Lab 5
William Keilsohn
Section 32
3/27/2014

```
Quit[]
```

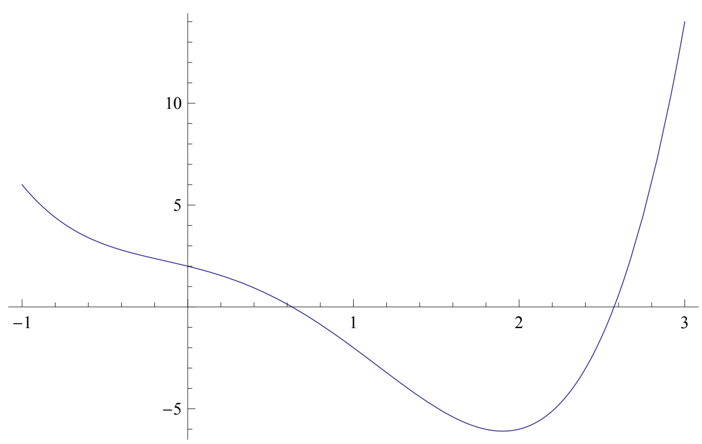
Question 1: Define f(x) and plot on [-1,3]

In[1]:= `f[x_] = (x^4) - (2 * x^3) - (x^2) - 2 * x + 2`

Out[1]= $2 - 2x - x^2 - 2x^3 + x^4$

In[2]:= `Plot[f[x], {x, -1, 3}]`

Out[2]=



Question 1.a: How many Roots are on The interval?

In[3]:= `Factor[f[x]]`

Out[3]= $2 - 2x - x^2 - 2x^3 + x^4$

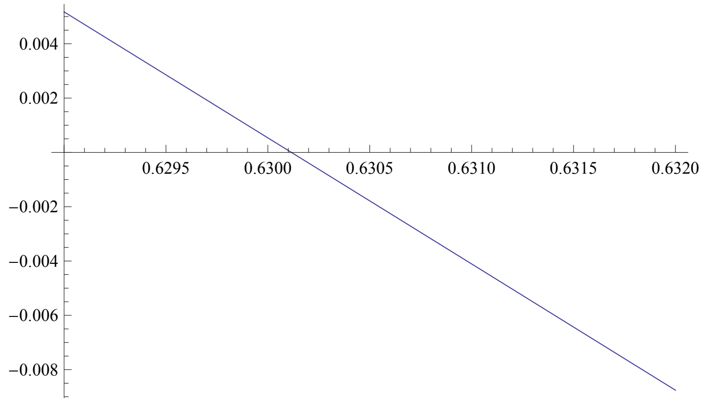
There are Two Roots on the interval [-1,3]

Question 1.b: By zooming in, determine the left root accurate to four decemil places.

Additional Plots removed upon request of prompt.

In[9]:= `Plot[f[x], {x, 0.629, 0.632}]`

Out[9]=



Therefore, the left root is approximatily 0.6301.

Question 1.c: Evaluate f at this value. How close is it to zero?

In[10]:= `f[0.6301]`

Out[10]= 0.0000714648

The value of f is 0.0000714648 and is 0.0000714648 units away from zero.

Question 2: Use bisection method to find this root.

In[18]:=
```
a = 0.0; b = 1.0; m = (a + b) / 2; output = {{m, f[m]}}
While[b - a > 10^(-5), If[Sign[f[a]] ≠ Sign[f[m]], b = m, a = m];
  m = (a + b) / 2; output = Append[output, {m, f[m]}]];
```

Out[18]= {{0.5, 0.5625}}

In[20]:= `output // TableForm`

Out[20]//TableForm=

0.5	0.5625
0.75	-0.589844
0.625	0.0236816
0.6875	-0.274155
0.65625	-0.122939
0.640625	-0.0490474
0.632813	-0.0125368
0.628906	0.00560907
0.630859	-0.0034547
0.629883	0.00107947
0.630371	-0.00118705
0.630127	-0.000053645
0.630005	0.000512948
0.630066	0.00022966
0.630096	0.0000880099
0.630112	0.000017183
0.630119	-0.0000182309
0.630116	-5.23913×10^{-7}

Based on bisection method the left root occurs at x= 0.630116 and results in a f values of -5.23913x10^(-7) witch is closer to zero than previously determined.

Question 3.a: Use newton’s method to find the left root at f(x)=0. Assume x0=0.0 and name all following approximations

In[21]:=
```
newt[t_] = t - f[t] / f'[t]
```

Out[21]=
$$t - \frac{2 - 2\,t - t^2 - 2\,t^3 + t^4}{-2 - 2\,t - 6\,t^2 + 4\,t^3}$$

In[22]:=
```
NestList[newt, 0.0, 10] // TableForm
```

Out[22]//TableForm=
```
0.
1.
0.666667
0.630769
0.630116
0.630115
0.630115
0.630115
0.630115
0.630115
0.630115
```

X0= 0.0
X1= 1.0
X2=0.666667
X3=0.630769
X4=0.630116
X5= 0.630115
No further Change in Values derived.

In[24]:=
```
N[NestList[newt, 0.0, 10], 8] // TableForm
```

In[25]:=
```
N[{0.`, 1.`, 0.6666666666666667`, 0.6307692307692307`, 0.6301156168428664`, 0.6301153961638684`, 0.6301153961638432`, 0.6301153961638432`, 0.6301153961638432`, 0.6301153961638432`, 0.6301153961638432`}, 8] // TableForm
```

Out[25]//TableForm=
```
0.
1.
0.666667
0.630769
0.630116
0.630115
0.630115
0.630115
0.630115
0.630115
0.630115
```

The left root is located at X=0.63011540 when calculated to 8 decimal places.

Question 3.b: What is the f value?

In[26]:=
```
f[NestList[newt, 0.0, 10]] // TableForm
```

Out[26]//TableForm=

2.
-2.
-0.17284
-0.00303597
-1.02434×10^{-6}
-1.16962×10^{-13}
5.55112×10^{-17}
5.55112×10^{-17}
5.55112×10^{-17}
5.55112×10^{-17}
5.55112×10^{-17}

In[29]:=
```
f[0.63011540]
```

Out[29]= -1.78065×10^{-8}

The value of f at the root is -1.78065×10^{-8}

Question 3.c: Explore what happens when X0 is of a value other than 0. Write your conlcusions.

In[30]:=
```
NestList[newt, 1.9, 10] // TableForm
```

Out[30]//TableForm=
```
1.9
-252.096
-188.948
-141.588
-106.068
-79.4288
-59.4504
-44.4678
-33.2324
-24.8079
-18.4921
```

In[31]:=
```
NestList[newt, 1.9, 30] // TableForm
```

Out[31]//TableForm=
```
1.9
-252.096
-188.948
-141.588
-106.068
-79.4288
-59.4504
-44.4678
-33.2324
-24.8079
-18.4921
-13.7585
-10.2122
-7.55688
-5.5701
-4.084
-2.97062
-2.1295
-1.47514
-0.916756
-0.284705
0.979991
0.664367
0.630692
0.630116
0.630115
0.630115
0.630115
0.630115
0.630115
0.630115
```

In[34]:=
```
NestList[newt, 0.5, 10] // TableForm
```

Out[34]//TableForm=
```
0.5
0.640625
0.630172
0.630115
0.630115
0.630115
0.630115
0.630115
0.630115
0.630115
0.630115
```

From what I can gather, the farther the value of X0 is from the root, the more values are generated before reaching the correct, or most accurate, value for the root. This is demonstrated in the work above in which X0=1.9 and X0= 0.5.

In[35]:=
```
Quit[]
```