

## Paper 0

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### Data Structures and Algorithms IT2070

Year two Semester two 2020  
Online Examination  
Sri Lanka Institute of Information Technology

**Time: 30 minutes**

**Paper Number 0 (20 marks)**

A recursive algorithm for the calculation for the multiplication of two numbers  $M$  and  $n$  is given below:

```
Multiply (M,n)
if (n = 1)
    return M;
else
    return (M + Multiply(M, n-1))
```

- Write a program in Python to read an integers from the keyboard for  $M$  and  $n$
- Develop a function in python named as multiply and implement the above recursive algorithm.
- Pass the input number as parameter to the function developed and get the multiplication of numbers as output.
- Use the loop to run the program and display the correct output until user input

Upload your answer using given template to the course web link "Paper Number 0"

**Grading Sheet:**

- 1) Program is compiling. 2 marks
- 2) Program is running successfully. 2 marks
- 3) Program takes the input number as integer. 2 marks
- 4) Correct implementation multiply function. 6 marks
- 5) Display the output correctly. 2 marks
- 6) Use of loop correctly. 4 marks
- 7) Include comments and properly indented. 2 marks
- 8) Plagiarism testing tool results: .....

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### **Answer 0**

```
def multiply(M, n):  
    if(n == 1):  
        return M  
    else:  
        return (M + multiply(M, n - 1))  
  
while(True):  
    M = int(input ("Enter an Integer (M): "))  
    if(M == -1):  
        break  
    n = int(input("Enter an Integer (n): "))  
    print("Multiplication of",M,"&",n,"is = ", multiply(M, n))
```

## Paper 2

Paper Number 2.doc - Protected View - Saved to this PC

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**Data Structures and Algorithms II 2070**  
Year two Semester two 2020  
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**Paper Number 2 (20 marks)**

The Fibonacci sequence is the series of numbers:  
0, 1, 1, 2, 3, 5, 8, 13, 21, 34,  
The next number is found by adding up the two numbers before it as given by the following mathematical function.

$$F_0 = 0$$
$$F_1 = 1$$
$$F_n = F_{n-1} + F_{n-2}, n > 1$$

A recursive algorithm for the Fibonacci calculation is given below:

---

**Algorithm 1: F(n)**

---

**Input:** Some non-negative integer  $n$   
**Output:** The  $n$ th number in the Fibonacci Sequence

```
if  $n \leq 1$  then  
    return  $n$   
else  
    return  $F(n-1) + F(n-2)$ ;
```

---

a) Write a program in Python to read an integer from the keyboard.  
b) Develop a function in python named as Fibonacci and implement the above recursive algorithm.  
c) Pass the input number as parameter to the function developed and get the Fibonacci number as output.  
d) Use the loop to run the program and display the correct output until user inputs -1.

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## **Answer 2**

```
def Fibonacci (n):  
    if(n <= 1):  
        return n  
    else:  
        return Fibonacci(n - 1) + Fibonacci(n - 2)  
  
while(True):  
    number = int(input("Enter an Integer : "))  
    if(number == -1):  
        break  
    else:  
        fibonacci = Fibonacci(number)  
        print("Fibonacci of ",number,"is ", fibonacci)
```

The power function can be defined as  $\text{pow}(x, n) = x^n$ . This can be evaluated using the multiplication as  $x^n = x \times x^{n-1}$  where  $x$  is any real number and  $n$  is a non-negative integer [Hint:  $\text{pow}(x, n-1) = x^{n-1}$ ]

A recursive algorithm for the power calculation is given below:

### Power

$$x^N = x * x^{N-1} \text{ for } N > 0$$
$$x^0 = 1$$

```
1 function Power returns a Num(base, exp)
2 // Computes the value of Baseexp
3 // Pre: exp is a non-negative integer
4 if (exp = 0) then
5     returns 1
6 else
7     returns base * Power(base, exp-1)
8 endif
9 endfunction
```

- Write a program in Python to read an integers from the keyboard for  $x$  and  $n$ .
- Develop a function in python named as power and implement the above recursive algorithm.
- Pass the input numbers as parameter to the function developed and get the power of number as output.
- Use the loop to run the program and display the correct output until user inputs -1.

Upload your answer using given template to the course web link "Paper Number 4"

#### Grading Sheet:

- Program is compiling. 2 marks
- Program is running successfully. 2 marks

#### **Answer 4**

```
def pow(base, exp):
```

```
    if(exp == 0):
```

```
        return 1
```

```
    else:
```

```
        return base * pow(base, exp - 1)
```

```
while(True):
```

```
    x = int(input("Input the base: "))
```

```
    if(x == -1):
```

```
        print("User choose to exit the program")
```

```
        break
```

```
    n = int(input("Input the exponential: "))
```

```
    if(n == -1):
```

```
        print("User choose to exit the program")
```

```
        break
```

```
        print(pow(x, n))
```

## Paper 6

### Paper Number 6 (20 marks)

The sum of the  $n$  cubes numbers are given by the following formula:

$$1^3 + 2^3 + 3^3 + \dots + n^3 = \frac{n^2(n+1)^2}{4}$$

A recursive algorithm for the sum of first  $n$  cube calculation is given below:

```
Algorithm 1 Algorithm  $S(n)$ 
1: //Input: A positive integer  $n$ 
2: //Output: The sum of the first  $n$  cubes
3: if  $n = 1$  then
4:   return 1
5: else
6:   return  $[S(n - 1) + n * n * n]$ 
```

- Write a program in Python to read an integer from the keyboard for  $n$ .
- Develop a function in python named as sumcube and implement the above recursive algorithm.
- Pass the input numbers as parameter to the function developed and get the sum of cubes of number as output.
- Use the loop to run the program and display the correct output until user inputs -1

## Answer 6

```
def sumcube(n):
```

```
    if(n == 1):
```

```
        return 1
```

```
    else:
```

```
        return sumcube(n - 1) + n * n * n
```

```
while(Ture):
```

```
    n = int(input("Enter an Integer : "))
```

```
    if(n == -1)
```

```
        break
```

```
    print("Sumation of = ", sumcube(n))
```



## Paper 8

### Paper Number 8 (20 marks)

The function  $sum(n)$  is defined as the sum of integers from 1 to  $n$ .

$$sum(n) = 1 + 2 + 3 + 4 + \dots + n$$

The recursive relation for  $sum(n)$  where  $n$  is a non-negative integer is given by

$$sum(n) = sum(n-1) + n$$

[Hint:  $sum(n-1) = 1 + 2 + 3 + 4 + \dots + (n-1)$ ]

$$\sum_{i=1}^n i = 1 + 2 + \dots + n$$

The sum of  $n$  is given here:

A recursive algorithm for the sum of  $n$  calculation is given below:

#### Algorithm 1 Algorithm $S(n)$

```
1: //Input: A positive integer  $n$ 
2: //Output: The sum of the first  $n$ 
3: if  $n = 1$  then
4:   return 1
5: else
6:   return  $[S(n-1) + n]$ 
```

- Write a program in Python to read an integer from the keyboard for  $n$ .
- Develop a function in python named as sum and implement the above recursive algorithm.
- Pass the input numbers as parameter to the function developed and get the sum of number as output.
- Use the loop to run the program and display the correct output until user inputs -1.

## Answer 8

```
def sum(n):
    if(n == 1):
        return 1
    else:
        return sum(n - 1) + n

while(True):
    number = int(input("Enter an Integer : "))
    if(number == -1):
        break
    else if(number < -1):
        print("Enter positive number only")
        continue
    print("Sum of",number,"is ", sum(number))
```



## Lab test (C)

**Lab Test (c)**

**IT No:**

The power function can be defined as  $pow(x, n) = x^n$ . This can be evaluated using the multiplication as  $x^n = x \times x^{n-1}$  where  $x$  is any real number and  $n$  is a non-negative integer.  
[Hint:  $pow(x, n-1) = x^{n-1}$ ]

Therefore recursive relations is  $pow(x, n) = x * pow(x, n-1)$

- Write a program in Python to read a value for  $x$  and  $n$  from the key board and saved as *power.py*.
- Complete the program to calculate power of  $x^n$  using the algorithm. Display the answer.

Upload your programs to the courseweb link "DSA2018\_Assignment2\_C"

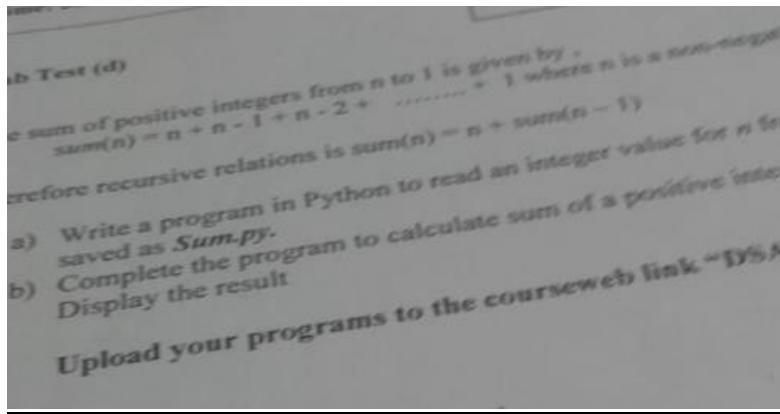
**Grading Sheet:**

- 1) Program is compiling. **3 marks**
- 2) Program is running successfully. **3 marks**
- 3) Program is reading the input number from the keyboard. **2 marks**
- 4) Correct implementation of the recursive algorithm. **8 marks**
- 5) Display the result **3 marks**
- 6) Include comments and properly indented. **1 mark**

## Answer

```
def pow(x, n):  
    if(n == 1):  
        return x  
    else:  
        return x * pow(x, n - 1)  
  
number = int(input("Enter an Integer : "))  
power = int(input("Enter power value : "))  
value = (pow(number, power))  
print("Power of = ", value)
```

## Lab test (D)



## Answer

def sum(n):

    if(n == 0):

        return n

    else:

        return n + sum(n - 1)

number = int(input("Enter an Integer : "))

value = sum(number)

print("Sequence sum of", number, "is = ", value)