



Data Representation

Numeric Data

Learning Intentions



By the end of this lesson you will be able to:

- ❑ Represent positive integers in binary up to 32 bits
- ❑ Describe and use the two's complement system to represent negative integers
- ❑ Describe the range of the numbers that can be represented using the two's complement system
- ❑ Describe the relationship between the mantissa/exponent and the range/precision of a floating point number
- ❑ Represent a real number in floating point representation

Integers and Real Numbers



We will look at two types of numbers

- ❑ **Integers**
- ❑ **Real Numbers**

Integers are **whole numbers**, they have **no decimal portions**.

Real numbers are numbers that have a **decimal portion**.

Decimal Numbers



We use the **decimal**(denary) or base 10 system
This means we have 10 digits : 0-9

Because of our ten
fingers?



Computers use the binary or base 2 system
There are only two digits: 0 and 1
Each figure is known as a **bit**
Binary digit

Off and On



Decimal Numbers



Lets look at how a decimal number is made up: 173

Hundreds	Tens	Units
1	7	3

Technically this is:

10^2	10^1	10^0
Hundreds	Tens	Units
1	7	3

Binary Numbers



Lets look at how the same number is stored in binary: 1010 1101

128	64	32	16	8	4	2	1
1	0	1	0	1	1	0	1

This number is constructed as shown above.
These values come from:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	1	0	1	1	0	1

Converting decimal to binary



Let's look at the same example:

$173/2 = 86$	r 1
$86/2 = 43$	r 0
$43/2 = 21$	r 1
$21/2 = 10$	r 1
$10/2 = 5$	r 0
$5/2 = 2$	r 1
$2/2 = 1$	r 0
$1/2 = 0$	r 1

Binary Number = **1010 1101**

Our binary number is:

1010 1101

Read the binary
number from **bottom**
up

How to convert from Binary



1. Create your table with the values in the top

128	64	32	16	8	4	2	1
0	1	1	0	0	1	1	0

2. Insert your binary value into the table
3. Add the place values that have a binary 1 in them: **$64+32+4+2 = 102$**

Advantages of the Binary system



Less rules of arithmetic.

- This means that there are less operations to be programmed

0's and 1's are easier to represent digitally.

- Using magnetic media or pits/lands on CD's

Any drop in voltage does not affect the data.

- 0 and 1 – There is either some signal or no signal

Summary



Binary only has **two** values– **0 & 1**

A single 0 or 1 is known as a **bit**

Binary Digit

The place values in binary start on the right at 1 and double every time going to the left.

Advantages of Binary:

1. There are less rules of arithmetic.
2. 0's and 1's are easier to represent.
3. Any drop in voltage doesn't effect data.