Hyperiondev

TASK

Your First Computer Program and Using Variables

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Introduction

WELCOME TO THE TASK ABOUT CREATING YOUR FIRST COMPUTER PROGRAM AND USING VARIABLES!

This task will begin by introducing the concept of pseudo code. Although pseudo code is not a formal programming language, it will ease your transition into the world of programming. Pseudo code makes creating programs easier because, as you may have guessed, programs can sometimes be complex and long — preparation is key. It is difficult to find errors without understanding the complete flow of a program, and writing pseudo code helps you to establish this high-level understanding.

Next, you will be introduced to the Python programming language. Python is a widely used programming language. It is consistently ranked in the top 10 most popular programming languages as measured by the **TIOBE Programming Community Index**. Many familiar organisations make use of Python, such as *Wikipedia*, *Google*, *Yahoo!*, *NASA,* and *Reddit* (which is written entirely in Python).

Python is a high-level programming language, along with other popular languages such as Java, C#, and Ruby. High-level programming languages are closer to human languages than machine code. They're called "high-level" as they are several steps removed from the actual code that runs on a computer's processor.

This task is a gentle introduction to Python, where you will be asked to create a simple program. In doing so, you will become familiar with the structure of a Python program.

Lastly, you will also be introduced to the concept of variables and the more complex programming problems that can be solved using these. A *variable* is a computer programming term that is used to refer to the storage locations for data in a program. Each variable has a name which can be used to refer to some stored information known as a *value*. By completing this task you will gain an understanding of variables and how to declare and assign values to them, as well as the different types of variables and how to convert between types.

INTRODUCTION TO PSEUDO CODE

What is pseudo code? And why do you need to know this? Well, being a programmer means that you will often have to visualise a problem and know how to implement the steps to solve a particular conundrum. This process is known as writing Pseudo Code.

Pseudo code is not actual code; instead, it is a detailed yet informal description of what a computer program or algorithm must do. It is intended for human reading rather than machine reading. Therefore, it is easier for people to understand than conventional programming language code. Pseudo code does not need to obey any specific syntax rules, unlike conventional programming languages. Hence it can be understood by any programmer, irrespective of the programming languages they're familiar with.

As a programmer, pseudo code will help you better understand how to implement an algorithm, especially if it is unfamiliar to you. You can then translate your pseudo code into your chosen programming language.

Pseudo code is easy to write and understand, even if you have no programming experience. You simply need to write down a logical breakdown of what you want your program to do. Therefore, it is a good tool to use in business to discuss, analyse, and agree on a program's design with a team of programmers, users, and clients before coding the solution.

WHAT IS AN ALGORITHM?

Simply put, an algorithm is a step-by-step method of solving a problem. To understand this better, it might help to consider an example that is not algorithmic. When you learned to multiply single-digit numbers, you probably memorised the multiplication table for each number (say *n*) all the way up to *n x 10*. In effect, you memorised 100 specific solutions. That kind of knowledge is not algorithmic. But along the way, you probably recognised a pattern and made up a few tricks.

For example, to find the product of *n* and 9 (when n is less than 10), you can write *n − 1* as the first digit and *10 − n* as the second digit (e.g. 7 x 9 = 63). This trick is a general solution for multiplying any single-digit number by 9. That's an algorithm! Similarly, the techniques you learned for addition with carrying, subtraction with borrowing, and long division are all algorithms.

One of the characteristics of algorithms is that they do not require any intelligence to execute. Once you have an algorithm, it's a mechanical process in which each step follows from the last according to a simple set of rules (like a recipe). However,

breaking down a hard problem into precise, logical algorithmic processes to reach the desired solution is what requires intelligence or computational thinking.

Generally, an algorithm should usually have some input and, of course, some eventual output.

Now that you understand the concepts of pseudo code and algorithms, let's look at an example of how to write an algorithm, in pseudo code, that validates passwords (i.e., checks whether an entered password is correct).

Problem: Write an algorithm that asks a user to input a password, and then stores the password in a variable (something you will learn more about later in this lesson) called *password*. For now, just think of a variable as a name for a container to store some information in. Once the user's chosen password has been stored, the algorithm must request input from the user. If the input does not match the password the user originally set, the algorithm must store the incorrect passwords in a list until the correct password is entered. At that point it must print out the value of the variable "*password*" (i.e., the user's chosen password that has been stored in the password variable/container), as well as the incorrect passwords:

Pseudo code solution:

```
request input from the user
store input into variable called “password”
request second input from the user
if the second input is equal to “password”
          output the “password” and the incorrect inputs (which should be none
at this point)
if the second input is not equal to “password”
          repeatedly request input until input matches password
          store the non-matching input for later output
when the input matches “password”
          output “password”
          and output all incorrect inputs.
```

In the practical tasks at the end of this lesson, you will practise creating high-level solutions to simple problems using pseudo code, as seen above.

A note from the Hyperion Team

Did you know that although Python is named after the Monty Python comedy group, it was created by '**Benevolent Dictator For Life**' Guido van Rossum in 1991, who now works for Microsoft? At the time when he began implementing the Python language, he was also reading the published scripts from *Monty Python's Flying Circus* (a BBC comedy series from the seventies). His inspiration for the name came from the comedy series, and his motivation for creating the Python language stemmed from the desire to create a simple scripting language drawing on his experience with the ABC programming language.

INTRODUCTION TO PYTHON

Python is a powerful, widely used programming language. In comparison with Java, Python is a more recent, efficient, and arguably a faster programming language. The syntax (the way the code is written) is, nonetheless, very similar to Java.

Here are a few more reasons to use Python:

- **Simple, yet powerful:** looking at languages like C++ and Java can flummox and scare the beginner, but Python is intuitive, with a user-friendly way of presenting code. Python's succinctness and economy of language allows for speedy development and less hassle over useful tasks. This makes Python easy on the eyes and mind.

- **From child's play to big business:** while Python is simple enough to be learned quickly (even by kids), it is also powerful enough to drive many big businesses. Python is used by some of the biggest tech firms such as

Google, *Yahoo!*, *Instagram*, *Spotify*, and *Dropbox*, which should speak volumes about the job opportunities out there for Python developers.

- **Python is on the web:** Python is a very appealing language of choice for web development. Sites such as *Pinterest* and *Instagram* make use of the versatility, rapidity, and simplicity of Django (a web development framework written in Python).

- **Even *Dropbox* was built using Python:** *Dropbox* must save massive quantities of files while supporting a similarly massive degree of user growth. Did you know that 99.9% of *Dropbox* code is written in Python? Using Python has helped *Dropbox* gain more than a hundred million users. With only a few hundred lines of Python code, they were able to scale their user numbers dramatically, proving the utility of the language!

🔥Know this – Python is hot!🔥

The demand for Python programmers is only growing. Python boasts the highest year-on-year increase in terms of demand by employers (as reflected in job descriptions online) as well as popularity among developers. Python developers are one of the highest-paid categories of programmers! The demand for Python is only set to grow further with its extensive use in analytics, data science, and machine learning.

THE ZEN OF PYTHON

The Zen of Python, written in 1999 by Tim Peters, mentions all the software principles that influence the design of the Python language.

Beautiful is better than ugly.
Explicit is better than implicit.
Simple is better than complex.
Complex is better than complicated.
Flat is better than nested.
Sparse is better than dense.
Readability counts.
Special cases aren't special enough to break the rules.
Although practicality beats purity.
Errors should never pass silently.
Unless explicitly silenced.
In the face of ambiguity, refuse the temptation to guess.
There should be one — and preferably only one — obvious way to do it.
Although that way may not be obvious at first unless you're Dutch.
Now is better than never.
*Although never is often better than *right* now.*
If the implementation is hard to explain, it's a bad idea.
If the implementation is easy to explain, it may be a good idea.
Namespaces are one honking great idea — let's do more of those!

Ever need to recall these principles? Try entering this into your Python interpreter:

```
import this
```

SETTING UP YOUR DEVELOPMENT ENVIRONMENT

If you still need to **set up your development environment**, please follow the instructions in the installation guide (entitled **Additional Reading - Installation**) provided either with your onboarding material or in the Dropbox folder for the first lesson.

WHAT IS PROGRAMMING?

Programmers write code statements to create *programs*. Programs are executable files that perform the instructions given by the programmer.

Code can be written in different programming *languages*, such as Python, Java, Javascript, and C++. In this course, you will start by learning Python.

After writing Python code, you need to save it in a Python file. A Python file has the following file naming format:

*filename**.py***

The filename can be any valid filename and **.py** is the file extension.

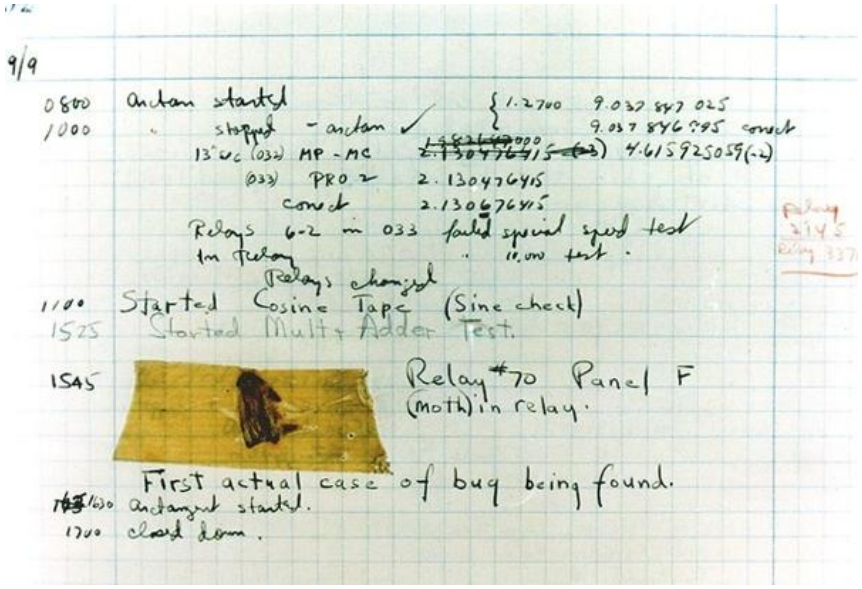
You can then 'run' the Python file. In this process, the Python program you have written is executed and displays the outcomes that may result based on what the code statements say. Information about how to 'run' Python files is given in the example file (**example.py**) that accompanies this task. We will now show you how to write some basic code in Python, and perform some basic operations.

A note from Riaz...

Sorry to interrupt, but did you know that the first computer “bug” was named after a real bug? Yes, you read that right! While using “bug” to mean a technical error was first coined by Thomas Edison in 1878, it was only 60 years later that someone else popularised the term.

In 1947, Grace Hopper, a US Navy admiral, recorded the first computer “bug” in her logbook. She was working on a Mark II computer when a moth was discovered stuck in a

relay, hindering the operation. She proceeded to remove the moth, thereby “debugging” the system, and taped it into her logbook! In her notes, she wrote, “First actual case of bug being found.”



Riaz Moola, *Founder and CEO*

THE PRINT() FUNCTION

You may want your program to display or output information to the user. The most common way to view program output is to use the `print` function. To use `print`, we enter the `print` command followed by one or more arguments in brackets. Let’s first take a moment to understand what arguments are, as well as two other new terms, parameters and variables.

Remember from earlier in this task that a **variable** is a computer programming term that is used to refer to the storage locations for data in a program. Each variable has a name which can be used to refer to some stored information known as a **value**.

Functions and methods in Python are blocks of code that perform one or more specific functions. A **parameter** is a variable in a function definition that tells you the sort of data you will need to give the function to work with when it runs. When a function is actually called (in other words, the programmer instructs the block of code making up the function to run), the **arguments** are the *data you pass into* the function's parameters (i.e., the actual data you give to the function to work on when it runs). The same is true of a method.

Now that you understand these basic concepts, let's review how `print` works. We enter the `print` command into a Python file followed by one or more arguments in brackets. In programming, a **command** is an instruction given by a user telling a computer to do something. Together a command and an argument are known as a **statement**. Consider the Python statement below:

```
print("Hello, World!")
```

When you run this program, the computer will output the argument "`Hello, World!`" that was passed into the input parameter. Note that the argument is enclosed in double quotes ("..."). This is because "Hello, World!" is a type of variable called a **string**, i.e., a list of characters. You'll learn more about strings and other variable types later in this task.

Note that the Python Shell (the window that is displayed when you run a Python program) only shows the output of the program. Other statements in your code that don't create output will be executed but not displayed in the Python Shell.

SYNTAX RULES

All programming languages have *syntax* rules. Syntax is the "spelling and grammar setup" of a programming language and determines how you write correct, well-formed code statements. If you make a mistake by breaking the "spelling and grammar" rules for code in Python, this is called a syntax error.

A common syntax error you could make in the print statement we looked at above is forgetting to add a closing quotation mark at the end of the string parameter ("). In strings, all opening quotation marks (") require a closing one - the opening one shows the string is starting, and the closing one shows where it ends. Another common syntax error that you could make in the print example above is forgetting to add a closing bracket ')'. Remember that all opening brackets '(' require a matching closing one, ')'!

Any program you write must be exactly correct. All code is case sensitive. This means that *'Print'* is not the same as *'print'*. If you enter an invalid Python command, misspell a command, or misplace a punctuation mark, you will get a syntax error when trying to run your Python program.

Errors appear in the Python shell when you try to run a program and it fails. Be sure to *read all errors carefully* to discover what the problem is. Error reports in the Python shell will even tell you what line of your program had an error. The process of resolving errors in code is known as *debugging*.

HOW TO GET INPUT

Sometimes you want a user to enter data, through the keyboard, that will be used by your program. To do this, you use the `input` command.

When the program runs, the `input` command, which can be seen in the example below, will show the text "Enter your name: " in the output box of the program. The program will then halt until the user enters something with their keyboard and presses enter.

```
name = input("Enter your name: ")
```

The variable *name* stores what the user entered into the box as a **string**. Storing and declaring variables doesn't produce any output.

WHAT ARE VARIABLES?

Let's consider variables in a little more depth. To be able to perform calculations and instructions, we need a place to store values in the computer's memory. This is where variables come in. A *variable* is a way to store information. It can be thought of as a type of "container" that holds information. In the example above, the input command was used to tell the computer to take whatever the user typed before they pressed enter and place that in a container as a variable of the **string** type.

Variables in programming work the same as variables in mathematics. We use them in calculations to hold values that can be changed. In maths, variables are named using letters, like x and y. In programming, you can name variables whatever you like, as long as you don't pick something that is a keyword (also known as a 'reserved' word) in the programming language. It is best to name them something useful and meaningful to the program or calculation you are working on. For example, `num_learners` could contain the number of learners in a class, or `total_amount` could store the total value of a calculation.

In Python, we use the following format to create a variable and assign a value to it:

```
variable_name = value_you_want_to_store
```

Check out this example:

```
num = 2
```

In the code above, the variable named `num` is assigned the integer (or whole number) 2. Hereafter when you type the "word" `num`, the program will refer to the appropriate space in memory where the variable is stored, and retrieve the value 2 that is stored there.

We use variables to hold values that can be changed (can vary). You can name a variable anything you like as long as you follow the rules shown below. However, as previously stated, giving your variables meaningful names is good practice.

Below is an example of bad naming conventions vs good naming conventions.

- `my_name = "Tom"` # Good variable name
- `variableOne = "Tom"` # Bad variable name
- `string_name = "Tom"` # Good variable name
- `h4x0r = "Tom"` # Bad variable name

Here, `my_name` and `string_name` are examples of descriptive variables as they reveal what they are and what content they store, whereas `variableOne` and `h4x0r` are terrible names because they are not descriptive.

A note from the Hyperion Team

Now that you are a little more familiar with Python and creating basic programs, we would like to show you some stuff to help you on your journey to becoming a seasoned programmer.

Creating excellent content requires good tools and equipment. This applies equally well to programming. There are some great tools and resources available online that you can start using as soon as possible, if you have not already, to make the coding process just that much more convenient. **Here** is a link to the HyperionDev Blog where you will find essential utilities and resources for programmers.

Let's think a bit more about how to name variables.

Variable Naming Rules

As previously mentioned, it is very important to give variables descriptive names that reference the value being stored. Here are the naming rules in Python (these can differ in other programming languages):

1. Variable names must start with a letter or an underscore.
2. The remainder of the variable name can consist of letters, numbers, and underscores.
3. Variable names are case sensitive so Number and number are each different variable names.
4. You cannot use a Python keyword (reserved word) as a variable name. A reserved word has a fixed meaning and cannot be redefined by the programmer. For example, you would not be allowed to name a variable *print* since Python already recognises this as a keyword. The same is true of the keyword *input*.

Variable Naming Style Guide

The way you write variable names will vary depending on the programming language you are using. For example, the **Java** style guide recommends the use of camel case — where the first letter is lowercase, but each subsequent word is capitalised with no spaces in between (e.g. thisIsAGoodExampleOfCamelCase)

The style guide provided for **Python** code, **PEP 8**, recommends the use of snake case — all lowercase with underscores in between instead of spaces (e.g. this_is_a_good_example_of_snake_case). You should use this type of variable naming for your Python tasks.

In maths, variables only deal with numbers, but in programming we have many different types of variables and many different types of data. Each variable data type is specifically created to deal with a specific type of information.

VARIABLE DATA TYPES

There are five major types of data that variables can store. These are **strings**, **chars**, **integers**, **floats**, and **booleans**.

- **string:** A string consists of a combination of characters. For example, it can be used to store the surname, name, or address of a person. It can also store

numbers, but when numbers are stored in a string you cannot use them for calculations without changing their data type to one of the types intended for numbers..

- **char**: Short for **char**acter. A char is a single letter, number, punctuation mark or any other special character. This variable type can be used for storing data like the grade symbol (A-F) of a pupil. Moreover, strings can be thought of (and treated by functions) as lists of chars in situations in which this approach is useful.

- **integer:** An integer is a whole number, or number without a decimal or fractional part. This variable type can be used to store data like the number of items you would like to purchase, or the number of students in a class.

- **float:** We make use of the float data type when working with numbers that contain decimals or fractional parts. This variable type can be used to store data like measurements or monetary amounts.

- **boolean:** Can only store one of two values, namely TRUE or FALSE.

The situation you are faced with will determine which variable type you need to use. For example, when dealing with money or mathematical calculations you would likely use **integers** or **floats**. When dealing with sentences or displaying instructions to the user you would make use of **strings**. You could also use **strings** to store data like telephone numbers that are numerical but will not be used for calculations. When dealing with decisions that have only two possible outcomes, you would use **booleans**, as the scenario could only either be True or False.

Variables store data and the type of data that is stored by a variable is intuitively called the *data type*. In Python, we do not have to declare the data type of the variable when we declare the variable (unlike certain other languages). This is known as “weak-typing” and makes working with variables easier for beginners. Python detects the variable's data type by reading how data is assigned to the variable, as follows:

- Strings are detected by quotation marks " ".
- Integers are detected by the lack of quotation marks and the presence of digits or other whole numbers.
- Floats are detected by the presence of decimal point numbers.
- Booleans are detected by being assigned a value of either True or False.

So, if you enter numbers, Python will automatically know you are using integers or floats. If you enter a sentence, Python will detect that it is storing a string. If you want to store something like a telephone number as a string, you can indicate this to Python by putting it in quotation marks, e.g. `phone_num = “082 123 4567”`.

You need to take care when setting a string with numerical information. For example, consider this:

```
number_str = "10"
print(number_str*2) # Prints 1010- prints string twice
print(int(number_str)*2) # Prints 20 because the string 10 is cast to number 10
```

Watch out here! Since you defined 10 within quotation marks, Python figures this is a string. It's not stored as an integer even though 10 is a number, as numbers can also be made into a string if you put them between quotation marks. Now, because 10 is declared as a string here, we will be unable to do any arithmetic calculations with it - the program treats it as if the numbers are letters. In the above example, when we ask Python to print the string times 2, it helpfully prints the string twice. If we want to print the value of the number 10 times 2, we have to *cast* the string variable to an integer (convert it) by writing `int(number_string)`. Take heed that all variable types can be converted from one to another, not just ints and strings.

There is also a way that you can determine what data type a variable is, using the `type()` built-in function. For example:

```
mystery_1 = "10"
mystery_2 = 10.6
mystery_3 = "ten"
mystery_4 = True

print(type(mystery_1))
print(type(mystery_2))
print(type(mystery_3))
print(type(mystery_4))
```

Output:

```
<class 'str'>
<class 'int'>
<class 'str'>
<class 'bool'>
```

The output shows us the data type of each variable in the inverted commas.

CASTING

Let's return to the concept of changing variable types from one to another. In the string-printing example above, you saw something we called *casting*. Casting means taking a variable of one particular data type and "turning it into" another data type. Putting the 10 in quotation marks will automatically convert it into a string, but there is a more formal way to change between variable types. This is known as *casting* or type conversion.

Casting in Python is pretty simple to do. All you need to know is which data type you want to convert to, and then you can use the corresponding function.

- **`str()`** — converts a variable to a string
- **`int()`** — converts a variable to an integer
- **`float()`** — converts a variable to a float

```
number = 30
number_str = "10"
print(number + int(number_str)) #Prints 40
```

This example converts **`number_str`** into an integer so that we can add two integers together and print the total. We cannot add a string and an integer together. (Are you curious what would happen if you didn't cast **`number_str`** to a string? Try copying the code in the block above, pasting it into VS Code, and running it. What happens?)

You can also convert the variable type entered via **`input()`**. **By default, anything entered into an `input()` is a string**. To convert the input to a different data type, simply use the desired casting function.

```
num_days = int(input("How many days did you work this month?"))
pay_per_day = float(input("How much is your pay per day?"))
salary = num_days * pay_per_day
print("My salary for the month is USD:{}".format(salary)) //explanation below
```

When writing programs, you'll have to decide what variables you will need.

Take note of what is in the brackets on line four above. When working with strings, we are able to put variables into our strings with the *format* method. To do this, we use curly braces **`{ }`** as placeholders for our values. Then, after the string, we put **`.format(variable_name)`**. When the code runs, the curly braces will be replaced by the value in the variable specified in the brackets after the format method.

Working with the f-string

The f-string is another approach to including variables in strings. The syntax for working with the f-string is quite similar to what is shown above in the format method example.

Notice that we declare the variables upfront, and we don't need to tag on the .format method at the end of our string the way we did when using the format approach. Also, note the ***f*** at the beginning of the string:

```
num_days = 28
pay_per_day = 50
print(f"I worked {num_days} days this month. I earned ${pay_per_day} per day.")
```

Output:

```
'I worked 28 days this month. I earned $50 per day.'
```

f-strings provide a less verbose way of interpolating (inserting) values inside string literals. You can **read more about f-strings here**.

If you wanted to use the `str.format()` method in the same scenario as the f-string example, you could do so as follows:

Example 1: insert values using index references

```
print("You worked {0} this month and earned ${1} per day".format(num_days = 22,
pay_per_day = 50))
```

Example 2: insert values using empty placeholders

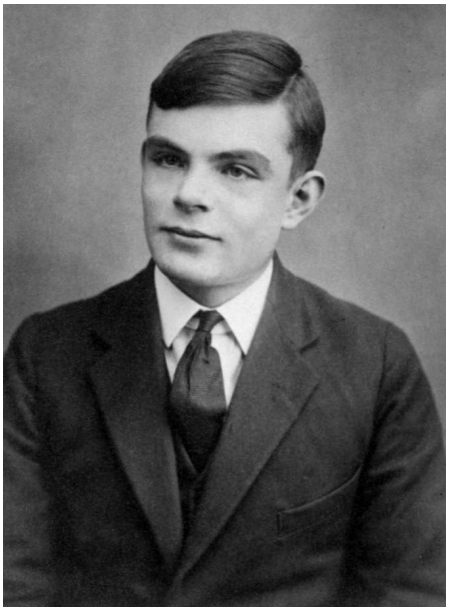
```
print("You worked {} this month and earned ${} per day".format(num_days = 22,
pay_per_day = 50))
```

What do you think the advantage might be of using index references?

A note from the
Hyperion Team

Father of modern-day computing

Hey there, have you heard about Alan Turing?



Alan Turing (1912 – 1954) was a British mathematician, logician, and cryptographer. He is considered by many to be the father of modern computer science. He designed and built some of the earliest electronic, programmable, digital computers.

During the Second World War, Alan Turing was recruited by the military to head a classified mission at Bletchley Park. This mission was to crack the Nazi's Enigma machine code which was used to send secret military messages. Many historians believe that breaking the Enigma code was key to bringing the war to an end in Europe. Turing published a paper in 1936 that is now recognised as the foundation of computer science.

Source: ***Wikipedia***

Now it's time to try your hand at a practical task.

Instructions

This lesson is continued in the example files (**example_first_program.py** and **example_variables.py**) provided in this task folder. Open these files using VS Code. The context and explanations provided in the examples should help you better understand some simple basics of Python.

You may run the examples to see the output. The instructions on how to do this are inside each example file. Feel free to write and run your own example code before attempting the task, to become more comfortable with Python.

Try to write comments in your code to explain what you are doing in your program (read the example files for more information, and to see examples of how to write comments).

You are not required to read the entirety of **Additional Reading.pdf**. It is purely for extra reference. That said, do take a look - you could find it very useful!

Practical Task 1

Follow these steps:

- Create a new Python file in the Dropbox folder for this task, and call it **hello_world.py**.
- First, provide pseudo code as comments in your Python file, outlining how you will solve this problem (you'll need to read the rest of this practical task first of course!).
- Now, inside your **hello_world.py** file, write Python code to take in a user's name using `input()` and then print out the name.
- Use the same input and output approach to take in a user's age and print it out.
- Finally, print the string "Hello World!" on a new line (the new line will happen by default if you use a separate print statement to the one you used immediately above to print out the age, because each print statement automatically inserts an "enter", or newline instruction, at the end).

Practical Task 2

Follow these steps:

- Create a new Python file in the Dropbox folder for this task, and call it **details.py**.
- As in practical task 1, please first provide pseudo code as comments in your Python file, outlining how you will solve this problem.
- Use an `input()` command to get the following information from the user.
    - Name
    - Age
    - House number
    - Street name
- Print out a single sentence containing all the details of the user.
- For example:

```
This is John Smith. He is  28 years old and lives at house number 42 on Hamilton Street.
```

Practical Task 3

Follow these steps:

- Create a new Python file in this folder called **conversion.py**
- As in the previous practical tasks, please first provide pseudo code as comments in your Python file, outlining how you will solve this problem.
- Declare the following variables:
    - `num1 = 99.23`
    - `num2 = 23`
    - `num3 = 150`
    - `string1 = “100”`
- Convert them as follows:
    - `num1` into an integer

    - `num2` into a float
    - `num3` into a String
    - `string1` into an integer
- Print out all the variables on separate lines

Thing(s) to look out for:

1. Make sure that you have installed and set up all programs correctly. You have set up **Dropbox** correctly if you are reading this, but **Python or your editor** may not be installed correctly.
2. If you are not using Windows, please ask one of our expert code reviewers for alternative instructions.

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