Software Engineering Process
Deliverable 1

Sidhant Gupta
SID : 40059256

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1 Problem-1

The Tangent(tan) function is one of the most familiar trigonometric functions.
In case of a right angled triangle, the tan of an angle can be defined as: the ratio between the length of the opposite side and the length of the adjacent side. This can be denoted as :

$tan(\theta) = \frac{length of opposite)}{length of adjacent}$

One of the common identities that shows the relation between various trigonometric identities is :

$tan(\theta) = \frac{sin(\theta)}{cos(\theta)}$

Features of tan( ) function :

1. Domain : $\{x \mid x \neq \frac{\pi}{2} + k\pi, k = ..., -1, 0, 1, ...\}$
2. Co-Domain : R
3. Period : π
4. tan(x) is symmetric

2 Problem-2

Functional requirements:
1. Assumptions:

    1. All inputs to the function will be numeric
    2. Input will be a real number
    3. Input will be assumed in degrees

2. Requirements:

- ID : ETRN-REQ-1
    1. Type : Functional requirement
    2. Version : 1.0
    3. Difficulty : Easy
    4. Owner : Author
    5. Description : User can enter any valid number for the function tan(x)
    6. Rationale : The tan() function returns valid values for all inputs except only for $x = \frac{\pi}{2} + k\pi$. In this case, NaN can be returned.
- ID : ETRN-REQ-2
    1. Type : Functional requirement
    2. Version : 1.0
    3. Difficulty : Medium
    4. Owner : Author
    5. Description : tan(x) returns the computed value when $x \neq \frac{\pi}{2} + k\pi$
    6. Rationale : The domain for tan(x) is satisfied. Hence calculated value will be returned.

- ID : ETRN-REQ-3
  1. Type : Functional requirement
  2. Version : 1.0
  3. Difficulty : Easy
  4. Owner : Author
  5. Description : tan(x) returns NaN when $x = \frac{\pi}{2} + k\pi$
  6. Rationale : The domain for tan(x) is not satisfied. The function returns NaN. No computation is required.
- ID : ETRN-REQ-4
  1. Type : Functional requirement
  2. Version : 1.0
  3. Difficulty : Easy
  4. Owner : Author
  5. Description : When input is non-numeric, Incorrect format exception is thrown
  6. Rationale : tan(x) is a mathematical function that only accepts numerical values.

3 Problem-3

Algorithm 1 : Calculation of tan(x) using Taylor series expansion

1. if x not in range(0,180) then,
2. Subtract largest multiple of 180 less than x
3. end if
4. if $x > 90 \ \wedge \ x < 180$ then,
5. $x \leftarrow x - 180$
6. end if
7. if $x > 45 \ \wedge \ x < 90$ then,
8. $x1 \leftarrow 90 - x$
9. return $\frac{1}{tan(x1)}$
10. end if
11. if $x > 22.5 \ \wedge \ x < 45$ then,
12. return $\frac{2 * tan(\frac{x}{2})}{1 - tan^2(\frac{x}{2})}$
13. end if
14. if $x < 22.5$ then,
15. $z \leftarrow x * \frac{\pi}{180}$
16. return $z + \frac{z^3}{3} + \frac{2z^5}{15} + \frac{17z^7}{315}$

Algorithm 2 : Computing tan(x) as a ratio of sin and cos

1. $x1 \leftarrow sin(x)$
2. $x2 \leftarrow cos(x)$
3. return $\frac{x1}{x2}$

Factors in algorithm selection :

1. Algorithm 1 gives accuracy of ± 0.000006
2. Algorithm 1 is efficient
3. Algorithm 2 uses ratio of 2 separately calculated values. This approach lacks precision.
4. Algorithm 2 is dependent on sin(x) and cos(x) functions