智慧醫療：台灣的機會和挑戰

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Taiwan's COVID spike
Automatic interpretation of radiological images

Monitoring disease risks

Develop new drugs

Predict COVID trend
It seemed that Watson could understand the meaning of language, rather than just patterns of words.
Watson’s Medical AI Moon Shot Project

Watson’s electronic brain
Dr. Watson

• Goal:
  • Reduce diagnosis errors
  • Optimize treatments
  • Alleviate doctor shortages

• How
  • Collection of symptoms and came up with a list of diagnoses and treatment
  • Each annotated with Watson’s confidence level and links to literature

• Confidence
  • Memory banks held knowledge of every rare disease and newest trials
  • Processors not susceptible to cognitive bias
Brief history of IBM Watson

- IBM Research Project (2006 – )
- Jeopardy! Grand Challenge (Feb 2011)
- Watson for Financial Services (Mar 2012 – )
- Watson Industry Solutions (2012 – )

Steps:
- R&D
- Demonstration
- Commercialization
- New Division
- Expansion
- Cross-industry Applications
“This product is a piece of sh-."

“Multiple examples of unsafe and incorrect treatment recommendations,”
It’s all about “DATA”

• That narrative text accounts for about 80 percent of a typical patient’s record—and it’s a stew of jargon, shorthand, and subjective statements

• Even for MD Anderson, they only have hundreds of beds, could not cover the vast variety of human diseases

• Trained the software on a small number of hypothetical cancer patients, rather than real patient data leads to disaster
Dirty Medical Data

• Heterogeneity
  • Different drug preference for different hospital/physicians
  • Different treatment recommendation over different periods
  • Different insight for different levels of doctors
  • Different selection of testing orders

• Problems specific for Taiwan
  • Use a lot of atypical short-hand
  • Physician’s note, not English, not Chinese, but “Taiwanese Chinglish”
  • Under-recording for doctor’s note, overrepresenting of nurse charting notes
Of 29 FDA approved SamD, Image applications account for >70%
台灣的機會和挑戰
資料 人才 算力 轉譯
Let’s build a Medical ImageNet of Taiwan
AI model is ethnic/region sensitive

AI model based on Western countries may not be able to apply to Asian countries
台灣三座金山

GOLDMINE 健保資料庫
GOLDMINE 電子病歷資料庫
GOLDMINE 人體生物資料庫
挑戰- Privacy Issue

A truly international resource

OVER 19,000 GLOBAL REGISTRATIONS

2012

307

85% UK
15% International

2019

5,947

22% UK International
78% International
資料

Opportunity

Challenge
Medical image needs lots of efforts for annotation
Cross-disciplinary Training
opportunities and challenges for cross-disciplinary professionals in AnnotationIST
台大醫院建置二套 NVIDIA DGX-A100
目前運算效能最快的AI超級電腦

醫學影像辨識、基因體分析需要龐大的電腦儲存與算力

- 醫療影像: 提升2倍效能
- 自然語言: 提升5倍效能
- GPU 分成七個執行體，提升7倍效能
- 支援基因高速運算，提升2.25倍效能
- 人類全基因定序僅需20分鐘
算力

Opportunity

Strong IT industry

Challenge

Underuse of cloud computing
AI paper hits record high
Newly funded AI startup record low
# Table 1 Clinical machine learning readiness levels

<table>
<thead>
<tr>
<th>TRL</th>
<th>NASA Definition</th>
<th>Clinical Definition</th>
<th>Explanation</th>
<th>Examples</th>
<th>Papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic principles observed and reported</td>
<td>Clinical problem identification</td>
<td>Identification of potential medical machine learning solution to defined clinical problem. Appraisal of the literature is carried out. Medical research question is defined.</td>
<td>Review of the literature giving clinical motivation for model</td>
<td>0%</td>
</tr>
</tbody>
</table>

Model prototyping & Model development

| 9   | Actual system proven through successful mission operations | Model integration | Model has proven to work in a research setting in its final form and in expected conditions. Model is integrated in the clinical workflow and evaluated in different centers (if appropriate) whether it meets specifications. | Long term model evaluation after integration in a clinical workflow | 0% |

Papers

- 93%
AI 模型需要第三期臨床試驗

第1期：確立藥物的安全性及合適的劑量
第2期：評估藥物對特定病患的療效和副作用
第3期：監測新藥物在被廣泛應用下的安全和療效情況
第4期：與現有藥物比較，如能達到預期療效，可通過國際藥物監管機構認證並上市。
台大醫院成立智慧醫療中心

資料
華人最優質的醫療大數據
算力
啟用2台AI超級電腦/建置運算專區
人才
60個臺灣大學人工智能團隊/
轉譯
臨床試驗場域/推動醫療醫材軟體試用
落地辦法

資訊安全

病患隱私資料不外洩

不影響Portal系統效能

確效機制與定期紀錄
台大醫院醫療器材軟體試用申請流程
<table>
<thead>
<tr>
<th>適用之醫療照護情況</th>
<th>提供的資訊對於臨床照護決策之重要性</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>治療或診斷</td>
</tr>
<tr>
<td>危急情況</td>
<td>IV</td>
</tr>
<tr>
<td>嚴重情形</td>
<td>III</td>
</tr>
<tr>
<td>非嚴重情形</td>
<td>II</td>
</tr>
</tbody>
</table>

說明：
1. 治療或診斷：藥材軟體輸出資訊直接作為醫師治療或診斷的依據
2. 驅動(drive)臨床管理: 藥材軟體輸出的資訊啟動護理人員對病人進行二度評估或介入
3. 告知(inform)臨床管理資訊：藥材軟體輸出之資訊僅供參考，醫療診斷或決策由護理人員執行
轉譯

Opportunity

High Quality Clinical Trial Center

Challenge

PHASE III TRIAL

Education Regulation
李建璋
台大智醫中心副主任

Thank You