

# Chapter 4: Computational Energy Analysis of Newton's Method

## A Study of the General $n$ th Root Algorithm

Energy-Efficient Computing Research

### Introduction

#### Research Question

How much **computational energy** does Newton's method consume when generalized to find any  $n$ th root?

- Newton's method is a powerful algorithm for finding roots
- We've generalized it from square roots to **any  $n$ th root**
- Why does energy matter?
  - Battery life in mobile devices
  - Server costs and carbon footprint
  - Real-time system constraints
  - IoT and edge computing limitations

### The General Algorithm

```
def newtons_nth_root(n: int, value: float, guess: float = 1.0):  
    """Find the nth root of a value using Newton's method"""  
    tolerance = 0.0001  
  
    while abs(guess**n - value) > tolerance:  
        # Newton's formula: y_new = y - f(y)/f'(y)  
        # For f(y) = y^n - value:  
        guess_new = guess - (guess**n - value) / (n * guess**(n-1))  
        guess = guess_new
```