Assignment (19-01-2026)

MA2221: Foundational Mathematics for ML

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 math:

   (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)

   $$\begin{aligned} (x+1)^2 &= x^2 + 2x + 1 && (1)\\ &= x^2 + 2x + 1 && (2) \end{aligned}$$

   (b)

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

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:

$$\frac{\partial u}{\partial x}$$