Batch: A1 Roll No.: 16010120015

Experiment / assignment / tutorial No.___6____

Grade: AA / AB / BB / BC / CC / CD /DD

Experiment No.:6

TITLE: IP classes and Implementation of Subnet mask concept.

AIM: To study IP classes and Implementation of Subnet mask concept.

An IP (Internet Protocol) address is a unique identifier for a node or host connection on an IP network. Subnetting an IP Network can be done for a variety of reasons, including organization, use of different physical media (such as Ethernet, FDDI, WAN, etc.), preservation of address space, and security. The most common reason is to control network traffic. In an Ethernet network, all nodes on a segment see all the packets transmitted by all the other nodes on that segment. Performance can be adversely affected under heavy traffic loads, due to collisions and the resulting retransmissions. A router is used to connect IP networks to minimize the amount of traffic each segment must receive.

This experiment enables student for identifying the class of the IP address and design particular subnets as per user requirements.

Expected Outcome of Experiment:
CO:
Demonstrate various network layer protocols and network design using IP addressing concepts

Books/ Journals/ Websites referred:

1. A. S. Tanenbaum, “Computer Networks”, Pearson Education, Fourth Edition
2. B. A. Forouzan, “Data Communications and Networking”, TMH, Fourth Edition

Pre Lab/ Prior Concepts: IP Address, Classes, Subnet concept

New Concepts to be learned: Subnet mask calculation, Subnet address calculation

Stepwise-Procedure:

Applying a subnet mask to an IP address allows to identify the network and node parts of

the address. The network bits are represented by the 1s in the mask, and the node bits are represented by the 0s. Performing a bitwise logical AND operation between the IP address and the subnet mask results in the *Network Address* or Number.

Default subnet masks:

Class A - 255.0.0.0 - 11111111.00000000.00000000.00000000
Class B - 255.255.0.0 - 11111111.11111111.00000000.00000000
Class C - 255.255.255.0 - 11111111.11111111.11111111.00000000

Additional bits can be added to the default subnet mask for a given Class to further subnet, or break down, a network. When a bitwise logical AND operation is performed between the subnet mask and IP address, the result defines the *Subnet Address* (also called the *Network Address* or *Network Number*). There are some restrictions on the subnet address. Node addresses of all "0"s and all "1"s are reserved for specifying the local network (when a host does not know its network address) and all hosts on the network (broadcast address), respectively. This also applies to subnets. A subnet address cannot be all "0"s or all "1"s. This also implies that a 1 bit subnet mask is not allowed. This restriction is required because older standards enforced this restriction. Recent standards that allow use of these subnets have superseded these standards, but many "legacy" devices do not support the newer standards. If you are operating in a controlled environment, such as a lab, you can safely use these restricted subnets.

CIDR -- **C**lassless **I**nter **D**omain **R**outing:

The "classful" system of allocating IP addresses can be very wasteful; Under supernetting, the classful subnet masks are extended so that a network address and subnet mask could, for example, specify multiple Class C subnets with one address.

For example, If about 1000 addresses are required, it could be possible to supernet 4 Class C networks together:

192.60.128.0 (11000000.00111100.10000000.00000000)Class C subnet address
192.60.129.0(11000000.00111100.10000001.00000000) Class C subnet address
192.60.130.0(11000000.00111100.10000010.00000000) Class C subnet address
192.60.131.0(11000000.00111100.10000011.00000000) Class C subnet address
---
192.60.128.0 (11000000.00111100.10000000.00000000) Supernetted subnet address
255.255.252.0 (11111111.11111111.11111100.00000000)Subnet Mask 192.60.131.255 (11000000.00111100.10000011.11111111) Broadcast address

In this example, the subnet 192.60.128.0 includes all the addresses from 192.60.128.0 to 192.60.131.255. In the binary representation of the subnet mask, the Network portion of the address is 22 bits long, and the host portion is 10 bits long. Under CIDR, the subnet mask notation is reduced to simplified shorthand. Instead of spelling out the bits of the subnet mask, it is simply listed as the number of 1s bits that start the mask. In the above example, instead of writing the address and subnet mask as 192.60.128.0, Subnet Mask 255.255.252.0 .the network address would be written simply as: 192.60.128.0/22 Which

indicates starting address of the network, and number of 1s bits (22) in the network portion of the address. Subnet mask in binary

11111111.11111111.11111100.00000000.

The use of a CIDR notated address is the same as for a Classful address. Classful addresses can easily be written in CIDR notation as Class A = /8, Class B = /16, and Class C = /24
To calculate the number of subnets or nodes,

No. of Nodes/ Subnets $=2^n-2$

Where n = number of bits in either field.

Multiplying the number of subnets by the number of nodes available per subnet gives you the total number of nodes available for your class and subnet mask. Also, note that although subnet masks with non-contiguous mask bits are allowed, they are not recommended.

Example:

10001100.10110011.11011100.11001000	140.179.220.200IP Address
11111111.11111111.**111**00000.00000000	255.255.**224**.000Subnet Mask
10001100.10110011.11000000.00000000	140.179.192.000Subnet Address
10001100.10110011.11011111.11111111	40.179.223.255 Broadcast Address

1. Program starts with taking IP address from user and the number of subnets from the user.
2. Then the calculation for subnet mask is done as specified in methodology.
3. Then with AND ing with subnet mask the subnet addresses are calculated.

IMPLEMENTATION: (printout of code)

```
import java.util.Scanner;
import java.net.InetAddress;

class subnet
{
  public static void main(String args[])
  {
    Scanner sc= new Scanner(System.in);
    System.out.print("Enter the ip address: ");
    String ip=sc.nextLine();
    String split_ip[] = ip.split("\\.");
    String split_bip[]= new String[4];
```

```
    String bip = "";
    for(int i=0;i<4;i++)
    {
      split_bip[i]=appendZeroes(Integer.toBinaryString(Integer.parseInt(split_ip
[i])));
      bip+=split_bip[i];
    }
    System.out.println("The binary Ip Address is: "+bip);
    System.out.println("Enter the number of address: ");
    int n=sc.nextInt();
    int bits=(int)Math.ceil(Math.log(n)/Math.log(2));
    System.out.println("The number of bits required: "+bits);
    int mask=(32-bits);
    String bin_mask = Integer.toBinaryString(mask);
    int total_address=(int)Math.pow(2,bits);
    System.out.println("Subnet mask in in Decimal is "+mask);
    System.out.println("Subnet mask in in Binary is "+mask);
    int fbip[]=new int[32];
    for(int i=0;i<32;i++)
    {
      fbip[i]=(int)bip.charAt(i)-48;
    }
    for(int i=31;i>31-bits;i--)
    {
      fbip[i] &=0;
    }
    String fip[]={"","","",""};
    for(int i=0;i<32;i++)
    {
      fip[i/8]=new String(fip[i/8]+fbip[i]);
    }
    int first_offset=0;
    int ipAddr[]=new int[4]; ;
    System.out.println("Group 1 \nThe First Address is:");
    for(int i=0;i<4;i++)
    {
      System.out.print(ipAddr[i]=first_offset=Integer.parseInt(fip[i],2));
      if(i!=3)
      System.out.print(".");
    }
    System.out.println();
    int lbip[]=new int [32];
    for(int i=0;i<32;i++)
    {
      lbip[i]=(int)bip.charAt(i)-48;
    }
    for(int i=31;i>31-bits;i--)
    {
```

```
      lbip[i]|= 1;
    }
    String lip[]={"","","",""};
    for(int i=0;i<32;i++)
    {
      lip[i/8]=new String(lip[i/8]+lbip[i]);
    }
    int ipLast[]=new int[4];
    System.out.println("The Last Address is:");
    for(int i=0;i<4;i++)
    {
      System.out.print(ipLast[i]=Integer.parseInt(lip[i],2));
      if(i!=3)
      System.out.print(".");
    }
    System.out.println();
    System.out.println("How many subnets do you want to form?");
    int scount=sc.nextInt();
    for(int j=1;j<scount;j++)
    {
      System.out.println(" GROUP "+ (j+1)+" FIRST ADDRESS:");
      for(int i=0;i<4;i++)
      {
        if(i<3)
        {
          System.out.print(ipAddr[i]+".");
        }
        else
          System.out.println(ipAddr[i]=ipAddr[i]+total_address);
      }
      System.out.println(" GROUP "+ (j+1)+" LAST ADDRESS:");
      for(int i=0;i<4;i++)
      {
        if(i<3)
        {
          System.out.print(ipLast[i]+".");
        }
        else
          System.out.println(ipLast[i]=ipLast[i]+total_address);
      }
      System.out.println();
    }
  }
  static String appendZeroes(String s)
  {
    String temp= new String("00000000");
    return temp.substring(s.length())+ s;
  }
```

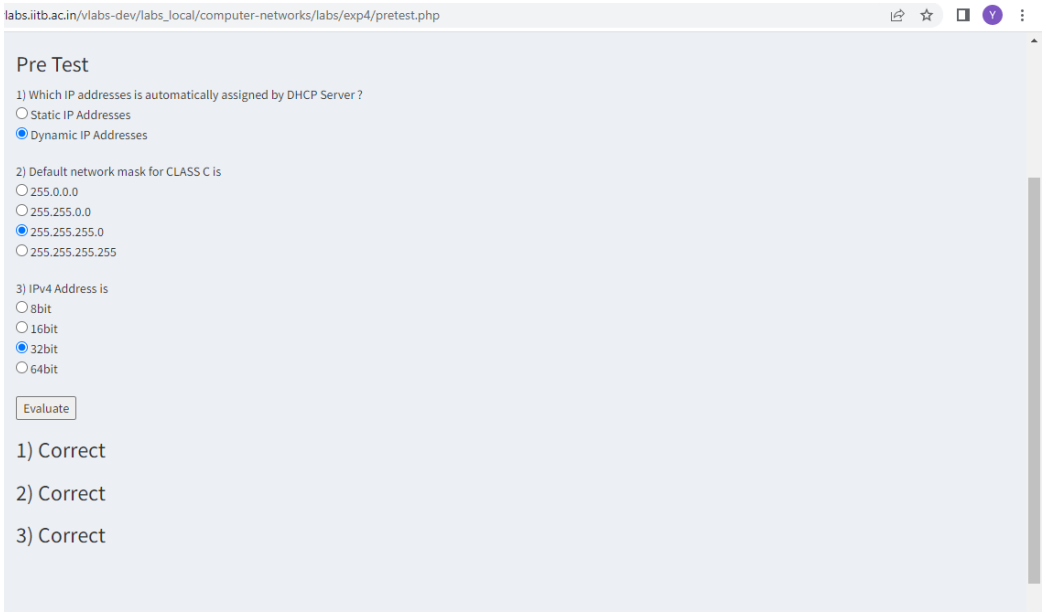
```
}
```

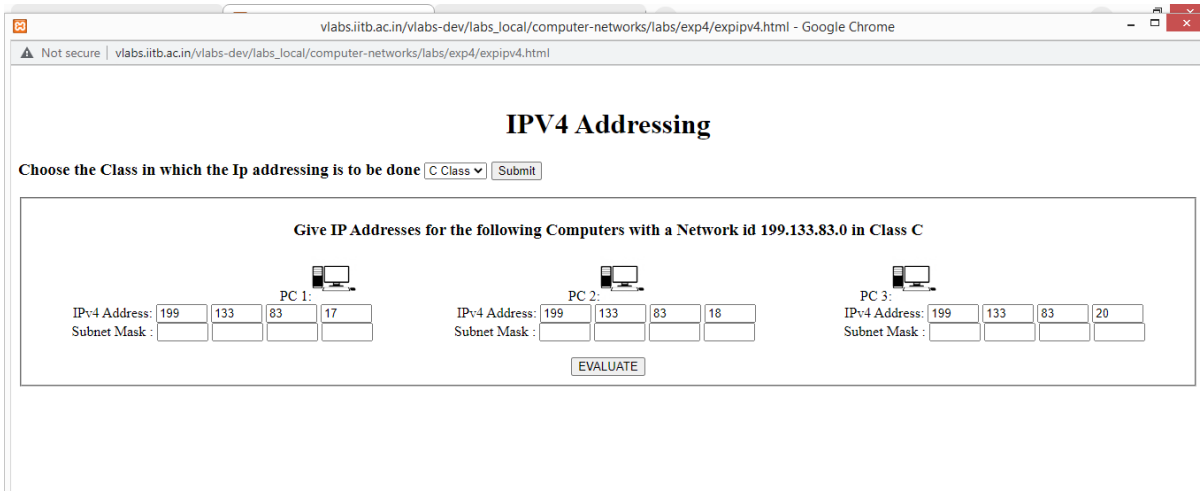
OUTPUT :

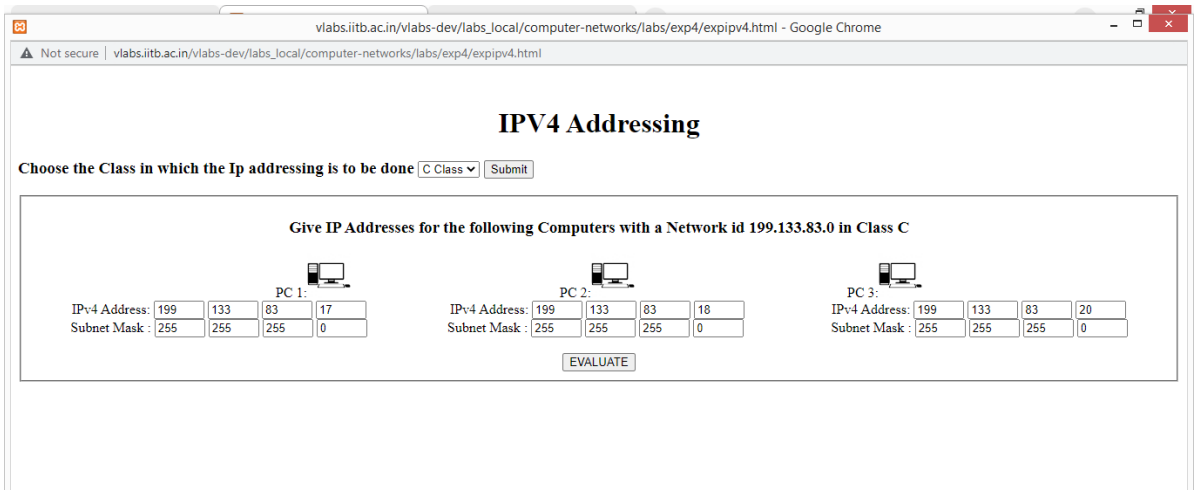
```
server=n,suspend=y,address=localhost:59528' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\kjsce_comp14\AppData\Roaming\Code\Us
er\workspaceStorage\d4f2683945bbd71df96fb6cbe94fbcef\redhat.java\jdt_ws\CN_Exp - 4_076_fadd1713\bin' 'subnet'
Enter the ip address: 120.119.07.0
The binary Ip Address is: 01111000011101110000011100000000
Enter the number of address:
4
The number of bits required: 2
Subnet mask in in Decimal is 30
Subnet mask in in Binary is 30
Group 1
The First Address is:
120.119.7.0
The Last Address is:
120.119.7.3
How many subnets do you want to form?
4
 GROUP 2 FIRST ADDRESS:
120.119.7.4
 GROUP 2 LAST ADDRESS:
120.119.7.7

 GROUP 3 FIRST ADDRESS:
120.119.7.8
 GROUP 3 LAST ADDRESS:
120.119.7.11

 GROUP 4 FIRST ADDRESS:
120.119.7.12
 GROUP 4 LAST ADDRESS:
120.119.7.15
```

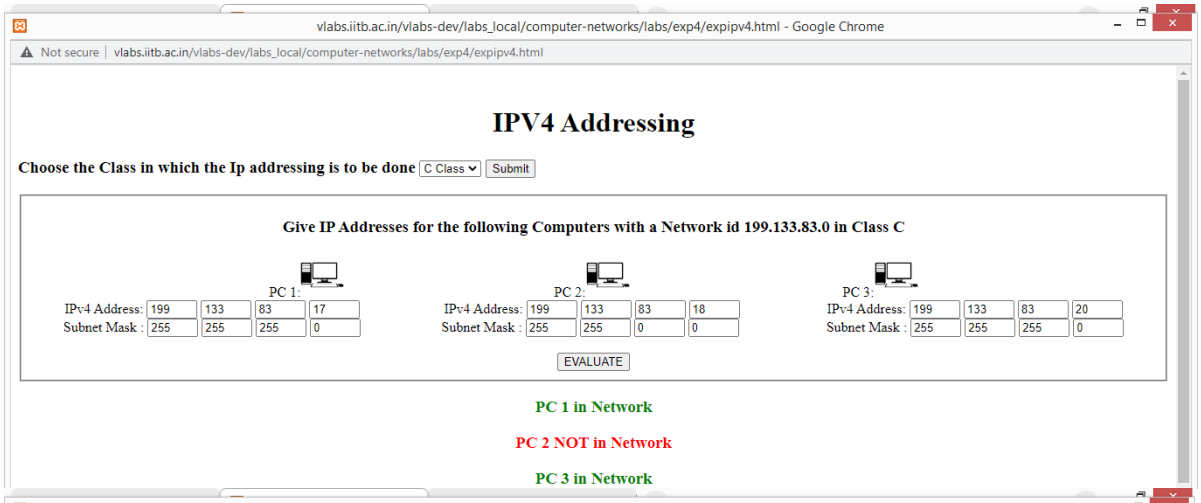
Vlab Screenshots :

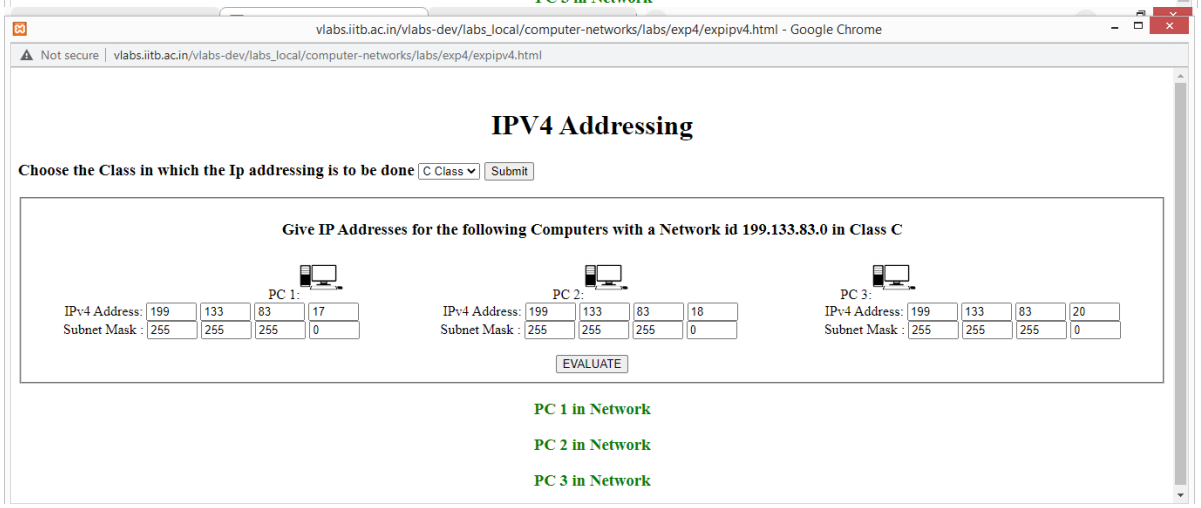
ADDRESSING:

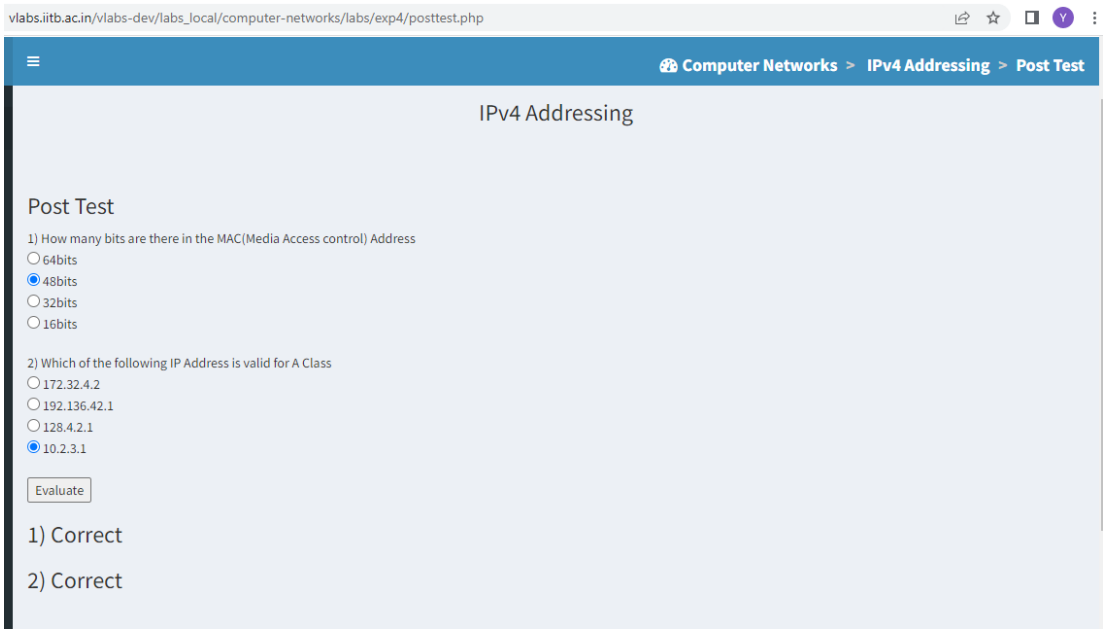

labs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/pretest.php
Pre Test
1) Which IP addresses is automatically assigned by DHCP Server ?
Static IP Addresses
Dynamic IP Addresses
2) Default network mask for CLASS C is
255.0.0.0
255.255.0.0
255.255.255.0
255.255.255.255
3) IPv4 Address is
8bit
16bit
32bit
64bit
Evaluate
1) Correct
2) Correct
3) Correct


vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html - Google Chrome
Not secure | vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html
IPV4 Addressing
Choose the Class in which the Ip addressing is to be done C Class Submit
Give IP Addresses for the following Computers with a Network id 199.133.83.0 in Class C
PC 1:
IPv4 Address: 199 133 83 17
Subnet Mask :
PC 2:
IPv4 Address: 199 133 83 18
Subnet Mask :
PC 3:
IPv4 Address: 199 133 83 20
Subnet Mask :
EVALUATE


vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html - Google Chrome
Not secure | vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html
IPV4 Addressing
Choose the Class in which the Ip addressing is to be done C Class Submit
Give IP Addresses for the following Computers with a Network id 199.133.83.0 in Class C
PC 1:
IPv4 Address: 199 133 83 17
Subnet Mask : 255 255 255 0
PC 2:
IPv4 Address: 199 133 83 18
Subnet Mask : 255 255 255 0
PC 3:
IPv4 Address: 199 133 83 20
Subnet Mask : 255 255 255 0
EVALUATE

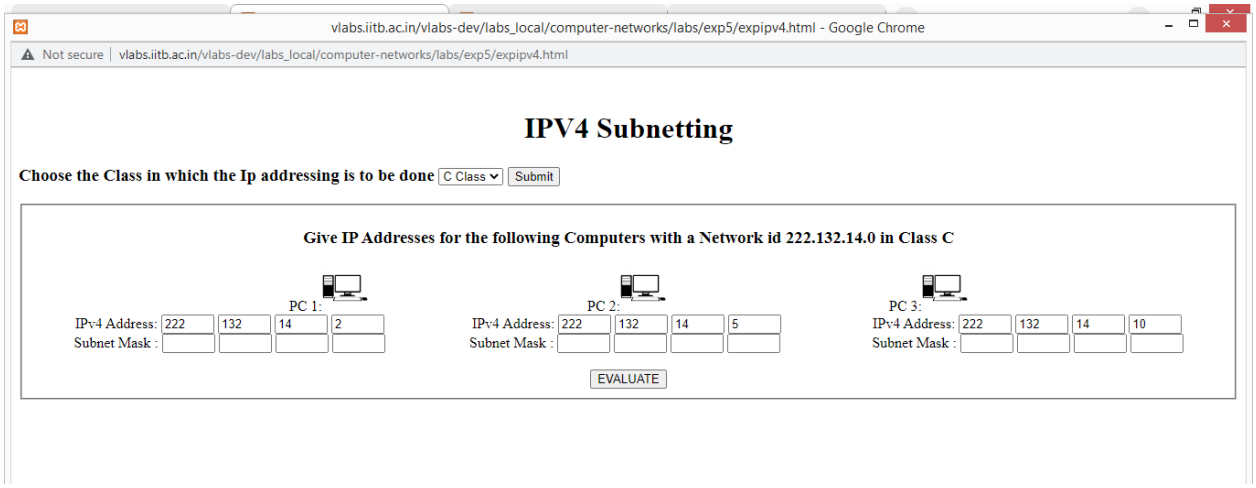

vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html - Google Chrome
Not secure | vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html
IPV4 Addressing
Choose the Class in which the Ip addressing is to be done C Class Submit
Give IP Addresses for the following Computers with a Network id 199.133.83.0 in Class C
PC 1:
IPv4 Address: 199 133 83 17
Subnet Mask : 255 255 255 0
PC 2:
IPv4 Address: 199 133 83 18
Subnet Mask : 255 255 0 0
PC 3:
IPv4 Address: 199 133 83 20
Subnet Mask : 255 255 255 0
EVALUATE
PC 1 in Network
PC 2 NOT in Network
PC 3 in Network

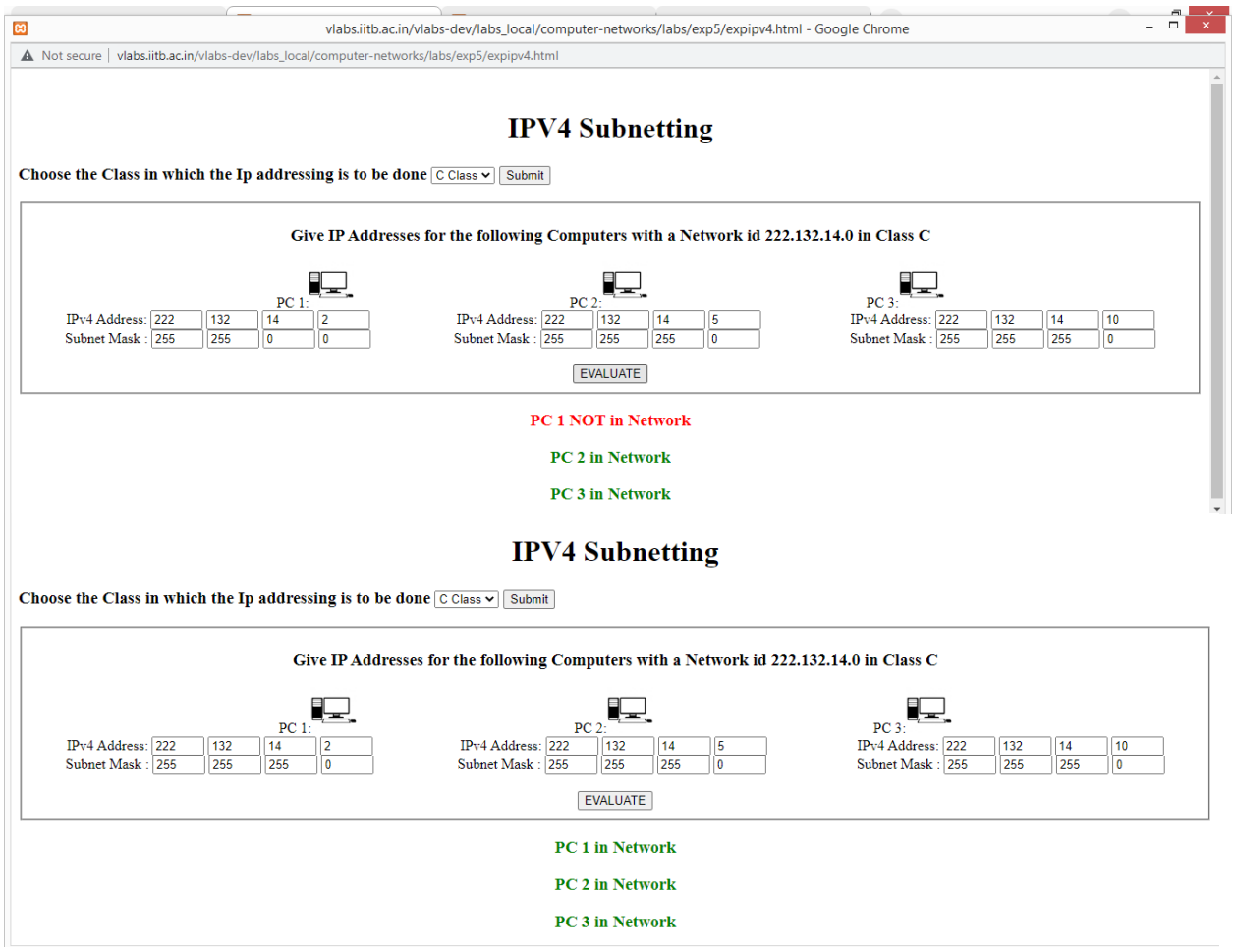

vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html - Google Chrome
Not secure | vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/expipv4.html
IPV4 Addressing
Choose the Class in which the Ip addressing is to be done C Class Submit
Give IP Addresses for the following Computers with a Network id 199.133.83.0 in Class C
PC 1:
IPv4 Address: 199 133 83 17
Subnet Mask : 255 255 255 0
PC 2:
IPv4 Address: 199 133 83 18
Subnet Mask : 255 255 255 0
PC 3:
IPv4 Address: 199 133 83 20
Subnet Mask : 255 255 255 0
EVALUATE
PC 1 in Network
PC 2 in Network
PC 3 in Network

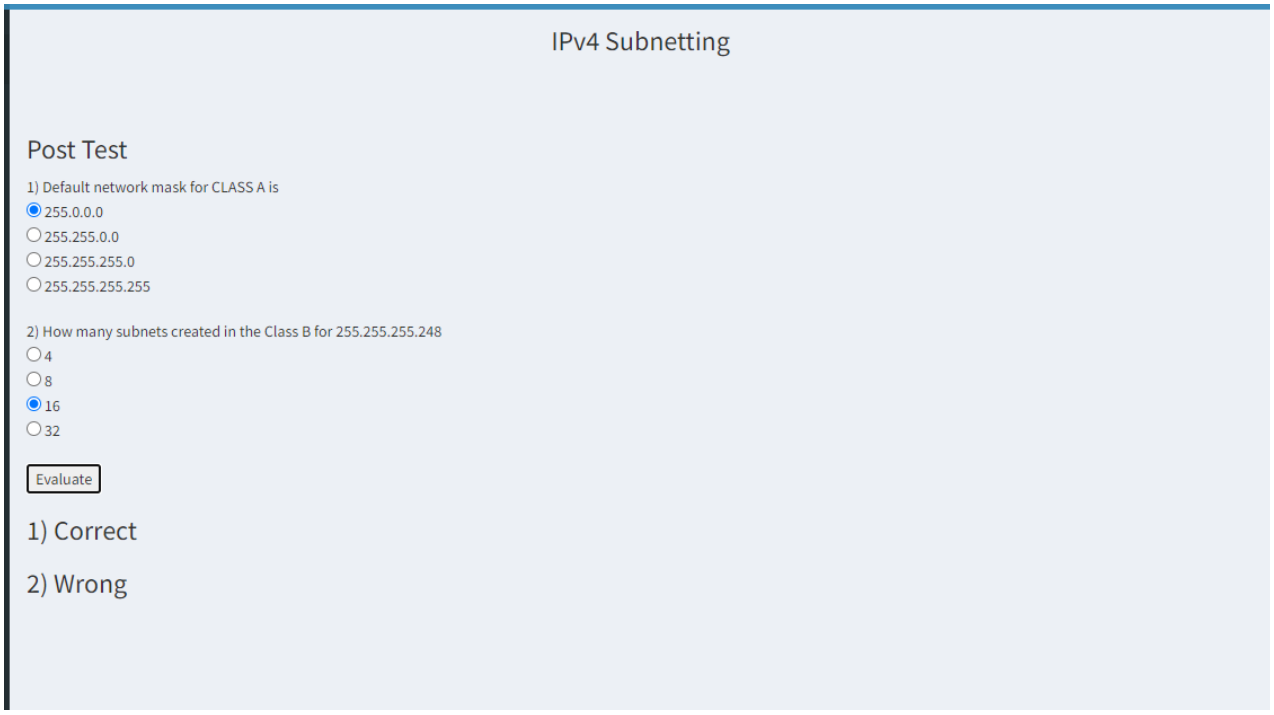

vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp4/posttest.php
Computer Networks > IPv4 Addressing > Post Test
IPv4 Addressing
Post Test
1) How many bits are there in the MAC(Media Access control) Address
64bits
48bits
32bits
16bits
2) Which of the following IP Address is valid for A Class
172.32.4.2
192.136.42.1
128.4.2.1
10.2.3.1
Evaluate
1) Correct
2) Correct

SUBNETTING :


Pre Test
Procedure
Simulation
Post Test
References
Pre Test
1) Default network mask for CLASS B is.
255.0.0.0
255.255.0.0
255.255.255.0
255.255.255.255
2) How many subnets created in the Class C for 255.255.255.248
8
16
32
64
3) How many hosts created in the Class B for 255.240.0.0
510
254
126
64
Evaluate
1) Correct
2) Correct
3) Correct


vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp5/expipv4.html - Google Chrome
Not secure | vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/exp5/expipv4.html
IPV4 Subnetting
Choose the Class in which the Ip addressing is to be done C Class Submit
Give IP Addresses for the following Computers with a Network id 222.132.14.0 in Class C
PC 1:
IPv4 Address: 222 132 14 2
Subnet Mask :
PC 2:
IPv4 Address: 222 132 14 5
Subnet Mask :
PC 3:
IPv4 Address: 222 132 14 10
Subnet Mask :
EVALUATE





2) Correct ans 8192 subnets created

CONCLUSION:

Post Lab Questions

1. Which of the following is private IP address?
   A. 12.0.0.1 B. 168.172.19.39
   C. 172.15.14.36 D. 192.168.24.43

   Ans : **192.168.24.43**

2. Which class of IP address provides a maximum of only 254 host addresses per network ID?
   A. Class A
   B. Class B
   C. Class C
   D. Class D

   Ans : **Class C**

3. What is the address range of a Class B network address in binary?
   A. 01xxxxxx
   B. 0xxxxxxx
   C. 10xxxxxx
   D. 110xxxxx

   Ans : **10xxxxxx**

4. Which two statements describe the IP address 10.16.3.65/23?
   1.The subnet address is 10.16.3.0 255.255.254.0.
   2.The lowest host address in the subnet is 10.16.2.1 255.255.254.0.
   3.The last valid host address in the subnet is 10.16.2.254 255.255.254.0.
   4.The broadcast address of the subnet is 10.16.3.255 255.255.254.0.
   A. 1 and 3
   B. 2 and 4
   C. 1, 2 and 4
   D. 2, 3 and 4

   Ans : **2 and 4**

5. What is the maximum number of IP addresses that can be assigned to hosts on a local subnet that uses the 255.255.255.224 subnet mask?

   A. 14 B. 15
   C. 16 D. C

   Ans : **C**

6. You need to subnet a network that has 5 subnets, each with at least 16 hosts. Which classful subnet mask would you use?

   A. 255.255.255.192 B. 255.255.255.224
   C. 255.255.255.240 D. 255.255.255.248

   Ans : **255.255.255.224**

7. You have a network that needs 29 subnets while maximizing the number of host addresses available on each subnet. How many bits must you borrow from the host field to provide the correct subnet mask?

   A. 2 B. 3
   C. 4 D. 5

   Ans : **4**

Date: _____10/10/22_____ **Signature of faculty in-charge**