```
function y = f
y = @(x) exp(x)-1.5-atan(x);
```

```
ans =

  function_handle with value:

    @(x)exp(x)-1.5-atan(x)
```

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```
function yp = fp
yp = @(x) exp(x)-1/(x^2+1);
```

```
ans =

  function_handle with value:

    @(x)exp(x)-1/(x^2+1)
```

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```
function T = newton(f,fp,x0,tol,Nmax)
X = zeros(Nmax,1);
X(1) = x0-f(x0)/fp(x0);
for k = 2:Nmax
    X(k) = X(k-1)-f(X(k-1))/fp(X(k-1));
    if abs(f(X(k))) < tol
        t = X(1:k);
        n = size(t,1);
        Iteration = zeros(n,1);
        x = zeros(n,1);
        F = zeros(n,1);
        for i = 1:n
            Iteration(i) = i;
            x(i) = X(i);
            F(i) = abs(f(X(i)));
        end
        R = table(Iteration,x,F,'VariableNames',{'Iteration','x','|f(x)|'});
        T = table(R,'VariableNames',{'Results for all Iterations'});
        return
    end
end
T = 'N/A';
disp('Newton method exceeds maximum iterations')
```

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```
x0 = -7;
tol = 10^-10;
Nmax = 30;
newton(f,fp,x0,tol,Nmax)
```

```
ans =

  5×1 table

                       Results for all Iterations
     Iteration                     x                      |f(x)|
    ___________________________________________________________________

    1.00000000000000e+00    -1.06770961766400e+01    2.25666081098759e-02
    2.00000000000000e+00    -1.32791673756327e+01    4.36601933391256e-03
    3.00000000000000e+00    -1.40536558542692e+01    2.39019777052984e-04
    4.00000000000000e+00    -1.41011099568664e+01    7.99584812360976e-07
    5.00000000000000e+00    -1.41012697709394e+01    9.00834962180852e-12
```

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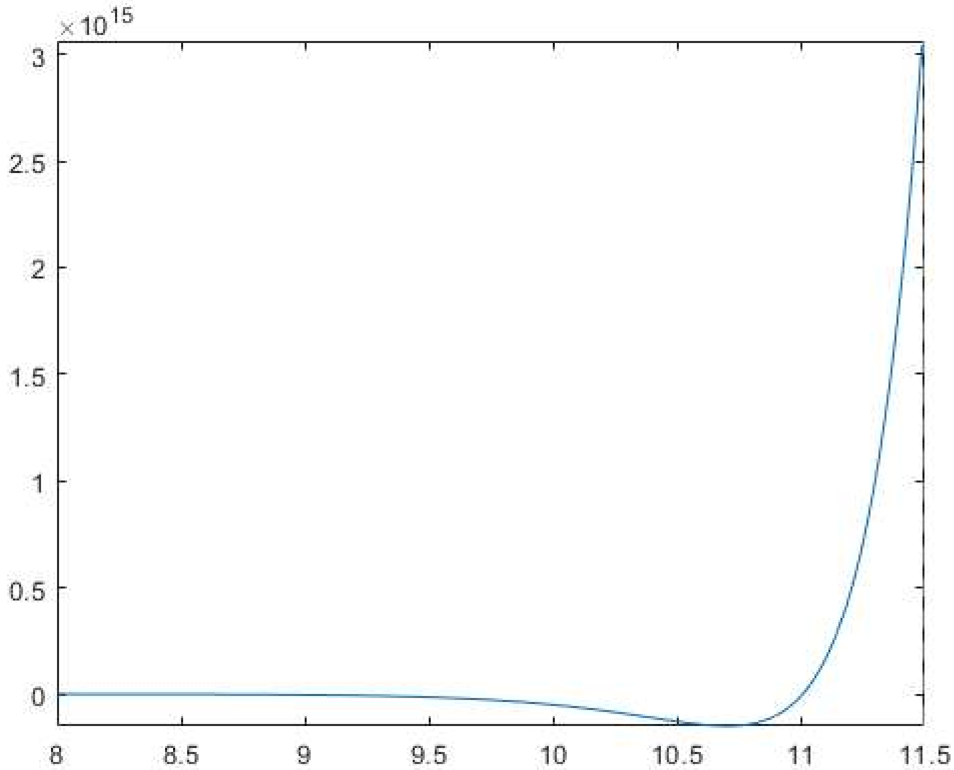
```
function y = f
y = @(x) 3.^(3*x+1)-7*5.^(2*x);
fplot(y,[8,11.5])
```

```
ans =

  function_handle with value:

    @(x)3.^(3*x+1)-7*5.^(2*x)
```



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```
function yp = fp
yp = @(x) log(3)*3^(3*x+2)-14*log(5)*5^(2*x);
critical = fzero(yp,1)
```

```
critical =

     1.070242694004809e+01


ans =

  function_handle with value:

    @(x)log(3)*3^(3*x+2)-14*log(5)*5^(2*x)
```

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```
function T = newton(f,fp,x0,tol,Nmax)
X = zeros(Nmax,1);
X(1) = x0-f(x0)/fp(x0);
for k = 2:Nmax
    X(k) = X(k-1)-f(X(k-1))/fp(X(k-1));
    if abs((X(k)-X(k-1)))/abs(X(k-1)) < tol
        t = X(1:k);
        n = size(t,1);
        Iteration = zeros(n-1,1);
        x = zeros(n-1,1);
        F = zeros(n-1,1);
        for i = 1:n-1
            Iteration(i) = i;
            x(i) = X(i);
            F(i) = abs((X(i+1)-X(i)))/abs(X(i));
        end
        R = table(Iteration,x,F,'VariableNames',{'Iteration','x','Relative Error'});
        T = table(R,'VariableNames',{'Results for all Iterations'});
        return
    end
end
T = 'N/A';
disp('Newton method exceeds maximum iterations')
```

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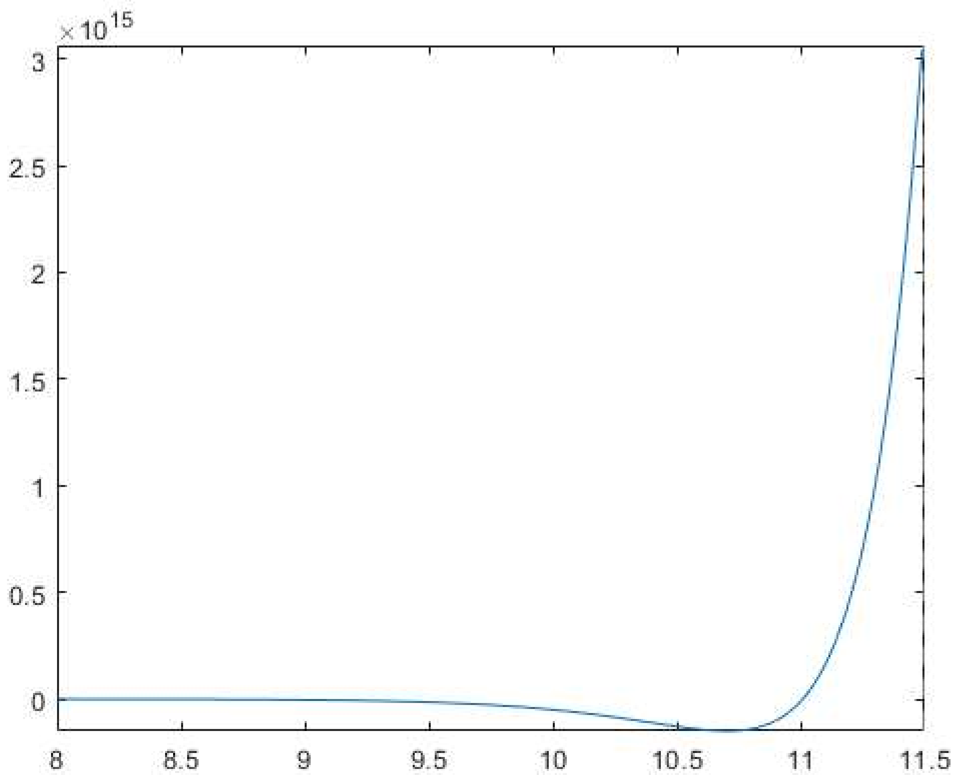
```
x0 = 11;
tol = 10^-10;
Nmax = 30;
newton(f,fp,x0,tol,Nmax)
```

```
critical =

     1.070242694004809e+01


ans =

  3×1 table

                       Results for all Iterations
     Iteration                      x                    Relative Error
    ____________________________________________________________________

    1.00000000000000e+00    1.10097380401553e+01    2.71672393864384e-05
    2.00000000000000e+00    1.10094389359663e+01    2.64952589170358e-08
    3.00000000000000e+00    1.10094386442684e+01    1.83937334349971e-14
```



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```
function Y = FF
Y{1} = @(x,y) 7*x^3-10*x-y-1;
Y{2} = @(x,y) 8*y^3-11*y+x-1;
```

```
ans =

  1×2 cell array

    {@(x,y)7*x^3-10*x-y-1}    {@(x,y)8*y^3-11*y+x-1}
```

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```
function A = JF
A{1,1} = @(x,y) 21*x^2-10;
A{1,2} = @(x,y) -1;
A{2,1} = @(x,y) 1;
A{2,2} = @(x,y) 24*y^2-11;
```

```
ans =

  2×2 cell array

    {@(x,y)21*x^2-10}    {       @(x,y)-1}
    {        @(x,y)1}    {@(x,y)24*y^2-11}
```

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```
function S = NNewton(FF,JF,X0,Nmax,tol)
[~,m] = size(FF);
N = zeros(m,Nmax);
Jac = zeros(m,m);
B = zeros(m,1);
Init = FF;
L = JF;
for i = 1:m
    B(i) = -feval(Init{i},X0(1),X0(2));
    for k = 1:m
        Jac(i,k) = feval(L{i,k},X0(1),X0(2));
    end
end
X = Jac\B;
N(:,1) = X+X0;
for p = 2:Nmax
    for i = 1:m
        B(i) = -feval(Init{i},N(1,p-1),N(2,p-1));
        for k = 1:m
            Jac(i,k) = feval(L{i,k},N(1,p-1),N(2,p-1));
        end
    end
    N(:,p) = Jac\B+N(:,p-1);
    if norm(B,inf) < tol
        t = N(:,1:p);
        n = size(t,2);
        Iteration = zeros(n-1,1);
        x = zeros(n-1,1);
        y = zeros(n-1,1);
        F = zeros(n-1,1);
        for i = 1:n-1
            Iteration(i) = i;
            x(i) = N(1,i);
            y(i) = N(2,i);
            for r = 1:m
                B(r) = -feval(Init{r},N(1,i),N(2,i));
            end
            F(i) = norm(B,inf);
        end
        R = table(Iteration,x,y,F,'VariableNames',{'Iteration','x','y','||f(x,y)||'});
        S = table(R,'VariableNames',{'Results for all Iterations'});
        return
    end
end
S = 'N/A';
disp('Newton method exceeds maximum iterations')
```

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```
X0 = [1,-2]';
tol = 10^-10;
Nmax = 30;
NNewton(FF,JF,X0,Nmax,tol)
```

```
ans =

  6×1 table

                                    Results for all Iterations
         Iteration                            x                         y                     ||f(x,y)||
    _____________________________________________________________________________________________________

    1.00000000000000e+00    1.22649572649573e+00    -1.50854700854701e+00    1.06436604847738e+01
    2.00000000000000e+00    1.18417792260737e+00    -1.26355206353424e+00    2.05548142543646e+00
    3.00000000000000e+00    1.18569965180473e+00    -1.18836372934502e+00    1.68036807384419e-01
    4.00000000000000e+00    1.18607182928602e+00    -1.18103989121078e+00    1.52666942097612e-03
    5.00000000000000e+00    1.18607512100179e+00    -1.18097211482281e+00    1.30204003134793e-07
    6.00000000000000e+00    1.18607512128382e+00    -1.18097210904148e+00    2.66453525910038e-15
```

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```
X0 = [2,2]';
tol = 10^-10;
Nmax = 30;
NNewton(FF,JF,X0,Nmax,tol)
```

```
ans =

  6×1 table

                                 Results for all Iterations
     Iteration                   x                       y                     ||f(x,y)||
    ________________________________________________________________________________________

    1.00000000000000e+00    1.54728977904944e+00    1.49944364965824e+00    1.10233778559015e+01
    2.00000000000000e+00    1.34344401308963e+00    1.24759205209909e+00    2.15480722841390e+00
    3.00000000000000e+00    1.29431470817365e+00    1.16769734481065e+00    1.87046191417671e-01
    4.00000000000000e+00    1.29130690831615e+00    1.15922584245951e+00    2.00636934008402e-03
    5.00000000000000e+00    1.29129333824564e+00    1.15913206944806e+00    2.44637659463365e-07
    6.00000000000000e+00    1.29129333758699e+00    1.15913205796458e+00    3.10862446895044e-15
```

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```
function Y = FF
Y{1} = @(x,y,z) sin(x)+x*exp(y-2)+x+y^2+cos(z)-4;
Y{2} = @(x,y,z) x^4+8*x*y+3*z+10*z*y-3*pi/2-10*pi;
Y{3} = @(x,y,z) cos(x^2+z^2)-y*exp(z)-cos((pi^2)/4)+2*exp(pi/2);
```

```
ans =

  1×3 cell array

  Column 1

    {@(x,y,z)sin(x)+x*exp(y-2)+x+y^2+cos(z)-4}

  Column 2

    {@(x,y,z)x^4+8*x*y+3*z+10*z*y-3*pi/2-10*pi}

  Column 3

    {@(x,y,z)cos(x^2+z^2)-y*exp(z)-cos((pi^2)/4)+2*exp(pi/2)}
```

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```
function A = JF
A{1,1} = @(x,y,z) cos(x)+exp(y-2)+1;
A{1,2} = @(x,y,z) x*exp(y-2)+2*y;
A{1,3} = @(x,y,z) -sin(z);
A{2,1} = @(x,y,z) 4*x^3+8*y;
A{2,2} = @(x,y,z) 8*x+10*z;
A{2,3} = @(x,y,z) 3+10*y;
A{3,1} = @(x,y,z) -2*x*sin(x^2+z^2);
A{3,2} = @(x,y,z) -exp(z);
A{3,3} = @(x,y,z) -2*z*sin(x^2+z^2)-y*exp(z);
```

```
ans =

  3×3 cell array

  Columns 1 through 2

    {@(x,y,z)cos(x)+exp(y-2)+1}    {@(x,y,z)x*exp(y-2)+2*y}
    {        @(x,y,z)4*x^3+8*y}    {      @(x,y,z)8*x+10*z}
    {@(x,y,z)-2*x*sin(x^2+z^2)}    {       @(x,y,z)-exp(z)}

  Column 3

    {                   @(x,y,z)-sin(z)}
    {                    @(x,y,z)3+10*y}
    {@(x,y,z)-2*z*sin(x^2+z^2)-y*exp(z)}
```

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```
function S = NNewton(FF,JF,X0,Nmax,tol)
[~,m] = size(FF);
N = zeros(m,Nmax);
Jac = zeros(m,m);
B = zeros(m,1);
Init = FF;
L = JF;
for i = 1:m
    B(i) = -feval(Init{i},X0(1),X0(2),X0(3));
    for k = 1:m
        Jac(i,k) = feval(L{i,k},X0(1),X0(2),X0(3));
    end
end
X = Jac\B;
N(:,1) = X+X0;
for p = 2:Nmax
    for i = 1:m
        B(i) = -feval(Init{i},N(1,p-1),N(2,p-1),N(3,p-1));
        for k = 1:m
            Jac(i,k) = feval(L{i,k},N(1,p-1),N(2,p-1),N(3,p-1));
        end
    end
    N(:,p) = Jac\B+N(:,p-1);
    if norm(B,inf) < tol
        t = N(:,1:p);
        n = size(t,2);
        Iteration = zeros(n-1,1);
        x = zeros(n-1,1);
        y = zeros(n-1,1);
        z = zeros(n-1,1);
        F = zeros(n-1,1);
        for i = 1:n-1
            Iteration(i) = i;
            x(i) = N(1,i);
            y(i) = N(2,i);
            z(i) = N(3,i);
            for r = 1:m
                B(r) = -feval(Init{r},N(1,i),N(2,i),N(3,i));
            end
            F(i) = norm(B,inf);
        end
        R = table(Iteration,x,y,z,F,'VariableNames',{'Iteration','x','y','z','||f(x,y,z)||'});
        S = table(R,'VariableNames',{'Results for all Iterations'});
        return
    end
end
S = 'N/A';
disp('Newton method exceeds maximum iterations')
```

```
X0 = [1,2,-5]';
tol = 10^-10;
Nmax = 30;
NNewton(FF,JF,X0,Nmax,tol)
```

```
Newton method exceeds maximum iterations

ans =

    'N/A'
```

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```
X0 = [0.1,1.9,1.5]';
tol = 10^-10;
Nmax = 30;
NNewton(FF,JF,X0,Nmax,tol)
```

```
ans =

  4×1 table

                                                  Results for all Iterations
     Iteration                        x                        y                        z                    ||f(x,y,z)||
    ________________________________________________________________________________________________________________________

    1.00000000000000e+00    -1.17585376743411e-02    2.00918204708973e+00    1.57192345359389e+00    5.73623114326729e-02
    2.00000000000000e+00    -8.48326577447198e-05    2.00005494005840e+00    1.57078528033005e+00    7.48438150644404e-04
    3.00000000000000e+00    -3.78931176463670e-09    2.00000000223725e+00    1.57079632601818e+00    4.33507665320576e-08
    4.00000000000000e+00    -4.33128410779509e-16    2.00000000000000e+00    1.57079632679490e+00    1.77635683940025e-15
```

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2c.) The real solution is x = $\frac{\log(7)-\log(3)}{3\log(3)-2\log(5)}$.

2d.) Plotting f shows a function with a horizontal asymptote at x=0, and a root at around 11.0094. We can choose any initial x0 greater than 10.70243 (f'=0) to find the root of f with newton's method. Choosing any value lower than this will result in a negative answer where the function approaches zero due to the horizontal asymptote. In this case, the newton method will give increasingly negative values based on the Nmax and tolerance inputs.