Practical 2(b): Regula-Falsi method

Theory: Regula falsi method iteratively determines a sequence of root enclosing intervals,(an,bn) containing the approximate root pn. Like in Bisection method, the interval under consideration must follow f(an)f(bn) < 0 however, pn is no longer the mid point of the interval (an,bn). In Regula falsi, pn is the x intercept of the line joining (an,f(an)) and (bn, f(bn)). pn is given by the following formula:

$$pn = bn - f(bn)[bn-an]/f(bn)-f(an)$$
$$= (an.f(bn)-bn.f(an))/f(bn)-f(an)$$

Q1 Perform 10 iterations of the Regula-Falsi method to obtain a real root of the following equation in the interval(-1,1):

$$f(x) = x^3-5x+1=0.$$

Solution:

```
kill(all)$
f(x):=x^(3)-5·x+1;
'x0=x0:-1.0;
'x1=x1:1.0;
n:10$
if(float(f(x0)·f(x1)>0)) then
print("change values")
else
for i:1 thru n do
(x2:float(((x0·f(x1))-(x1·f(x0)))/(f(x1)-f(x0))),
    if (f(x2)·f(x1)<0) then x0:x2 /*If f(x2)f(x1) < 0,
    then it means x2 and x1 are of opposite signs. The new interval
    is (x2,x1), so we do the replacement x0:x2.*/
     else (x1:x2),print("iteration",i,"gives",x2))$
print("After",n," iterations the root is",x2)$
wxplot2d(f(x),[x,-1,1]);
```

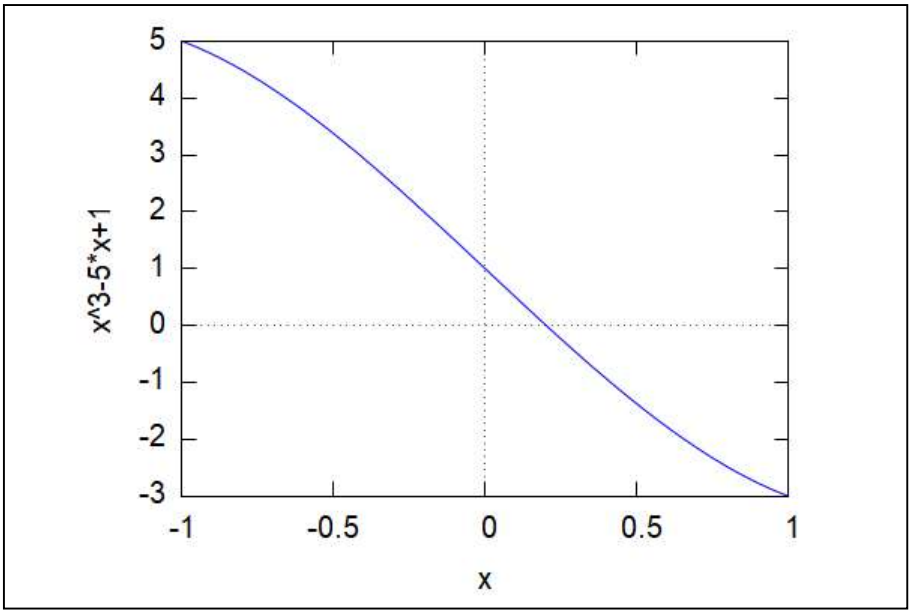
(%o1) $f(x):=x^3-5x+1$

(%o2) $x0=-1.0$

(%o3) $x1=1.0$

```
iteration 1 gives 0.25
iteration 2 gives 0.1940298507462687
iteration 3 gives 0.2016886549593477
iteration 4 gives 0.2016397213245381
iteration 5 gives 0.201639675765857
iteration 6 gives 0.2016396757234442
iteration 7 gives 0.2016396757234047
iteration 8 gives 0.2016396757234046
iteration 9 gives 0.2016396757234047
iteration 10 gives 0.2016396757234047
After 10 iterations the root is 0.2016396757234047
```

(%t7)



(%o7)

Q2 Perform 6 iterations of the Regula-Falsi method to obtain a real root of the following equation in the interval(-1,1):

$$f(x) = x^2-4=0.$$

Solution:

```
kill(all)$
f(x):=x^(2)-4;
x0=x0:-1.0;
x1=x1:1.0;
n:6$
if(float(f(x0)·f(x1)>0)) then
print("change values")
else
for i:1 thru n do
(x2:float(((x0·f(x1))-(x1·f(x0)))/(f(x1)-f(x0))),
    if (f(x2)·f(x1)<0) then x0:x2
     else (x1:x2),print("iteration",i,"gives",x2))$
print("After",n," iterations the root is",x2)$
```

(%o1) $f(x):=x^2-4$

(%o2) $x0=-1.0$

(%o3) $x1=1.0$

change values

After 6 iterations the root is x2

Assignment: Do two similar questions.