

ITI1100A
Assignment # 1
SOLUTIONS

1.3

$$(4310)_5 = 4 * 5^3 + 3 * 5^2 + 1 * 5^1 = 580_{10}$$

$$(198)_{12} = 1 * 12^2 + 9 * 12^1 + 8 * 12^0 = 260_{10}$$

$$(435)_8 = 4 * 8^2 + 3 * 8^1 + 5 * 8^0 = 285_{10}$$

$$(345)_6 = 3 * 6^2 + 4 * 6^1 + 5 * 6^0 = 137_{10}$$

1.7

$$64CD = 0110_0100_1100_1101_2 = 110_010_011_001_101 = (62315)_8$$

1.9

(a) $10110.0101_2 = 16 + 4 + 2 + .25 + .0625 = 22.3125$

(b) $16.5_{16} = 16 + 6 + 5*(.0615) = 22.3125$

(c) $26.24_8 = 2 * 8 + 6 + 2/8 + 4/64 = 22.3125$

(d) $DADA.B_{16} = 13*16^3 + 10*16^2 + 13*16 + 10 + 11/16 = 56,026.6875$

(e) $1010.1101_2 = 8 + 2 + .5 + .25 + .0625 = 10.8125$

1.13

(a) Convert 27.315 to binary:

	Integer Quotient		Remainder	Coefficient
$27/2 =$	13	+	$1/2$	$a_0 = 1$
$13/2$	6	+	$1/2$	$a_1 = 1$
$6/2$	3	+	0	$a_2 = 0$
$3/2$	1	+	$1/2$	$a_3 = 1$
$1/2$	0	+	$1/2$	$a_4 = 1$

$$27_{10} = 11011_2$$

	Integer		Fraction	Coefficient
$.315 \times 2 =$	0	+	.630	$a_{-1} = 0$
$.630 \times 2 =$	1	+	.26	$a_{-2} = 1$
$.26 \times 2 =$	0	+	.52	$a_{-3} = 0$
$.52 \times 2 =$	1	+	.04	$a_{-4} = 1$

$$.315_{10} \cong .0101_2 = .25 + .0625 = .3125$$

$$27.315 \cong 11011.0101_2$$

(b) $2/3 \cong .666666667$

	Integer		Fraction	Coefficient
$.6666_6666_67 \times 2 =$	1	+	$.3333_3333_34$	$a_{-1} = 1$

$$\begin{array}{rcll}
.3333333334 \times 2 = & 0 & + .6666666668 & a_2 = 0 \\
.6666666668 \times 2 = & 1 & + .3333333336 & a_3 = 1 \\
.3333333336 \times 2 = & 0 & + .6666666672 & a_4 = 0 \\
.6666666672 \times 2 = & 1 & + .3333333344 & a_5 = 1 \\
.3333333344 \times 2 = & 0 & + .6666666688 & a_6 = 0 \\
.6666666688 \times 2 = & 1 & + .3333333376 & a_7 = 1 \\
.3333333376 \times 2 = & 0 & + .6666666752 & a_8 = 0 \\
.6666666667_{10} \cong .10101010_2 = .5 + .125 + .0313 + ..0078 = .6641_{10}
\end{array}$$

(c). $10101010_2 = .1010_2 = .AA_{16} = 10/16 + 10/256 = .6641_{10}$ (Same as (b)).

1.14

(a) 0001_0000 1's comp: 1110_1111 2's comp: 1111_0000	(b) 0000_0000 1's comp: 1111_1111 2's comp: 0000_0000	(c) 1101_1010 1's comp: 0010_0101 2's comp: 0010_0110
(d) 1010_1010 1's comp: 0101_0101 2's comp: 0101_0110	(e) 1000_0101 1's comp: 0111_1010 2's comp: 0111_1011	(f) 1111_1111 1's comp: 0000_0000 2's comp: 0000_0001

1.16

	C3DF	C3DF: 1100_0011_1101_1111
15's comp:	3C20	1's comp: 0011_1100_0010_0000
16's comp:	3C21	2's comp: 0011_1100_0010_0001 = 3C21

1.17

(a) $2,579 \rightarrow 02,579 \rightarrow 97,420$ (9s comp) $\rightarrow 97,421$ (10's comp)
 $4637 - 2,579 = 2,579 + 97,421 = 2058_{10}$

(b) $1800 \rightarrow 01800 \rightarrow 98199$ (9s comp) $\rightarrow 98200$ (10's comp)
 $125 - 1800 = 00125 + 98200 = 98325$ (negative)
Magnitude: 1675
Result: $125 - 1800 = -1675$

(c) $4,361 \rightarrow 04361 \rightarrow 95638$ (9s comp) $\rightarrow 95639$ (10s comp)
 $2043 - 4361 = 02043 + 95639 = 97682$ (Negative)
Magnitude: 2318
Result: $2043 - 6152 = -2318$

(d) $745 \rightarrow 00745 \rightarrow 99254$ (9s comp) $\rightarrow 99255$ (10s comp)
 $1631 - 745 = 01631 + 99255 = 0886$ (Positive)
Result: $1631 - 745 = 886$

1.18

Note: Consider sign extension with 2s complement arithmetic.

- (a)
$$\begin{array}{r} 0_10010 \\ 1's\ comp: 1_01101 \\ 2's\ comp: 1_01110 \\ \hline 0_10011 \\ \text{Diff: } \underline{0_00001} \text{ (Positive)} \\ \text{Check: } 19 - 18 = +1 \end{array}$$
- (b)
$$\begin{array}{r} 0_100110 \\ 1's\ comp: 1_011001 \text{ with sign extension} \\ 2's\ comp: 1_011010 \\ \hline 0_100010 \\ \underline{1_111100} \text{ sign bit indicates that the result is negative} \\ 0_000011 \text{ 1's complement} \\ 0_000100 \text{ 2's complement} \\ 000100 \text{ magnitude} \\ \text{Result: } -4 \\ \text{Check: } 34 - 38 = -4 \end{array}$$
- (c)
$$\begin{array}{r} 0_110101 \\ 1's\ comp: 1_001010 \\ 2's\ comp: 1_001011 \\ \hline 0_001001 \\ \underline{1_010100} \text{ (negative)} \\ 0_101011 \text{ (1s comp)} \\ 0_101100 \text{ (2s complement)} \\ 101100 \text{ (magnitude)} \\ -44_{10} \text{ (result)} \end{array}$$
- (d)
$$\begin{array}{r} 0_010101 \\ 1's\ comp: 1_101010 \text{ with sign extension} \\ 2's\ comp: 1_101011 \\ \hline 0_101000 \\ \underline{0_010011} \text{ sign bit indicates that the result is positive} \\ \text{Result: } 19_{10} \\ \text{Check: } 40 - 21 = 19_{10} \end{array}$$