MA322 Scientific Computing Lab Quiz

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

Ques.1

```
~/Desktop/IITG_SEMVI/sci_lab/lab_Quiz
python3 180123029_NamanGoyal.py
------------------Q1------------------

Part A ------>
Using Bisection Method:
Number of iteration required: 24
Expected number of iteration required(based on convergence analysis): 28
Approximate root of given equation: 1.210000
f(1.210000): -0.000000009753487

Part B ------>
Fixed Point Iteration
The root of the equation comes out to be 1.21
Number of iterations required are 1
-----------------------------------------------------
```

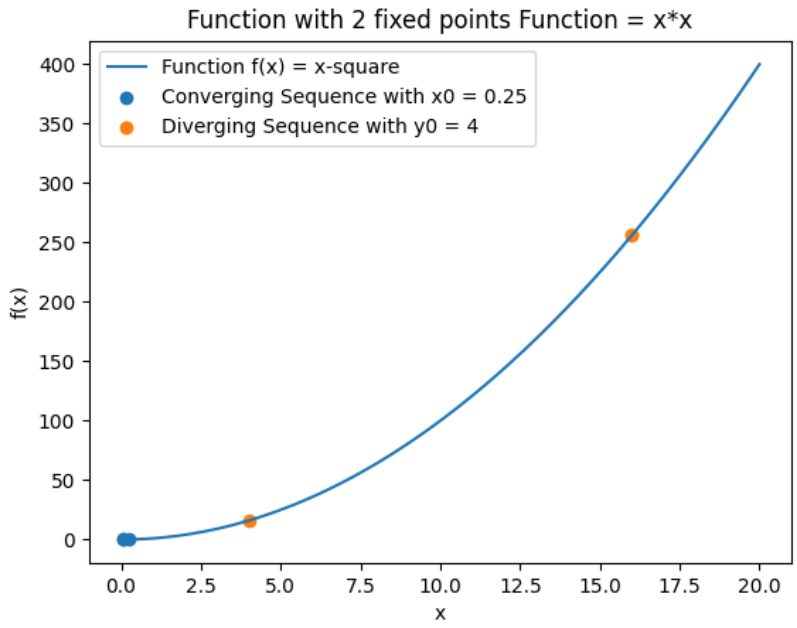
Ques.2

```
------------------Q2------------------

Bisection Method ---->
The root obtained:  0.44742187499999997
Error in approximation: 9.668e-06
Secant Method ---->
The root obtained:  -2956.366770720262
Error in approximation:  2956.8142022633
-----------------------------------------------------
```

- The Bisection Method is surely better than the Secant method because error observed in Secant is way too high as compared to Bisection method.

Ques.3



- The function chosen is x*x (x- square). The converging sequence's initial value was taken as 0.25 (¼) and the diverging sequence's initial value was taken as 4. The 3 terms are shown above in the graph.

Ques.4

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-------------------Q4-------------------

Euler Method ---->

  Iter    h    Xi     Yi    Actual Y       Err
------  ---  ----  -----  ----------  --------
     0    1     0  1         1         0
     1    1     1  0.5       0.819592  0.319592
     2    1     2  0.75      1.10364   0.353638
     3    1     3  1.375     1.66939   0.29439

  Iter    h    Xi        Yi    Actual Y        Err
------  ---  ----  --------  ----------  ---------
     0  0.5   0    1           1         0
     1  0.5   0.5  0.75        0.836402  0.0864023
     2  0.5   1    0.6875      0.819592  0.132092
     3  0.5   1.5  0.765625    0.9171    0.151475
     4  0.5   2    0.949219    1.10364   0.15442
     5  0.5   2.5  1.21191     1.35951   0.1476
     6  0.5   3    1.53394     1.66939   0.135455

  Iter     h    Xi        Yi    Actual Y        Err
------  ----  ----  --------  ----------  ---------
     0  0.25  0     1           1         0
     1  0.25  0.25  0.875       0.897491  0.0224907
     2  0.25  0.5   0.796875    0.836402  0.0395273
     3  0.25  0.75  0.759766    0.811868  0.0521022
     4  0.25  1     0.758545    0.819592  0.0610471
     5  0.25  1.25  0.788727    0.855784  0.0670575
     6  0.25  1.5   0.846386    0.9171    0.0707137
     7  0.25  1.75  0.928088    1.00059   0.0724983
     8  0.25  2     1.03083     1.10364   0.0728116
     9  0.25  2.25  1.15197     1.22396   0.071984
    10  0.25  2.5   1.28923     1.35951   0.0702877
    11  0.25  2.75  1.44057     1.50852   0.0679454
    12  0.25  3     1.60425     1.66939   0.0651388
```

Iter	h	Xi	Yi	Actual Y	Err
0	0.125	0	1	1	0
1	0.125	0.125	0.9375	0.943239	0.00573919
2	0.125	0.25	0.886719	0.897491	0.010772
3	0.125	0.375	0.846924	0.862087	0.0151635
4	0.125	0.5	0.817429	0.836402	0.0189738
5	0.125	0.625	0.797589	0.819847	0.0222576
6	0.125	0.75	0.786802	0.811868	0.0250654
7	0.125	0.875	0.784502	0.811946	0.0274433
8	0.125	1	0.790158	0.819592	0.0294336
9	0.125	1.125	0.803274	0.834348	0.031075
10	0.125	1.25	0.823381	0.855784	0.0324029
11	0.125	1.375	0.850045	0.883495	0.0334496
12	0.125	1.5	0.882855	0.9171	0.0342449
13	0.125	1.625	0.921426	0.956242	0.0348156
14	0.125	1.75	0.9654	1.00059	0.0351864
15	0.125	1.875	1.01444	1.04982	0.0353797
16	0.125	2	1.06822	1.10364	0.0354159
17	0.125	2.125	1.12646	1.16177	0.0353138
18	0.125	2.25	1.18887	1.22396	0.0350901
19	0.125	2.375	1.25519	1.28995	0.0347602
20	0.125	2.5	1.32518	1.35951	0.034338
21	0.125	2.625	1.3986	1.43244	0.0338362
22	0.125	2.75	1.47525	1.50852	0.0332661
23	0.125	2.875	1.55492	1.58756	0.0326381
24	0.125	3	1.63743	1.66939	0.0319614

Modified Euler Method ---->

Iter	h	Xi	Yi	Actual Y	Err
0	1	0	1	1	0
1	1	1	0.875	0.819592	0.055408
2	1	2	1.17188	1.10364	0.0682367
3	1	3	1.73242	1.66939	0.0630314

Iter	h	Xi	Yi	Actual Y	Err
0	0.5	0	1	1	0
1	0.5	0.5	0.84375	0.836402	0.00734765
2	0.5	1	0.831055	0.819592	0.0114627
3	0.5	1.5	0.930511	0.9171	0.0134118
4	0.5	2	1.11759	1.10364	0.0139488
5	0.5	2.5	1.37311	1.35951	0.0136005
6	0.5	3	1.68212	1.66939	0.0127305

Iter	h	Xi	Yi	Actual Y	Err
0	0.25	0	1	1	0
1	0.25	0.25	0.898438	0.897491	0.000946792
2	0.25	0.5	0.838074	0.836402	0.00167138
3	0.25	0.75	0.814081	0.811868	0.00221288
4	0.25	1	0.822196	0.819592	0.00260428
5	0.25	1.25	0.858658	0.855784	0.00287335
6	0.25	1.5	0.920143	0.9171	0.00304341
7	0.25	1.75	1.00372	1.00059	0.00313399
8	0.25	2	1.1068	1.10364	0.00316141
9	0.25	2.25	1.2271	1.22396	0.00313924
10	0.25	2.5	1.36259	1.35951	0.00307874
11	0.25	2.75	1.51151	1.50852	0.00298921
12	0.25	3	1.67227	1.66939	0.0028783

Iter	h	Xi	Yi	Actual Y	Err
0	0.125	0	1	1	0
1	0.125	0.125	0.943359	0.943239	0.000120187
2	0.125	0.25	0.897717	0.897491	0.000225814
3	0.125	0.375	0.862406	0.862087	0.000318206
4	0.125	0.5	0.836801	0.836402	0.000398578
5	0.125	0.625	0.820315	0.819847	0.000468047
6	0.125	0.75	0.812395	0.811868	0.000527638
7	0.125	0.875	0.812524	0.811946	0.000578295
8	0.125	1	0.820213	0.819592	0.000620879
9	0.125	1.125	0.835005	0.834348	0.000656183
10	0.125	1.25	0.856469	0.855784	0.000684934
11	0.125	1.375	0.884203	0.883495	0.000707794
12	0.125	1.5	0.917825	0.9171	0.000725373
13	0.125	1.625	0.95698	0.956242	0.000738226
14	0.125	1.75	1.00133	1.00059	0.000746861
15	0.125	1.875	1.05057	1.04982	0.000751743
16	0.125	2	1.10439	1.10364	0.000753293
17	0.125	2.125	1.16252	1.16177	0.000751897
18	0.125	2.25	1.22471	1.22396	0.000747908
19	0.125	2.375	1.29069	1.28995	0.000741643
20	0.125	2.5	1.36025	1.35951	0.000733394
21	0.125	2.625	1.43316	1.43244	0.000723423
22	0.125	2.75	1.50923	1.50852	0.00071197
23	0.125	2.875	1.58826	1.58756	0.00069925
24	0.125	3	1.67008	1.66939	0.00068546

Runge Kutta Order 4 Method ---->

Iter	h	Xi	Yi	Actual Y	Err
0	1	0	1	1	0
1	1	1	0.820312	0.819592	0.000720521
2	1	2	1.10451	1.10364	0.000874209
3	1	3	1.67019	1.66939	0.000795509

Iter	h	Xi	Yi	Actual Y	Err
0	0.5	0	1	1	0
1	0.5	0.5	0.836426	0.836402	2.3432e-05
2	0.5	1	0.819628	0.819592	3.6498e-05
3	0.5	1.5	0.917142	0.9171	4.26372e-05
4	0.5	2	1.10368	1.10364	4.42747e-05
5	0.5	2.5	1.35956	1.35951	4.31017e-05
6	0.5	3	1.66943	1.66939	4.02814e-05

Iter	h	Xi	Yi	Actual Y	Err
0	0.25	0	1	1	0
1	0.25	0.25	0.897491	0.897491	7.47324e-07
2	0.25	0.5	0.836404	0.836402	1.31902e-06
3	0.25	0.75	0.81187	0.811868	1.74605e-06
4	0.25	1	0.819594	0.819592	2.05451e-06
5	0.25	1.25	0.855787	0.855784	2.26638e-06
6	0.25	1.5	0.917102	0.9171	2.40009e-06
7	0.25	1.75	1.00059	1.00059	2.47108e-06
8	0.25	2	1.10364	1.10364	2.49225e-06
9	0.25	2.25	1.22396	1.22396	2.47433e-06
10	0.25	2.5	1.35952	1.35951	2.42621e-06
11	0.25	2.75	1.50852	1.50852	2.35524e-06
12	0.25	3	1.66939	1.66939	2.26744e-06

Iter	h	Xi	Yi	Actual Y	Err
0	0.125	0	1	1	0
1	0.125	0.125	0.943239	0.943239	2.35957e-08
2	0.125	0.25	0.897491	0.897491	4.43322e-08
3	0.125	0.375	0.862087	0.862087	6.24694e-08
4	0.125	0.5	0.836402	0.836402	7.82461e-08
5	0.125	0.625	0.819847	0.819847	9.18818e-08
6	0.125	0.75	0.811868	0.811868	1.03578e-07
7	0.125	0.875	0.811946	0.811946	1.1352e-07
8	0.125	1	0.819592	0.819592	1.21876e-07
9	0.125	1.125	0.834349	0.834348	1.28804e-07
10	0.125	1.25	0.855784	0.855784	1.34444e-07
11	0.125	1.375	0.883495	0.883495	1.38929e-07
12	0.125	1.5	0.9171	0.9171	1.42376e-07
13	0.125	1.625	0.956242	0.956242	1.44896e-07
14	0.125	1.75	1.00059	1.00059	1.46587e-07
15	0.125	1.875	1.04982	1.04982	1.47542e-07
16	0.125	2	1.10364	1.10364	1.47843e-07
17	0.125	2.125	1.16177	1.16177	1.47566e-07
18	0.125	2.25	1.22396	1.22396	1.4678e-07
19	0.125	2.375	1.28995	1.28995	1.45548e-07
20	0.125	2.5	1.35951	1.35951	1.43926e-07
21	0.125	2.625	1.43244	1.43244	1.41966e-07
22	0.125	2.75	1.50852	1.50852	1.39715e-07
23	0.125	2.875	1.58756	1.58756	1.37216e-07
24	0.125	3	1.66939	1.66939	1.34507e-07

Runge Kutta Order 2 Method ---->

Iter	h	Xi	Yi	Actual Y	Err
0	1	0	1	1	0
1	1	1	0.875	0.819592	0.055408
2	1	2	1.17188	1.10364	0.0682367
3	1	3	1.73242	1.66939	0.0630314

Iter	h	Xi	Yi	Actual Y	Err
0	0.5	0	1	1	0
1	0.5	0.5	0.84375	0.836402	0.00734765
2	0.5	1	0.831055	0.819592	0.0114627
3	0.5	1.5	0.930511	0.9171	0.0134118
4	0.5	2	1.11759	1.10364	0.0139488
5	0.5	2.5	1.37311	1.35951	0.0136005
6	0.5	3	1.68212	1.66939	0.0127305

Iter	h	Xi	Yi	Actual Y	Err
0	0.25	0	1	1	0
1	0.25	0.25	0.898438	0.897491	0.000946792
2	0.25	0.5	0.838074	0.836402	0.00167138
3	0.25	0.75	0.814081	0.811868	0.00221288
4	0.25	1	0.822196	0.819592	0.00260428
5	0.25	1.25	0.858658	0.855784	0.00287335
6	0.25	1.5	0.920143	0.9171	0.00304341
7	0.25	1.75	1.00372	1.00059	0.00313399
8	0.25	2	1.1068	1.10364	0.00316141
9	0.25	2.25	1.2271	1.22396	0.00313924
10	0.25	2.5	1.36259	1.35951	0.00307874
11	0.25	2.75	1.51151	1.50852	0.00298921
12	0.25	3	1.67227	1.66939	0.0028783

Iter	h	Xi	Yi	Actual Y	Err
0	0.125	0	1	1	0
1	0.125	0.125	0.943359	0.943239	0.000120187
2	0.125	0.25	0.897717	0.897491	0.000225814
3	0.125	0.375	0.862406	0.862087	0.000318206
4	0.125	0.5	0.836801	0.836402	0.000398578
5	0.125	0.625	0.820315	0.819847	0.000468047
6	0.125	0.75	0.812395	0.811868	0.000527638
7	0.125	0.875	0.812524	0.811946	0.000578295
8	0.125	1	0.820213	0.819592	0.000620879
9	0.125	1.125	0.835005	0.834348	0.000656183
10	0.125	1.25	0.856469	0.855784	0.000684934
11	0.125	1.375	0.884203	0.883495	0.000707794
12	0.125	1.5	0.917825	0.9171	0.000725373
13	0.125	1.625	0.95698	0.956242	0.000738226
14	0.125	1.75	1.00133	1.00059	0.000746861
15	0.125	1.875	1.05057	1.04982	0.000751743
16	0.125	2	1.10439	1.10364	0.000753293
17	0.125	2.125	1.16252	1.16177	0.000751897
18	0.125	2.25	1.22471	1.22396	0.000747908
19	0.125	2.375	1.29069	1.28995	0.000741643
20	0.125	2.5	1.36025	1.35951	0.000733394
21	0.125	2.625	1.43316	1.43244	0.000723423
22	0.125	2.75	1.50923	1.50852	0.00071197
23	0.125	2.875	1.58826	1.58756	0.00069925
24	0.125	3	1.67008	1.66939	0.00068546
