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07190

Dated: DLD Homework #1

Q1) a) $(124)_5 = 1\times5^2 + 2\times5^1 + 4\times5^0$
$= 25 + 10 + 4 = (39)_{10}$

(b) $(397)_{12} = 3\times12^2 + 9\times12^1 + 7\times12^0$
$= 432 + 108 + 7 = (547)_{10}$

(c) $(534.276)_8 = 5\times8^2 + 3\times8^1 + 4\times8^0 + \cdots + 2\times8^{-1} + 7\times8^{-2} + 6\times8^{-3}$
$= 320 + 24 + 4 + 0.3710937\bar{5}$
$= (348.3710937\bar{5})_{10}$

d) $(0.234)_6 = 0. + 2\times6^{-1} + 3\times6^{-2} + 4\times6^{-3}$
$= (0.435185185\bar{2})_{10}$

Q2) a) $(715)_8 \rightarrow 13$
$(715)_8 = 7\times8^2 + 1\times8^1 + 5\times8^0 = (461)_{10}$
$461 \div 13 = 35 \div 13 = 2 \div 13 = 0$
r = 6, r = 9, r = 2
$(461)_{10} = \underline{(296)_{13}}$

b) $(34.41)_6 \rightarrow 8$
$(34.41)_6 = 3\times6^1 + 4\times6^0 + 0. + 4\times6^{-1} + 1\times6^{-2}$
$= (22.694)_{10}$
$22 + 0.694$
$\therefore 22 \div 8 = 2,$ [illegible] $\Rightarrow$ [illegible]
r = 6 $\Rightarrow$ (26)
$\therefore 0.694 \times 8 = 5 + [0.552 \times 8 = 4 + [0.416 \times 8$
$= 3 + [0.328 \times 8 = 2 + 0.624 - - - -$
$= (5432\text{--})$
Num $\Rightarrow (26.5432)_8$
$(34.41)_6 \rightarrow (26.5432)_8$

Dated:

(c) $(0.6775)_8 \rightarrow 16$

0. 6 7 7 5

110 111 111 101

1101 1111 1101

0. D F D

$\Rightarrow (0.DFD)_{16}$

d) $(110110.011)_2 \rightarrow 10$

32 16 8 4 2 1 2^{-1} 2^{-2} 2^{-3}

1 1 0 1 1 0 . 0 1 1

$\Rightarrow 32 + 16 + 4 + \frac{1}{4} + \frac{1}{8} = (54.375)_{10}$

Q3) 1 0 0 0 1 0 0 1 0 1 1 1

(a) Unsigned = $2^{11} + 2^7 + 2^4 + 2^2 + 2^1 + 2^0 = (2199)_{10}$

(b) Signed (2s Comp) * Left most is sign.

1, 0 0 0 1 0 0 1 0 1 1 1

↳ 2s Comp = 1 1 1 0 1 1 0 1 0 0 1

Num $\Rightarrow$ 1 1 1 0 1 1 0 1 0 0 1

$\Rightarrow -[2^{10} + 2^9 + 2^8 + 2^6 + 2^5 + 2^3 + 2^0] = (-1897)_{10}$

c) Signed (1s Comp) * Left most is sign.

1, 0 0 0 1 0 0 1 0 1 1 1

↳ 1s Comp = 1 1 1 0 1 1 0 1 0 0 0

Num $\Rightarrow$ 1 1 1 0 1 1 0 1 0 0 0

$-[2^{10} + 2^9 + 2^8 + 2^6 + 2^5 + 2^3] = (-1896)_{10}$

d) BCD $\Rightarrow$ 1000 1001 0111

8 9 7

$(897)_{10} \rightarrow$ BCD

Dated:

Q4) @ # $ % + & < >

(a) 0 1 2 3 4 5 6 7

Actual:	0	1	2	3	4	5	6	7	8	9	10	11	12
Coded:	@	#	$	%	+	&	<	>	#@	##	#$	#%	#+

* Follows a base 8 system where digits from 0-7 are replaced by symbols

(b) $(43)_{10} \rightarrow 43 \div 8 = 5$

$r = 3 \Rightarrow (53)_8 \Rightarrow (\& \%)_{CODED}$

(c) $(\$@\#)_{CODED} \Rightarrow (201)_8$

$(201)_8 \Rightarrow 2\times8^2 + 0\times8^1 + 1\times8^1 = (129)_{10}$

Q5) $(34+25)^* 45 = 3425$

$[[3\cdot u^1 + 4\cdot u^0] + [2\cdot u^1 + 5\cdot u^0]]^* [4\cdot u^1 + 5\cdot u^0]$

$= [3\cdot u^3 + 4\cdot u^2 + 2\cdot u^1 + 5\cdot u^0]$

$\Rightarrow [(3u+4)+(2u+5)] * (4u+5) = 3u^3 + 4u^2 + 2u + 5$

$\Rightarrow (5u+9) * (4u+5) = 3u^3 + 4u^2 + 2u + 5$

$20u^2 + 61u + 45 = 3u^3 + 4u^2 + 2u + 5$

$3u^3 - 16u^2 - 59u - 4020$

$u = 8, -1, 5/3$

$\Rightarrow \boxed{u = 8}$

* Since a base 8 number system was used, the aliens had 8 fingers as that is the base they would count in naturally.

Dated:

Q6) $(789)_{10}$

- Directly:

2	789	
2	394	r 1
2	197	r 0
2	98	r 1
2	49	r 0
2	24	r 1
2	12	r 0
2	6	r 0
2	3	r 0
2	1	r 1
	0	r 1

$(1100010101)_2$

- First Hexa then binary:

16	789	
16	49	r 5
16	3	r 1
	0	r 3

$(315)_{16}$

3 1 5

0011 0001 0101

$\hookrightarrow (1100010101)_2$

* Converting to hexa then binary was faster as dividing by a larger base resulted in bigger remainders & reduced the number of times division had to be done. Then each digit could be converted to binary with ease, thus reducing time.

Q7) (a) 16 = G, 17 = H, 18 = I, 19 = J,

(b) 8 Lmen months $\Rightarrow (DHJSF)_{20} + (21DHH)_{20} + (5B3E)_{20} + (5B3E)_{20}$

$$\left[\begin{array}{r} D\ H\ J\ 5\ F \\ +\ 2\ 1\ D\ H\ H \\ \hline F\ J\ D\ 3\ C \end{array}\right] + \left[\begin{array}{r} 5\ B\ 3\ E \\ +\ 5\ B\ 3\ E \\ \hline B\ 2\ 7\ 8 \end{array}\right] \Rightarrow \text{Total} = \begin{array}{r} F\ J\ D\ 3\ C \\ +\ B\ 2\ 7\ 8 \\ \hline G\ A\ F\ B\ O \end{array}$$

A has to pay back $(GAFBO)_{20}$.

(c) Profit = 21DHH + B278 = 2CG55

$(2CG55)_{20} = 2\times20^4 + C\times20^3 + G\times20^2 + 5\times20^1 + 5\times20^0$

$= (422505)_{10}$

* A earns a profit of $(422505)_{10}$.

Dated:

Q8) First: ali (61 6C 69) X1
Last : asa (61 73 61) X2.

(a) X1 − X2 61 6C 69
0 − 61 73 61

X2 → 16s compliment FFFFFF
617361
9E8C9E +1 ⇒ 9F8C9F.

⇒ 61'6'C'69
+ 9F8C9F.
FFF908. 16s Comp FFFFFF
FFF908
000 6F7 +1
6F8

X1 − X2 = $(-6F8)_{16}$

(b) X2 − X1 61 7361
616C69

X1 → 15s Complement ⇒ FFFFFF
616C69
9F9396

⇒ 16'1 7361
+ 9F 9396
1000 6F7
(→Drop last digit. ⇒ (000 6F7)

(c) X1 → 616C69
⇒ 0110 0001 0110 1100 0110 1001
(3 0 2 6 6 1 5 1)8

X2 ⇒ 6 1 7 3 6 1
⇒ 011,000,010,111,001,101,100,001
(3 0 2 7 1 5 4 1)8

Dated:

X1 $30'266'151$

+ X2 30271541

60557712

$X1 + X2 \Rightarrow (60557712)_8$

Q9) a) $(11043)_8 - (5214)_8$

77777

-05214

$72563 + 1 \Rightarrow (7256 4)_8$

$11'043$

$+72564$

103627

↳ Drop last most digit

$\Rightarrow (03627)_8$

$(11043)_8 - (5214)_8 = (03627)_8$

b) $(10111.001)_2 - (01101.001)_2$

01101.001 2s Comp $(10010.111)_2$

$1'0'1'1'1.'0'0 1$

$+10010.111$

101010.000

↳ Drop last digit ⇒ exceeding. $\Rightarrow (01010.000)_2$

Dated:

Q10) a) 579 - 286

10's Comp of 286 ⇒ 999 - 286 + 1 = $(714)_{10}$

579	→	0111	0111	1001
+ 714	→	0111	0001	0100
		1110	1000	1101
	+	0110	+1	0110
Drop ←	(1)	0010	1001	0011
		0010	1001	0011
		2	9	3

579 - 286 = $(293)_{10}$

b) 865 + 1356

1356	→	0001	0011	0101	0110
+ 0865	→	0000	1000	0110	0101
		0001	1011	1011	1011
			0110	0110	0110
		0010	0010	0010	0001
		2	2	2	1

865 + 1356 = $(2221)_{10}$

c) 78.54 - 32.91

10's Comp of 32.91 ⇒ 99.9 - 32.9 + 0.1 = 67.09

78.54	→	0111	1000	0101	0100
+ 67.09	→	0110	0111	0000	1001
		1101	1111	0101	1101
		0110	0110	0101	0110
Drop ←		0100	0101	0110	0100
		4	5	6	4

Dated:

c) $78.54 - 32.91$

10's Comp of 32.91 $\Rightarrow 99.99 - 32.91 + 0.01 = 67.09$

78.54 → 0111 1000 . 0101 0100

+67.09 → 0110 0111 . 0000 1001

1001 1111 . 0101 1101

0110 0110 . 0110

Drop ← (1) 0100 0101 . 0110 0011

4 5 . 6 3

$\Rightarrow (45.63)_{10}$

d) $0.4938 + 1.965$ ....

1.9650 → 0001 . 1001 0110 0101 0000

+0.4938 → 0000 . 0100 1001 0011 1000

0001 . 1101 1111 1000 1000

0110 0110

0010 . 0100 0101 1000 1000

2 . 4 5 8 8

$\Rightarrow (2.4588)_{10}$

Q11) (a) $(+9)_{10} + (+12)_{10}$

+9 → 01001

+12 → 01100

10101 → Overflow since we need an extra bit to store sign.

b) $(+12)_{10} - (+9)_{10}$

(+12) 01100 ⇒ 01100

−(+9) − 01001 ⇒ +10111

Drop ← 10 0011 ⇒ $(00011)_{2's} \Rightarrow (+3)_{10}$

No Overflow

Dated:

(c) $(-13)_{10} + (-12)_{10}$

-13 11101 → 10011

-12 11100 → 10100

Extra = 100111

Overflow. 111001 → $(-25)_{10}$

(d) $(-13)_{10} + (-5)_{10}$

-13 11101 → 10011

-5 10101 → 11011

Extra = 101110

Overflow 10010

Q12) $(0111\ 1111)_2 = (+127)_{10} = (7F)_{16}$

Largest binary number is $(01111111)_2$

Decimal is $(+127)_{10}$

Hexadecimal is $(7F)_{16}$

Q13)

Decimal	Signed Mag	Signed 1s Comp.	Signed 2's Comp.
-0	10000000	1111 1111	~~10000000~~
-8	10001000	11110111	1111 1000
+40	0010 1000	0010 1000	0010 1000
-64	1100 0000	1011 1111	1100 0000
+127	0111 1111	0111 1111	0111 1111
-128	—	—	10000000

Q14) (a) 11011010 → 111011010

(b) 10000101 → 100000101

Dated:

Q15) as 1001 0101 0011 0111

1001 0101 0011 0111

\+ 0011 0011 0011 0011

1100 1000 0110 1010

= (1100 1000 0110 1010)$_{XS3}$