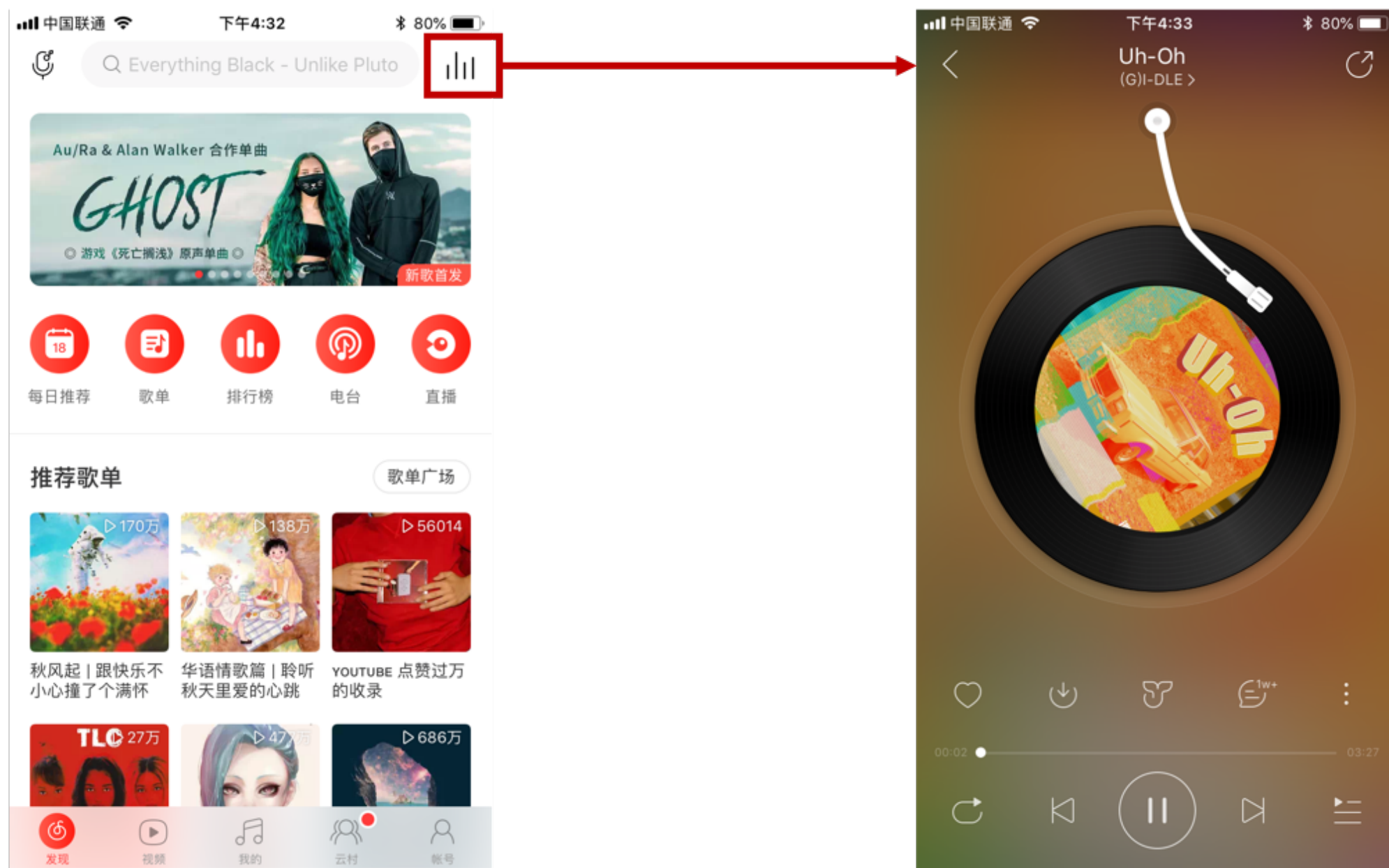


# LinkRadar: Assisting the Analysis of Inter-app Page Links via Transfer Learning

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## Background

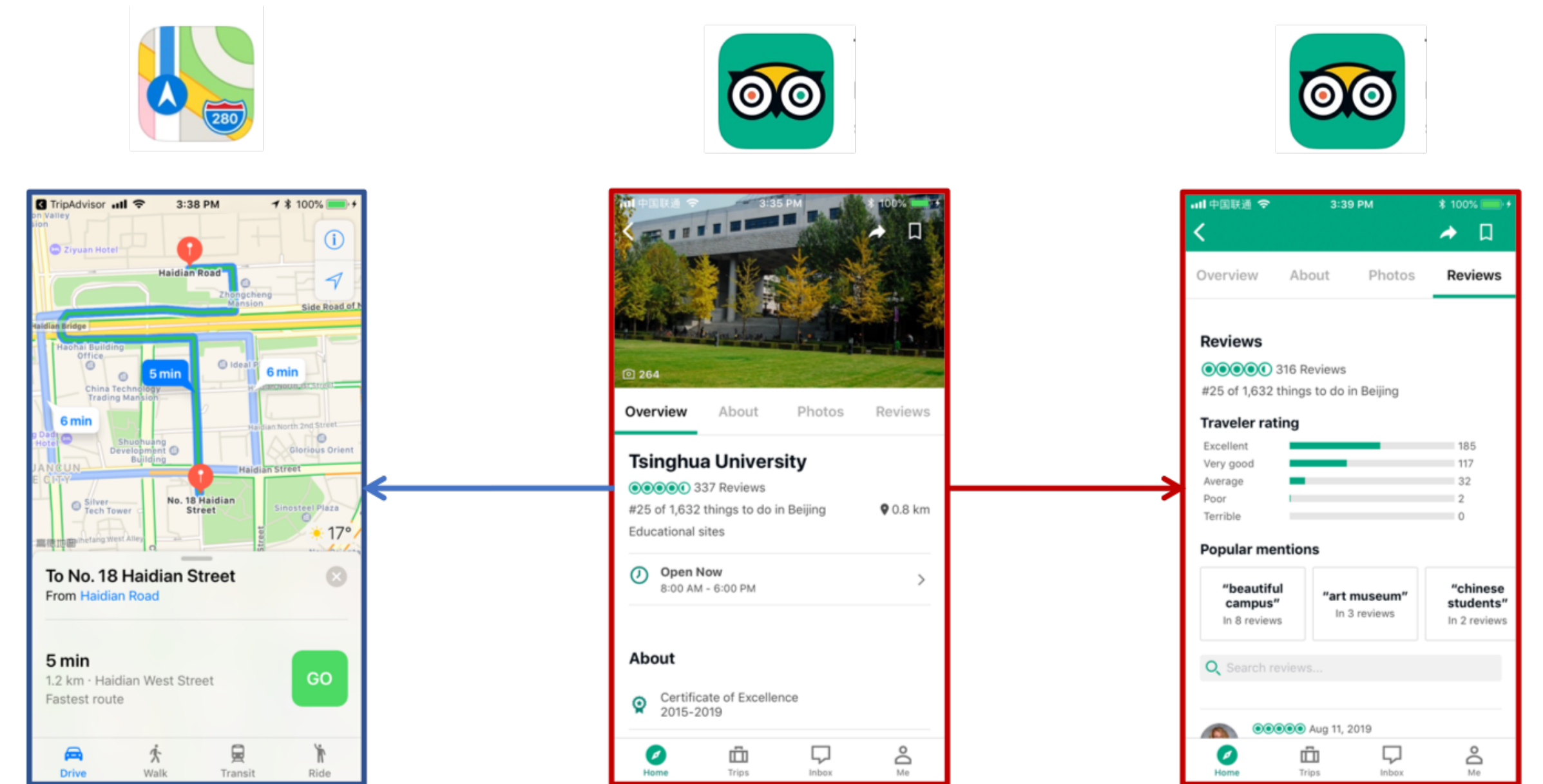
- App pages are linked with one another to provide additional service for mobile users



- App link analysis:** A critical component in many fields (i.e., service recommendation, malicious data access detection)
- Current inter-app link analysis work mostly relies on static analysis, which produces a lot of false positives, requiring significant manual effort to verify the links
- We propose **LinkRadar** to assist the analysis of inter-app page links with a data-driven approach

## Challenge

- How to learn the pattern of inter-app page links with few inter-app links in the data set?**
- Fact: Inter-app links and intra-app links are similar: both kinds of links connect two app pages with relative contents and different functions.



Route

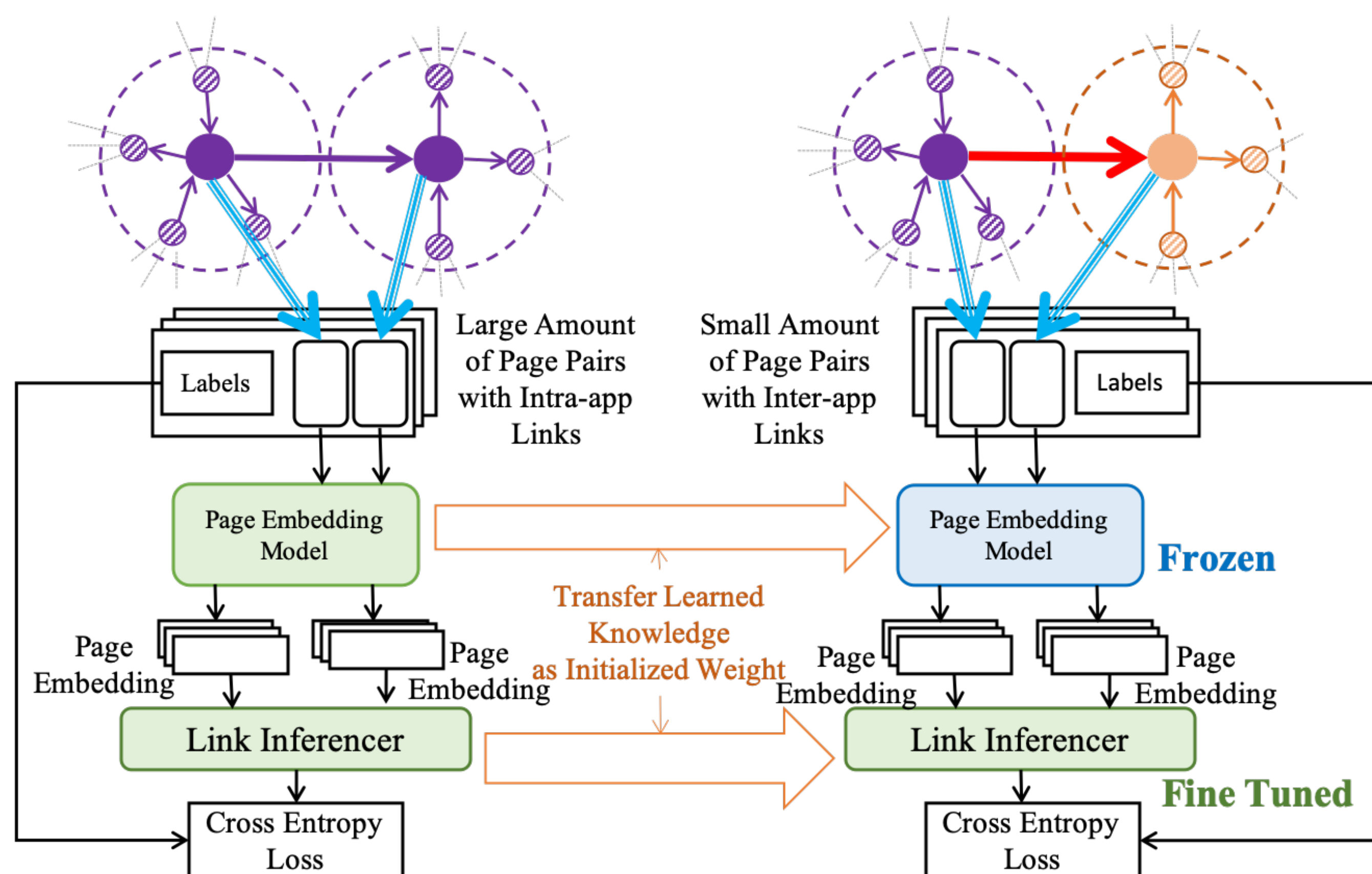
Detail of a place

Comment

- Learn to infer intra-app page links first and then transfer the knowledge to infer inter-app page links

## Approach

- Page Embedding Model (PEM):** For each page, the *Page Embedding Model* learns its specific representations from app pages in "neighborhood" and its own features such as text, screen snapshots, UI-tree, app meta data and so on
- Link Inferencer:** Explores linkage relationship between page representation pairs



Schematic overview of LinkRadar

- Transfer learning:** We first train LinkRadar with large amounts of page pairs with intra-app links and then transfer what we learned as initialized weights to learn on the inter-app data. PEM is always fixed in the process of transfer learning. The parameters of the Link Inferencer are set trainable to adapt the patterns typical of inter-app page links.

## Evaluation

- Evaluation Methods
  - Accuracy and precision
  - Compare the inference result of LinkRadar with manually validated result
- Baseline Methods
  - Random (Random numbers from 0 to 1)
  - LinkRadar-NoF (The LinkRadar model without fine tuning)
  - LinkRadar-NoN (The LinkRadar Model without neighborhood information)

	Precision	Recall	MAP	MRR
LinkRadar	0.71	1.00	0.257	0.412
Random	0.07	0.44	0.089	0.103
LinkRadar-NoF	0.33	0.88	0.206	0.253
LinkRadar-NoN	0.32	0.95	0.227	0.280

- Applying LinkRadar on the result of static analysis tools:

