Assignment 1

Is on website
Due Thurs Jan 22, 8:30am
Submit pdf or jpeg files
to D2L Dropbox.

1.4 Converting From Decimal Cont'd

Ex: Convert 628 to base 3, and check your answer.

	Q	R	
$628 \div 3$	209	1	$\leftarrow 3 \times 0.333\ldots$
$209 \div 3$	69	2	
$69 \div 3$	23	0	
$23 \div 3$	7	2	
$7 \div 3$	2	1	
$2 \div 3$	0	2	

base

decimal part

$$628 = 212021_3$$

$$212021_3 = 2\times3^5 + 1\times3^4 + 2\times3^3 + 2\times3^1 + 1\times3^0$$

3^5 place

3^0 place

$= 2 \times 243 + 1 \times 81 + 2 \times 27 + 2 \times 3 + 1 \times 1$

$= 628$

To convert non-integer numbers from decimal to another base, we do repeated multiplication.

Ex: Convert 0.375 to binary. ← base 2

	Integer	Non-Integer
0.375×2	0	0.75
0.75×2	1	0.5
0.5×2	1	0

Stop when non-integer = 0.
Digits are the integer values, in order.

$0.375 = 0.011_2$

Optional Check:

$0.011_2 = 1 \times 2^{-2} + 1 \times 2^{-3}$

2^{-1} place, 2^{-3} place

$= 1 \times \frac{1}{4} + 1 \times \frac{1}{8}$

$= 0.375$

Ex: Convert 0.8125 to binary

base 2

	I	N
0.8125×2	1	0.625
0.625×2	1	0.25
0.25×2	0	0.5
0.5×2	1	0

$0.8125 = 0.1101_2$

Ex: Convert 0.734375 to hexadecimal. (base 16)

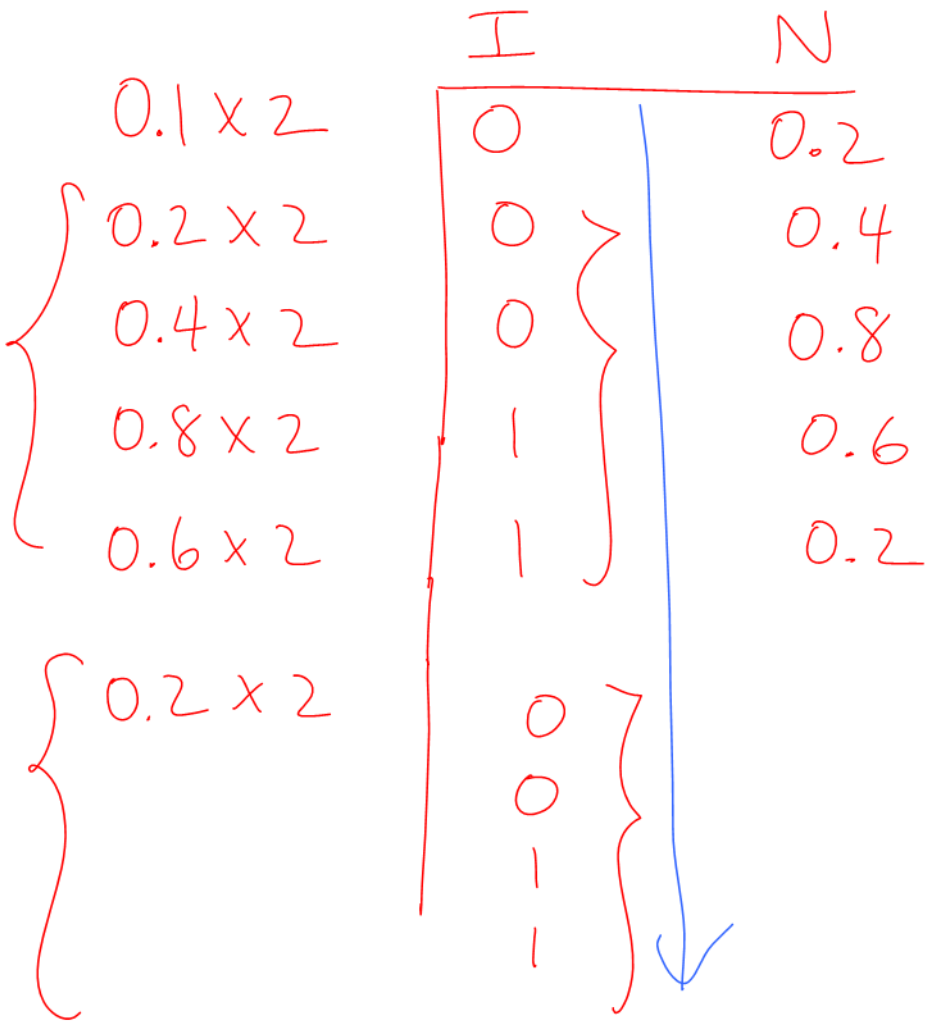
	I	N
0.734375×16	~~11~~ B	0.75
0.75×16	~~12~~ C	0

($A_{16} = 10$ $B_{16} = 11$ ... $F_{16} = 15$)

$0.734375 = 0.BC_{16}$

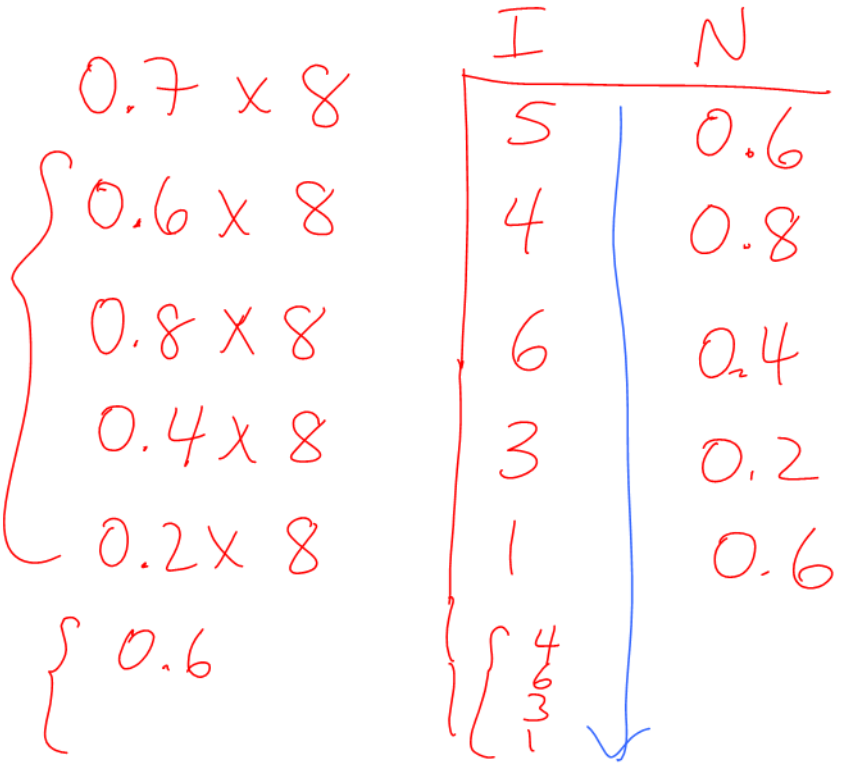
Ex: Repeating Pattern

Convert 0.1 to binary. ← base 2



$$0.1 = 0.0\overline{0011}_2$$

Ex: Convert 0.7 to octal. ← base 8



$$0.7 = 0.5\overline{4631}_8$$

Ex: Convert 19.96875 to octal.

	Q	R
19 ÷ 8	2	3
2 ÷ 8	0	2

	I	N
0.96875 × 8	7	0.75
0.75 × 8	6	0

8 × 0.375

$$23.76_8$$

Ex: Convert 52.5625 to base 4

	Q	R
52 ÷ 4	13	0
13 ÷ 4	3	1
3 ÷ 4	0	3

	I	N
0.5625 × 4	2	0.25
0.25 × 4	1	0

$52.5625 = 310.21_4$

Ex: Convert 142.828125 to hexadecimal

base 16

	Q	R
$142 \div 16$	8	~~14~~ E
$8 \div 16$	0	8

	I	N
0.828125×16	~~13~~ D	0.25
0.25×16	4	0

A_{16}	B_{16}	C_{16}	D_{16}	E_{16}	F_{16}
10	11	12	13	14	15

$8E.D4_{16}$

1.5 Converting Between Binary, Octal and Hexadecimal

In this section all bases are powers of 2.

Octal	Binary	Octal	Binary
0_8	000_2	4_8	100_2
1_8	001_2	5_8	101_2
2_8	010_2	6_8	110_2
3_8	011_2	7_8	111_2

One digit in octal becomes three digits in binary.

$$634_8 = \underline{110}\ \underline{011}\ \underline{100}_2$$

Ex: Convert to binary

a) 15_8

$= \underline{001}\ \underline{101}_2$ ✓

$= 1101_2$ ✓

Can drop leading zeros in an integer:

7, 07, 007 are all the same.

b) 703_8

$= 111000011_2$

c) 42.62_8

$= 100010.110010_2$ ✓

$= 100010.11001_2$ ✓

Can drop trailing zeros in a non-integer:

0.42, 0.420, 0.4200 are all the same.

Ex: Convert to octal

a) 10101110_2

$= \underline{010}\,\underline{101}\,\underline{110}_2$

$= 256_8$

b) 1010.11_2

$= 001010.110_2$

$= 12.6_8$

c) 0.10101_2

$= 000.101010_2$

$= 0.52_8$

Hexadecimal	Binary
0_{16}	0000_2
1_{16}	0001_2
2_{16}	0010_2
3_{16}	0011_2
4_{16}	0100_2
5_{16}	0101_2
6_{16}	0110_2
7_{16}	0111_2

Hex.	Binary
8_{16}	1000_2
9_{16}	1001_2
A_{16}	1010_2
B_{16}	1011_2
C_{16}	1100_2
D_{16}	1101_2
E_{16}	1110_2
F_{16}	1111_2

Ex: Convert to binary

a) 94_{16}

$= \underline{1001}\ \underline{0100}_2$

Each hexadecimal digit becomes 4 ~~binary digits~~ bits.

b) FAB_{16}

$= \underline{1111}\ \underline{1010}\ \underline{1011}_2$

c) $2.E_{16}$

$= \underline{0010}.\underline{1110}_2$ ✓

$= 10.111_2$ ✓

Ex: Convert to hexadecimal:

11.01_2

$= \underline{0011}.\underline{0100}_2$

$= 3.4_{16}$

Ex: $705_8 \rightarrow$ hexadecimal

705_8

$= 111\,000\,101_2$ blocks of 3 bits

$= 0001\,1100\,0101_2$ blocks of 4 bits

$= 1C5_{16}$