MA322 Scientific Computing lab: 06

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- To execute my .py file
  Run **$python3 180123029_NamanGoyal.py** on the terminal. Screenshots are attached question-wise

Ques. 1&2

```
 ~/Desktop/sci_lab/lab06
 python3 180123029_NamanGoyal.py
--------------------Q1 && Q2--------------------

Part A ------------>
y(0.00) = 1.000000000
y(0.00) (Actual) = 1.000000000
Absolute Error = 0.000000
Relative Error = 0.000000%

y(0.50) = 1.183939721
y(0.50) (Actual) = 1.214023061
Absolute Error = 0.030083
Relative Error = 2.477988%

y(1.00) = 1.436252215
y(1.00) (Actual) = 1.489880126
Absolute Error = 0.053628
Relative Error = 3.599478%
```

```
Part B ------------>
y(1.00) = 2.000000000
y(1.00) (Actual) = 2.000000000
Absolute Error = 0.000000
Relative Error = 0.000000%

y(1.50) = 2.333333333
y(1.50) (Actual) = 2.354101966
Absolute Error = 0.020769
Relative Error = 0.882232%

y(2.00) = 2.708333333
y(2.00) (Actual) = 2.741657387
Absolute Error = 0.033324
Relative Error = 1.215471%
```

```
Part C ------------>
y(2.00) = 2.000000000
y(2.00) (Actual) = 2.000000000
Absolute Error = 0.000000
Relative Error = 0.000000%

y(2.25) = 2.207106781
y(2.25) (Actual) = 2.244121110
Absolute Error = 0.037014
Relative Error = 1.649391%

y(2.50) = 2.490998908
y(2.50) (Actual) = 2.564451949
Absolute Error = 0.073453
Relative Error = 2.864278%

y(2.75) = 2.854680348
y(2.75) (Actual) = 2.965193834
Absolute Error = 0.110513
Relative Error = 3.727024%

y(3.00) = 3.302596465
y(3.00) (Actual) = 3.451286652
Absolute Error = 0.148690
Relative Error = 4.308254%
```

```
Part D ------------>
y(1.00) = 2.000000000
y(1.00) (Actual) = 2.000000000
Absolute Error = 0.000000
Relative Error = 0.000000%

y(1.25) = 1.227324357
y(1.25) (Actual) = 1.403198969
Absolute Error = 0.175875
Relative Error = 12.533833%

y(1.50) = 0.832150157
y(1.50) (Actual) = 1.016410147
Absolute Error = 0.184260
Relative Error = 18.128507%

y(1.75) = 0.570446772
y(1.75) (Actual) = 0.738009772
Absolute Error = 0.167563
Relative Error = 22.704713%

y(2.00) = 0.378826615
y(2.00) (Actual) = 0.529687098
Absolute Error = 0.150860
Relative Error = 28.481057%

------------------------------------------------------
```

- The approximate solutions using Euler’s Method are given above. Errors have been computed itself with the solutions as we can see above.
- Euler’s method is used to find solutions to the given Differential equations. Error is calculated using | y(xn) - yn |.

Ques.3

- The Part A screenshot is so big to be put here so I am writing my observations here.

Part A ------------>
y(1.000) = -1.000000000
y(1.000) (Actual) = -1.000000000
Absolute Error = 0.000000
Relative Error = 0.000000%

y(1.050) = -0.950000000
y(1.050) (Actual) = -0.952380952
Absolute Error = 0.002381
Relative Error = 0.250000%

y(1.100) = -0.904535431
y(1.100) (Actual) = -0.909090909
Absolute Error = 0.004555
Relative Error = 0.501103%

y(1.150) = -0.863007087
y(1.150) (Actual) = -0.869565217
Absolute Error = 0.006558
Relative Error = 0.754185%

y(1.200) = -0.824916918
y(1.200) (Actual) = -0.833333333
Absolute Error = 0.008416
Relative Error = 1.009970%

y(1.250) = -0.789847554
y(1.250) (Actual) = -0.800000000
Absolute Error = 0.010152
Relative Error = 1.269056%

y(1.300) = -0.757446610
y(1.300) (Actual) = -0.769230769
Absolute Error = 0.011784
Relative Error = 1.531941%

y(1.350) = -0.727414517
y(1.350) (Actual) = -0.740740741
Absolute Error = 0.013326
Relative Error = 1.799040%

y(1.400) = -0.699494991
y(1.400) (Actual) = -0.714285714
Absolute Error = 0.014791
Relative Error = 2.070701%

y(1.450) = -0.673467485
y(1.450) (Actual) = -0.689655172
Absolute Error = 0.016188
Relative Error = 2.347215%

y(1.500) = -0.649141178
y(1.500) (Actual) = -0.666666667
Absolute Error = 0.017525
Relative Error = 2.628823%

y(1.550) = -0.626350130
y(1.550) (Actual) = -0.645161290
Absolute Error = 0.018811
Relative Error = 2.915730%

y(1.600) = -0.604949356
y(1.600) (Actual) = -0.625000000
Absolute Error = 0.020051
Relative Error = 3.208103%

y(1.650) = -0.584811625
y(1.650) (Actual) = -0.606060606
Absolute Error = 0.021249
Relative Error = 3.506082%

y(1.700) = -0.565824820
y(1.700) (Actual) = -0.588235294
Absolute Error = 0.022410
Relative Error = 3.809781%

y(1.750) = -0.547889762
y(1.750) (Actual) = -0.571428571
Absolute Error = 0.023539
Relative Error = 4.119292%

y(1.800) = -0.530918397
y(1.800) (Actual) = -0.555555556
Absolute Error = 0.024637
Relative Error = 4.434688%

y(1.850) = -0.514832283
y(1.850) (Actual) = -0.540540541
Absolute Error = 0.025708
Relative Error = 4.756028%

y(1.900) = -0.499561307
y(1.900) (Actual) = -0.526315789
Absolute Error = 0.026754
Relative Error = 5.083352%

y(1.950) = -0.485042616
y(1.950) (Actual) = -0.512820513
Absolute Error = 0.027778
Relative Error = 5.416690%

y(2.000) = -0.471219699
y(2.000) (Actual) = -0.500000000
Absolute Error = 0.028780
Relative Error = 5.756060%

- For Part B, Screenshot is been attached below:

```
Part B ------------>
For X = 1.052
Actual Value = -0.950570342
Estimated Value = -0.948181417
Absolute Error = 0.002389
Relative Error = 0.251315%

For X = 1.555
Actual Value = -0.643086817
Estimated Value = -0.624210052
Absolute Error = 0.018877
Relative Error = 2.935337%

For X = 1.978
Actual Value = -0.505561173
Estimated Value = -0.477301782
Absolute Error = 0.028259
Relative Error = 5.589707%

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```

Ques.4

- This being a subjective question, so the pdf is attached with this assignment submission. The file is named **180123029_NamanGoyal_lab06_Q4.pdf.**

Ques.5

```
-------------------Q5-------------------

Actual Value = 0.141120008
Computed value = -785.288649835
Absolute Error = 785.429769843
Error Bound = 0.750000000
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```

- We can clearly observe that the Actual error exceeds the computed error. The error depends on the value of lambda and h which in our case lambda = -20 and h = 0.5. But according to the theorem, there exists a value of h for which the above bound will hold true, but in our case the value of h may be different for which the error is unbounded.
