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CSE-3024 WEB MINING

LAB ASSIGNMENT 5

Aim: Write a python program to perform the following encoding and decoding for the EVEN numbers between 1-20

1) Unary
2) Elias Gamma
3) Elias Delta
4) Golomb (b=10)

Procedure:

- Firstly, we import the numpy library to use mathematical functions such as logarithm in our code.
- We create two functions, one to convert integer to binary and the other to create binary to integer.
- We write respective functions for each of the given methods. The functions are corresponding to Unary Encoding, Unary Decoding, Elias Gamma Encoding, Elias Gamma Decoding, Elias Delta Encoding, Elias Delta Decoding, Golomb Encoding and Golomb Decoding.
- In main program, we run a loop from 2 to 21 with a jump of 2 to get even numbers in the range from 1-20.
- We perform the above functions to each of the iterators in the above loop.

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Code:

```
#Importing Library
import numpy as np


#Converting Integer to Binary
def intToBin(var):
    return bin(var).split("0b")[1]


#Converting Binary to Integer
def binToInt(var):
    return int(var, 2)


#Unary Encoding
def unaryEncoding(var):
    unary = ""
    for i in range(var-1):
        unary='0'+unary
    unary=unary+'1'
    return unary


#Unary Decoding
def unaryDecoding(var):
    counter=0
    while(var[0]=='0'):
        var=var[1:]
        counter=counter+1
    return counter+1


#Elias Gamma Encoding
def eliasGammaEncoding(var):
    var = intToBin(var)
    n=len(var)-1
    for i in range(n):
        var = '0'+var
    return var


#Elias Gamma Decoding
def eliasGammaDecoding(var):
    counter=0
```

```
    while(var[0]=='0'):
        var=var[1:]
        counter=counter+1
    var=var[0:counter+1:1]
    return binToInt(var)


#Elias Delta Encoding
def eliasDeltaEncoding(var):
    selector = eliasGammaEncoding(1+int(np.log2(var)))
    var = intToBin(var)
    offset=""
    for i in range(1, len(var)):
        offset=offset+var[i]
    return (selector+offset)


#Elias Delta Decoding
def eliasDeltaDecoding(var):
    Nbits=eliasGammaDecoding(var)-1
    ans=""
    for i in range(Nbits):
        ans=var[-(i+1)]+ans
    return binToInt('1'+ans)


#Golomb Encoding
def golombEncoding(var, b):
    quotientunary=unaryEncoding(int(var/b) +1)
    remainder=var%b
    i=int(np.log2(b))
    d= (2**(i+1))-b
    if (remainder<d):
        r = intToBin(remainder)
        while len(r)<i:
            r='0'+r
    else:
        r=intToBin(remainder+d)
        while len(r)<i+1:
            r='0'+r
    return quotientunary+r


#Golomb Decoding
def golombDecoding(var, b):
    quotient=unaryDecoding(var)-1
    i=int(np.log2(b))
    d=(2**(i+1))-b
```

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```
    counter=0
    while (var[0]=='0'):
        var=var[1:]
        counter=counter+1
    var=var[1:]
    remainder=var[0:i]
    remainder=binToInt(remainder)
    if (remainder>=d):
        remainder=intToBin(remainder)
        remainder=var[0:i+1]
        remainder=binToInt(remainder)-d
    ans=quotient*b+remainder
    return ans


for i in range(2,21,2):
    print("\n\nNumber=",i)
    UE = unaryEncoding(i)
    print("\tUnaryEncoding: ", UE)
    EGE=eliasGammaEncoding(i)
    print("\tElias Gamma Encoding: ",EGE)
    EDE=eliasDeltaEncoding(i)
    print("\tElias Delta Encoding: ",EDE)
    GE=golombEncoding(i,10)
    print("\tGoloumb Encoding: ",GE)
    print("\tUnary Decoding:", unaryDecoding(UE))
    print("\tElias Gamma Decoding:", eliasGammaDecoding(EGE))
    print("\tElias Delta Decoding:", eliasDeltaDecoding(EDE))
    print("\tGolomb Decoding:", golombDecoding(GE,10))
```

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Code Snippet and Outputs:

```
In [1]: #Importing Library
        import numpy as np
```

Here we are importing the numpy library

```
In [2]: #Converting Integer to Binary
        def intToBin(var):
            return bin(var).split("0b")[1]

In [3]: #Converting Binary to Integer
        def binToInt(var):
            return int(var, 2)
```

Here we define two utility functions. The first one is used to convert integer number to binary and the second one is used to convert binary number to integer.

```
In [4]: #Unary Encoding
        def unaryEncoding(var):
            unary = ""
            for i in range(var-1):
                unary='0'+unary
            unary=unary+'1'
            return unary

In [5]: #Unary Decoding
        def unaryDecoding(var):
            counter=0
            while(var[0]=='0'):
                var=var[1:]
                counter=counter+1
            return counter+1
```

Here we create two functions, the first one is to perform unary Encoding and the second one is used to perform unary decoding.

In [6]:
```
#Elias Gamma Encoding
def eliasGammaEncoding(var):
    var = intToBin(var)
    n=len(var)-1
    for i in range(n):
        var = '0'+var
    return var
```

In [7]:
```
#Elias Gamma Decoding
def eliasGammaDecoding(var):
    counter=0
    while(var[0]=='0'):
        var=var[1:]
        counter=counter+1
    var=var[0:counter+1:1]
    return binToInt(var)
```

Here we again define two functions, one to perform Elias Gamma Encoding and the other to perform Elias Gamma decoding. The decoding function utilizes the binary to Integer utility function.

In [8]:
```
#Elias Delta Encoding
def eliasDeltaEncoding(var):
    selector = eliasGammaEncoding(1+int(np.log2(var)))
    var = intToBin(var)
    offset=""
    for i in range(1, len(var)):
        offset=offset+var[i]
    return (selector+offset)
```

In [9]:
```
#Elias Delta Decoding
def eliasDeltaDecoding(var):
    Nbits=eliasGammaDecoding(var)-1
    ans=""
    for i in range(Nbits):
        ans=var[-(i+1)]+ans
    return binToInt('1'+ans)
```

Here we define the Elias Delta Encoding and Elias Delta Decoding Functions. The decoding one again utilized the binary to integer utility function.

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In [10]:
```
#Golomb Encoding
def golombEncoding(var, b):
    quotientunary=unaryEncoding(int(var/b) +1)
    remainder=var%b
    i=int(np.log2(b))
    d= (2**(i+1))-b
    if (remainder<d):
        r = intToBin(remainder)
        while len(r)<i:
            r='0'+r
    else:
        r=intToBin(remainder+d)
        while len(r)<i+1:
            r='0'+r
    return quotientunary+r
```

In [11]:
```
#Golomb Decoding
def golombDecoding(var, b):
    quotient=unaryDecoding(var)-1
    i=int(np.log2(b))
    d=(2**(i+1))-b
    counter=0
    while (var[0]=='0'):
        var=var[1:]
        counter=counter+1
    var=var[1:]
    remainder=var[0:i]
    remainder=binToInt(remainder)
    if (remainder>=d):
        remainder=intToBin(remainder)
        remainder=var[0:i+1]
        remainder=binToInt(remainder)-d
    ans=quotient*b+remainder
    return ans
```

Here we have our Golomb Encoding and Golomb Decoding functions. Both the function use the utility function of Integer to Binary conversion.

```
In [12]: for i in range(2,21,2):
             print("\n\nNumber=",i)
             UE = unaryEncoding(i)
             print("\tUnaryEncoding: ", UE)
             EGE=eliasGammaEncoding(i)
             print("\tElias Gamma Encoding: ",EGE)
             EDE=eliasDeltaEncoding(i)
             print("\tElias Delta Encoding: ",EDE)
             GE=golombEncoding(i,10)
             print("\tGoloumb Encoding: ",GE)
             print("\tUnary Decoding:", unaryDecoding(UE))
             print("\tElias Gamma Decoding:", eliasGammaDecoding(EGE))
             print("\tElias Delta Decoding:", eliasDeltaDecoding(EDE))
             print("\tGolomb Decoding:", golombDecoding(GE,10))
```

```
Number= 2
        UnaryEncoding:  01
        Elias Gamma Encoding:  010
        Elias Delta Encoding:  0100
        Goloumb Encoding:  1010
        Unary Decoding: 2
        Elias Gamma Decoding: 2
        Elias Delta Decoding: 2
        Golomb Decoding: 2
```

Here we are running loop to iterate the even numbers in range 1-20 and then use the above functions to get our results. We are defining the variables such as UE, EGE, EDE, GE to store Unary Encoding, Elias Gamma Encoding, Elias Delta Encoding and Golomb Encoding results.

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Results:

```
Number= 2
        UnaryEncoding:  01
        Elias Gamma Encoding:  010
        Elias Delta Encoding:  0100
        Goloumb Encoding:  1010
        Unary Decoding: 2
        Elias Gamma Decoding: 2
        Elias Delta Decoding: 2
        Golomb Decoding: 2
```

```
Number= 4
        UnaryEncoding:  0001
        Elias Gamma Encoding:  00100
        Elias Delta Encoding:  01100
        Goloumb Encoding:  1100
        Unary Decoding: 4
        Elias Gamma Decoding: 4
        Elias Delta Decoding: 4
        Golomb Decoding: 4
```

```
Number= 6
        UnaryEncoding:  000001
        Elias Gamma Encoding:  00110
        Elias Delta Encoding:  01110
        Goloumb Encoding:  11100
        Unary Decoding: 6
        Elias Gamma Decoding: 6
        Elias Delta Decoding: 6
        Golomb Decoding: 6
```

```
Number= 8
        UnaryEncoding:  00000001
        Elias Gamma Encoding:  0001000
        Elias Delta Encoding:  00100000
        Goloumb Encoding:  11110
        Unary Decoding: 8
        Elias Gamma Decoding: 8
        Elias Delta Decoding: 8
        Golomb Decoding: 8
```

Harshit Mishra (19BCE0799)

```
Number= 10
        UnaryEncoding:  0000000001
        Elias Gamma Encoding:  0001010
        Elias Delta Encoding:  00100010
        Goloumb Encoding:  01000
        Unary Decoding: 10
        Elias Gamma Decoding: 10
        Elias Delta Decoding: 10
        Golomb Decoding: 10
```

```
Number= 12
        UnaryEncoding:  000000000001
        Elias Gamma Encoding:  0001100
        Elias Delta Encoding:  00100100
        Goloumb Encoding:  01010
        Unary Decoding: 12
        Elias Gamma Decoding: 12
        Elias Delta Decoding: 12
        Golomb Decoding: 12
```

```
Number= 14
        UnaryEncoding:  00000000000001
        Elias Gamma Encoding:  0001110
        Elias Delta Encoding:  00100110
        Goloumb Encoding:  01100
        Unary Decoding: 14
        Elias Gamma Decoding: 14
        Elias Delta Decoding: 14
        Golomb Decoding: 14
```

```
Number= 16
        UnaryEncoding:  0000000000000001
        Elias Gamma Encoding:  000010000
        Elias Delta Encoding:  001010000
        Goloumb Encoding:  011100
        Unary Decoding: 16
        Elias Gamma Decoding: 16
        Elias Delta Decoding: 16
        Golomb Decoding: 16
```

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```
Number= 18
        UnaryEncoding:  000000000000000001
        Elias Gamma Encoding:  000010010
        Elias Delta Encoding:  001010010
        Goloumb Encoding:  011110
        Unary Decoding: 18
        Elias Gamma Decoding: 18
        Elias Delta Decoding: 18
        Golomb Decoding: 18
```

```
Number= 20
        UnaryEncoding:  00000000000000000001
        Elias Gamma Encoding:  000010100
        Elias Delta Encoding:  001010100
        Goloumb Encoding:  001000
        Unary Decoding: 20
        Elias Gamma Decoding: 20
        Elias Delta Decoding: 20
        Golomb Decoding: 20
```

The result for each number is:

Number= 2

UnaryEncoding: 01

Elias Gamma Encoding: 010

Elias Delta Encoding: 0100

Goloumb Encoding: 1010

Unary Decoding: 2

Elias Gamma Decoding: 2

Elias Delta Decoding: 2

Golomb Decoding: 2

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Number= 4

UnaryEncoding: 0001

Elias Gamma Encoding: 00100

Elias Delta Encoding: 01100

Goloumb Encoding: 1100

Unary Decoding: 4

Elias Gamma Decoding: 4

Elias Delta Decoding: 4

Golomb Decoding: 4

Number= 6

UnaryEncoding: 000001

Elias Gamma Encoding: 00110

Elias Delta Encoding: 01110

Goloumb Encoding: 11100

Unary Decoding: 6

Elias Gamma Decoding: 6

Elias Delta Decoding: 6

Golomb Decoding: 6

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Number= 8

UnaryEncoding: 00000001

Elias Gamma Encoding: 0001000

Elias Delta Encoding: 00100000

Goloumb Encoding: 11110

Unary Decoding: 8

Elias Gamma Decoding: 8

Elias Delta Decoding: 8

Golomb Decoding: 8

Number= 10

UnaryEncoding: 0000000001

Elias Gamma Encoding: 0001010

Elias Delta Encoding: 00100010

Goloumb Encoding: 01000

Unary Decoding: 10

Elias Gamma Decoding: 10

Elias Delta Decoding: 10

Golomb Decoding: 10

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Number= 12

UnaryEncoding: 000000000001

Elias Gamma Encoding: 0001100

Elias Delta Encoding: 00100100

Goloumb Encoding: 01010

Unary Decoding: 12

Elias Gamma Decoding: 12

Elias Delta Decoding: 12

Golomb Decoding: 12

Number= 14

UnaryEncoding: 00000000000001

Elias Gamma Encoding: 0001110

Elias Delta Encoding: 00100110

Goloumb Encoding: 01100

Unary Decoding: 14

Elias Gamma Decoding: 14

Elias Delta Decoding: 14

Golomb Decoding: 14

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Number= 16

UnaryEncoding: 0000000000000001

Elias Gamma Encoding: 000010000

Elias Delta Encoding: 001010000

Goloumb Encoding: 011100

Unary Decoding: 16

Elias Gamma Decoding: 16

Elias Delta Decoding: 16

Golomb Decoding: 16

Number= 18

UnaryEncoding: 00000000000000001

Elias Gamma Encoding: 000010010

Elias Delta Encoding: 001010010

Goloumb Encoding: 011110

Unary Decoding: 18

Elias Gamma Decoding: 18

Elias Delta Decoding: 18

Golomb Decoding: 18

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Number= 20

UnaryEncoding: 00000000000000000001

Elias Gamma Encoding: 000010100

Elias Delta Encoding: 001010100

Goloumb Encoding: 001000

Unary Decoding: 20

Elias Gamma Decoding: 20

Elias Delta Decoding: 20

Golomb Decoding: 20