

Project 3: Python

To complete this project you need to write five small Python programs, each similar to the temperature converter program (`cels.py`) shown in the lecture notes.

Put all five files in a single folder named `python`, compress the folder, and submit the resulting zip file to Canvas.

You can compress the folder with Finder (macOS) or File Browser (Windows), or you can create a zip file from the command line. Use `cd` to navigate to the directory that contains your `python` folder and type this command:

```
$ zip -r python.zip python
```

BMI

Write a program that computes a person's body mass index (BMI). The formula is

$$\text{BMI} = \frac{w}{h^2} \times 703$$

where h is the person's height, in inches, and w is their weight, in pounds.¹

The program should be saved in a file named `bmi.py`. When the program is run it should get the height and weight values from the command line.

Here are two examples you can use to test your program:

```
$ python bmi.py 72 180
24.4
```

```
$ python bmi.py 60 130
25.4
```

Notice how the output value has been rounded to a single decimal point.

¹https://en.wikipedia.org/wiki/Body_mass_index

Monthly Payment

Write a program that computes the monthly payment amount for a loan. The inputs for this program are the loan amount, the annual interest rate, and the number of years to pay off the loan.

For example, suppose a person wants to buy a house with a \$200,000 loan, at a mortgage rate of 4.5% per year, using a 30-year loan:

```
$ python pmt.py 200000 4.5 30
1013.37
```

The output shows their monthly payment would be \$1,013.37.

The first step is to convert the annual interest rate into a monthly rate. Use this formula:

$$r = \text{rate}/12/100$$

where `rate` is the value from the command line. Next compute the number of payments, which is simply

$$N = 12 \times \text{years}$$

where `years` is the value from the command line.

Then the formula for computing the monthly payment c is

$$c = \frac{r \times P}{1 - (1 + r)^{-N}}$$

where P is the loan amount (the “principle”).²

Here is another example you can use to test your program, a 5-year car loan of \$30,000 at 2%:

```
$ python pmt.py 30000 2.0 5
525.83
```

You can print a number with two decimal points, as shown above, but for an extra challenge figure out how to print a dollar sign immediately before the first digit, *e.g.*

```
$ python pmt.py 200000 4.5 30
$1013.37
```

Another challenge (which will take a lot more detective work): figure out how to print the number with commas:

```
$ python pmt.py 200000 4.5 30
$1,013.37
```

²https://en.wikipedia.org/wiki/Mortgage_calculator

LCM

The *least common multiple* (LCM) of two integers a and b is the smallest number that is evenly divisible by both a and b .

For example, suppose $a = 4$ and $b = 6$. The number 48 is a common multiple because 48 is evenly divisible by both 4 and 6. But the *smallest* number that is evenly divisible by both 4 and 6 is 12, so $\text{lcm}(4, 6) = 12$.

It's simple to compute the LCM of two numbers if we know their *greatest common divisor* (GCD). The GCD of two numbers is the largest factor they have in common. If we factor the two numbers, $4 = 2 \times 2$ and $6 = 3 \times 2$, we can see the largest common factor is 2, so $\text{gcd}(4, 6) = 2$.

Here is the formula for the least common multiple, assuming we know the GCD.³ Assuming a and b are both positive integers:

$$\text{lcm}(a, b) = \frac{a \times b}{\text{gcd}(a, b)}$$

Python (version 3.5 and later) has a function named `gcd` in its math library. You can import this function and use it in your program.

```
$ python lcm.py 4 6
12
```

```
$ python lcm.py 21 6
42
```

Pythagorean Triples

A set of three integers a , b , and c is a *Pythagorean triple* if $a^2 + b^2 = c^2$.

Write a program that will read three numbers from the command line and print a message that says whether or not the numbers are a Pythagorean triple.

```
$ python pythag.py 3 4 5
yes: 9 + 16 = 25
```

```
$ python pythag.py 2 4 6
no
```

Note: the term “Pythagorean triple” comes from the Pythagorean formula, which tells how to compute the length of the hypotenuse of a right triangle: $c = \sqrt{a^2 + b^2}$. For some triangles a , b , and c are all integers, and these are the Pythagorean triples.⁴

³https://en.wikipedia.org/wiki/Least_common_multiple

⁴https://en.wikipedia.org/wiki/Pythagorean_triple

Pig Latin

Write a program that reads an English word from the command line and translates it into “Pig Latin.” Some examples:

```
$ python pig.py beer
eerbay
```

```
$ python pig.py ale
aleway
```

A complete description of the rules can be found on Wikipedia.⁵ You only need to implement the two simplest cases:

- If the word starts with a vowel (a, e, i, o, or u) just append way to the end of the word (e.g. ale becomes aleway).
- Otherwise remove the first letter, move it to the end of the word, and append ay (e.g. beer becomes eerbay).

Style Challenge: Can you write your program so the test for a vowel at the front of a word is done with a single `if` statement? *i.e.* see if you can avoid a “cascade” of `if-elif` statements.

Additional Challenges (Optional): Implement some of the other cases described on the Wikipedia page. If a word starts with multiple consonants all of them are moved to the end. For example, cheese becomes eesechay and string becomes ingstray.

⁵https://en.wikipedia.org/wiki/Pig_Latin