Exercise 6

```
format
format compact
syms x
F = @(x) atan(x) + x - 1
```

```
F = function_handle with value:

    @(x)atan(x)+x-1
```

```
F1 = eval(['@(x)' char(diff(F(x)))])
```

```
F1 = function_handle with value:

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

```
G=@(x) x.^3-x-1
```

```
G = function_handle with value:

    @(x)x.^3-x-1
```

```
G1=eval(['@(x)' char(diff(G(x)))])
```

```
G1 = function_handle with value:

    @(x)3*x^2-1
```

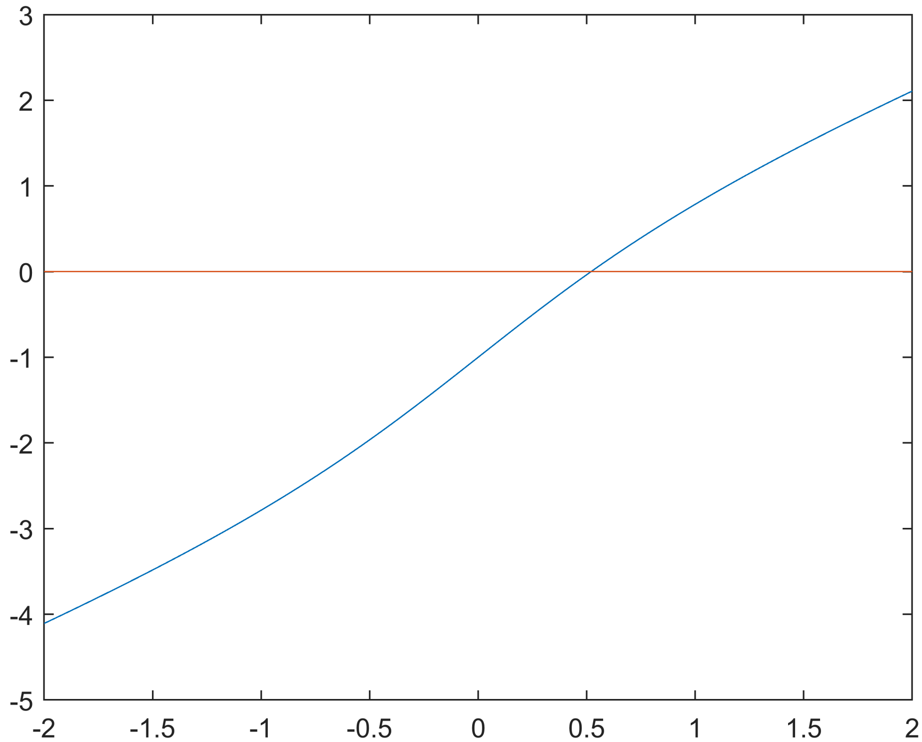
```

yzero=@(x) 0.*x.^(0)
```

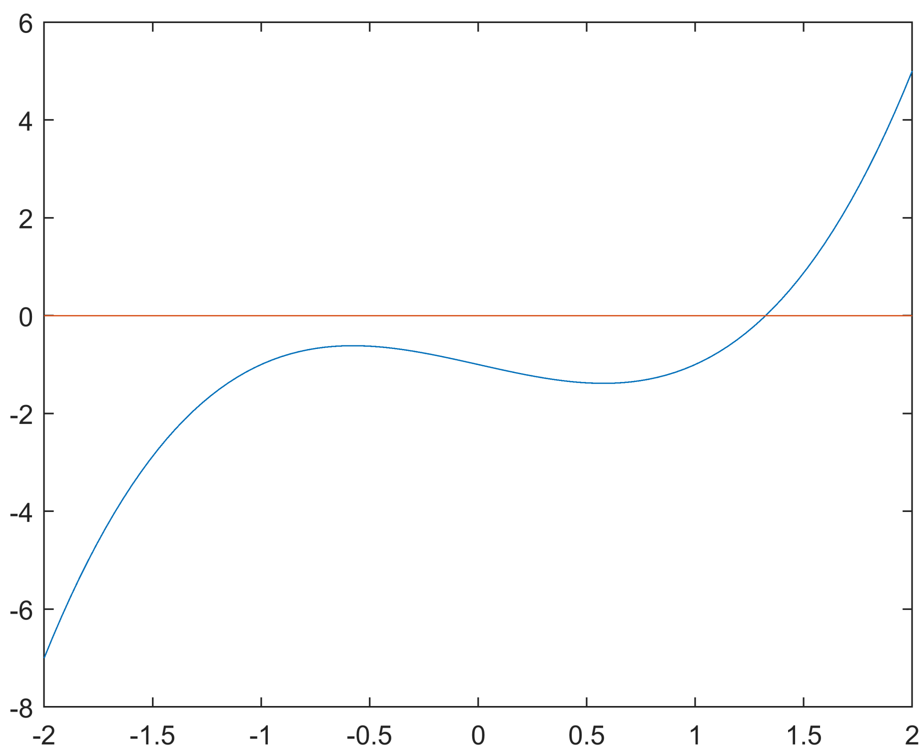
```
yzero = function_handle with value:

    @(x)0.*x.^(0)
```

```
x=linspace(-2,2);
plot(x,F(x),x,yzero(x));
```




```
plot(x,G(x),x,yzero(x));
```



```
syms x
p=x^3-x-1;
roots(sym2poly(p))
```

```
ans = 3×1 complex
   1.3247 + 0.0000i
  -0.6624 + 0.5623i
  -0.6624 - 0.5623i
```

```
type newtons
```

```
function root=newtons(fun,dfun,x0)
format long

x=fzero(fun,x0)
fprintf('x is the MATLAB approximation of the real zero\n')

n = 0;
xn = x0;
while(abs(xn-x)>=10^(-12))
    xn = xn - fun(xn)/dfun(xn);
    n = n+1;
end
fprintf('\nnumber of iterations = %i \n', n)
root = xn;
end
```

Part (a)

```
fun=F;
dfun=F1;
root=newtons(fun, dfun, 0.5)
```

```
x =
   0.520268992719590
x is the MATLAB approximation of the real zero

number of iterations = 3
root =
   0.520268992719590
```

```
root=newtons(fun, dfun, 0.55)
```

```
x =
   0.520268992719590
x is the MATLAB approximation of the real zero

number of iterations = 3
root =
   0.520268992719590
```

```
root=newtons(fun, dfun, 0.6)
```

```
x =
   0.520268992719590
x is the MATLAB approximation of the real zero

number of iterations = 3
root =
   0.520268992719579
```

Part (b)

```
fun=G;
dfun=G1;
%(1)
root=newtons(fun, dfun, 1.3)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 3
root =
   1.324717957244843
```

```
%(2)
root=newtons(fun, dfun, 1)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 5
root =
   1.324717957244790
```

```
%(3)
root=newtons(fun, dfun, 0.6)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 12
root =
   1.324717957244747
```

```
%(4)
root=newtons(fun, dfun, 0.577351)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 38
root =
   1.324717957244746
```

```
%(5)
x0=1/sqrt(3)
```

```
x0 =
   0.577350269189626
```

```
root=newtons(fun, dfun, x0)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero
```

```
number of iterations = 95
root =
   1.324717957244746
```

```
%(6)
root=newtons(fun, dfun, 0.577)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 100
root =
   1.324717957244807
```

```
%(7)
root=newtons(fun, dfun, 0.4)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 13
root =
   1.324717957244746
```

```
%(8)
root=newtons(fun, dfun, 0.1)
```

```
x =
   1.324717957244746
x is the MATLAB approximation of the real zero

number of iterations = 34
root =
   1.324717957244746
```

The general pattern is that the number of iterations increases as the intitial approximation gets farther from the real zero. However, choices (4)-(6) don't follow this pattern. This is because the intitial approximations for (4)-(6) are close to the zero of G1 (the derivative of G). Choice (5) is the actual 0 of G1, and therefore shouldn't even work since it would lead to dividing by 0, but MATLAB rounds the value of 1/sqrt(3).