

# pr3\_i\_math548\_midterm\_Lazizbek

March 19, 2024

## 1 Math 548, Midterm. Problem 3. LS

### Problem 3

You would like to use the fixed-point iteration method to find the roots of  $f(x) = x - x^2 = 0$ . Consider the following two formulations.

1.

$$x = x + 2(x - x^2).$$

2.

$$x = x - (x - x^2) / (1 - 2x).$$

- For each formulation carry out the iterations first using the starting value 0.8 and then, using the starting value 0.2.
- Comment and justify your observations.

#Problem 3. (i)

$$x = x + 2(x - x^2).$$

```
[1]: import pandas as pd

initials = list([0.8, 0.2])
steps = list()
approximations = list()
epsilon = 0.000001

for i in range(2):
    x0 = initials[i]
    M = 10
    try:
        for k in range(M):
            steps.append(k)
            approximations.append(x0)
            x1 = x0 + 2*(x0-(x0)**2)
            if abs(x0-x1) < epsilon:
                print(f"\nWhen x0={initials[i]}, |g'({initials[i]})| < 1, so iteration_
↳converges with tolerance of {epsilon} in {k} steps as follows:")
```

```

        break
    x0 = x1

    d = {'step k = ': steps, 'approximation x = ': approximations}
    df = pd.DataFrame(data=d)
    print(df)
    steps = []
    approximations = []

except:
    print(f"\nWhen x0={initials[i]}, |g'({initials[i]})|>=1, so iteration
↳diverges in {k} steps as follows:")
    steps.pop()
    approximations.pop()
    d = {'step k = ': steps, 'approximation x = ': approximations}
    df = pd.DataFrame(data=d)
    print(df)
    steps = []
    approximations = []

```

	step k =	approximation x =
0	0	0.800000
1	1	1.120000
2	2	0.851200
3	3	1.104517
4	4	0.873635
5	5	1.094429
6	6	0.887738
7	7	1.087057
8	8	0.897786
9	9	1.081319

  

	step k =	approximation x =
0	0	0.200000
1	1	0.520000
2	2	1.019200
3	3	0.980063
4	4	1.019142
5	5	0.980125
6	6	1.019085
7	7	0.980186
8	8	1.019028
9	9	0.980247

```

[ ]: # !sudo apt-get install texlive-xetex texlive-fonts-recommended
↳texlive-plain-generic

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[ ]: # !jupyter nbconvert --to pdf /content/Math548_hw6_Lazizbek.ipynb
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