Von Neumann

The computer and the brain

John von Neumann (1903–1957) was a mathematician greatly renowned for his theory of games, which has had considerable influence on the field of economics, and for his work at the Electronic Computer Project at the Institute for Advanced Study, Princeton, where he was one of the institute's original professors. During his relatively short lifetime he made significant contributions to quantum physics, logic, applied mathematics, and computer science; much of his work is still in use today. With F. J. Murray, he developed the theory behind the quantum concept "rings of operators," now termed von Neumann algebras. A forerunner in the field of computer science, he addressed design questions such as how to construct cellular automata and the use of the bit in computer memory. He served as a military consultant during World War II and later participated in the creation of the hydrogen bomb. At the time of his death from cancer in 1957, he was a member of the Atomic Energy Commission.

Biography

- Von Neumann

約翰·馮·諾伊曼

20世紀40年代的馮·諾伊曼

出生	1903年12月28日 匈牙利布達佩斯
逝世	1957年2月8日 美國華盛頓

約翰·馮·諾伊曼（英語：John von Neumann，1903年12月28日－1957年2月8日），匈牙利語原名：Neumann János，出生於匈牙利的美國籍猶太人數學家，現代電腦創始人之一。他在電腦科學、經濟、物理學中的量子力學及幾乎所有數學領域都作過重大貢獻。

1926年以22歲的年齡獲得了布達佩斯大學數學博士學位，相繼在柏林大學和漢堡大學擔任數學講師。1930年接受了普林斯頓大學客座教授的職位，初來美國時，他在紐約對當地居民表演過默記電話簿的驚人記憶力，1931年成爲該校終身教授。1933年轉入普林斯頓高等研究院，與愛因斯坦等人成爲該院最初的四位教授之一，不須上課。這一年，他解決了希爾伯特第5個問題，證明了局部歐幾里得緊群是李群。1937年成爲美國公民，1938年獲頒博修獎（Bôcher Memorial Prize），一生結過兩次婚，馮·諾伊曼是個不重視生活細節的人，他在一間房子住上多年，有一次居然憂心忡忡的問老婆杯子放在哪裡。1954年任美國原子能委員會委員。1954年夏天，右肩受傷，手術時發現患有骨癌，治療期間，依然參加每週三次的原子能委員會會議，甚至美國國防部長，陸、海、空三軍參謀長聚集在病房開會。1957年2月8日，在華盛頓德里醫院去世。晚年，有學生請教他做事的方法，他說：「簡單」（simple）。1994年被授予美國國家基礎科學獎。

量子力學

馮·諾伊曼認為，量子理論是普遍有效的，不僅適用於微觀粒子世界，也適用於現實的測量儀器。1932年約翰·馮·諾伊曼將量子力學的最重要的基礎嚴謹地公式化。按照諾伊曼的一個物理系統有三個主要部分：其量子態、其可觀察量和其動力學（即其發展趨勢），此外物理對稱性也是一個非常重要的特性。馮·諾伊曼的量子力學教科書《量子力學的數學基礎》首次以數理分析清晰地提出了波函數的兩類演化過程。

- 瞬時的、非連續的波函數坍縮過程
- 波函數的連續演化過程，遵循薛丁格方程式

- Von Neumann wrote 150 published papers in his life; 60 in pure mathematics, 20 in physics, and 60 in applied mathematics. His last work, Gravestone of John von Neumann written while in the hospital and later published in book form as *The Computer and the Brain*, gives an indication of the direction of his interests at the time of his death.

- **Logic and set theory**
- **Quantum mechanics**
- **Economics and game theory**
- **Mathematical statistics and econometrics**
- **Nuclear weapons**
- **Computer science**

范紐曼型架構

- **von Neumann architecture**

范紐曼型架構的設計概念。
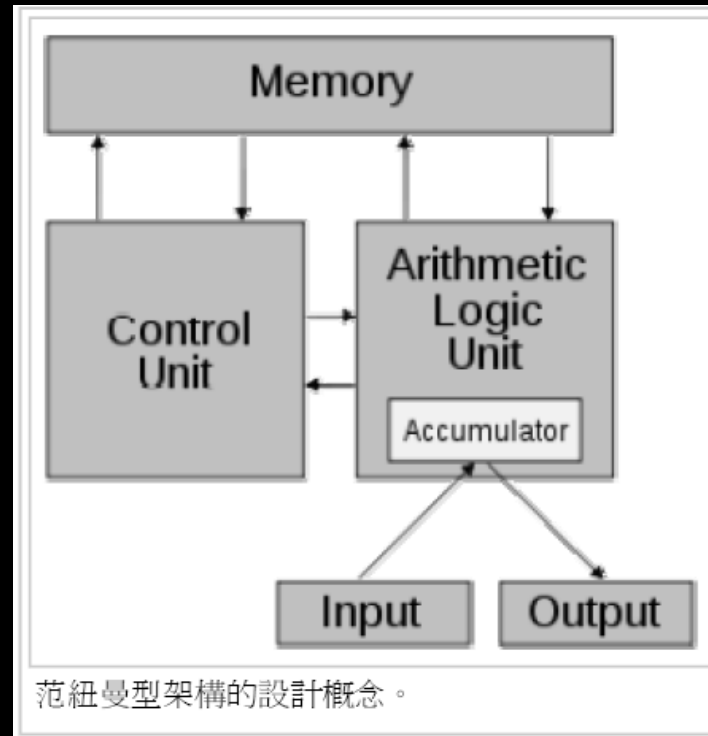
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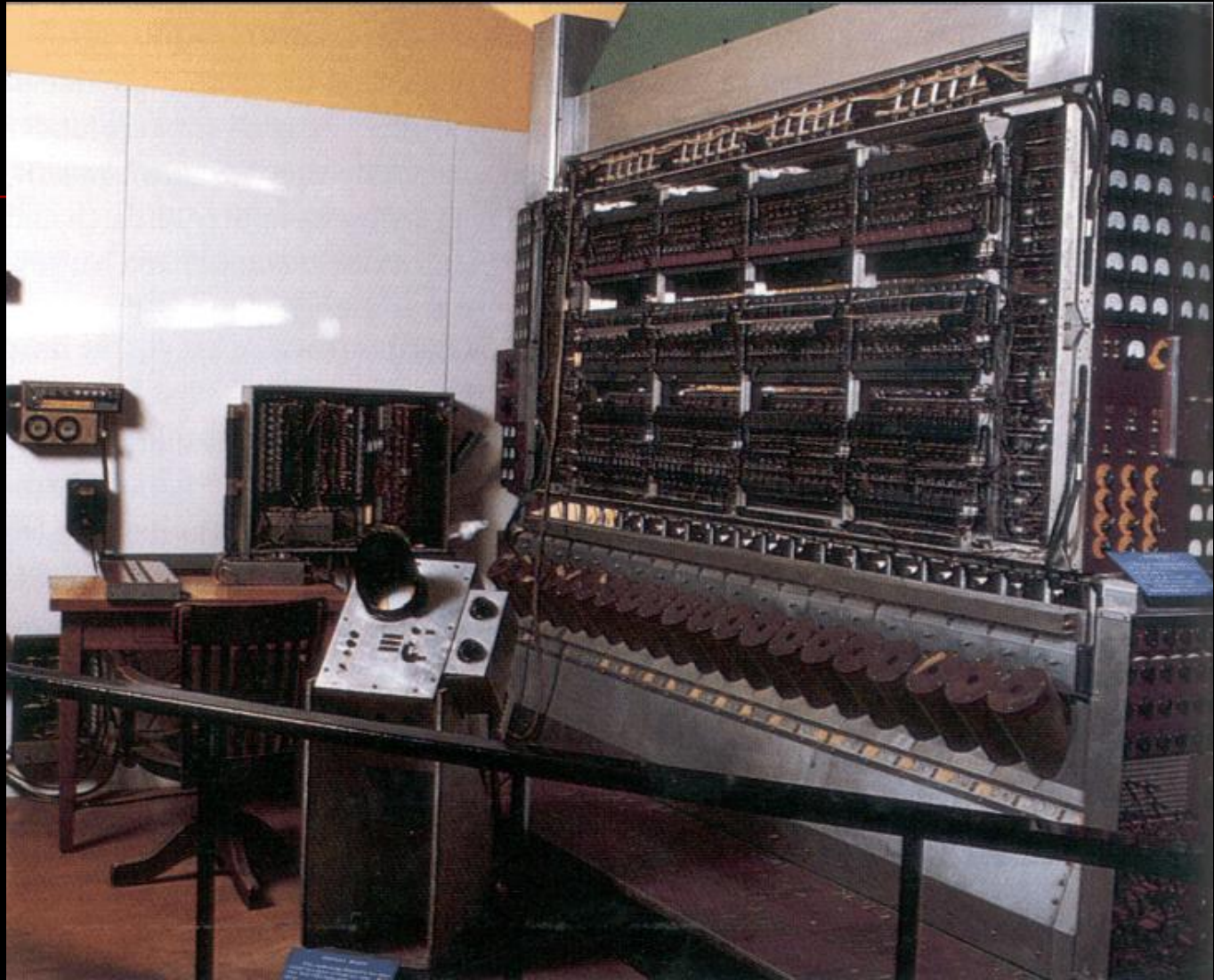
Computer architecture

- ☐　用二進制數字
- ☐　序列執行 (一個指令接著一個指令地執行，不是平行計算)
- ☐　程式與資料都儲存在電腦裡面 (因此需要設計記憶體)

The computer and the brain

- [The computer and the brain](#)

The basic component of this system is the *nerve cell*, the *neuron*, and the normal function of a neuron is to generate and to propagate a *nerve impulse*. This impulse is a rather complex process, which has a variety of aspects—electrical, chemical, and mechanical. It seems, nevertheless, to be a reasonably uniquely defined process, i.e. nearly the same under all conditions; it represents an essentially reproducible, unitary response to a rather wide variety of stimuli.

Chapters

The Nature of the Nerve Impulse

Stimulation Criteria

The Problem of Memory in the Nervous System

Digital and Analog Parts in the Nervous System

Control of the Functioning of a Machine

The Logical Structure of the Nervous System

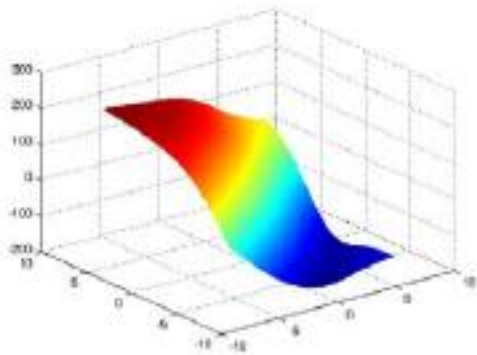Nature of the System of Notations Employed

Question of Language

Function Exploration

Two-dimensional Functions

One dimensional function: Mapping from R to R

- tanh(x)
- sin(x)
- cos(x)

(a)

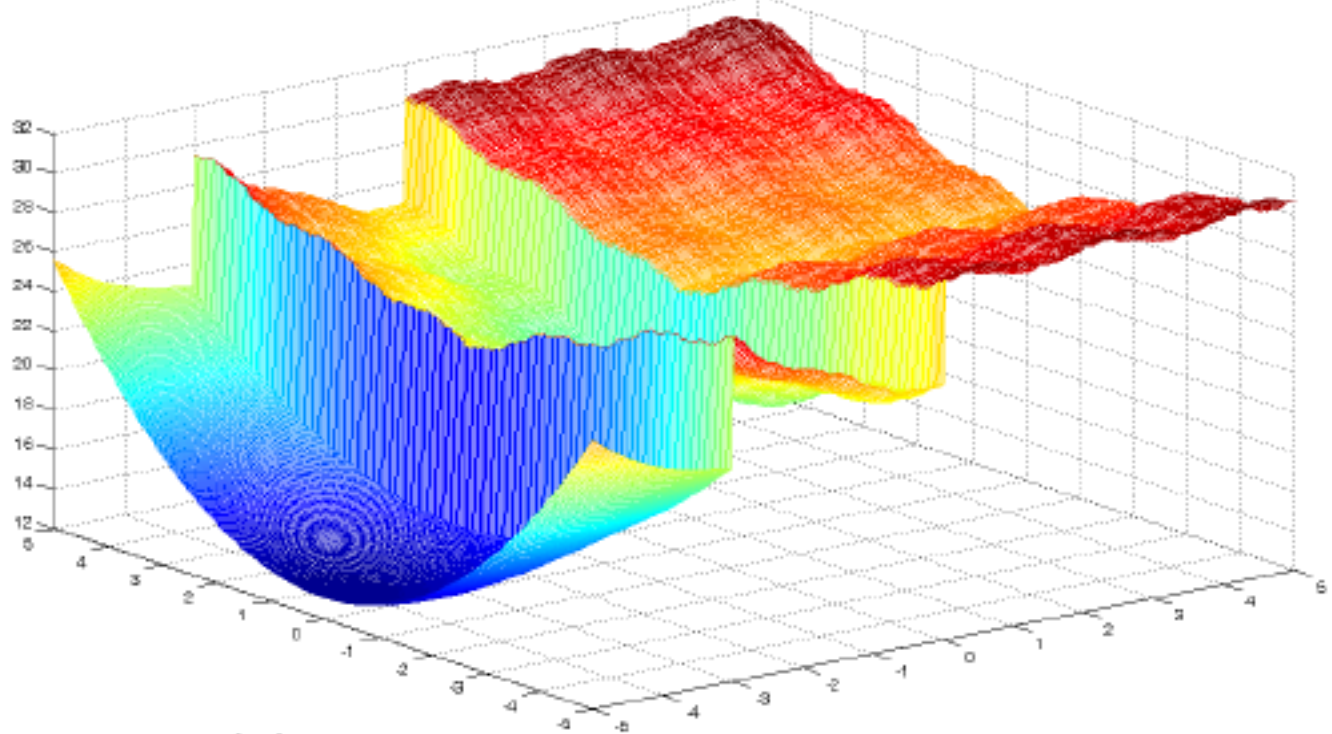MRBF by neural&SFE learning

(b)

NREF by smoothed FE learning

(c)

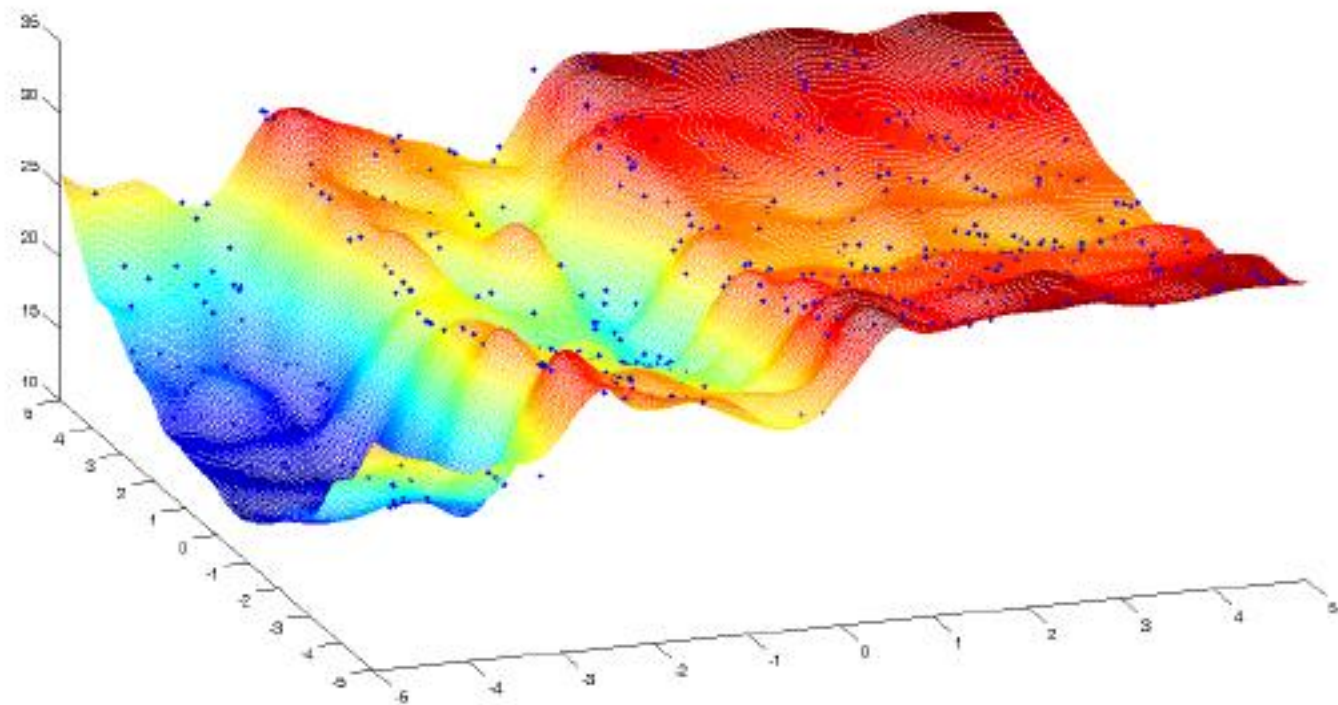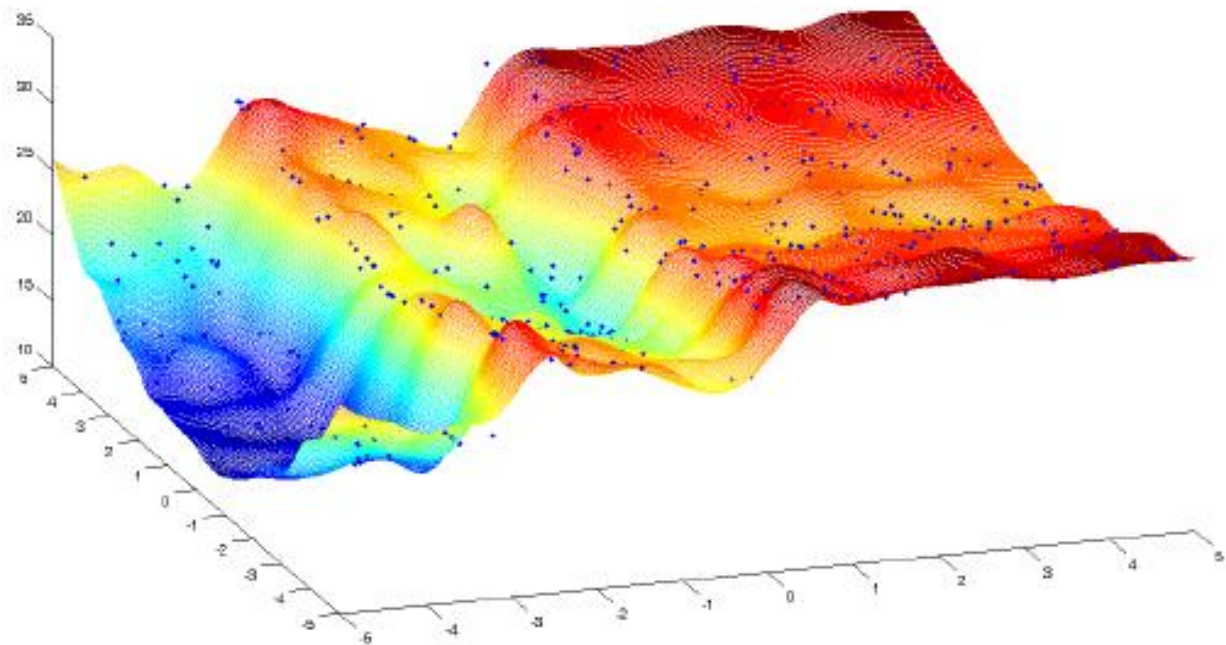NREF by convoled FE learning
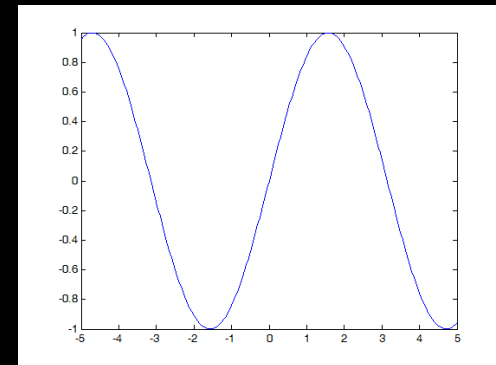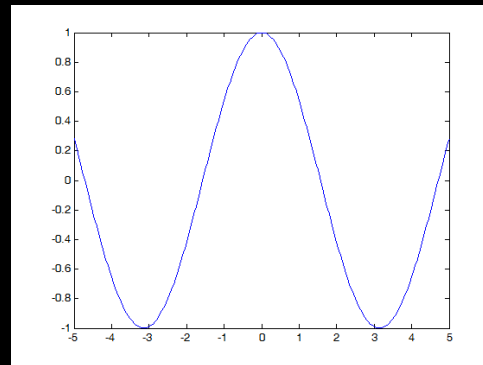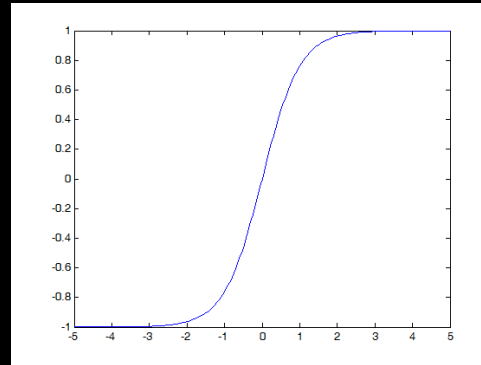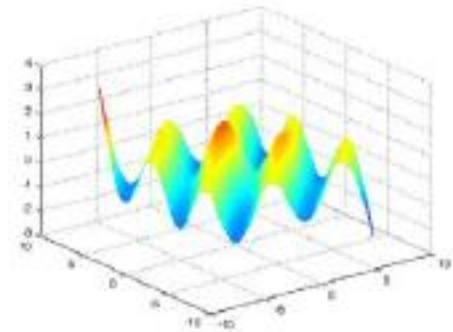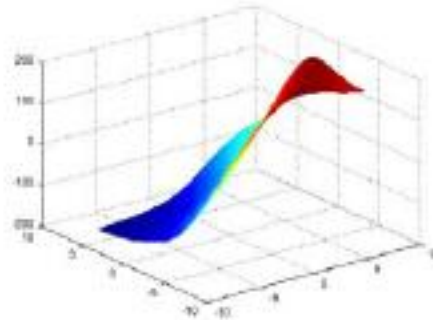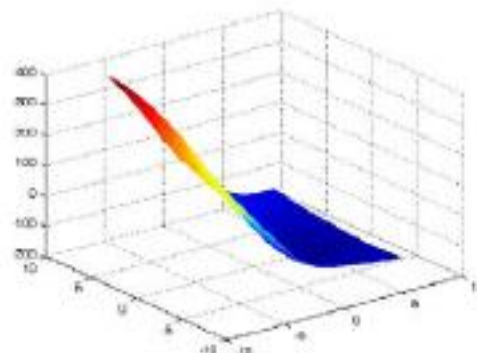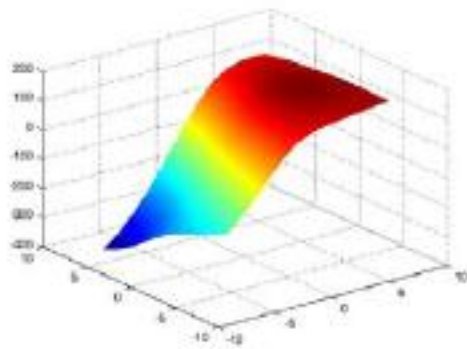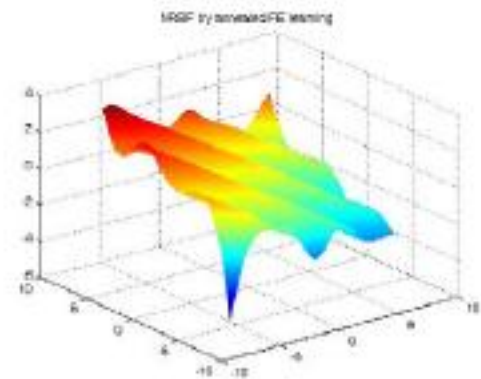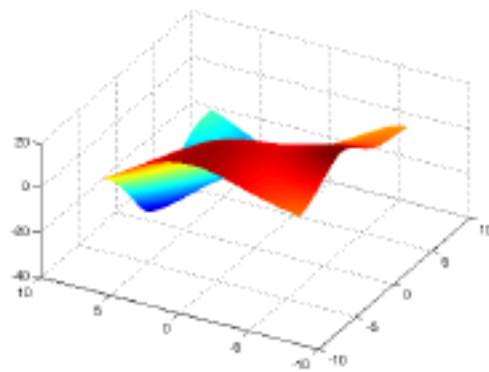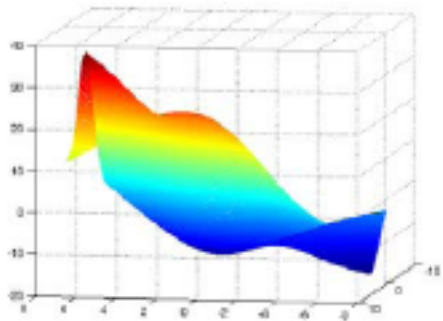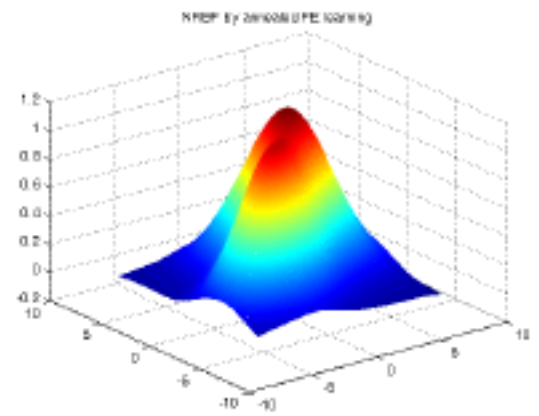
NRBF by annealed FE learning

(a)

(b)

(b)

Function visualization

- Two-dimensional functions
- Mapping from R^2 to R^2
- Linear functions
  - f(x,y)=x+y+2

Nonlinear functions

- $f(x,y)=\tanh(x+y)$
- $f(x,y)=\tanh(x+y)+\tanh(x-2y)$
- $f(x,y)=x^2+y^2$
- $f(x,y)=\sin(x+y)+\cos(x-y)$