ENGR 101
Engineering Technology

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Week 16: The Big Review

- Number Systems

Conversion to decimal

- Convert to decimal:
  - $(1011)_2 = 1\times2^0 + 1\times2^1 + 0\times2^2 + 1\times2^3 = 8+2+1 = 11$
  - $(121)_8 = 1\times8^0 + 2\times8^1 + 1\times8^2 = 1+16+64 = 81$
  - $(12C)_{16} = 12\times16^0 + 2\times16 + 1\times16^2 = 12+32+256 = 300$
  - $(0.1011)_2 = \frac{1}{2} + \frac{0}{2^2} + \frac{1}{2^3} + \frac{1}{2^4} = \frac{11}{16} = 0.6875$
  - $(0.121)_8 = \frac{1}{8} + \frac{2}{8^2} + \frac{1}{8^3} = 0.1582$

Conversion from decimal

- Convert the following decimal values…
  - $(75)_{10}$ to binary $= 1001011$

    $64 + 11$

    $8 + 2 + 1$

    $75/2 = 37\ R1$
    $37/2 = 18\ R1$
    $18/2 = 9\ R0$
    $9/2 = 4\ R1$
    $4/2 = 2\ R0$
    $2/2 = 1\ R0$
    $1/2 = 0\ R1$
  - 75 to octal $= (113)_8$

    $3 \times 8^0 + 1 \times 8 + 1 \times 64 = 75$ ✓

    $75/8 = 9\ R3$
    $9/8 = 1\ R1$
    $1/8 = 0\ R1$
  - 75 to hexadecimal $= (4B)_{16}$

    $75/16 = 4\ R11$
    $4/16 = 0\ R4$
  - 0.192 to binary (stop after 4 decimal places and find the rounding error) P/0

    0.0011

    $0.192 \approx (0.0011)_2$

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

    $0.192 \times 2 = 0.384$
    $0.384 \times 2 = 0.768$
    $0.768 \times 2 = 1.536$
    $0.536 \times 2 = 1.072$
    $0.072 \times 2 = 0.\ldots$

    $\text{error} = \frac{.192 - .1875}{.192} \times 100\% = \frac{0.0045}{0.192} \times 100\% = 2.344\%$

Binary number representation

- Represent -75 in 10-bit binary using…
  - signed integer
  - ones complement
  - twos complement

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`