

E&CE 223
Assignment 1 - Solutions

Mano 1.3

$$(101110)_2 = 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 32 + 8 + 4 + 2 = 46$$

$$(1110101.11)_2 = 64 + 32 + 16 + 4 + 1 + 0.5 + 0.25 = 117.75$$

$$(110110100)_2 = 256 + 128 + 32 + 16 + 4 = 436$$

Mano 1.5

$$1231 / 2 = 615 \text{ rem } 1$$

$$615 / 2 = 307 \text{ rem } 1$$

$$307 / 2 = 153 \text{ rem } 1$$

$$153 / 2 = 76 \text{ rem } 1$$

$$76 / 2 = 38 \text{ rem } 0$$

$$38 / 2 = 19 \text{ rem } 0$$

$$19 / 2 = 9 \text{ rem } 1$$

$$9 / 2 = 4 \text{ rem } 1$$

$$4 / 2 = 2 \text{ rem } 0$$

$$2 / 2 = 1 \text{ rem } 0$$

$$1 / 2 = 0 \text{ rem } 1$$

$$(1231)_{10} = (10011001111)_2$$

$$673 / 2 = 336 \text{ rem } 1$$

$$336 / 2 = 168 \text{ rem } 0$$

$$168 / 2 = 84 \text{ rem } 0$$

$$84 / 2 = 42 \text{ rem } 0$$

$$42 / 2 = 21 \text{ rem } 0$$

$$21 / 2 = 10 \text{ rem } 1$$

$$10 / 2 = 5 \text{ rem } 0$$

$$5 / 2 = 2 \text{ rem } 1$$

$$2 / 2 = 1 \text{ rem } 0$$

$$1 / 2 = 0 \text{ rem } 1$$

$$0.23 \times 2 = 0.46 \text{ coeff} = 0$$

$$0.46 \times 2 = 0.92 \text{ coeff} = 0$$

$$0.92 \times 2 = 1.84 \text{ coeff} = 1$$

$$0.84 \times 2 = 1.68 \text{ coeff} = 1$$

$$0.68 \times 2 = 1.36 \text{ coeff} = 1$$

$$0.36 \times 2 = 0.72 \text{ coeff} = 0$$

$$(673.23)_{10} = (1010100001.001110 \dots)_2$$

$$(10000)_{10} = (100111000100000)_2$$

$$(1998)_{10} = (11111001110)_2$$

Mano 1.6

(a)

$$7562 / 8 = 945 \text{ rem } 2$$

$$945 / 8 = 118 \text{ rem } 1$$

$$118 / 8 = 14 \text{ rem } 6$$

$$14 / 8 = 1 \text{ rem } 6$$

$$1 / 8 = 0 \text{ rem } 1$$

$$0.45 \times 8 = 3.6 \text{ coeff} = 3$$

$$0.60 \times 8 = 4.8 \text{ coeff} = 4$$

$$0.80 \times 8 = 6.4 \text{ coeff} = 6$$

$$0.40 \times 8 = 3.2 \text{ coeff} = 3$$

$$0.20 \times 8 = 1.6 \text{ coeff} = 1$$

$$0.60 \times 8 = 4.8 \text{ coeff} = 4$$

$$(7562.45)_{10} = (16612.346314 \dots)_8$$

(b)

$$1938 / 16 = 121 \text{ rem } 2$$

$$121 / 16 = 7 \text{ rem } 9$$

$$7 / 16 = 0 \text{ rem } 7$$

$$0.257 \times 16 = 4.112 \text{ coeff} = 4$$

$$0.112 \times 16 = 1.792 \text{ coeff} = 1$$

$$0.792 \times 16 = 12.672 \text{ coeff} = 12 \rightarrow C$$

$$0.672 \times 16 = 10.752 \text{ coeff} = 10 \rightarrow A$$

$$0.752 \times 16 = 12.032 \text{ coeff} = 12 \rightarrow C$$

$$0.032 \times 16 = 0.512 \text{ coeff} = 0$$

$$(1938.257)_{10} = (792.41CAC0 \dots)_{16}$$

$$(c) (175.175)_{10} = (10101111.001011 \dots)_2$$

1-8.	<u>Decimal</u>	<u>Binary</u>	<u>Octal</u>	<u>Hexadecimal</u>
	225	11100001	341	E1
	215	11010111	327	D7
	403	110010011	623	193
	10949	10101011000101	25305	2AC5

Note binary to octal and hexadecimal can be done by grouping (from binary point) the appropriate number of binary digits.

$$(225)_{10} = (11100001)_2$$

$$(11\ 100\ 001)_2 = (341)_8$$

$$(1110\ 0001)_2 = (E1)_{16}$$

1-15.	<u>Number</u>	<u>1's complement</u>	<u>2's complement</u>
	10101110	01010001	01010010
	10000001	01111110	01111111
	10000000	01111111	10000000
	00000001	11111110	11111111
	00000000	11111111	00000000

Mano 1.17

(a) $11010 - 10000$

$$\begin{array}{r} 11010 \\ +10000 \text{ (2's complement of 10000)} \\ \hline 101010 \\ \wedge \end{array}$$

\wedge carry out discarded - result is positive value 01010

(b) $11010 - 01101$

$$\begin{array}{r} 11010 \\ +10011 \text{ (2's complement of 01101)} \\ \hline 101101 \\ \wedge \end{array}$$

\wedge carry out discarded - result is positive value 01101

(c) $100 - 110000$

$$\begin{array}{r} 000100 \\ +010000 \text{ (2's complement of 110000)} \\ \hline 010100 \\ \wedge \end{array}$$

\wedge no carry out - result is negative value in 2's comp form
result = - 101100

(d) $1010100 - 1010100$

$$\begin{array}{r} 1010100 \\ +0101100 \text{ (2's complement of 1010100)} \\ \hline 10000000 \\ \wedge \end{array}$$

\wedge carry out discarded - result is positive value 0000000

Mano 1.17 (1's complement)

(a) $11010 - 10000$

$$\begin{array}{r} 11010 \\ +01111 \text{ (1's complement of 10000)} \\ \hline 101001 \\ + \quad 1 \text{ (end-around carry)} \\ \hline 01010 \text{ positive result} \end{array}$$

(b) $11010 - 1101$

$$\begin{array}{r} 11010 \\ +10010 \text{ (1's complement of 01101)} \\ \hline 101100 \\ + \quad 1 \text{ (end around carry)} \\ \hline 01101 \text{ positive result} \end{array}$$

(c) $100 - 110000$

$$\begin{array}{r} 000100 \\ +001111 \text{ (1's complement of 110000)} \\ \hline 010011 \\ \wedge \end{array}$$

^ no end carry result is negative number in 1's complement form

$$\text{result} = -101100$$

(d) $1010100 - 1010100$

$$\begin{array}{r} 1010100 \\ +0101011 \text{ (1's complement of 1010100)} \\ \hline 1111111 \\ \wedge \end{array}$$

^ no end carry, result is negative number in 1's complement form

$$\text{result} = -000000 = 0$$

Mano 1.19

(a) $101011 + 111000$

$$\begin{array}{r} 101011 \quad (-21) \\ +111000 \quad (-8) \\ \hline 1100011 \\ \wedge \end{array}$$

^ ignore carry, result = 100011 or $-011101 = -29$

(b) $001110 + 110010$

$$\begin{array}{r} 001110 \quad (+14) \\ +110010 \quad (-14) \\ \hline 1000000 \\ \wedge \end{array}$$

^ ignore carry, result = 000000

(c) $111001 - 001010$ [$(-7) - (+10) = (-17)$]

$$\begin{array}{r} 111001 \quad (-7) \\ +110110 \quad (2's \text{ complement of } 001010) \quad (-10)_{10} \\ \hline 1101111 \\ \wedge \end{array}$$

^ ignore carry, result = $101111 = (-17)_{10}$

(d) $101011 - 100110$ [$(-21) - (-26) = (+5)$]

$$\begin{array}{r} 101011 \quad (-21) \\ +011010 \quad (2's \text{ complement of } 100110) \quad (+26) \\ \hline 1000101 \\ \wedge \end{array}$$

^ ignore carry, result = $000101 = (+5)_{10}$

Mano 1.23

- | | | |
|-----|--------------|---------------------|
| (a) | 8620 in BCD | 1000 0110 0010 0000 |
| (b) | in excess-3 | 1011 1001 0101 0011 |
| (c) | in 2421 code | 1110 1100 0010 0000 |
| (d) | binary | 10000110101100 |
| (e) | 84-2-1 code | 1000 1010 0110 0000 |