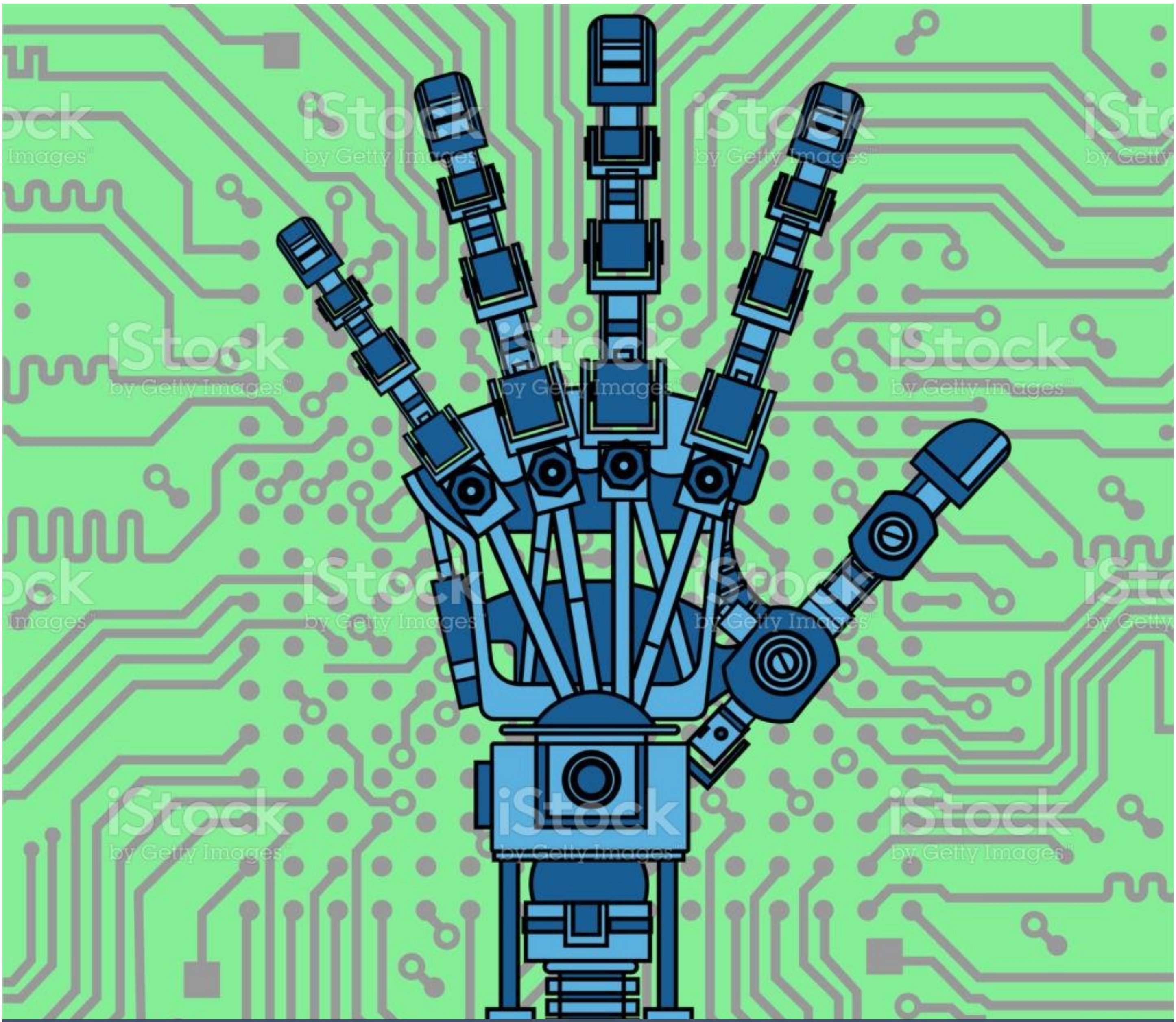


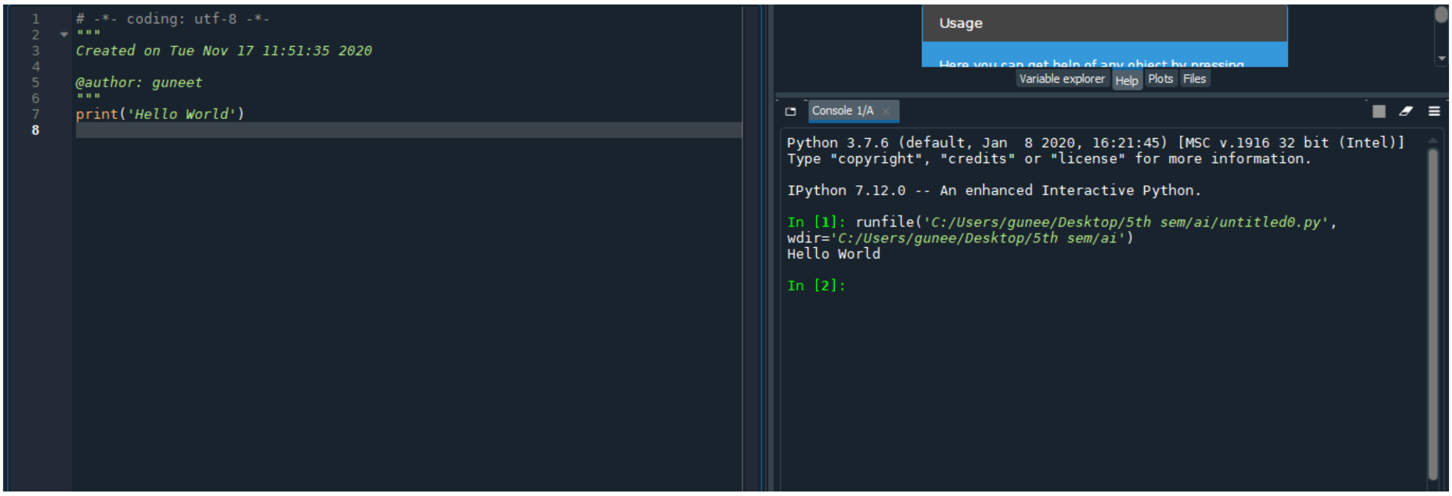
ARTIFICIAL INTELLIGENCE LABORATORY

LPCCS-106

Guneet Kohli URN: 1805172 CRN: 1815017 D3 CSEA1

1. WAP to print Hello World in Python

print('Hello World')

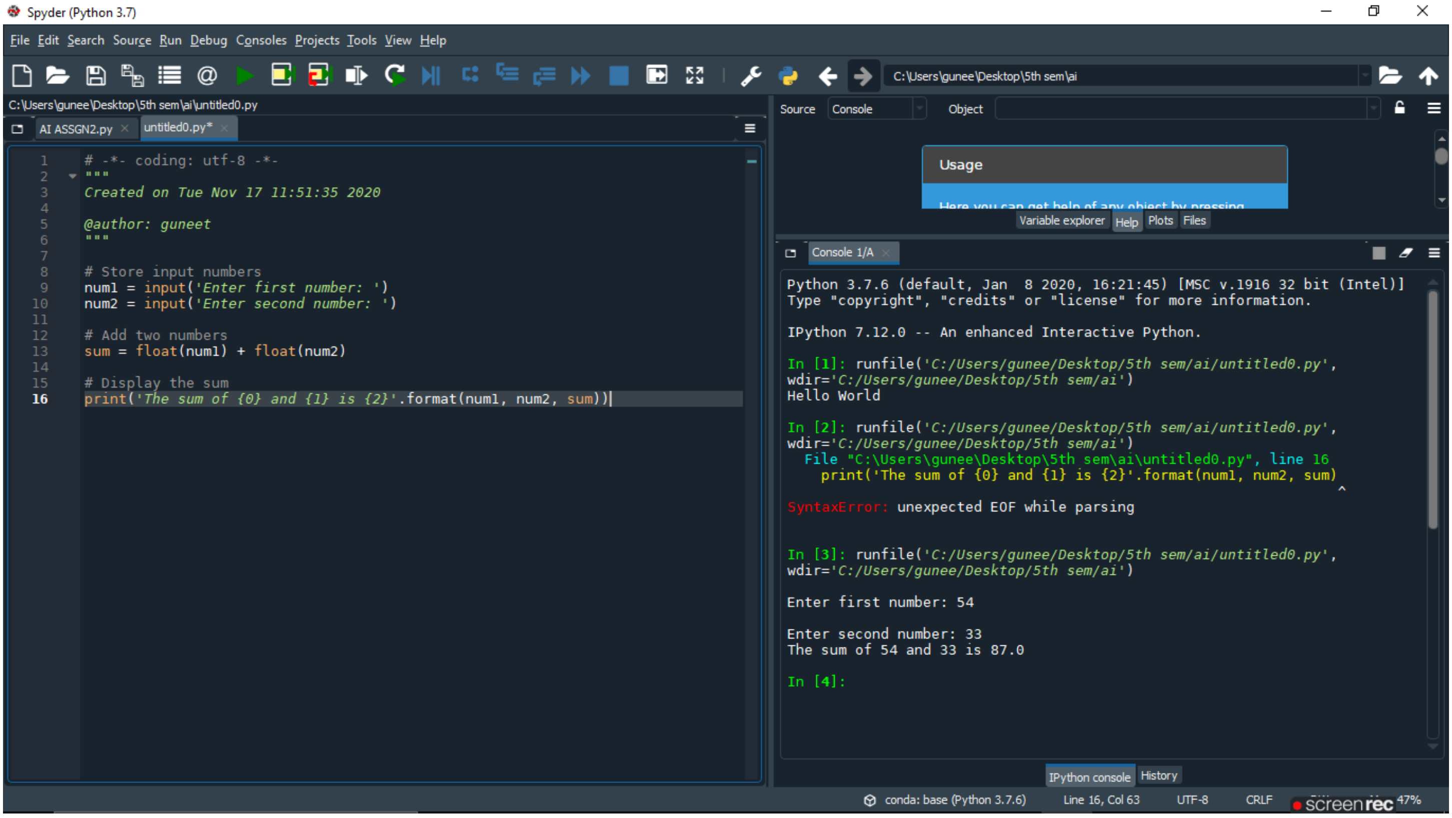


```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""
print('Hello World')
```

```
Python 3.7.6 (default, Jan  8 2020, 16:21:45) [MSC v.1916 32 bit (Intel)]
Type "copyright", "credits" or "license" for more information.

IPython 7.12.0 -- An enhanced Interactive Python.

In [1]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Hello World

In [2]:
```

2. WAP to calculate sum of two numbers in Python

```
# Store input numbers

num1 = input('Enter first number: ')

num2 = input('Enter second number: ')


# Add two numbers

sum = float(num1) + float(num2)


# Display the sum

print('The sum of {0} and {1} is {2}'.format(num1, num2, sum))
```


Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
Source
Console
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History
conda: base (Python 3.7.6)
Line 16, Col 63
UTF-8
CRLF
screenrec
47%

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""

# Store input numbers
num1 = input('Enter first number: ')
num2 = input('Enter second number: ')

# Add two numbers
sum = float(num1) + float(num2)

# Display the sum
print('The sum of {0} and {1} is {2}'.format(num1, num2, sum))
```

```
Python 3.7.6 (default, Jan  8 2020, 16:21:45) [MSC v.1916 32 bit (Intel)]
Type "copyright", "credits" or "license" for more information.

IPython 7.12.0 -- An enhanced Interactive Python.

In [1]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Hello World

In [2]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
  File "C:\Users\gunee\Desktop\5th sem\ai\untitled0.py", line 16
    print('The sum of {0} and {1} is {2}'.format(num1, num2, sum)
                                                                  ^

SyntaxError: unexpected EOF while parsing


In [3]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter first number: 54

Enter second number: 33
The sum of 54 and 33 is 87.0

In [4]:
```

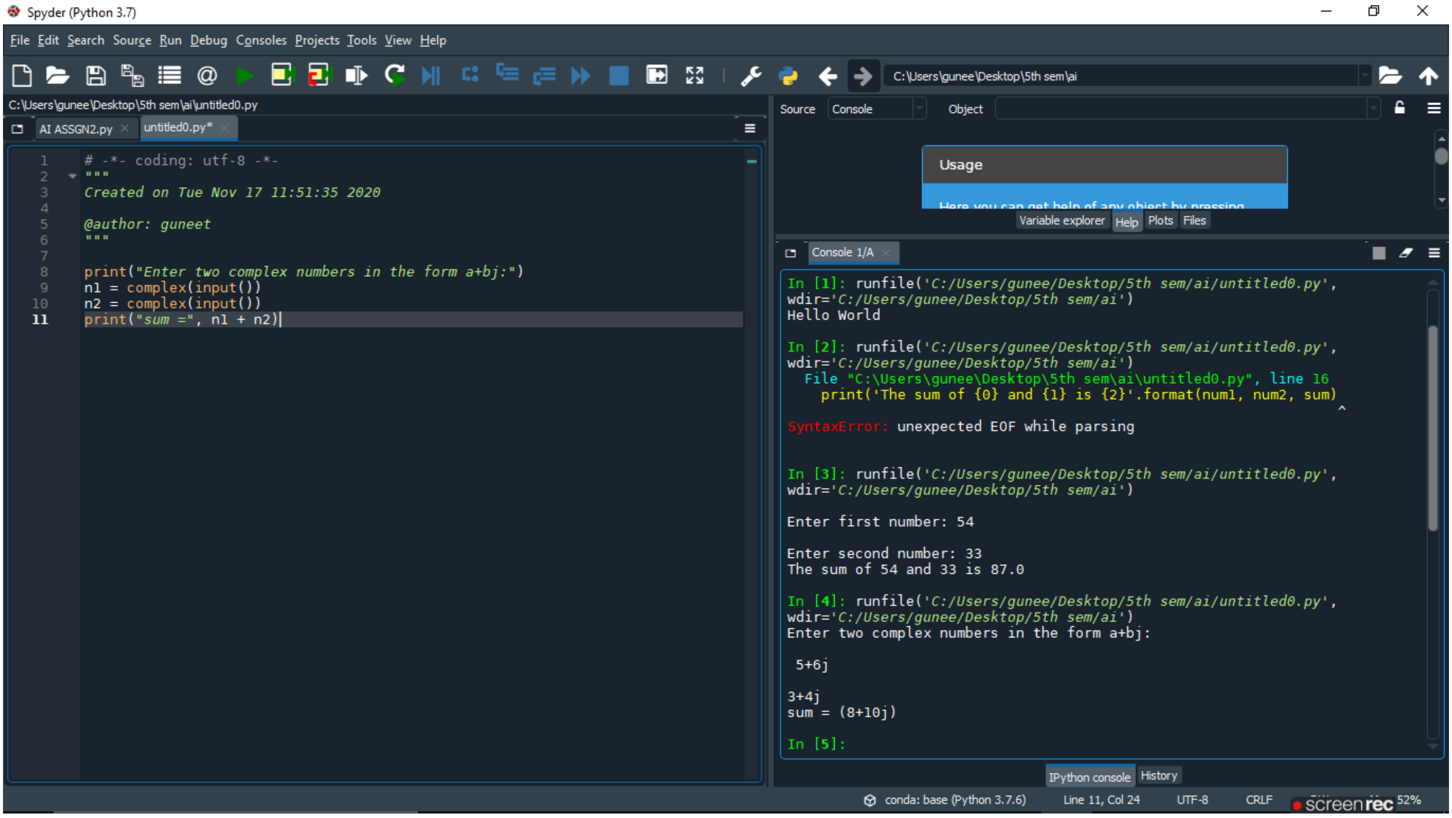
3. WAP to calculate sum of two complex numbers in Python

```
print("Enter two complex numbers in the form a+bj:")

n1 = complex(input())

n2 = complex(input())

print("sum =", n1 + n2)
```


Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
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Console 1/A
IPython console
History
conda: base (Python 3.7.6)
Line 11, Col 24
UTF-8
CRLF
screenrec
52%

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""

print("Enter two complex numbers in the form a+bj:")
n1 = complex(input())
n2 = complex(input())
print("sum =", n1 + n2)
```

```
In [1]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Hello World

In [2]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
  File "C:\Users\gunee\Desktop\5th sem\ai\untitled0.py", line 16
    print('The sum of {0} and {1} is {2}'.format(num1, num2, sum)
                                                                 ^
SyntaxError: unexpected EOF while parsing


In [3]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter first number: 54

Enter second number: 33
The sum of 54 and 33 is 87.0

In [4]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Enter two complex numbers in the form a+bj:

 5+6j

3+4j
sum = (8+10j)

In [5]:
```

4. WAP to check if number is even or odd in Python

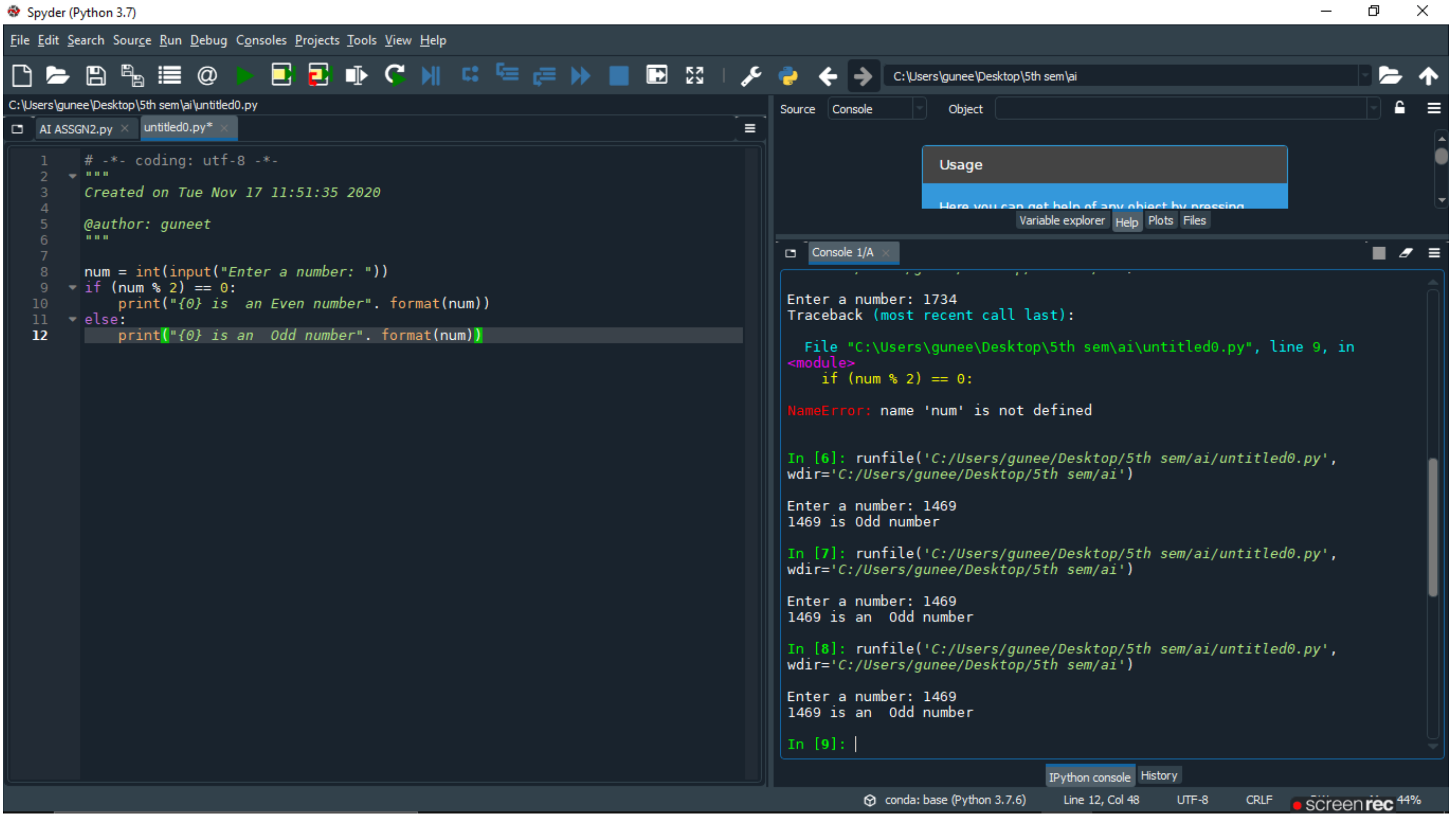
```
num = int(input("Enter a number: "))

if (num % 2) == 0:

   print("{0} is an Even number". format(num))

else:

   print("{0} is an  Odd number". format(num))
```



Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
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History
conda: base (Python 3.7.6)
Line 12, Col 48
UTF-8
CRLF
screenrec
44%

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""

num = int(input("Enter a number: "))
if (num % 2) == 0:
    print("{0} is  an Even number". format(num))
else:
    print("{0} is an  Odd number". format(num))
```

```
Enter a number: 1734
Traceback (most recent call last):

  File "C:\Users\gunee\Desktop\5th sem\ai\untitled0.py", line 9, in
<module>
    if (num % 2) == 0:

NameError: name 'num' is not defined


In [6]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 1469
1469 is Odd number

In [7]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 1469
1469 is an  Odd number

In [8]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 1469
1469 is an  Odd number

In [9]: |
```

5. WAP to find greatest of 3 numbers in Python

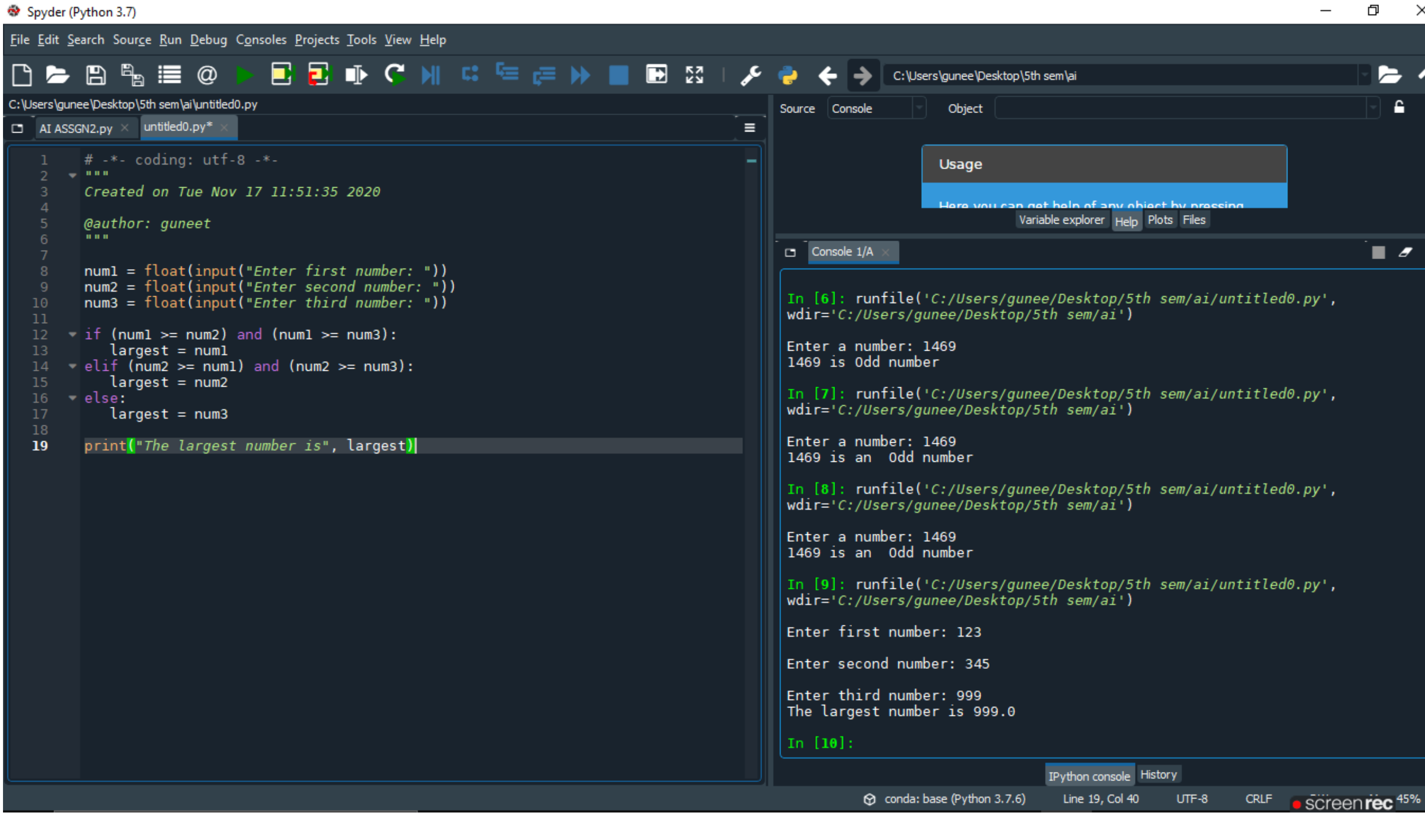
```
num1 = float(input("Enter first number: "))

num2 = float(input("Enter second number: "))

num3 = float(input("Enter third number: "))


if (num1 >= num2) and (num1 >= num3):
   largest = num1
elif (num2 >= num1) and (num2 >= num3):
   largest = num2
else:
   largest = num3


print("The largest number is", largest)
```


Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
Source
Console
Object
Usage
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Variable explorer
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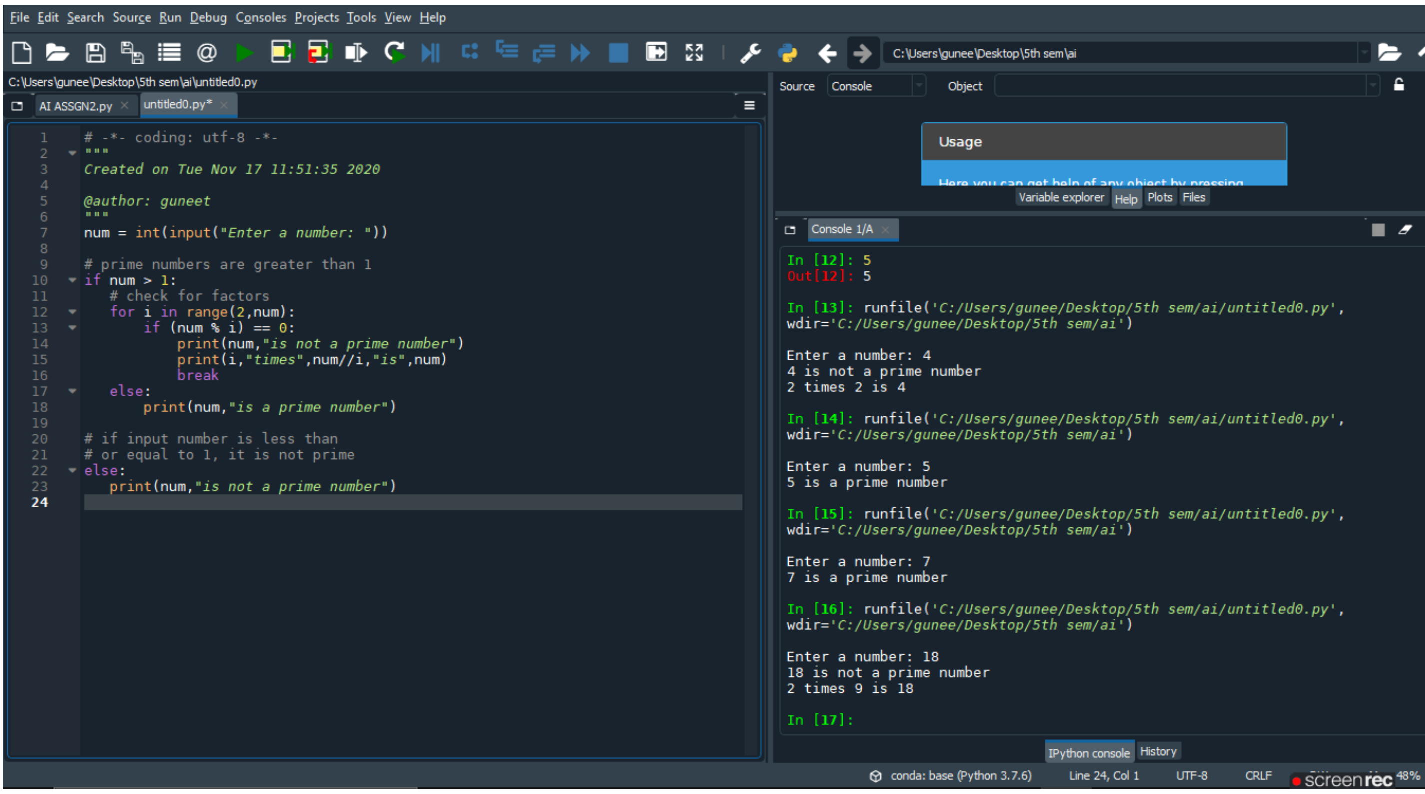
Console 1/A
IPython console
History
conda: base (Python 3.7.6)
Line 19, Col 40
UTF-8
CRLF
screenrec
45%

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""

num1 = float(input("Enter first number: "))
num2 = float(input("Enter second number: "))
num3 = float(input("Enter third number: "))

if (num1 >= num2) and (num1 >= num3):
    largest = num1
elif (num2 >= num1) and (num2 >= num3):
    largest = num2
else:
    largest = num3

print("The largest number is", largest)
```

```
In [6]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 1469
1469 is Odd number

In [7]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 1469
1469 is an  Odd number

In [8]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 1469
1469 is an  Odd number

In [9]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter first number: 123

Enter second number: 345

Enter third number: 999
The largest number is 999.0

In [10]:
```

6. WAP to find whether a number is prime or not in Python

```
num = int(input("Enter a number: "))

# prime numbers are greater than 1

if num > 1:

  # check for factors

  for i in range(2,num):

     if (num % i) == 0:

        print(num,"is not a prime number")

        print(i,"times",num//i,"is",num)

        break

  else:

     print(num,"is a prime number")

  # if input number is less than or equal to 1, it is not prime

else:

  print(num,"is not a prime number”)
```


File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
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Here you can get help of any object by pressing
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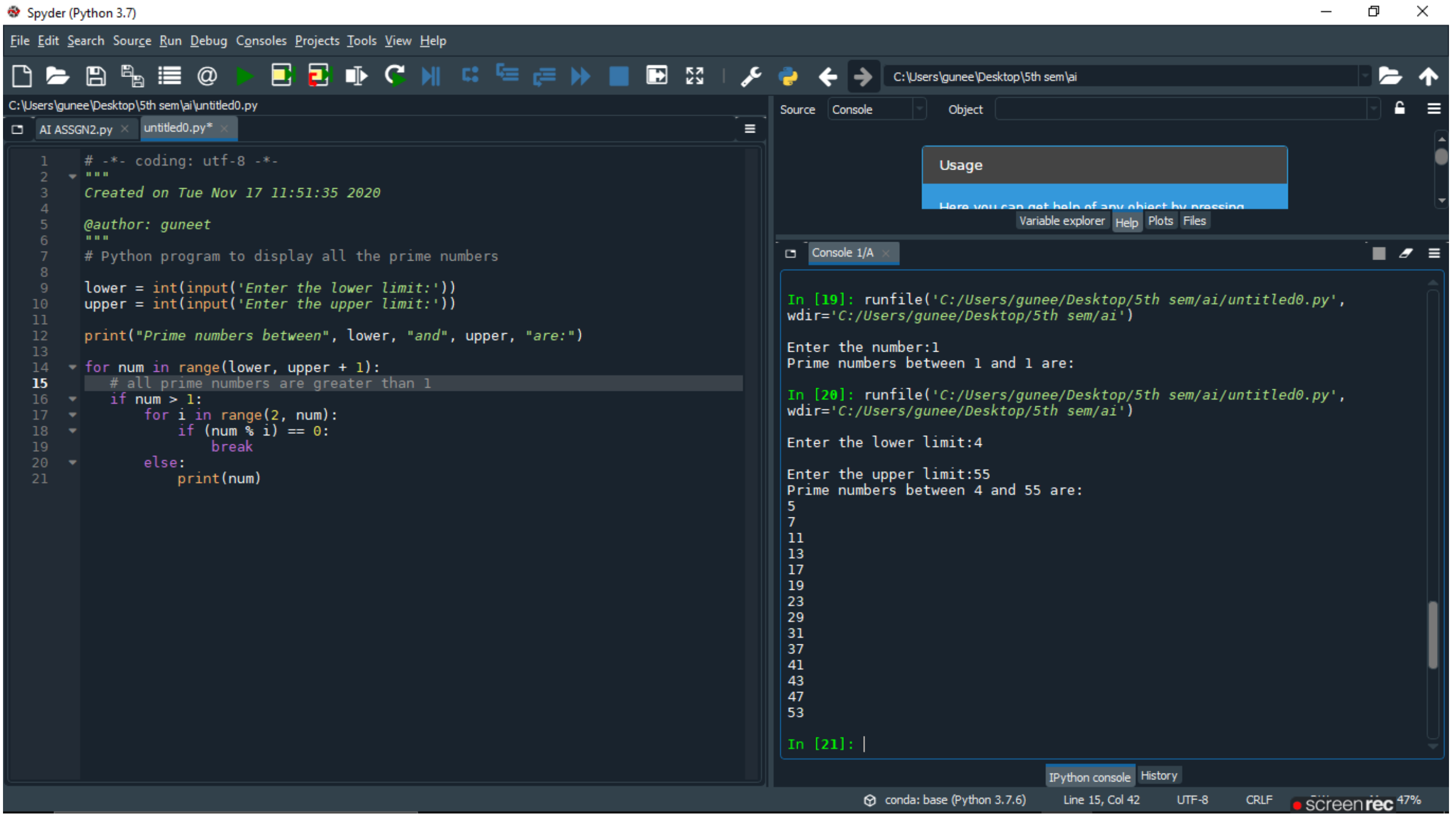
Console 1/A
IPython console
History
conda: base (Python 3.7.6)
Line 24, Col 1
UTF-8
CRLF
screenrec

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""
num = int(input("Enter a number: "))

# prime numbers are greater than 1
if num > 1:
    # check for factors
    for i in range(2,num):
        if (num % i) == 0:
            print(num,"is not a prime number")
            print(i,"times",num//i,"is",num)
            break
    else:
        print(num,"is a prime number")

# if input number is less than
# or equal to 1, it is not prime
else:
    print(num,"is not a prime number")
```

```
In [12]: 5
Out[12]: 5

In [13]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 4
4 is not a prime number
2 times 2 is 4

In [14]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 5
5 is a prime number

In [15]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 7
7 is a prime number

In [16]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter a number: 18
18 is not a prime number
2 times 9 is 18

In [17]:
```

7. WAP to find prime numbers in a range using for loop in Python

```
lower = int(input('Enter the lower limit:'))
upper = int(input('Enter the upper limit:'))


print("Prime numbers between", lower, "and", upper, "are:")


for num in range(lower, upper + 1):
  # all prime numbers are greater than 1
  if num > 1:
      for i in range(2, num):
          if (num % i) == 0:
              break
      else:
          print(num)
```

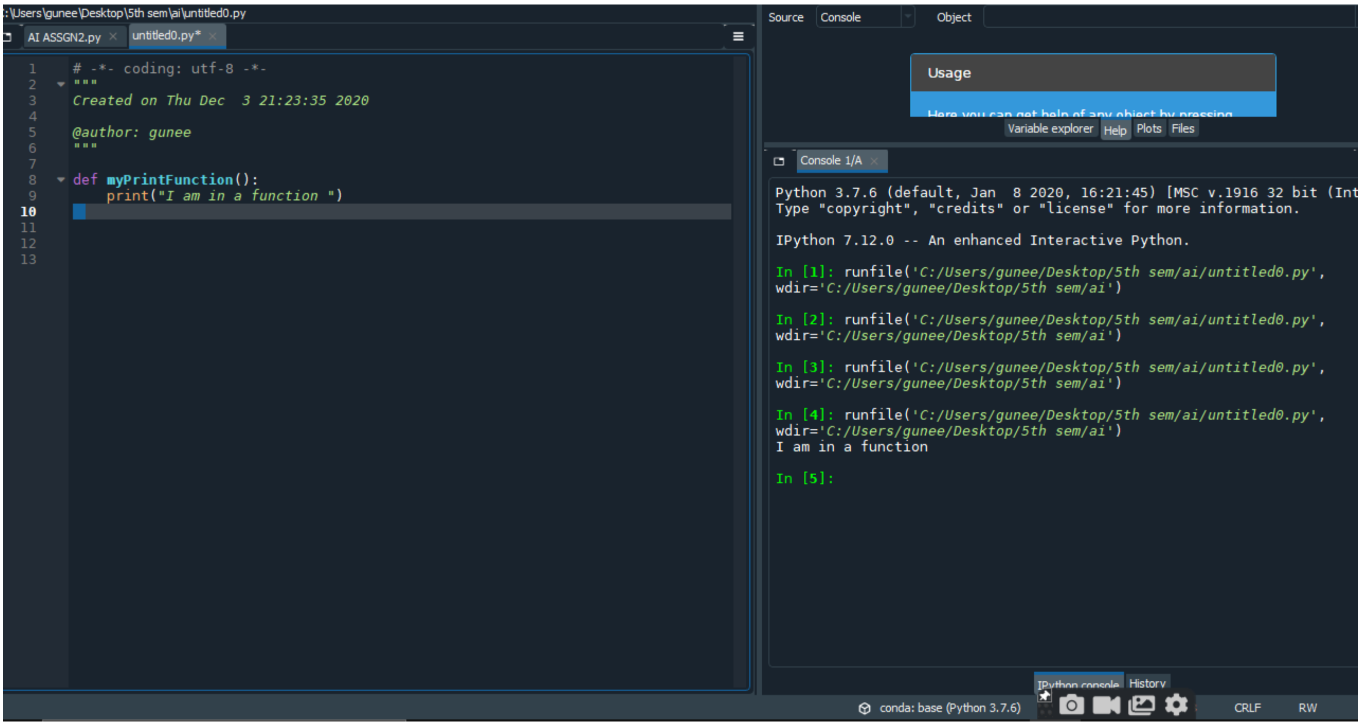

Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
Source
Console
Object
Usage
Here you can get help of any object by pressing
Variable explorer
Help
Plots
Files
Console 1/A
IPython console
History
conda: base (Python 3.7.6)
Line 15, Col 42
UTF-8
CRLF
screenrec
47%

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 17 11:51:35 2020

@author: guneet
"""
# Python program to display all the prime numbers

lower = int(input('Enter the lower limit:'))
upper = int(input('Enter the upper limit:'))

print("Prime numbers between", lower, "and", upper, "are:")

for num in range(lower, upper + 1):
   # all prime numbers are greater than 1
   if num > 1:
       for i in range(2, num):
           if (num % i) == 0:
               break
       else:
           print(num)
```

```
In [19]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter the number:1
Prime numbers between 1 and 1 are:

In [20]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

Enter the lower limit:4

Enter the upper limit:55
Prime numbers between 4 and 55 are:
5
7
11
13
17
19
23
29
31
37
41
43
47
53

In [21]: |
```

8. Function that prints a simple message “I am in a function”.

```
def myPrintFunction():
  print("I am in a function ")

myPrintFunction()
```



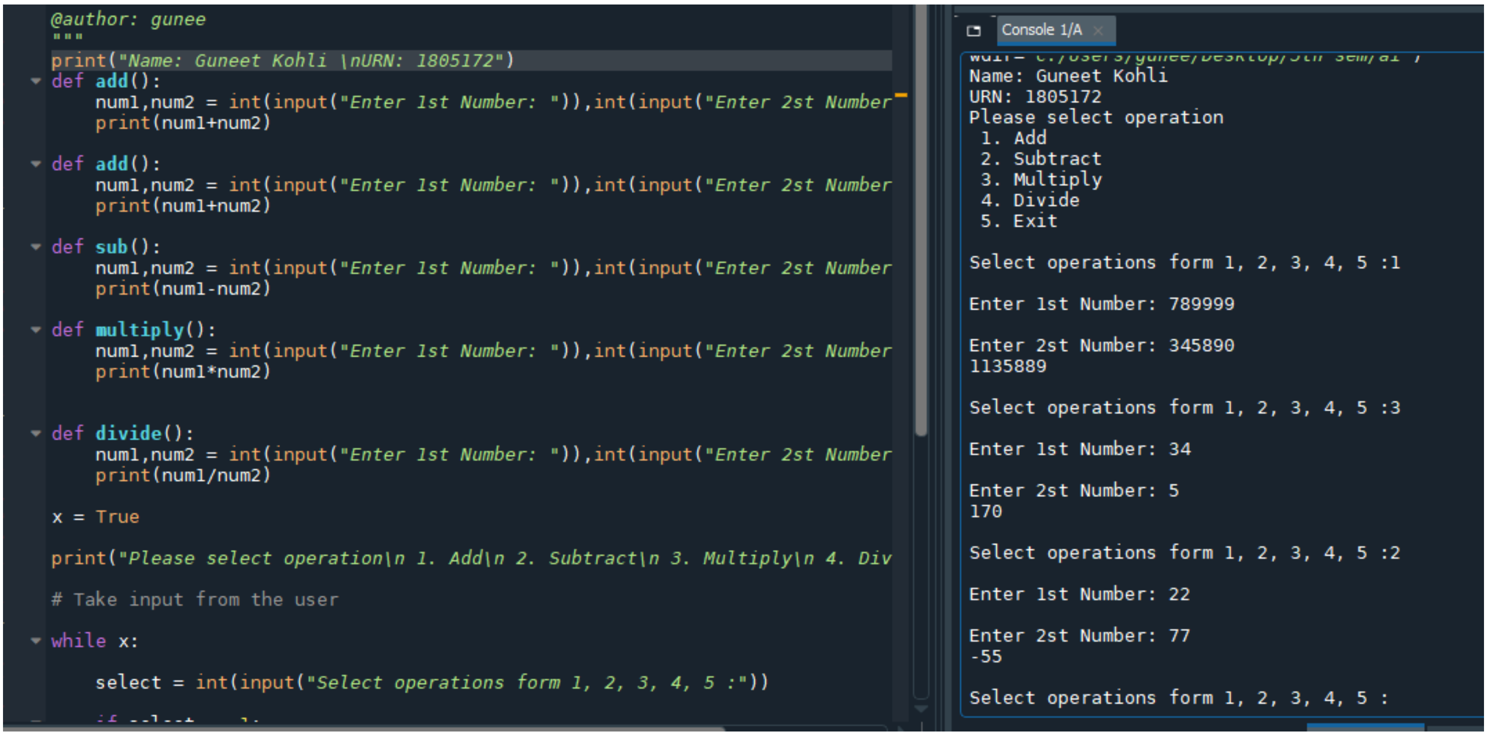
```
# -*- coding: utf-8 -*-
"""
Created on Thu Dec  3 21:23:35 2020

@author: gunee
"""

def myPrintFunction():
    print("I am in a function ")
```

```
Python 3.7.6 (default, Jan  8 2020, 16:21:45) [MSC v.1916 32 bit (Int
Type "copyright", "credits" or "license" for more information.

IPython 7.12.0 -- An enhanced Interactive Python.

In [1]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

In [2]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

In [3]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

In [4]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
I am in a function

In [5]:
```

9. WAP to create a simple calculator. user will enter choice (addition/ subtraction/ division/ multiplication/ exit) specific function will be called.

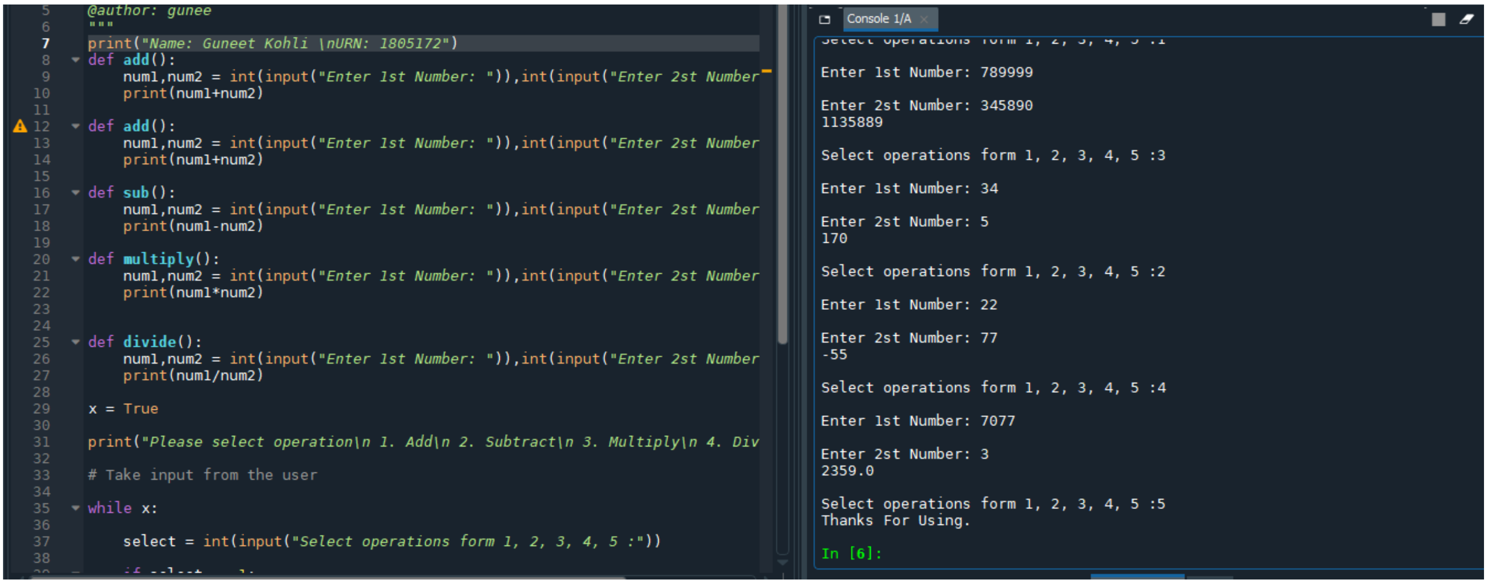
```
print("Name: Guneet Kohli \nURN: 1805172")


def add():

    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number: "))

    print(num1+num2)


def add():

    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number: "))

    print(num1+num2)


def sub():

    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number: "))

    print(num1-num2)


def multiply():

    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number: "))

    print(num1*num2)




def divide():

    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number: "))

    print(num1/num2)


x = True
```

```
print("Please select operation\n 1. Add\n 2. Subtract\n 3. Multiply\n 4. Divide\n 5. Exit")

# Take input from the user

while x:

   select = int(input("Select operations form 1, 2, 3, 4, 5 :"))

   if select == 1:
      add()

   elif select == 2:
      sub()

   elif select == 3:
      multiply()

   elif select == 4:
      divide()

   elif select == 5:
      print("Thanks For Using.")
      x = False

   else:
      print("Invalid input")
```



```
@author: gunee
"""
print("Name: Guneet Kohli \nURN: 1805172")
def add():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1+num2)

def add():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1+num2)

def sub():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1-num2)

def multiply():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1*num2)


def divide():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1/num2)

x = True

print("Please select operation\n 1. Add\n 2. Subtract\n 3. Multiply\n 4. Div

# Take input from the user

while x:

    select = int(input("Select operations form 1, 2, 3, 4, 5 :"))

    if select == 1:
```

```
wdir='C:/Users/gunee/Desktop/5th sem/a1')
Name: Guneet Kohli
URN: 1805172
Please select operation
 1. Add
 2. Subtract
 3. Multiply
 4. Divide
 5. Exit

Select operations form 1, 2, 3, 4, 5 :1

Enter 1st Number: 789999

Enter 2st Number: 345890
1135889

Select operations form 1, 2, 3, 4, 5 :3

Enter 1st Number: 34

Enter 2st Number: 5
170

Select operations form 1, 2, 3, 4, 5 :2

Enter 1st Number: 22

Enter 2st Number: 77
-55

Select operations form 1, 2, 3, 4, 5 :
```

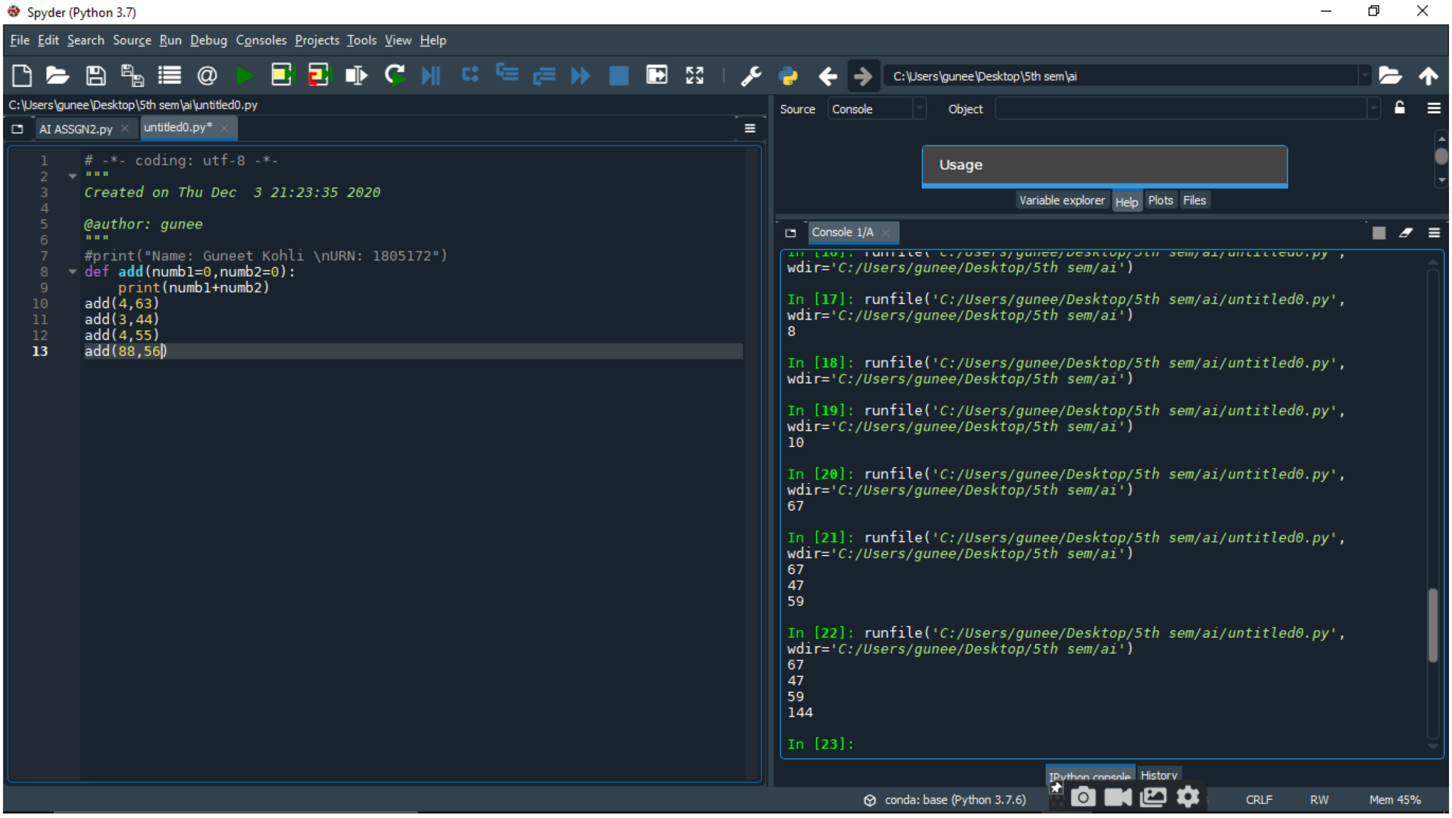


```
@author: gunee
"""
print("Name: Guneet Kohli \nURN: 1805172")
def add():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1+num2)

def add():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1+num2)

def sub():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1-num2)

def multiply():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1*num2)


def divide():
    num1,num2 = int(input("Enter 1st Number: ")),int(input("Enter 2st Number
    print(num1/num2)

x = True

print("Please select operation\n 1. Add\n 2. Subtract\n 3. Multiply\n 4. Div

# Take input from the user

while x:

    select = int(input("Select operations form 1, 2, 3, 4, 5 :"))

    if select == 1:
```

```
Select operations form 1, 2, 3, 4, 5 :1

Enter 1st Number: 789999

Enter 2st Number: 345890
1135889

Select operations form 1, 2, 3, 4, 5 :3

Enter 1st Number: 34

Enter 2st Number: 5
170

Select operations form 1, 2, 3, 4, 5 :2

Enter 1st Number: 22

Enter 2st Number: 77
-55

Select operations form 1, 2, 3, 4, 5 :4

Enter 1st Number: 7077

Enter 2st Number: 3
2359.0

Select operations form 1, 2, 3, 4, 5 :5
Thanks For Using.

In [6]:
```

10. Pass arguments in above (pass arbitrary arguments in Add function)

```
def add(numb1=0,numb2=0):
   print(numb1+numb2)
add(4,63)
add(3,44)
add(4,55)
add(88,56)
```


Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
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C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
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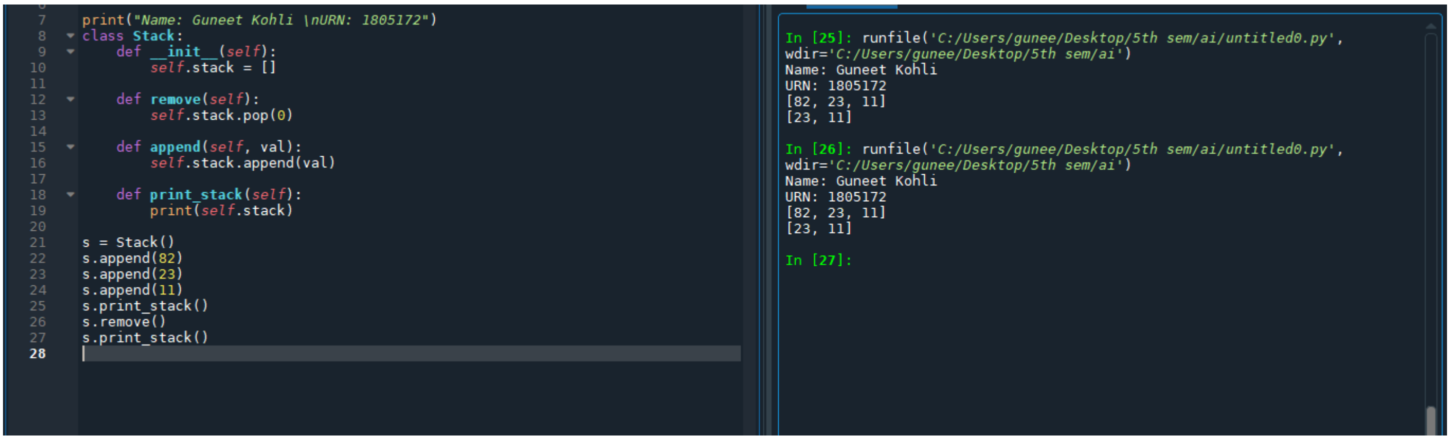
IPython console History
conda: base (Python 3.7.6) CRLF RW Mem 45%

```
# -*- coding: utf-8 -*-
"""
Created on Thu Dec  3 21:23:35 2020

@author: gunee
"""
#print("Name: Guneet Kohli \nURN: 1805172")
def add(numb1=0,numb2=0):
    print(numb1+numb2)
add(4,63)
add(3,44)
add(4,55)
add(88,56)
```

```
In [16]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

In [17]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
8

In [18]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')

In [19]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
10

In [20]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
67

In [21]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
67
47
59

In [22]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
67
47
59
144

In [23]:
```

11. Implement stacks and queues using lists

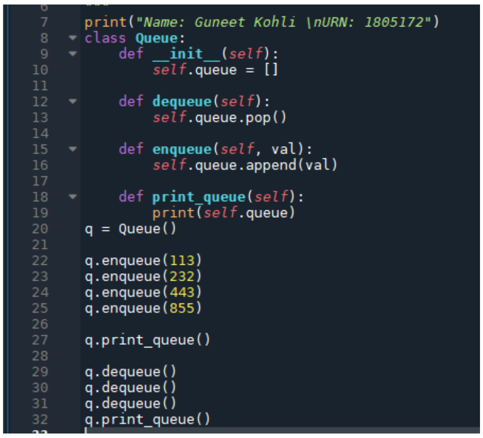
```
class Stack:

   def _init_(self):

      self.stack = []


   def remove(self):

      self.stack.pop(0)


   def append(self, val):

      self.stack.append(val)


   def print_stack(self):

      print(self.stack)


s = Stack()

s.append(82)

s.append(23)

s.append(11)

s.print_stack()

s.remove()

s.print_stack()
```



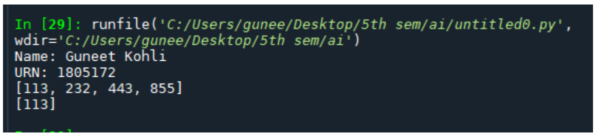
```
print("Name: Guneet Kohli \nURN: 1805172")
class Stack:
    def __init__(self):
        self.stack = []

    def remove(self):
        self.stack.pop(0)

    def append(self, val):
        self.stack.append(val)

    def print_stack(self):
        print(self.stack)

s = Stack()
s.append(82)
s.append(23)
s.append(11)
s.print_stack()
s.remove()
s.print_stack()
```

```
In [25]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Name: Guneet Kohli
URN: 1805172
[82, 23, 11]
[23, 11]

In [26]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Name: Guneet Kohli
URN: 1805172
[82, 23, 11]
[23, 11]

In [27]:
```

```
class Queue:
  def __init__(self):
    self.queue = []

  def dequeue(self):
    self.queue.pop()

  def enqueue(self, val):
    self.queue.append(val)

  def print_queue(self):
    print(self.queue)
q = Queue()

q.enqueue(113)
q.enqueue(232)
q.enqueue(443)
q.enqueue(855)

q.print_queue()

q.dequeue()
q.dequeue()
q.dequeue()
q.print_queue()
```



```
print("Name: Guneet Kohli \nURN: 1805172")
class Queue:
    def __init__(self):
        self.queue = []

    def dequeue(self):
        self.queue.pop()

    def enqueue(self, val):
        self.queue.append(val)

    def print_queue(self):
        print(self.queue)
q = Queue()

q.enqueue(113)
q.enqueue(232)
q.enqueue(443)
q.enqueue(855)

q.print_queue()

q.dequeue()
q.dequeue()
q.dequeue()
q.print_queue()
```

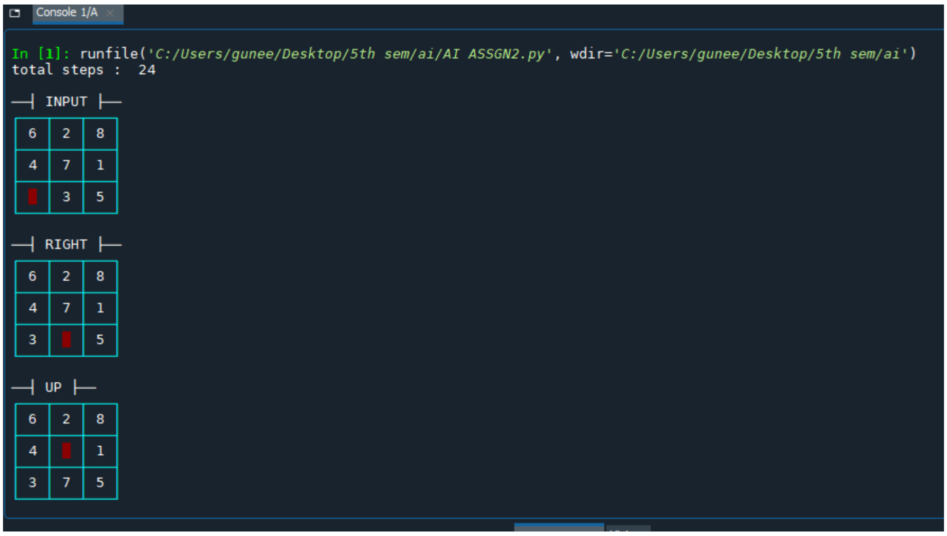


```
In [29]: runfile('C:/Users/gunee/Desktop/5th sem/ai/untitled0.py',
wdir='C:/Users/gunee/Desktop/5th sem/ai')
Name: Guneet Kohli
URN: 1805172
[113, 232, 443, 855]
[113]
```

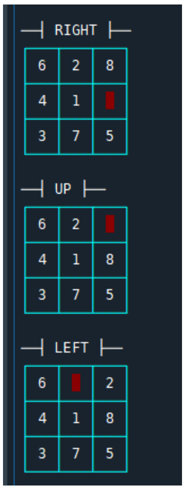
12. WAP to implement A* algorithm (8 Puzzle Problem)

```
"""
Created on Wed Sep 11 21:08:24 2020


@author: guneet
"""
from copy import deepcopy
from colorama import Fore, Back, Style
# unicode
left_down_angle = '\u2514'
right_down_angle = '\u2518'
right_up_angle = '\u2510'
left_up_angle = '\u250C'
middle_junction = '\u253C'
top_junction = '\u252C'
bottom_junction = '\u2534'
right_junction = '\u2524'
left_junction = '\u251C'
bar = Style.BRIGHT + Fore.CYAN + '\u2502' + Fore.RESET + Style.RESET_ALL
dash = '\u2500'
first_line = Style.BRIGHT + Fore.CYAN + left_up_angle + dash + dash + dash + top_junction + dash + dash + dash + top_junction + dash + dash + dash + right_up_angle + Fore.RESET + Style.RESET_ALL
middle_line = Style.BRIGHT + Fore.CYAN + left_junction + dash + dash + dash + middle_junction + dash + dash + dash + middle_junction + dash + dash + dash + right_junction + Fore.RESET + Style.RESET_ALL
last_line = Style.BRIGHT + Fore.CYAN + left_down_angle + dash + dash + dash + bottom_junction + dash + dash + dash + bottom_junction + dash + dash + dash + right_down_angle + Fore.RESET + Style.RESET_ALL


DIRECTIONS = {"U": [-1, 0], "D": [1, 0], "L": [0, -1], "R": [0, 1]}
END = [[1, 2, 3], [4, 5, 6], [7, 8, 0]]
def print_puzzle(array):
    print(first_line)
    for a in range(len(array)):
        for i in array[a]:
            if i == 0:
                print(bar, Back.RED + ' ' + Back.RESET, end=' ')
            else:
                print(bar, i, end=' ')
        print(bar)
        if a == 2:
            print(last_line)
        else:
            print(middle_line)
class Node:
    def __init__(self, current_node, previous_node, g, h, dir):
        self.current_node = current_node
        self.previous_node = previous_node
        self.g = g
        self.h = h
        self.dir = dir
    def f(self):
        return self.g + self.h
def get_pos(current_state, element):
    for row in range(len(current_state)):
        if element in current_state[row]:
            return (row, current_state[row].index(element))
def euclidianCost(current_state):
    cost = 0
    for row in range(len(current_state)):
        for col in range(len(current_state[0])):
            pos = get_pos(END,current_state[row][col])
            cost += abs(row - pos[0]) + abs(col - pos[1])
    return cost
def getAdjNode(node):
    listNode = []
    emptyPos = get_pos(node.current_node, 0)
    for dir in DIRECTIONS.keys():
        newPos = (emptyPos[0] + DIRECTIONS[dir][0], emptyPos[1] + DIRECTIONS[dir][1])
        if 0 <= newPos[0] < len(node.current_node) and 0 <= newPos[1] < len(node.current_node[0]):
            newState = deepcopy(node.current_node)
            newState[emptyPos[0]][emptyPos[1]] = node.current_node[newPos[0]][newPos[1]]
            newState[newPos[0]][newPos[1]] = 0
            # listNode += [Node(newState, node.current_node, node.g + 1, euclidianCost(newState), dir)]
            listNode.append(Node(newState, node.current_node, node.g + 1, euclidianCost(newState), dir))
    return listNode
def getBestNode(openSet):
    firstIter = True
    for node in openSet.values():
        if firstIter or node.f() < bestF:
            firstIter = False
            bestNode = node
            bestF = bestNode.f()
    return bestNode
def buildPath(closedSet):
    node = closedSet[str(END)]
    branch = list()
    while node.dir:
        branch.append({
            'dir': node.dir,
            'node': node.current_node
        })
        node = closedSet[str(node.previous_node)]
    branch.append({
        'dir': '',
        'node': node.current_node
    })
    branch.reverse()
    return branch
def main(puzzle):
    open_set = {str(puzzle): Node(puzzle, puzzle, 0, euclidianCost(puzzle), "")}
    closed_set = {}
    while True:
        test_node = getBestNode(open_set)
        closed_set[str(test_node.current_node)] = test_node
        if test_node.current_node == END:
            return buildPath(closed_set)
        adj_node = getAdjNode(test_node)
        for node in adj_node:
            if str(node.current_node) in closed_set.keys() or str(node.current_node) in open_set.keys() and open_set[
                str(node.current_node)].f() < node.f():
                continue
            open_set[str(node.current_node)] = node
        del open_set[str(test_node.current_node)]
if __name__ == '__main__':
    br = main([[6, 2, 8],
               [4, 7, 1],
               [0, 3, 5]])
    print('total steps : ', len(br) - 1)
    print()
    print(dash + dash + right_junction, "INPUT", left_junction + dash + dash)
    for b in br:
        if b['dir'] != '':
            letter = ''
            if b['dir'] == 'U':
                letter = 'UP'
            elif b['dir'] == 'R':
                letter = "RIGHT"
            elif b['dir'] == 'L':
                letter = 'LEFT'
            elif b['dir'] == 'D':
                letter = 'DOWN'
            print(dash + dash + right_junction, letter, left_junction + dash + dash)
        print_puzzle(b['node'])
        print()
    print(dash + dash + right_junction, 'ABOVE IS THE OUTPUT', left_junction + dash + dash)
```

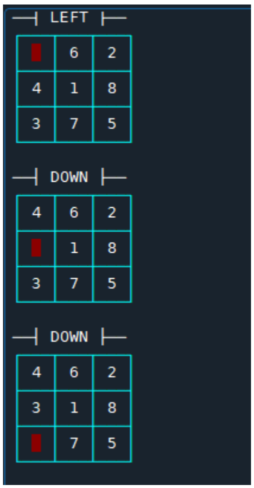
#OUTPUT:



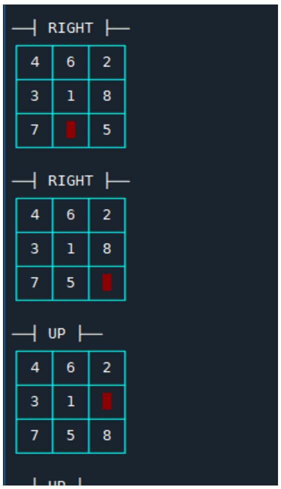
```
In [1]: runfile('C:/Users/gunee/Desktop/5th sem/ai/AI ASSGN2.py', wdir='C:/Users/gunee/Desktop/5th sem/ai')
total steps :  24

─┤ INPUT ├─
┌───┬───┬───┐
│ 6 │ 2 │ 8 │
├───┼───┼───┤
│ 4 │ 7 │ 1 │
├───┼───┼───┤
│ █ │ 3 │ 5 │
└───┴───┴───┘

─┤ RIGHT ├─
┌───┬───┬───┐
│ 6 │ 2 │ 8 │
├───┼───┼───┤
│ 4 │ 7 │ 1 │
├───┼───┼───┤
│ 3 │ █ │ 5 │
└───┴───┴───┘

─┤ UP ├─
┌───┬───┬───┐
│ 6 │ 2 │ 8 │
├───┼───┼───┤
│ 4 │ █ │ 1 │
├───┼───┼───┤
│ 3 │ 7 │ 5 │
└───┴───┴───┘
```



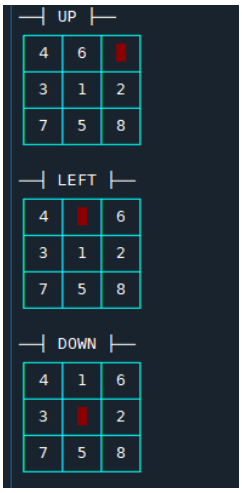
```
─┤ RIGHT ├─
┌───┬───┬───┐
│ 6 │ 2 │ 8 │
├───┼───┼───┤
│ 4 │ 1 │ █ │
├───┼───┼───┤
│ 3 │ 7 │ 5 │
└───┴───┴───┘

─┤ UP ├─
┌───┬───┬───┐
│ 6 │ 2 │ █ │
├───┼───┼───┤
│ 4 │ 1 │ 8 │
├───┼───┼───┤
│ 3 │ 7 │ 5 │
└───┴───┴───┘

─┤ LEFT ├─
┌───┬───┬───┐
│ 6 │ █ │ 2 │
├───┼───┼───┤
│ 4 │ 1 │ 8 │
├───┼───┼───┤
│ 3 │ 7 │ 5 │
└───┴───┴───┘
```



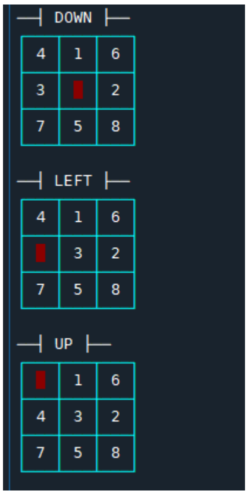
```
─┤ LEFT ├─
┌───┬───┬───┐
│ █ │ 6 │ 2 │
├───┼───┼───┤
│ 4 │ 1 │ 8 │
├───┼───┼───┤
│ 3 │ 7 │ 5 │
└───┴───┴───┘

─┤ DOWN ├─
┌───┬───┬───┐
│ 4 │ 6 │ 2 │
├───┼───┼───┤
│ █ │ 1 │ 8 │
├───┼───┼───┤
│ 3 │ 7 │ 5 │
└───┴───┴───┘

─┤ DOWN ├─
┌───┬───┬───┐
│ 4 │ 6 │ 2 │
├───┼───┼───┤
│ 3 │ 1 │ 8 │
├───┼───┼───┤
│ █ │ 7 │ 5 │
└───┴───┴───┘
```



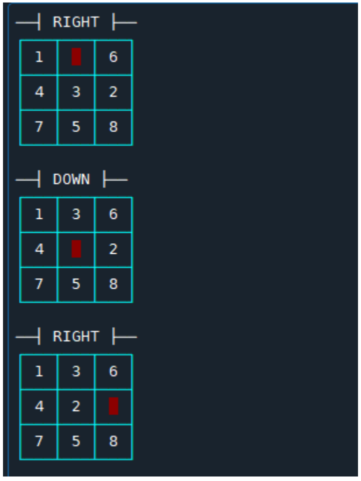
```
─┤ RIGHT ├─
┌───┬───┬───┐
│ 4 │ 6 │ 2 │
├───┼───┼───┤
│ 3 │ 1 │ 8 │
├───┼───┼───┤
│ 7 │ █ │ 5 │
└───┴───┴───┘

─┤ RIGHT ├─
┌───┬───┬───┐
│ 4 │ 6 │ 2 │
├───┼───┼───┤
│ 3 │ 1 │ 8 │
├───┼───┼───┤
│ 7 │ 5 │ █ │
└───┴───┴───┘

─┤ UP ├─
┌───┬───┬───┐
│ 4 │ 6 │ 2 │
├───┼───┼───┤
│ 3 │ 1 │ █ │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ UP ├─
```



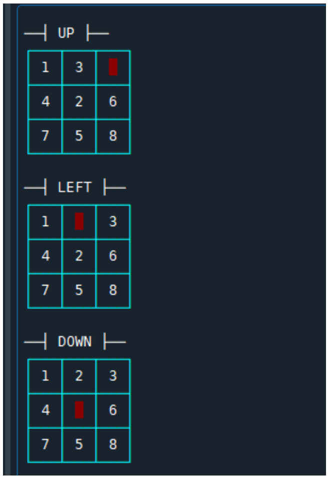
```
─┤ UP ├─
┌───┬───┬───┐
│ 4 │ 6 │ █ │
├───┼───┼───┤
│ 3 │ 1 │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ LEFT ├─
┌───┬───┬───┐
│ 4 │ █ │ 6 │
├───┼───┼───┤
│ 3 │ 1 │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ DOWN ├─
┌───┬───┬───┐
│ 4 │ 1 │ 6 │
├───┼───┼───┤
│ 3 │ █ │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘
```



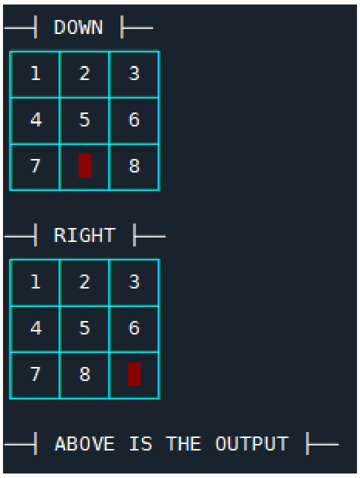
```
─┤ DOWN ├─
┌───┬───┬───┐
│ 4 │ 1 │ 6 │
├───┼───┼───┤
│ 3 │ █ │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ LEFT ├─
┌───┬───┬───┐
│ 4 │ 1 │ 6 │
├───┼───┼───┤
│ █ │ 3 │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ UP ├─
┌───┬───┬───┐
│ █ │ 1 │ 6 │
├───┼───┼───┤
│ 4 │ 3 │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘
```



```
─┤ RIGHT ├─
┌───┬───┬───┐
│ 1 │ █ │ 6 │
├───┼───┼───┤
│ 4 │ 3 │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ DOWN ├─
┌───┬───┬───┐
│ 1 │ 3 │ 6 │
├───┼───┼───┤
│ 4 │ █ │ 2 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ RIGHT ├─
┌───┬───┬───┐
│ 1 │ 3 │ 6 │
├───┼───┼───┤
│ 4 │ 2 │ █ │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘
```



```
─┤ UP ├─
┌───┬───┬───┐
│ 1 │ 3 │ █ │
├───┼───┼───┤
│ 4 │ 2 │ 6 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ LEFT ├─
┌───┬───┬───┐
│ 1 │ █ │ 3 │
├───┼───┼───┤
│ 4 │ 2 │ 6 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘

─┤ DOWN ├─
┌───┬───┬───┐
│ 1 │ 2 │ 3 │
├───┼───┼───┤
│ 4 │ █ │ 6 │
├───┼───┼───┤
│ 7 │ 5 │ 8 │
└───┴───┴───┘
```



```
─┤ DOWN ├─
┌───┬───┬───┐
│ 1 │ 2 │ 3 │
├───┼───┼───┤
│ 4 │ 5 │ 6 │
├───┼───┼───┤
│ 7 │ █ │ 8 │
└───┴───┴───┘

─┤ RIGHT ├─
┌───┬───┬───┐
│ 1 │ 2 │ 3 │
├───┼───┼───┤
│ 4 │ 5 │ 6 │
├───┼───┼───┤
│ 7 │ 8 │ █ │
└───┴───┴───┘

─┤ ABOVE IS THE OUTPUT ├─
```

13. WAP to implement Trees

```
class Node(object):
    def __init__(self, value):
        self.left=None
        self.right=None
        self.value=value

class BinaryTree(object):
    def __init__(self, root):
        self.root=Node(root)

    def printTree(self, traversalType):
        if traversalType=='preorder':
            return self.PreOrderPrint(tree.root,'')

    def PreOrderPrint(self,start, traversal):
        #Root-> Left-> Right
        if start:
            traversal+= (str(start.value) + '-')
            traversal=self.PreOrderPrint(start.left, traversal)
            traversal=self.PreOrderPrint(start.right, traversal)
        return traversal

#       1
#    2      3
#   4  5    6  7
        #PreOrder  1-2-7-5-3-6
tree=BinaryTree(1) #rootnode
tree.root.left=Node(2) #left child
tree.root.right=Node(3) #right child
tree.root.left.left=Node(4) #left left child
tree.root.left.right=Node(5)
```

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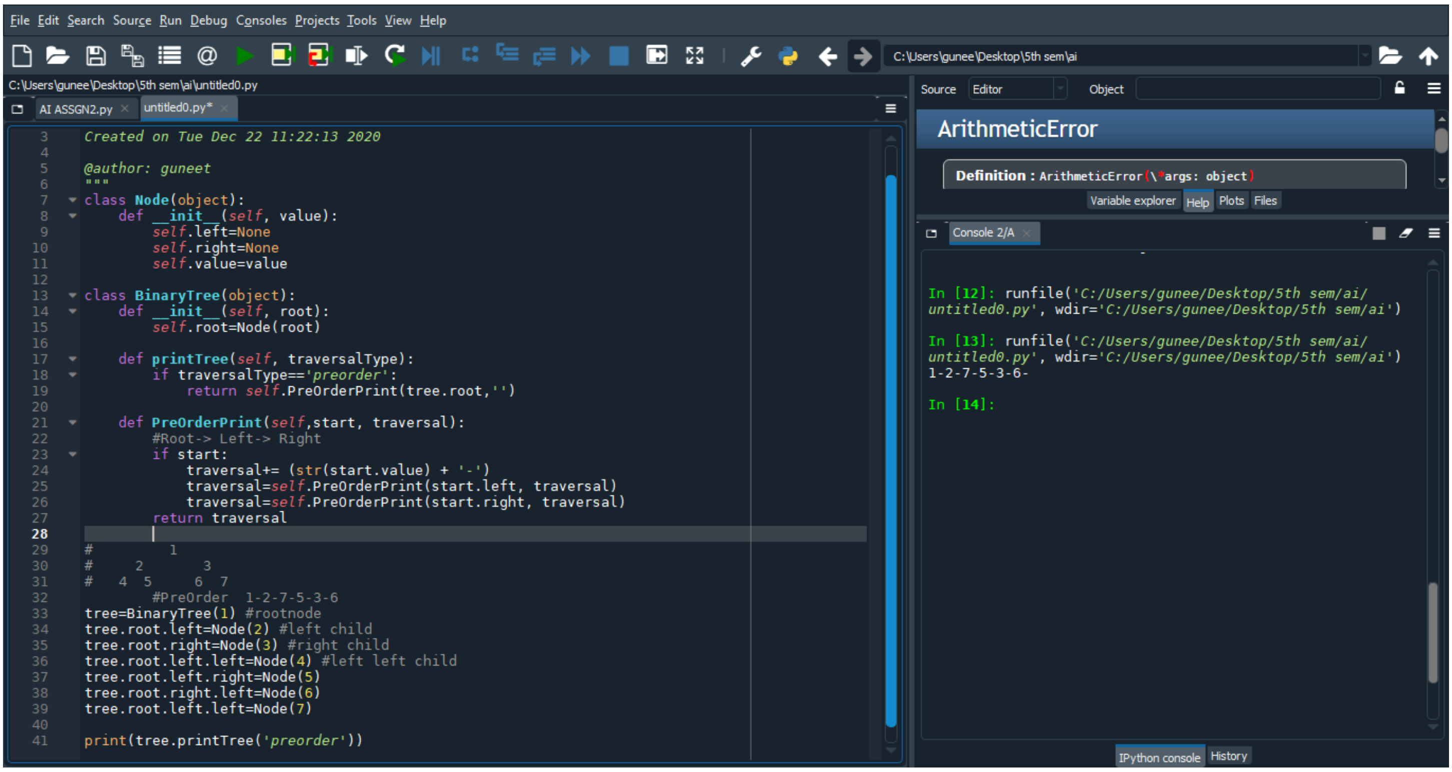
tree.root.right.left=Node(6)

tree.root.left.left=Node(7)

print(tree.printTree('preorder'))


File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
untitled0.py*
Source Editor Object
ArithmeticError
Definition : ArithmeticError(*args: object)
Variable explorer Help Plots Files
Console 2/A
IPython console History

```
Created on Tue Dec 22 11:22:13 2020

@author: guneet
"""
class Node(object):
    def __init__(self, value):
        self.left=None
        self.right=None
        self.value=value

class BinaryTree(object):
    def __init__(self, root):
        self.root=Node(root)

    def printTree(self, traversalType):
        if traversalType=='preorder':
            return self.PreOrderPrint(tree.root,'')

    def PreOrderPrint(self,start, traversal):
        #Root-> Left-> Right
        if start:
            traversal+= (str(start.value) + '-')
            traversal=self.PreOrderPrint(start.left, traversal)
            traversal=self.PreOrderPrint(start.right, traversal)
        return traversal

#          1
#     2         3
#   4  5      6  7
        #PreOrder  1-2-7-5-3-6
tree=BinaryTree(1) #rootnode
tree.root.left=Node(2) #left child
tree.root.right=Node(3) #right child
tree.root.left.left=Node(4) #left left child
tree.root.left.right=Node(5)
tree.root.right.left=Node(6)
tree.root.left.left=Node(7)

print(tree.printTree('preorder'))
```

```
In [12]: runfile('C:/Users/gunee/Desktop/5th sem/ai/
untitled0.py', wdir='C:/Users/gunee/Desktop/5th sem/ai')

In [13]: runfile('C:/Users/gunee/Desktop/5th sem/ai/
untitled0.py', wdir='C:/Users/gunee/Desktop/5th sem/ai')
1-2-7-5-3-6-

In [14]:
```

14. WAP to implement Water Jug Problem using DFS

```
#Write a program to implement DEPTH First search for water jug problem

capacity = (12,8,5)

# Maximum capacities of 3 jugs -> x,y,z

x = capacity[0]

y = capacity[1]

z = capacity[2]


# to mark visited states

memory = {}


# store solution path

ans = []


def get_all_states(state):

	# Let the 3 jugs be called a,b,c

	a = state[0]

	b = state[1]

	c = state[2]


	if(a==6 and b==6):

		ans.append(state)

		return True


	# if current state is already visited earlier

	if((a,b,c) in memory):

		return False


	memory[(a,b,c)] = 1
```

```
    #empty jug a
    if(a>0):
        #empty a into b
        if(a+b<=y):
            if( get_all_states((0,a+b,c)) ):
                ans.append(state)
                return True
        else:
            if( get_all_states((a-(y-b), y, c)) ):
                ans.append(state)
                return True
        #empty a into c
        if(a+c<=z):
            if( get_all_states((0,b,a+c)) ):
                ans.append(state)
                return True
        else:
            if( get_all_states((a-(z-c), b, z)) ):
                ans.append(state)
                return True

    #empty jug b
    if(b>0):
        #empty b into a
        if(a+b<=x):
            if( get_all_states((a+b, 0, c)) ):
                ans.append(state)
                return True
        else:
            if( get_all_states((x, b-(x-a), c)) ):
                ans.append(state)
                return True
        #empty b into c
        if(b+c<=z):
            if( get_all_states((a, 0, b+c)) ):
```

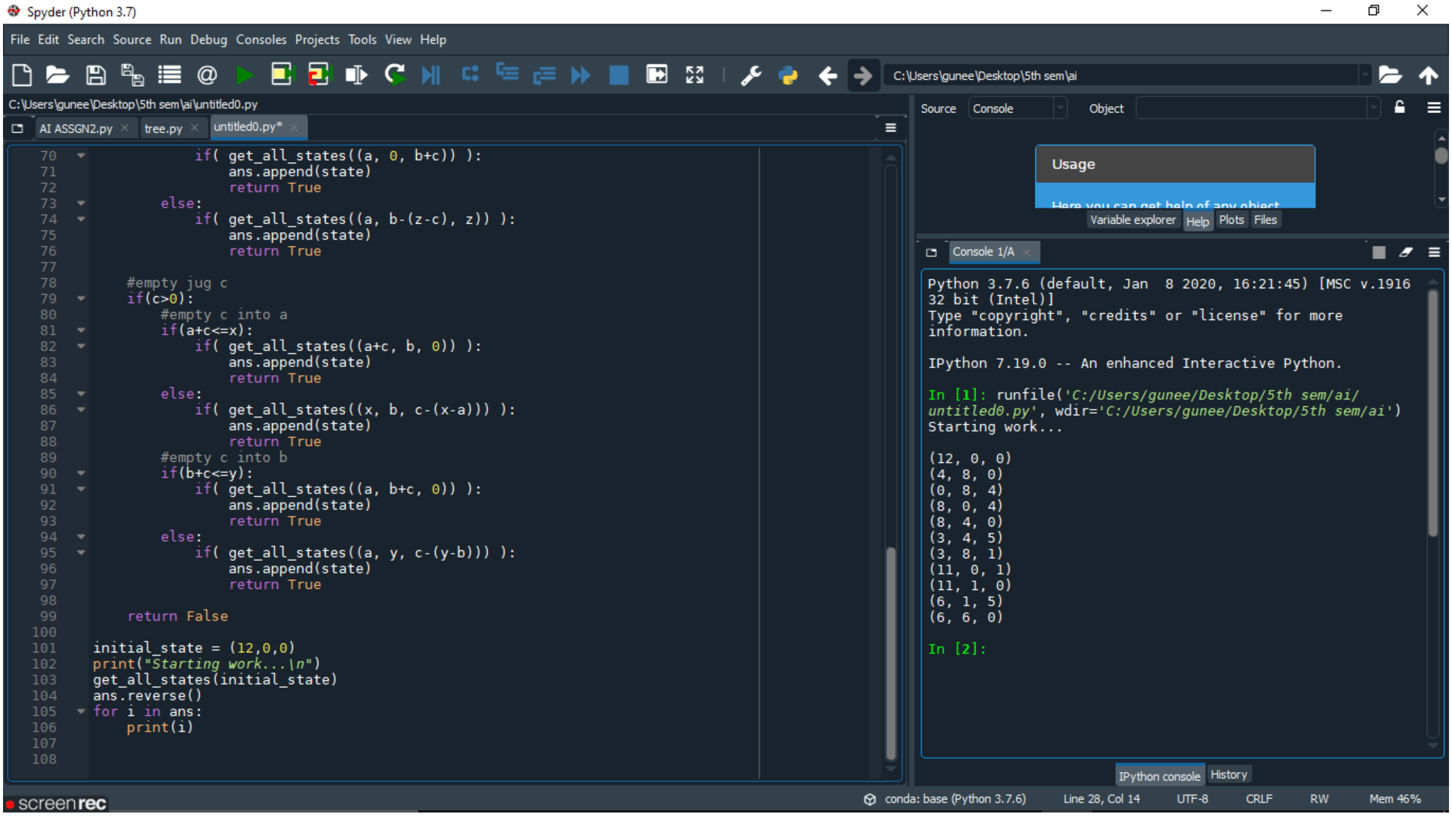
```
                        ans.append(state)
                        return True
            else:
                if( get_all_states((a, b-(z-c), z)) ):
                        ans.append(state)
                        return True

    #empty jug c
    if(c>0):
            #empty c into a
            if(a+c<=x):
                if( get_all_states((a+c, b, 0)) ):
                        ans.append(state)
                        return True
            else:
                if( get_all_states((x, b, c-(x-a))) ):
                        ans.append(state)
                        return True
            #empty c into b
            if(b+c<=y):
                if( get_all_states((a, b+c, 0)) ):
                        ans.append(state)
                        return True
            else:
                if( get_all_states((a, y, c-(y-b))) ):
                        ans.append(state)
                        return True

    return False

initial_state = (12,0,0)
print("Starting work...\n")
get_all_states(initial_state)
```

```
ans.reverse()
for i in ans:
        print(i)
```


Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\gunee\Desktop\5th sem\ai
C:\Users\gunee\Desktop\5th sem\ai\untitled0.py
AI ASSGN2.py
tree.py
untitled0.py*
Source
Console
Object
Usage
Here you can get help of any object
Variable explorer
Help
Plots
Files
Console 1/A
IPython console
History
screenrec
conda: base (Python 3.7.6)
Line 28, Col 14
UTF-8
CRLF
RW
Mem 46%

```
            if( get_all_states((a, 0, b+c)) ):
                ans.append(state)
                return True
        else:
            if( get_all_states((a, b-(z-c), z)) ):
                ans.append(state)
                return True

    #empty jug c
    if(c>0):
        #empty c into a
        if(a+c<=x):
            if( get_all_states((a+c, b, 0)) ):
                ans.append(state)
                return True
        else:
            if( get_all_states((x, b, c-(x-a))) ):
                ans.append(state)
                return True
        #empty c into b
        if(b+c<=y):
            if( get_all_states((a, b+c, 0)) ):
                ans.append(state)
                return True
        else:
            if( get_all_states((a, y, c-(y-b))) ):
                ans.append(state)
                return True

    return False

initial_state = (12,0,0)
print("Starting work...\n")
get_all_states(initial_state)
ans.reverse()
for i in ans:
    print(i)
```

```
Python 3.7.6 (default, Jan  8 2020, 16:21:45) [MSC v.1916
32 bit (Intel)]
Type "copyright", "credits" or "license" for more
information.

IPython 7.19.0 -- An enhanced Interactive Python.

In [1]: runfile('C:/Users/gunee/Desktop/5th sem/ai/
untitled0.py', wdir='C:/Users/gunee/Desktop/5th sem/ai')
Starting work...

(12, 0, 0)
(4, 8, 0)
(0, 8, 4)
(8, 0, 4)
(8, 4, 0)
(3, 4, 5)
(3, 8, 1)
(11, 0, 1)
(11, 1, 0)
(6, 1, 5)
(6, 6, 0)

In [2]:
```