Scientific Computing Lab MA – 322 Lab – 4

Name – Rasesh Srivastava

Roll Number – 210123072

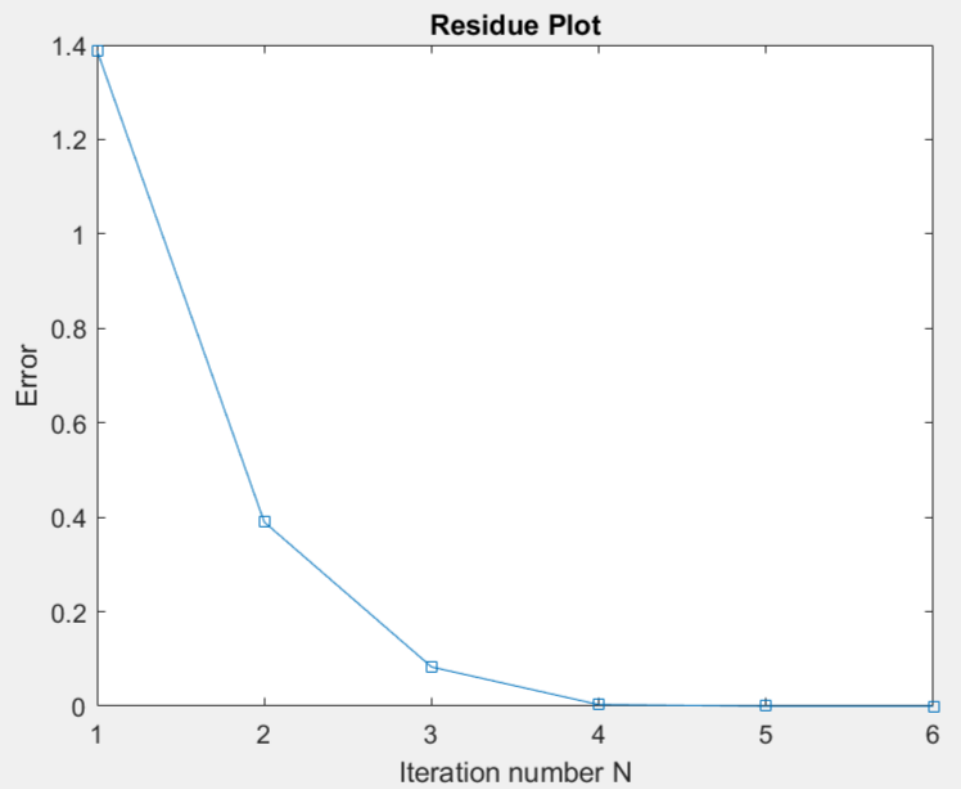
Branch – Mathematics and Computing

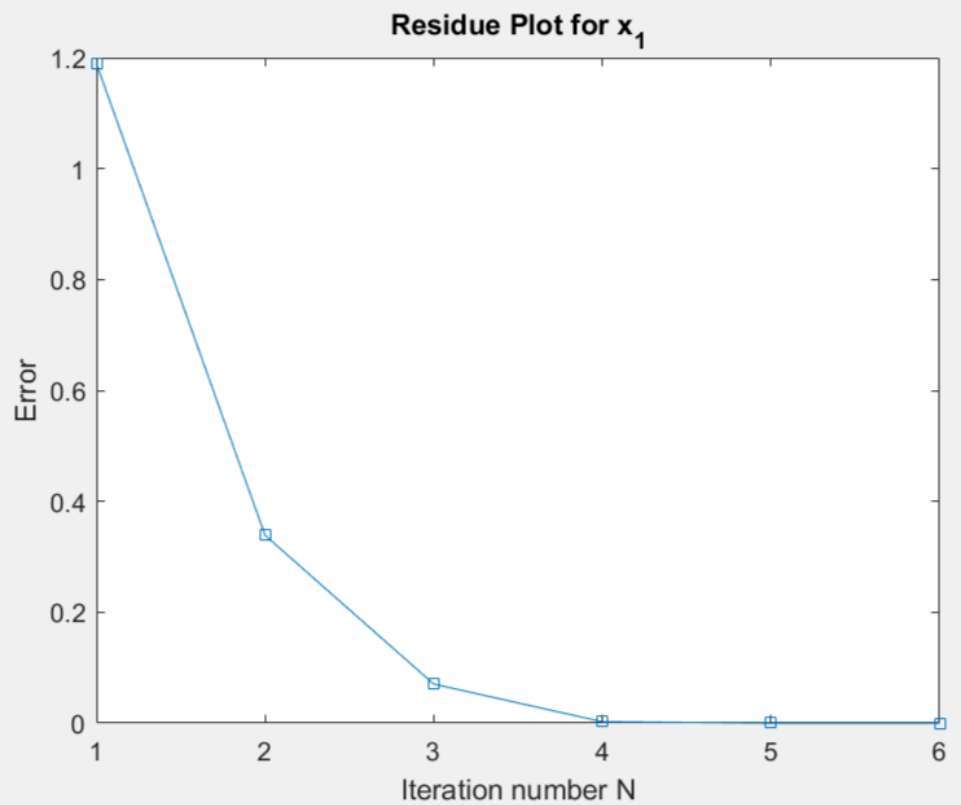
1) Initial Approximation $x_0 = (1,1,1)^T$

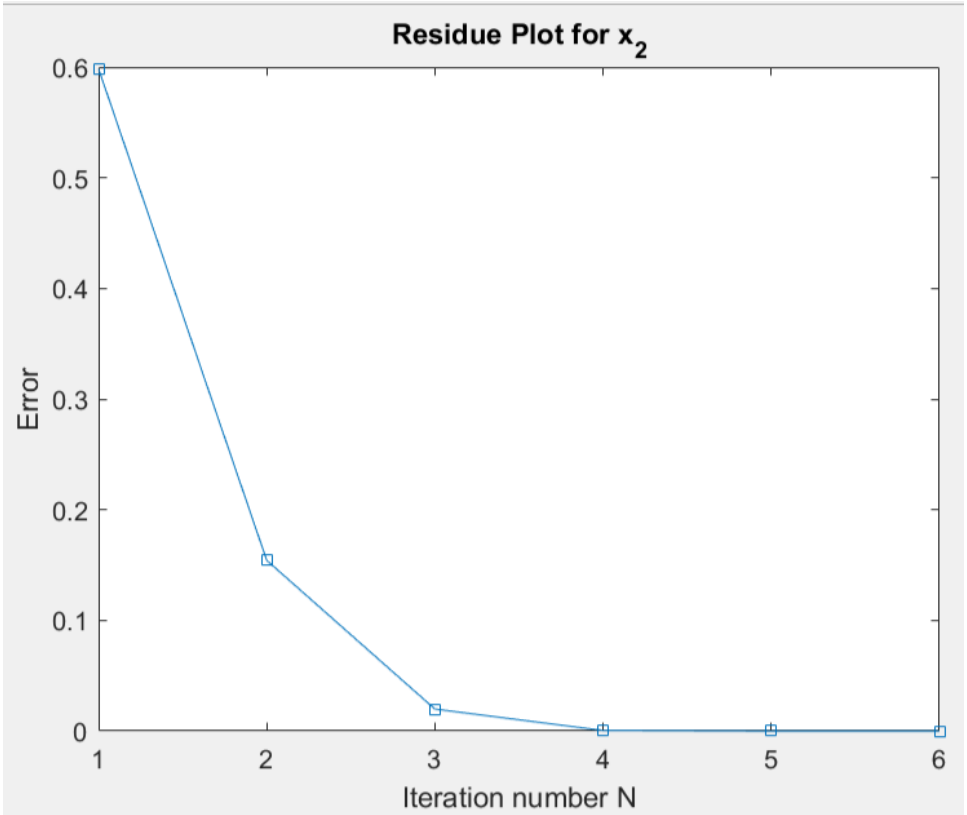
Carrying out 6 iterations of Newton's Method

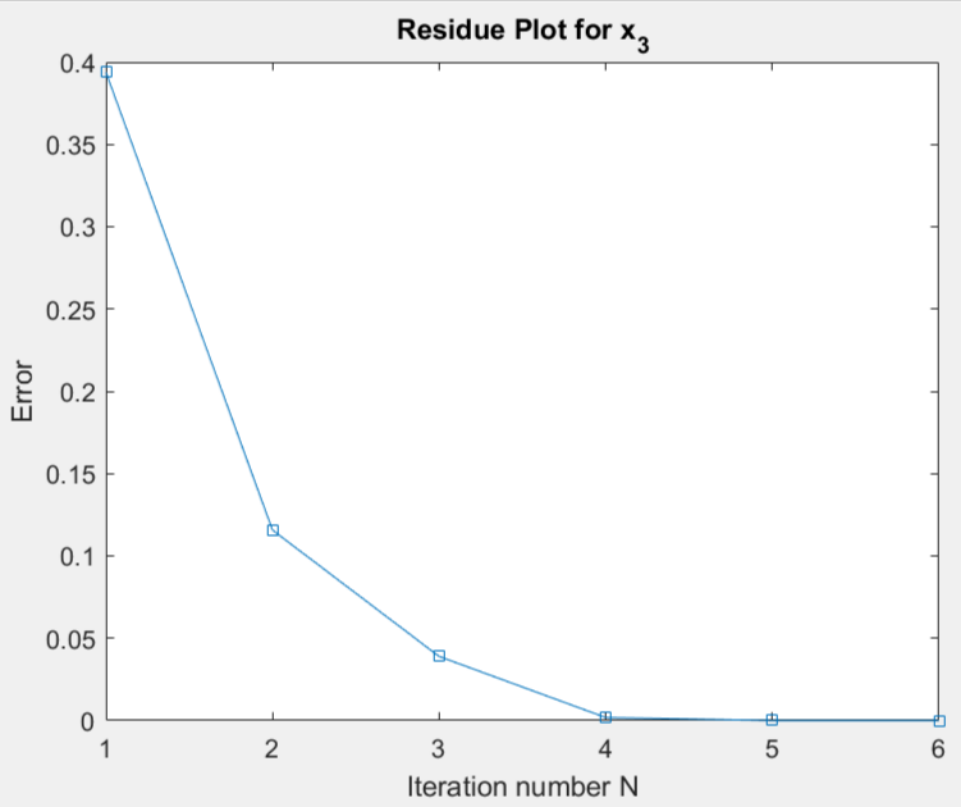
```
Newton's method for Question 1

Iteration Number 0:
First Component (x_1) = 1.000000, Second Component (x_2) = 1.000000, Third Component (x_3) = 1.000000

Iteration Number 1:
(x_1)= 2.189326, (x_2)=1.598475, (x_3) = 1.393901
Error = 1.388462 | Error in x_1 = 1.189326| Error in x_2 = 0.598475 | Error in x_3 = 0.393901

Iteration Number 2:
(x_1)= 1.850590, (x_2)=1.444251, (x_3) = 1.278224
Error = 0.389754 | Error in x_1 = 0.338736| Error in x_2 = 0.154224 | Error in x_3 = 0.115677

Iteration Number 3:
(x_1)= 1.780161, (x_2)=1.424436, (x_3) = 1.239292
Error = 0.082876 | Error in x_1 = 0.070428| Error in x_2 = 0.019815 | Error in x_3 = 0.038932

Iteration Number 4:
(x_1)= 1.777675, (x_2)=1.423961, (x_3) = 1.237474
Error = 0.003117 | Error in x_1 = 0.002486| Error in x_2 = 0.000475 | Error in x_3 = 0.001819

Iteration Number 5:
(x_1)= 1.777672, (x_2)=1.423961, (x_3) = 1.237471
Error = 0.000004 | Error in x_1 = 0.000003| Error in x_2 = 0.000000 | Error in x_3 = 0.000003

Iteration Number 6:
(x_1)= 1.777672, (x_2)=1.423961, (x_3) = 1.237471
Error = 0.000000 | Error in x_1 = 0.000000| Error in x_2 = 0.000000 | Error in x_3 = 0.000000
```

```
Using Newton's method, we get:
First Component x_1 = 1.777672
Second Component x_2 = 1.423961
Third Component x_3 = 1.237471

Number of iterations done = 6
```


Residue Plot
Error
Iteration number N
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6


Residue Plot for x1
Error
Iteration number N
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6



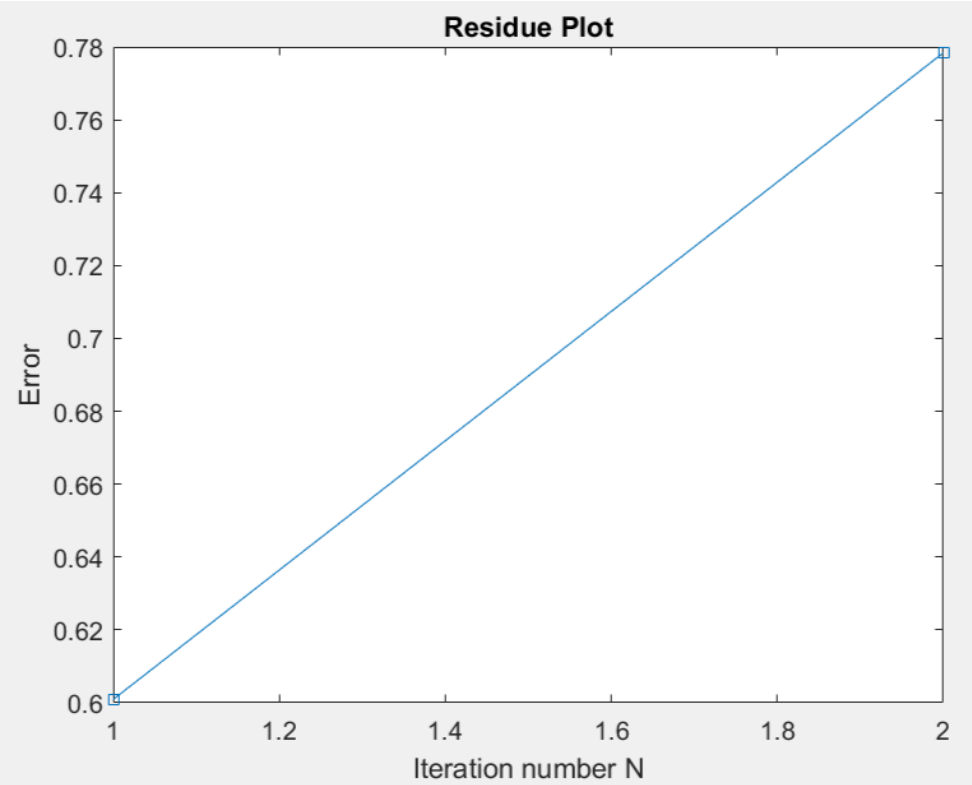


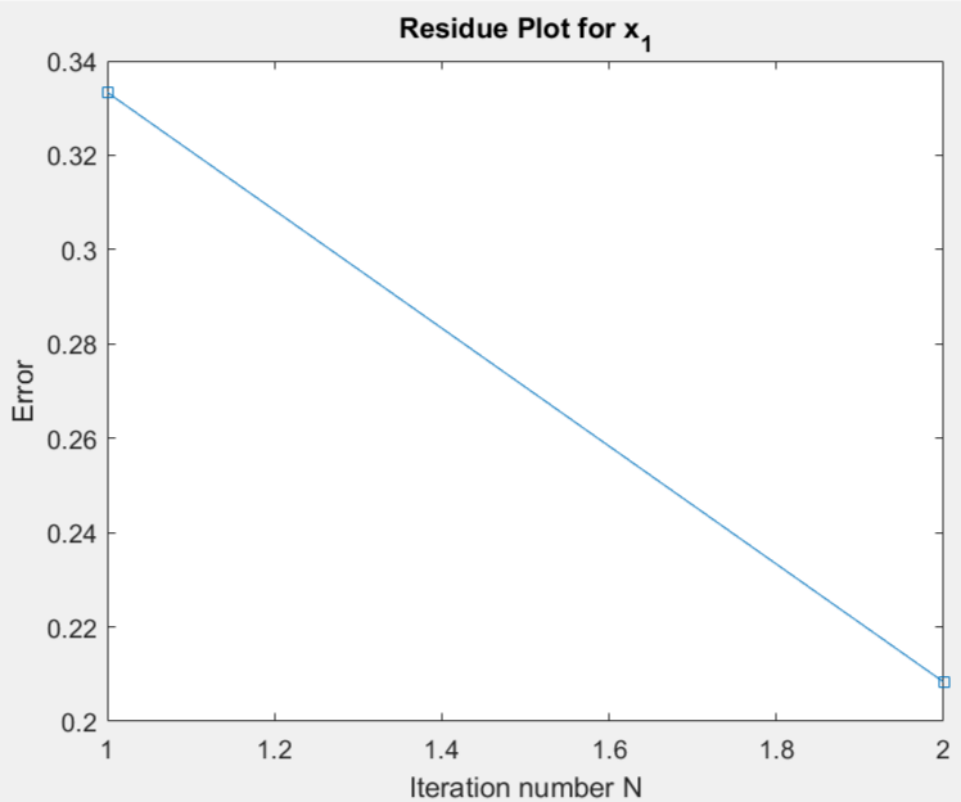
2)

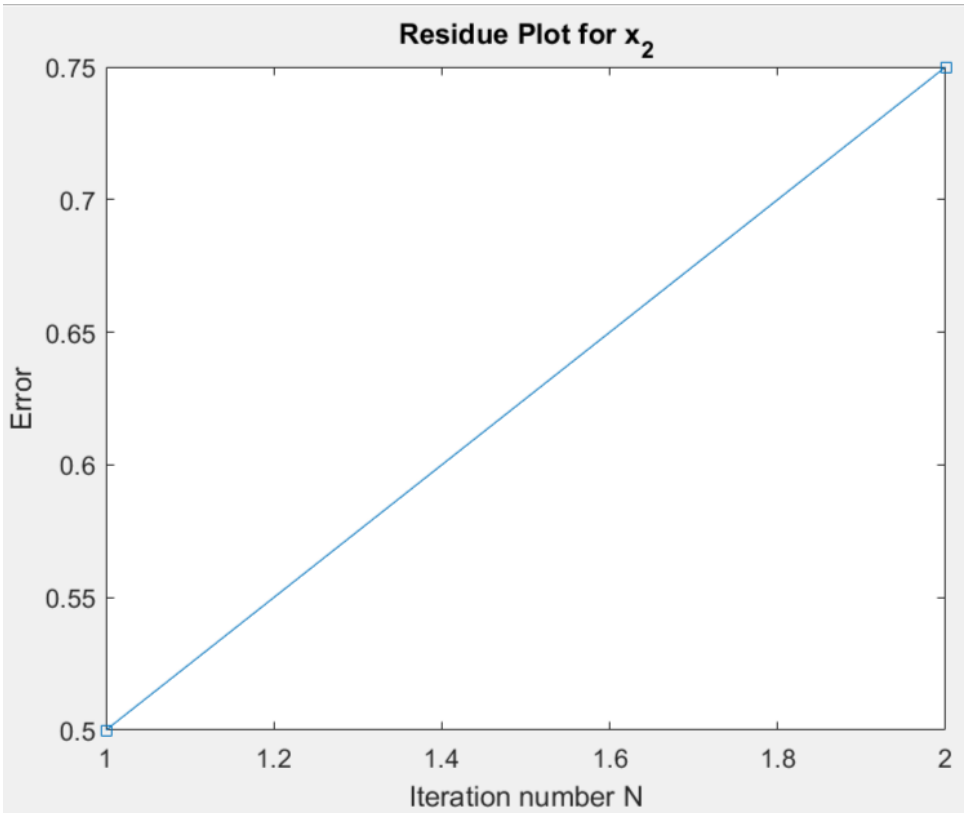
a) Initial Approximation $x_0 = (0,1)^T$

Performing 2 iterations of Newton's Method

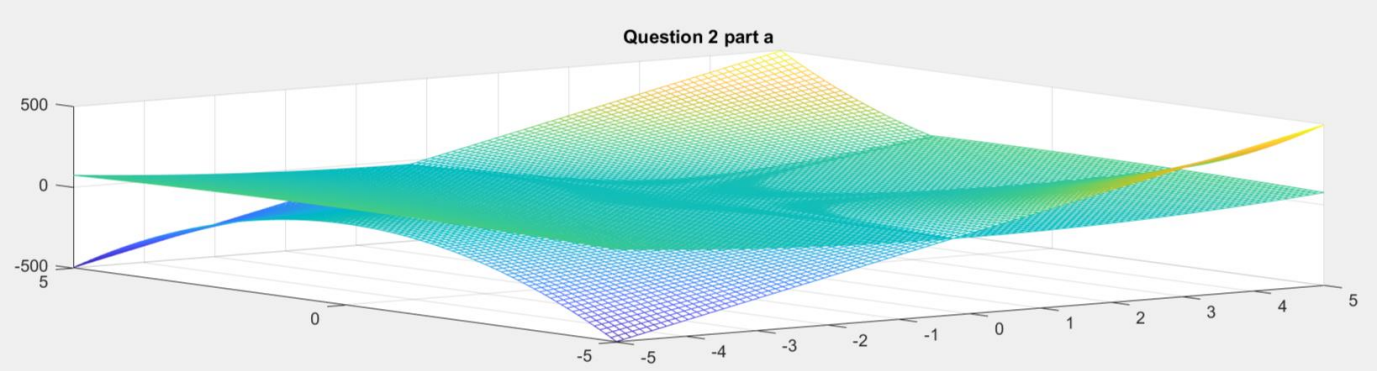
```
Newton's method for Question 2 part a
Iteration Number 0:
First Component (x_1) = 0.000000, Second Component (x_2) = 1.000000

Iteration Numebr 1:
(x_1) = 0.333333, (x_2) = 0.500000
Error = 0.600925 | Error in x_1 = 0.333333 | Error in x_2 = 0.500000

Iteration Numebr 2:
(x_1) = 0.541667, (x_2) = 1.250000
Error = 0.778398 | Error in x_1 = 0.208333 | Error in x_2 = 0.750000

Using Newton's method, we get:
First Component x_1 = 0.541667
Second Component x_2 = 1.250000

Number of iterations done = 2
```







Function Plot



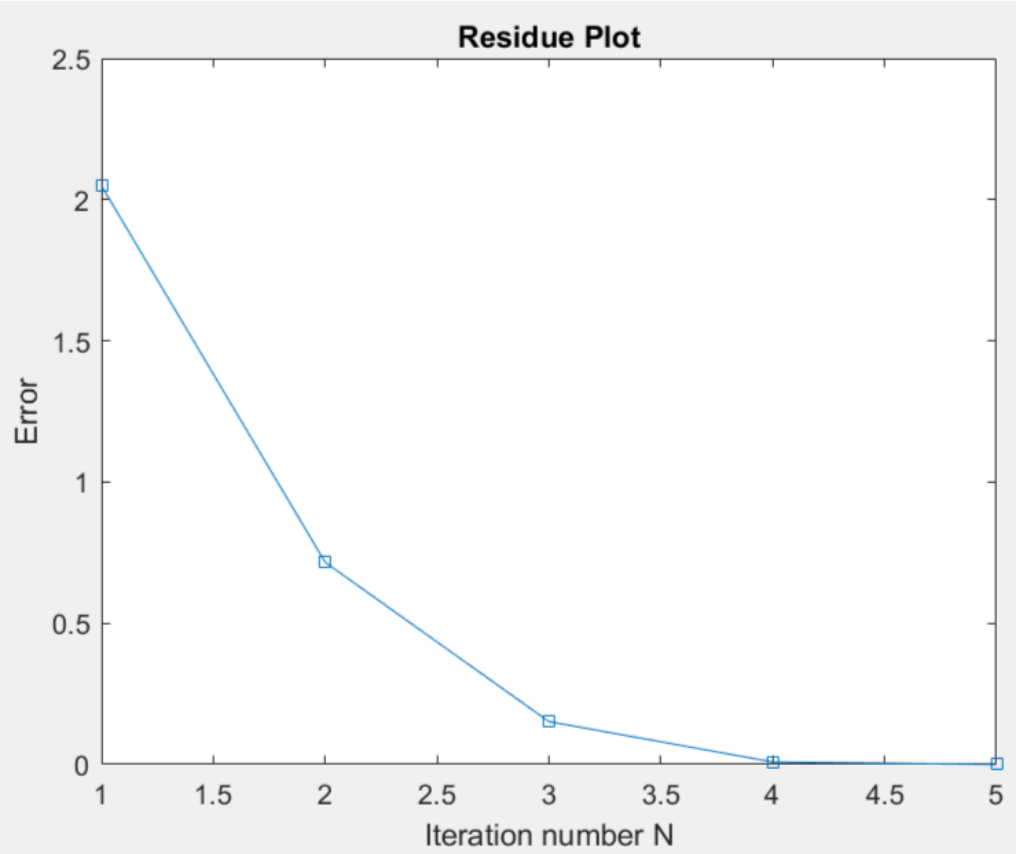
b) Initial Approximation $x_0 = (-1,4)^T$

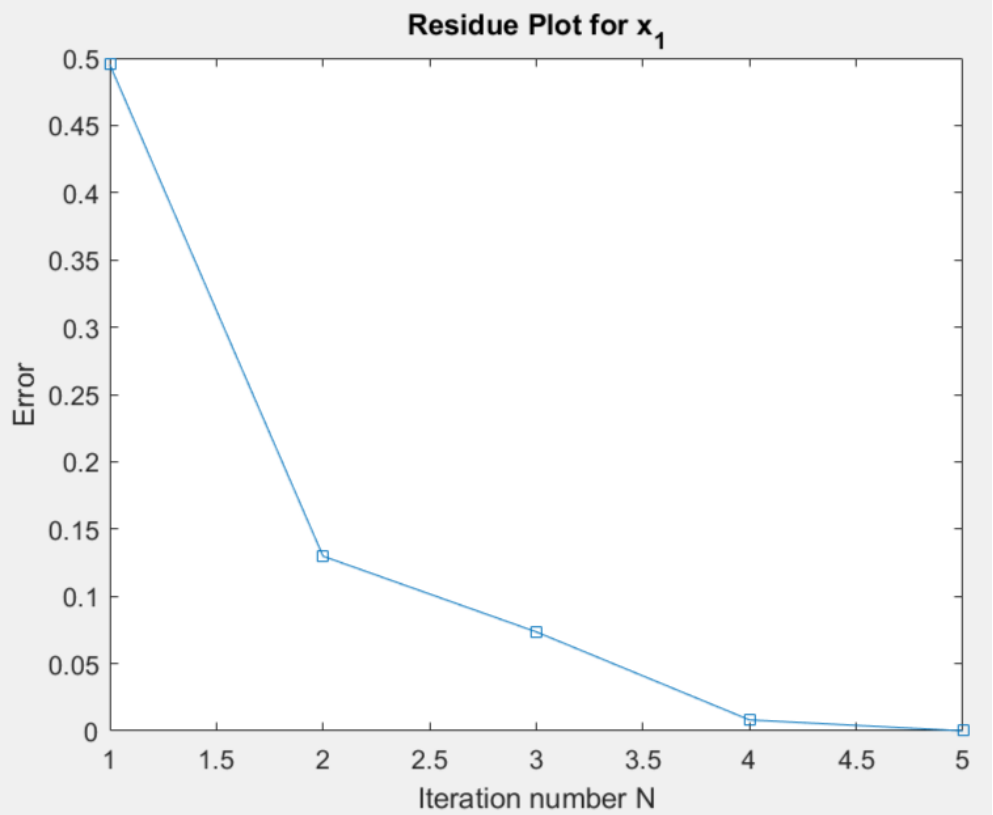
Here, x is taken to be x_1 and y is taken to be x_2. So, x is equivalent to x_1 and y is equivalent to x_2

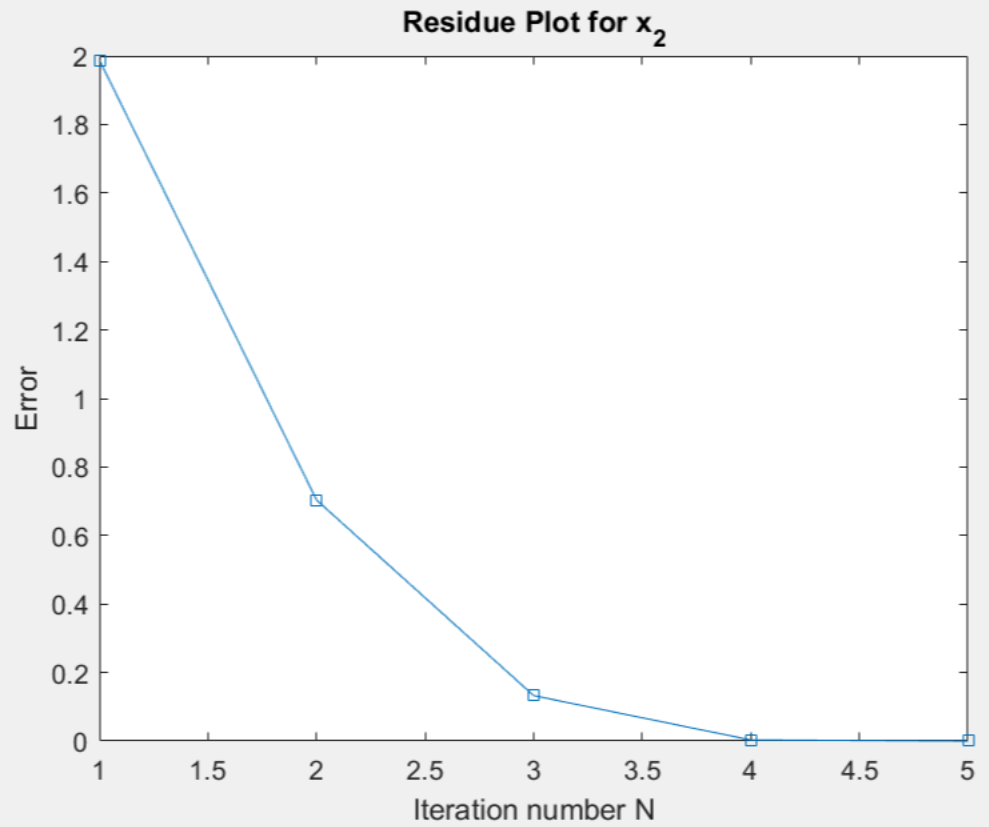
Performing 5 iterations of Newton's Method

```
Newton's method for Question 2 part b
Iteration Number 0:
First Component (x_1) = -1.000000, Second Component (x_2) = 4.000000

Iteration Numebr 1:
(x_1) = -0.504703, (x_2) = 2.012047
Error = 2.048726 | Error in x_1 = 0.495297 | Error in x_2 = 1.987953

Iteration Numebr 2:
(x_1) = -0.374867, (x_2) = 1.308330
Error = 0.715594 | Error in x_1 = 0.129836 | Error in x_2 = 0.703717

Iteration Numebr 3:
(x_1) = -0.301307, (x_2) = 1.175764
Error = 0.151608 | Error in x_1 = 0.073560 | Error in x_2 = 0.132566

Iteration Numebr 4:
(x_1) = -0.293178, (x_2) = 1.172634
Error = 0.008711 | Error in x_1 = 0.008129 | Error in x_2 = 0.003130

Iteration Numebr 5:
(x_1) = -0.293163, (x_2) = 1.172660
Error = 0.000030 | Error in x_1 = 0.000015 | Error in x_2 = 0.000025
```

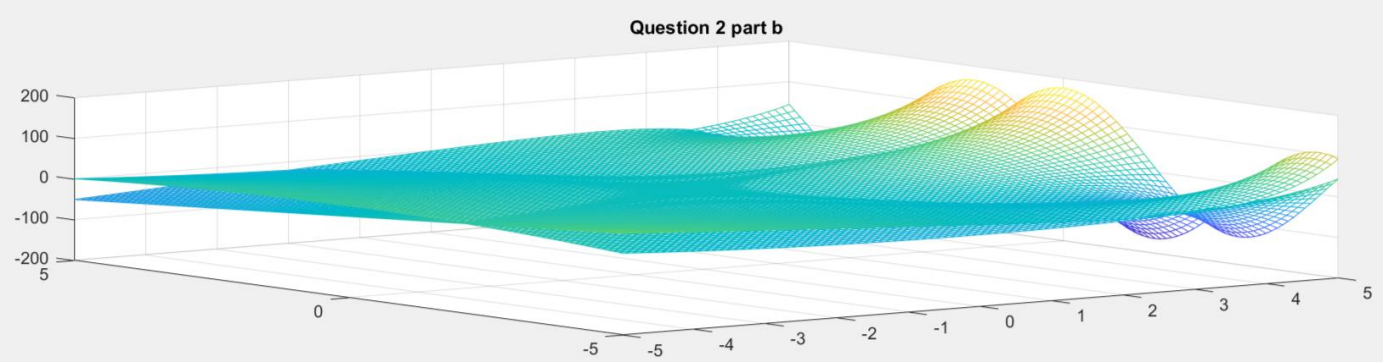
```
Using Newton's method, we get:
First Component x_1 = -0.293163
Second Component x_2 = 1.172660

Number of iterations done = 5
```





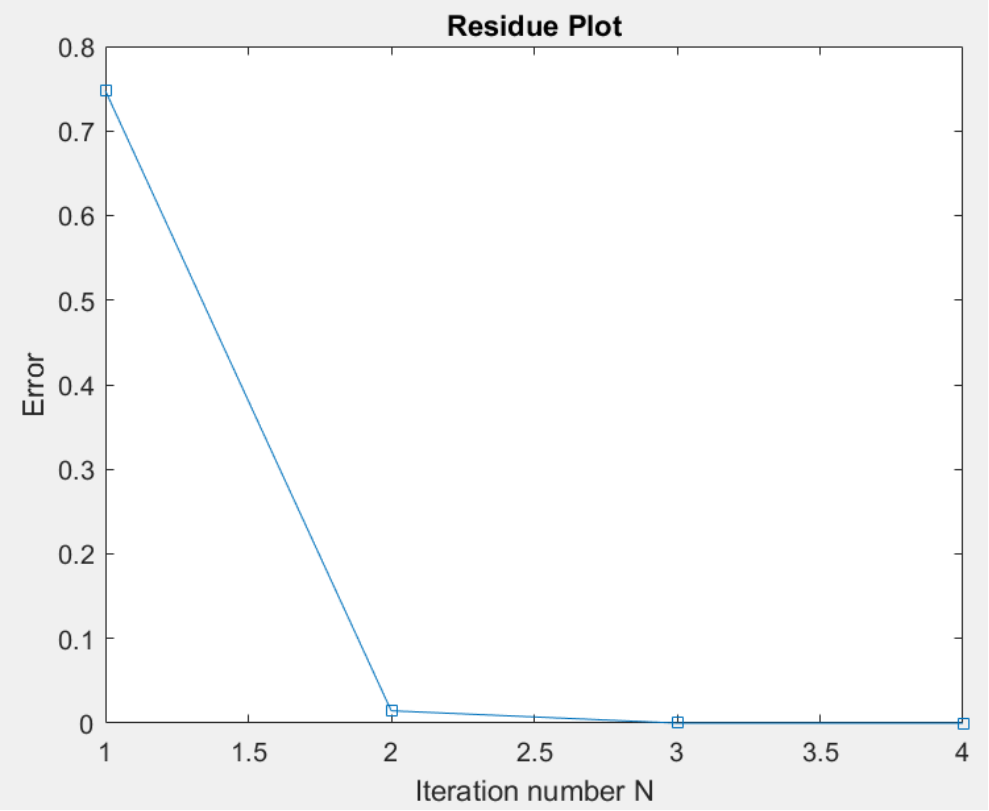


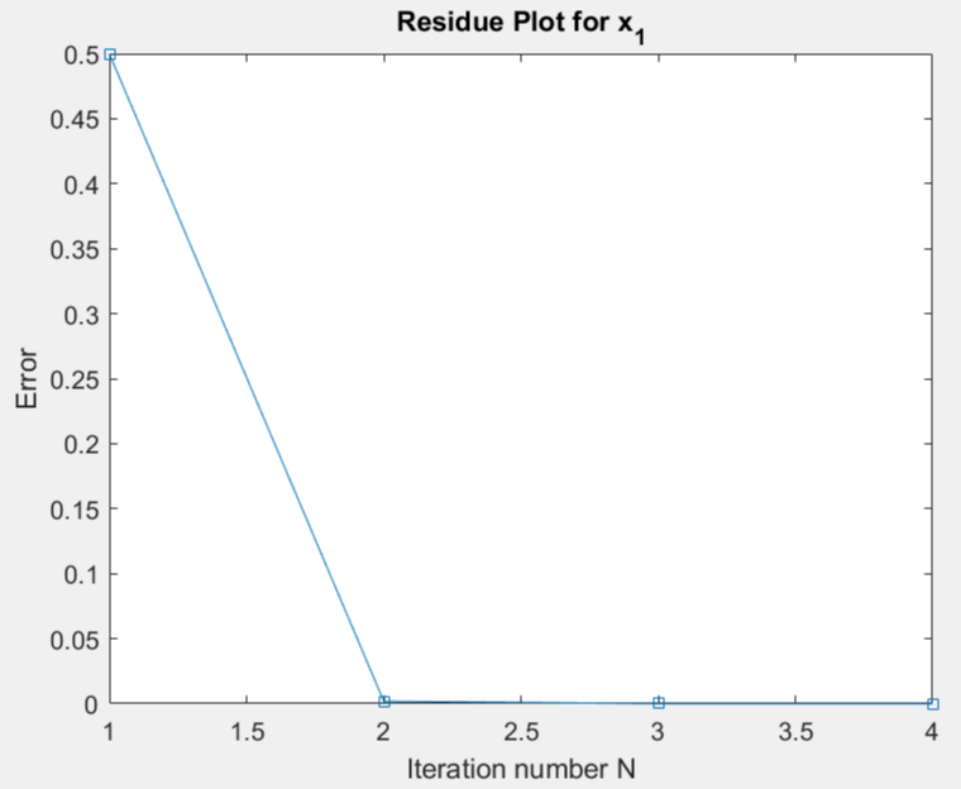
Function Plot

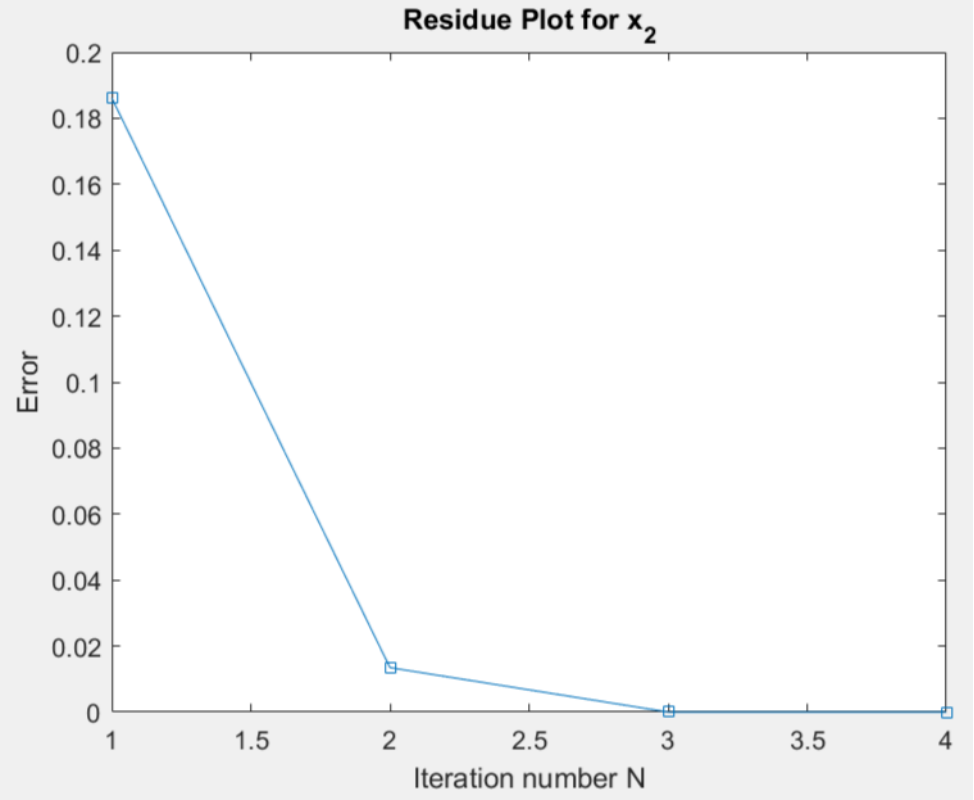


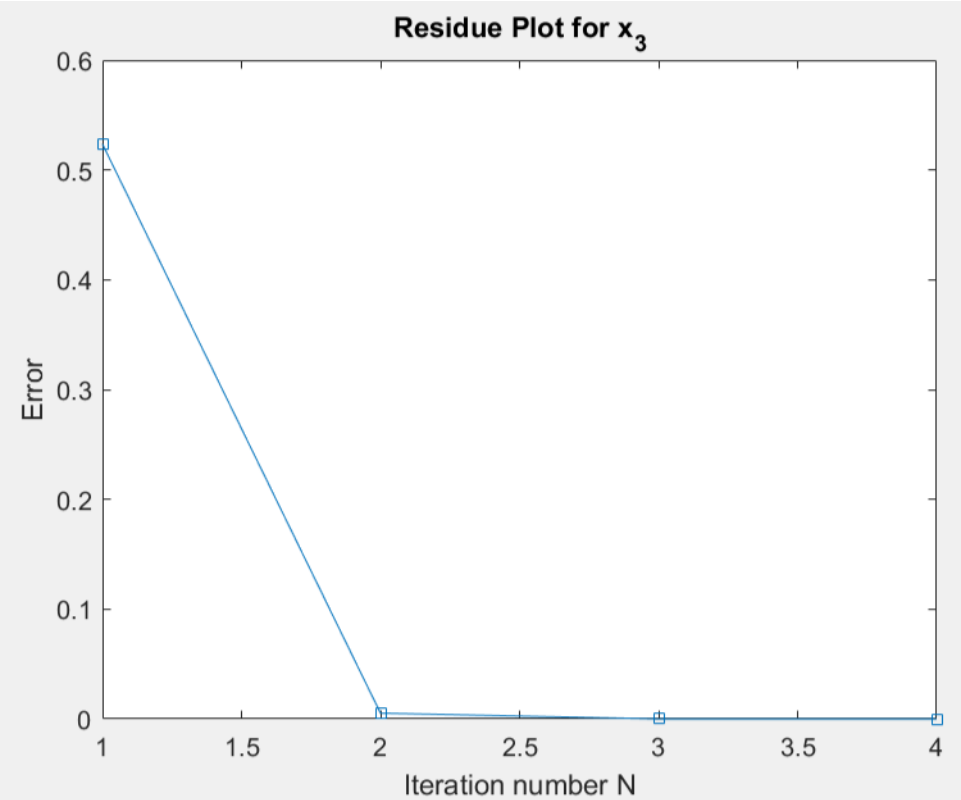
3) Initial Approximation $x_0 = (0,0,0)^T$

```
Newton's method for Question 3

Iteration Number 0:
First Component (x_1) = 0.000000, Second Component (x_2) = 0.000000, Third Component (x_3) = 0.000000

Iteration Number 1:
(x_1)= 0.500000, (x_2)=-0.186142, (x_3) = -0.523599
Error = 0.747532 | Error in x_1 = 0.500000| Error in x_2 = 0.186142 | Error in x_3 = 0.523599

Iteration Number 2:
(x_1)= 0.498158, (x_2)=-0.199607, (x_3) = -0.528826
Error = 0.014561 | Error in x_1 = 0.001842| Error in x_2 = 0.013464 | Error in x_3 = 0.005228

Iteration Number 3:
(x_1)= 0.498145, (x_2)=-0.199606, (x_3) = -0.528826
Error = 0.000013 | Error in x_1 = 0.000013| Error in x_2 = 0.000001 | Error in x_3 = 0.000000

Iteration Number 4:
(x_1)= 0.498145, (x_2)=-0.199606, (x_3) = -0.528826
Error = 0.000000 | Error in x_1 = 0.000000| Error in x_2 = 0.000000 | Error in x_3 = 0.000000

Using Newton's method, we get:
First Component x_1 = 0.498145
Second Component x_2 = -0.199606
Third Component x_3 = -0.528826

Number of iterations done = 4
```


Residue Plot
Error
Iteration number N
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
1.5
2
2.5
3
3.5
4


Residue Plot for x1
Error
Iteration number N
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1
1.5
2
2.5
3
3.5
4


Residue Plot for x2
Error
Iteration number N
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
1.5
2
2.5
3
3.5
4


Residue Plot for x3
Error
Iteration number N
0.6
0.5
0.4
0.3
0.2
0.1
0
1
1.5
2
2.5
3
3.5
4