

# COMP 10280

## Programming I (Conversion)

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COMP 10280 Programming I (Conversion)/Lecture 11

# Outline

Program to calculate the factorial

Program to calculate the Fibonacci Series

# The factorial

- In mathematics, the **factorial** of a non-negative integer is the product of all positive integers less than or equal to the number
- The factorial of a number  $n$  is denoted by  $n!$
- For example, the factorial of 6,  $6!$ , is
$$6 \times 5 \times 4 \times 3 \times 2 \times 1 = 120$$
- $0!$  is defined to be 1
- $1!$  is defined to be 1

## Defining the factorial

- The factorial may be defined formally as follows:

$$n! = \begin{cases} 1 & n = 0 \\ 1 & n = 1 \\ n \times n - 1 \times n - 2 \times \dots \times 1 & n > 1 \end{cases}$$

# Python program 1 to calculate the factorial

```
# Calculating the factorial of a number
# Program prompts the user for the number

# Prompt the user for a number
number = int(input('Enter the number for which you wish
                    to calculate the factorial (an int >= 0): '))

if number < 0:
    print('Error:  Number entered was less than 0.')
elif number == 0:
    fact = 1
elif number == 1:
    fact = 1
else:
    fact = 1
    i = 1
    while i <= number:
        fact *= i
        i += 1

print('Factorial of', number, 'is', fact)

print('Finished!')
```

# Corrected Python program 1 to calculate the factorial

```
# Calculating the factorial of a number
# Program prompts the user for the number

# Prompt the user for a number
number = int(input('Enter the number for which you wish
                    to calculate the factorial (an int >= 0): '))

if number < 0:
    print('Error:  Number entered was less than 0.')
else:
    if number == 0:
        fact = 1
    elif number == 1:
        fact = 1
    else:
        fact = 1
        i = 1
        while i <= number:
            fact *= i
            i += 1

    print('Factorial of', number, 'is', fact)

print('Finished!')
```

## Python program 2 to calculate the factorial

```
# Calculating the factorial of a number
# Program prompts the user for the number
# Uses a for loop

# Prompt the user for a number
number = int(input('Enter the number for which you wish
                    to calculate the factorial (an int >= 0): '))

if number < 0:
    print('Error:  Number entered was less than 0.')
elif number == 0:
    fact = 1
elif number == 1:
    fact = 1
else:
    fact = 1
    for i in range(1, number + 1):
        fact *= i

print('Factorial of', number, 'is', fact)

print('Finished!')
```

## Corrected Python program 2 to calculate the factorial

```
# Calculating the factorial of a number
# Program prompts the user for the number
# Uses a for loop

# Prompt the user for a number
number = int(input('Enter the number for which you wish
                    to calculate the factorial (an int >= 0): '))

if number < 0:
    print('Error:  Number entered was less than 0.')
else:
    if number == 0:
        fact = 1
    elif number == 1:
        fact = 1
    else:
        fact = 1
        for i in range(1, number + 1):
            fact *= i

    print('Factorial of', number, 'is', fact)

print('Finished!')
```



# The Fibonacci Series

- In mathematics, the **Fibonacci Series** or **Fibonacci numbers** are the numbers in the following sequence:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...

or

1, 1, 2, 3, 5, 8, 13, 21, 34, ...

- By definition, the first two numbers in the Fibonacci series are either 1 and 1 or 0 and 1, depending on the chosen starting point
- Each subsequent number is the sum of the previous two numbers
- For example, the next number in the series is  $21 + 34 = 55$

# Applications of the Fibonacci Series

- Mathematics (eg computational analysis of Euclid's Greatest Common Divisor algorithm)
- Economics
- The breeding of rabbits (Fibonacci's own [unrealistic] example)
- Branching in trees
- The arrangement of leaves on a stem
- The fruitlets of a pineapple
- The flowering of artichoke
- An uncurling fern
- The arrangement of a pine cone
- The family tree of honeybees
- ...

# Defining the Fibonacci Series

- The Fibonacci Series may be defined formally as follows:

$$f(n) = \begin{cases} 0 & n = 0 \\ 1 & n = 1 \\ f(n-1) + f(n-2) & n > 1 \end{cases}$$

## Program to calculate the Fibonacci Series

*Prompt the user for the number of terms to calculate*

*Read limit*

***if limit == 1 then***

*print 0*

***else if limit == 2 then***

*print 0, 1*

***else***

*print 0, 1*

*a = 0*

*b = 1*

*i = 2*

***while i < limit do***

*fib = b + a*

*Print fib*

*a = b*

*b = fib*

*Increment i*

# Python program to calculate the Fibonacci Series (1)

```
# Calculating the Fibonacci Series
# Program prompts the user for the number of terms
# Uses a while loop

f_0 = 0
f_1 = 1

# Prompt the user for how far they want to go
limit = int(input('Enter the number of terms
                  you want to calculate (an int > 0): '))

if limit <= 0:
    print('Error:  Number entered was less than or equal to 0')
elif limit == 1:
    print('Series is:', f_0)
elif limit == 2:
    print('Series is: ', f_0, ', ', f_1, sep = "")
```

## Python program to calculate the Fibonacci Series (2)

```
else:
    print('Series is: ', f_0, ', ', f_1, sep = "", end = "")

    a = f_0
    b = f_1

    i = 2

    while i < limit:
        fib = b + a
        print(', ', fib, end = "")

        a = b
        b = fib
        i += 1

# Print a newline
print()

print('Finished!')
```

# Python program to calculate the Fibonacci Series (3)

## Using a for loop

```
else:
    print('Series is: ', f_0, ', ', f_1, sep = "", end = "")

    a = f_0
    b = f_1

    for i in range(2, limit):
        fib = b + a
        print(', ', fib, end = "")

        a = b
        b = fib

# Print a newline
print()

print('Finished!')
```

# Python program to calculate the Fibonacci Series (4)

## Using multiple assignment

```
else:
    print('Series is: ', f_0, ', ', f_1, sep = "", end = "")

    b, a = f_1, f_0
    for i in range(2, limit):
        fib = b + a
        print(', ', fib, end = "")

        b, a = fib, b

# Print a newline
print()

print('Finished!')
```



# Python program to calculate the Fibonacci Series (5)

Without using the variable `fib`

```
else:
    print('Series is: ', f_0, ', ', f_1, sep = "", end = "")

    b, a = f_1, f_0
    for i in range(2, limit):
        b, a = b + a, b

        print(', ', b, end = "")

# Print a newline
print()

print('Finished!')
```