DENARY ARITHMETIC

Decimal	0	1	2	3	4	5	6	7	8	9

- 5 + 1 = ?
- 5 + 3 = ?
- 9 + 1 = ?

DENARY ARITHMETIC

- Place value table
- 5
- 26
- 189
- 9 + 1 = 10
- 18 + 2 = 20
- 19 + 3 = 22

Place value table			
10^3	10^2	10^1	10^0
1000	100	10	1

DENARY ARITHMETIC

Worked example

369 + 733

Place values	**10^3** **1000**	**10^2** **100**	**10^1** **10**	**10^0** **1**
Carry over	**1**	**1**	**1**	
		3	6	9
		7	3	3
Total	**1**	**1**	**0**	**2**
		100 + 300 + 700 = 1100 The 1000 is carried over leaving 100.	10 + 60 + 30 = 100 The 100 is carried over.	9 + 3 = 12 The 10 is carried over leaving 2.

Binary addition works in the same way but a 'carry over' is needed if the result is greater than 1.

CONVERTING DECIMAL TO BINARY (BASE10 - BASE2)

- 70 in decimal to binary
- Follow these steps
  1. Write place value table
  2. Multiple each place value with 0 or 1; Put 1 into the place values that can make to total of result equals to the target

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

CONVERTING DECIMAL TO BINARY (BASE10 - BASE2)

- Convert these denary numbers to binary
- 3
- 8
- 13
- 100
- 255

CONVERTING BINARY TO DECIMAL (BASE2 – BASE10)

- 01000110 in binary to decimal
- Follow these steps
  1. Write place value table
  2. Put binary into the place value table
  3. Multiply each place value with 0 or 1
  4. Sum up the value

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

CONVERTING BINARY TO DECIMAL (BASE2 – BASE10)

- Convert these binary numbers to denary
- 10
- 101
- 0110
- 1010
- 10110

Binary	0	1

CONVERTING BINARY TO DECIMAL (BASE2 – BASE10)

- Convert these binary numbers to denary
- Highest value of 4-bit binary
- Lowest value of 4-bit binary

BINARY ARITHMETIC

- Add up these numbers
- 0+0 = ?
- 0+1 = ?
- 1+0 = ?
- 1+1 = ?
- 1+1+1 =?

BINARY ARITHMETIC

Worked example

11010110 + 01100111

Place values	2^7 128	2^6 64	2^5 32	2^4 16	2^3 8	2^2 4	2^1 2	2^0 1
Carry over	1				1	1		
1	1	1	0	1	0	1	1	0
	0	1	1	0	0	1	1	1
Total	0	0	1	1	1	1	0	1
	128 + 128 = 256 This should be carried over.	64 + 64 = 128 The 128 is carried over.	No carry over needed.	No carry over needed.	No carry over needed.	4 + 4 + 4 = 12 The 8 is carried over leaving one 4.	2 + 2 = 4 The 4 is carried over.	No carry over needed.

OVERFLOW

- What happens when 70 + 226
  - 70 + 226 = 296
  - The highest value of eight bits binary is 255
  - Thus, 296 cannot be represented in eight bits binary
  - The computer reports an error as “overflow”
  - When the result is too big to be represented by the given number of bits

$$\begin{array}{r} {\scriptstyle 1\quad\ 11} \\ 01000110_{(2)} \\ +\ 11100010_{(2)} \\ \hline 100101000_{(2)} \end{array}$$