Assignment 1
Due date: 1 October 2025
TA: 林琮祐, 張意苹, 楊昀潼 (ECG 706)

1. (30%) Horner's rule is a strategy for evaluating a polynomial

$$A(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$$

at point x_0 using a minimum number of multiplications. This rule is:

$$A(x_0) = (\cdot((a_n x_0 + a_{n-1})x_0 + \cdots + a_1)x_0 + a_0)$$

Write a C program to evaluate a polynomial using Horner's rule.

> **Input:** $a_n\, a_{n-1} \ldots a_1\, a_0\, x$ (float numbers separated by space)
>
> **output:** $A(x)$

2. (30%) Ackerman's function $A(m, n)$ is defined as:

$$A(m,n) = \begin{cases} n+1, & \text{if } m = 0 \\ A(m-1,1), & \text{if } n = 0 \\ A(m-1, A(m,n-1)), & \text{otherwise.} \end{cases}$$

This function grows very quickly for small values of m and n. Write a recursive (15%) and iterative (15%) versions of this function.

> **Input:** $m\, n$ (two integers separated by space)
>
> **output:** $A(m, n)$

3. (20%) Show that the following statements are correct.
   a. $5n^2 – 6n = \Theta(n^2)$.
   b. $n! = O(n^n)$.
   c. $2n^2 + n \log n = \Theta(n^2)$.
   d. $\sum_{i=0}^{n} i^2 = \Theta(n^3)$.

4. (20%) Show that the following statements are incorrect.
   a. $2n^2 + 1 = O(n)$.
   b. $n \log n = \Theta(n)$.