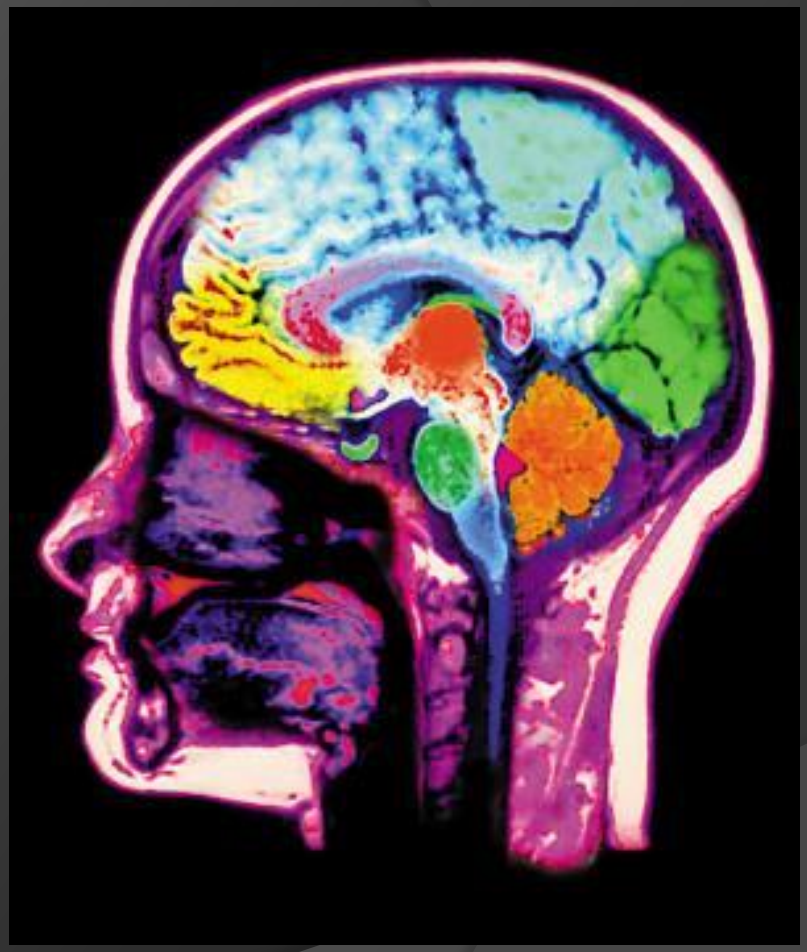
讀心術



第九組
陳建安 曾煥富 楊理博

Outline

1. What is Mind Reading?
2. How to Achieve Mind Reading?
3. What is fMRI?
4. How to use fMRI for mind reading?
5. Conclusion

What is Mind Reading?

How to Achieve Mind Reading?

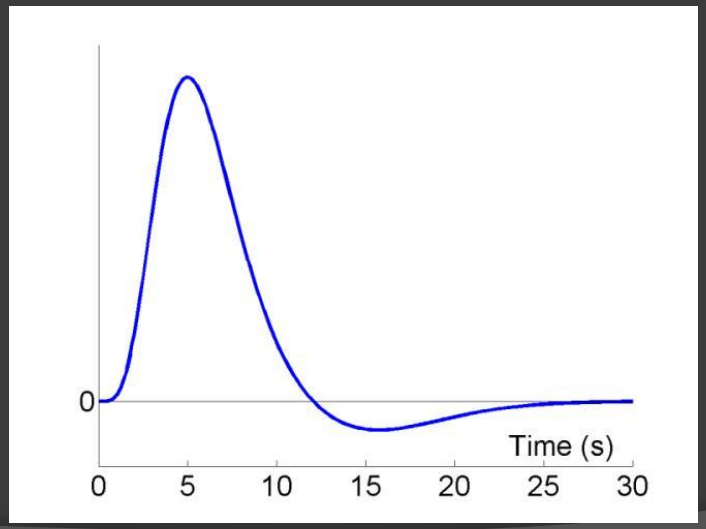
- 表情分析 Expression Analysis
- 心理測驗
- Thought Identification
  - 利用神經成像技術
  - 辨識高維度的大腦圖案
  - 以達到鑑別人腦思想的目的

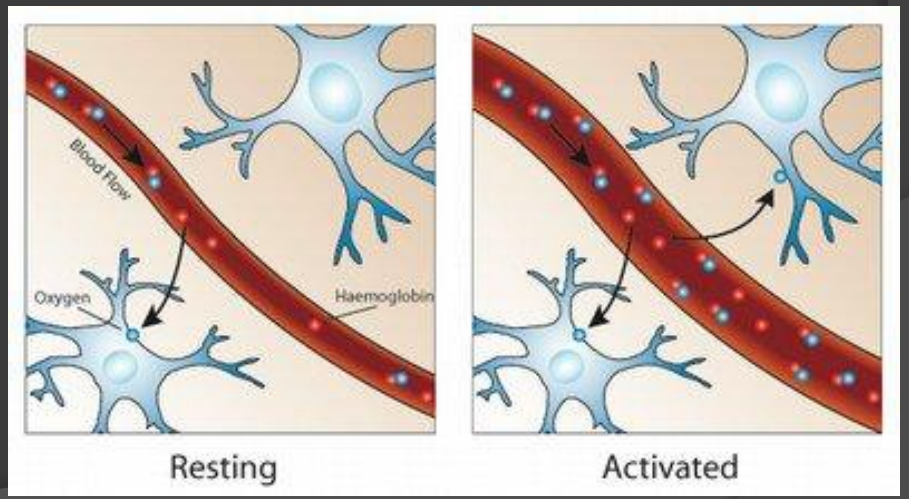
What is fMRI?

- Functional MRI
- 利用 MRI 的方法掃描大腦的神經活化狀態圖
  - 應用 MRI 技術
  - 辨認帶氧/不帶氧血紅素的反/順磁性
  - 量測T2*

fMRI signal

- Blood Oxygenation Level Dependent (BOLD)
  - Blood flow response of electric signal
  - Discovered by Seiji Ogawa
- Hemodynamic response
  - Blood increase corrleates to the activity of neurons





Time and Space Preprocessing

- Time filter
- Space filter
  - Gaussian filter
    - Estimation FWHM = 2.35s

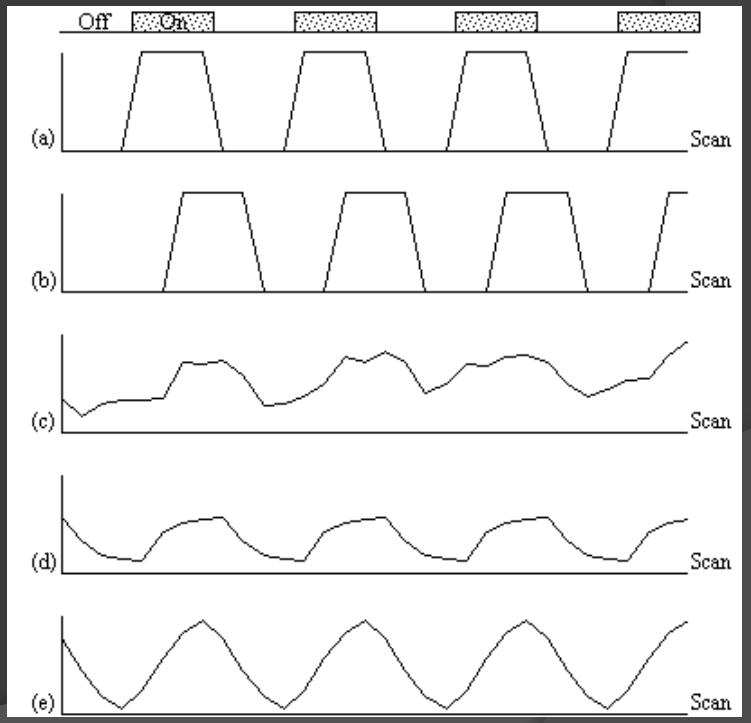
預處理

- Motion Correction
  - 因為在測量過程中，受試者頭部可能轉動，用3D-norm-preserving linear transform，可以對回來。利用cost function 之minimization，可以optimize。
  - 而建立資料庫時，要將不同受試者頭部影像對準參考影像，必須做更複雜的伸縮、擠壓、變形。

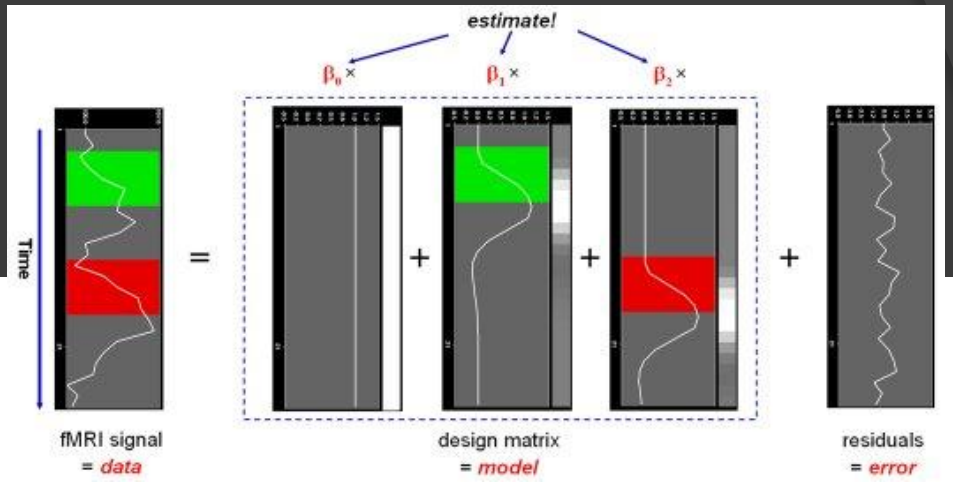
簡而言之...

How to use fMRI for mind reading?

- 信號處理技巧：
  1. Generalized Linear Model
  2. Serial T-Test
  3. Subtraction Techniques
  4. Correlation Techniques



Generalized Linear Model



$$y_i = x_i\beta + \varepsilon_i \quad (6.10)$$

$$\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon}, \quad (6.11)$$

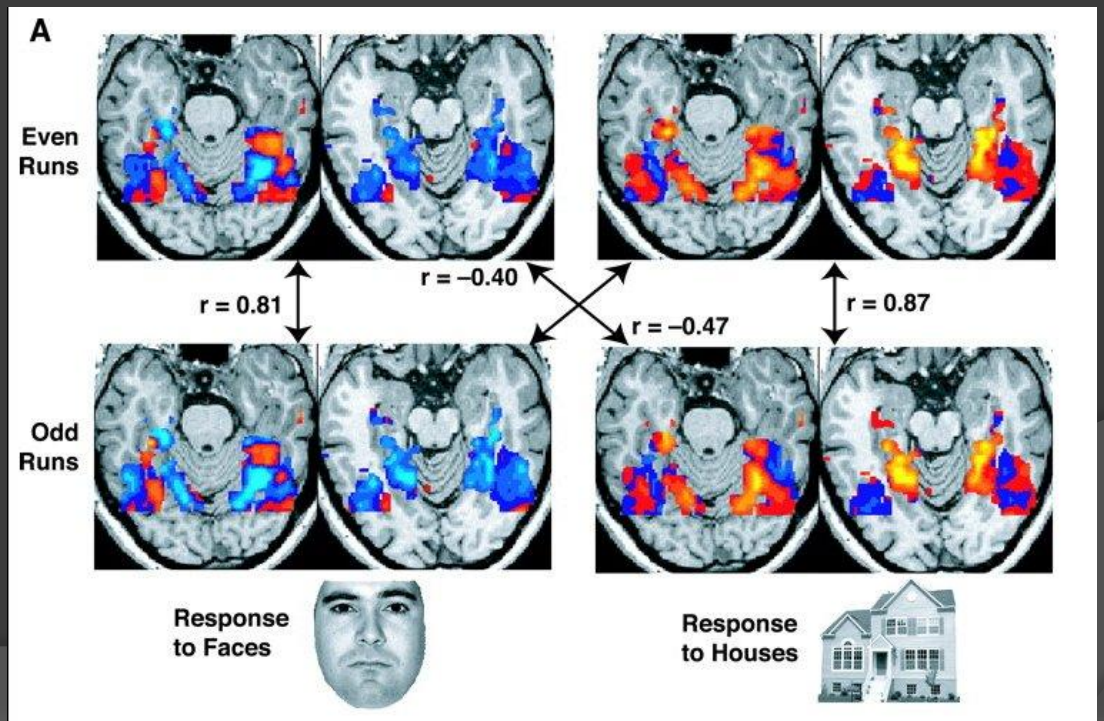
Y is the vector of observed pixel values, **b**is the vector of parameters and **e** is the vector of error terms. The matrix **X** is known as the design matrix.

$$\mathbf{X}^T\mathbf{Y} = \left(\mathbf{X}^T\mathbf{X}\right)\hat{\boldsymbol{\beta}} \quad (6.12)$$

$$\hat{\boldsymbol{\beta}} = \left(\mathbf{X}^T\mathbf{X}\right)^{-1}\mathbf{X}^T\mathbf{Y} \quad . (6.13)$$

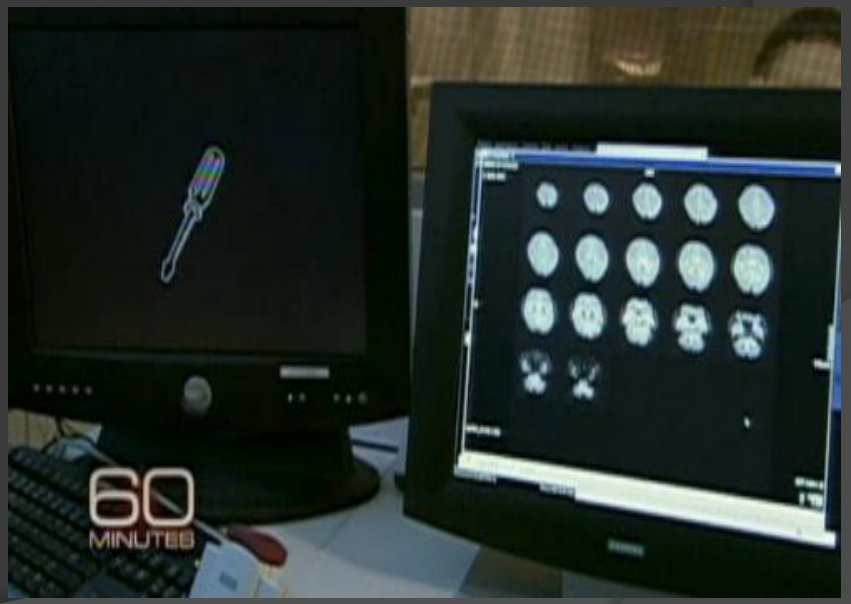
三個實例

- 辨認腦中所想的物體
- 辨認意圖
- 辨認對環境的記憶



辨認腦中所想的物體

- 實驗方法：
  給受測者兩張不同物品的圖片，腦中想著其中一張
- 如何辨認：
  分析人想到某些特定物品時腦中被活化的區域
- 結論：普世性



辨認意圖

- 實驗方法：
  給受測者兩個數字，自行選擇做加、減法
- 如何辨認：
  分析腦中決策的區域

辨認對環境的記憶

- 實驗方法：
  受測者觀看環境影片，記錄腦中活性變化
- 應用：
  刑事辦案
- 問題：
  驗證性

Conclusion

- 待解決之問題：
  - 機器體積龐大
  - 測量耗時
  - 成本高
- 聽聽專家怎麼說！