Concordia University

SOEN 6011 - Software Engineering Process

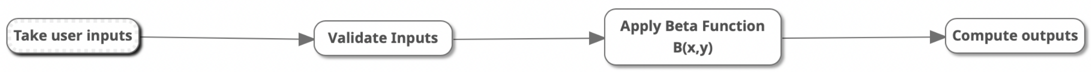
ETERNITY : FUNCTIONS
Function 6 : B(x,y)

Problem Solution 3

Juhi Birju Patel
Student ID : 40190446
https://github.com/JuhiCodes/SOEN-6011-Course-Project

Contents

1 Mindmap



2 Algorithms

2.1 Algorithm 1

Stirling's approximation is used for calculating approximation of factorials. It is a good approximation which leads to accurate results even for small values of n. Stirling's approximation is defined as:

$$B(x, y) = \frac{\Gamma x \Gamma y}{\Gamma(x + y)}$$

$$\Gamma x = \sqrt{\frac{2\pi}{x}}(\frac{x}{e})^x$$

Technical reasons for selecting this algorithm

- It is easy to implement and provides with reliable approximation.
- It allows us to increase the domain of the function as it does not make use of any periodic functions.

Advantages

- The algorithm is easy to implement and reduces the complexity of the code.

- The algorithm results in correct output for most of the inputs.
- The algorithm works for all real positive numbers.
- The algorithm provides an reliable estimation for the integral.

Disadvantages

- The algorithm is easy to implement but it is quite complex than other algorithms.
- Debugging the code to spot the error is difficult hence time consuming.
- The algorithm fails in providing accurate results.
- The difference in the results for smaller input values id large.

Algorithm 1 Calculating Beta Function using Sterling's approximation

Input: $(x, y) \in R^+$
Output: $Beta(x, y)$

$pi \leftarrow 3.141592653589793$
$e \leftarrow 2.718281828459045$
procedure CALCULATEBETAFUNCTION(x, y, z)
  $z \leftarrow x + y$
  $gammaX \leftarrow$ CALCULATEGAMMA(x)
  $gammaY \leftarrow$ CALCULATEGAMMA(y)
  $gammaZ \leftarrow$ CALCULATEGAMMA(z)
  $beta \leftarrow \frac{gammaX * gammaY}{gammaZ}$
  return $beta$ ▷ Result

procedure CALCULATEGAMMA(num)
  $num \leftarrow num - 1$
  $root \leftarrow 2 * pi * num$
  $sqRoot \leftarrow$ COMPUTESQUAREROOT$(root)$
  $power \leftarrow$ COMPUTEPOWER(num, e)
  return $(sqRoot) * (power)$ ▷ Result of gamma

procedure CALCULATEPOWER$(num1$,$num2)$
  $temp \leftarrow 1$
  for do$i \leftarrow 1$ to $num2$
    $temp \leftarrow temp * num1$
  return $temp$ ▷ Result of power calculation

procedure CALCULATESQUAREROOT(ele)
  $temp \leftarrow 0.0$
  $squareRoot \leftarrow ele/2$
  $temp \leftarrow squareRoot$
  $squareRoot \leftarrow (temp + (ele/temp))/2 \; ((temp - squareRoot)! = 0)$
  return $squareRoot$ ▷ return the square root

$beta \leftarrow$ CALCULATEBETAFUNCTION(x, y)

2.2 Algorithm 2

This algorithm calculates beta function using the gamma function in the factorial form for positive inputs.

$$B(x, y) = \frac{\Gamma x \Gamma y}{\Gamma(x + y)}$$

$$\Gamma x = (x - 1)!$$

Technical reasons for selecting this algorithm

- This algorithm is faster and easy to implement in any programming language.
- When the input to the function is integers, then this algorithm results in accurate results.

Advantages

- The algorithm is faster to compute the results.
- The algorithm gives accurate results.
- The algorithm is simple and easy to implement and debug.
- The algorithm is more efficient to calculate beta function.

Disadvantages

- The algorithm works only for positive value inputs.
- The algorithm fails when given negative inputs.
- The algorithm doesn't work for integer inputs

Algorithm 2 Calculating Beta function using factorial function

Input: $(x, y) \in R^+$
Output: $Beta(x, y)$

procedure CALCULATEGAMMA(num)
    $num \leftarrow num - 1$
    $gamma \leftarrow$ CALCULATEFACTORIAL(num)
    return $gamma$

procedure CALCULATEBETAFUNCTION(x, y, z)
    $z \leftarrow x + y$
    $gammaX \leftarrow$ CALCULATEGAMMA(x)
    $gammaY \leftarrow$ CALCULATEGAMMA(y)
    $gammaZ \leftarrow$ CALCULATEGAMMA(z)
    $beta \leftarrow \frac{gammaX * gammaY}{gammaZ}$
    return $beta$ ▷ Result

procedure CALCULATEFACTORIAL(num)
    if $num \leq 1$ **then**
        return 1
    else
        return $num * calculateFactorial(num - 1)$

$beta \leftarrow$ CALCULATEBETAFUNCTION(x, y)

Bibliography

[1] Wikipedia,
`https://en.wikipedia.org/wiki/Beta_function`

[2] Stirlingwiki,
`https://en.wikipedia.org/wiki/Stirling%27s_approximation`

[3] Gamma,
https://en.wikipedia.org/wiki/Gamma_function