

## Assumptions

1.  $x$  and  $y$  are positive real numbers  $x, y \in R^+$ .
2. It is simpler to calculate  $B(x, y)$  using the factorial for  $x, y \in Z^+$ .
3. If  $x$  and  $y$  are real numbers, there is no need to compute the integral function. The gamma values of the numbers may be used to derive the beta value using Stirling's approach.

## Requirements

### 1. First Requirement

- **ID** = FR1
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = The Beta function  $B(x, y)$  requires  $x$  and  $y$  as its two variable inputs in order to operate.
- **Rationale** =  $x$  and  $y$

### 2. Second Requirement

- **ID** = FR2
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = The Beta function  $B(x, y)$  requires two real positive numbers as it's defined in the  $R^+$  domain.
- **Rationale** =  $x \geq 0$  and  $y \geq 0$

### 3. Third Requirement

- **ID** = FR3
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = The Beta Value of the function is in real positive numbers i.e  $R^+$
- **Rationale** =  $B(x, y) \geq 0$

#### 4. Fourth Requirement

- **ID** = FR4
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = If the given inputs are positive integers then beta Values can be easily computed by using the Beta - Gamma Function relation.
- **Rationale** =  $\{ \forall x, y \in \mathbb{Z}^+ \mid B(x,y)=\Gamma x \Gamma y_{\overline{\Gamma(x+y)}} \}$

#### 5. Fifth Requirement

- **ID** = FR5
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Moderate
- **Description** = To calculate Beta function for large integer values, Gamma Function should be used in order to prevent stack overflow by using tail recursive function.
- **Rationale** =  $\{ \forall x, y \in \mathbb{R}^+ \mid B(x,y)=\Gamma x \Gamma y_{\overline{\Gamma(x+y)}} \text{ where } \Gamma n = (n - 1)! \}$

#### 6. Sixth Requirement

- **ID** = FR6
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Difficult
- **Description** = For the decimal number gamma value can be calculated using the stirlings's approximation which helps in determining the Beta value without using the integral functions.
- **Rationale** =  $\{ \forall x, y \in \mathbb{R}^+ \mid B(x,y)=\Gamma x \Gamma y_{\overline{\Gamma(x+y)}} \text{ where } \Gamma n = \sqrt{2 \cdot \pi \cdot n} \cdot (\frac{n}{e})^n \}$

#### 7. Seventh Requirement

- **ID** = FR7
- **Type** = Functional Requirements
- **Version** = 1.0
- **Difficulty** = Moderate
- **Description** = There is no definition of beta values for negative or zero values. There shouldn't be any inputs besides the numeric values; x and y can be similar or different, but there shouldn't be any inputs other than the numeric values.
- **Rationale** =  $\{ \forall x, y \in \mathbb{R}^+ \mid x>0 \text{ and } y>0, x = y \text{ or } x \neq y \}$

#### 8. Eighth Requirement

- **ID** = QR1
- **Type** = Non-Functional Requirement
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = The system should be maintainable and changes can be easily applied to the system.
- **Rationale** = The maintainability is provided by dividing distinct tasks into different modules or functions.

#### 9. Ninth Requirement

- **ID** = QR2
- **Type** = Non-Functional Requirement
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = The system should be portable and able to run on different system such as various operating system.
- **Rationale** = The Java (requires version 1.8 or above) programs are compatible with any system architecture that has a JVM (Java Virtual Machine).

#### 10. Tenth Requirement

- **ID** = QR3
- **Type** = Non-Functional Requirement
- **Version** = 1.0
- **Difficulty** = Easy
- **Description** = The system design should be easy to understand for any user and can easily interpret the error message displayed on the system even for non-technical users.
- **Rationale** = The error message should clearly state what went wrong.