CpE111 HW#1 · Solutions.

1.

Given 2.10

b. $110111.101_2 = 32+16+4+2+1+0.5+0.125$

$= 55.625_{10}$

f. $1475.2_8 = 1\times8^3 + 4\times8^2 + 7\times8^1 + 5\times8^0$

$+ 2\times8^{-1} = 512 + 256 + 56 + 5 + 0.25$

$= 829.25_{10}$

h. $AD.E_{16} = 10\times16^1 + 13\times16^0 + 14\times16^{-1}$

$= 160 + 13 + 0.875 = 173.875_{10}$

Given 2.11

a.
$2\lfloor 42 \cdots 0$
$2\lfloor 21 \cdots 1$
$2\lfloor 10 \cdots 0$
$2\lfloor 5 \cdots 1$
$2\lfloor 2 \cdots 0$
$2\lfloor 1 \cdots 1$
$0$

$\Rightarrow 101010_2$

b.

Integer part
$2\lfloor 78 \cdots 0$
$2\lfloor 39 \cdots 1$
$2\lfloor 19 \cdots 1$
$2\lfloor 9 \cdots 1$
$2\lfloor 4 \cdots 0$
$2\lfloor 2 \cdots 0$
$2\lfloor 1 \cdots 1$
$0$

fraction part.
$.5 \times 2 = \boxed{1}\,0$

$\Rightarrow 1001110.1_2$

f. $56.3_8$

$101 \quad 110 . 011_2$

Givone 2.14

a.

$2 \mid 163 \cdots 1$
$2 \mid 81 \cdots 1$
$2 \mid 40 \cdots 0$
$2 \mid 20 \cdots 0$
$2 \mid 10 \cdots 0$
$2 \mid 5 \cdots 1$
$2 \mid 2 \cdots 0$
$2 \mid 1 \cdots 1$
$0$

$.75 \times 2 = 1.5$ → 1
$.5 \times 2 = 1.0$ → 1
stop.

$10100011.11_2$

$2 \mid 202 \cdots 0$
$2 \mid 101 \cdots 1$
$2 \mid 50 \cdots 0$
$2 \mid 25 \cdots 1$
$2 \mid 12 \cdots 0$
$2 \mid 6 \cdots 0$
$2 \mid 3 \cdots 1$
$2 \mid 1 \cdots 1$
$0$

$.9 \times 2 = 1.8$ → 1
$.8 \times 2 = 1.6$ → 1
$.6 \times 2 = 1.2$ → 1
$.2 \times 2 = 0.4$ → 0
$.4 \times 2 = 0.8$ → 0
repeat

$11001010.\overline{11100}_2$

c. $243.6_8$ & $312.\overline{71463}_8$

d. $A3.C_{16}$ & $CA.E\overline{B}_{16}$

2. a. $2^2 = 4$

b. $2^4 = 16$

c. $2^6 = 64$

3. a. 8 MB = $8 \times 2^{20} \times 8$ = 67108864 bits

b. 8 Mb = $8 \times 2^{20}$ = 8388608 bits

c. 64 KB = $64 \times 2^{10}$ = 65536 bits

d. 128 KB = 1048576 bits.

4. DIRECTION = $D_2 D_1 D_0$.

encoding table

| $D_2$ $D_1$ $D_0$ | Direction |
|---|---|
| 0 0 0 | N |
| 0 0 1 | S |
| 0 1 0 | E |
| 0 1 1 | W |
| 1 0 0 | NE |
| 1 0 1 | NW |
| 1 1 0 | SE |
| 1 1 1 | SW |

For 4 additional directions... we need an additional bit in word DIRECTION.

Since $2^4 = 16 > 12$

Also, the empty table should be updated, too.

| $D_3$ $D_2$ $D_1$ $D_0$ | Direction |
|---|---|
| 0 0 0 0 | N |
| 0 0 0 1 | S |
| 0 0 1 0 | E |
| 0 0 1 1 | W |
| 0 1 0 0 | NE |
| 0 1 0 1 | NW |
| 0 1 1 0 | SE |
| 0 1 1 1 | SW |
| 1 0 0 0 | NNW |
| 1 0 0 1 | NNE |
| 1 0 1 0 | SSW |
| 1 0 1 1 | SSE |
| ⋮ | ⋮ |

The other bit patterns are not used.

5. a. $101111_2 = 32+8+4+2+1 = 47_{10}$

b. $0111000_2 = 16+8 = 24_{10}$

c. $111011_2 = 32+16+8+2+1 = 53_{10}$

d. $011101 = 16+8+4+1 = 29_{10}$

6. a. $0\,1110100 = 64+32+16+4 = 116_{10}$

b. $11\,001001 = 128+64+8+1 = 201_{10}$

c. $10000010 = 128+2 = 130_{10}$

7. a.
$2\,|\,125 \cdots 1$
$2\,|\,62 \cdots 0$
$2\,|\,31 \cdots 1$
$2\,|\,15 \cdots 1$
$2\,|\,7 \cdots 1$
$2\,|\,3 \cdots 1$
$2\,|\,1 \cdots 1$
$0$

b.
$2\,|\,153 \cdots 1$
$2\,|\,76 \cdots 0$
$2\,|\,38 \cdots 0$
$2\,|\,19 \cdots 1$
$2\,|\,9 \cdots 1$
$2\,|\,4 \cdots 0$
$2\,|\,2 \cdots 0$
$2\,|\,1 \cdots 1$
$0$

c.
$2\,|\,212 \cdots 0$
$2\,|\,106 \cdots 0$
$2\,|\,53 \cdots 1$
$2\,|\,26 \cdots 0$
$2\,|\,13 \cdots 1$
$2\,|\,6 \cdots 0$
$2\,|\,3 \cdots 1$
$2\,|\,1 \cdots 1$
$0$

$\Rightarrow 1111101_2$ $\Rightarrow 10011001_2$ $\Rightarrow 11010100_2$

8. a. $0x1FB1 = \overline{0001}\,\overline{1111}\,\overline{1011}\,\overline{0001}_2$
$= 8113_{10}$

b. $0X0ACC = \overline{0000}\,\overline{1010}\,\overline{1100}\,\overline{1100}_2$
$= 2764_{10}$

c. $0x11F2 = \overline{0111}\,\overline{0001}\,\overline{1111}\,\overline{0010}_2$
$= 29170_{10}$

d. $0X70BA = \overline{0111}\,\overline{0000}\,\overline{1011}\,\overline{1010}_2 = 28858_{10}$

9. It can display 0 - 9999. so, 10000 bit patterns are needed.
So, the min word size has to be. 14 bits.

$2^{14} > 10000 > 2^{13}$.