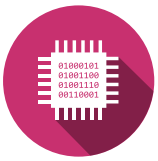


Numerical Representation and Codes

Exercises Digital Design

Solution vs. Hints:
While not every response provided herein constitutes a comprehensive solution, some serve as helpful hints intended to guide you toward discovering the solution independently. In certain instances, only a portion of the solution is presented.

1 | NUM - Number systems

1.1 Determine up to what value you can count with numbers coded on:

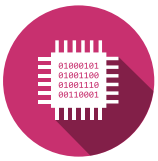
a) 0 to 15
b) 0 to 255
c) 0 to 1023
d) 0 to 65535
e) 0 to 4′294′967′295 (4 Gbit)

num/number-systems-01

1.2 Determine up to which value can be counted, with hexadecimal numbers encoded on:

a) 0 to 65535
b) 0 to 4′294′967′295 (4 Gbit)

num/number-systems-02



2 | NUM - Converting from one numbering system to another

2.1 Perform the conversion of the following pure binary numbers in decimal format:

a) 6_{10}
b) 15_{10}
c) 74_{10}
d) 11_{10}
e) 255_{10}

num/conversion-01

2.2 Perform the conversion of the following decimal numbers in binary format:

a) $111\ 1101_2$
b) $1\ 0000_2$
c) $1111\ 1110\ 0101\ 1001_2$
d) $1\ 0000\ 0000_2$
e) 1001_2

num/conversion-02

2.3 Perform the conversion of the following hexadecimal numbers in binary format:

a) 1110_2
b) $1\ 0101\ 1100_2$
c) $1010\ 1011\ 0011\ 1101_2$
d) $1001\ 1111\ 0111_2$
e) $10\ 0011\ 0100\ 0110_2$

num/conversion-03

2.4 Perform the conversion of the following binary numbers in hexadecimal format:

a) A_{16}
b) 6_{16}
c) EB_{16}
d) $2F_{16}$
e) C_{16}

num/conversion-04

2.5 Perform the conversion of the following hexadecimal numbers in decimal format:

a) 13_{10}
b) 348_{10}
c) 564_{10}
d) 254_{10}
e) 42681_{10}

num/conversion-05

2.6 Perform the conversion of the following decimal numbers in hexadecimal format:

1. 80_{16}
2. 10_{16}
3. $\mathrm{FE59}_{16}$
4. $\mathrm{D1}_{16}$
5. 9_{16}

3 | NUM - Operation on logical numbers

3.1 Perform the following additions in the binary system:

1. $0010\ 1010_2$
2. $0110\ 1001_2$
3. $1011\ 0011_2$
4. $1000\ 0000_2$

num/operation-01

3.2 Perform the following subtractions in the binary system:

1. $0011\ 1010_2$
2. $0011\ 1010_2$
3. $0000\ 1100_2$
4. $0111\ 1111_2$

num/operations-02

3.3 Perform the following multiplications in binary:

1. $0011\ 1100_2$
2. $0011\ 1100_2$
3. $0011\ 0000_2$
4. $0110\ 0010_2$

num/operation-03

3.4 Perform the following additions in the hexadecimal system:

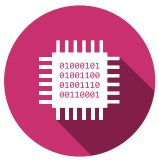
1. 1300_{16}
2. 8984_{16}
3. 1333_{16}
4. 13534_{16}

num/operation-04

3.5 Determine the binary value of:

1. 1001_2
2. 110001_2
3. 11100001_2
4. 111110000001_2 ; $(2^{n-1} - 1) * 2^{n+1} + 1$

num/operation-05



4 | NUM - Codes

4.1 Perform the following additions on BCD encoded numbers:

1. $0100\ 0100\ 0100_{\text{BCD}}$
2. $0110\ 0011\ 0011_{\text{BCD}}$
3. $1001\ 0010_{\text{BCD}}$
4. $0001\ 0000\ 0000_{\text{BCD}}$

num/codes-01

4.2 Perform the conversion of the Gray code 1001_{Gray} using the recursion formula in the script.

1110_2

num/codes-02

5 | NUM - Representation of signed numbers

5.1 Represent the following decimal and pure binary numbers encoded to 8 bits using the sign-size, one's complement, and two's complement methods:

1. $0001\ 0010_{s}$
   $0001\ 0010_{1cl}$
   $0001\ 0010_{2cl}$
2. $1000\ 0011_{s}$
   $1111\ 1100_{1cl}$
   $1111\ 1101_{2cl}$
3. $0000\ 0000_{s}$;$1000\ 0000_{s}$
   $0000\ 0000_{1cl}$;$1111\ 1111_{1cl}$
   $0000\ 0000_{2cl}$
4. $0001\ 1010_{s}$
   $0001\ 1010_{1cl}$
   $0001\ 1010_{2cl}$
5. $0000\ 1010_{s}$
   $0000\ 1010_{1cl}$
   $0000\ 1010_{2cl}$
6. $1110\ 0100_{s}$
   $1001\ 1011_{1cl}$
   $1001\ 1100_{2cl}$

num/representation-01

1. $1111\ 1111_{2}$
2. $1000\ 1000_{2}$
3. $0001\ 0000_{2}$
4. FF_{16}
5. BC_{16}
6. $7F_{16}$

num/representation-02

5.2 Given the numbers 0001_{2} and 1001_{2} expressed as two's complement encoded on 4 bits. Represent the same numbers encoded as two's complement on 8 bits.

0000 0001;1111 1001

num/representation-03