Lab 4

Ex 1)

Problem 2.1)

$$x_{K+1} = \frac{1}{5}(x_K^3 + 1) = f(x)$$

initial value = 0.7
error = 10e-7
iterations = 5
root = 0.201639 .

$|f'(x)| < 1$ near root (refer graph)
$\Rightarrow$ converging.

P2.2) $x_{K+1} = (5x_K - 1)^{1/3} = f(x)$

initial value = 0.7
error = 10e-7
iterations = 15
root = 2.1284 .

$|f'(x)| \geq 1$ near root (refer graph)
$\Rightarrow$ diverging

P2.3) $x_{K+1} = x_K^3 - 4x_K + 1$.
initial value = 0
error = 10e-7
iterations = 10
root = -2

$|f'(x)| \geq 1$ near root (refer graph)
$\Rightarrow$ diverging

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Problem 3.1.)

$g(x) = x_{K+1} = -\frac{1}{x_K}(a x_K + b)$, converges to α if $|\alpha| > |\beta|$

$f(x) = x^3 - 3x + 2 \quad a = -3, b = 2.$

Here $\alpha = 2, \beta = 1$

root = 2.00024
iterations = 11
starting value = 3

$|g'(x)| < 1$ when $x \to \alpha$ as seen in the graph

3.2) $x_{K+1} = \frac{-b}{x_{K+a}} = g(x)$ converges to α if $|\alpha| < |\beta|$

Here $\alpha = 1, \beta = 2$
starting value = 0
root = 0.99975
iterations = 11

$|g'(x)| < 1$ when $x \to \alpha$ as seen in the graph.

3.3) $x_{K+1} = -\frac{1}{a}(x_K^2 + b) = g(x)$, converge to α if $2|\alpha| < |1+\beta|$

Here $\alpha = 1, \beta = 2.$
root = 0.999, iterations = 11
starting value = 0

$|g'(x)| < 1$ when $x \to \alpha$ (refer graph)

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Problem 4)

$$x_{n+1} = \frac{x_n}{2a}(3a - x_n^2) = g(x)$$

When $a = 4$,
root = 2
iterations = 11

When $a = 16$
root = 4
iterations = 11

Thus it converges to $\sqrt{a}$.

Checking for convergence we get.

$$|g'(x)| = 0$$
when $x \longrightarrow \sqrt{a}$

It can be seen in the graph.

Ex 2) Taking $\alpha = 1$

Starting value = 2.1
root = 2.0000007
iterations = 11

Taking $\alpha = 2$
Starting value = 2.1, iterations = 17
root = 2.000000000029

Taking $\alpha = 3$
Starting value = 2.1, iterations = 9
root = 1.9999998

Ex 3.)

Problem 10.1.) Secant.

$x^3 - \sinh + 4x^2 + 6x + 9 = 0 = g(x)$

Taking

$x_0 = 7.0$

$x_1 = 7.1$

iterations = 4

root = 7.11 30634 (converging assumed)

Regula-Falsi

checking for $g(x_n) \cdot g(x_{n-1}) < 0$ for each iteration, we get

root = 7.11305

iterations = 2

Converging proved.

Problem 10.2) Secant.

$x^5 + x^3 + 3 = 0$ $x_0 = -1$ and $x_1 = 1$

for itr = 5, root = -0.4458

itr = 10, root = 0.9999

itr = 15, root = ~~-1.30 9999~~ -1.30

itr = 20, root = 0.9999

Regular falsi: It gives, condition not satisfied after second iteration and breaks at value = 1.0015