

There are total of 4 .m files (q1b1st.m, q1b2nd.m, modNew.m and regFal.m)

### Question 1a:

if  $m = 1$ , i have a simple root, the iteration reduces to Newton's method and we know that in this case, Newton's method converges quadratically.

If  $m > 1$ , i have a multiple root, if the multiplicity  $m$  of the root is not known, it is possible to estimate  $m$  after carrying out one or two iterations, and then use that value to increase the rate of convergence. And if  $f$  has a root of multiplicity  $m$  at  $r$ , it can be written in the form  $f(x) = (x-r)^m h(x)$  where  $h(m) \neq 0$ .

### question 1b: MATLAB code included

```
Trial>> newton(@q1b1st,@q1b2nd,2,1.e-14,1.e-14,40,1)
      n          x          f(x)
-----
  0    2.000000000000000e+00    9.092974268256817e-01
  1    1.351635557442477e+00    1.206899464868009e-01
  2    1.182443568613935e+00    3.080700831938035e-02
  3    1.094503838176041e+00    7.936965672604908e-03
  4    1.048376396358047e+00    2.028116232138904e-03
  5    1.024520441722393e+00    5.137489353918490e-04
  6    1.012350933914866e+00    1.293708263735457e-04
  7    1.006199202460510e+00    3.246592075861730e-05
  8    1.003105674448199e+00    8.132313067839542e-06
  9    1.001554373427801e+00    2.035085125412034e-06
 10    1.000777573033405e+00    5.090238990579363e-07
 11    1.000388883382135e+00    1.272876628339964e-07
 12    1.000194465943245e+00    3.182588367196684e-08
 13    1.000097239039153e+00    7.956967348928823e-09
 14    1.000048621037020e+00    1.989303918344176e-09
 15    1.000024310897941e+00    4.973337414271062e-10
 16    1.000012155543837e+00    1.243344056939130e-10
 17    1.000006077795636e+00    3.108372272298189e-11
 18    1.000003038903748e+00    7.770945843608019e-12
 19    1.000001519453356e+00    1.942738356171025e-12
 20    1.000000759727049e+00    4.856848260922205e-13
 21    1.000000379863617e+00    1.214212361009371e-13
 22    1.000000189931832e+00    3.035531270472133e-14
 23    1.000000094965922e+00    7.588828636115946e-15

ans =

    1.0000
```

```
Trial>> modNew(@q1b1st,@q1b2nd,2,1.e-14,1.e-14,40,1)
      n          x          f(x)
-----
  0    2.000000000000000e+00    9.092974268256817e-01
  1    7.032711148849542e-01    5.694208139907744e-02
  2    1.062933597207048e+00    3.460749262124927e-03
  3    1.001083188557545e+00    9.879818538832161e-07
  4    1.000000375655677e+00    1.187460473834373e-13
  5    1.000000000000045e+00    1.726553066824054e-27

ans =

    1.0000
```

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comment on the convergence rates of the two methods:  
as you can tell, modified Newton's Method only took 5 iterations compare to Newton's 23 iterations to converge, it is more efficient and is robust, the convergence rate is merely linear (errors reduced by a constant factor at each step).

Question 2: MATLAB code included.  
the result is shown as follows:

```
Trial>> regFal
```

```
c =
```

```
1.0000
```