NUMBER SYSTEMS

- Number System Defined
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- Conversion from Decimal Number Base System to Any Number Base System
- Conversion from Other Number Base System to Decimal Number System

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NUMBER SYSTEMS

- Conversion from Binary Number Base System to Octal and Hexadecimal Number Base System
- Conversion from Octal and Hexadecimal Number Base System to Binary Number Base System
- Conversion of Fractions: Decimal to Any Bases
- Conversion of Fractions: Any Bases to Decimal

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Number System Defined

- ***Number System***
  - It is a system that uses distinct symbols to represent a number inside the computer's memory
- ***Base or Radix***
  - This refers to the number of different symbols (digits) required to represent any given number

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Types of Number System

Numeral System	Base (N)	Valid Values
Binary	2	0, 1
Octal	8	0, 1, 2,3, 4, 5, 6, 7
Decimal	10	0, 1, 2,3, 4, … 9
Hexadecimal	16	0, 1, 2,3, 4, … 9, A-F Where: A=10; B=11; C=12; D=13; E=14; F=15

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Conversion from Decimal Number Base System to Any Number Base System

- ***Subtracting the Powers of Base 2 Method***
- ***Successive/Repeated Division by Powers of Base (n) Method***
- ***Successive/Repeated Division by Base (n) Method***

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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Subtracting the Powers of Base 2 Method***
  - Step 1: List the powers of base 2 in a "base 2 table" from right to left. Make the list up until a power of base 2 that is very close to the value of the given decimal number has been reached
  - Step 2: Look for a power of base 2 that will fit into the given decimal number and then subtract it. ***Note:*** Put "0" to the power of base 2 that is greater than the given

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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Subtracting the Powers of Base 2 Method***
  - Step 3: Repeat step 2, but this time use the obtained difference until it becomes zero (0)
  - Step 4: Placed one (1) under the highest value that can be subtracted from a number; everything else is automatically a zero (0)

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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Successive/Repeated Division by Powers of Base (n) Method***
  - Step 1: Plot the powers of the desired base (n)
  - Step 2: Divide the given by the power of (n) that is lesser than the given. ***Note:*** Put zero (0) to the power of n that is greater than the given

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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Successive/Repeated Division by Powers of Base (n) Method***
  - Step 3: Repeat step 2 but replacing the given with the remainder that was obtained until the recursive remainder becomes zero (0). ***Note:*** If in case, however the remainder is lesser than the next powers of base (n), put zero (0) to the corresponding column while retaining the remainder, which will be used as a dividend

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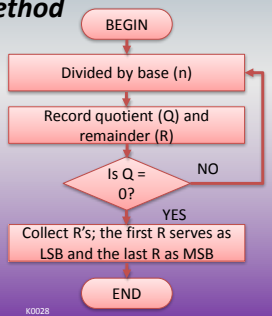
Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Successive/Repeated Division by Base (n) Method***



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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Successive/Repeated Division by Base (n) Method***
  - Step 1: Divide the decimal number to be converted by the value of the new base (n)
  - Step 2: Get the remainder from Step 1 as the rightmost digit (least significant digit) of new base number

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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Successive/Repeated Division by Base (n) Method***
  - Step 3: Divide the quotient of the previous divide by the new base (n)
  - Step 4: Record the remainder from Step 3 as the next digit (to the left) of the new base number

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Conversion from Decimal Number Base System to Any Number Base System

- ***Rules for Successive/Repeated Division by Base (n) Method***
  - Step 5: Repeat Steps 3 and 4, getting the remainders from right to left, until the quotient becomes zero in Step 3
  - Step 6: The last remainder obtained will be the most significant digit (MSD) of the new base (n)

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Conversion from Decimal Number Base System to Any Number Base System

- ***Practice Exercises***
  - $165_{10} \rightarrow N_8$
  - $165_{10} \rightarrow N_{16}$

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Conversion from Other Number Base System to Decimal Number System

- ***Multiply and Add Method***
- ***Positional Value Method***

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Conversion from Other Number Base System to Decimal Number System

- ***Rules for Multiply and Add Method***
  - Step 1: Multiply the ***LEFTMOST DIGIT*** by the base (n) then add the ***NEXT DIGIT*** to the product
  - Step 2: Multiply the ***SUM OF STEP 1*** by the base (n) and then add again the next digit to the product; ***Note:*** If the rightmost digit is already added, the operation will automatically stop and the resulting sum is the actual decimal equivalent

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Conversion from Other Number Base System to Decimal Number System

- ***Rules for Positional Value Method***
  - Step 1: Starting with the ***RIGHTMOST DIGIT***, multiply each digit with powers of base (n) ***RAISED TO A POWER OF ZERO***; ***Note:*** Increase the power of base n by 1 as you continue the operation with the digits to the left
  - Step 2: Take the ***SUM OF ALL THE PRODUCTS*** calculated in Step 1; The total is the decimal equivalent of the base (n) number

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Conversion from Other Number Base System to Decimal Number System

- ***Practice Exercises***
  - $126_8 \rightarrow N_{10}$
  - $A34_{16} \rightarrow N_{10}$

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Conversion from Binary Number Base System to Octal and Hexadecimal Number Base System

- Step 1: Starting from the ***RIGHTMOST DIGIT***, group the binary digits into groups of ***THREE (3) DIGITS*** (octal) and ***FOUR (4) DIGITS*** (hexadecimal) each
- Step 2: Convert each group of three/four binary digits to one octal/hexadecimal symbol through replacing each group of ***THREE (3) BINARY DIGITS*** with ***its EQUIVALENT OCTAL DIGIT (421 CODE)*** and replacing each group of ***FOUR (4) BINARY DIGITS*** with its ***EQUIVALENT HEXADECIMAL DIGIT (8421 CODE)***

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Conversion from Binary Number Base System to Octal and Hexadecimal Number Base System

- ***Practice Exercises***
  - $111000000001110_2 \rightarrow N_8$
  - $1111101011001110_2 \rightarrow N_{16}$

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Conversion from Octal and Hexadecimal Number Base System to Binary Number Base System

- Step 1: Treat each digit in a given number as a single decimal number, and then replace each digit with the equivalent ***THREE (3) BINARY DIGIT (421 CODE)*** (for octal) and ***FOUR (4) BINARY DIGIT (8421 CODE)*** (for hexadecimal)
- Step 2: Put **1** to the 421 and/or 8421 Code that will result to the sum of the octal/hexadecimal digit and **0** to the remaining numbers of the code
- Step 3: Combine all the resulting binary groups (of 3 and/or 4 digits each) into a single binary number

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Conversion from Octal and Hexadecimal Number Base System to Binary Number Base System

- ***Practice Exercises***
  - $765432_8 \rightarrow N_2$
  - $FACADE_{16} \rightarrow N_2$

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Conversion of Fractions: Decimal to Any Bases

- Step 1: Multiply the ***FRACTIONAL PART*** of the given decimal number by the ***DESIRED BASE***
- Step 2: Take the fractional part of the previous result and multiply by the desired base (n) again; If the fractional part ***REACHES ZERO (0)***, this is the last multiplication needed to find our answer
- Step 3: Copy the ***INTEGRAL PART*** *from* ***TOP TO BOTTOM***

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Conversion of Fractions: Decimal to Any Bases

- ***Practice Exercises***
  - $0.386_{10} \rightarrow N_2$
    $\rightarrow N_8$
    $\rightarrow N_{16}$
  - $0.765_{10} \rightarrow N_2$
    $\rightarrow N_8$
    $\rightarrow N_{16}$

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Conversion of Fractions: Any Bases to Decimal

- Step 1: Accomplished by using the **POSITIONAL VALUE METHOD** but the powers of base n is of **NEGATIVE VALUES** and starts with the power of **NEGATIVE ONE (-1)** and with the **LEFTMOST DIGIT**

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Conversion of Fractions: Any Bases to Decimal

- ***Practice Exercises***
  - $0.1100111_2 \rightarrow N_{10}$
  - $0.475_8 \rightarrow N_{10}$
  - $0.A9F_{16} \rightarrow N_{10}$

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Quiz

- ***Perform the following number system conversions:***
  - (a) $1101011_2 = ?_{16}$
  - (b) $67.24_8 = ?_2$
  - (c) $DEAD.BEEF_{16} = ?_8$
  - (d) $10100.1101_2 = ?_{10}$

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Quiz

- ***Perform the following number system conversions:***
  - (e) $7156_8 = ?_{10}$
  - (f) $15C.38_{16} = ?_{10}$
  - (g) $125_{10} = ?_2$
  - (h) $1435_{10} = ?_8$

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