

Week 6 – Networking

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Assignment 6.1: Working from home

Screenshot installation openssh-server:

```
andrii@andrii-VM:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  libllvm19
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  ncurses-term openssh-sftp-server ssh-import-id
Suggested packages:
  molly-guard monkeysphere ssh-askpass
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
0 upgraded, 4 newly installed, 0 to remove and 119 not upgraded.
Need to get 832 kB of archives.
After this operation, 6,743 kB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-sftp-server amd64 1:9.6p1-3ubuntu13.14 [37.3 kB]
Get:2 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-server amd64 1:9.6p1-3ubuntu13.14 [510 kB]
Get:3 http://nl.archive.ubuntu.com/ubuntu noble/main amd64 ncurses-term all 6.4+20240113-1ubuntu2 [275 kB]
Get:4 http://nl.archive.ubuntu.com/ubuntu noble-updates/main amd64 ssh-import-id all 5.11-0ubuntu2.24.04.1 [10.1 kB]
Fetched 832 kB in 0s (4,768 kB/s)
Preconfiguring packages ...
Selecting previously unselected package openssh-sftp-server.
(Reading database ... 193217 files and directories currently installed.)
Preparing to unpack .../openssh-sftp-server_1:9.6p1-3ubuntu13.14_amd64.deb ...
Unpacking openssh-sftp-server (1:9.6p1-3ubuntu13.14) ...
Selecting previously unselected package openssh-server.
Preparing to unpack .../openssh-server_1:9.6p1-3ubuntu13.14_amd64.deb ...
Unpacking openssh-server (1:9.6p1-3ubuntu13.14) ...
Selecting previously unselected package ncurses-term.
```

```
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for ufw (0.36.2-6) ...
andrii@andrii-VM:~$ sudo systemctl enable ssh
Synchronizing state of ssh.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable ssh
Created symlink /etc/systemd/system/ssh.service → /usr/lib/systemd/system/ssh.service.
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /usr/lib/systemd/system/ssh.service.
andrii@andrii-VM:~$ sudo systemctl status
● andrii-VM
   State: running
  Units: 553 loaded (incl. loaded aliases)
   Jobs: 1 queued
 Failed: 0 units
   Since: Wed 2025-12-17 15:51:24 CET; 9min ago
 systemd: 255.4-1ubuntu8.11
  CGroup: /
```

Screenshot successful SSH command execution:

```

C:\Users\user>ssh andrii@192.168.139.136
The authenticity of host '192.168.139.136 (192.168.139.136)' can't be established.
ED25519 key fingerprint is SHA256:nPsGz1wThqpMy4dsiVXSEKLPQl9njX8A5dNx1uHedj4.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? Yes
Warning: Permanently added '192.168.139.136' (ED25519) to the list of known hosts.
andrii@192.168.139.136's password:
Permission denied, please try again.
andrii@192.168.139.136's password:
Permission denied, please try again.
andrii@192.168.139.136's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.14.0-36-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/pro

Expanded Security Maintenance for Applications is not enabled.

59 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

17 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

*** System restart required ***

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

andrii@andrii-VM:~$ |

```

Screenshot successful execution SCP command:

```

andrii@andrii-VM:~$ exit
logout
Connection to 192.168.139.136 closed.

C:\Users\user>scp C:\Users\aleho\test.txt andrii@192.168.139.136 C:/home/andrii/
C:/home/andrii/: No such file or directory

C:\Users\user>scp C:\Users\aleho\test.txt andrii@192.168.139.136:/home/andrii/
scp: stat local "C:/Users/aleho/test.txt": No such file or directory

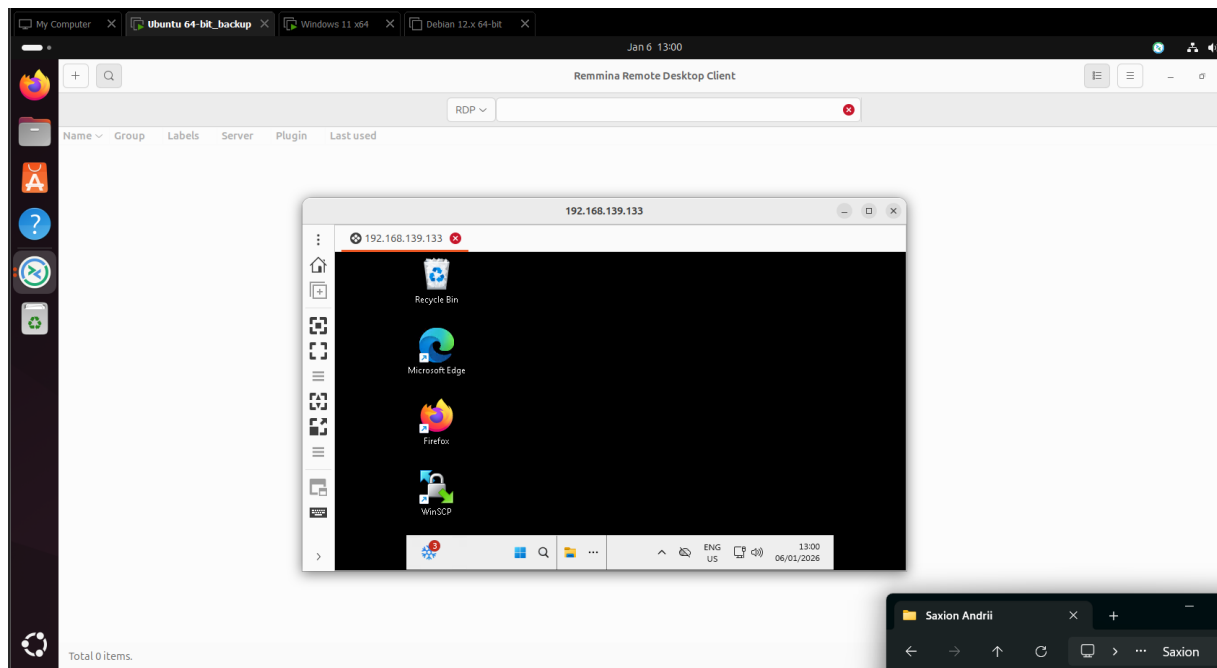
C:\Users\user>scp C:\Users\user\test.txt andrii@192.168.139.136:/home/andrii/
andrii@192.168.139.136's password:
test.txt

C:\Users\user>

andrii@andrii-VM:~$ ls
archiveFolder  Desktop      Downloads    file.txt    Music      output.gif  ppp.txt  sherlock.txt  Templates  Videos
archive.tar    Documents    email-base64.txt  hello      oldcar     Pictures     Public    snap          test.txt
andrii@andrii-VM:~$

```

Screenshot remmina:



Assignment 6.2: IP addresses websites

Relevant screenshots nslookup command:

Microsoft Windows [Version 10.0.26100.7462]
(c) Microsoft Corporation. All rights reserved.

C:\Users\aleho>nslookup
Default Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

> amazon.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: amazon.com
Addresses: 98.87.170.71
98.82.161.185
98.87.170.74

> google.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: google.com
Addresses: 2a00:1450:400e:804::200e
142.251.39.142

> one.one.one.one
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: one.one.one.one
Addresses: 2606:4700:4700::1111
2606:4700:4700::1001
1.0.0.1
1.1.1.1

> dns.google.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

> dns.google.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

Non-authoritative answer:
Name: dns.google.com
Addresses: 2001:4860:4860::8888
2001:4860:4860::8844
8.8.8.8
8.8.4.4

> bol.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

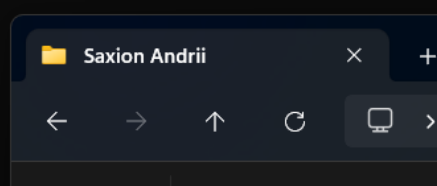
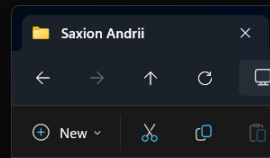
Non-authoritative answer:
Name: bol.com
Address: 79.170.100.62

> w3schools.com
Server: d-hk-mer-ib02.infra.saxion.net
Address: 145.2.14.10

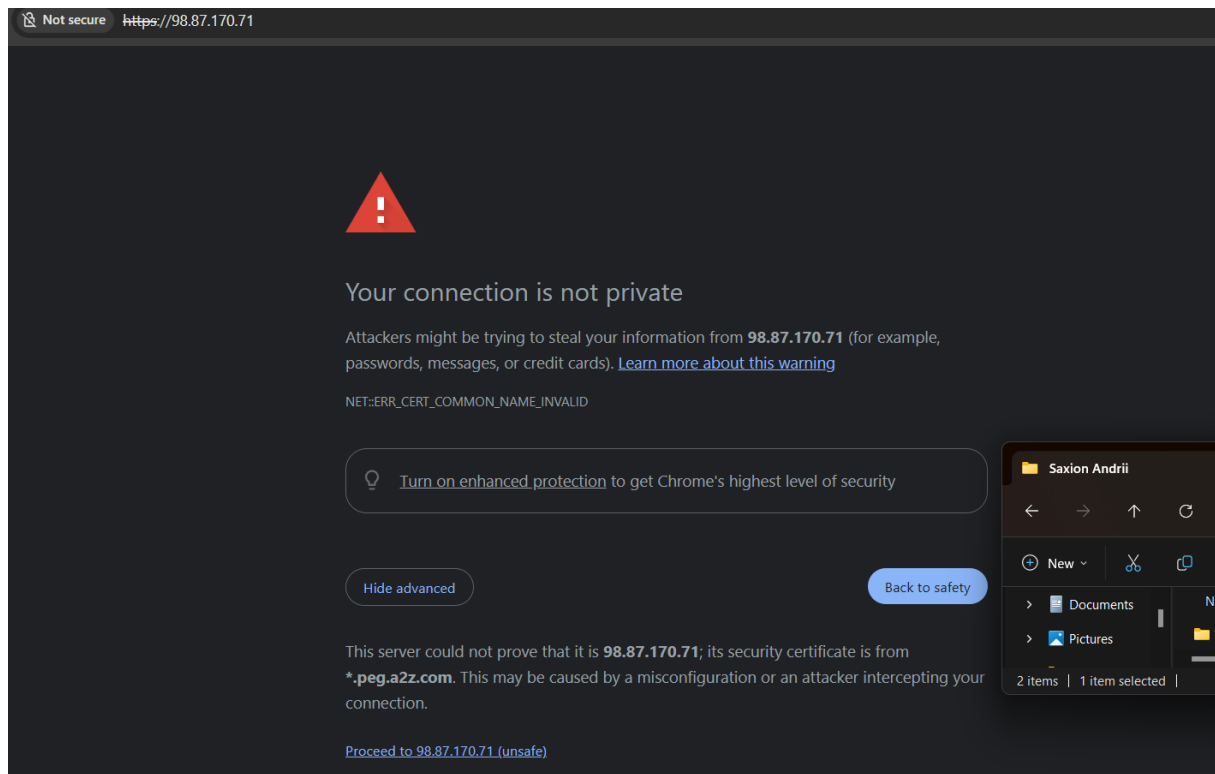
Non-authoritative answer:
Name: w3schools.com
Addresses: 76.223.115.82
13.248.240.135

> exit

C:\Users\aleho>



Screenshot website visit via IP address:



Assignment 6.3: subnetting

How many IP addresses are in this network configuration 192.168.110.128/25?

There are 128 IP addresses in total, because 7 bits are used for host addresses and 2 to the power of 7 is 128.

What is the usable IP range to hand out to the connected computers?

The usable IP range is from 192.168.110.129 to 192.168.110.254, so 126 usable IPs.

Check your two previous answers with this Linux command: `ipcalc 192.168.110.128/25`

```

0 upgraded, 1 newly installed, 0 to remove and 41 not upgraded.
Need to get 24.5 kB of archives.
After this operation, 72.7 kB of additional disk space will be used.
Get:1 http://nl.archive.ubuntu.com/ubuntu noble/universe amd64 ipcalc all 0.51-1
[24.5 kB]
Fetched 24.5 kB in 0s (361 kB/s)
Selecting previously unselected package ipcalc.
(Reading database ... 196549 files and directories currently installed.)
Preparing to unpack .../archives/ipcalc_0.51-1_all.deb ...
Unpacking ipcalc (0.51-1) ...
Setting up ipcalc (0.51-1) ...
Processing triggers for man-db (2.12.0-4build2) ...
andrii@andrii-VM:~$ ipcalc 192.168.110.128/25
Address:    192.168.110.128      11000000.10101000.01101110.1 0000000
Netmask:    255.255.255.128 = 25 11111111.11111111.11111111.1 0000000
Wildcard:   0.0.0.127           00000000.00000000.00000000.0 1111111
=>
Network:    192.168.110.128/25   11000000.10101000.01101110.1 0000000
HostMin:    192.168.110.129      11000000.10101000.01101110.1 0000001
HostMax:    192.168.110.254      11000000.10101000.01101110.1 1111110
Broadcast:  192.168.110.255      11000000.10101000.01101110.1 1111111
Hosts/Net:  126                  Class C, Private Internet

andrii@andrii-VM:~$

```

Explain the above calculation in your own words.

The subnet 192.168.110.128/25 starts at .128 and ends at .255. The first address is the network address and the last one is the broadcast address, so they cannot be used by computers. That leaves 126 usable IP addresses that can be assigned to devices in the network. The /25 means that first 25 bits are used to identify the network and last 7 is to identify the device.

Assignment 6.4: HTML

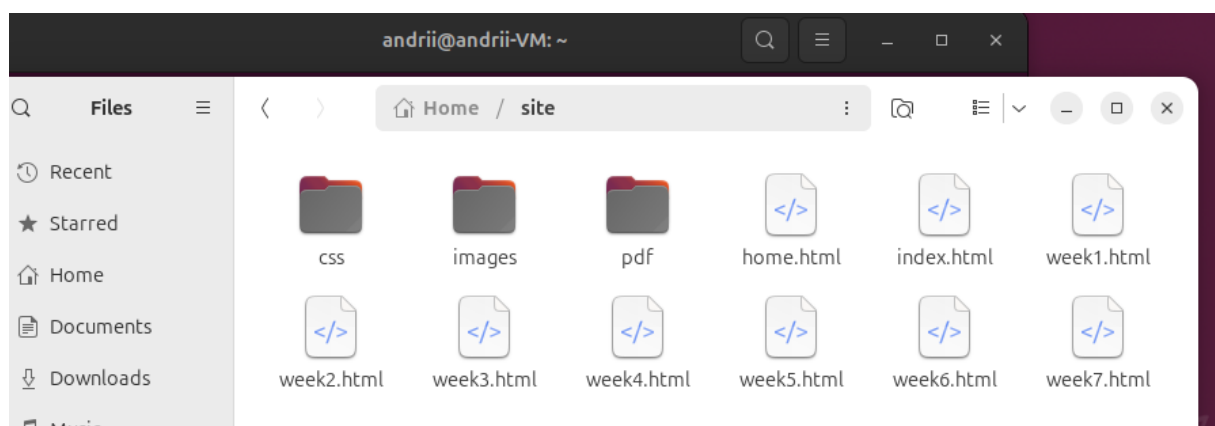
Screenshot IP address Ubuntu VM:

```

andrii@andrii-VM:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:85:4f:64 brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.139.136/24 brd 192.168.139.255 scope global dynamic noprefixroute ens33
        valid_lft 915sec preferred_lft 915sec
    inet6 fe80::20c:29ff:fe85:4f64/64 scope link
        valid_lft forever preferred_lft forever
andrii@andrii-VM:~$

```

Screenshot of Site directory contents:



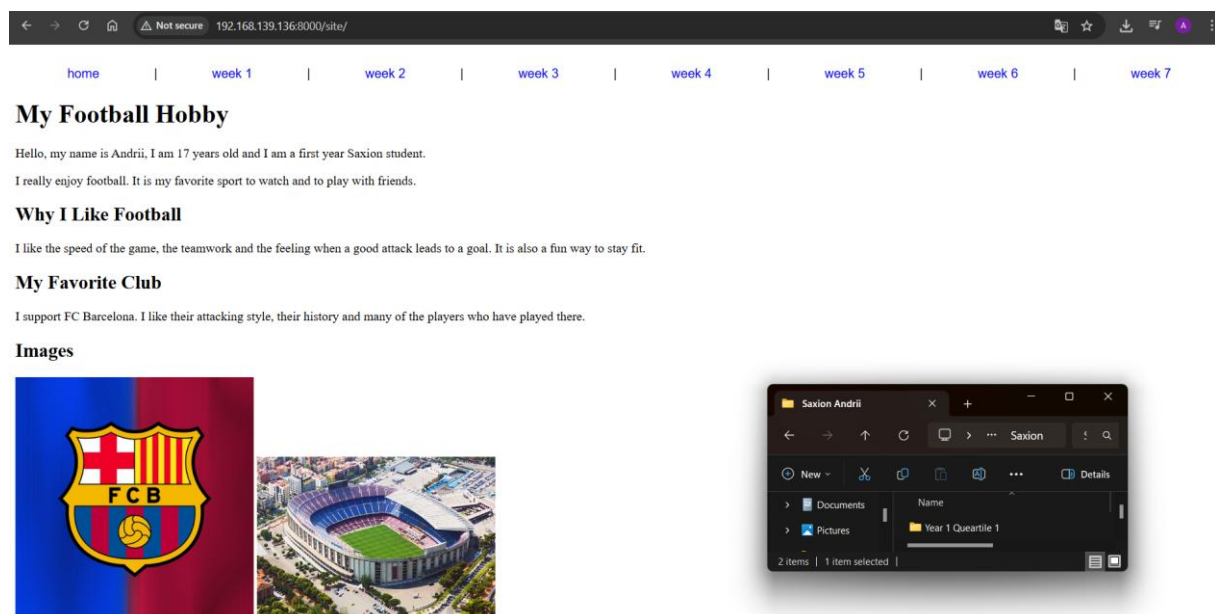
Screenshot python3 webserver command:

```

andrii@andrii-VM:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:85:4f:64 brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.139.136/24 brd 192.168.139.255 scope global dynamic noprefixroute ens33
        valid_lft 915sec preferred_lft 915sec
    inet6 fe80::20c:29ff:fe85:4f64/64 scope link
        valid_lft forever preferred_lft forever
andrii@andrii-VM:~$ python3 -m http.server 8000
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...

```

Screenshot web browser visits your site



Assignment 6.5: Network segment

Remember that bitwise java application you've made in week 2? Expand that application so that you can also calculate a network segment as explained in the PowerPoint slides of week 6. Use the bitwise & AND operator. You need to be able to input two Strings. An IP address and a subnet.

IP: 192.168.1.100 and subnet: 255.255.255.224 for /27

Example: 192.168.1.100/27

Calculate the network segment

IP Address: 11000000.10101000.00000001.01100100

Subnet Mask: 11111111.11111111.11111111.11100000

Network Addr: 11000000.10101000.00000001.01100000

This gives 192.168.1.96 in decimal as the network address.

For a /27 subnet, each segment (or subnet) has 32 IP addresses (2^5).

The range of this network segment is from 192.168.1.96 to 192.168.1.127.

Paste source code here, with a screenshot of a working application.

```
public class Main {
    public static void main(String[] args) {
        exercise1();
        exercise2();
        exercise3();
        exercise4();
        exercise5();
        exercise6();
        exercise7();
        System.out.println(calculateNetworkAddress("192.168.1.100", "255.255.255.224"));
    }

    public static void exercise1(){
        int number = 5;
        if((number & 1) == 1){
            System.out.println("number is odd");
        }else{
            System.out.println("number is even");
        }
    }

    public static void exercise2(){
        int number = 3;
        if((number & (number-1)) == 0){
            System.out.println("number is a power of 2");
        }
        else System.out.println("number isn't a power of 2");
    }

    public static void exercise3(){
        final int READ = 4;
        final int WRITE = 2;
        final int EXECUTE = 1;

        int userPermissions = 7;
        if ((userPermissions & READ) == 4 ){
```

```

        System.out.println("User has read permissions");
    }else {
        System.out.println("User can't read. No permissions.");
    }
}

public static void exercise4(){
    final int READ = 4;
    final int WRITE = 2;
    final int EXECUTE = 1;

    int userPermissions = READ | EXECUTE;
    System.out.println("User permissions: "+userPermissions);
}

public static void exercise5(){
    final int READ = 4;
    final int WRITE = 2;
    final int EXECUTE = 1;

    int userPermissions = 6;
    userPermissions = userPermissions ^ WRITE;
    System.out.println("User permissions: "+userPermissions);
}

public static void exercise6(){
    int number = 5;
    number = ~ (number - 1);
    System.out.println("Number: " + number);
}

public static void exercise7(){
    int number = 10;
    System.out.println("Decimal number is: " + number);

    String binary = Integer.toBinaryString(number);
    String octal = Integer.toOctalString(number);
    String hex = Integer.toHexString(number);

    System.out.println("Binary number: " + binary);
    System.out.println("Octal number: " + octal);
    System.out.println("Hex number: " + hex);
}

public static String calculateNetworkAddress(String ip, String subnet) {
    String[] ipParts = ip.split("\\.");
    String[] subnetParts = subnet.split("\\.");
    String network = "";

    for (int i = 0; i < ipParts.length; i++){
        int andOperation = Integer.parseInt(ipParts[i]) & Integer.parseInt(subnetParts[i]);

```

```
        if (i == ipParts.length - 1){
            network += andOperation;
        }else {
            network += andOperation + ".";
        }
    }

    return network;
}
}
```



```
C:\Users\aleho\.jdk\ms-21.0.8\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2025
number is odd
number isn't a power of 2
User has read permissions
User permissions: 5
User permissions: 4
Number: -5
Decimal number is: 10
Binary number: 1010
Octal number: 12
Hex number: a
192.168.1.96

Process finished with exit code 0
```