

ENGR 101

Engineering Technology

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*Te Whare Wānanga
o te Ūpoko o te Ika a Māui*



CAPITAL CITY UNIVERSITY

Week 16: The Big Review

- Number Systems

Conversion to decimal

- Convert to decimal:

- $(1011)_2 = 1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 = 8 + 2 + 1 = 11$

- $(121)_8 = 1 \times 8^0 + 2 \times 8^1 + 1 \times 8^2 = 1 + 16 + 64 = 81$

- $(12C)_{16} = 12 \times 16^0 + 2 \times 16^1 + 1 \times 16^2 = 12 + 32 + 256 = 300$

- $(0.1011)_2 = \frac{1}{2} + \frac{0}{2^2} + \frac{1}{2^3} + \frac{1}{2^4} = \frac{11}{16} = 0.6875$

- $(0.121)_8 = \frac{1}{8} + \frac{2}{8^2} + \frac{1}{8^3} = 0.1582$

Conversion from decimal

- Convert the following decimal values...

- (75)₁₀ to binary = 1001011₂
 $64 + 8 + 4 + 1$

- 75 to octal = (113)₈
 $3 \times 8^0 + 1 \times 8 + 1 \times 64 = 75 \checkmark$

- 75 to hexadecimal = (4B)₁₆

$$\begin{aligned} 75/2 &= 37 R1 \\ 37/2 &= 18 R1 \\ 18/2 &= 9 R0 \\ 9/2 &= 4 R1 \\ 4/2 &= 2 R0 \\ 2/2 &= 1 R0 \\ 1/2 &= 0 R1 \end{aligned}$$

$$\begin{aligned} 75/8 &= 9 R3 \\ 9/8 &= 1 R1 \\ 1/8 &= 0 R1 \\ 75/16 &= 4 R11 \\ 4/16 &= 0 R4 \end{aligned}$$

- 0.192 to binary (stop after 4 decimal places and find the rounding error)

$0.192 \approx (0.0011)_2$

$$(0.0011)_2 = \frac{1}{8} + \frac{1}{16} = 0.1875$$

$$\text{error} = \frac{0.192 - 0.1875}{0.192} \times 100\% = \frac{0.0045}{0.192} \times 100\% = 2.344\%$$

$$\begin{aligned} 0.192 \times 2 &= 0.384 \\ 0.384 \times 2 &= 0.768 \\ 0.768 \times 2 &= 1.536 \\ 0.536 \times 2 &= 1.072 \\ 0.072 \times 2 &= 0.144 \end{aligned}$$

Binary number representation

- Represent **-75** in 10-bit binary using...

- signed integer

$+75 = 0001001011$
 $-75 = 1001001011$

↳ 9 bits + sign bit

$+75 = 0001001011$
 $-75 = 1001001011$

- ones complement

1110110100

- twos complement

1110110101

Binary arithmetic

Solve for the following. You must show your work.
 Check each by converting to decimal and solving.

- $1011001 + 100111$
- $1011001 - 100111$
- $1011001 * 100111$

$$\begin{array}{r}
 111111 \\
 + 1011001 = 89 \\
 + 100111 = 39 \\
 \hline
 10000000 = 128 \quad \checkmark
 \end{array}$$

$$\begin{array}{r}
 010 \quad 010 \\
 1011001 = 89 \\
 - 100111 = 39 \\
 \hline
 0110010 = 50 \quad \checkmark
 \end{array}$$

$$\begin{array}{r}
 \\
 \\
 \hline
 1111011001 \\
 1011001 \\
 \hline
 110110001111 \\
 2048 = 3471 \quad \checkmark \\

 \end{array}$$