

```
itest = 3;
```

```
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```

```
if(itest == 1)
```

```
    x = input('Enter initial guess for x : ');
```

```
    for i=1:10
```

```
        f = 3*x^4 + 2*x^2 + 1;
```

```
        df_dx = 12*x^3 + 4*x;
```

```
        x = x - f/df_dx;
```

```
        disp([i x])
```

```
    end
```

```
elseif (itest==2)
```

```
    x = input('Enter initial guess for x : ');
```

```
    num_pts = 100;
```

```
    x_iter = linspace(0,0,num_pts);
```

```
    for i=1:num_pts
```

```
        x_iter(i) = x;
```

```
        f = 3*x^4 + 2*x^2 + 1;
```

```
        df_dx = 12*x^3 + 4*x;
```

```
        x = x - f/df_dx;
```

```
        disp([i x])
```

```
    end
```

```
    figure;
```

```
    iter_vect = [0:num_pts-1];
```

```
    plot(x_iter);
```

```
    title('Newton''s method for  $f(x) = 3x^4 + 2x^2 + 1$ ');
```

```
    xlabel('Iteration');
```

```
else
```

```
x_guess = [-2:0.01:2];
```

```
% Make a plot of the function
```

```
f_plot = 0*x_guess;
```

```
df1_plot = 0*x_guess;
```

```

df2_plot = 0*x_guess;
for i=1:length(x_guess)
    x = x_guess(i);
    f_plot(i) = 3*x^4 + 2*x^2 + 1;
    df1_plot(i) = 12*x^3 + 4*x;
    df2_plot(i) = 36*x^2 + 4;
end

figure;
plot(x_guess,f_plot);
title('Plot of f(x) = 3*x^4 + 2*x^2 + 1');
xlabel('x');
ylabel('f(x)');
hold on;
plot(x_guess,0*x_guess,'--');

```

% Look at convergence

```

x_soln = 0*x_guess;
iter_conv = 0*x_guess;

for i=1:length(x_guess)

    x = x_guess(i);

    for j=1:100
        f = 3*x^4 + 2*x^2 + 1;
        if(abs(f) < 1e-10)
            iter_conv(i) = j;
            break;
        end
        df_dx = 12*x^3 + 4*x;
        x = x - f/df_dx;
    end

    x_soln(i) = x;
end

disp('Finished calculating roots.');
```

```

figure;
plot(x_guess,x_soln,'.');
title('Convergence of 1-D Newton's method, f(x) = 3*x^4 + 2*x^2 + 1');
xlabel('Initial guess');
ylabel('Result of Newton's method');

```

% Make plot of convergence vs. 1st step update

figure;

```
subplot(2,1,1);  
plot(x_guess,x_soln,'.');  
title('Convergence of  $f(x) = 3x^4 + 2x^2 + 1$  w.r.t.  $u(x) = -f(x)/f''(x)$ ');  
xlabel('Initial guess');  
ylabel('Result (.), u(x)');  
hold on;  
plot(x_guess,0*x_guess,'--');  
u = -f_plot ./ df1_plot;  
plot(x_guess,u);  
xmin = min(x_guess); xmax = max(x_guess);  
%axis([xmin xmax -2 5]);
```

```
subplot(2,1,2);  
plot(x_guess,iter_conv);  
xlabel('Initial guess');  
ylabel('# of iterations to make  $|g| < 10^{-10}$ ');
```

```
figure;  
hold on;  
plot(x_guess,0*x_guess,'--');  
u = -f_plot ./ df1_plot;  
plot(x_guess,u);  
title('Newton step for  $f(x) = 3x^4 + 2x^2 + 1 = u(x) = -f(x)/f''(x)$ ');  
xlabel('Initial guess');  
ylabel('u(x)');
```

end