

## Lab 1: Expressions, Statements, and Control structures

Name: \_\_\_\_\_

University Number: \_\_\_\_\_

### Exercise 1: Surface Area and Volume of a Hexagonal Pyramid

#### AIM:

Write a Python program that prompts the user for side length  $l$  of the base and height  $h$  in cm of a hexagonal pyramid (i.e. a pyramid with a hexagonal base and six isosceles triangular faces that intersect at the apex), computes the surface area  $A$  and volume  $V$  of the pyramid using the formulas  $A = 3l(\sqrt{3}l + \sqrt{3l^2 + 4h^2})/2$  and  $V = \sqrt{3}hl^2/2$ , and finally outputs the results. Here are the sample input and output of this program:

```
Enter the side length l of the base of the pyramid in cm: 3
```

```
Enter the height h of the pyramid in cm: 4
```

```
The surface area of the pyramid is 66.3099499659424 cm^2.
```

```
The volume of the pyramid is 31.17691453623979 cm^3.
```

#### ALGORITHM:

#### PROGRAM:

OUTPUT:

## Exercise 2: Operation of Two Integers

### AIM:

Write a Python program that prompts for two integer operands and one of the binary operators  $+$ ,  $-$ ,  $*$ ,  $/$ , or  $\%$  from the user, performs the operation on the operands with the operator using an `if-elif-else` statement, and finally prints the result. Your program should check whether the input operator is valid. Here are the sample input and output of this program:

```
Enter the integer A: 5
```

```
Enter the integer B: 4
```

```
Enter a binary operator (+,-,*,/,%): +
```

```
5 + 4 = 9
```

```
Enter the integer A: 2
```

```
Enter the integer B: 3
```

```
Enter a binary operator (+,-,*,/,%): =
```

```
Invalid input. The operator must be one of the followings: +,-,*,/,%.
```

### ALGORITHM:

### PROGRAM:

OUTPUT:

**Exercise 3: Taylor Series of  $x(1+x^2)^{1/2}$** **AIM:**

Write a Python program that prompts for a real number  $x$  in the open interval  $(-1, 1)$  and a positive integer  $n$  from the user, computes the sum of the first  $n$  terms of the Taylor series

$$x\sqrt{1+x^2} = \sum_{i=0}^{n-1} \frac{(-1)^{i-1}(2i)!}{4^i(i!)^2(2i-1)} x^{2i+1}$$

for any  $x \in (-1, 1)$  using a `for` loop, and finally output the result. Your program should check whether the user input is valid. Here are the sample input and output of this program:

```
Enter a real number x in (-1, 1): 0.6
```

```
Enter a positive integer n: 5
```

```
The sum of first 5 terms of the Taylor series of x*(1+x^2)^(1/2)
for x = 0.6 is 0.6996359400000001
```

```
Enter a real number x in (-1, 1): 2.2
```

```
Enter a positive integer n: 7
```

```
Invalid input. x must have absolute value less than 1!
```

```
Enter a real number x in (-1, 1): -0.9
```

```
Enter a positive integer n: -5
```

```
Invalid input. n must be a positive integer!
```

**ALGORITHM:****PROGRAM:**

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OUTPUT:

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## Exercise 4: Greatest Common Divisor

### AIM:

The Greatest Common Divisor (GCD) of two integers is the largest positive integer that divides both of them without leaving a remainder. An efficient way for finding the GCD of two natural numbers (i.e. non-negative integers) is the Euclidean algorithm which works as follows:

- (a) If one of the numbers is zero, then the GCD is the other number and we can stop.
- (b) Compute the remainder of the larger number divided by the smaller one and then replace the larger number by the remainder
- (c) Repeat step (b) until the remainder is zero. The GCD is the larger number in this case.

Write a Python program that prompts the user for two natural numbers, find their GCD with the Euclidean algorithm using a `while` loop, an `if-else` statement, and `if-elif-else` statements, and finally outputs the result. Your program should check whether the user input is valid. Here are the sample input and output of this program:

```
Enter a natural number x: 168
Enter another natural number y: 180
The GCD of 168 and 180 is 12

Enter a natural number x: 25
Enter another natural number y: -10
Invalid input. Both x and y must be integers >= 0!

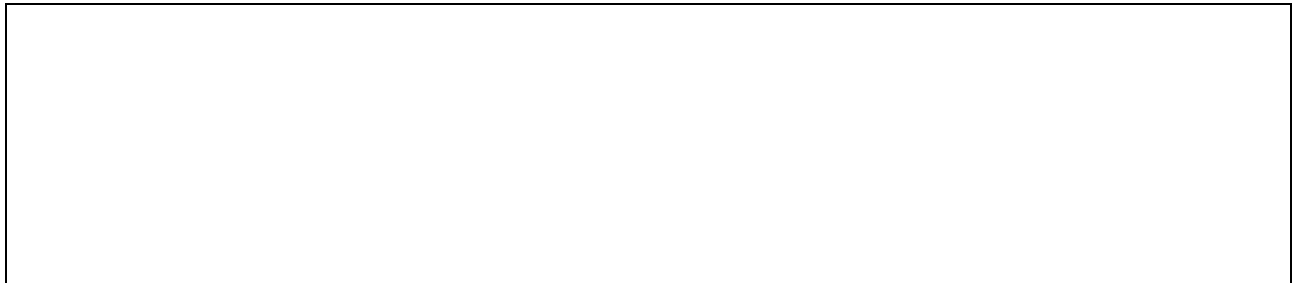
Enter a natural number x: 18
Enter another natural number y: 18
Invalid input. x and y must be different numbers!
```

### ALGORITHM:

### PROGRAM:



OUTPUT:





## Exercise 5: Displaying a Number Pattern

### AIM:

Write a Python program that prompts the user for a line number  $n$  which is a positive integer  $< 10$  and then displays a number pattern of  $2n-1$  lines with the following format:

```
1
121
12321
1234321
123454321
1234321
12321
121
1
```

using nested `for` loops. Your program should check whether the input value of  $n$  is valid.

### ALGORITHM:

### PROGRAM:

OUTPUT: