**Computer Architecture**

**Lab 1:**

**Number Systems**

|  |
| --- |
| 1. Convert the following binary numbers to decimal:    1. 1111011   123   * 1. 0110101011   427   * 1. 10101101110.1101   1390.8125 |
| 1. Convert the following decimal numbers to binary:    1. 97.54   1100001.10001010001111010111  0.54 × 2 = 1 + 0.08 0.08 × 2 = 0 + 0.16 0.16 × 2 = 0 + 0.32 0.32 × 2 = 0 + 0.64 0.64 × 2 = 1 + 0.28 0.28 × 2 = 0 + 0.56 0.56 × 2 = 1 + 0.12 0.12 × 2 = 0 + 0.24000000000001 0.24000000000001 × 2 = 0 + 0.48000000000002 0.48000000000002 × 2 = 0 + 0.96000000000004  Here is the answer to 0.54 decimal to binary number: **0.1000101000**   * 1. 256.25   100000000.01   * 1. 127.223   1111111.00111001000101101 |
| 1. Convert the following decimal numbers to 8-bit binary values:    1. 53   00110101   * 1. 98   01100010   * 1. 176   10110000 |
| 1. Convert the following hexadecimal numbers to binary:    1. AB34   1010 1011 0011 0100   * 1. CE122   1100 1110 0001 0010 0010   * 1. F01DB   1111 0000 0001 1101 1011 |
| 1. Convert the following binary numbers to hexadecimal:    1. 111001   39   * 1. 1011101101011101   BB5D   * 1. 101101010010100001   2D4A1 |
| 1. Convert the following hexadecimal numbers to decimal:    1. BA33   (BA33)₁₆ = (11 × 16³) + (10 × 16²) + (3 × 16¹) + (3 × 16⁰) = (47667)₁₀   * 1. FE76B   (FE76B)₁₆ = (15 × 16⁴) + (14 × 16³) + (7 × 16²) + (6 × 16¹) + (11 × 16⁰) = (1042283)₁₀   * 1. 7339D   (7339D)₁₆ = (7 × 16⁴) + (3 × 16³) + (3 × 16²) + (9 × 16¹) + (13 × 16⁰) = (471965)₁₀ |
| 1. Convert the following decimal numbers to hexadecimal:    1. 872   Divide by the base 16 to get the digits from the remainders:   | Division by 16 | Quotient | Remainder  (Digit) | Digit # | | --- | --- | --- | --- | | (872)/16 | 54 | 8 | 0 | | (54)/16 | 3 | 6 | 1 | | (3)/16 | 0 | 3 | 2 |   = (368)16   * 1. 1282   Divide by the base 16 to get the digits from the remainders:   | Division by 16 | Quotient | Remainder  (Digit) | Digit # | | --- | --- | --- | --- | | (1282)/16 | 80 | 2 | 0 | | (80)/16 | 5 | 0 | 1 | | (5)/16 | 0 | 5 | 2 |   = (502)16   * 1. 22014   Divide by the base 16 to get the digits from the remainders:   | Division by 16 | Quotient | Remainder  (Digit) | Digit # | | --- | --- | --- | --- | | (22014)/16 | 1375 | 14 | 0 | | (1375)/16 | 85 | 15 | 1 | | (85)/16 | 5 | 5 | 2 | | (5)/16 | 0 | 5 | 3 |   = (55FE)16 |
| 1. Convert the following octal numbers to binary:    1. 637   Convert each octal digit to 3 binary digits (see conversion table below):  637  = 6 3 7  = 110 011 111  = 110011111   * 1. 2340   Convert each octal digit to 3 binary digits (see conversion table below):  2340  = 2 3 4 0  = 010 011 100 000  = 010011100000   * 1. 1571   Convert each octal digit to 3 binary digits (see conversion table below):  1571  = 1 5 7 1  = 001 101 111 001  = 001101111001 |
| 1. Convert the following binary numbers to octal:    1. 111001011   Convert every 3 binary digits (from bit0) to octal digit (see conversion table below):  111001011  = 111 001 011  = 7 1 3  = 713   * 1. 1001010100   Convert every 3 binary digits (from bit0) to octal digit (see conversion table below):  1001010100  = 1 001 010 100  = 1 1 2 4  = 1124   * 1. 10101011111   Convert every 3 binary digits (from bit0) to octal digit (see conversion table below):  10101011111  = 10 101 011 111  = 2 5 3 7  = 2537 |
| 1. Convert the following octal numbers to decimal:    1. 67   67 = (6 × 8¹) + (7 × 8⁰) = 55   * 1. 532   532 = (5 × 8²) + (3 × 8¹) + (2 × 8⁰) = 346   * 1. 246   246 = (2 × 8²) + (4 × 8¹) + (6 × 8⁰) = 166 |
| 1. Convert the following decimal numbers to octal:    1. 168   Divide by the base 8 to get the digits from the remainders:   | Division by 8 | Quotient | Remainder  (Digit) | Digit # | | --- | --- | --- | --- | | (168)/8 | 21 | 0 | 0 | | (21)/8 | 2 | 5 | 1 | | (2)/8 | 0 | 2 | 2 |   = (250)8   * 1. 129   Divide by the base 8 to get the digits from the remainders:   | Division by 8 | Quotient | Remainder  (Digit) | Digit # | | --- | --- | --- | --- | | (129)/8 | 16 | 1 | 0 | | (16)/8 | 2 | 0 | 1 | | (2)/8 | 0 | 2 | 2 |   = (201)8   * 1. 2345   Divide by the base 8 to get the digits from the remainders:   | Division by 8 | Quotient | Remainder  (Digit) | Digit # | | --- | --- | --- | --- | | (2345)/8 | 293 | 1 | 0 | | (293)/8 | 36 | 5 | 1 | | (36)/8 | 4 | 4 | 2 | | (4)/8 | 0 | 4 | 3 |   = (4451)8 |
| 1. Convert each of the following decimal numbers to BCD:    1. 9   1001   * 1. 27   0010 0111   * 1. 568   0101 0110 1000 |
| 1. Convert each of the following BCD numbers to decimal:    1. 1001   9   * 1. 01 0111 0011   173   * 1. 0101 0010 0100   524 |
| 1. Perform the following arithmetic operations:    1. 10002 + 11012   1000 + 1101  = 010101   * 1. 0101101002 + 011010112   010110100 + 01101011  = 0100011111   * 1. 111102 – 100112   11110 – 10011  = 01011010 – 10111  = 011   |  |  |  | | --- | --- | --- | | 18 | 1A | B | | + |  | B | 7 | 8 | |  | | | | | | = | 1 | 4 | 2 | 3 |   Hex addition follows the same rules as decimal addition with the only difference being the added numerals A, B, C, D, E, and F. It may be convenient to have the decimal equivalent values of A through F handy when performing hex operations if the values have not yet been committed to memory. Below is an example of hex addition. Work through the example, and refer to the text below it for further details.   * 1. CD16 + 7C16   cd + 7c = 149   * 1. E816 – 1A16   e8 - 1a = CE   * 1. FE16 – DF16   fe - df = 1F |

\*Upload your group work in Wiki