Python Mini Lessons

last update: May 29, 2018

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These Python mini lessons will teach you all the Python Programming statements you need to know, so you can write 90% of any Python Program.

Lesson 1 Input and Output
Lesson 2 Functions
Lesson 3 Classes
Lesson 4 Operators, Lists, Tuples and Dictionaries
Lesson 5 Programming Statements
Lesson 6 File I/O and List Compression

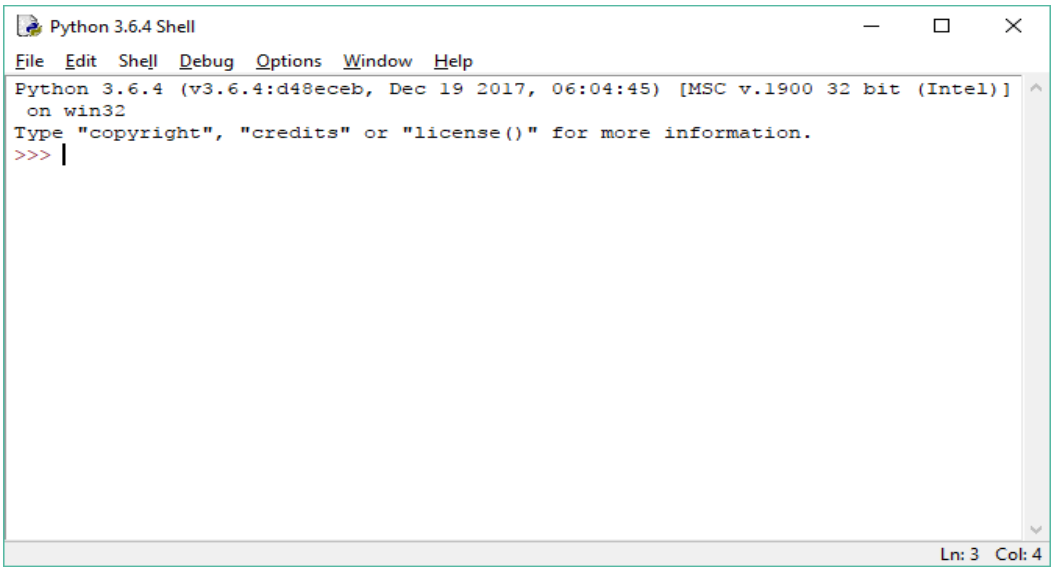
Let's get started!

You first need a Python interpreter to run Python Programs.

Download from this site: https://www.python.org/downloads/

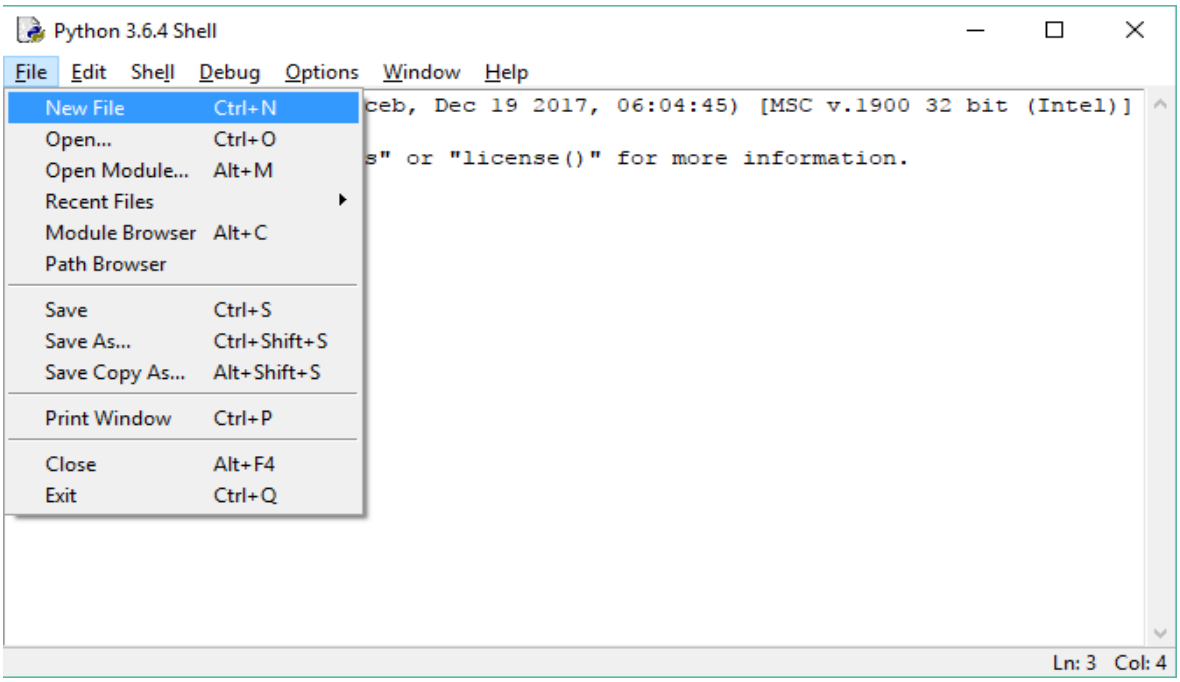
Choose Python version 3.6.4

Once you download and run you will get this screen known as the Python interpreter Shell:

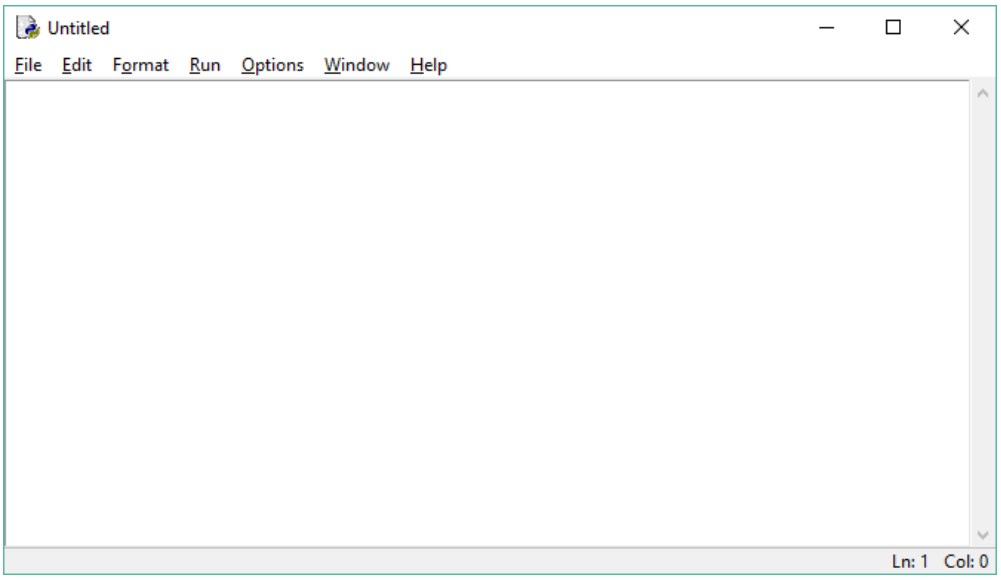


Lesson 1 Input and Output

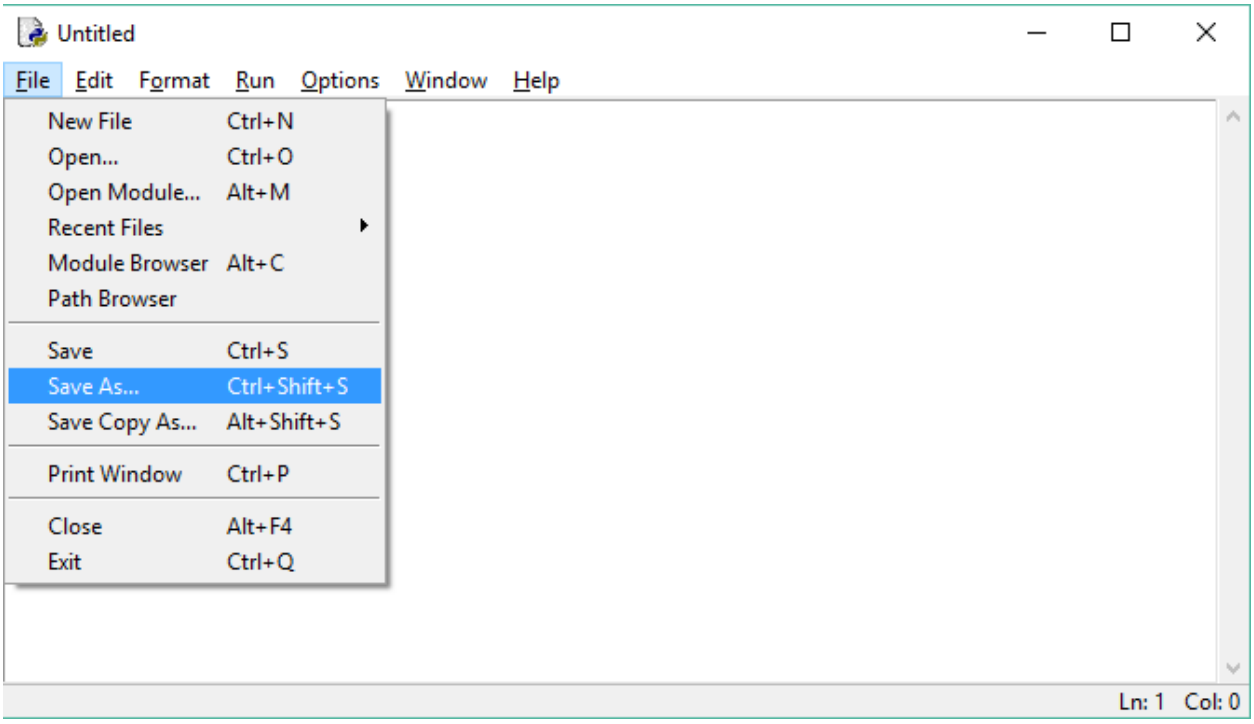
It is best to store all your lesson programs in a file rather than using the Python interpreter shell. A Python program is also known as script, because it is an interpretive language, meaning the python programming statements are executed one by one as they appear in the file. From the File Menu select New File.



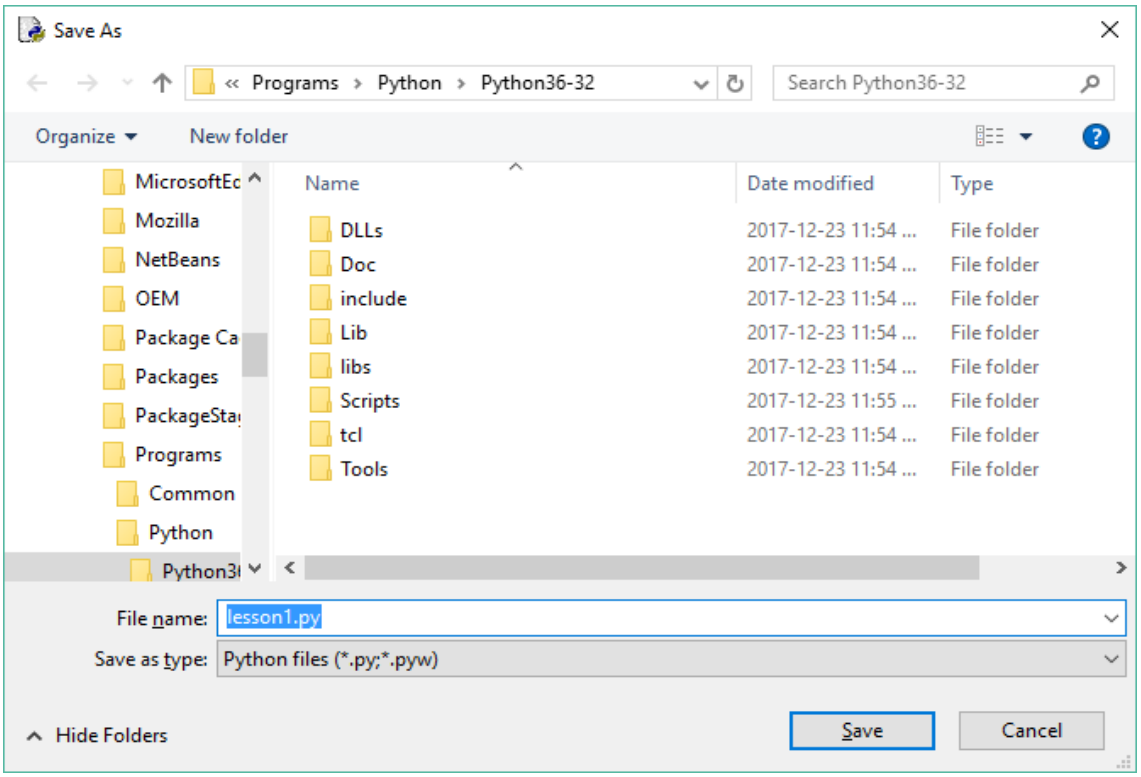
The editor window appears where you can type in Python programming statements that you can save and run.



From the File menu select File Save As

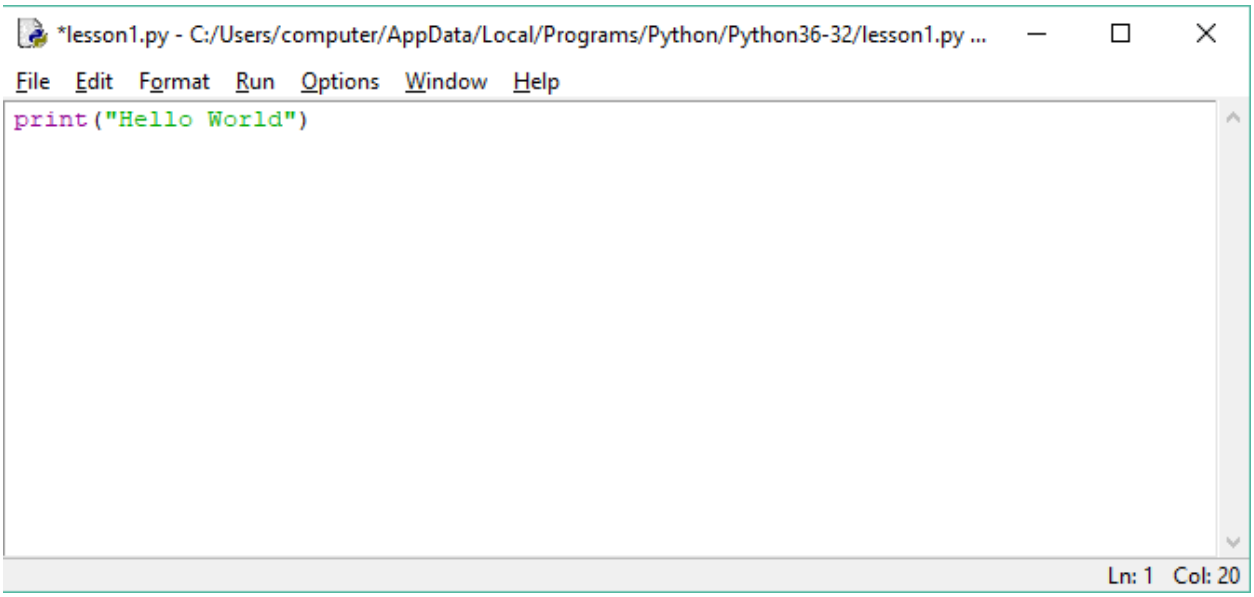


Save file as lesson1.py

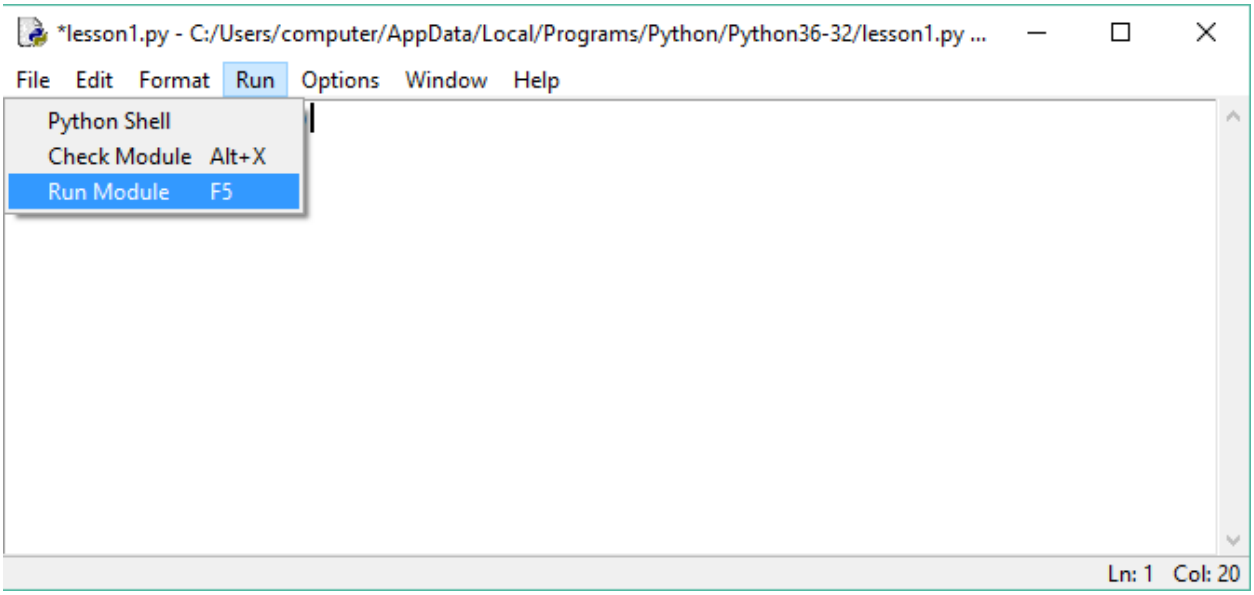


It's now time to write your first Python Programming Statement. You will print Hello World on the screen. In the Python Editor type:

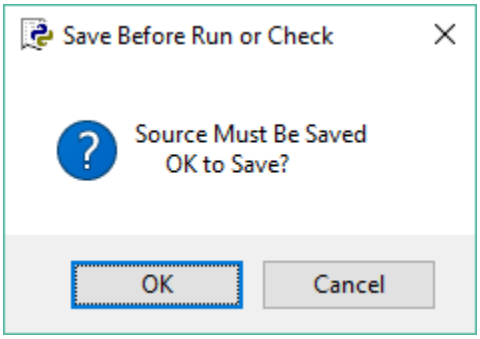
print("Hello World")



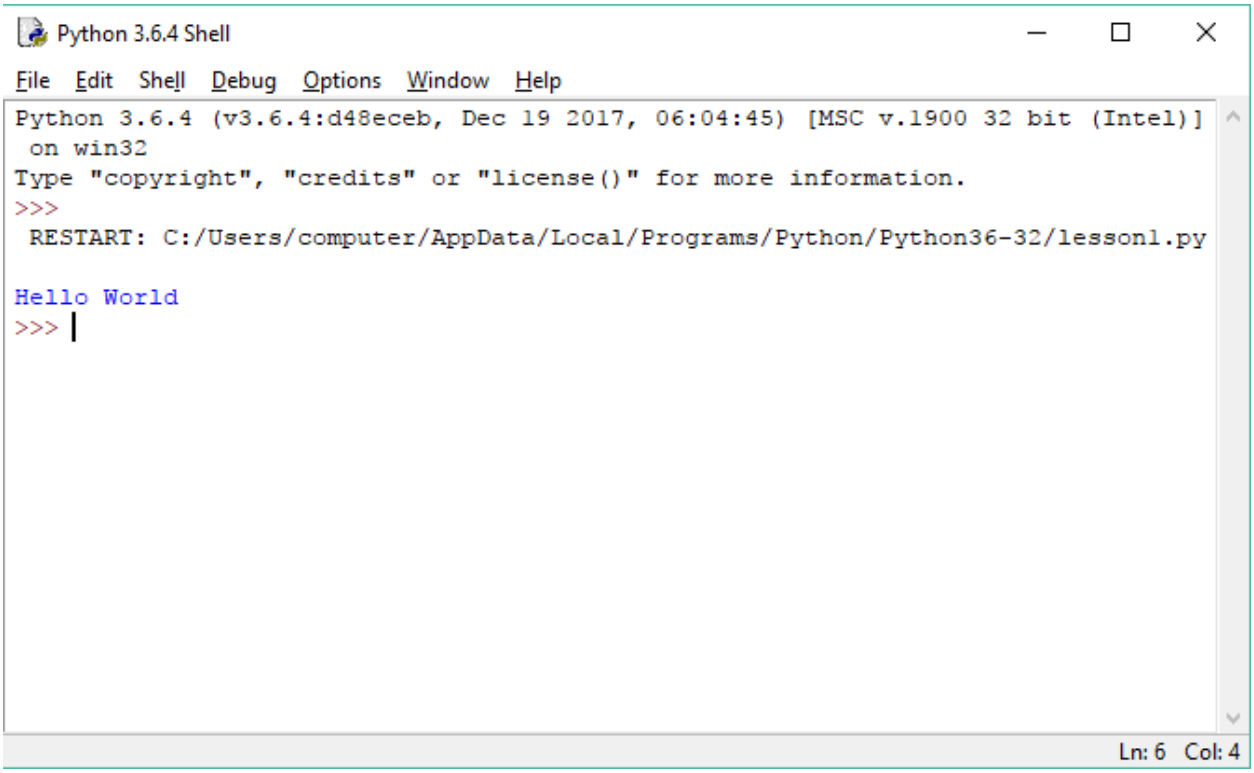
To run your program select Run Module from the Run Menu.



Select OK



Hello World is now printed on the screen in another Python Shell. The **print** statement was used to print a message on the screen like Hello World

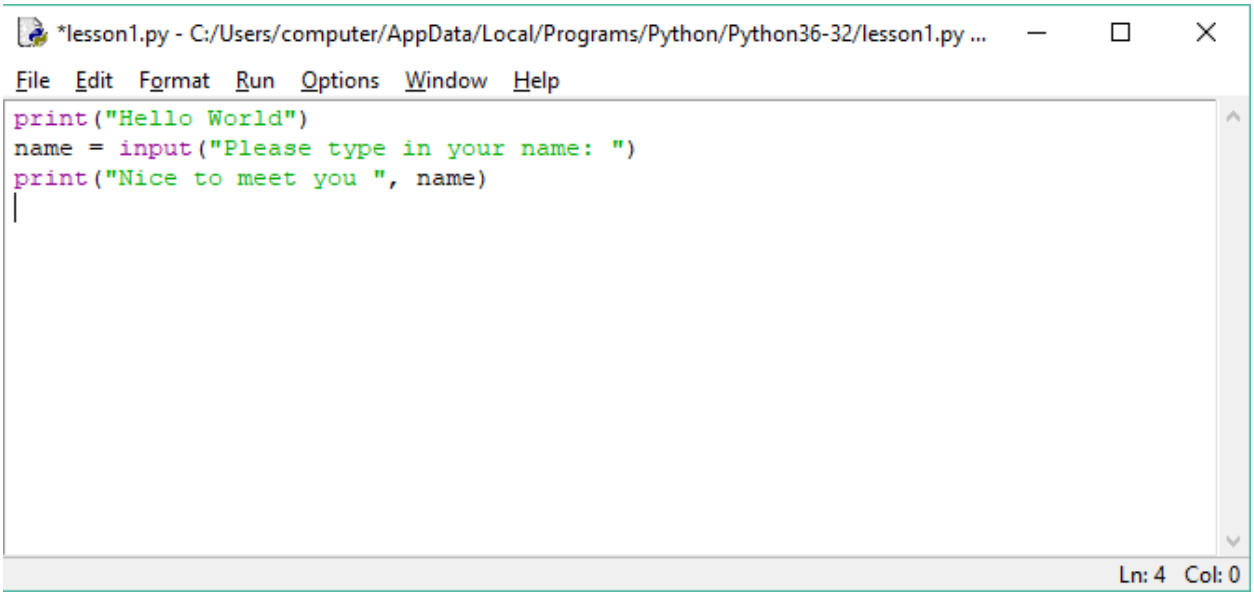


The next thing we need to do is get values from the keyboard. We will ask the user to type in their name and then greet them.

Type in the following statements in the python editor right after the Hello World statement. The **input** statement is used to read values from the keyboard.

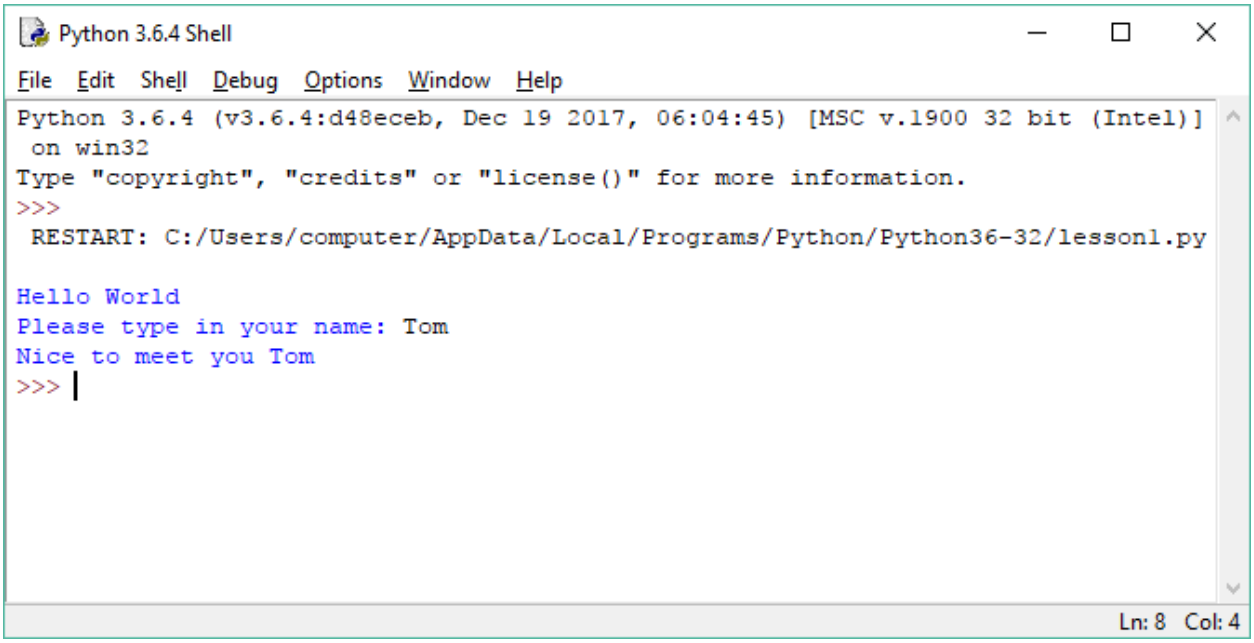
name = input("Please type in your name: ")

print("Nice to meet you ", name)



Now run your program, you will get something like this:

(You may want to close the previous Python interpreter shell before running.)



Recapping: The **print** statements writes messages on the screen the **input** statement reads values from the key board. Python has two types of values **string** values and **numeric** values. String values are messages enclosed in double or single quotes like "Hello World" or ‘Hello World’ where as numeric values are numbers like 5 and 10.5 Numeric values without decimal points like 5 are known as an **int**

and numbers with decimal points like 10.5 are known as a **float**. Variables store string or numeric values that can be used later in your program. The variable **name** stores the string value entered from the keyboard, in this case the persons name.

name = input("Please type in your name: ")

The print statement prints out the string message "Nice to meet you" and the name of the user stored in the variable name.

print("Nice to meet you ", name)

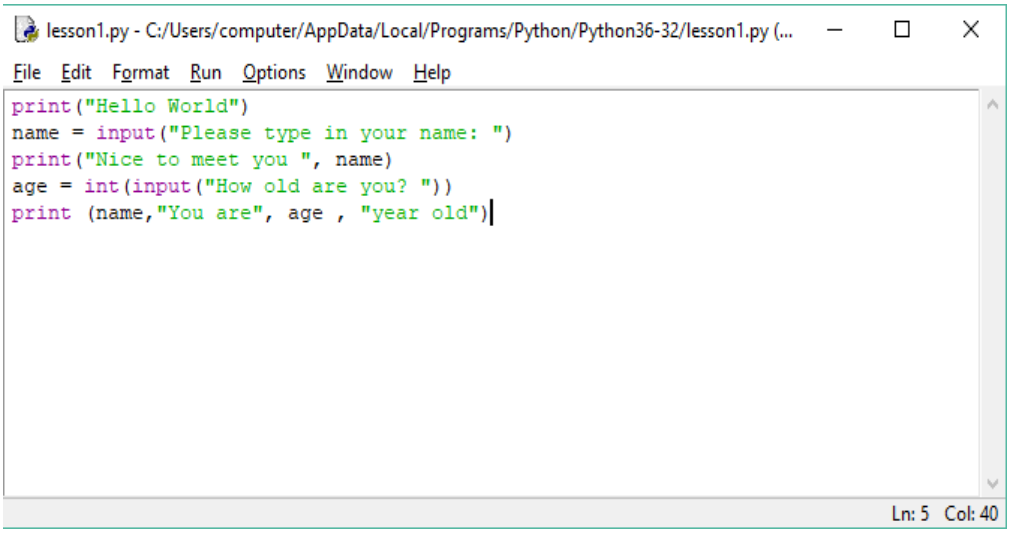
Note inside the print statement the string message and variable name are separated by commas.

We now ask the user how old they are.

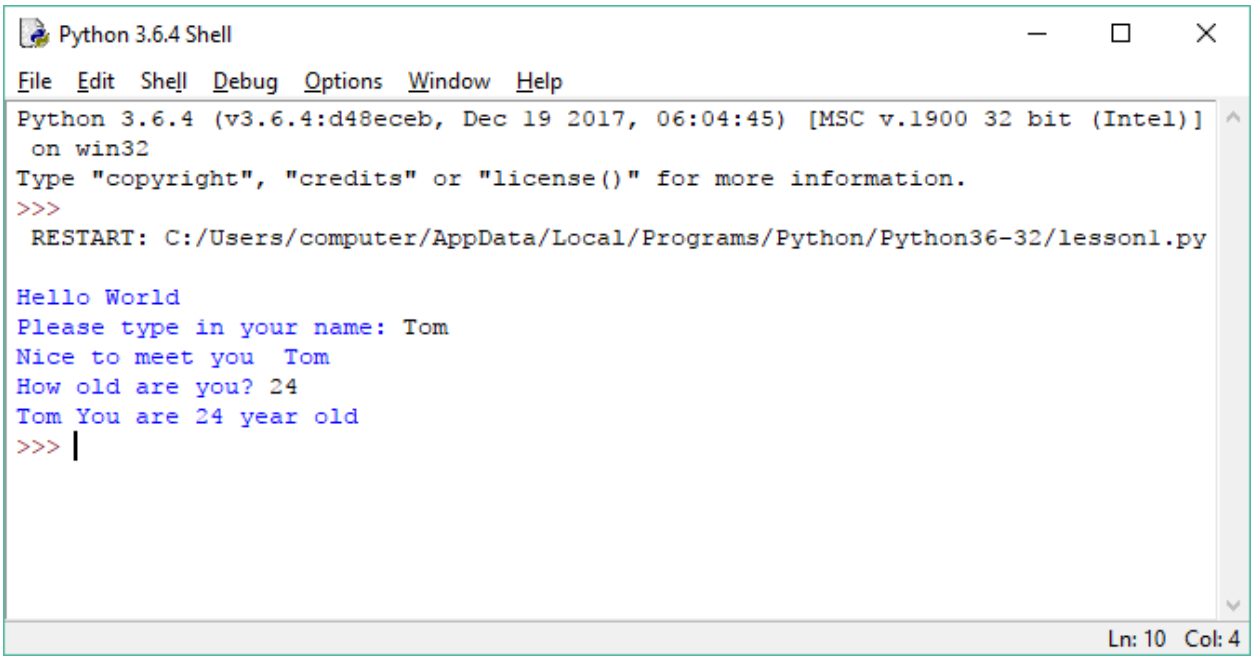
Type in the following statements at the end of your program and then run the program.

age = int(input("How old are you? "))

print (name,"You are", age , "year old")



Run the program and enter Tom for name and 24 for age



Recapping: The **input** statement asks the user to enter their age. The **int** statement converts the entered age to a **int** number and the variable age holds the age value. We need to convert the string input to a numeric value using the **int** statement.

age = int (input ("How old are you? "))

The print statement is used to print out the messages, the persons name and age.

print (name,"You are", age , "year old")

If you have got this far then you will be a great python programmer soon.

Most people find Programing difficult to learn. The secret of learning program is to figure out what you need to do and then choose the right program statement to use. If you want to print messages and values to the screen you use a **print** statement. If you want to get values from the user, you use an **input** statement. If you need a numeric value, you use a **int** statement or **float** statement on the **input** statement to convert the input value to a numeric value.

Lesson 2 Functions

Functions allow you to group many programming statements together so that you can reuse them repeatedly in your Python Program. The most common function to use is the main function. We will now group our previous programming statements in a main function and then call the main function from the python script.

Start a new python File from the Python shell called lesson2.py. Then type in the following python statements.

```
def main():
    print("Hello World")
    name = input("Please type in your name: ")
    print("Nice to meet you ", name)
    age = int(input("How old are you? "))
    print (name,"You are", age , "year old")


main()
```

Now run your program, it will do the same thing as the previous program.

All functions in Python start with the key word **def**. Function name's end with 2 rounds brackets (). The round brackets distinguish a function name from a variable name. After the function name and the round brackets () there is a colon : the colon states there are programming statements to follow that belong to the current function name. Function statements are indented with a tab. All indented statements following **def** and the function name belong to the function. In the above function our function name is main.

The last program statement **main()** is un-indented indicating the end of the main function. This statement calls our main function. It has the same name as the main function and also includes the round brackets. This indentation makes python very awkward to use and is the most cause of many program errors and unexpected program executions. Fortunately, you will get use to indentation and realize its importance in a python program to define the python program structure.

If you get your program running them you are doing good.

Python has many built in functions that you can use, that make python easier to use. You already used some of them in lesson 1, **print**, **input**, **int** and **float**. As we proceed with these lessons you will learn and use many more functions.

It is now time to add more functions to our lesson 2 program.

We will make a welcome, getName ad getAge functions.

Functions usually are defined at the top of the program in order as they are used. The main function is the last one because it will call all the proceeding functions. When a function is called in a programming statement it means it is executed. In a Python script the functions must be defined before they are used.

Here is our program now divided into functions. So, upgrade your program file and run it.

```
def welcome():
  print("Hello World")

def getName():
   name = input("Please type in your name: ")
   return name

def getAge():
   age = int(input("How old are you? "))
   return age

def printDetails(name, age):
    print("Nice to meet you ", name)
    print (name,"You are", age , "year old")

def main():
   welcome()
   name = getName()
   age = getAge()
   printDetails(name, age)

main()
```

Functions make your program more organized and manageable to use. Functions have three different purposes. Functions can receive values, return values or not receive or return values.

The welcome function just prints a statement and receives no values or returns no value.

```
def welcome():
  print("Hello World")
```

The get Name() and getAge() function both return a value using the return statement.

```
def getName():
   name = input("Please type in your name: ")
   return name
def getAge():
   age = int(input("How old are you? ")
   return age
```

The printDetails function receive a name and age value to print out, but return's no value.

```
def printDetails(name, age):
    print("Nice to meet you ", name)
    print (name,"You are", age , "year old")
```

The **name** and **age** inside the round brackets of the **printDetails** function definition statement are known as **parameters** and contain values to be used by the function. The parameters just store values from the calling function and are not the same variables that are in the calling function. Although the parameter names and values may be same as in the calling function variable names, they are different memory locations. The main purpose of the parameters is to transfer or pass values to the function. The main functions call the preceding functions to run them and store the values in variables and pass the stored variable values to the functions. Calling a function means to execute the function. The values that are passed to the called function from the calling function are known as **arguments**. Variables inside a function are known as local variables and are known to that function only. Name and age are local variables in the main function but are also arguments to the printDetails function.

```
def main():
    welcome()
    name = getName()
    age = getAge()
    printDetails(name, age)
```

Its now time to comment your program. All programs need to be commented so that the user knows what the program is about. Just by reading the comments in your program you will know exactly what the program is supposed to do. We have two types of comments in python. Header comments that are at the start of a program or a function. They start with 3 double quotes and end with three double quotes and can span multiple lines like this.

"""

Program to read a name and age from a user and
print the details on the screen

"""

Other comments are for one line only and explain what the current or proceeding program statement it is to do,

The one-line comment starts with a # like this:

 # function to read a name from the key board are return the value

We now comment the program as follow. Please add all these comments to your program.

"""

Program to read a name and age from a user and print

the details on the screen

"""

```
# function to print a welcome message
def welcome():
  print("Hello World")

# function to read a name from the key board are return the value
def getName():
   name = input("Please type in your name: ")
   return name
```

```
# function to read an age from the key board are return the value
def getAge():
   age = int(input("How old are you? ")
   return age

# function to print out a user name and age
def printDetails(name, age):
    print("Nice to meet you ", name)
    print (name,"You are", age , "year old"

# main function to run program
def main():
   welcome()  # welcome user
   name = getName() # get user name
   age = getAge() # get user age
   printDetails(name, age) # print user name an age

main() # call main function to run program
```

Lesson 3 Classes

We now take a big step in Python Programing. This is very important step to take. **Classes** represent another level in program organization. They represent programming units that contain variables to store values and contain functions to do operations on these variables that store the values. This concept is known as **Object Oriented Programming**, and is a very powerful concept. It allows these programming units to be used over again in other programs. The main benefit of a class is to store values and do operations on them transparent from the user of the class. It is very convenient for the programmers to use classes. The are like building blocks that are to create many sophisticated programs with little effort.

A class starts with the keyword **class** and the class name like this:

```
class Person:
```

The class uses another keyword **self** that indicates which variables and functions belong to this class. The keyword **self** is a little awkward to use, but we have no choice but to accept and use properly. Class definitions are little more automatic in other programming languages. Classes in Python are just probably an add on hack. All functions in a Python class must contain the **self** keyword.

We now convert our previous program to use a class. We will have a Person class that has variables to stores a name and age and includes functions to do operations on them, like initializing retrieval, assignment and output.

```
"""
Person Class to store a person's name and age
A main function to read a name and age from a user and print
the details on the screen using the Person class
"""
```

```
# define a class Person
class Person:
    # initialize Person
    def __init__(self, name, age):
        self.name = name
        self.age = age

    # return name
    def getName(self):
        return self.name

    # return age
    def getAge(self):
        return self.age

   # assign name
    def setName(self,name):
        self.name = name

    # assign age
    def setAge(self, age):
        self.age = age
```

```
    # return person info as a string
    def __str__(self):
        sout = "Nice to meet you " + self.name + "\n";
        sout += self.name + " You are " +  str(self.age) +  " years old"
        return sout
```

recapping:

The Person class definition starts with the class key word and class name Person

class Person:

A class contains an **__init__()** function that initializes the class. This **__init__()** function is also known as a **constructor**. (__ is 2 under scores) The mechanism that allocates memory in the computer for the variables defined in the class, is known as **instantiation**. When a class is instantiated it is known as an object. A class refers the class definition code that is typed into the program, an object refers to the memory that is allocated for the values of the variables defined in the class.

```
# initialize Person
    def __init__(self, name, age):
        self.name = name
        self.age = age
```

Notice the **self** keyword in the constructor parameter list. The **self** keyword is passed to every function in the Person class and represents the memory location of the Person class variable values. The programming statements inside the constructor define the Person class variables name and age and are assigned values from the parameters name and age.

```
        self.name = name
        self.age = age
```

The keyword **self** specifies which variables belongs to the Person class. The parameter name and age just to pass values to be assigned to the Person class variables and are not the same ones in the Person class.

The get functions also known as **getters** and just return values of the variables stored in the Person class. Again, you notice the self keyword.

```
    # return name
    def getName(self):
        return self.name

    # return age
    def getAge(self):
        return self.age
```

We also have set functions known as **mutators** that allow the user of the class to assign new values to the stored Person class variables.

```
    # assign name
    def setName(self,name):
        self.name = name

    # assign age
    def setAge(self, age):
        self.age = age
```

You will notice the parameter list has the keyword self and an additional parameter to assign the name or age value. Again, the **self** keyword distinguishes the person variables from the parameters since they both have the same names.

All classes should have a **__str__()** function so that it can easily return the class variables as a string message.

```
# return person info as a string
def __str__(self):
    sout = "Nice to meet you " + self.name + "\n";
    sout += self.name + " You are " +  str(self.age) +  " years old"
    return sout
```

Notice we have no print statement in our **__str__** function. We assign information to the local variable sout and return the sout value. A local variable is just known to the function it resides in. The sout variable must use the + operator to join values together as a message. Unfortunately, the + operator only joins string variables in case of numeric values the **str** function is used to convert a numeric value to string value. The **str** function is a common built in python function that return a string value.

The class definition should not contain any input or output statements. A class must be a reusable program unit, not dependent on any input or output print statements. The purpose of the class is to contain information that can be easily accessed.

Therefore, our main function must provide all the input and output print statements. We will use the input and output functions from our previous program.

```
# function to print a welcome message
def welcome():
   print("Hello World")
```

```
# function to read a name from the key board are return the value
def getName():
    name = input("Please type in your name: ")
    return name

# function to read an age from the key board are return the value
def getAge():
    age = int(input("How old are you? ")
    return age

# main function to instantiate class Person and run program
def main():
    welcome()  # welcome user
    name = getName() # get user name from keyboard
    age = getAge() # get user age from key board
    p = Person(name, age) # create Person class
    print(p) # print user name and age from person class

main() # call main function
```

Notice we create the Person class with the following statement:

```
p = Person(name, age)    # create Person class
```

This statement calls the **__init__()** function of the person class to create the person object and initialized with the values name and age.

Using the p variable the print statement automatically calls **__str__()** function

print(p)

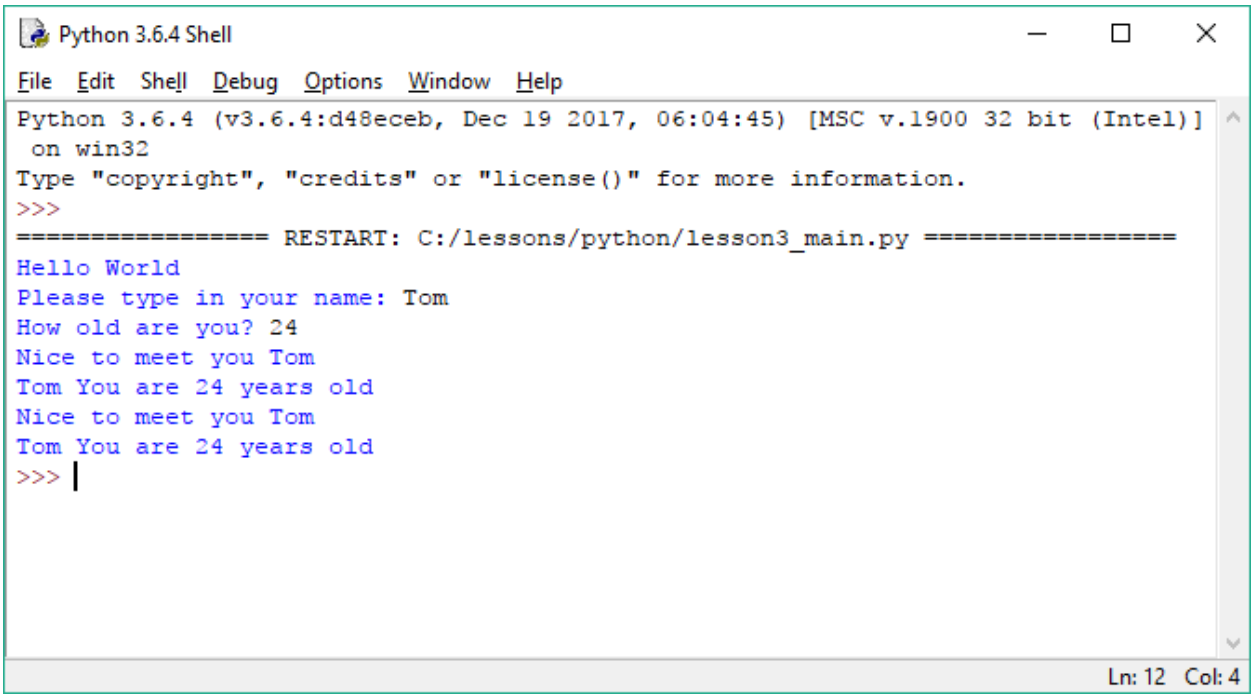
We also have default constructors that receive no values but can specify what variables a class may need and assign default values to them

```
def __init__(self):
    self.name = ""
    self.age = 0
```

Type in the class and main function in a python program lesson3.py. and run the program. You will get the same output as the previous program.

Once you got this program running make a new person called p2 using the default constructor. Copy the values from person p using the getters and setters and print out the person p2 details,

You should get something like this:



If you can do this, you are almost great python programmer!

Classes are usually put into their own files So put all the Person class code in a file called person.py. Put all the main functions in a file called lesson3_main.py. Lesson3_main.py needs some extra statements. We need to tell file lesson3_main.py to use the Person class. Put this statement just below the header comment of lessone3_main.py file near the top of the file.

```
from person import Person
```

This means from file person.py use the code from the Person class. You also need to tell the python interpreter that lesson3_main.py is the file to run. You cannot run a class without a main program. Classes do not run by them selves. Put this statement just above the main() statement at the bottom of the file.

```
if __name__ == "__main__":
    main() # call main function
```

INHERITANCE

The beauty of classes is that they can be extended to increase their functuality. We can make a Student class using the variables and functions from the Person class. This is known as **inheritance**.

A Student class will have an additional variable called idnum that will represent a string student id number. Using inheritance, the student class will be able to use the variables and functions of the Person class. The Person class is known as the **super** or **base** class and the Student class is known as the **derived** class. The Person class knows nothing about the Student class where as the Student class knows all about the Person class.

Open a new python file called student.py. Create a class called Student using this statement

```
Class Student (Person)
```

The above statement means to define a class Student that inherits the Person class.

On the top of the student.py file just below the header comment you need to tell the python interpreter to use the Person class

```
from person import Person
```

This means from the file person.py use code from the Person class**.** Now make a constructor that will initialize the student name, age and idnum.

```
# initialize Student
def __init__(self, name, age, idnum):
    Person.__init__(self,name, age)
    self.idnum = idnum
```

Notice we pass the name and age to the super Person class by calling the Person.__init()__ constructor and passing self, name and age

You should now be able to make the getID and setID getters and setters without our help.

The last thing you need to make the **__str__()** function. By using the **super()** function you can call functions directly from the super Person class inside the Student derived class. Here is the Student **__str__()** function

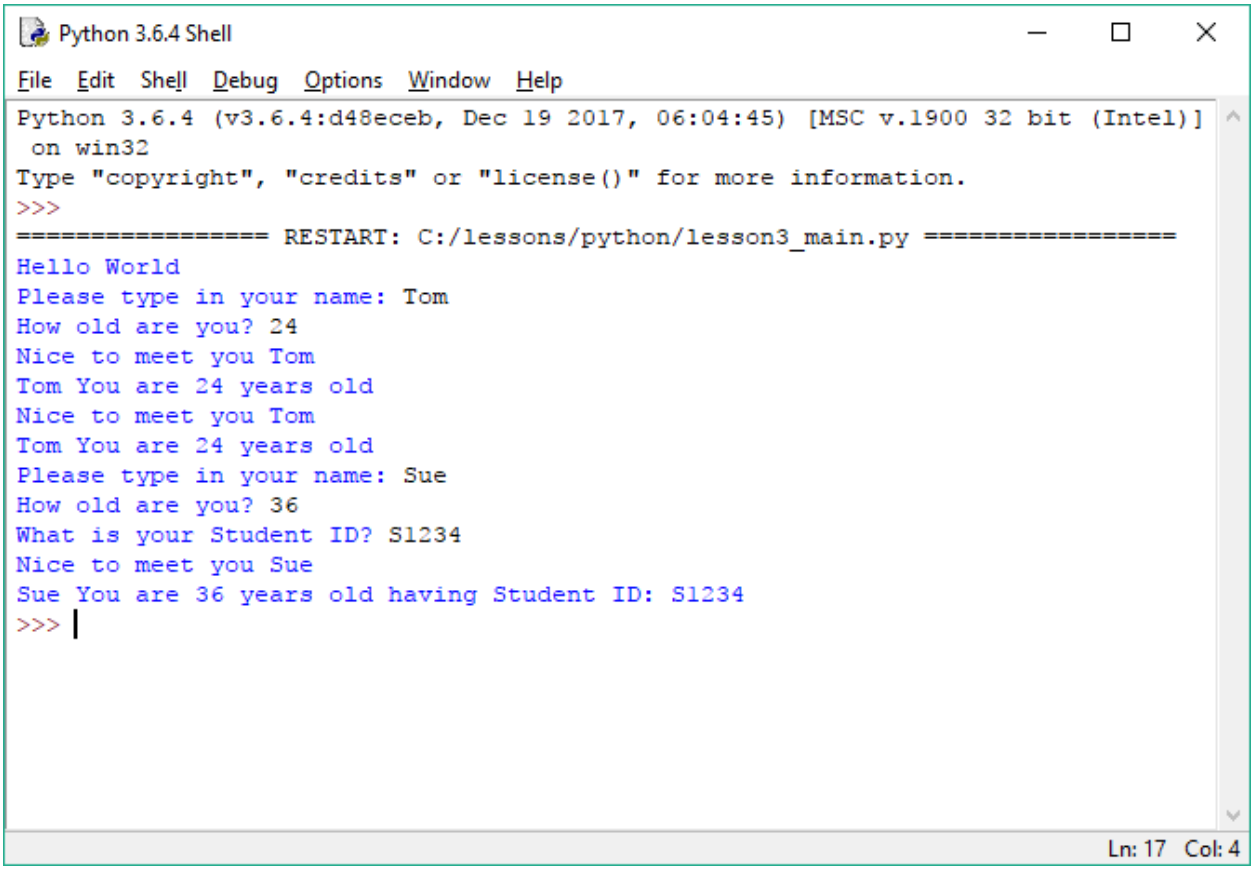
```
# return student info as a string
  def __str__(self):
    sout = super().__str__()
    sout += " having Student ID: " + self.idnum;
    return sout
```

Once you got the Student class made then add programming statements to the lessons3_main.py file to obtain a student name, age and idnum. You will have to make an additional getID() function to obtain a student id number from the key board.

You will also need an additional import statement at the top of the file for the Student class.

from student import Student

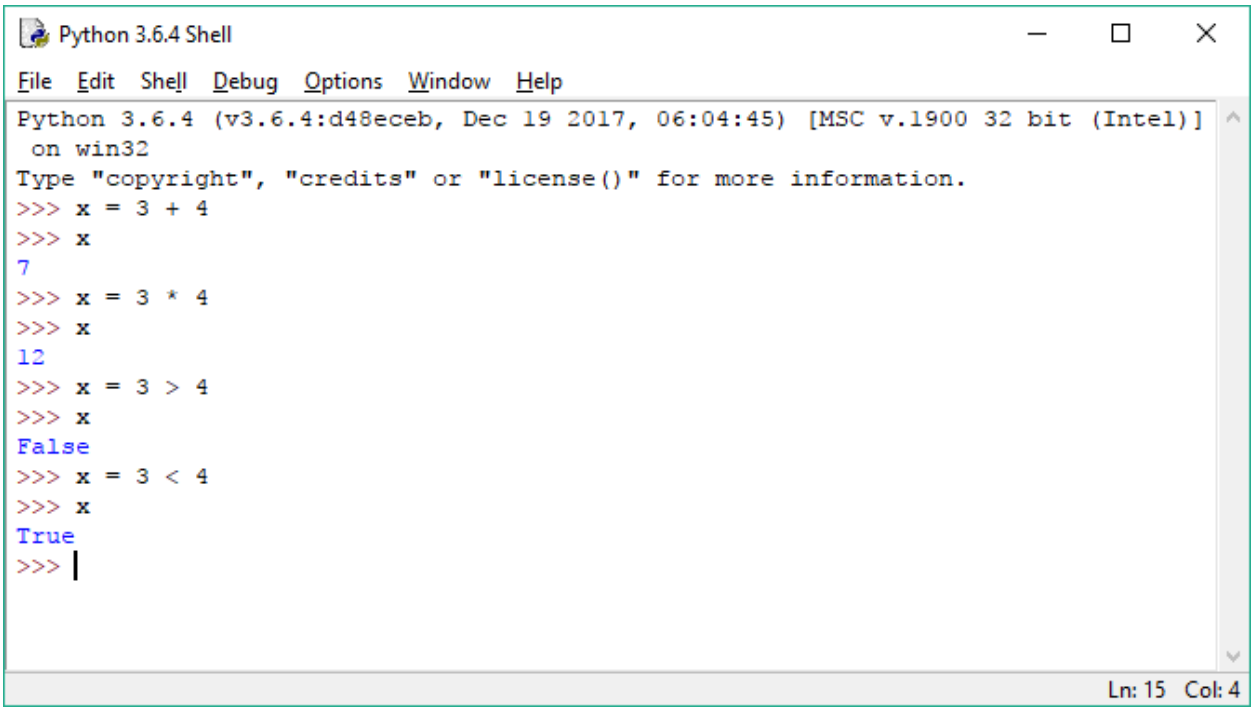
Then make a student object and use the obtained name, age and idnum then print out the student details. You should get something like this:



Lesson 4 Operators, Lists, Tuples and Dictionaries

Operators

Operators do operations on variables like addition + , subtraction -comparisons > < etc. You can test Python programing statements directly on the Python shell, which is very convenient to use. You just type in the program statement and it gets executed automatically. To see the value of a variable you just type in the variable name and the value is displayed automatically. Hint: To type in more than 1 line at a time end the last line with a extra enter to get back to the shell prompt.



We now present all the Python operators. You can type all the examples in the python shell or put in a python file called lesson4.py

If you use a python file, then you will have to use print statements to see the result on the screen like this:

```
print (3 + 4)
```

or like this using variables:

```
x = 3
y = 4
print (x + y)
```

Arithmetic Operators

Arithmetic operators are used to do operations on numbers like addition and subtraction.

Operator	Description	Example	Result
+	Add two operands or unary plus	x = 3 +2	5
-	Subtract right operand from the left or unary minus	x -= 3-2 x = -2	1 -2
*	Multiply two operands	x = 3 * 2	6
/	Divide left operand by the right one	x = 5 / 2	2.5
%	Modulus - remainder of the division of left operand by the right	x = 5 % 2	3
//	Floor division - division that results into whole number	x = 5 // 2	2
**	Exponent - left operand raised to the power of right	x = 5**2	25

Comparison Operators

Comparison operators are used to compare values. It either returns True or False according to the condition. In python true and false start with capital letters True or False**.**

Operator	Description	Example	Result
>	Greater than - True if left operand is greater than the right	5 > 3	True
<	Less than - True if left operand is less than the right	3 < 5	True
==	Equal to - True if both operands are equal	5 == 5	True
!=	Not equal to - True if operands are not equal	5!= 5	True
>=	Greater than or equal to - True if left operand is greater than or equal to the right	5 >= 3	True
<=	Less than or equal to - True if left operand is less than or equal to the right	5 <= 3	True

Logical Operators

Logical operators are the **and**, **or**, ***not*** boolean operators.

Operator	Description	Example	Result
And	True if both the operands are true	True and True	True
Or	True if either of the operands is true	True or False	True
Not	True if operand is false (complements the operand)	Not False	True

Bitwise Operators

Bitwise operators act on operands as if they were binary digits. It operates bit by bit. Binary numbers are base 2 and contain only 0 and 1's. Every decimal number has a binary equivalent. Every binary number has a decimal equivalent. For example, decimal 2 is 0010 in binary and decimal 7 is binary 0111.

In the table below: Let x = 10 (0000 1010 in binary) and y = 4 (0000 0100 in binary)

Operator	Description	Example and Result
&	Bitwise AND	x & y = 0 (0000 0000)
|	Bitwise OR	x | y = 14 (0000 1110)
~	Bitwise NOT	~x = -11 (1111 0101)
^	Bitwise XOR	x ^ y = 14 (0000 1110)
>>	Bitwise right shift	x>> 2 = 2 (0000 0010)
<<	Bitwise left shift	x<< 2 = 40 (0010 1000)

Assignment Operators

Assignment operators are used in Python to assign values to variables.

x = 5 is a simple assignment operator that assigns the value 5 on the right to the variable a on the left.

There are various compound operators in Python like x += 5 that adds to the variable and later assigns the same. It is equivalent to x = x + 5.

Operator	Compound	Equivalent
=	x = 5	x = 5
+=	x += 5	x = x + 5
-=	x -= 5	x = x - 5
*=	x *= 5	x = x * 5
/=	x /= 5	x = x / 5
%=	x %= 5	x = x % 5
//=	x //= 5	x = x // 5
**=	x **= 5	x = x ** 5
&=	x &= 5	x = x & 5
|=	x |= 5	x = x | 5
^=	x ^= 5	x = x ^ 5
>>=	x >>= 5	x = x >> 5
<<=	x <<= 5	x = x << 5

Identity Operators

is and **is not** are the identity operators in Python. They are used to check if two values (or variables) are located on the same part of the memory. Two variables that are equal does not imply that they are identical.

Operator	Description	Example
Is	True if the operands are identical	x is y
is not	True if the operands are not identical	x is not y

As stated earlier you should type in all the examples and try them out. You will be using them soon in the next lesson.

String Operators

String operators are used to do operations on strings like joining strings or getting parts of a string. You will be using string operators a lot.

```
# join two strings together

s1 = "hello"
s2 = "there"
s3 = s1 + s2
print(s3)    # hellothere


# get a character from string

c = s3[0]
print (c)    # h


# get a substring

s4 = s3[0:5]
print (s4) # hello


# add a character to a string

s5 = s3[0:5] + 'X' + s3[5:]
print (s5) # helloXthere


# reverse a string

s6 = s5[::-1]
print (s6) # erehtXolleh
```

```
# make string upper case

s7 = s6.lower() # erehtxolleh
print(s7) # EREHTXOLLEH


# make string upper case

s8 = s6.upper()
print(s8) # EREHTXOLLEH


# change a character to a ASCII number

x = ord('A')
print(x) #65


#change a ASCII number to a character

c = chr(x)|
print(c) # A
```

Lists

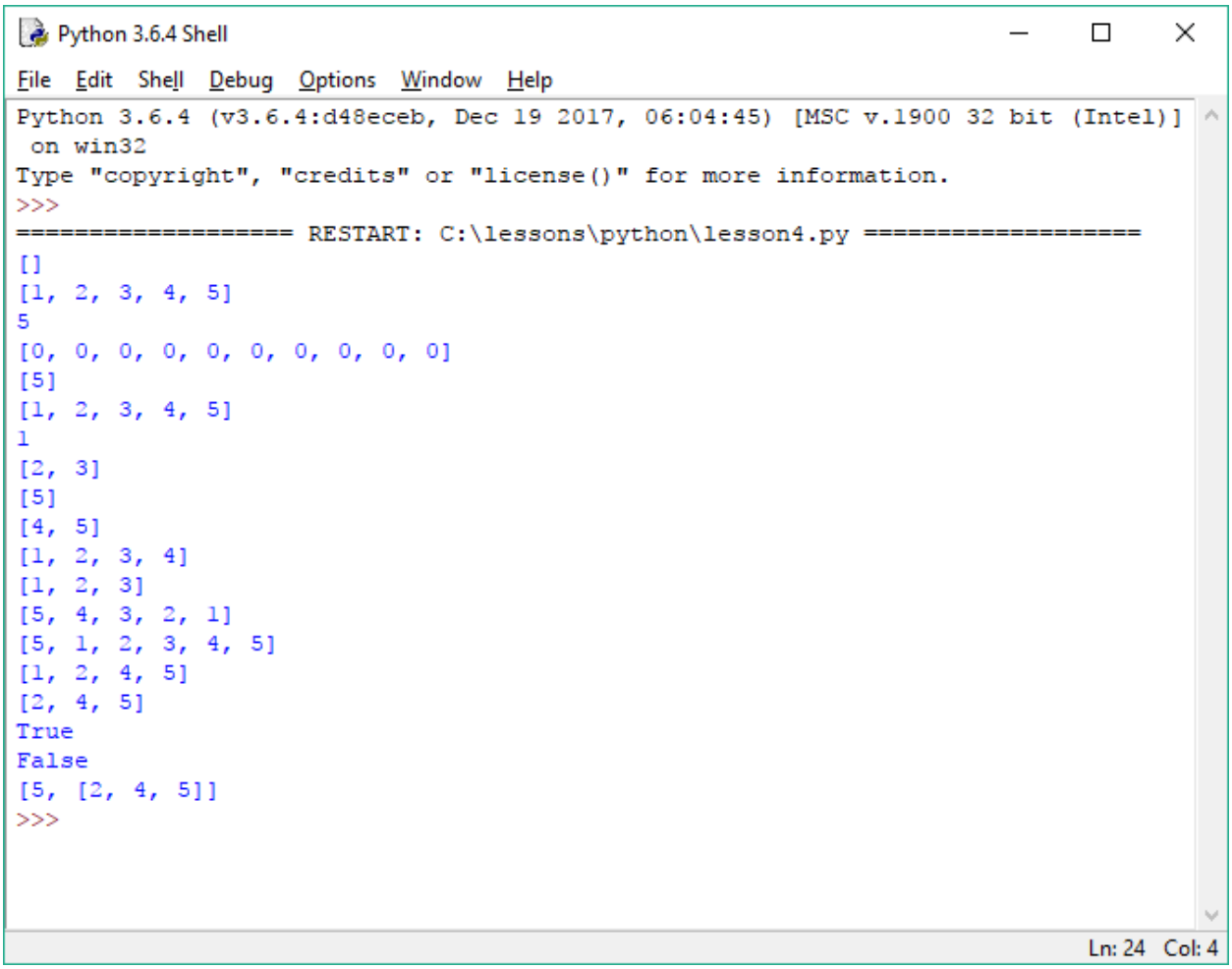
Lists store many sequential values together. Lists are analogous to arrays in other programing languages. Lists in python are very powerful and can do many things. We now present many list examples. Put the following programing statements in a python file called lesson4.py and run it.

```
# To create an empty list
list1 = []
print(list1)
```

```
# To create a list with preinitialized values
list2 = [1,2,3,4, 5]
print(list2)

# get the number of elements in an list
x = len(list2)
print (x)

# Create a list preinitialized with one values of a specified length.
# an list of 10 0's is created
list3 = [0] * 10
print(list3)

# Add a value to a list
list1.append(5)
print(list1)

# Print a list
print(list2)

# Get a value from a list at a specified location
x = list2[0]
print(x)

# Get part of a list
x = list2[1:3]
print(x)

# Get last value of list
x = list2[-1:]
print(x)

# Get last 2 values of list
x = list2[-2:]
print(x)
```

```
# get all values except last value
x = list2[:-1]
print(x)

# get all values except last 2 values
x = list2[:-2]
print(x)

# Reverse a list
x = list2[::-1]
print(x)

# add 2 lists together
x = list1 + list2;
print(x)

# remove a value from a list
list2.remove(3);
print(list2)

# remove a list item by index
del list2[0]
print(list2)

# test if a value is in a list returns True or False
x = 2 in list2
print (x)

x = 1 in list2
print (x)

# join 2 lists together (result is list inside a list)
list1.append(list2);
print(list1)
```

This should be your program output



Two Dimensional Lists

Two dimensional lists are analogues to 2 dimensional arrays in other programming languages. To make a two dimensional list you make a one dimensional list and then assign additional one dimensional lists to it.

```
# make a one-dimensional list of size 3

List3 = [None]  * 3;
```

We use **None** as a value because the one dimensional will include another one-dimensional array. (None means nothing or null in other programming languages)

```
# assign one dimensional list's of size 5 to the one-dimensional list

List3[0] = [0] * 5
List3[1] = [0] * 5
List3[2] = [0] * 5

Print(list3)  # [[0, 0, 0], [0, 0, 0], [0, 0, 0]]

# assign value by row and column

list3[1][2] = 5

# retrieve value by row and column

x = list3[1][2]

print(x)  # 5
```

Tuples

Tuples store a group of values. They are not as powerful as lists and their main purpose is to return multiple value from functions or represent multiple values when they are needed. They are read only, meaning you cannot change their values once they are created.

```
# make a tuple

t = (1,2,3)

print(t)    # (1,2,3)

# retrieve a value from a tuple

x = t[0]
print(x) # 1

# print values from a tuple

print(t[0])   #  1
print(t[1])   #  2
print(t[2])   #  3
```

Dictionaries

Dictionaries contain a key and a value. A dictionary can have many keys and corresponding values. Think of a dictionary is like a telephone book with the name as the key and the telephone number as the value.

```
 # make empty dictionary
d = {}
print (d)  # {}
# add values to a dictionary
d["name"] = "Tom"
d["age"] = 24
d["idnum"]= "S1234"
print(d)   # {'name': 'Tom', 'age': 24, 'idnum': 'S1234'}
# make dictionary with values
d2 = {"name": "tom", "age": 24, "idnum": "S1234"}
print (d2);   #  {'name': 'tom', 'age': 24, 'idnum': 'S1234'}
# get values from a dictionary
print(d2["name"])   # tom
print(d2["age"])    # 24
print(d2["idnum"])  # S1234
#print keys of a dictionary
keys = d2.keys()
print(keys)
```

```
dict_keys(['name', 'age', 'idnum'])
```

```
# print values of a dictionary
values = d2.values()
print(values)
```

```
dict_values(['tom', 24, 'S1234'])
```

Type all the above examples in your file lesson4.py and, make sure you get the same results. We will be using the lists, tuples and dictionaries in our next lesson.

Lesson 5 Programming Statements

Programming statements allow you to write complete Python Program scripts. We have already looked at simple input, print and assignment statements. We now need to control the flow of our program. Branch control statements allow certain program statements to execute and other not. Loop control statements allow program statements to repeat themselves.

Start a new python program lesson5.py to test al the control statements

```
"""
lesson5.py
Programming statements
"""
```

Branch Control Statements

The **if** branch **control** statements use conditional operators from the previous lessons to direct program flow.

If condition :

Statement(s)

When the condition is evaluated to be true the statements belonging to the if statement will execute.

```
# if statement
x = 5
if x == 5:
        print("x is 5")
print("I like Python Programming")
```

```
x is 5
I like Python Programming
```

We now add an else statement. An if-else control construct is a two-way branch operation.

If condition :

statements

else:

statements

```
# if – else statement
x = 2
if x == 5:
   print("x is 5")
else:
   print ("x is not 5")
print("I like Python Programming")
```

```
x is not 5
I like Python Programming
```

We can also have extra else if statements to make a multi-branch. Python contracts else if to **elif**

```
# multi if else
x = 10
if x == 5:
   print("x is 5")
elif x < 5:
   print("x less than  5")
elif x > 5:
   print("x greater than  5")
print("I like Python Programming")
```

```
x greater than  5
I like Python Programming
```

Our multi branch if-else can also end with an else statement.

```
# multi if-else else
x = 5
if x < 5:
        print("x less than  5")
elif x > 5:
   print("x greater than  5")
else: print("x is 5")
print("I like Python Programming")
```

```
x is  5
I like Python Programming
```

if statements can be nested to make complicated conditions simpler

```
# nested if statement
x = 5
if x >= 0:
   if x > 5:
      print("x greater than 5")
   else:
      print("x less than equal 5")
```

```
x less than equal 5
I like Python Programming
```

While loop

Our next control statement is the while loop

while condition:

statement(s)

The while loop allows you to repeat programming statements repeatedly until some condition is satisfied

```
# while loop
x = 5
while x > 0:
   print(x)
   x-=1
```

```
5
4
3
2
1
```

For Loop

The other loop is the for loop. Ii is much more powerful then the while loop but more difficult to use.

All loops much have counter mechanism. The for loop uses the range functuin that supplies' the couther stat value step value and end value for the for loop.

for counter in range(start_value, increment, end_value-1, increment):

Statement(s)

The default value for increment is 1

Using a for loop to loop 1 to 5 using the range function. The i variable cannot be changed and belongs to the for loop.

```
# for loop using range
for i in range(1,5+1,1):
   print (i)
```

```
1
2
3
4
5
```

Here is a for lop that counts backwards using a negarive increment

```
# for loop using range counting backward
for i in range(5,1-1,-1):
   print (i)
```

```
5
4
3
2
1
```

Nested for loops

Nested for loops are used to print out 2 dimensional objects by row and column

```
# nested for loop
for r in range(1,5+1):
   print(r, ":", end="")
   for c in range(1,5+1):
      print("",c,end="")
   print("")
```

Note we use the end directive so we do not start a new line every time we print out a column value

```
1 : 1 2 3 4 5
2 : 1 2 3 4 5
3 : 1 2 3 4 5
4 : 1 2 3 4 5
```

Loops can also be used to print out characters in a string variable

```
# print out characters in a string
s = "Hello"
for c in s:
   print(c)
```

```
H
e
l
l
o
```

We also can print out the values in a list

For loops can also print out values from lists

```
# print out values in a list
list1 = [1,2,3,4,5]
for x in list1:
 print (x)
```

```
1
2
3
4
5
```

Here we print out values from a two-dimensional array

```
# print out two-dimensional list
list2 = [[1,2,3],[4,5,6],[7,8,9]]
for r in list2:
   for c in r:
print (c,end=" ")
print("")
```

```
1 2 3
4 5 6
7 8 9
```

For loops can also print out dictionaries. The main purpose is to print out the dictionary in order by key or order by values

```
# print dictionary by key
# make dictionary
d = {"name": "tom", "age": "24", "idnum": "S1234"}
for key, value in d.items() :
        print (key, value)
```

```
name tom
age 24
idnum S1234
```

```
# print dictionary by value
for key, value in d.items() :
  print (value, key)
```

```
tom name
24 age
S1234 idnum
```

```
# print dictionary sorted by key
for key in sorted(d.keys()):
    print ("%s: %s" % (key, d[key]))
```

```
age: 24
idnum: S1234
name: tom
```

```
# print dictionary sorted by value
for v in sorted( str(d.values()) ):
   for key in d:
      if d[ key ] == v:
         print (key, v)
         break
```

```
age: 24
idnum: S1234
name: tom
```

LESSON 6 File I/O and List Compression

File Access

Files store data that can be read and written to. Make a Leson6.py file to store all the following python statements.

We first write lines to a file so that we can read it back. We use the open method to open the file using the "w" file mode specifier and then use the write method to print a line to the file. We then use the close method to close the file. If you do not close the file you will lose all the data written to the file.

```
# write lines to a file

f = open("output.txt", "w")
f.write("hello")
f.write("\n")
f.close()
```

```
hello
```

We then read the file back and print it to the screen. We use the open method to open the file with the "r" file mode specifier and then use the readlines method to read the lines from the file. We then use the close method to close the file. If you do not close the file then the file may not be able for use to other programs.

```
# Open the file for read

f = open('input.txt', "r")

# read all lines in the file to a list

lines = f.readlines()
print(lines)

# close the file

f.close()
```

```
hello
```

We can also read the file line by line using the readline function

```
# Open the file for read
f = open('input.txt')
# Read the first line
line = f.readline()
# read line one at a time
# till the file is empty
while line:
   print (line)
   line = f.readline()
f.close() # close file
```

```
hello
```

We can also use a for loop to read each line from a file

```
# Open the file for read

f = open('input.txt')

## Read the first line

# read line one at a time
# till the file is empty

for line in f.readLines():

   print (line)

f.close()  # close file
```

You can also write lines to end of an existing file use the **"a"** file mode specifier

```
# write lines to end of a file

f = open("test.txt", "a")

f.write("hello")

f.write("\n")

f.close()
```

Write to a csv file.

A csv file is known as comma separated values and are used to store data by rows and commas.

```
# write lines to end of a file

f = open("test.csv", "w")

f.write("one,teo,three,four")

f.write("\n")

f.close()
```

Read from a csv file.

A csv file is known as comma separated values and are used to store data by rows and commas. We read a line from the file using the readline function them use the strip method to remove the end of line character and then use the split function to separate the words between the commas. The words are placed in a list called tokens.

```
# read csv file

# Open the file for read

f = open('test.csv')

## Read the first line

line = f.readline()

# read line one at a time

# till the file is empty

while line:

   # strip removes '\n'
   # split separates line into tokens

   tokens = line.strip().split(",")

   print (tokens)

   line = f.readline()

f.close()
```

```
['one,two,three,four']
```

Catch file error

You need to catch a error when a file cannot be opened. If you do not then program will stop working. The try – except block will report the file error.

```
try:
    f = open('test.txt', 'r')
    for line in  f.readlines():
      print(line)
    f.close()

except IOError:
    print ('cannot open file test.txt')
```

LIST COMPRESSION

List compression is an easy way to append items to a list. The syntax is a little complicated to understand but accept that it works is the best approach to take.

The syntax is very intimidating, but list compression is very power full

```
new_list = [ expression for loop iteration ]
```

Here is a list compression example that builds a list with the values 1 to 10.

new_list = [i for i in range(10)]

print (new_list)

would print out

[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

In out above example the expression is i and for loop iteration is:

for i in range(10)]

which is the same i

This list compression statement is equivalent to:

```
new_list  = []
for i in range(10)
      new_list.append(i)
```

We can expand out expression to do some calculation like square root

```
new_list = [i*i for i in range(10)]

print (new_list)
```

would print out

[0, 1, 4, 9, 16, 25, 36, 49, 64, 81]

We can add a filter to out list compression just to print out even number squares. The condition is applied to the x in the iteration not to the output value appended to the output list.

```
squares = [x*x for x in range(10) if x % 2 == 0]

print (squares)
```

would print out:

[0, 4, 16, 36, 64]

To do:

Write a list compression to print out odd number squares

Here is a list compression example that does operation on another list

The syntax is

```
new_list = [ expression for item in old_list ]
```

old_list = [1, 2, 3, 4, 5]

new_list = [x*2 for x in old_list]

print(new_list)

would print out

[2, 4, 6, 8, 10]

This example is a little easier to understand it basically iterates through the old_list item by item and each item is multiplied by 2 and then appended to the new list.

The list compression statement is equivalent to:

```
old_list  = [1, 2, 3, 4, 5]
new_list = []
for x in old_list
      new_list.append(x * 2)


print(new_list)
```

would print out:

[2, 4, 6, 8, 10]

Here is a list example to add a condition to filter our output. We just print out the even number using a condition filter the condition is applied to the x of the old list not the output o the new list

The syntax is

```
[ expression for item in list if conditional ]
```

old_list = [1, 2, 3, 4, 5]

new_list = [x*2 for x in old_list if x % 2 == 0]

print(new_list)

would print out:

[4, 8]

To do:

Write a list compression to print out the odd number.

List compression has many uses like initializing lists with values. Converting values etc. Here are examples to create a 1-dimensional array with list compression

oneD_array = [0 for i in range(3)]

print(oneD_array)

[0, 0, 0]

Here are examples to create 2-dimensional array with list compression

num_rows = 2

num_columns=3

twoD_array = [[0 for i in range(num_columns)] for j in range(num_rows)]

print(twoD_array)

[[0, 0, 0], [0, 0, 0]]

PYTHON PROJECTS

Project 1 Spelling Corrector

Read in a text file with spelling mistakes, find the incorrect spelled words and offer corrections. The user should be able to choose the correct choice from a menu. Look for missing or extra letters or adjacent letters on the keyboard. Download a word dictionary from the internet as to check for correct spelled words. Use a Hash table to store the words. Store the correct spelled file.

Project 2 MathBee

Make a Math bee for intermixed addition, subtraction, multiplication and division single digit questions. Use random numbers 1 to 9 and use division numbers that will divide even results. Have 10 questions and store results in a file. Keep track of the users score.

Project 3 Quiz App

Make a quiz app with intermixed multiple choice, true and false questions.

You should have a abstract Question super class and two derived classes MultiipleChoice and TrueAndFalse. Each derived class must use the abstract methods to do the correct operation. Store all questions in one file. Store the results in another file indicating the quiz results.

Project 4 Phone Book App

Make a phone book app that uses a HashMap to store Phone numbers and names. You need a Contact class to store name and phone number. You should be able to view, add, delete, scroll up and down contacts as menu operations. Contacts need to be displayed in alphabetically orders. Offer to lookup by name or by phone number. Contacts should be stored in a file, read when app runs, and saved with app finished running. Bonus, add email and address lookups as well.

Project 5 Appointment App

Make an Appointment book app that uses a HashMap to store Appointments. You need an Appointment class to store name, description and time. You should be able to view, add, delete, scroll up and down appointments as menu operations. Appoints need to be displayed in chronological orders. Appointments should be stored in a file, read when app runs, and saved with app finished running.

END