

CSE330 Section 20, Assignment 3

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1 Instructions

1. The deadline is **23 April 2026, during class**. There will be **no deadline extension**. Hence, don't wait for the last minute to submit.
2. Please start the assignment as soon as possible. If you start it just a day before the deadline, you might not be able to complete it.
3. If you take help from your friend (even if your friend is from a different section), or if you use ChatGPT to help you understand the material, you have to mention it on top of the first page of your assignment. Failing to do so will be considered as plagiarism and will have consequences as per the plagiarism policy.
4. Copying AI-generated answers without understanding or attribution will be treated as academic misconduct.
5. The total mark of this assignment is 15. However, there is 1 bonus question that is worth 2 points. Attempt the bonus questions only after you have solved all the other problems. If you get more than 15, then the extra points will be adjusted with other assignments.
6. Please feel free to reach out to me if you have any questions.

2 Problems

Problem 1 (3 + 2 + 5 = 10 marks). Consider $f(x) = 1 - \cos x$.

- (a) Can you find the root of this function using bisection method? Explain briefly why or why not.
- (b) Suppose you know that $x_* = 0$ is a root of this function. If you use Newton-Raphson method, what kind of convergence property does it have? In other words, does it converge linearly, superlinearly, or doesn't converge, or can't be determined?
- (c) If $g(x) = x - f(x)$, starting with $x_0 = 0.5$, do 10 iterations of the fixed-point method. Find the error $|x_{10} - x_*|$, for $x_* = 0$.

Problem 2 (1 + 2 + 2 + 2 = 5 + 2(Bonus) points). Suppose I asked you to find x such that $x = \cos x$. In other words, you need to find the fixed-point of $g(x) = \cos x$.

- (a) Plot the function $f(x) = \cos x - x$ on desmos/geogebra, and guess the value of the root x_* .
- (b) If you want to use fixed-point iteration to find the fixed-point of $g(x)$, what kind of convergence property does it have? In other words, does it converge linearly, superlinearly, or doesn't converge, or can't be determined? Give a decision based on $|g'(x_*)|$.
- (c) Starting with $x_0 = 0.5$, do 10 iterations of the fixed-point method. Find the error $|x_{10} - x_*|$, for the value x_* you got in (a).
- (d) (Bonus, 2 points) If you start with $[a, b] = [0, 1]$ to find the root of $f(x) = \cos x - x$ using Bisection method, how many iterations would it take to get accuracy of $\varepsilon_M = 1.1 \times 10^{-16}$?