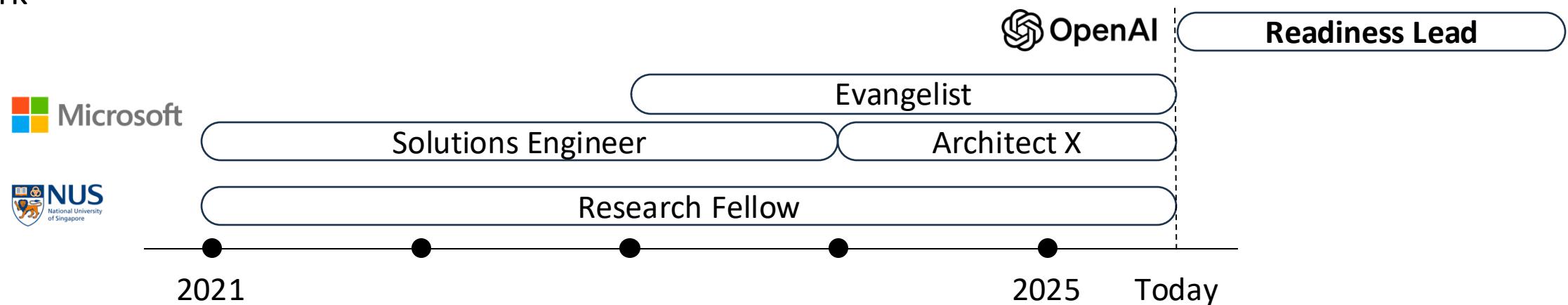


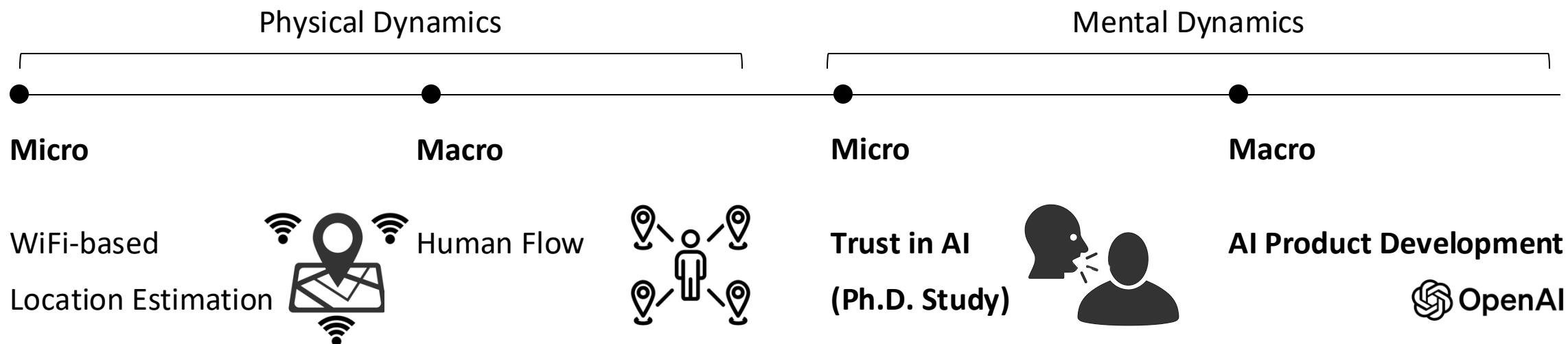
Kohei Yamamoto

Readiness Lead at OpenAI | Ph.D. Student (Cognitive Informatics)

Work



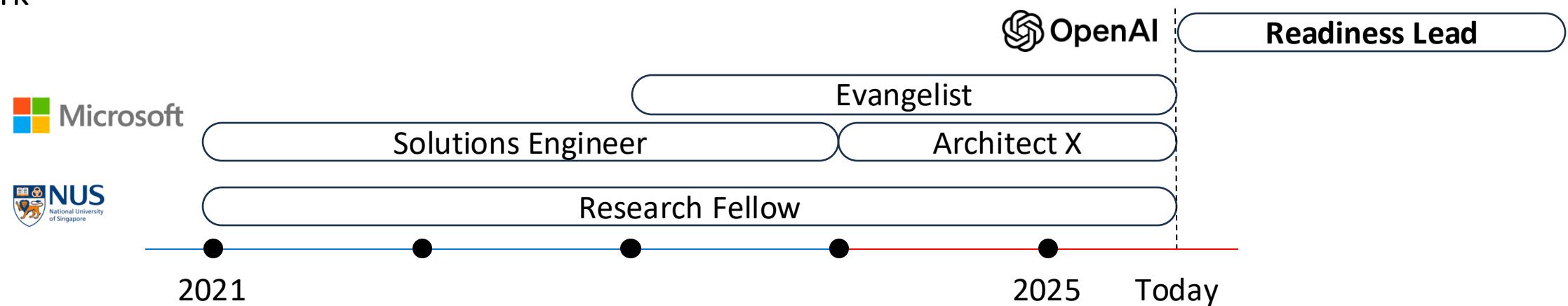
Research (Human Dynamics)



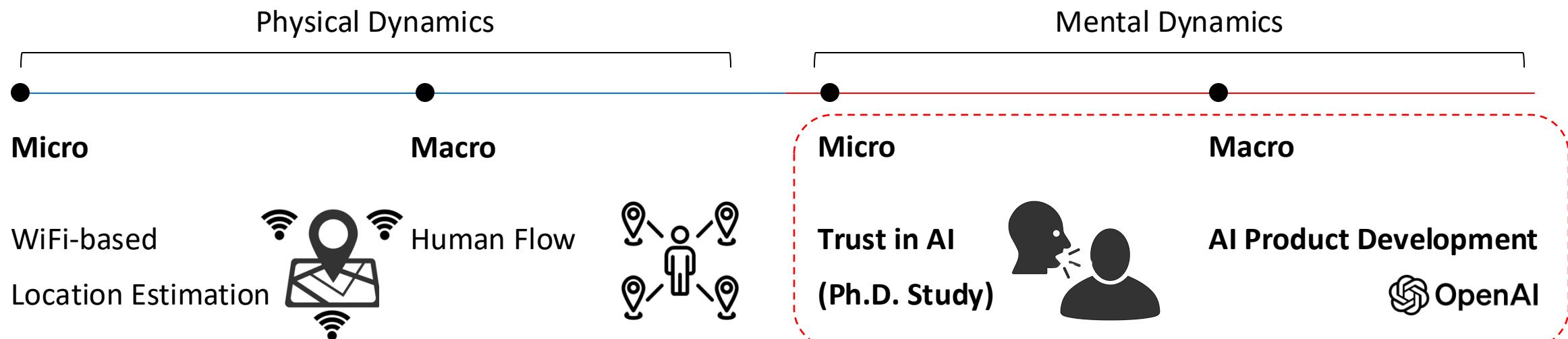
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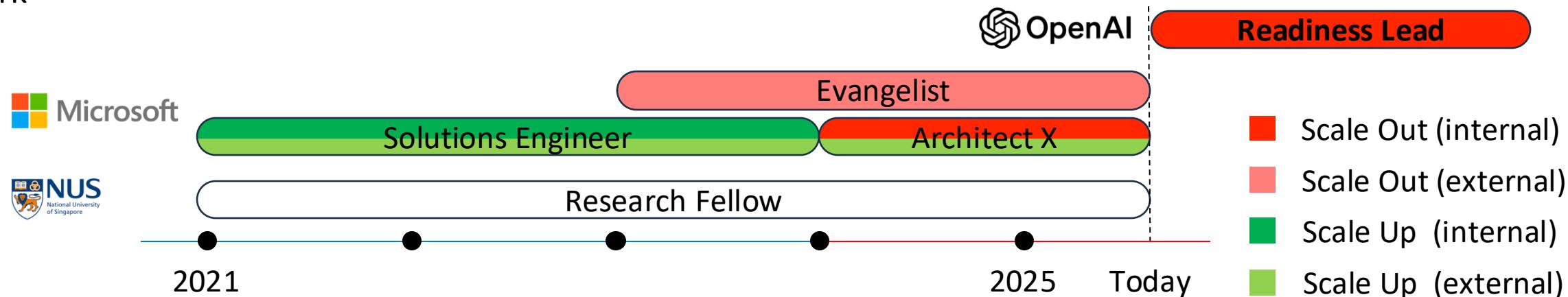
Research (Human Dynamics)



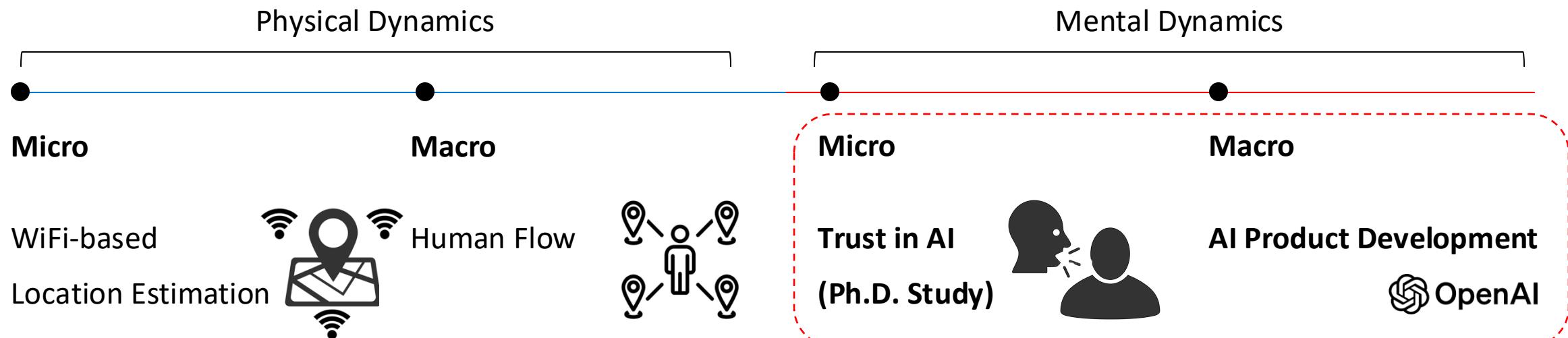
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Research (Human Dynamics)



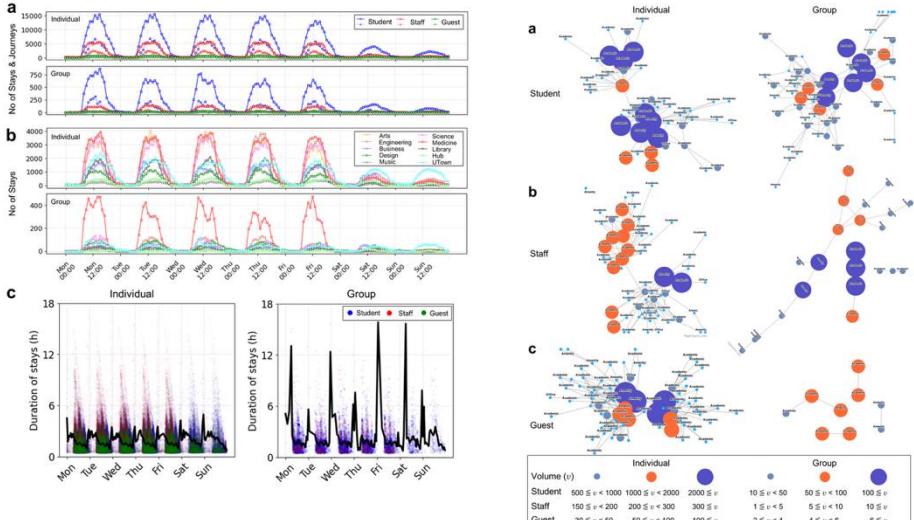
Juxtaposing Individual and Group Mobility from Sparse WiFi Signatures with Cloud-Assisted Computing ~ Transforming Juxtaposed Mobility Framework into Cloud-Native Solution ~

Kohei Yamamoto (Microsoft), Zhou Guo (Sun Yat-sen University), Chen-Chieh Feng (NUS; National University of Singapore)

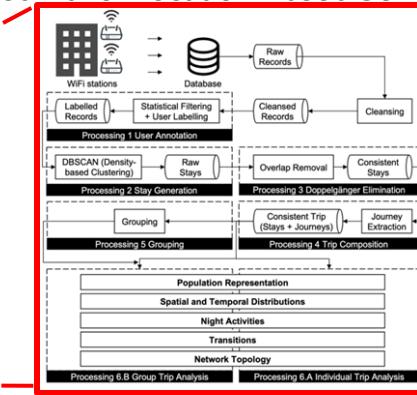
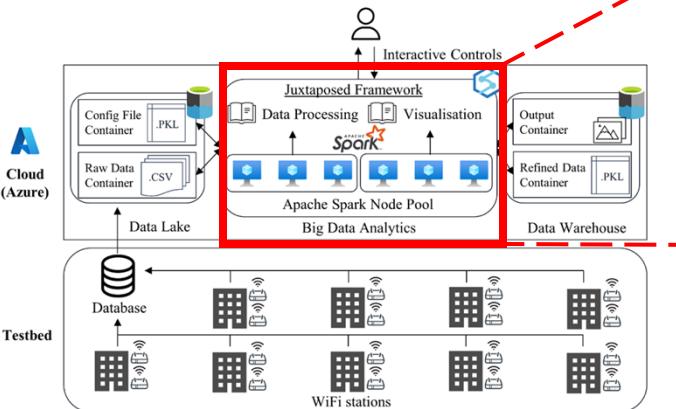
Proposed a **juxtaposed analysis framework** on human mobility. Spatiotemporal patterns of individuals and groups from WiFi connections are investigated while **compressing the computation time to about 6%** of the conventional cost using a cloud. Results **published** in Journal of Location-Based Services.

Challenge

- Increased focus on **human mobility** after COVID-19 pandemic.
- Empirical **juxtaposed analysis** of individual and group mobility is still scarce.
- Testing the framework using WiFi histories spans **several days**
 - Heterogeneity between **individuals and groups?**
 - Variations among **different attributes?**
 - **Computation optimisation** on cloud-assisted infrastructure



Solution



- High-performance** computing using Spark Cluster-based distributed infrastructure.
- Rapid conversion in about 1 week** using GitHub Copilot to fit PySpark.

Agility

Scalability

Performance

Benefit

- Implemented **scalably** on a big data platform
- Compressed cost spanning 2-3 days to **2-3 hours**
- Investigating 100M records from 46K people on **NUS campus**, proved **the validity of juxtaposed framework** in a **real-world** scenario.
- Suggested the **practicality** of cloud architecture
- Published** in **Journal of Location-Based Services**

User Voice

"It proposes a novel framework utilising Wi-Fi and Geo-spatial technology to analyse both individual and group mobility dynamics, offering valuable insights into human behaviour and mobility patterns with practical applications."

Guo Zhou

Associate Professor, Sun Yat-Sen University

"The Azure-based geospatial framework greatly improved our ability to make sense of human mobility dynamics by offering a computationally efficient means to analyse massive amount of Wi-Fi data."

Chen-Chieh Feng

Associate Professor, NUS





Analytical Framework in Cloud-Native Environments for Auto-Modelling Sparse Human Mobility Considering Memory of Past Contexts ~ Transforming ML Framework into Cloud-Native Solution ~

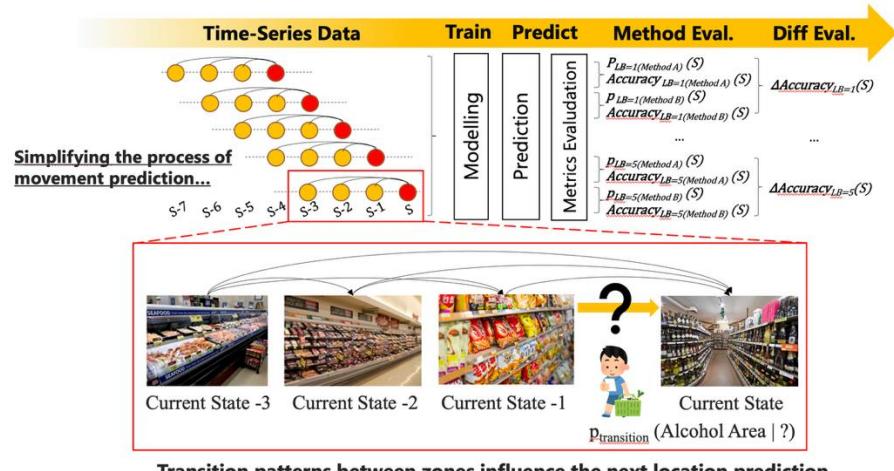
Kohei Yamamoto (Microsoft), Joie Lim (NUS; National University of Singapore), Filip Biljecki (NUS), Rudi Stouffs (NUS)

Approximately **60 times more efficient** in total computation time for machine learning parameter sets.

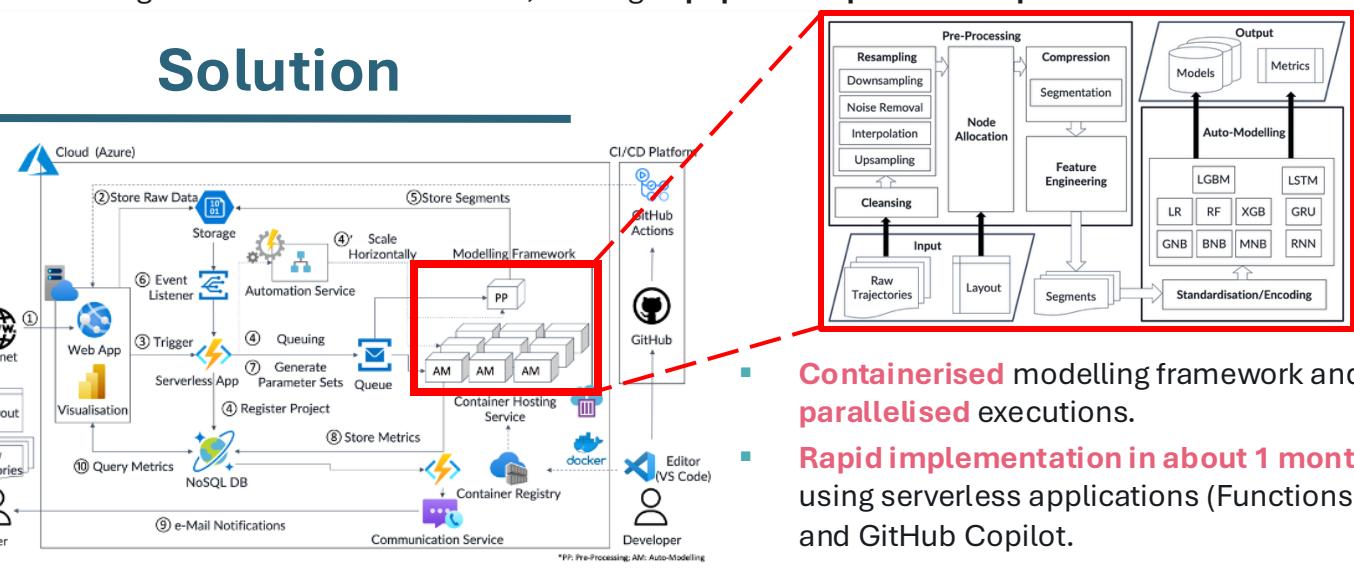
Swiftly executed hypothesis validation in academic institutions using **cloud-native architecture**, leading to **paper acceptance and presentation at IEEE**.
Submitted to an international journal of cloud.

Challenge

- Increased focus on **individual movement predictions** due to the COVID-19 pandemic.
- Approximately **one week or less of computational cost** for iterative hypothesis testing of nearly 10,000 parameter sets:
 - How much past information should be incorporated?
 - How much difference will there be among methods?
 - How much difference will there be in feature importance?



Solution



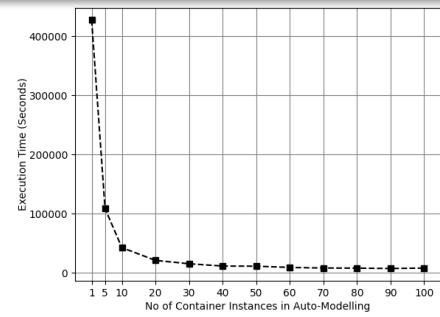
Agility

Scalability

Reliability

Benefit

- Implemented **quickly and scalably** using PaaS.
- Compressed weekly computational costs to **1-2 hours**.
- Tested hypotheses using data from a supermarket within **Tsinghua University (China)**, suggesting the practicality of the modelling framework and cloud architecture.
- Academic paper accepted at **IEEE** & presented in India.
- Currently submitting to an **international journal in the field of cloud computing**.



User Voice

"Leveraging cloud technology in research and education enables the tackling of more computationally challenging tasks, leading to new opportunities."

Rudi Stouffs

Associate Professor & Assistant Dean, NUS



Juxtaposing Individual and Group Mobility from Sparse WiFi Signatures with Cloud-Assisted Computing ~個人と集団移動における並置解析フレームワークのクラウドネイティブ化~

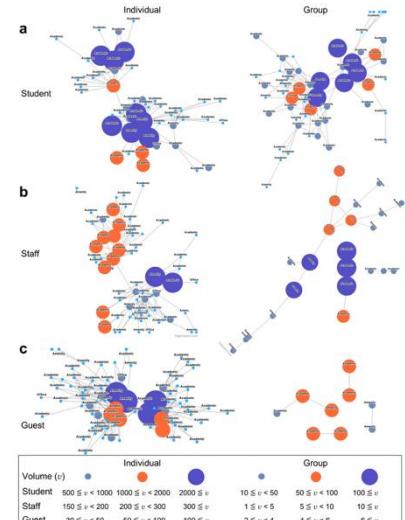
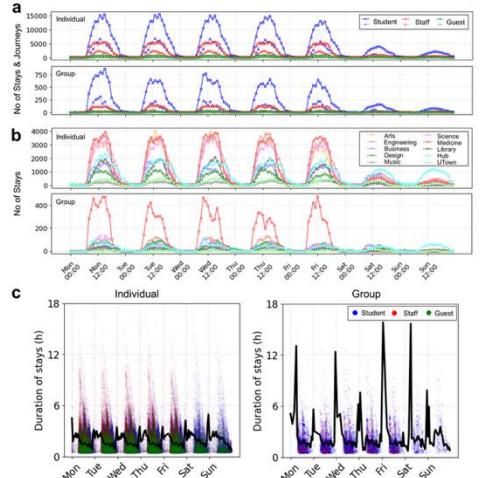
Kohei Yamamoto (マイクロソフト), Zhou Guo (中山大学), Chen-Chieh Feng (シンガポール国立大学)

膨大な WiFi の接続履歴から、個人と集団の時空間におけるパターン解析の総計算コストを従来の約 6 %までに圧縮。

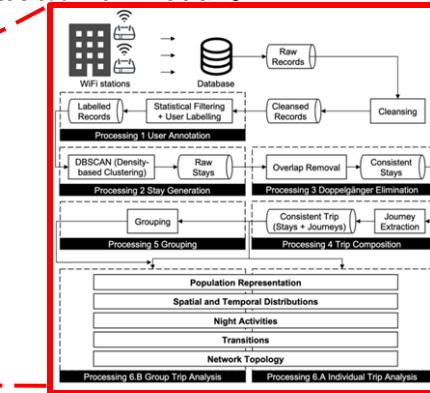
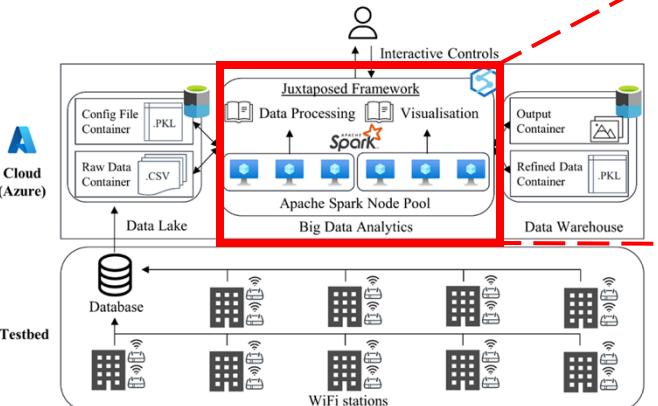
クラウドネイティブな並置解析フレームワークを提唱。学術機関での仮説検証を迅速に実行し、位置情報に関する国際論文誌で採択。

Challenge

- コロナ禍もあり **人の移動予測**が大きく注目
- 個人と集団移動での実証的 **並置解析**はまだ乏しい
- フレームワークは **数日に及ぶ計算コスト**が発生
 - 仮説1: WiFi 接続履歴で個人と集団の異質性検証
 - 仮説2: 属性間での変異を検証
 - 仮説3: クラウド基盤での計算による計算効率化



Solution



- 分析フレームワークを Spark Cluster ベースの **分散基盤**で高速解析
- GitHub Copilot の活用により隙間時間**約1週間**でコード変換・実装

Agility

Scalability

Performance

Benefit

- ビッグデータ分析基盤で **スケーラブル**に実装
- 数日をまたぐ計算コストが **2~3時間**に圧縮
- シンガポール国立大学キャンパスの4.6万人1億超レコードで仮説を検証し、個人と集団の並置解析フレームワークの妥当性を実証環境で証明
- クラウドアーキテクチャの **実用性**を示唆
- 位置情報専門の **国際論文誌**で採択

User Voice

"It proposes a novel framework utilising Wi-Fi and Geo-spatial technology to analyse both individual and group mobility dynamics, offering valuable insights into human behaviour and mobility patterns with practical applications."

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Associate Professor, NUS



Yamamoto, K., Zhou, G., and Feng, C. 2024. Juxtaposing individual and group mobility from sparse WiFi signatures with cloud-assisted computing: a case study for a multidisciplinary university campus, Journal of Location Based Services, 18(2), 205–236. DOI: 10.1080/17489725.2024.2330922



Analytical Framework in Cloud-Native Environments for Auto-Modelling Sparse Human Mobility Considering Memory of Past Contexts ~ 機械学習フレームワークのクラウドネイティブ化 ~

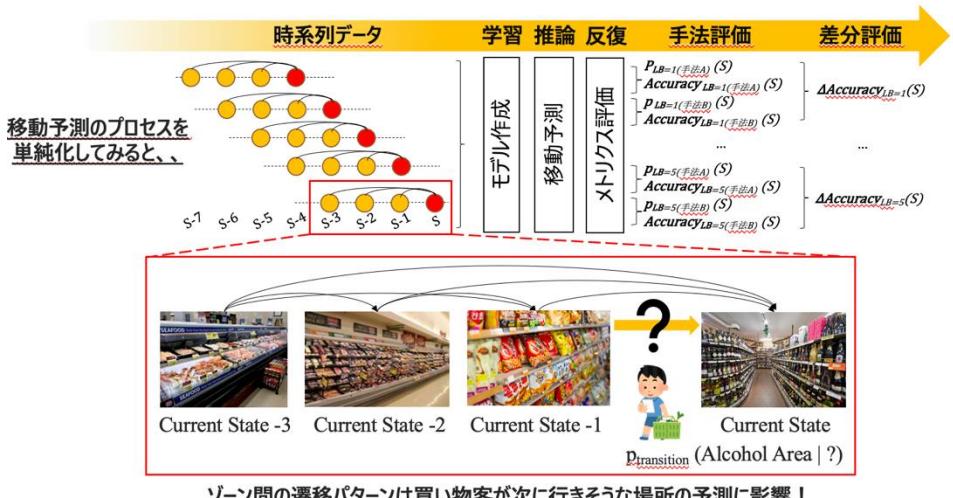
Kohei Yamamoto (マイクロソフト), Joie Lim (NUS; シンガポール国立大学), Filip Biljecki (NUS), Rudi Stouffs (NUS)

機械学習パラメータセット総計算時間を約60倍効率化。

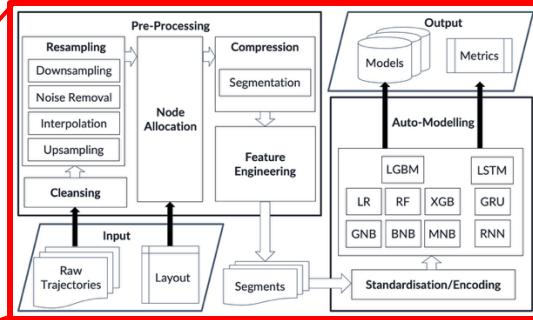
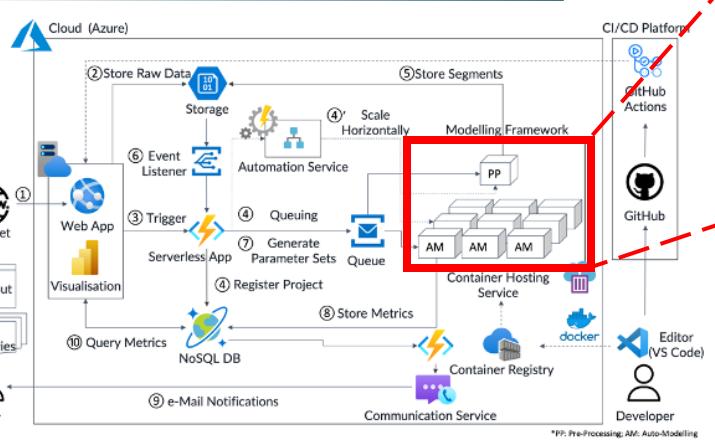
クラウドネイティブなアーキテクチャで学術機関での仮説検証を迅速に実行し、IEEEにて学術論文採択・登壇。クラウドの国際論文誌に提出。

Challenge

- コロナ禍もあり個人の移動予測が大きく注目
- 1万弱パラメータセットの反復的な仮説検証に1週間弱の計算コストが発生
 - 仮説1: どれほど過去情報を畳み込むべきか
 - 仮説2: 手法間でどれくらい差が出るか
 - 仮説3: 特徴量でどれくらい差が出るか



Solution



- 分析フレームワークをコンテナ化・並列モジュール化
- サーバレス型のアプリ(Functions)やGitHub Copilotの活用により隙間時間約1ヶ月で迅速に実装

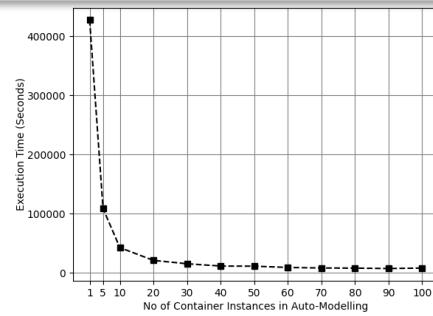
Agility

Scalability

Reliability

Benefit

- PaaS の組み合わせで迅速かつスケーラブルに実装
- 週レベルの計算コストが1~2時間に圧縮
- 清华大学(中国)構内のスーパー市場のデータで仮説を検証し、分析フレームワークおよびクラウドアーキテクチャの実用性を示唆
- IEEEにて学術論文採択 & インドで登壇
- クラウド分野の国際論文誌への投稿中



User Voice

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Rudi Stouffs
Associate Professor & Assistant Dean, NUS

