1.4 Converting From Decimal

$$\frac{19}{8} = 2 + \frac{3}{8}$$

2 is the quotient (Q for short)

3 " remainder (R for short)

$$19 \div 8 = 2.375$$

$Q = 2$

$R = 8 \times 0.375 = 3$

Ex: Find Q and R

$133 \div 16$

$= 8.3125$

$Q = 8$

$R = 16 \times 0.3125 = 5$

To convert from decimal to another base we do repeated division.

Ex: Convert 106_{10} to octal (base 8)

	Q	R
$106 \div 8$	13	2
$13 \div 8$	1	5
$1 \div 8$	0	1

Stop when you reach $Q = 0$.

Answer is R-values, in reverse order.

$$106_{10} = 152_8$$

Ex: Convert 58 to binary (base 2).

	Q	R
$58 \div 2$	29	0
$29 \div 2$	14	1
$14 \div 2$	7	0
$7 \div 2$	3	1
$3 \div 2$	1	1
$1 \div 2$	0	1

$$58 = 111010_2$$

Ex: Convert 1792 to octal (base 8)

	Q	R
$1792 \div 8$	224	0
$224 \div 8$	28	0
$28 \div 8$	3	4
$3 \div 8$	0	3

$$1792 = 3400_8$$

Ex: Convert 547 to base 5

	Q	R
$547 \div 5$	109	2
$109 \div 5$	21	4

$21 \div 5$

$4 \div 5$

$\begin{array}{cc} 4 & 1 \uparrow \\ 0 & 4 \end{array}$

$547 = 4142_5$

Ex: Convert 537_{10} to hexadecimal (base 16)

	Q	R	
$537_{10} \div 16$	3356	~~14~~ E	
$3356 \div 16$	209	~~12~~ C	
$209 \div 16$	13	1	
$13 \div 16$	0	~~13~~ D	

$A_{16} = 10$
$B_{16} = 11$
$C_{16} = 12$
$D_{16} = 13$
$E_{16} = 14$

$537_{10} = DICE_{16}$

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

Ex: Convert 0.375 to binary.

	Integer		Non-Integer
0.375×2	0		0.75
0.75×2	1		0.50
0.50×2	1	↓	0

Stop when Non-Integer = 0
Answer is Integers, in order.

$$0.375_{10} = 0.011_2$$

Ex: Convert 0.8125 to binary

	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

$$0.8125_{10} = 0.1101_2$$

Ex: Convert 0.734375 to hexadecimal

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

$$0.734375 = 0.BC_{16}$$

$$10 = A_{16}$$
$$11 = B_{16}$$
$$12 = C_{16}$$

Ex: Repeating pattern
Convert 0.1 to binary

0.1 × 2

$\left\{\begin{array}{l}\end{array}\right.$ 0.2 × 2

0.4 × 2

0.8 × 2

0.6 × 2

$\left\{\begin{array}{l}\end{array}\right.$ 0.2 × 2

I	N
0	0.2
0	0.4
0	0.8
1	0.6
1	0.2

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

Ex: Convert 0.7 to octal

0.7 × 8

$\left\{\begin{array}{l}\end{array}\right.$ 0.6 × 8

0.8 × 8

0.4 × 8

0.2 × 8

I	N
5	0.6
4	0.8
6	0.4
3	0.2
1	0.6

$$\left\{ \quad 0.6 \times 8 \right.$$

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

Ex: Convert 19.96875 to octal

	Q	R
$19 \div 8$	2	3 ↑
$2 \div 8$	0	2

	I	N
0.96875×8	7	0.75
0.75×8	6 ↓	0

$$19.96875 = 23.76_8$$

Ex: Convert 52.5625 to base 4

	Q	R
$52 \div 4$	13	0 ↑
$13 \div 4$	3	1
$3 \div 4$	0	3

	I	N
0.5625×4	2	0.25
0.25×4	1 ↓	0

$$52.5625 = 310.21_4$$

1.3 Sugg HW #16
Convert to decimal (round to
3 decimal places)

$$2 0 C 4 . B 7_{16}$$

16^3 place (pointing to the 2)

1 place (pointing to the 4)

16^{-1} place (pointing to the B)

$$= 2 \times 16^3 \qquad + \underset{12}{C} \times 16^1 + 4 \times 16^0 + \underset{11}{B} \times 16^{-1} + 7 \times 16^{-2}$$

$$= 2 \times 4096 \qquad + 12 \times 16 + 4 + \frac{11}{16} + \frac{7}{16^2}$$

$$\approx 8388.715$$