COL100
Introduction to Computer Science
Assignment 1

August 13, 2023

1 Unit Conversions and Type Casting

This section of the assignment aims to assess your understanding of unit conversions and their application in programming. Through a series of problems, we will explore various scenarios involving lengths, temperatures, currencies, times, speeds, weights, areas, digital storage, energy, and distances.

1.1 Cube Mania [2 Marks]

Given a large solid metallic cuboid, we wish to extract out smaller cubes from it and perform some basic operations. You will be given a length, breadth, and height of the cuboid as inputs. As part of this task you will:

- compute and print the volume of the cuboid
- considering a two-unit length cube, calculate the number of cubes that can be part of this cuboid.
- How much more surface area does the cubes have compared to the cuboid.

Please print the outputs of all three questions within the same file following the the given sample input/sample output formatting:

1.1.1 Sample Input

10 10 10

1.1.2 Sample Output

1000 125 2400

1.1.3 Explanation

Note that cube is also a cuboid. Hence, this is a valid test case.
Volume of the cuboid: 10x10x10 = **1000**
Volume of 1 cube: 2x2x2 = 8. Hence, total cubes possible = 1000/8 = **125**.

Total surface area of cuboid: 6x100 = 600
Total surface area of 125 cubes = 125x(6x4) = 3000
Extra surface area = 3000 - 600 = **2400**

Note that in case the volume of cuboid is not perfectly divisible by the volume of cube, you need to leave the remainder volume out from the calculation involving the count of surface area.

Also note that you don't need to print extra text. For example, the following output will be invalid:
Volume of the cuboid: 1000
Number of cubes that can fit in the cuboid: 125
Extra surface area of cubes compared to the cuboid: 2400

Just print the values in the same order as shown above.

1.2 Rational Number [2 Marks]

We know that Rational Number is represented in form of $\frac{p}{q}$ where p,q $\in \mathbb{Z}$ and q $\neq 0$. There is also an alternative ways to represent any Rational Number known as Decimal Representation. In this form Rational Number can be decompose into two parts : Integral part(I) and Fractional part(f).

For example : $\frac{5}{2} = 2.5$ here for rational number $\frac{5}{2}$, Integral part (I) = 2 and fractional part (f) = 0.5 . In some cases the the fractional part can be non-terminating like in case of $\frac{4}{3} = 1.333..$, here fractional part(f) = 0.333... which is non-terminating in nature.

Problem Statement : Given two integers (p and q) as input , you have to output the Integral part (I) and Fractional part(f) of that rational number and for fractional part output its value up to 2 decimal places.

1.2.1 Sample Input and Output

Input
4 3
Output
1 0.33
Explanation
As $\frac{4}{3} = 1.33... = 1 + 0.33...$ then Integral part (I) = 1 and Fractional part (f) = 0.33..

1.2.2 Sample Input and Output

Input
5 2
Output
2 0.50
Explanation
As $\frac{5}{2} = 2.50 = 2 + 0.50$ then Integral part (I) = 2 and Fractional part (f) = 0.50

2 Converting numbers from Decimal to Binary and Binary to Decimal [4 Marks]

This section of the assignment aims to assess your understanding of conversions between Decimal to Binary and vice versa. We will also explore some basic binary operation like 1's Complement.

2.1 Decimal to Binary Conversion

Given an integer between 0 and 7 (both included) as input ,output its 3 bit Binary Representation. For example if input is 2 then your output should be 010.

2.1.1 Sample Input and Output

Input
2
Output
010
Explanation
When we convert 2 to 3 bit binary number then it is 010.

2.2 Binary to Decimal Conversion

In this part you will be given 3 integers as input (each integer will be either 0 or 1) which is representing a 3 bit Binary Number where first input integer represent most significant bit(MSB) and 3rd/last input integer represent least significant bit (LSB) of that Binary Number. Your task is to output its Decimal form.

2.2.1 Sample Input and Output

Input
1 0 0
Output
4
Explanation
4 is Decimal Number representation of Binary Number 100.

2.3 1's Complement

In this part you will be given 3 integers as input (each integer will be either 0 or 1) which is representing a 3 bit Binary Number where first input integer represent MSB and 3rd/last input integer represent LSB of that Binary Number.Your task is to output 3 integers representing its 1's Complement.

2.3.1 Sample Input and Output

Input
0 1 0
Output
101
Explanation
101 is 1's Complement of 010.

3 Star Question [Optional]

3.1 Circular English Alphabet

Suppose set of natural numbers is recognized by letters of English Alphabet . The circular mapping of number is such that 1 - a , 2 -b , ... , 26 - z , 27 - a , 28 - b , ..., 52 - z , 53 - a ,.... this circular mapping of numbers to letter goes till infinity.

Problem Statement : Given a natural number (positive Integer) as input , output its corresponding alphabet character .

3.1.1 Sample Input and Output

Input
28
Output
b

Explanation
As 28 is mapped to letter b , hence output for 28 is b.

4 Appendix

This section contains information about various conversion techniques that might be useful for your assignment and lab exercises.

4.1 Temperature Conversion

Temperature conversions can be done between Celsius (C), Fahrenheit (F), and Kelvin (K) using the following formulas:

$$\text{Fahrenheit (F)} = \left(\text{Celsius (C)} \times \frac{9}{5}\right) + 32$$
$$\text{Kelvin (K)} = \text{Celsius (C)} + 273.15$$

4.2 Currency Converter

Currency conversion can be done using the exchange rates for different currencies. Let's denote the amount in the original currency as $Amount_{\text{original}}$, the exchange rate from the original currency to the target currency as $Rate_{\text{original\_to\_target}}$, and the amount in the target currency as $Amount_{\text{target}}$. The conversion formula is given by:

$$Amount_{\text{target}} = Amount_{\text{original}} \times Rate_{\text{original\_to\_target}}$$

4.3 Time Conversion

Time conversion involves converting time given in hours, minutes, and seconds to total seconds, total minutes, and total hours. Let's denote the time in hours as h, the time in minutes as m, the time in seconds as s, the total time in seconds as T_{seconds}, the total time in minutes as T_{minutes}, and the total time in hours as T_{hours}. The conversion formulas are as follows:

$$T_{\text{seconds}} = (h \times 3600) + (m \times 60) + s$$
$$T_{\text{minutes}} = (h \times 60) + m$$
$$T_{\text{hours}} = h$$

4.4 Speed Units

Speed conversion can be done between kilometers per hour (km/h), meters per second (m/s), and miles per hour (mph) using the following formulas:

$$\text{m/s} = \frac{\text{km/h} \times 1000}{3600}$$
$$\text{mph} = \text{km/h} \times 0.621371$$

4.5 Weight Conversion

Weight conversion can be done between kilograms (kg) and pounds using the following formula:

$$\text{pounds} = \text{kg} \times 2.20462$$

4.6 Area Units

Area conversion can be done between square meters (m^2), square feet (ft^2), and acres using the following formulas:

$$\text{ft}^2 = \text{m}^2 \times 10.7639$$
$$\text{acres} = \text{m}^2 \times 0.000247105$$

4.7 Digital Storage

Digital storage conversion can be done between gigabytes (GB), megabytes (MB), kilobytes (KB), and bytes using the following formulas:

$$\text{MB} = \text{GB} \times 1024$$
$$\text{KB} = \text{MB} \times 1024$$
$$\text{bytes} = \text{KB} \times 1024$$

4.8 Energy Conversion

Energy conversion can be done between joules (J), kilojoules (kJ), and calories using the following formulas:

$$\text{kJ} = \frac{\text{J}}{1000}$$
$$\text{calories} = \frac{\text{J}}{4.184}$$

4.9 Distance Units

Distance conversion can be done between kilometers (km), miles, and nautical miles using the following formulas:

$$\begin{aligned} \text{miles} &= \text{km} \times 0.621371 \\ \text{nautical miles} &= \text{km} \times 0.539957 \end{aligned}$$