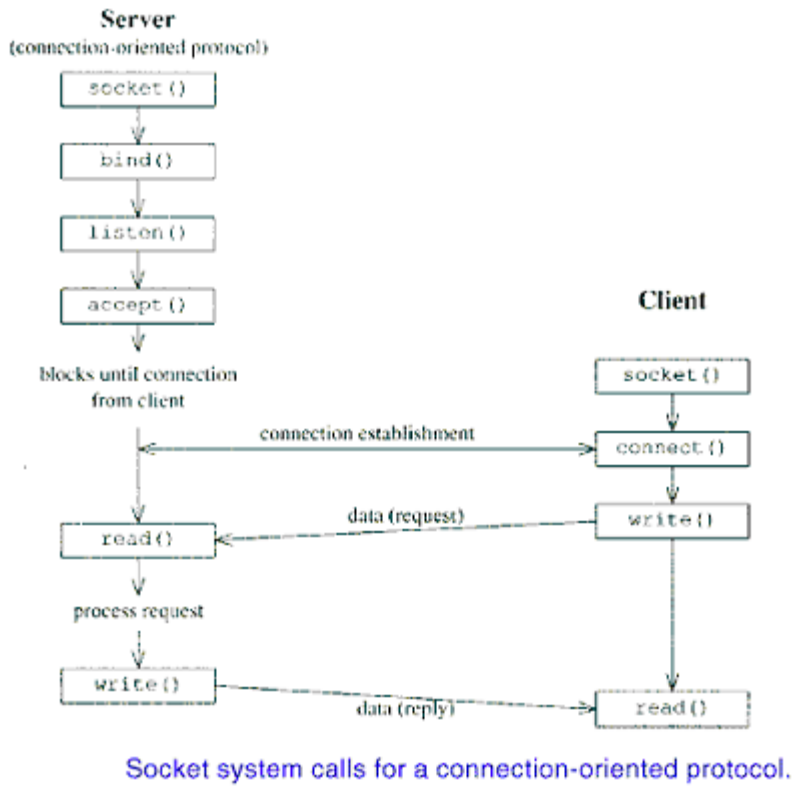

Figure 6-2

Question 7 [15 marks]

(i) What are the three problems with the current IP scheme?

[3 marks]

The three problems are a result of the phenomenal growth of the Internet over the past few years.

- Over half of all Class B addresses have already been all allocated.
- 32-bit IP addresses in general are inadequate for the predicated long –term growth of the Internet.
- Continued growth of the routing table

(ii) Could IP be redesigned to use hardware addresses instead of 32-bit addresses it currently uses? Why or why not?

[4 marks]

▪ IP could not be redesigned to use hardware addresses to replace the current 32-bit network addresses because hardware addresses such as 48-bit Ethernet addresses are chosen from a flat address space and have no provision for a "network address" to be used for Internet routing.
▪ IP could be redesigned to use hardware addresses to replace the hosted component of the Internet address if the IP network address were enlarged to accommodate any hardware address as a hosted. For example, " IP version 6 (Ipv6) uses 128-bit network addresses with a hosted component that can accommodate 48-bit Ethernet addresses.

(iii) Assume that you have been assigned the Class B address 132.45.0.0 and you need to create 500 sub-networks. Answer the following questions: [8 marks]

(a) What is the subnet mask?
(b) List the first three valid network numbers.
(c) List the range of host IP addresses on those three networks.
(d) List the last valid network and range of IP addresses.
(e) How many subnets does this solution allow?
(f) How many host addresses can be on each subnet?

Answer
(a) 255.255.255.128
(b) 132.45.0.128, 132.45.1.0, 132.45.1.128
(c) 132.45.0.129-132.45..0.254 132.45.1.1-132.45.1.126 132.45.1.129-132.45.1.254
(d) Network: 132.45.255.0 Range of IP addresses: 132.45.255.1-132.45.255.126

(e) 510
(f) 126

Question 8 (15 marks)

i) Consider a TCP connection between host A and host B. Suppose that the TCP segments travelling from host A to host B have source port number *x* and destination port number *y*. What are the source and destination port numbers for the segments travelling from host B to host A? [3 marks]

Answer
Source port number y and destination port number x.

ii) Is it possible for an application to enjoy reliable data transfer even when the application runs over UDP? If so, how? [4 marks]

Answer
Yes. The application developer can put reliable data transfer into the application layer protocol. However, this would require a significant amount of work and debugging.

iii) As illustrated in the following diagram (Figure 8-1), the source workstation on LAN A will send data to the destination workstation on LAN B via gateways.

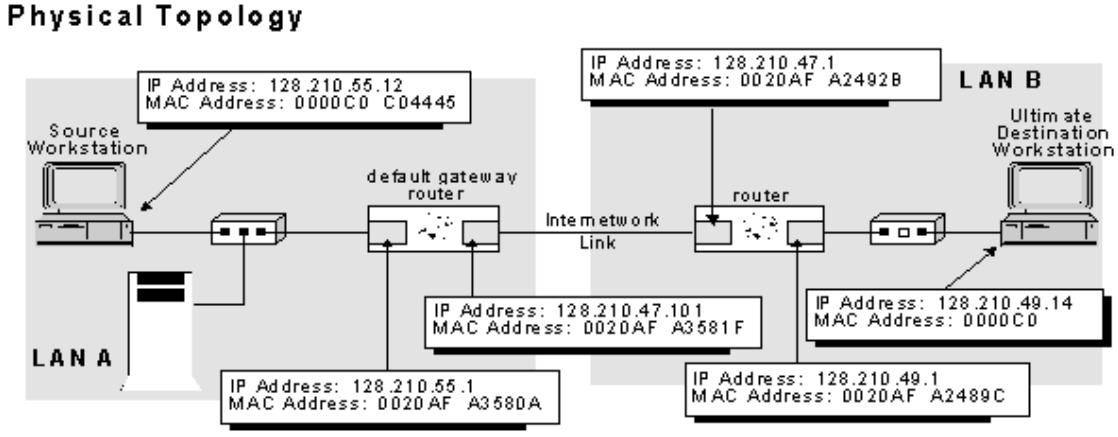

Figure 8-1

Describe how the Internet Protocol (IP) Addresses and Media Access Control (MAC) Addresses in the network are found and used for messages travelling through the entire routing process. [8 marks]

1.	The source workstation to fill in the source address field in the IP header with its own IP address and the destination address field in the IP header with the IP address of the ultimate destination workstation. Since the destination workstation is not on the local LAN, the IP packet must be forwarded to the local gateway, or router, which have sufficient information to forward this packet.
2.	The source workstation looks in its IP configuration information to find the IP address of its default gateway. To deliver this IP packet to the local router for further processing, the IP packet must be wrapped in a data-link layer frame. Addresses included in the data-link layer header are Media Access Control (MAC) addresses. The source workstation does not know the MAC address of that local router, it broadcasts a request for that MAC address using **address resolution protocol (ARP)**.
3.	The source workstation encapsulates the IP packet in a data-link layer frame with the MAC address associated with its own NIC as the source address in the data-link layer frame and the MAC address of the default gateway in the destination address of the data-link layer frame.
4.	The default gateway or router receives the data-link layer frame explicitly addressed to it, discards the data-link layer frame and examines the ultimate destination address held in the IP packet. The router will determine the path to the ultimate destination workstation. The IP packet and its addresses are not modified but are reencapsulated in a fresh data-link layer frame, with the MAC layer destination address of either the ultimate destination workstation or the next router along the path to the workstation.

Question 9 (15 marks)

(i) Explain the functions of the following five well-known Internet Applications:

1. Telnet;
2. SMTP;
3. DNS ; and
4. SNMP

[4 marks]

1. Telnet: It enables user to connect to another host
2. SMTP, it is the service that transfers your email to the recipients
3. DNS, it maps domain names into their corresponding IP addresses
4. SNMP, SNMP defines a framework on which network management functions can be built, but it doesn't define any specific network management function;

(ii) What is the difference between SET and SSL? [3 marks]

SET ensures that companies and cardholders are exactly who they claim to be, whereas SSL only encrypts card information - which is the equivalent to a company accepting a payment without PIN code or signature

(iii) Describe four baseline statistics you would obtain as manager of a network. [4 marks]

Any four of the following:

- Network utilization
- Packet traffic
- Bytes sent per second
- Error rates
- Peak times
- Slow times
- Disk access statistics
- Disk and CPU access queue lengths
- Traffic generated by specific servers and hosts

(iv) Refers to the following figure and attempt the questions:

- What does the function netstat do?
- What is MTU ?

```
[ptsang@plbpc010 ptsang]$ netstat -in
Kernel Interface table
Iface   MTU Met    RX-OK RX-ERR RX-DRP RX-OVR    TX-OK TX-ERR TX-DRP TX-OVR Flg
eth0   1500   0  1360365      0      0      0   731897      0      0      0 BRU
lo     3924   0     2316      0      0      0     2316      0      0      0 LRU
[ptsang@plbpc010 ptsang]$
```

[4 marks]

Answer

The 'netstat' command shows the TCP/IP protocol statistics and current TCP/IP connection

MTU, maximum transmission unit, is a characteristic of the link layer. Many Link Layer protocols define a maximum frame size that may be sent.

- End –