

Assignment 1

Due date: 3 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: $a_n a_{n-1} \dots a_1 a_0 x$ (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. $n \log n = \Theta(n)$.