Lab - Use a Calculator for Binary Conversions

# Objectives

* Switch among Windows Calculator modes.
* Use Windows Calculator to convert between decimal and binary.
* Use Windows Calculator to determine the number of hosts in a network with powers of 2.

# Background / Scenario

When working with networking devices, a network technician should understand binary and decimal numbers. In this lab, you will use the Windows Calculator application to convert between these numbering systems. You will also use the “powers” function to determine the number of hosts that can be addressed based on the number of bits available.

# Required Resources

* PC (Windows 10)

# Instructions

## Using Windows Calculator

### Access Windows Calculator and determine mode of operation.

* + - 1. Open the Windows Calculator application. Click **Start**, type **Calculator**. Select **Calculator** in the results.

#### Question:

What mode is the Calculator in?

Type your answers here.

* + - 1. Click the **Open Navigation** icon (**≡**) located in the upper left-hand corner. The Windows calculator supports different mode of calculations.

#### Question:

List the five modes for the calculator.

Type your answers here.

### Switch between modes.

* + - 1. To switch between calculator modes, click the **Open Navigation** icon (**≡**) and select desired mode.
      2. Practice switching between calculator modes to see which options they provide.

#### Question:

Briefly explain the function of each mode.

Type your answers here.

## Binary System

### Convert between number systems.

* + - 1. Select the **Programmer** mode calculator.
      2. The Programmer calculator supports four numbering systems — HEX (Hexadecimal), DEC (Decimal), OCT (Octal), and BIN (Binary).

#### Questions:

Which number system is currently active?

Type your answers here.

Which numbers on the number pad are active in Decimal mode?

Type your answers here.

* + - 1. Click **BIN**.

#### Question:

Which numbers on the number pad are now active?

Type your answers here.

Why do you think the other numbers are grayed out?

Type your answers here.

* + - 1. Click **DEC**. Using your mouse, click on the number **1** followed by the number **5** on the number pad. The decimal number 15 has now been entered.
      2. Now click **BIN**.

#### Question:

What happened to the number 15 listed in the textbox at the top of the window?

Type your answers here.

* + - 1. Enter the number 220 and select BIN.

#### Question:

What is the binary equivalent of 220?

Type your answers here.

* + - 1. Clear the binary value representing 220 in the window. From Binary mode, type in the following binary number: **11001100**. Select the **DEC**.

#### Question:

What is the decimal equivalent to the binary number of 11001100?

Type your answers here.

### Practice the conversion between binary and decimal numbering system.

#### Questions:

Convert the following decimal numbers to binary.

| Decimal | Binary |
| --- | --- |
| 86 | blank |
| 175 | blank |
| 204 | blank |
| 19 | blank |

Convert the following binary numbers to decimal.

| Binary | Decimal |
| --- | --- |
| 1100 0011 | blank |
| 0010 1010 | blank |
| 0011 1000 | blank |
| 1001 0011 | blank |

## Network Addresses

### Convert host IP addresses.

* + - 1. Computer hosts usually have two addresses, an Internet Protocol (IP) address and an Ethernet Media Access Control (MAC) address. For the benefit of humans, the IP address is normally represented as a dotted decimal notation, such as 192.168.10.2. Each of the decimal octets in the address or a mask can be converted to 8 binary bits. Remember that the computer only understands binary bits.

#### Question:

If all 4 octets were converted to binary, how many bits would there be?

Type your answers here.

* + - 1. IP addresses are normally shown with four decimal numbers ranging from 0 to 255 and separated by a period.

#### Question:

Convert the 4 parts of the IP address 192.168.10.2 to binary.

| Decimal | Binary |
| --- | --- |
| 192 | blank |
| 168 | blank |
| 10 | blank |
| 2 | blank |

### Convert host IP subnet masks.

Subnet masks, such as 255.255.255.0, are also represented as dotted decimal. A subnet mask will always consist of four 8-bit octets, each one represented as a decimal number. With the exception of decimal 0 (all 8 binary zeros) and decimal 255 (all 8 binary ones), each octet will have some number of ones on the left and some number of zeros on the right.

#### Questions:

Convert the 8 possible decimal subnet octet values to binary.

| Decimal | Binary |
| --- | --- |
| 0 | blank |
| 128 | blank |
| 192 | blank |
| 224 | blank |
| 240 | blank |
| 248 | blank |
| 252 | blank |
| 254 | blank |
| 255 | blank |

Convert the four parts of the subnet mask 255.255.255.0 to binary.

| Decimal | Binary |
| --- | --- |
| 255 | blank |
| 255 | blank |
| 255 | blank |
| 0 | blank |

### Manipulate powers of 2 to determine the number of hosts on a network

* + - 1. Binary numbers use two digits, 0 and 1. When you calculate how many hosts can be on a subnetwork, you use powers of two because binary is being used. As an example, we have a subnet mask that leaves six bits in the host portion of the IP address. In this case, the number of hosts on that network is 2 to the 6th power minus 2 (because you need a number to represent the network and a number that can be used to reach all the hosts—the broadcast address). The number 2 is always used because we are working in binary. The number 6 is the number of bits that are used for the host bits.
      2. Change the calculator view to **Scientific** mode. Input the number **2**. Select the **xy** key on the calculator, the key which raises a number to a power. Input the number **6**. To compete the operation, click on the =key, press **Enter** on the keyboard, or press the **=** key on the keyboard. The number 64 appears in the output. To subtract two, click on the minus (-) key and then the **2** key followed by the **=** key. The number 62 appears in the output. This means 62 hosts could be utilized.

#### Questions:

Using the previously described process, determine the number of hosts if the following number of bits are used for host bits.

| No. of Bits Used for Hosts | No. of Hosts |
| --- | --- |
| 5 | blank |
| 14 | blank |
| 24 | blank |
| 10 | blank |

Using a similar technique as learned previously, determine what 10 to the 4th power equals.

Type your answers here.

* + - 1. Close the Windows Calculator application.

# Reflection

List one other thing for which you might use the Windows Calculator scientific mode. It does not have to be related to networking.

Type your answers here.

# Answer Key

## Using Windows Calculator

### Access Windows Calculator and determine mode of operation.

What mode is the Calculator in?

Answers can vary. It can be in the Standard, Scientific, Programmer, Date calculator or Converter.

List the five modes for the calculator.

The five calculator modes are Basic, Scientific, Programmer, Date calculation, and Converter.

### Switch between modes.

Briefly explain the function of each mode.

The standard mode is for basic math. The Scientific mode is for more advanced calculations. The Programmer mode supports different number systems, such as binary, hexadecimal, octal, and decimal. The Data calculation is for working with date. The Converter is for converting between different units of measurements.

## Binary System

### Convert between number systems.

Which number system is currently active?

DEC

Which numbers on the number pad are active in Decimal mode?

0 thru 9

Which numbers on the number pad are now active?

0 and 1

Why do you think the other numbers are grayed out?

Because the only digits used in binary (Base 2) are 0 and 1

What happened to the number 15 listed in the textbox at the top of the window?

It converted into the decimal number 15 to four binary 1 digits (1111)

What is the binary equivalent of 220?

11011100

What is the decimal equivalent to the binary number of 11001100?

204

### Practice the conversion between binary and decimal numbering system.

Convert the following decimal numbers to binary.

| Decimal | Binary |
| --- | --- |
| 86 | 01010110 |
| 175 | 10101111 |
| 204 | 11001100 |
| 19 | 00010011 |

Convert the following binary numbers to decimal.

| Binary | Decimal |
| --- | --- |
| 1100 0011 | 195 |
| 0010 1010 | 42 |
| 0011 1000 | 56 |
| 1001 0011 | 147 |

## Network Addresses

### Convert host IP addresses.

If all 4 octets were converted to binary, how many bits would there be?

IP address is 32 bits, 4x8

Convert the 4 parts of the IP address 192.168.10.2 to binary.

| Decimal | Binary |
| --- | --- |
| 192 | 11000000 |
| 168 | 10101000 |
| 10 | 1010 |
| 2 | 10 |

### Convert host IP subnet masks.

Convert the 8 possible decimal subnet octet values to binary.

| Decimal | Binary |
| --- | --- |
| 0 | 00000000 |
| 128 | 10000000 |
| 192 | 11000000 |
| 224 | 11100000 |
| 240 | 11110000 |
| 248 | 11111000 |
| 252 | 11111100 |
| 254 | 11111110 |
| 255 | 11111111 |

Convert the four parts of the subnet mask 255.255.255.0 to binary.

| Decimal | Binary |
| --- | --- |
| 255 | 11111111 |
| 255 | 11111111 |
| 255 | 11111111 |
| 0 | 00000000 |

### Manipulate powers of 2 to determine the number of hosts on a network

Using the previously described process, determine the number of hosts if the following number of bits are used for host bits.

| No. of Bits Used for Hosts | No. of Hosts |
| --- | --- |
| 5 | 30 |
| 14 | 16382 |
| 24 | 16777214 |
| 10 | 1022 |

Using a similar technique as learned previously, determine what 10 to the 4th power equals.

10000

# Reflection

List one other thing for which you might use the Windows Calculator scientific mode. It does not have to be related to networking.

Answers will vary. As an example, the scientific mode can be used for calculating the angles and length of a triangle for engineering problems.

End of document