Chapter 1: 重點在 last pages 14 & 15

- Global sense
- Limitation of Boolean operation + ~….
- Neural model operation
- See figures in Cheaper 1
- Hyperspace 銀杏葉 B.18+B.26
- Solution space of Boolean neurons and cellular automata Chap. 7+8, B.1

Chapter 2 重點

- McCulloch-Pitts neurons 1943
- Perceptron 1957
- LMS learning, Widrow 1960
- Perceptrons,
- Minsky and Papert 1967
- Solution space 2005 2010

Training & learning behaviors

Solution space 2005 2010

- Solve, by training & learning,

  Boolean algebra
  Linear algebra
  Logic circuit
  Graph theory
  Geometrical representation

Two leaps

- Widrow 1960, linear neuron, LMS
- Sigmoid functions

  replace hard limited function

  differentiable fctn + well behave

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Widrow's LMS learning

- Linear neuron
- Makes the learning possible.
- Introduces an error surface.
- The surface slope shows the better one.

- All design comes from his imagination.

Remark on Perceptron

- Learning hard vs. learning easy

I: 2 inputs, there are 16 Boolean fctns

2 out 16 cannot be implemented XOR

II: 2 inputs 3 neurons (2-2-1)

14x14x14=2744 total combinations

16 among 14x14x14 for the XOR

144 among 2744 for the AND

Remark for 3 inputs

- for 3 inputs 256 fctns

  152 out 256 cannot be implemented
- 3 inputs 3-2-1 cannot solve

  $x1 \oplus x2 \oplus x3$ and $\sim(x1 \oplus x2 \oplus x3)$.
- 3-3-1 can solve all 256 fctns.

  see the 3-3-1 plot in Chapter 1

Perceptron是不等式 有方向的線

- Complementary part of linear algebra
- Missing part of linear algebra
- Restrictions of linear algebra (等式):
- X all N planes pass the same point 相交
- X Det|.| square matrix 是關鍵靈魂,
  Jacobian matrix and determinant (靈魂)
- # of eqs.= # of variables
- 因為 全新元素 (故另取名) 可建造新結構
- SVM 的基礎

Remarks on Widrow LMS 1960

- Multiple neurons, perceptron 1957 如虎填翼
- Weights can do self-tuning in swiftly changed environments
- Least–mean-square LMS (不須統計假設)
- Linear fctn (not hard-limiting fctn)
- 賦與 perceptron 全自動 自調能力
- Incapable of Boolean algebra; set theory; linear algebra; TM; AI; automaton(1959) etc..

  之前所有方法皆無此自調學習威力

Remark on perceptron

- 銀杏葉邊界是什麼弧線？
  solution space of F2
  0-dimension point
  可以完整代表整個巨大的
  N-1 dimensional hyperplane

  Collection of such points = soln. space
  14 solution spaces for 14 boolean fctns
  (Math. Homogeneity isomorphism 等價於 同質同構) 可以解釋所有 perceptron 自調學習古怪行為

Perceptron

- In BP, certain neurons in slow learning period ‘D’ have fixed fctns, the MSE is reduced by the rest neurons that change fctns swiftly.

- Least–mean-square LMS (不須此統計 mean 假設 直接降低錯誤值就可 Chapter 2)

Remark on perceptron 鑑別 區分線

- 扭轉改變 Boolean logic 意義 方向
- 新方向為 分類 Classification 鑑別 區分 分割
- Perceptron = 區分線 鑑別線 區別線 分割線
- 新數學仍具有 Boolean 代數 威力
- Boolean 分類
- A+B=1 OR 集合
- AB=1 AND 集合
- 連立方程 A+B=1 ^ AB=1 交集 A=1 B=1

Remark on Perceptron

- 文獻中 perceptron 的 learning 皆被視為 black box 黑盒子
- Chap.2 找出背後隱藏的規則
- Perceptron 沒有 local minimum
- 所有的 14X13 個 fctns 直接收斂到 global minimum, convex
- 座標在 input space, X,上 非 weight space W
- 找出 Equivalent Isomorphism
- 14 個Boolean fctns 異質同構 等價結構