

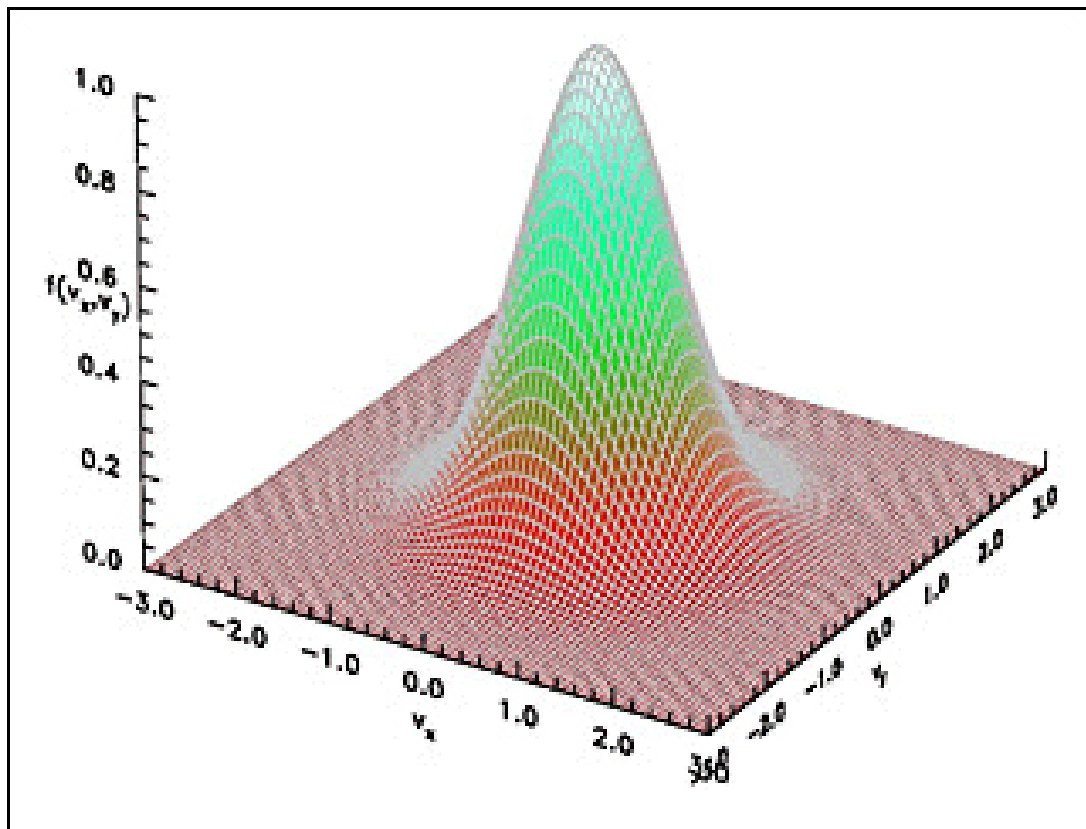
CSIE5123: Numerical Method

Vinsong

January 16, 2026

Abstract

The lecture note of 2023 Spring Numerical Method by professor 林智仁.



Contents

Chapter 1

Floating-point systems

Lecture 1

1.1 Floating-point basics

This chapter is mainly based on the science of floating-point arithmetics which is based on the IEEE standard 754.

1.1.1 Why learning floating-point operations?

Example. A one-variable problem

$$\min_x f(x) \quad \text{where } x \geq 0$$

In the normal program, we should set an **upper bound** of x , or x may be wrongly increased to ∞ . We have to find the largest representable number in the computer

Example. A ten-variable problem

$$\min_{\mathbf{x}} f(\mathbf{x}) \quad \text{where } x_i \geq 0, i = 1, 2, \dots, 10$$

We want to know how many are zeros, we may use

```
1 for (int i = 0; i < 10; i++)
2     if (x[i] == 0) count++;
```

But people say that don't do the comparison of floating-point

```
1 double epsilon = 1.0e-12;
2 for (int i = 0; i < 10; i++)
3     if (x[i] <= epsilon) count++;
```

Which is better? How to choose `epsilon`? Can't do the comparison of floating-point? We need to understand the floating-point representation.

1.1.2 Floating-point Format

We know `float` (single precision): 4 bytes and `double` (double precision) 8 bytes in C/C++.

Definition 1.1.1 (*format*). A floating-point system requires a base β , precision p , significand (mantissa) $d.d \dots d$