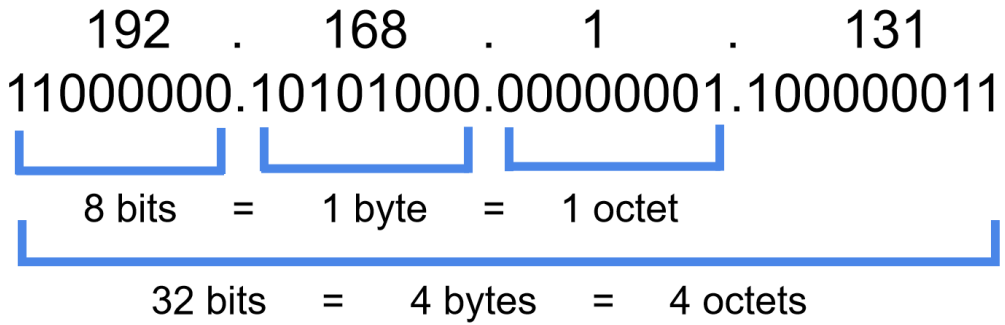
# Understanding IPv4 Addresses & Binary Math

# Understanding IPv4 Addresses

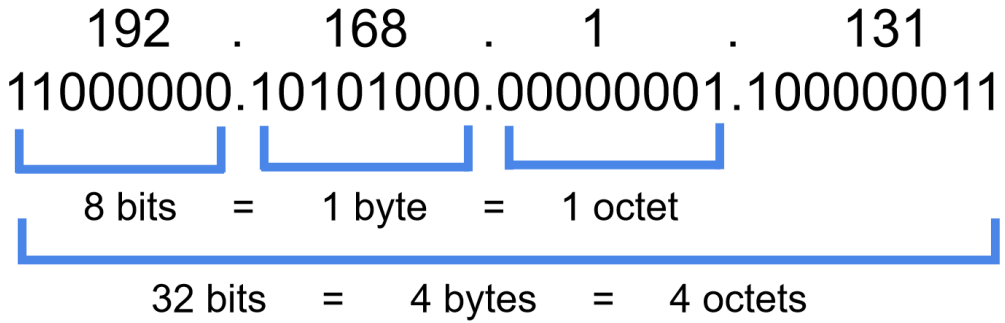
- An IP Address is a **logical address** used in order to **uniquely identify** a device on an IP network.
- It's a **Network Layer** Address
- There are Two Versions:
  - IP version 4 (IPv4)
  - IP version 6 (IPv6)
- This lesson focuses on IPv4, and we'll discuss IPv6 later in the course.

# IPv4 Address Anatomy

- Made up of 32 binary bits, which can be divided into a **network portion** and a **host portion** with the help of a subnet mask.
  - The 32 binary bits are broken into four octets (1 octet = 8 bits).
  - Each octet is converted to decimal and separated by a period (dot).
  - For this reason, an IP address is said to be expressed in dotted decimal format.



# IPv4 Address Anatomy




| First Octet | | Second Octet | | Third Octet | | Fourth Octet |
|---|---|---|---|---|---|---|
| 192 | . | 168 | . | 1 | . | 131 |
| 11000000 | . | 10101000 | . | 00000001 | . | 10000011 |
| 8 bits | | 8 bits | | 8 bits | | 8 bits |

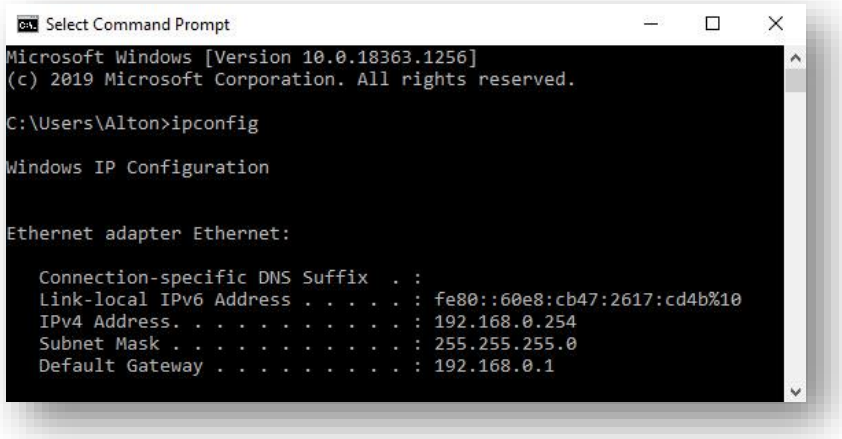
# Network and Host Portion

- An IP address is broken down into two parts:
  - **Network Address**
    - Uniquely identifies each network
    - Your Street Name: 7682 **Wilshire Drive**
  - **Host Address**
    - Uniquely identifies each machine on a network
    - Your House Address: **7682** Wilshire Drive

- Network Address + Host Address = IP Address
  - **Wilshire Drive 7682**

# IPv4 Address Components

- Each device on a network is assigned an IP address, subnet mask and default gateway:
  - **IP Address**: Unique logical address assigned to each device on a network.
  - **Subnet Mask**: Used by the device to determine what subnet it's on, specifically the network and host portions of the IP address.
  - **Default Gateway**: The IP address of a network's router that allows devices on the local network to communicate with other networks.



# Binary Math Basics

# Basics of Binary Math

## Lecture Goals

- Convert Binary to Decimal
- Convert Decimal to Binary

# Basics of Binary Math

## Why is it important?

We need to know basic binary math to perform subnetting, as well as to understand how IPv4 addresses work.

## Remember This

128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255

INSTRUCTOR ALTON

# What is the binary 11111111 in decimal?

| | 128 | | 64 | | 32 | | 16 | | 8 | | 4 | | 2 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | |
| **Decimal** | 128 | + | 64 | + | 32 | + | 16 | + | 8 | + | 4 | + | 2 | + | 1 | = | **255 Decimal** |

Add the number where there is a “1”.
Add zero, when there is a “0”.

INSTRUCTOR ALTON

# What is the binary 10101010 in decimal?

| | 128 | | 64 | | 32 | | 16 | | 8 | | 4 | | 2 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** | 1 | | 0 | | 1 | | 0 | | 1 | | 0 | | 1 | | 0 | | |
| **Decimal** | 128 | + | 0 | + | 32 | + | 0 | + | 8 | + | 0 | + | 2 | + | 0 | = | **170 Decimal** |

Add the number where there is a “1”.
Add zero, when there is a “0”.

INSTRUCTOR ALTON

# What is the binary 10000011 in decimal?

| | 128 | | 64 | | 32 | | 16 | | 8 | | 4 | | 2 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** | 1 | | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | |
| **Decimal** | 128 | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | + | 2 | + | 1 | = | **131 Decimal** |

Add the number where there is a “1”.
Add zero, when there is a “0”.

INSTRUCTOR ALTON

# What's 192 in binary?

| | 128 | | 64 | | 32 | | 16 | | 8 | | 4 | | 2 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** | 1 | | 1 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | = | **11000000** |
| **Decimal** | 128 | + | 64 | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | = | **192 Decimal** |

Start adding the numbers from left to right until you achieve the decimal amount you are looking for!

INSTRUCTOR ALTON

# What's 202 in binary?

| | 128 | | 64 | | 32 | | 16 | | 8 | | 4 | | 2 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** | 1 | | 1 | | 0 | | 0 | | 1 | | 0 | | 1 | | 0 | = | **11001010** |
| **Decimal** | 128 | + | 64 | + | 0 | + | 0 | + | 8 | + | 0 | + | 2 | + | 0 | = | **202 Decimal** |

Start adding the numbers from left to right until you achieve the decimal amount you are looking for!

INSTRUCTOR ALTON

# What's 54 in binary?

| | 128 | | 64 | | 32 | | 16 | | 8 | | 4 | | 2 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Binary** | 0 | | 0 | | 1 | | 1 | | 0 | | 1 | | 1 | | 0 | = | **00110110** |
| **Decimal** | 0 | + | 0 | + | 32 | + | 16 | + | 0 | + | 4 | + | 2 | + | 0 | = | **54 Decimal** |

Start adding the numbers from left to right until you achieve the decimal amount you are looking for!

INSTRUCTOR ALTON

# IP Address Conversion Process

| 192. | 168. | 32. | 4 | Dotted Decimal |
|---|---|---|---|---|
| 11000000. | 10101000. | 00100000. | 00000100 | Binary |
| 1st Octet | 2nd Octet | 3rd Octet | 4th Octet | |

Whether you are given an IP address in dotted-decimal or binary format, follow the respective process above for each octet one by one until you have completed the process.