

Data System Seminar Series
August, 2023



HINCare: Data-Driven Volunteering

Prof. Reynold Cheng
Department of Computer Science
University of Hong Kong

<https://reynold.hku.hk>

ckcheng@cs.hku.hk

Reynold Cheng



THE UNIVERSITY OF HONG KONG
DEPARTMENT OF
COMPUTER SCIENCE

Current positions

Associate Dean, Engineering
Associate Director, Institute of Data Science
Director, Data Science & Engineering
Director, STAR Lab

Research

Data science, big graph
analytics, uncertain data
management

Education

Purdue (PhD, MSc, 00-05),
HKU (BSc, MPhil 95-00)

Research Awards

AI 2000 Most Influential Scholar 2023
World's Top 2% Scientists by Stanford 2022
SIGMOD Research Highlights Award 2020
Universitas 21 Fellowship 2011-12
HKU Outstanding Young Researcher Award (2011-12)
Performance Reward, HKPolyU (2006, 2007)

Knowledge Exchange Awards

HKU Knowledge Exchange Award (Engineering) 2021
HKICT Award 2021
Asia Smart Apps Competition (2020, 2021)

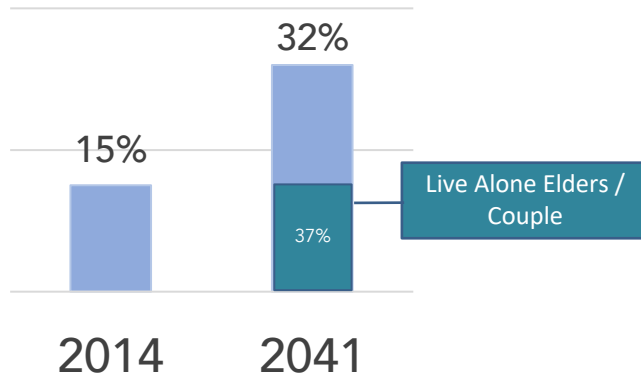
Helper shortage for Elderly Care Services



1 Volunteer to 10 Elders

30% shortage of staff in Elderly Centers

% of HK population over 65



Elders Queuing for Residential Care > 39k
Queueing time > 38 months



Timebanking: mutual help & social credits
volunteering & timebanking

HINCare Team

Computer Science



Prof. Reynold Cheng

Principal Investigator



Prof. Ben Kao

Social Work & Social Administration



Prof. Terry Lum



Dr. Hao Luo

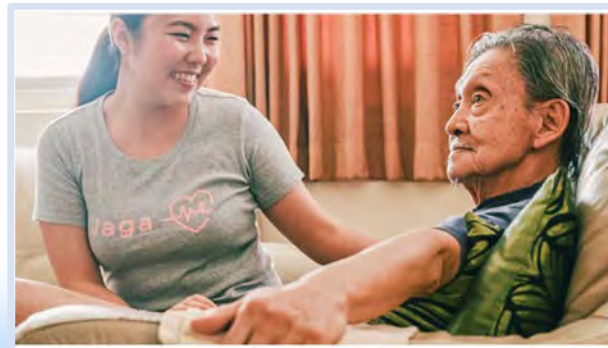


Social Technology And Research



HINCare: Intelligent Elderly-Care Recommendation

- A software that encourages citizens to help each other through **timebanking**
- Developed by **\$4M ITF MRP** (midstream research project) grant from 2019-22, and now by 12 NGOs



HINCare



THE UNIVERSITY OF HONG KONG
DEPARTMENT OF
COMPUTER SCIENCE

 創新科技署
Innovation and Technology Commission



Department of Social Work
and Social Administration
The University of Hong Kong



HKU Musketeers Foundation
Institute of Data Science
香港大學同心基金數據科學研究院



Serving 12 NGOs
(6000+ users from
NGO-based centres)



HINCare

12+ NGOs



香港聖公會將軍澳安老服務大樓
HONG KONG SHENG KUNG HUI TSEUNG KWAN O AGED CARE COMPLEX



基督教家庭服務中心
Christian Family Service Centre



安徒生會
Hans Andersen Club
Est. 1963



循道衛理楊震社會服務處
Yang Memorial Methodist Social Service



香港中華基督教青年會
Chinese YMCA of Hong Kong



賽馬會齡活城市
Jockey Club Age-friendly City



香港聖公會東涌綜合服務
H.K.S.K.H. Tung Chung Integrated Services



長者學苑



浸信宣道會恩禧中心



循理會
社會服務
FMC SOCIAL SERVICE
循理會德潤耆安會所



香港傷健協會
Hong Kong PHAB Association



HINCare



front-end



back-end

- Time-banking
- Multiple NGO subscription
- Intelligent matching



Mobile App

- Allow a user:
 - (1) As service recipient: request for services
 - (2) As service provider: find services to perform
- With large fonts and spacing



Mobile App Features

- Reward Redemption with time credits



Mobile App Features

- Agent for elders (e.g., family members)



Mobile App Features

- Voice-over navigation for visually impaired



Mobile App Features

- On-line Account registration



Mobile App Features

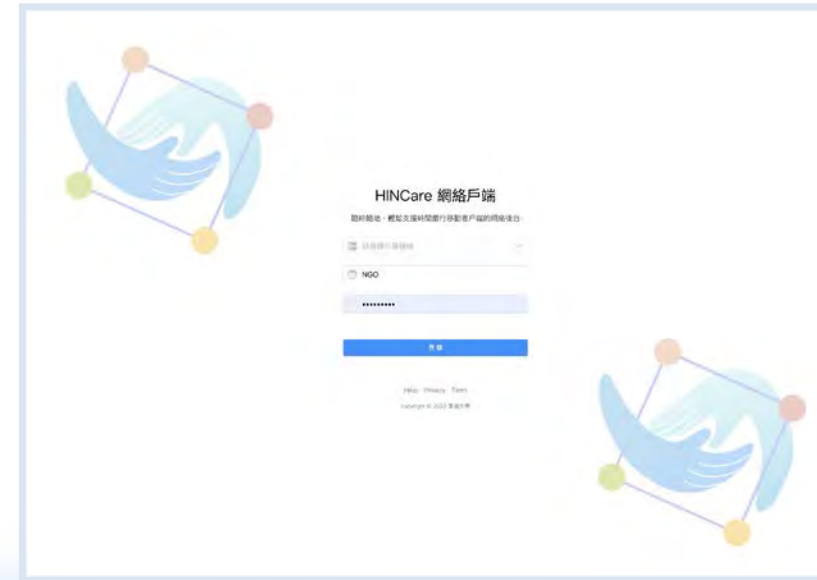
- Bilingual Support



Co-creation with NGOs
to design
user interface!

HINCare is Ready to Go

- NGO can set up HINCare in minutes!
 - No software installation
 - A few customization steps.
- Supports **multiple organizations**, for data sharing and collaboration.
- A scalable cloud-based system that supports up to 100 **organizations**



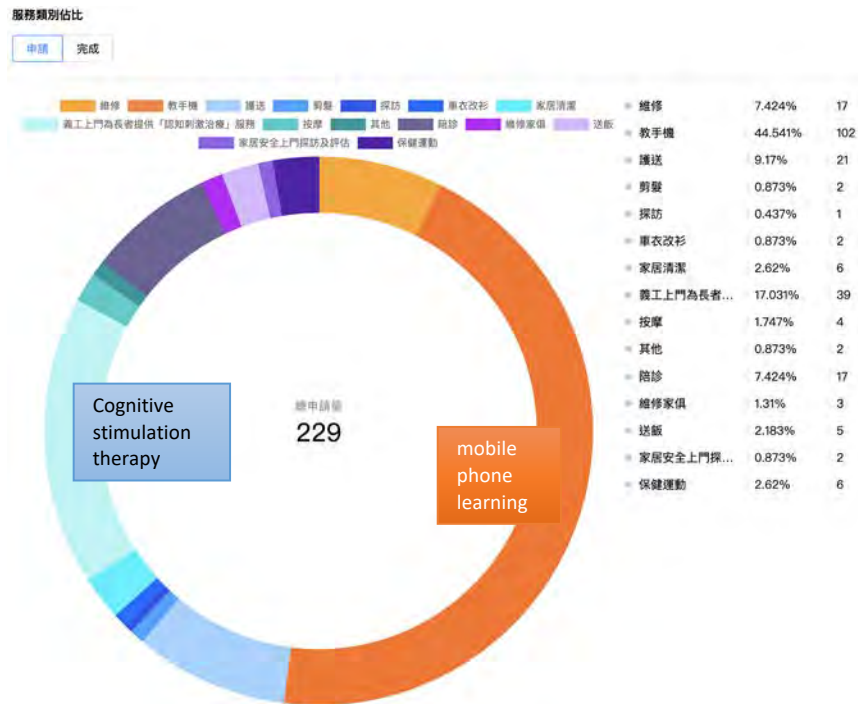
Web-based backend

- A user-friendly web-based backend system for center administrators
- Provide simple and secure management, and data analytics

The screenshot displays the HINCare web-based backend system interface. The top navigation bar includes the title "HINCare 網絡用戶端", the user role "時間銀行·生活助手", and the user name "管理員". A left sidebar menu lists various management options: 概覽, 職員, 用戶, 活動, 通告, 獎勵兌換, 攤分池, 後台設置, 數據分析, 垃圾桶, and 登出. The main content area is titled "概覽" and features a dashboard with several key components:

- Alerts and Actions:** A row of four icons for "緊急狀況" (Emergency Status), "新增用戶" (Add User), "新增活動" (Add Activity), and "新增公告" (Add Notice).
- Activity Table:** A table titled "中心活動" (Center Activity) with columns for 編號 (ID), 用戶 (User), 電話號碼 (Phone Number), 日期 (Date), 服務類別 (Service Category), 義工 (Volunteer), 時分 (Time), 狀態 (Status), and 操作 (Action). The table contains five rows of activity data.
- Summary Cards:** Three cards providing key performance indicators:
 - 義工服務總交易時分 (Volunteer Service Total Transaction Time):** 3,101. Sub-cards show 總交易時分 (Total Transaction Time) of 6,069, 義工服務平均交易時分 (Average Volunteer Service Transaction Time) of 3.03, 中心活動總交易時分 (Center Activity Total Transaction Time) of 2,967, and 中心活動平均交易時分 (Average Center Activity Transaction Time) of 23.35.
 - 申請量 (Application Volume):** 421, accompanied by a bar chart showing daily fluctuations.
 - 推薦成功率 (Recommendation Success Rate):** 94%, shown with a progress bar.
- Footer:** Includes links for "幫助" (Help), "私隱" (Privacy), and "條款" (Terms), along with the copyright notice "copyright © 2020 香港大學".

Web-based backend



Accompanying for activities

Telephone condolences



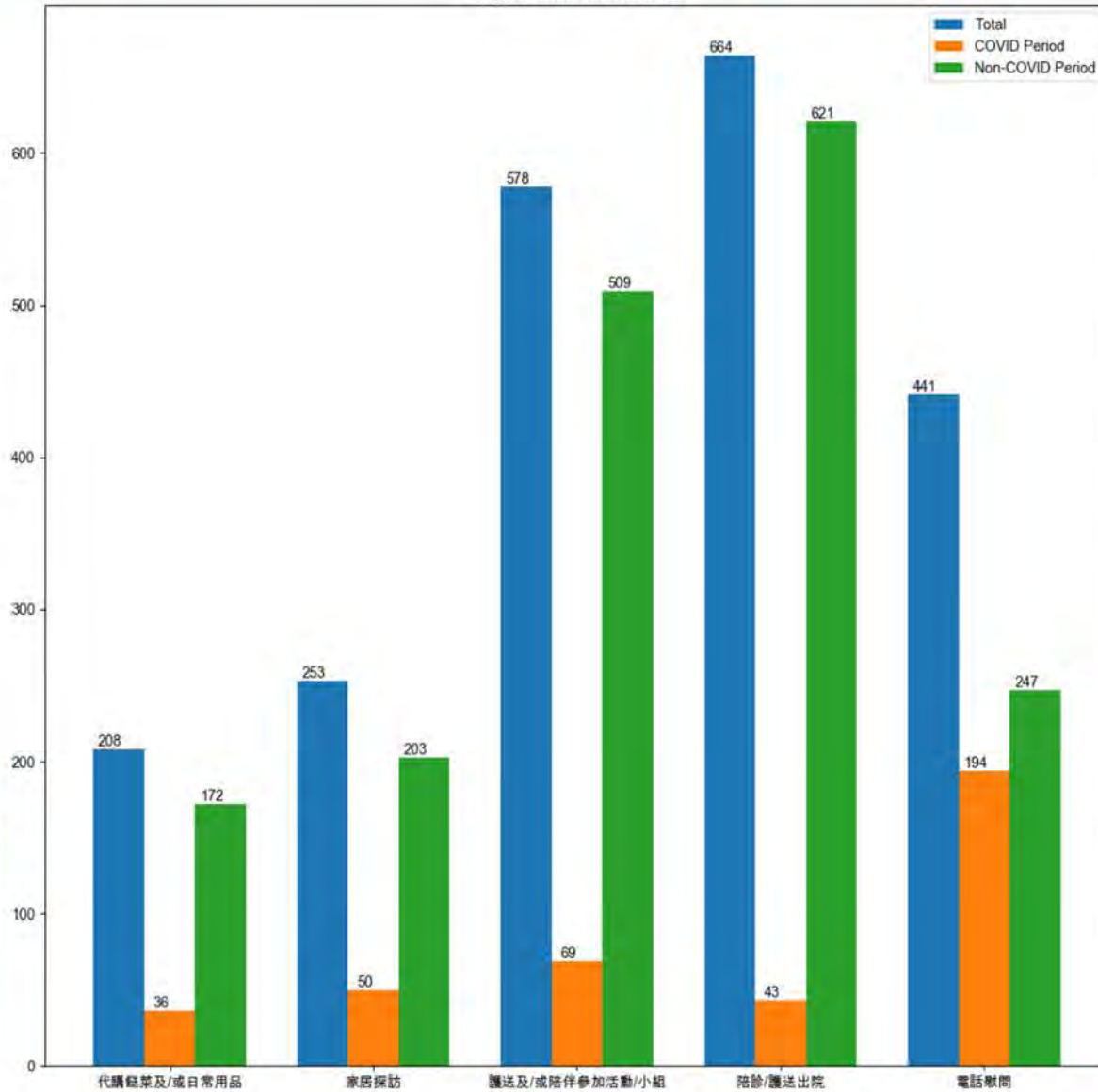
香港聖公會將軍澳安老服務大樓
HONG KONG SHENG KUNG HUI TSEUNG KWAN O AGED CARE COMPLEX



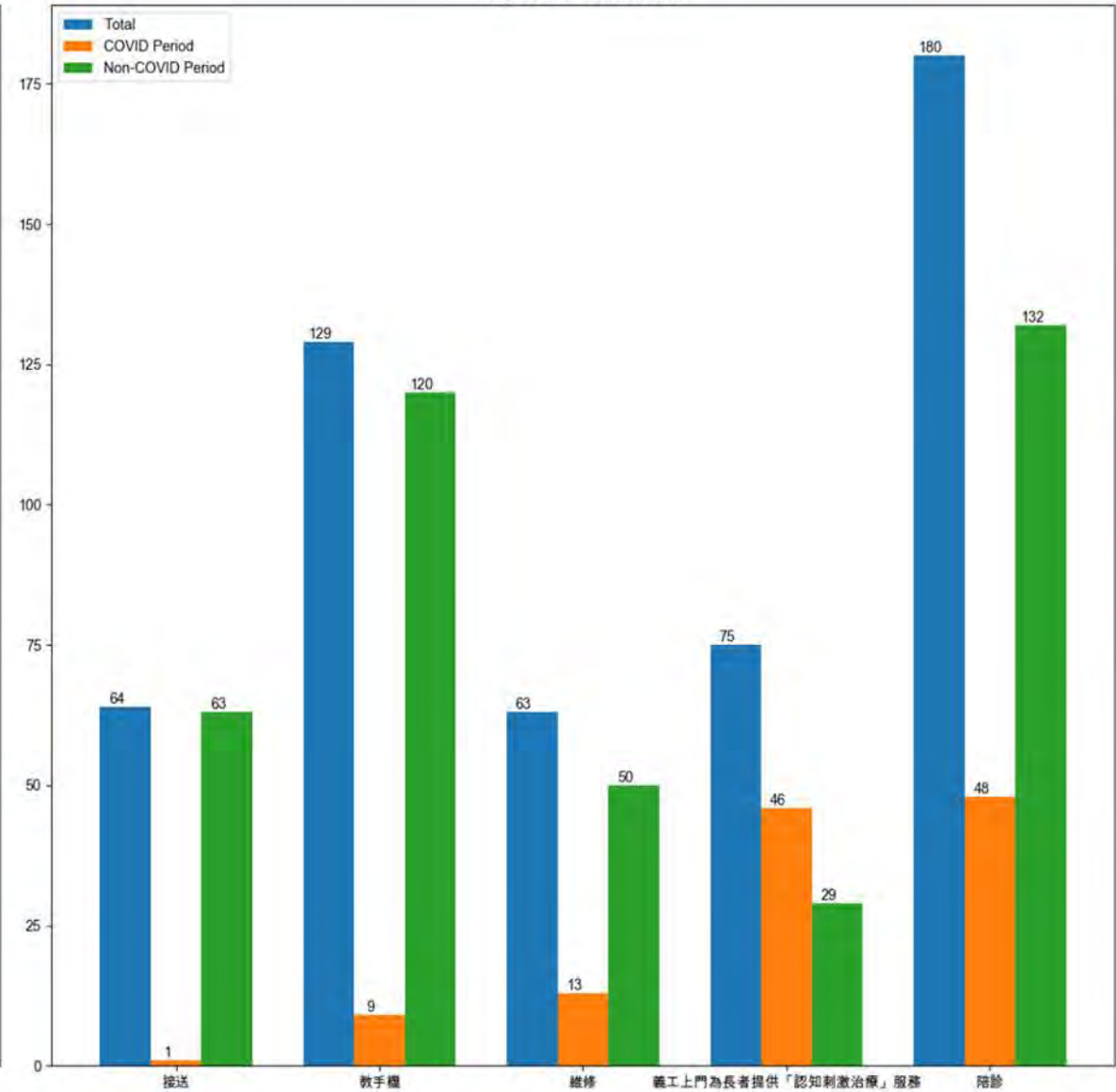
Request Distribution of CFSC and SKH



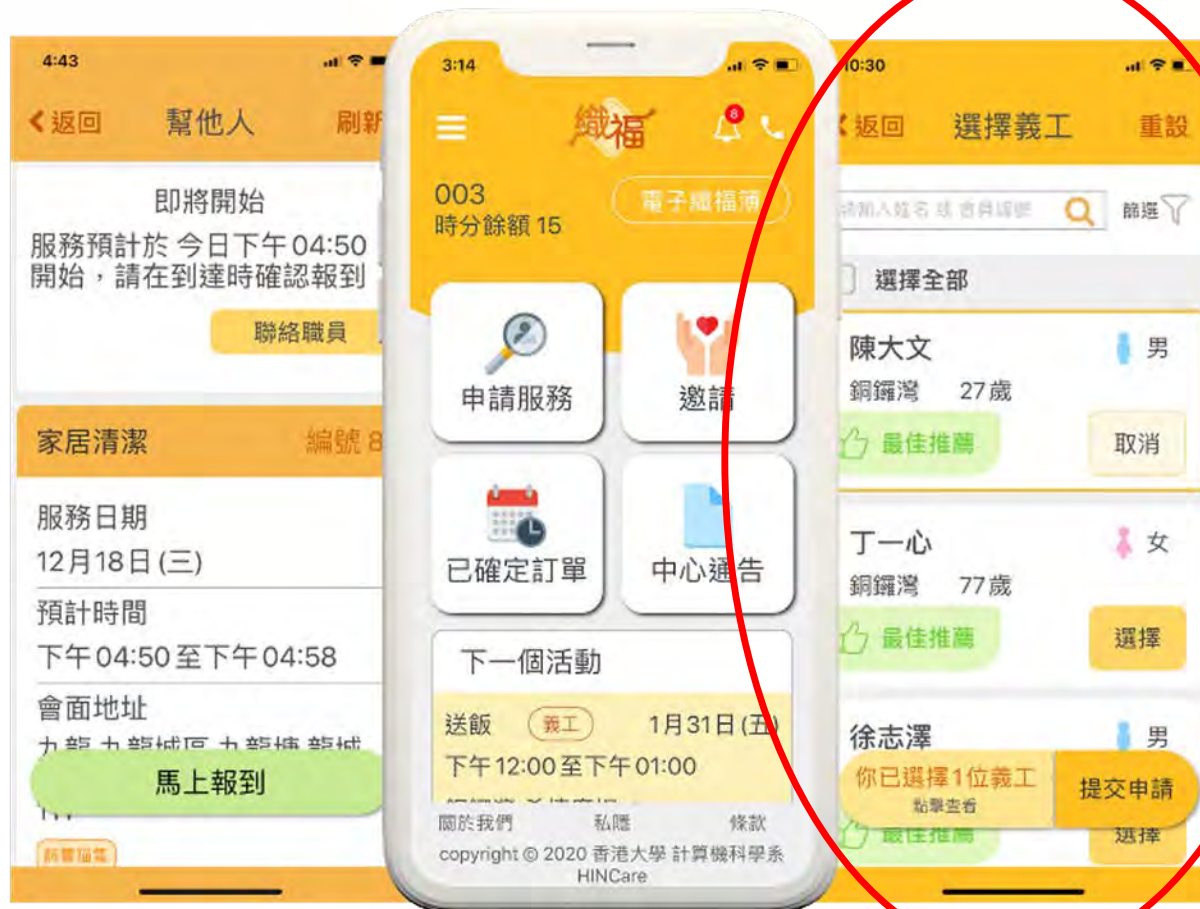
Request distribution of CFSC



Request distribution of SKH



Elder-helper matching



Can be a long list!

- Can a "good" volunteer's information be shown on the top of the user's screen?
- The item recommendation problem

Item recommendation

- An important function for e-commerce and o

How?
Use
HIN!



product → User



movie → User



helper → elder



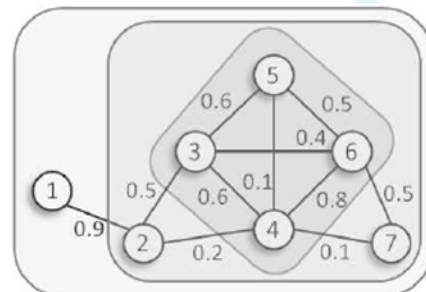
Heterogeneous Information Network (HIN)



Facebook



Knowledge base



protein network

User-item purchase graph

People Who Bought This Item Also Bought [Top of Page](#)

Belkin Grip Sleeve for iPad, Black	Targus A7 iPad Slip Case	iFrogz iPad Silicone Wrapz Case, Black	Case Logic Apple iPad Sleeve, EVA Protection	Speck iPad SeeThru Satin Case, Black
site to store \$38.88	site to store \$37.91	site to store \$32.08	site to store \$30.31	site to store \$34.14

HIN – Movie

○ Example: IMDB

○ Node (Type):

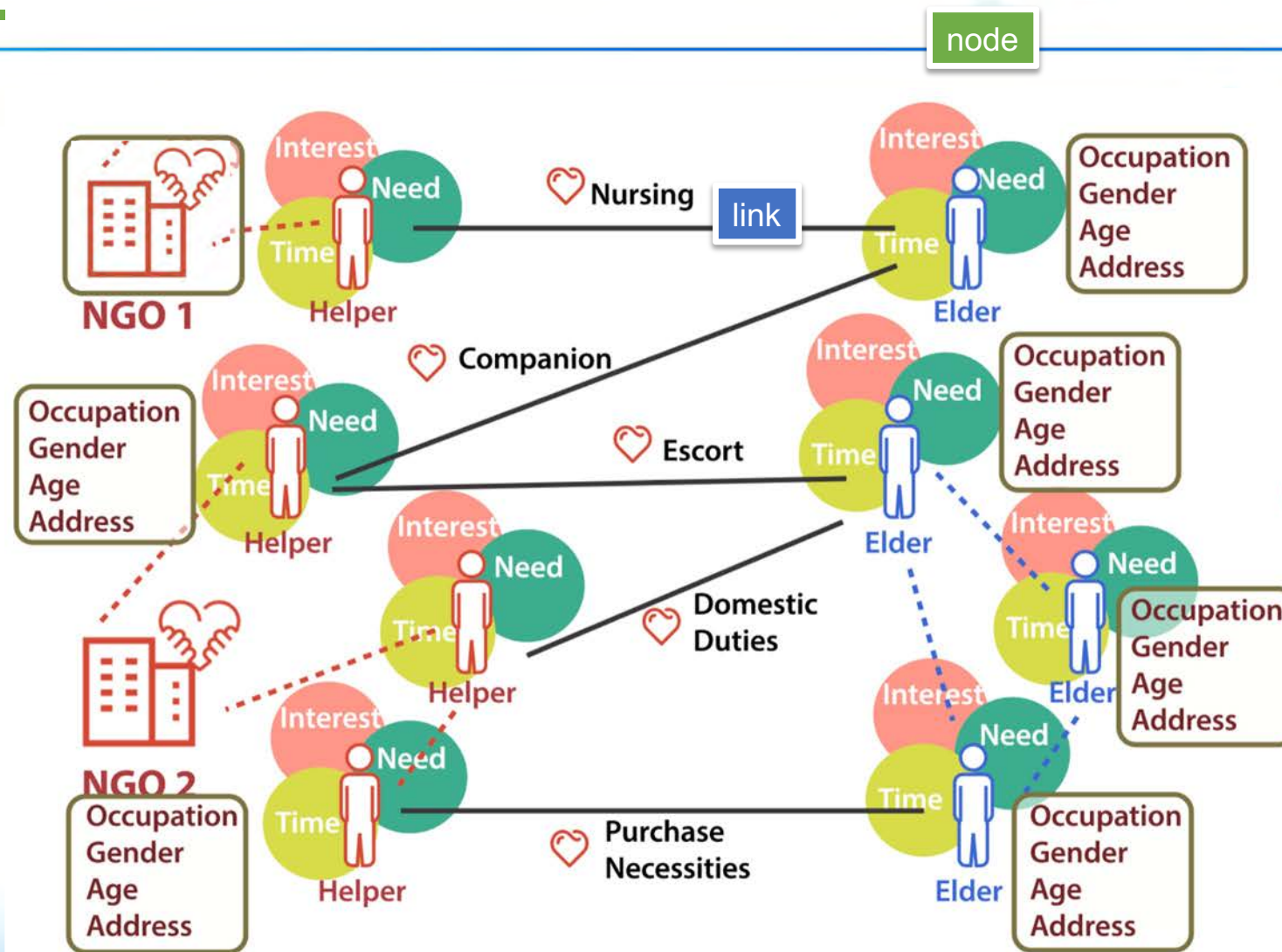
- Dune (Movie)
- Tom Cruise (Actor)

○ Link (Type):

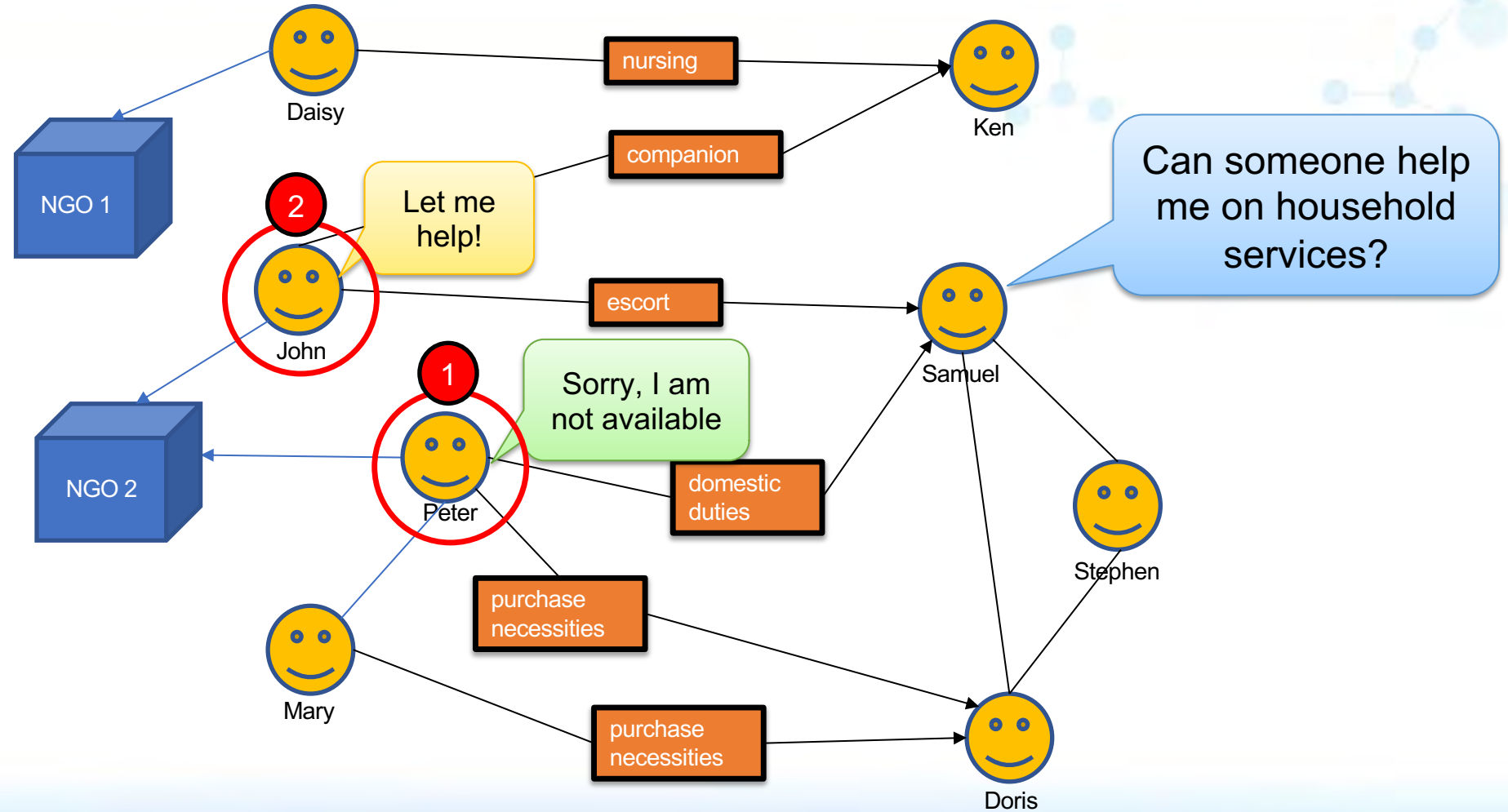
- Make (Producer → Movie)
- Act (Actor → Movie)



HIN — elderly care



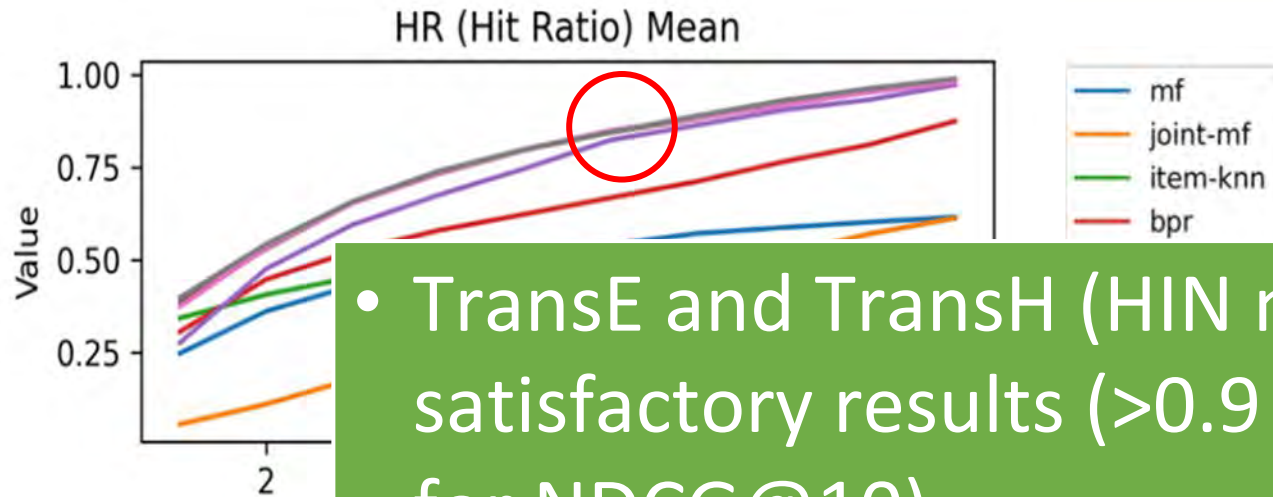
HIN-based recommendation



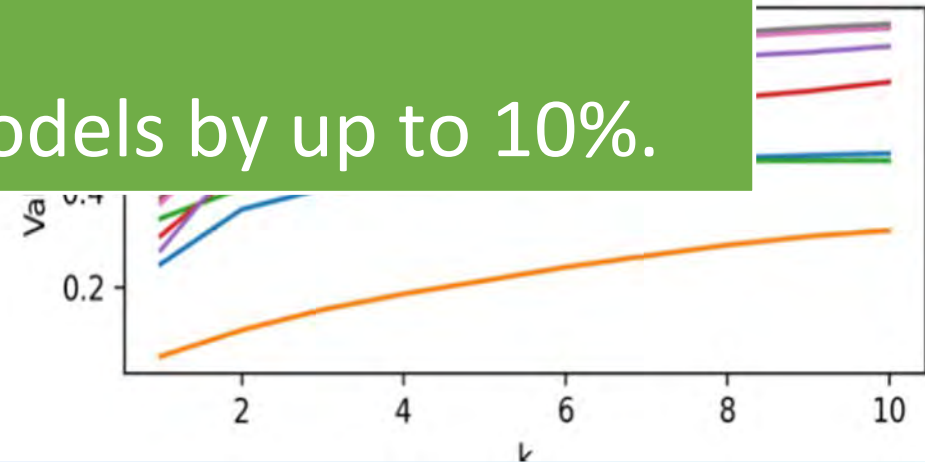
Recommendation Performance Metrics

- Performance metrics for recommending k helpers to elders:
 - hit ratio (HR@ k)
 - normalized discounted cumulative gain (NDCG@ k)

Key results



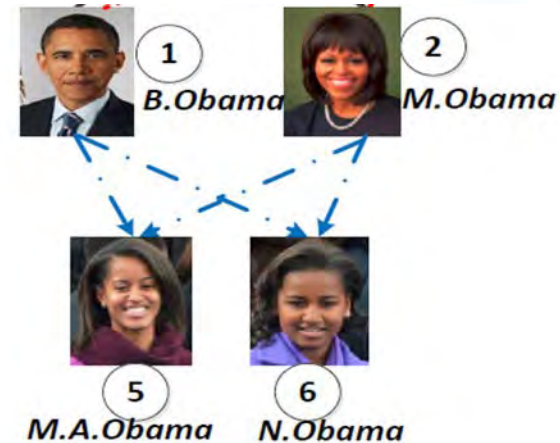
- TransE and TransH (HIN methods) achieved satisfactory results (>0.9 for HR@10 and >0.7 for NDCG@10)
- They outperform other models by up to 10%.



Meta Path [Sun VLDB11]

Meta path: a sequence of **node classes** connected by **edge types**

m_1 : USPresident $\xrightarrow{\text{hasChild}}$ Person $\xrightarrow{\text{hasChild}^{-1}}$ USFirstLady,
 m_2 : USPresident $\xrightarrow{\text{memberOf}}$ USPoliticalParty $\xrightarrow{\text{memberOf}^{-1}}$ USFirstLady,
 m_3 : USPresident $\xrightarrow{\text{citizenOf}}$ Country $\xrightarrow{\text{citizenOf}^{-1}}$ USFirstLady.



Meta paths help us to understand the high-level relationship (**relevance**) between two graph nodes.

The Meta Path Discovery Problem

○ Design solutions that:

- (1) Discovers the best meta paths between 2 nodes
- (2) Efficient algorithms & data structures for high-performance access

Changping Meng, Reynold Cheng, Silviu Maniu, Pierre Senellart, and Wangda Zhang. "Discovering Meta-Paths in Large Heterogeneous Information Networks", WWW 2015.

Z. Zhu, R. Cheng, L. Do, Z. Huang, and H. Zhang. *Evaluating Top-k Meta Path Queries on Large Heterogeneous Information Networks*. In the IEEE Intl. Conf. on Data Mining (IEEE ICDM 2018), Singapore, 2018, pp. 1470-1475.

Z. Zhu, T. N. Chan, R. Cheng, L. Do, Z. Huang, and H. Zhang. *Effective and Efficient Discovery of Top-k Meta Paths in Heterogeneous Information Networks*. In the Transactions on Knowledge and Data Engineering (IEEE TKDE) 2020.



IEEE ICDM 2018



W. Ning, R. Cheng, J. Shen, N. Haldar, B. Kao, X. Yan, N. Huo, W. Lam, T. Li, and B. Tang. Automatic Meta-Path Discovery for Effective Graph-Based Recommendation. CIKM 2022.



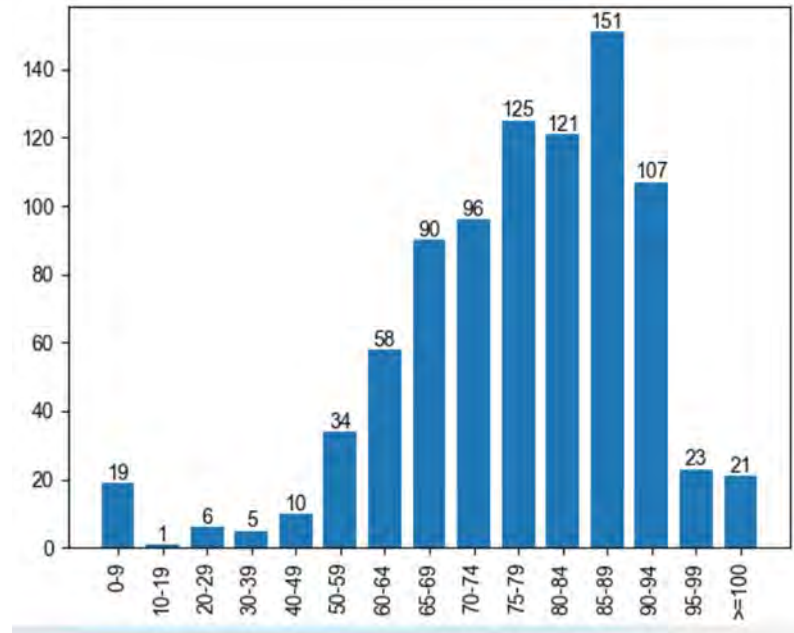
Meta-Paths for HINCare: main results

○ **We found 8 meta-paths from the HINs of CSFC and SKH.**

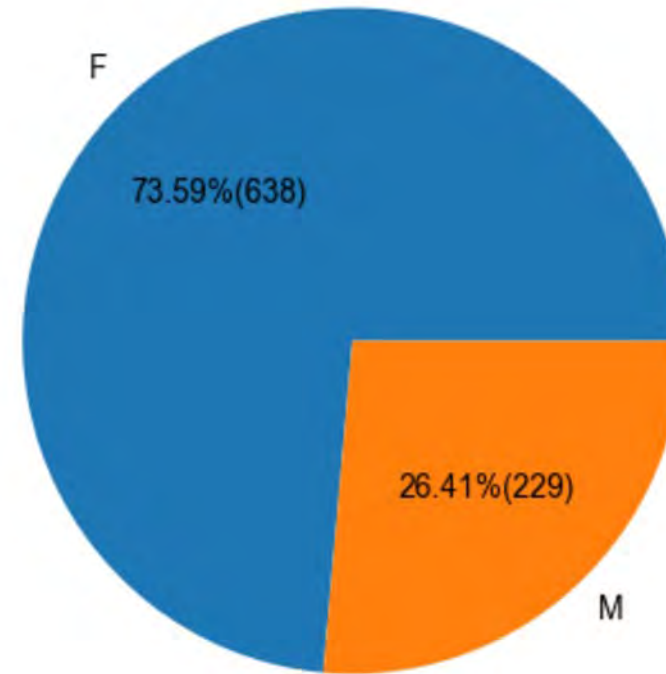
1. User - User
2. User - Event - User
3. User - Service - ServiceType - Service
4. User - Service - User
5. User - Event - User
6. User - Service - User - Event - User
7. User - Service - User - Service - User
8. User - Event - User - Service - User

○ **They can further be used in recommendation or other tasks.**

Data analysis (1)



Age of most users > 65 years
19 users are younger than 10 years

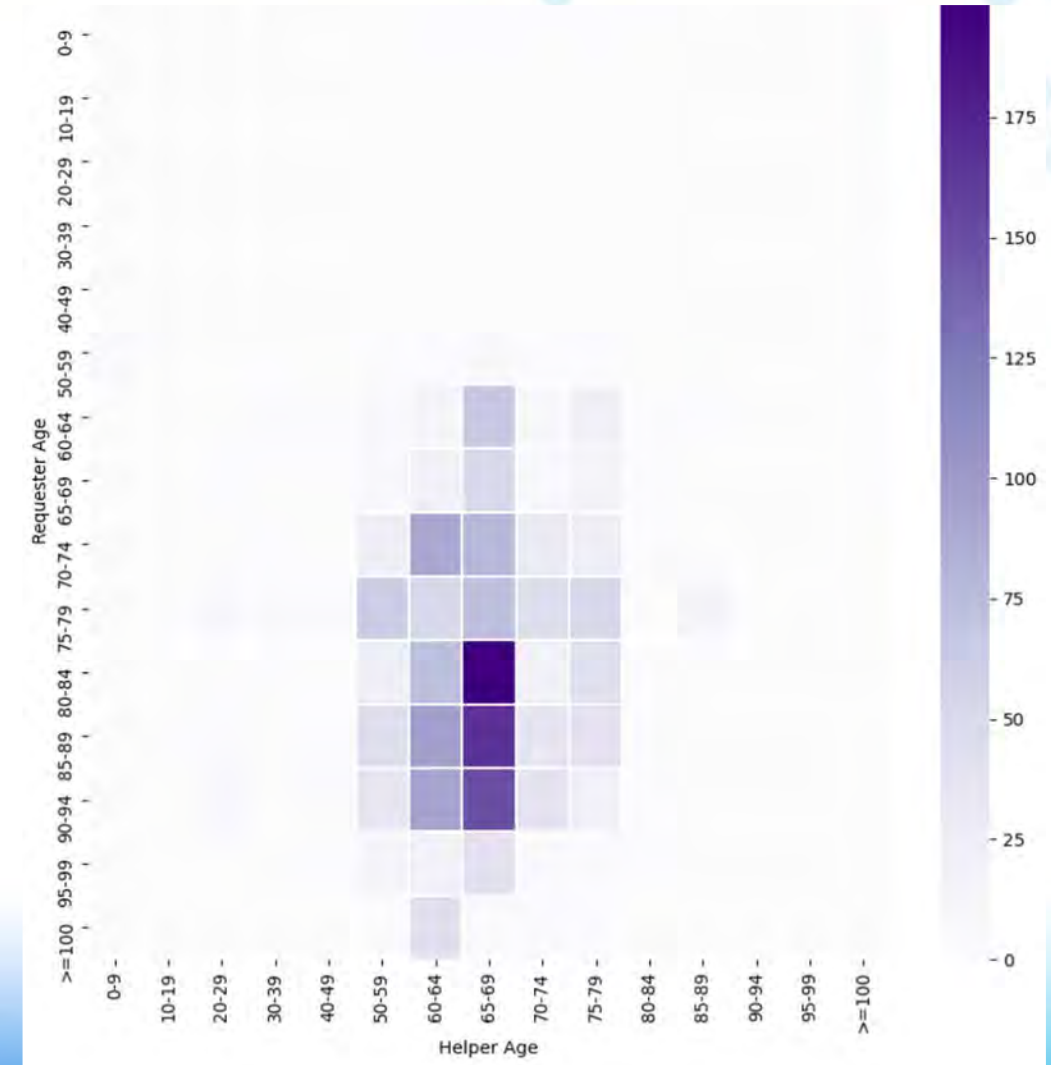


No. of female participants are 3
times the no. of males

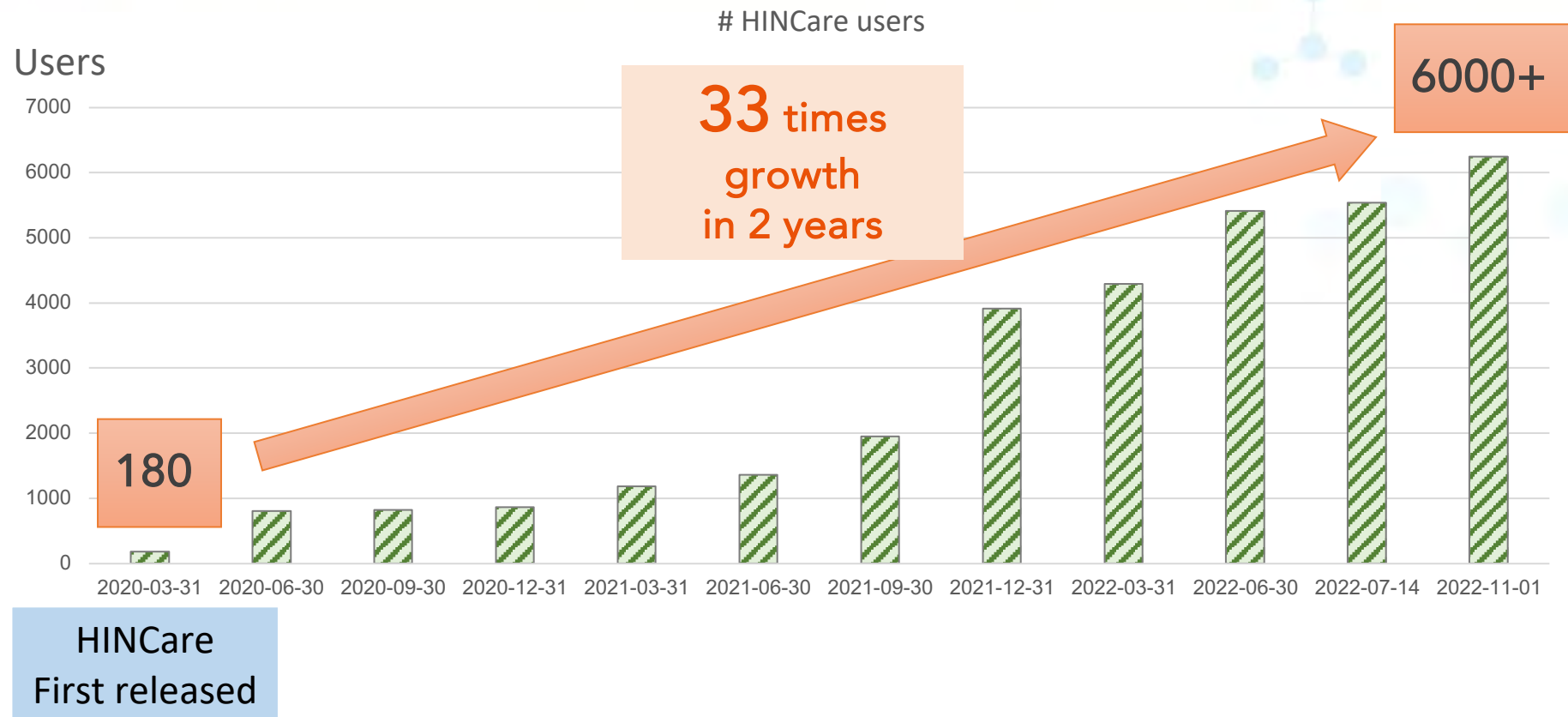
Data analysis (2)

For a timebanking task,
requester: age 80-90
helper: age 60-70

Mutual help culture is
enabled, reducing
pressure of volunteer
shortage

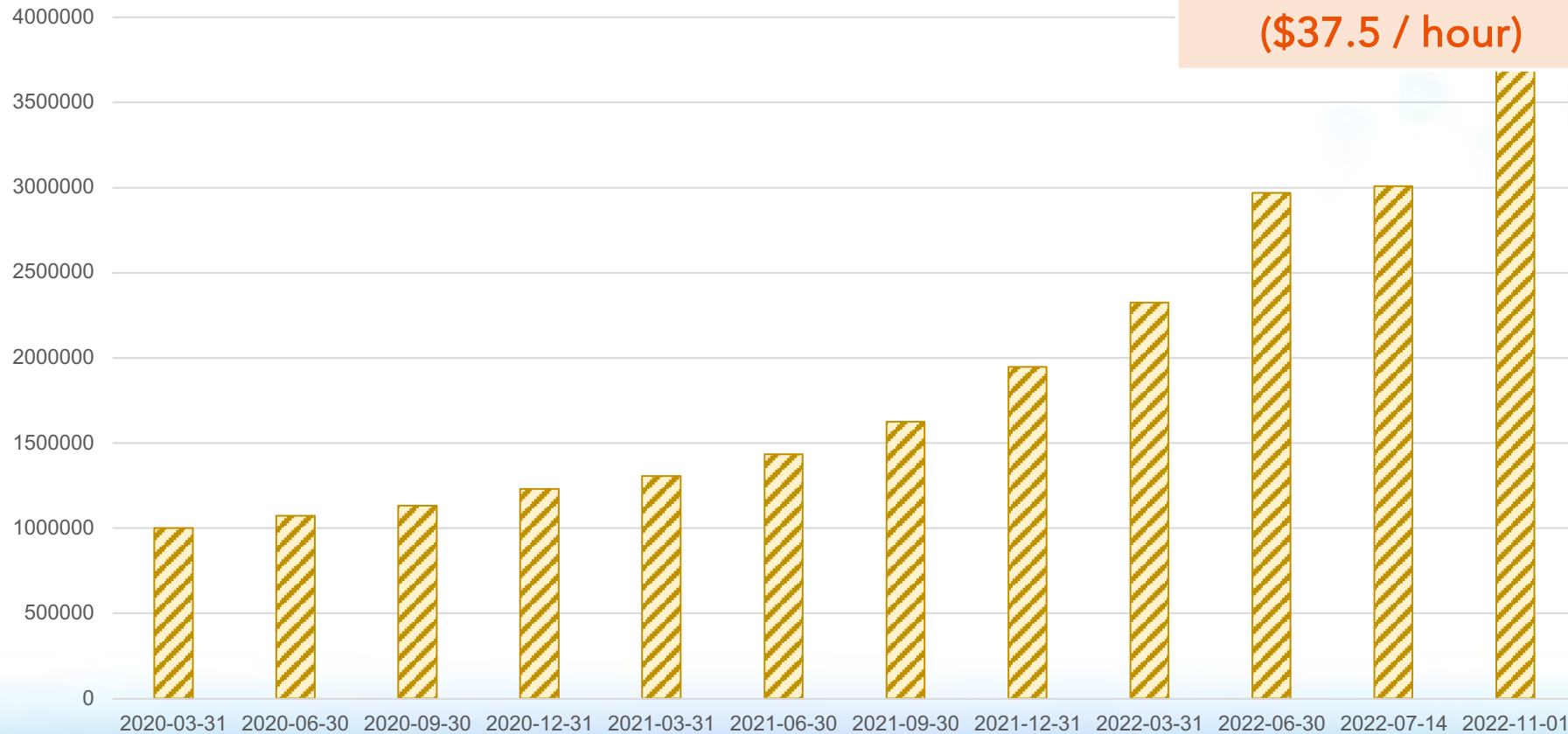


User Growth (as at 1 Nov 2022)

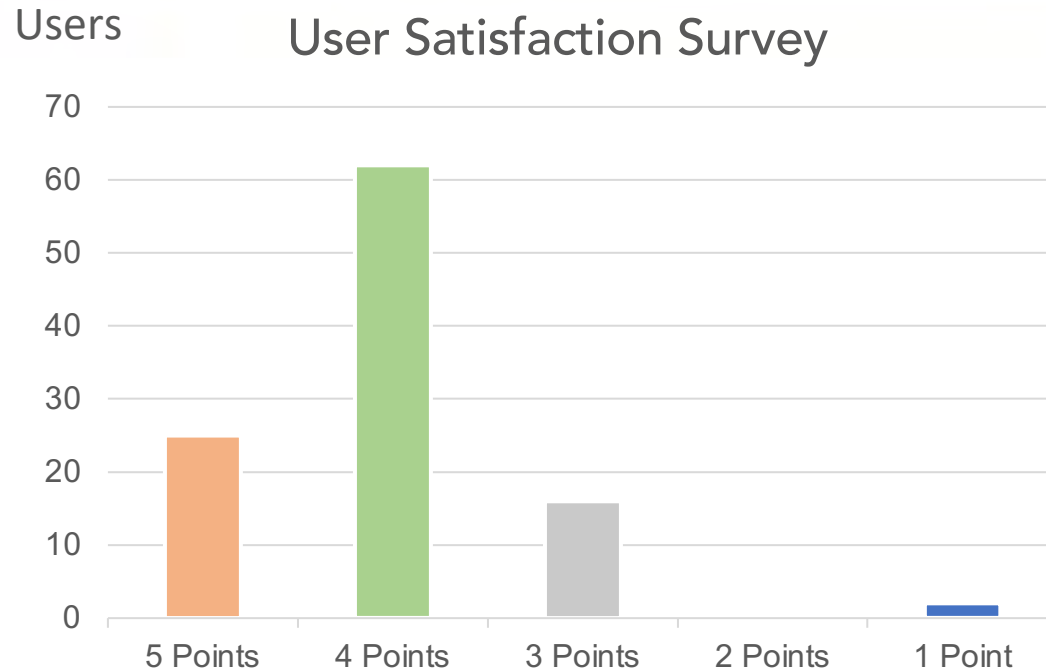


Time Credits & Equivalent Wages (as at 1 Nov 2022)

Time Credits
(Million Minutes)

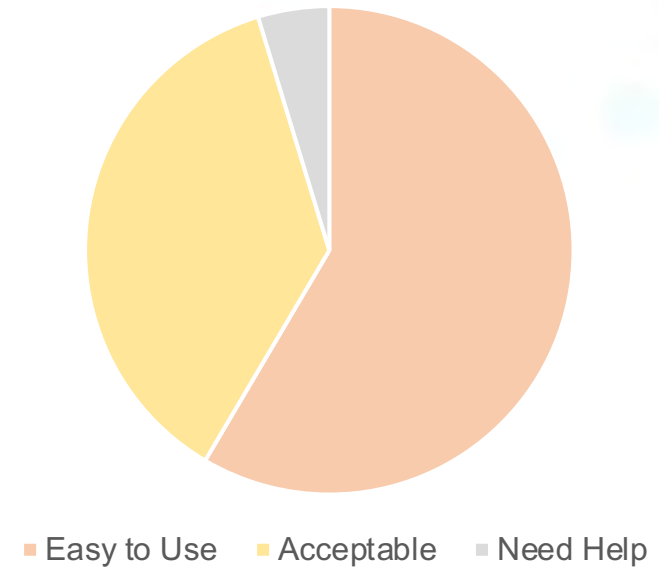


User Feedback for HINCare



5 Points = Most Satisfactory
1 Point = Least Satisfactory

Accessibility Survey



Number of respondents: 106
Source: SKH, CFSC, SWSA
Data Collected in 2021
Age: 50-80 years old

Users' Comments

慶芬用「織福2」手機程式

▼ 申請維修和轉帳時分給師傅



慶芬：

「我個櫃好好地用咗好多年，依家衣櫃個鉸鬆咗，我好擔心個櫃門會無意中鬆脫下來，傷及家人。但又冇理由因為 2 個小小的鉸，而浪費一筆金錢重新買過個衣櫃。我一個仔移咗民，另一個仔同女婿又唔識維修。唯有搵織福會幫忙，好多謝織福計劃鍾祺幫手，用咗 60 分就修理好衣櫃的門較位，好開心衣櫃又可以用得喇！多謝！」

A helper spent 60 min to help the elder to fix her wardrobe and earnt time credits.

婉如：

「我廚櫃度門成個甩咗出來。鍾祺好好，上到來幫我重新裝過，仲幫手檢查其他木櫃。當年入伙度身訂造的櫃，過咗禁耐都開始有啲問題。袁生逐一幫忙換過門鉸，仲有一個櫃個鉸唔啱，專程為我配過，來了兩趟。見到佢身水身汗都義不容辭，傾談之間知道佢已經76歲！果真是「老有所為」！好多謝，好感激！同時，我覺得聖公會冇呢個做法好好，既能發揮師傅的技巧，長者又好能受惠，沒有花錢就能解決到需要。」

The helper is 76 years old, and the elder is happy that she can get free service.

卿卿並同時介紹了 18 位長者參加織福計劃。因為她認同該計劃的助人自助精神，一方面賺取積分，待日後自己有需要時使用，另一方面又可發揮自我潛能，建立自信，還可以推動鄰里互相關懷，互相幫助，達至社區和諧共融。

The helper is happy that he can still help others at such an old age.

NGOs' Comments

未有應用程式前，會員每兩個月要交回紙本存摺（俗稱「打簿」），由同事手動計算交易分數；現在應用程式實時紀錄時分，隨時隨地就能查閱帳戶的時分。

新冠疫情下無法舉辦大型活動，「織福2」協助克服限制，例如以往有「大笪地」讓有手藝的會員擺檔賣自製作品，疫情下改用「織福2」物品兌換功能，讓會員「網購」手作。

系統自動產生圖表及報表，分析每季時分交易趨勢、會員排行榜及勾選不活躍會員，協助職員能更細緻地管理時間銀行及跟進會員情況。

—— 黃慧慈姑娘 (Bobo)
香港聖公會將軍澳安老服務大樓督導主任

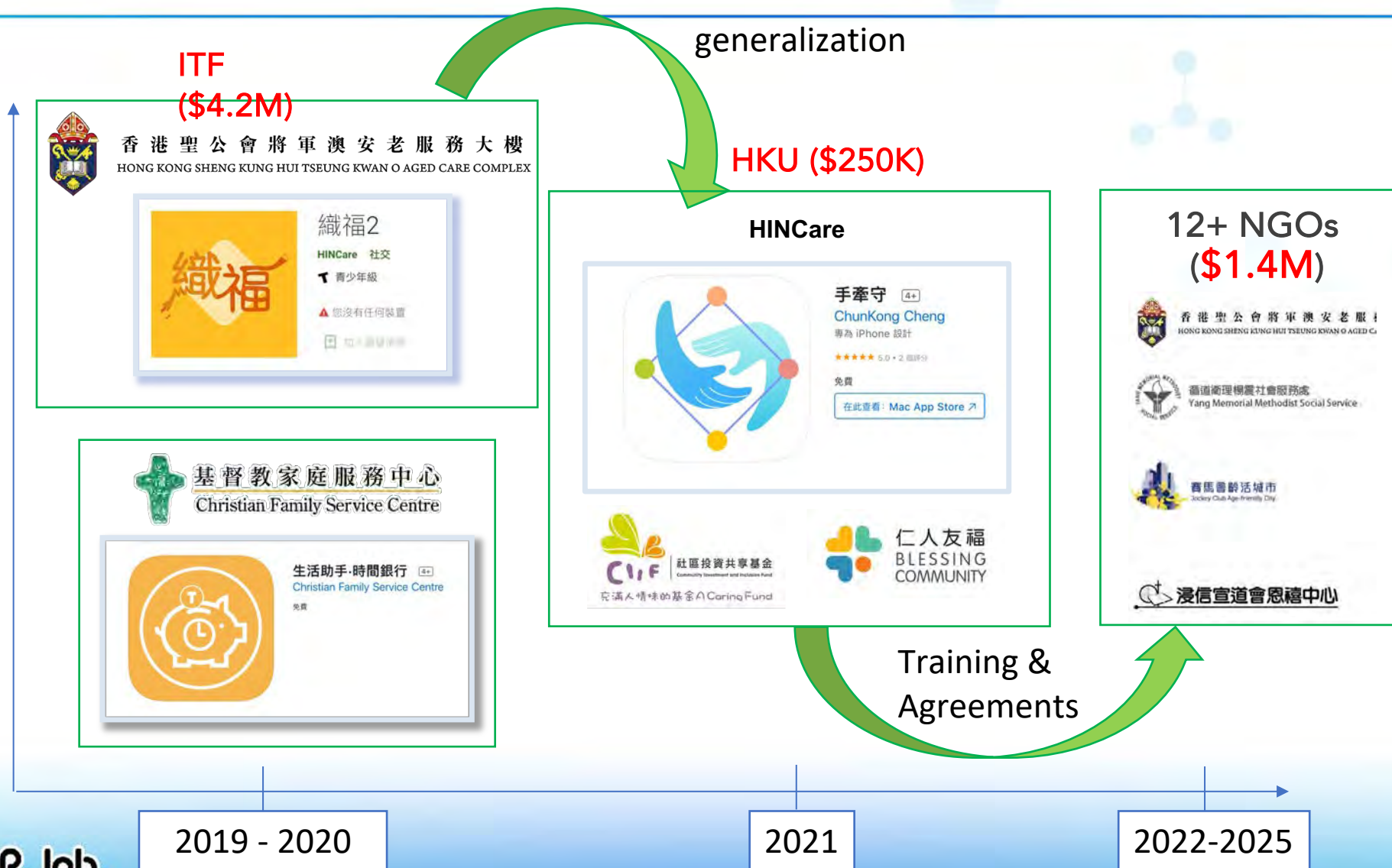
- HINCare facilitates book-keeping & checking of time-credits, buy/sell items
- Data analysis helps to understand trends & identify inactive users

以往的服務可能只限於透過手機社交媒體(如WhatsApp群組)去邀請義工，HINCare平台使義工能用獨立的帳號去獲取有關服務資訊，提高靈活性和私隱度，令義工和服務使用者的配對上更完善和方便。

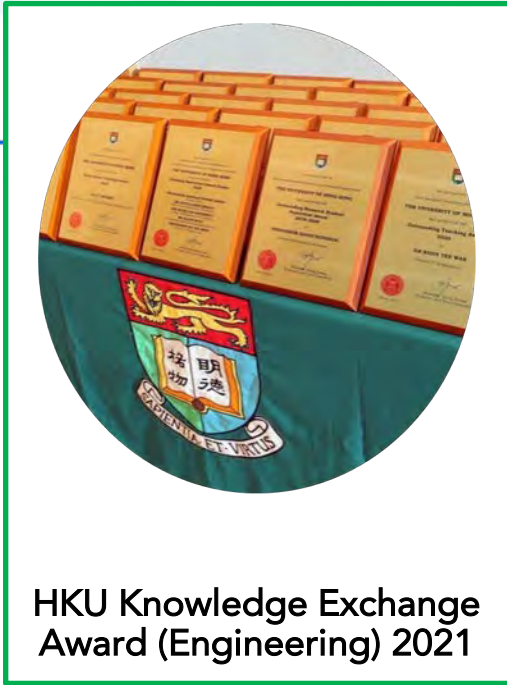
—— Mei Yi姑娘（社工）
基督教家庭服務中心

HINCare provides a private solution for helpers and service recipients, and makes matching easier

HINCare Evolution



4 Awards in the Past 3 Years



HKU Knowledge Exchange Award (Engineering) 2021



4 Awards in the Past 3 Years



Asia Smart App Awards x 2 (2020, 2021)

We are working with CIIF, Blessing Community, and more NGOs in the next 3 years.



**Website
(English/Chinese):**

<https://www.hincare.hku.hk>



The screenshot shows the HINCare website interface. At the top, there are logos for HINCare, The University of Hong Kong, and the Department of Social Work and Social Administration. Below the logos are navigation links: 關於 (About), 團隊 (Team), 產品 (Products), 最新消息 (Latest News), 出版刊物 (Publications), and 加入我們 (Join Us). The main content area features three panels:

- HINCare:** 我們旨在提供一個平台，利用我們開發的智能技術，識別數據庫中潛在於香港社交網絡中的義工資源，並將其推薦給所涉及的老年護理機構，為需要幫助的老人家匹配適合的義工。
- 智能匹配:** HINCare平台運用大數據，利用被稱為異構信息 (Heterogeneous Information Network) 的網絡來存儲大量信息 (例如，關於老年人的技能和社交網絡)，智能推薦最適合幫助老人家的義工。
- 跨機構合作:** HINCare項目得到多個相關領域的專家同機構的參與，聯合香港大學計算機科學系、社會工作系的學者和關注老年人關懷服務的民間團體職員的工作成果，一齊為老年關懷服務出力。



S.T.A.R. lab.

- Social Technology And Research Laboratory



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DEPARTMENT OF
COMPUTER SCIENCE



HKU Musketeers Foundation
Institute of Data Science
香港大學同心基金數據科學研究院



香港賽馬會慈善信託基金
The Hong Kong Jockey Club Charities Trust



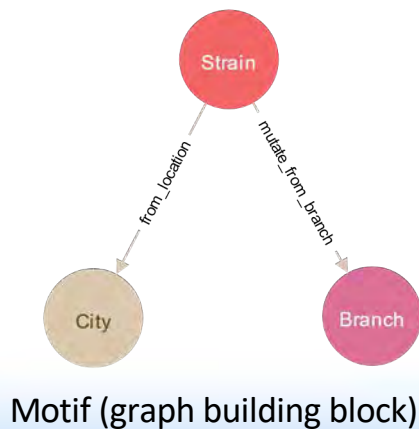
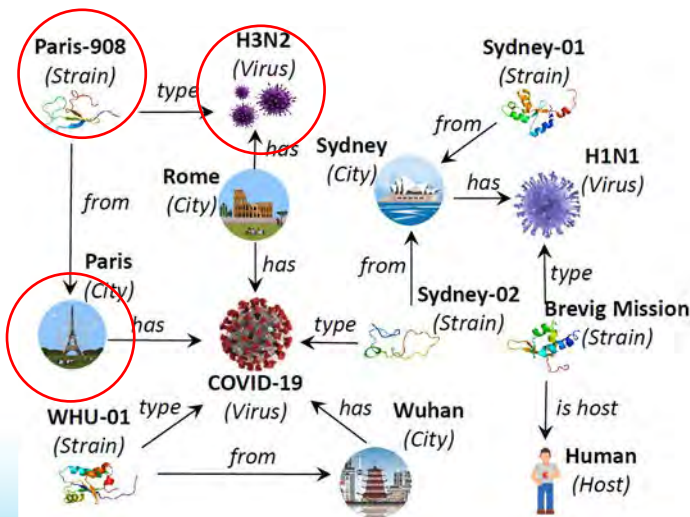
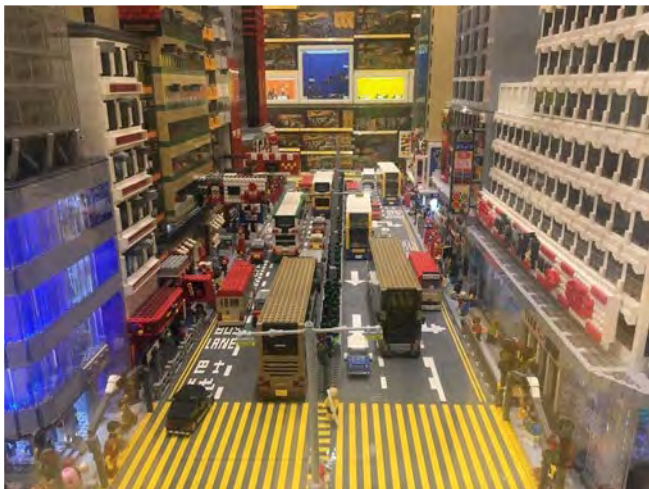
HKU Med LKS Faculty of Medicine
School of Public Health
香港大學公共衛生學院



HKU SWSA Department of Social Work and Social Administration
The University of Hong Kong
香港大學社會工作及社會行政學系

- Engaged in *Data Science for Social Good (DSSG)*
- 4 professors, 5 postdocs, 10 PhD students, 20 developers
- 3 years in website, app, game, and video production

Higher-Order Graph Analytics

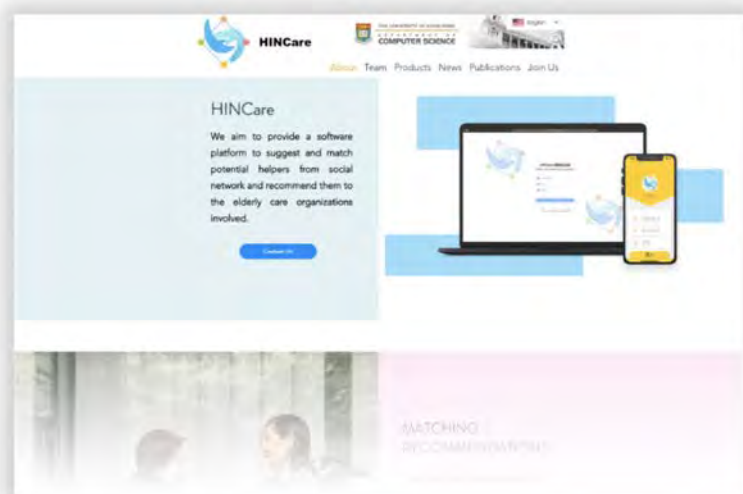



Research

- *Efficient Algorithms for Densest Subgraph Discovery on Large Directed Graphs* [SIGMOD20, Research Highlight Award]
- *On Analyzing Graphs with Motif-Paths.* [VLDB21]
- *LINC: A Motif Counting Algorithm for Uncertain Graphs* [VLDB19]

Demos

- *M-Cypher: A GQL Framework Supporting Motifs, demonstrated by Covid-19 Knowledge Graph Analysis.* [CIKM20]
- *MC-Explorer: Analyzing and Visualizing Motif-Cliques on Large Networks* [ICDE20]



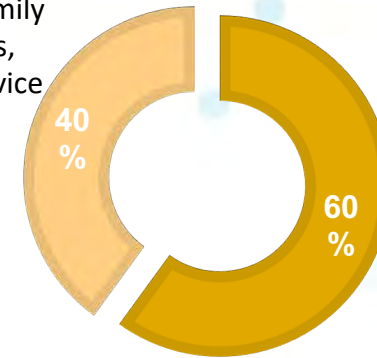


賽馬會 Jockey Club **智家樂計劃**
SMART Family-Link Project

HK Jockey Club Charities Trust funded \$1.49B in 2019-25



NGOs
(Integrated Family
Service Centres,
Integrated Service
Centres

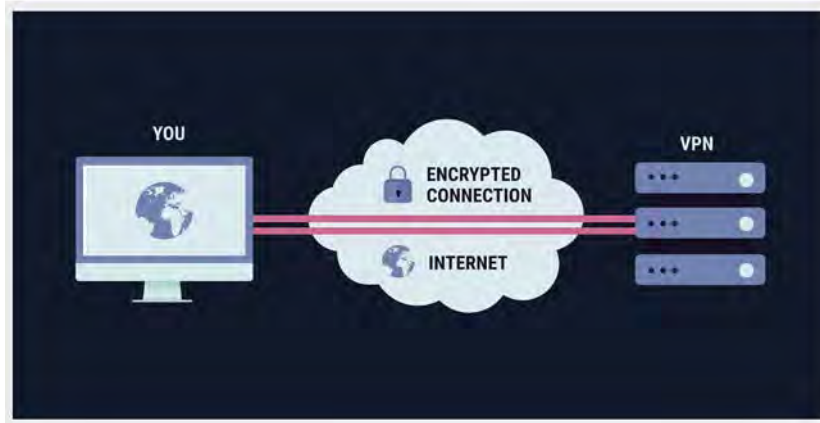


11 NGO Partners



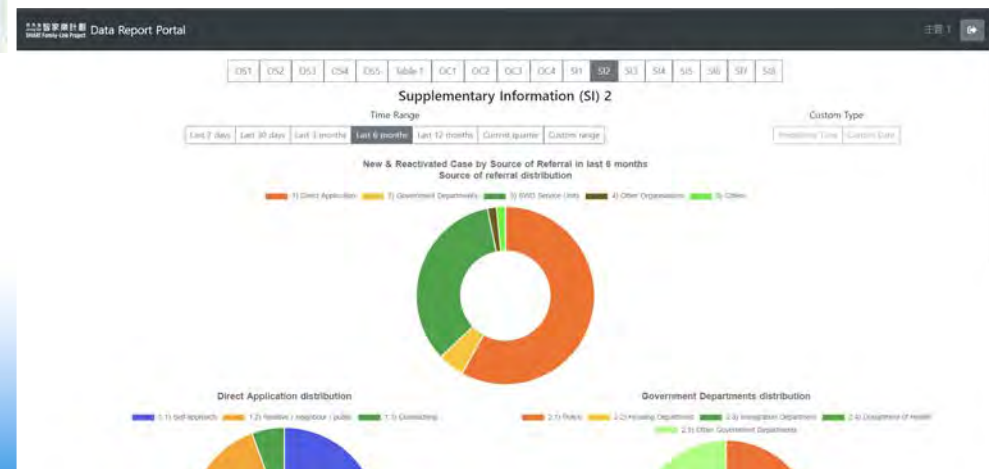
Key Features

- 1st system that establishes software interfaces with SWD
- State-of-the-art security protection



(meeting with SWD representatives at SWD WanChai office)

- Data science for social good
 - Data Analysis System





S.T.A.R. Lab.

[<https://star.hku.hk>]

Data Science

For Social Good



HKU Musketeers Foundation
Institute of Data Science
香港大學同心基金數據科學研究院

<https://datascience.hku.hk>



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Yang Memorial Methodist Social Service



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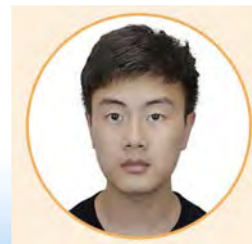
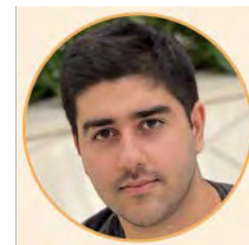
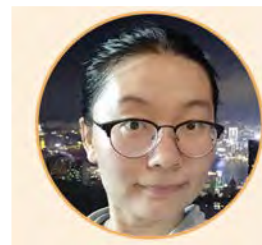
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Thank You!