AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES

(AIMS RWANDA, KIGALI)

Name: HERI KIMBELE Yves

Course: Introduction to computing

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1 Algorithm for average

Write an algorithm that will ask the user for 10 numbers and then prints their average.

1.1 Algorithm

Algorithm 1 Average ( )

Begin
   $Sum \leftarrow 0$;
   for $i \leftarrow 1 \ to \ 10 \ (+1)$ **do**
      Read (a) ;
      $S \leftarrow S + a$;
   end for
   $Average \leftarrow Sum/10$;
   Write ("The average is", Average) ;
End

1.2 Python code

```
    Sum=0
for i in range(10) :
    a=int(input("Enter a number : "))
    Sum=Sum+a
Average=Sum/10
print("The average is ",Average)
```

2 Algorithm for factorial

Write an algorithm that asks the user to enter a positive integer n, computes and print its factorial given by $n! = 1 \times 2 \times \ldots \times n$.

2.1 Algorithm

Algorithm 2 Factorial ( )

Begin
  Read (n)   ;
  if n=0 **then**
    Write(" 0! is 1 ")
  else
    $Fact \leftarrow 1$;
    for $i \leftarrow 1 \ to \ n$ (+1) **do**
      $Fact \leftarrow Fact \times i$;
    end for
    Write (n,"! is",Fact)   ;
End

2.2 Python code

```python
n=int(input('Enter a positive number: '))
if n==0:
    print("0 ! is 1")
else:
    Fact=1
    for i in range(n):
        Fact=Fact*(i+1)
    print(n,'! is',Fact)
```

3 Algorithm Squares counting

Write a an algorithm that asks the user to input a positive integer n and counts how many of the squares of the integers from 1 to n end in a 1.

3.1 Algorithm

Algorithm 3 SquareCounting ( )

Begin
   Read (n) ;
   $Number \leftarrow 0$;
   for $i \leftarrow 1\ to\ n\ (+1)$ **do**
      if $i^2\ mod\ 10 = 1$ **then**
         $Number \leftarrow Number + 1$;
      end if
   end for
   Write ('The number of squares ending with 1 is',Number) ; =0
End

3.2 Python code

```python
n=int(input("Enter a positive number :"))
Number=0
for i in range(n+1):
    if (i**2 % 10) ==1:
        Number=Number+1
print('The number of squares ending with 1 is',Number)
```

4 Algorithm squares counting 2

Write a an algorithm that asks the user to input a positive integer n and counts how many of the squares of the integers from 1 to n end in a 1.Write a an algorithm that asks the user to input a positive integer n and counts how many of the squares of the integers from 1 to n end in a 4 and how many end in a 9.

4.1 Algorithm

Algorithm 4 SquareCounting2 ( )

Begin
  Read (n)   ;
  $Number4 \leftarrow 0$;
  $Number9 \leftarrow 0$;
  for ı $\leftarrow 1 \; to \; n$ (+1) **do**
    if $i^2 \; mod \; 10 = 4$ **then**
      $Number4 \leftarrow Number4 + 1$;
    else if $i^2 \; mod \; 10 = 9$ **then**
      $Number9 \leftarrow Number9 + 1$;
    end if
  end for
  Write ('The number of squares ending with 4 is',Number4) ;
  Write ('The number of squares ending with 9 is',Number9) ;
End

4.2 Python code

```python
n=int(input("Enter a positive number :"))
Number4=0
Number9=0
for i in range(n+1):
    if (i**2 % 10) ==4:
        Number4=Number4+1
    elif(i**2 % 10) ==9:
        Number9=Number9+1
print('The number of squares endind with 4 is',Number4)
print('The number of squares endind with 9 is',Number9)
```

5 Algorithm Compute A_n

Write an algorithm that asks the user to enter a positive integer n, and then computes

$$A_n = (1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + ... + \frac{1}{n}) - \ln n \tag{1}$$

5.1 Algorithm

Algorithm 5 ComputeA_n ( )

Begin
  Read (n) ;
  $B_n \leftarrow 0$;
  for ı $\leftarrow 1$ *to* n $(+1)$ **do**
    $B_n = B_n + 1/i$;
  end for
  $A_n \leftarrow B_n - \ln n$;
  Write ('A_n is equal to', A_n) ;
End

5.2 Python code

```python
import math

n=int(input('Enter a positive number :'))
Bn=0
for i in range(n):
    Bn=Bn+1/(i+1)
An=Bn-math.log(n)
print('An is equal to',An)
```

6   Algorithm Compute B_n

Write an algorithm that asks the user to enter a positive integer n, and then computes

$$B_n = 1 - 2 + 34 + ... + (2n - 1) - 2n \tag{2}$$

6.1   Algorithm

Algorithm 6 ComputeB_n ( )

Begin
   Read (n)   ;
   Write ('B_n is equal to', $-n$)   ;
End

6.2   Python code

```
n=int(input('Enter a positive number :'))
print('Bn is equal to',-n)
```

7 Algorithm The largest number

Write an algorithm that asks the user to enter ten numbers and then prints the largest one.

7.1 Algorithm

Algorithm 7 LargestNumber ( )

Begin
   $Largest \leftarrow 0$;
   for $i \leftarrow 1 \ to \ 10 \ (+1)$ **do**
      Read (a) ;
      if $a \geq Largest$ **then**
         $Largest \leftarrow a$;
      end if
   end for
   Write ('The largest number is :',Largest) ;
End

7.2 Python code

```python
Largest=0
for i in range(10):
    a=int(input('Enter a number: '))
    if a>=Largest:
        Largest=a
print('The largest number is : ',Largest)
```

8 Algorithm Sum of divisors

Write an algorithm that asks the user to enter a positive integer n and prints the sum of the divisors of n.

8.1 Algorithm

Algorithm 8 SumOfDivisors ( )

Begin
  Read (n) ;
  $Sum \leftarrow 0$;
  for $i \leftarrow 1 \ to \ n \ (+1)$ **do**
    if $n \ mod \ i \ = 0$ **then**
      $Sum \leftarrow Sum + i$;
    end if
  end for
  Write ('The sum of divisors of',n,' is ', Sum) ;
End

8.2 Python code

```python
n=int(input('Enter a positive number :'))
Sum=0
for i in range(n):
    if n%(i+1)==0:
        Sum=Sum+(i+1)
print('The sum of divisors of',n,' is ',Sum)
```

9 Algorithm Perfect numbers

A number is called a perfect number if it is equal to the sum of all of its divisors, not including the number itself. Write an algorithm that asks the user to enter a positive integer n and prints all the perfect numbers that are less than n.

9.1 Algorithm

Algorithm 9 PerfectNumbers ( )

Begin
  Read (n) ;
  $Sum \leftarrow 0$;
  for $i \leftarrow 1 \; to \; [n/2] \; (+1)$ **do**
    if $n \; mod \; i \; = 0$ **then**
      $Sum \leftarrow Sum + i$;
    end if
  end for
  if $Sum = n$ **then**
    Write(n,' is a perfect number) ;
  else
    Write(n,' is not a perfect number) ;
End

9.2 Python code

```python
n=int(input('Enter a positive number :'))
Sum=0
for i in range(int(n/2)):
    if n%(i+1)==0:
        Sum=Sum+(i+1)
if n==Sum:
    print(n,' is a perfect number')
else:
    print(n,' is not perfect number')
```

10 Algorithm Square free

An integer is called *squarefree* if it is not divisible by any perfect squares other than 1. Write an algorithm that asks the user to enter a positive integer n and tells them if it is squarefree or not.

10.1 Algorithm

Algorithm 10 SquareFree ( )

Begin
  Read (n) ;
  $SquareF \leftarrow 1$;
  for $i \leftarrow 2 \ to \ n - 1 \ (+1)$ **do**
    if $n \ mod \ i^2 \ = \ 0$ **then**
        $SquareF \leftarrow 0$;
    end if
  end for
  if $SquareF = 1$ **then**
      Write(n,'is a perfect square') ;
  else
      Write(n,'is a perfect square') ;
  end if=0
End

10.2 Python code

```python
n=int(input('Enter a positive number :'))
squareF = 1
for i in range(2,n-1):
    if n%(i**2)==0:
        squareF=0
if squareF==1:
    print(n,' is a square free number')
else:
    print(n,' is not a square free number')
```

11 Algorithm Prime number

Write an algorithm that asks the user to enter a positive integer n and tells if n is a prime number or not.

11.1 Algorithm

Algorithm 11 PrimeNumber ( )

Begin
  Read (n) ;
  $prime \leftarrow 1$;
  for $i \leftarrow 2\ to\ n - 1\ (+1)$ **do**
    if $n\ mod\ i\ = 0$ **then**
      $prime \leftarrow 0$;
    end if
  end for
  if $prime = 1$ **then**
    Write(n,' is a prime number) ;
  else
    Write(n,' is not a prime number) ;
  end if
End

11.2 Python code

```python
prime=1
n=int(input('Enter a positive number :'))
for i in range(2,n-1):
    if n%i==0:
        prime=0
if prime==1:
    print(n,' is a prime number')
else:
    print(n,' is not a prime number')
```

12 Algorithm Swap three variables

Write an algorithm that swaps the values of three variables x, y, and z input by the user, so that x gets the value of y, y gets the value of z, and z gets the value of x.

12.1 Algorithm

Algorithm 12 Swap3Numbers ( )

Begin
   Read (x,y,z) ;
   $temp \leftarrow x$;
   $x \leftarrow y$;
   $y \leftarrow z$;
   $z \leftarrow temp$;
   Write('Now the value of x is',x) ;
   Write('Now the value of y is',y) ;
   Write('Now the value of z is',z) ;
End

12.2 Python code

```python
x=int(input('Enter x :'))
y=int(input('Enter y :'))
z=int(input('Enter z :'))
temp=x
x=y
y=z
z=temp
print('Now the value of x is ',x)
print('Now the value of y is ',y)
print('Now the value of z is ',z)
```

13 Algorithm Perfect Square, Cube and Fith

Write an algorithm to count how many integers from 1 to n (where n is inputted by the user) are not perfect squares, perfect cubes, or perfect fifth powers.

13.1 Algorithm

Algorithm 13 Perfect ( )

Begin
  Read (n) ;
  $Np \leftarrow 0$;
  for $i \leftarrow 1\ to\ n$ (+1) **do**
    for $j \leftarrow 1\ to\ i$ (+1) **do**
      if $i = j^2\ or\ i = j^3\ or\ i = j^5$ **then**
        $Np \leftarrow Np + 1$;
      end if
    end for
  end for
End

13.2 Python code

```python
n=int(input('Enter a positive number :'))
Np=0
for i in range(1,n+1):
    for j in range(1,i+1):
        if (i==j**2) or (i==j**3) or (i==j**5):
            Np=Np+1
Nnp=n-Np
print('There are ',Nnp,' non perfect powers')
```

14 Algorithm Test scores

14.1 Python code

```python
Max1 = 0
Max2 = 0
Min = 100
S = 0
G100 = 0
for i in range(10):
    a=int(input('Enter a score :'))
    if a < 100:
        G100 = 1
        if a > Max1:
            Max2 = Max1
            Max1 = a
            if a < Min:
                Min = a
        elif a > Max2 and a < Max1:
            Max2=a
            if a < Min:
                Min = a
    else:
        if a > Max1:
            Max2 = Max1
            Max1 = a
            if a < Min:
                Min = a
        elif a > Max2 and a < Max1:
            Max2 = a
            if a < Min:
                Min = a
    S=S+a
print('The maximum is ',Max1,' and the minmum is ',Min)
Average=S/10
print('The average is ',Average)
if G100==1:
    print('Warning a value over 100 has been entered')
NewAverage=(S-Max1-Max2)/8
print('The new average is ',NewAverage)
```

14.2 Algorithm

Algorithm 14 TestScores ( )

Begin
  $Max1 \leftarrow 0$;
  $Max2 \leftarrow 0$;
  $Min \leftarrow 100$;
  $S \leftarrow 0$;
  $G100 \leftarrow 0$;
  for $i \leftarrow 0 \ to \ 10$ **do**
    Read (a) ;
    if $a > 100$ **then**
      $G100 \leftarrow 1$;
      if $a > Max1$ **then**
        $Max2 \leftarrow Max1$;
        $Max1 \leftarrow a$;
        if $a < Min$ **then**
          $Min \leftarrow a$;
        end if
      else if $a > Max2 \ and \ a < Max1$ **then**
        $Max2 \leftarrow a$;
        if $a < Min$ **then**
          $Min \leftarrow a$;
        end if
      end if
    else
      if $a > Max1$ **then**
        $Max2 \leftarrow Max1$;
        $Max1 \leftarrow a$;
        if $a < Min$ **then**
          $Min \leftarrow a$;
        end if
      else if $a > Max2 \ and \ a < Max1$ **then**
        $Max2 \leftarrow a$;
        if $a < Min$ **then**
          $Min \leftarrow a$;
        end if
      end if
    end if
    $S \leftarrow S + a$;
  end for
  Write ('The maximum is ',Max1,' and the minmum is ',Min) ;
  $Average \leftarrow S/10$;
  Write ('The average is ', Average) ;
  if $G100 = 1$ **then**
    Write ('Warning a value over 100 has been entered') ;
  end if
  $NewAverage \leftarrow (S - Max1 - Max2)/8$;
  Write ('The new average is ',NewAverage') ;
End

15 Algorithm Leap year

1. Write a algorithm that asks the user for a year and prints out whether it is a leap year or not.

2. Write a algorithm that asks the user for a two different years n, m and prints how many leap years are between year n and m.

15.1 Algorithm $15a$

Algorithm 15 LeapYear ( )

Begin
  Read (year) ;
  if ($year\ mod\ 4 = 0\ and\ year\ mod\ 100\ \neq 0$) or ($year\ mod400\ = 0$) **then**
    Write(year,' is a leap year') ;
  else
    Write(year,' is not a leap year);
  end if
End

15.2 Python code $15a$

```
year=int(input('Enter the year :'))
if (year%4==0 and year%100!=0)or(year%400==0):
    print(year, ' is a leap year')
else:
    print(year, ' is not leap year')
```

15.3 Algorithm $15b$

Algorithm 16 LeapYear2 ( )

Begin
  Read (n,m) ;
  $Number \leftarrow 0$;
  for $i \leftarrow n\ to\ m\ (+1)$ **do**
    if ($i\ mod\ 4 = 0\ and\ i\ mod\ 100\ \neq 0$) or ($i\ mod\ 400\ = 0$) **then**
      $Number = Number + 1$;
    end if
  end for
  Write ('There are ',Number,' leap years') ;
End

15.4   Python code $15b$

```python
n=int(input('Enter the first year :'))
m=int(input('Enter the second year :'))
Number=0
for i in range(n,m+1):
    if (i%4==0 and i%100!=0)or(i%400==0):
        Number=Number+1
print('There are ',Number,' leap years')
```