

# CENG216 – Numerical Computation

## Homework 1

March 15, 2024

**Due Date:** March 29 16:59, 2024

### Exercise 1. Horner's Method (10 pts)

Rewrite the following polynomials using Horner's Method. Identify the number of addition and multiplication operations before and after applying Horner's method.

- a.  $P(x) = -2x^4 - x^3 + 5x^2 + 4x - 1$
- b.  $P(x) = -3x^5 + 2x^3 + 7x - 5$

### Exercise 2. Floating Point Representation (40 pts)

We have a format that matches the IEEE 754 standard but has 1 bit for the sign, 4 bits for the exponent, and 7 bits for the significand parts.

- a. What is the smallest positive subnormal number representable in this format?
- b. What is the largest negative subnormal number representable in this format?
- c. What is the largest positive subnormal number representable in this format?
- d. What is the smallest positive normalized number representable in this format?
- e. What is the largest negative normalized number representable in this format?
- f. What is the smallest negative normalized number representable in this format?

- g. What is the smallest number that is greater than 1?
- h. What is the largest number that is smaller than 1?

	sign	exp	frac	value
a				
b				
c				
d				
e				
f				
g				
h				

Answer the questions by filling the blanks in the table above in a way similar to what you have seen in the course slides. Please write the values in their exact but simplified forms, e.g.,  $\frac{2}{3}$  rather than  $\frac{4}{6}$  or 0.6667.

### Exercise 3. Root Finding (50 pts)

- a. Use the Bisection Method to find the root of the equation with a bias value of 0.01

$$-3 \ln x + \frac{2}{3}x^2 - 5 = 0$$

You will need to perform the Bisection Method on the interval  $[3, 4]$ . Do not round the values of interval points.

- b. Use Newton's Method to find the root to nine decimal places of the equation

$$2x^3 + 5x - 3 = 0$$

Write down the  $x$  values for three iterations. Calculate the forward and backward errors for the root  $r = 0.537785964$ .

- c. Show that -1, 0, and 1 are fixed points of

$$\frac{x^2 - 9x}{x^2 + x - 10}$$

### Important Notes

1. This is an individual homework. Any collaboration between homeworks is not allowed and will be considered as cheating.
2. You are expected to submit the **hard copies** of your homeworks.