Section 1.3: Converting Non-integer Numbers to Decimal

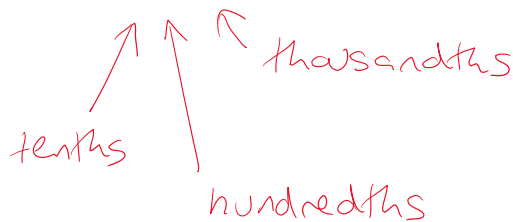let's review once again how decimal numbers work

$$12.3$$

the dot is called the decimal point

the first digit to the right of the decimal is in the "tenths" place — meaning that the number 12.3 is equal to $12 + \frac{3}{10}$

$$2.345$$

tenths
hundredths
thousandths

so $2.345 = 2 + \dfrac{3}{10} + \dfrac{4}{100} + \dfrac{5}{1000}$

$$= 2 \times 10^0 + 3 \times 10^{-1} + 4 \times 10^{-2} + 5 \times 10^{-3}$$

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how does this work for non-decimal numbers?

$$57.14_8 = 5 \times 8^1 + 7 \times 8^0 + 1 \times 8^{-1} + 4 \times 8^{-2}$$

the zero exponent belong to the term whose digit is to the left of the dot

$$= 40 + 7 + \frac{1}{8} + \frac{4}{82}$$

$$= 40 + 7 + \frac{1}{8} + \frac{4}{8^2}$$

$$= 40 + 7 + 0.125 + 0.0625$$

$$= 47.1875$$

note: 57.14_8

↑

we can't call the dot the "decimal point"

for this number, it's the "octal point"

or if you want, the generic term is the
"radix point"

examples: convert to decimal, showing your work

a) $11.011_2 = 1 \times 2^1 + 1 \times 2^0 + 0 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3}$

↑

$$= 3.375$$

b) $A0.3F6_{16}$ (round to 3 decimal places)

$A_{16} = 10$

$F_{16} = 15$

$$= 10 \times 16^1 + 0 \times 16^0 + 3 \times 16^{-1} + 15 \times 16^{-2} + 6 \times 16^{-3}$$

$$= 160.248$$

c) $765.4_8 = 7 \times 8^2 + 6 \times 8^1 + 5 \times 8^0 + 4 \times 8^{-1}$

$$= 501.5$$