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Assignment 2 Roots of Equations

1. Use Bisection method to find the root of $\sqrt[4]{\mathbf{13}}$ in the interval of 1.5 and 2.0

1.1 show your work for 4 iterations

Iteration 0: X_L=1.5,X_R =2.0

Step1:X_M =$\frac{1.5+2.0}{2}$ =1.75

f(x): x= $\sqrt[4]{\mathbf{13}}$ -> x^4 = 13 -> x^4-13 =0

find f(X_M) = $(1.75)^4$-13 = -3.621093

find f(X_R) =$(2.0)^4$-13 = 16-13 = 3

Step2:f(X_M)·f(X_R)= -3.621093 · 3 = -10.863279 < 0

Step3: f(X_M)·f(X_R) <0 -> X_L=X_M -> X_L= 1.75

Iteration 1: X_L=1.75 , X_R=2

Step1:X_M=$\frac{1.75+2}{2}$= 1.875

find f(X_M) = $(1.875)^4$-13 = -0.64

find f(X_R) =$(2.0)^4$-13 = 16-13 = 3

Step2: :f(X_M)·f(X_R) <0

Step3: f(X_M)·f(X_R) <0 -> X_L=X_M -> X_L= 1.875

Step4:$\left|\frac{1.875-1.75}{1.875}\right|$x 100% = 6.67%

Iteration 2: X_L=1.875 , X_R=2

Step1:X_M =$\frac{1.875+2}{2}$ =1.9375

find f(X_M) = $(1.9375)^4$-13 = 1.09

find f(X_R) =$(2.0)^4$-13 = 16-13 = 3

Step2:f(X_M)·f(X_R)>0

Step3: f(X_M)·f(X_R) >0 -> X_R=X_M -> X_R= 1.9375

Step4:$\left|\frac{1.9375-1.875}{1.9375}\right|$x 100% =3%

Iteration 3: X_L=1.875 , X_R=1.9375

Step1:X_M =$\frac{1.875+1.9375}{2}$ =1.90625

find f(X_M) = $(1.90625)^4$-13 = 0.204

find f(X_R) =$(1.9375)^4$-13 = 1.09

Step2: :f(X_M)·f(X_R)>0

Step3: f(X_M)·f(X_R) >0 -> X_R=X_M -> X_R= 1.90625

Step4:$\left|\frac{1.90625-1.9375}{1.90625}\right|$x 100% =1%

Iteration 4: X_L=1.875 , X_R=1.90625

Step1:X_M =$\frac{1.875+1.90625}{2}$ =1.890625

find f(X_M) = $(1.890625)^4$-13 = -0.223

find f(X_R) =$(1.90625)^4$-13 = 0.204

Step2: :f(X_M)·f(X_R)<0

Step3: f(X_M)·f(X_R) >0 -> X_L=X_M -> X_L= 1.890625

Step4:$\left|\frac{1.890625-1.90625}{1.890625}\right|$x 100% =0.8%

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1.2 write a program to iteratively find the answer till there is no changes in the answer for six significant figures

```
f=function(x){
    return Math.pow(x,4)-13;
}
var l=1.5;
var r=2.0;
var t=1.898828;
var m;
for(i=0;i<5;i++){
    m=(l+r)/2;
    if(f(m)*f(r)>0){
        r=m;
    }
    else{
        l=m;
    }
    console.log(m);
}
```

```
1.75
1.875
1.9375
1.90625
1.890625
[nodemon] clean exit - waiting for changes before restart
```

```
f = function(x){
    return Math.pow(x,4)-13;
}
var r = 1.5
var l = 1.0;
var m = 0;
var t = 1.8a4 ;
for(i=0;i<5;i++){
    m = (l+r)/2;
    if (f(m)*f(r)>0){
            r = m;
    }
    else{
            l = m;
    }
    console.log(m);
    console.log(error);
}
```

```
var prevm = 0;
var error = Math.abs(m - prevm);

error = Math.abs((m-prevm)/m)
        * 100;

error = Math.abs((m-prevm)/m)*100;
```

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2. Use False-Position method to find the value of $\frac{1}{43}$ in the interval of 0.02 และ 0.03

2.1 show your work for 4 iterations

f(x) : x=$\frac{1}{43}$ -> 43x = 1 -> 43x – 1 = 0

Iteration0: X_L=0.02 , X_R=0.03

Step1: $X_1 = \frac{X_L\, f(X_R) - X_R\, f(X_L)}{f(X_R) - f(X_L)}$

= $\frac{(0.02)(0.29) - (0.03)(-0.14)}{(0.29)-(-0.14)}$ $\frac{=(0.0058)-(-0.0042)}{0.43}$ =0.02325

$f(X_L)$ = -0.14

$f(X_R)$ =0.29

$f(X_1)$=43(0.02325)-1=-0.00025

Step2: $f\ (X_1) \cdot\ f(X_R)$<0

Step3: X_L=X_1 -> X_L=0.02325

Step4: $\left|\frac{X_1^{new} - X_1^{old}}{X_1^{new}}\right|$x 100% =$\left|\frac{0.02325-0.03}{0.02325}\right|$x 100% = 29%

Iteration1: X_L=0.02325 , X_R=0.03

Step1: $X_1 = \frac{X_L\, f(X_R) - X_R\, f(X_L)}{f(X_R) - f(X_L)}$ =

$\frac{(0.0067425)-(-0.0000075)}{0.29}$=0.02327

$f(X_L)$ =43(0.02325)-1 =-0.00025

$f(X_R)$ =43(0.03)-1=0.29

$f(X_1)$=43(0.02327)-1=0.00061

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Step2: $f\ (X_1)\cdot\ f(X_R)$>0

Step3: X_R=X_1 -> X_R=0.02327

Step4: $\left|\frac{X_1^{new}-X_1^{old}}{X_1^{new}}\right|$x 100%

=$\left|\frac{0.02327-0.02325}{0.02327}\right|x\ 100\%$=0.08594%

Iteration2: X_L=0.02325 , X_R=0.02327

Step1: $X_1=\frac{X_L\,f(X_R)-X_R\,f(X_L)}{f(X_R)-f(X_L)}$ =

$\frac{(0.000014)-(-0.0000058)}{0.00086}$=0.02302

$f(X_L)$ =43(0.02325)-1 =-0.00025

$f(X_R)$ =43(0.02327)-1=0.00061

$f(X_1)$=43(0.02302)-1=-0.01014

Step2: $f\ (X_1)\cdot\ f(X_R)$<0

Step3: X_L=X_1 -> X_L=0.02302

Step4: $\left|\frac{X_1^{new}-X_1^{old}}{X_1^{new}}\right|$x 100% =$\left|\frac{0.02302-0.02327}{0.02302}\right|x\ 100\%$=1.08%

Iteration3: X_L=0.02302 , X_R=0.02327

Step1: $X_1=\frac{X_L\,f(X_R)-X_R\,f(X_L)}{f(X_R)-f(X_L)}$ = $\frac{(0.000014)-(-0.00023)}{0.01061}$=0.0229

$f(X_L)$ =-0.01

$f(X_R)$ =0.00061

$f(X_1)$= -0.0153

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Step2: $f\ (X_1) \cdot\ f(X_R)$<0

Step3: X_L=X_1 -> X_L=0.0229

Step4: $\left|\frac{X_1^{new}-X_1^{old}}{X_1^{new}}\right|$x 100% =$\left|\frac{0.0229-0.02302}{0.0229}\right|$ x 100%=0.524%

Iteration4: X_L=0.0229 , X_R=0.02327

Step1: $X_1 = \frac{X_L\, f(X_R)-X_R\, f(X_L)}{f(X_R)-f(X_L)}$ = $\frac{(0.000013)-(-0.00035)}{0.01591}$=0.0228

$f(X_L)$ =-0.0153

$f(X_R)$ =0.00061

$f(X_1)$=-0.0196

Step2: $f\ (X_1) \cdot\ f(X_R)$<0

Step3: X_L=X_1 -> X_L=0.0228

Step4: $\left|\frac{X_1^{new}-X_1^{old}}{X_1^{new}}\right|$x 100% =$\left|\frac{0.0228-0.0229}{0.0228}\right|$ x 100%=0.4385%

2.2 write a program provide that the error is lesser than 0.000001%

```
f=function(x){
    return (43*x)-1;
}
var l=0.02;
var r=0.03;
var t =0.023255;
var x1;
for(i=0;i<5;i++){
    x1=(l*f(r))-(r*f(l))/f(r)-f(l);
    if((f(x1)*f(r))>0){
        r=x1;
    }
```

```
    else{
        l=x1;
    }
    console.log(x1);
}
```

```
[nodemon] starting `node home2.js`
0.16028275862068966
0.2616515536288036
0.34859375895297784
0.42327917881581506
0.4874651881877338
[nodemon] clean exit - waiting for changes befo
```

3. Use ONE-POINT ITERATION method to find the value of $\frac{1}{2}$ with an initial guess of 0.00

3.1 show your work for 4 iterations

F(x): x=$\frac{1}{2}$ -> 2x-1=0

Iteration1: X_{i+1}=$2x_i - 1$ -> using 0.00

Iteration2: X_2=$2x_1 - 1$ =2(0.00) – 1 = -1

$\left|\frac{X_{new}-X_{old}}{X_{new}}\right|$x 100% = $\left|\frac{-1-0.00}{-1}\right|$ x 100% = 100%

Iteration3: X_3=$2x_2 - 1$ =2(-1) – 1 = -3

$\left|\frac{X_{new}-X_{old}}{X_{new}}\right|$x 100% = $\left|\frac{-3-(-1)}{-3}\right|$ x 100% = 66.67%

Iteration4: X_4=$2x_3 - 1$ =2(-3) – 1 = -7

```
f = function(x){
    return (43*x) - 1;
}
var l = 1.5;
var r = 2.0;
var x1;
var prevx1 = 0;
var error;
for(i=0; i<10; i++){
    x1 = (l*f(r) - r*f(l)) / (f(r)-f(l));
    if( f(x1)*f(r) > 0){
            r = x1;
    }
    else{
            l = x1;
    }
console.log(x1);
console.log(error);
```

```
error = (Math.abs(error-prevx1)/error)
        *100;
prevx1 = error;
```

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$$\left|\frac{X_{new} - X_{old}}{X_{new}}\right| \text{x } 100\% = \left|\frac{-7-(-3)}{-7}\right| \text{ x } 100\% = 57.14\%$$

3.2 write a program with error lesser than 0.000001%

```
f=function(x){
    return (2*news)-1;
}
var x1=0.00;

var news=0.00;
for(i=0;i<5;i++){
    news=f(x1);

    console.log(news);
}
```

```
[nodemon] starting `node home3.js`
-1
-3
-7
-15
-31
[nodemon] clean exit - waiting for changes before restart
```

$x - \frac{1}{2}$

```
f = function(x){
    return news - (1/2);
}

var x1 = 0.00;
var news = 0.00;
for (i = 0 ; i < 6 ; i++){
    news = f(x1);
    error = Math.abs((news - x1)/news) * 100;
    console.log(news);
    console.log(error);
}
```

```
var error;
```