MA2221: Foundational Mathematics for ML

Assignment – Writing maths in Notebook (19–01–2026)

Instructor: **Biswarup Biswas**

Instructions:

- This assignment was conducted during the **lab session**.
- Students were required to type all answers using **Markdown with LaTeX**.
- Correct mathematical typesetting was the primary objective.
- Mathematical understanding was **not required** unless explicitly stated.

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1. **Inline Mathematics**

   Typeset the following sentences exactly as written, ensuring that inline mathematics renders correctly.

   (a) The quadratic polynomial $ax^2 + bx + c$ has discriminant $b^2 - 4ac$.

   (b) The solution of $ax^2 + bx + c = 0$ is given by
   $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

   (c) For small h, the finite difference approximation is
   $$\frac{f(x+h) - f(x)}{h}.$$

2. **Displayed Equations**

   Typeset the following equations using displayed mathematics.

   (a) Taylor expansion of the exponential function:
   $$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

   (b) A definite integral:
   $$\int_0^1 x^2 \, dx = \frac{1}{3}.$$

3. **Aligned Equations**

   Use the `align` environment to typeset the following multi-line expressions.

   (a)
   $$
   \begin{align}
   (x+1)^2 &= x^2 + 2x + 1 \tag{1} \\
   &= x^2 + 2x + 1 \tag{2}
   \end{align}
   $$

   (b)
   $$
   \begin{align}
   \int_0^1 (3x^2 + 2x + 1) \, dx &= \left[x^3 + x^2 + x \right]_0^1 \tag{3} \\
   &= 3 \tag{4}
   \end{align}
   $$

4. **Mathematical Paragraph**

   You are **not required to understand** the mathematics below. Your task is to typeset the paragraph correctly.

   Newton's method is an iterative algorithm for solving nonlinear equations. Starting from an initial guess x_0, the method generates a sequence $\{x_n\}$ using the formula

   $$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}.$$

   Under suitable conditions, the sequence converges to a root of the equation $f(x) = 0$.

5. **Common Mathematical Symbols**

   Typeset the following expressions correctly.

   (a) Limit:
   $$\lim_{x \to 0^+} \frac{\log x}{\log(1/x)} = -1$$

   (b) Summation:
   $$\sum_{k=1}^{n} k = \frac{n(n+1)}{2}$$

   (c) Partial derivative:
   $$\frac{\partial u}{\partial x}$$

End of Assignment