Deliverable1

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1 Introduction

$y = log_b x$ is a logarithmic function and the inverse of an exponential function. It can be defined as logarithm of x to the base b is y, where x and b are both real numbers. It can also be represented in the following exponential form: $b^y = x$ where b is a positive real number except 1 and y is a rational number. For solving exponents, logarithms use a special kind of notation. xy = z in exponent form would result in logx (z) = y in logarithm notation.

1.1 Graph:

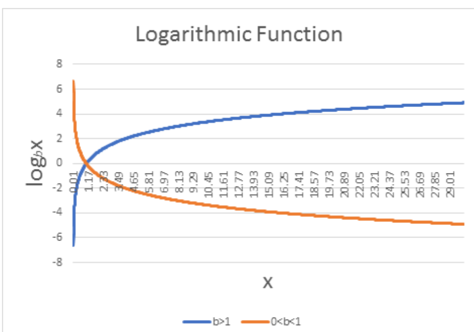

Figure 1: Graphs fr Original Cosine and Arccos Function

Domain: x∈R|x>0 **Codomain:**$(-\infty, \infty)$

1.2 Characteristics:

- It is an inverse of Exponential Function

- It is a one-to-one function
- It has vertical asymptote along y-axis
- When Base b= 2, it is a Binary Logarithm
- When Base b= e, it is a Natural Logarithm
- When Base b= 10, it is Common Logarithm

1.3 Properties:

- $y = log_b ac = log_b a + log_b c$
- $y = log_b 1/2 = log_b a - log_b c$
- $y = log_b x^p = plog_b x$
- $log_b x = log_m x/log_m b$

1.4 Practical Applications:

- It is very helpful when we want to convert complex multiplication problems to addition problems. Eg. Differentiation problems
- Log transformation is widely used to transform skewed data to linear data.

2 Requirements

2.1 Assumptions:

- User gives input values for both x and b
- We need to calculate the value of y based on certain logarithmic equations.

2.2 Requirements:

1. **First Requirement** ID = FR1
   Type = Functional
   Version = 1.0
   Difficulty = easy
   Description = System shall take an input number x and base number b to give an output of logbx which is y.
2. **Second Requirement** ID = FR2
   Type = Functional Requirement
   Version = 1.0
   Difficulty = easy
   Description = The input value for x, where, $x > 0$

3. **Third Requirement** ID = FR3
   Type = Functional Requirement
   Version = 1.0
   Difficulty = easy
   Description = The function should accept only integer values for input value x, if a non-integer value is provided, like char then it should not accept the input

4. **Fourth Requirement** ID = FR4
   Type = Functional Requirement
   Version = 1.0
   Difficulty = medium
   Description = Express the function in the form of equation by=x to get the desired results without using log function

5. **Fifth Requirement** ID = FR5
   Type = Functional Requirement
   Version = 1.0
   Difficulty = medium
   Description = logbx can be computed using the logarithms of x and b with respect to an arbitrary base k.
   Logbx= logkx/ logkb

6. **Sixth Requirement** ID = FR6
   Type = Functional Requirement
   Version = 1.0
   Difficulty = easy
   Description = logarithm of a number greater than 1 is positive and is one less than the number of digits in the integral part of the number

7. **Seventh Requirement** ID = FR7
   Type = Non-Functional Requirement
   Version = 1.0
   Difficulty = Medium
   Description = System should display the output with correct results within 5 seconds for system efficiency.

3 PseudoCode

The main reason for choosing this algorithm for calculating the value of y=$lob_b x$ is because it makes use of power function to calculate the value of y or the output of log function. The complexity of this algorithm is $O(2^n)$ which is efficient and will produce the correct results in less time.

Algorithm 1 Logarithm Function

```
procedure POWER(b, e)
    p ← 1
    for i ← 1, e do
        p ← p * b
    end for
    return p
end procedure

procedure LOG(input)
    total ← 0

    j ← (input − 1)/(input + 1)

    for i ← 1, ∞ do

        k ← (2 * i) − 1

        total ← total + (1/k) * P(j, k)

    end for

    return 2 * total
end procedure


a ← LOG(x)
b ← LOG(b)
output ← a/b
```

4 References

[Johansson, 2019] Implementation of elementary functions for logarithmic number systems. By Johansson, K., Gustafsson, O. and Wanhammar, L.

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[Sanders, 1992] Product Development Research for the 1990s. By E. B.-N. Sanders. Design Management Journal. Volume 3. Number 4. 1992. Pages 49-54.