

## Assignment 1

Due date: 2 October 2024

TA: 薛凱駿, 楊承霖, 吳奇軒 (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.  $10n^2 + 9 = O(n)$ .

b.  $n^2 \log n = \Theta(n^2)$ .