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1 Number conversions

1.1 Convert following numbers to binary numbers

a) $55_{10} = 1\cdot2^5 + 1\cdot2^4 + 1\cdot2^3 + 0\cdot2^2 + 1\cdot2^1 + 1\cdot2^0 = 11\ 0111_2$

b) $677_{10} = 1\cdot2^9 + 0\cdot2^8 + 1\cdot2^7 + 0\cdot2^6 + 1\cdot2^5 + 0\cdot2^4 + 0\cdot2^3 + 1\cdot2^2 + 0\cdot2^1 + 1\cdot2^0 = 10\ 1010\ 0101_2$

c) $65_{10} = 1\cdot2^6 + 0\cdot2^5 + 0\cdot2^4 + 0\cdot2^3 + 0\cdot2^2 + 0\cdot2^1 + 1\cdot2^0 = 100\ 0001_2$

d) $700_{10} = 1\cdot2^9 + 0\cdot2^8 + 1\cdot2^7 + 0\cdot2^6 + 1\cdot2^5 + 1\cdot2^4 + 1\cdot2^3 + 1\cdot2^2 + 0\cdot2^1 + 0\cdot2^0 = 10\ 1011\ 1100_2$

1.2 Convert following base-10 numbers to 2-complement 8 bits numbers.

a) +59 $= -0\cdot2^7 + 0\cdot2^6 + 1\cdot2^5 + 1\cdot2^4 + 1\cdot2^3 + 0\cdot2^2 + 1\cdot2^1 + 1\cdot2^0 = 0011\ 1011_2$

b) -1 $= -1\cdot2^7 + 1\cdot2^6 + 1\cdot2^5 + 1\cdot2^4 + 1\cdot2^3 + 1\cdot2^2 + 1\cdot2^1 + 1\cdot2^0 = 1111\ 1111_2$

c) -128 $= -1\cdot2^7 + 0\cdot2^6 + 0\cdot2^5 + 0\cdot2^4 + 0\cdot2^3 + 0\cdot2^2 + 0\cdot2^1 + 0\cdot2^0 = 1000\ 0000_2$

d) -97 $= -1\cdot2^7 + 0\cdot2^6 + 0\cdot2^5 + 1\cdot2^4 + 1\cdot2^3 + 1\cdot2^2 + 1\cdot2^1 + 1\cdot2^0 = 1001\ 1111_2$

1.3 Convert the following unsigned numbers to the specified radix and size if it is possible. If conversion is not possible state the reason why.

a) 0xE5 → 8 bit binary
$E5_{16} = 1110\ 0101_2$

b) 0x3F1 → 8 bit binary
$3F1_{16} = 0011\ 1111\ 0001_2$ → Can't convert to 8 bit binary

c) 0x3E8 → 10 bit binary
$3E8_{16} = 0011\ 1110\ 1000_2$ → $11\ 1110\ 1000_2$

d) 0x73B → 16 bit binary
$73B_{16} = 0111\ 0011\ 1011_2$ → $0000\ 0111\ 0011\ 1011_2$

e) $0011\ 0010_2$ → 10 bit binary
$0011\ 0010_2$ → $00\ 0011\ 0010_2$

f) $0000\ 0100\ 1000\ 1011_2$ → 12 bit binary
$0000\ 0100\ 1000\ 1011_2$ → $0100\ 1000\ 1011_2$

g) $1101\ 1001_2$ → 16 bit binary
$1101\ 1001_2$ → $0000\ 0000\ 1101\ 1001_2$

h) $0010\ 0011\ 1011_2$ → 8 bit binary
$0010\ 0011\ 1011_2$ → Can't convert to 8 bit binary

1.4 Convert the following signed two's complement numbers to the given size if possible. If conversion is not possible state the reason why.

a) $1001\ 1101_2$ → 12 bit binary
$1001\ 1101_2 = -99_{10} = 1111\ 1001\ 1101_2$

b) $0001\ 0001_2$ → 16 bit binary
$0001\ 0001_2 = 17_{10} = 0000\ 0000\ 0001\ 0001_2$

c) $1111\ 1111\ 1010\ 1111_2$ → 8 bit binary
$1111\ 1111\ 1010\ 1111_2 = -81_{10} = 1010\ 1111_2$

d) $1110\ 1011\ 1001\ 0001_2$ → 12 bit binary
$1110\ 1011\ 1001\ 0001_2 = -5231_{10}$ → Smaller than smallest 12 bit binary (-2048) → Can't convert to 12 bit binary

e) 0xFAC → 16 bit binary
$FAC_{16} = 1111\ 1010\ 1100_2 \rightarrow 0000\ 1111\ 1010\ 1100_2 \rightarrow 1111\ 0000\ 0101\ 0100_2$

f) 0x0F → 16 bit binary
$0F_{16} = 0000\ 1111_2 \rightarrow 0000\ 0000\ 0000\ 1111_2 \rightarrow 1111\ 1111\ 1111\ 0001_2$

g) 0x42 → 10 bit binary
$42_{16} = 0100\ 0001_2 \rightarrow 00\ 0100\ 0001_2 \rightarrow 11\ 1011\ 1111_2$

h) 0xFF13 → 10 bit binary
$FF13_{16} = 1111\ 1111\ 0001\ 0011_2$ → Can't convert to 10 bit binary