MA322 : Scientific Computing
Lab Assignment 1

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Q.3) Given, $f(x) = \sqrt{x^2 + 1} - 1$

$$g(x) = \frac{x^2}{\sqrt{x^2+1} + 1}$$

Despite the fact that both the functions are identical, f(x) abruptly becomes 0, while g(x) does not. This is because the subtraction required means that f(x) loses some significant digits.

The following is the output for the various values of x : -

```
For i = 1:     f(x) = 0.00778221853731871;     g(x) = 0.00778221853731871
For i = 2:     f(x) = 0.000122062862828759;     g(x) = 0.000122062862828759
For i = 3:     f(x) = 1.90734681382657e-06;     g(x) = 1.90734681382657e-06
For i = 4:     f(x) = 2.98023219436061e-08;     g(x) = 2.98023219436061e-08
For i = 5:     f(x) = 4.65661287199319e-10;     g(x) = 4.65661287199319e-10
For i = 6:     f(x) = 7.27595761418343e-12;     g(x) = 7.27595761415696e-12
For i = 7:     f(x) = 1.13686837721616e-13;     g(x) = 1.1368683772161e-13
For i = 8:     f(x) = 1.77635683940025e-15;     g(x) = 1.77635683940025e-15
For i = 9:     f(x) = 0;     g(x) = 2.77555756156289e-17
For i = 10:    f(x) = 0;     g(x) = 4.33680868994202e-19
For i = 11:    f(x) = 0;     g(x) = 6.7762635780344e-21
For i = 12:    f(x) = 0;     g(x) = 1.05879118406788e-22
For i = 13:    f(x) = 0;     g(x) = 1.65436122510606e-24
For i = 14:    f(x) = 0;     g(x) = 2.58493941422821e-26
For i = 15:    f(x) = 0;     g(x) = 4.03896783473158e-28
```

Q.4) $f(x) = \dfrac{1 - \cos x}{x^2}$ is the given function.

Since this function includes subtraction, significant digits may be lost.
So, we use the following function : -

$$g(x) = \dfrac{2\sin^2(\frac{x}{2})}{x^2}$$

Since this function does not require subtraction near 0, it returns 0.5 rather than the value of 0 returned by f(x).

The following is the output for the various values of x : -

```
For i = -10 :     f(x) = 0.0183907152907645 ;    g(x) = 0.0183907152907645
For i = -0.1 :     f(x) = 0.499583472197418 ;    g(x) = 0.499583472197423
For i = -0.001 :    f(x) = 0.499999958325503 ;    g(x) = 0.499999958333335
For i = -1e-05 :     f(x) = 0.500000041370185 ;    g(x) = 0.499999999995833
For i = -1e-07 :     f(x) = 0.49960036108132 ;    g(x) = 0.5
For i = -1e-09 :     f(x) = 0 ;    g(x) = 0.5
For i = -1e-11 :     f(x) = 0 ;    g(x) = 0.5


For i = 1e-11 :     f(x) = 0 ;    g(x) = 0.5
For i = 1e-09 :     f(x) = 0 ;    g(x) = 0.5
For i = 1e-07 :     f(x) = 0.4996003361081321 ;    g(x) = 0.5
For i = 1e-05 :     f(x) = 0.500000041370186 ;    g(x) = 0.499999999995833
For i = 0.001 :     f(x) = 0.499999958325503 ;    g(x) = 0.499999958333335
For i = 0.1 :     f(x) = 0.499583472197418 ;    g(x) = 0.499583472197423
For i = 10 :     f(x) = 0.0183907152907645 ;    g(x) = 0.0183907152907645
```