

POI recommendation on uncertain check-ins

1. Objective

Next Point-of-Interest Recommendation systems nowadays often assume that the users' check-in records are accurate. However, the accuracy and certainty of a user's check-in history may not be guaranteed in a real-world application due to the nature of the recording mechanism or the inaccuracy during the recording process. For example, the user may be recorded visited Mall P5, but not which specific store.

Our model aims to give as accurate as possible POI recommendation given that the check-in history is fuzzy and uncertain.



2. Data Preparation

Check-in histories from two public data sets: Yelp and Foursquare were used. Three cities which have relatively high data volume in both data sets were chosen: Charlotte (US), Phoenix (US) and Calgary (CA).

The valid visit sequences for each user were extracted together with the related time, category and space information. The amount of data for model training is shown in Table 1.

City	POIs	Users	Check-ins	Categories
CLT	1580	1791	20940	239
CAL	301	985	13954	184
PHO	1623	2441	22620	251

Table 1: Available data after data processing

3. Proposed Model

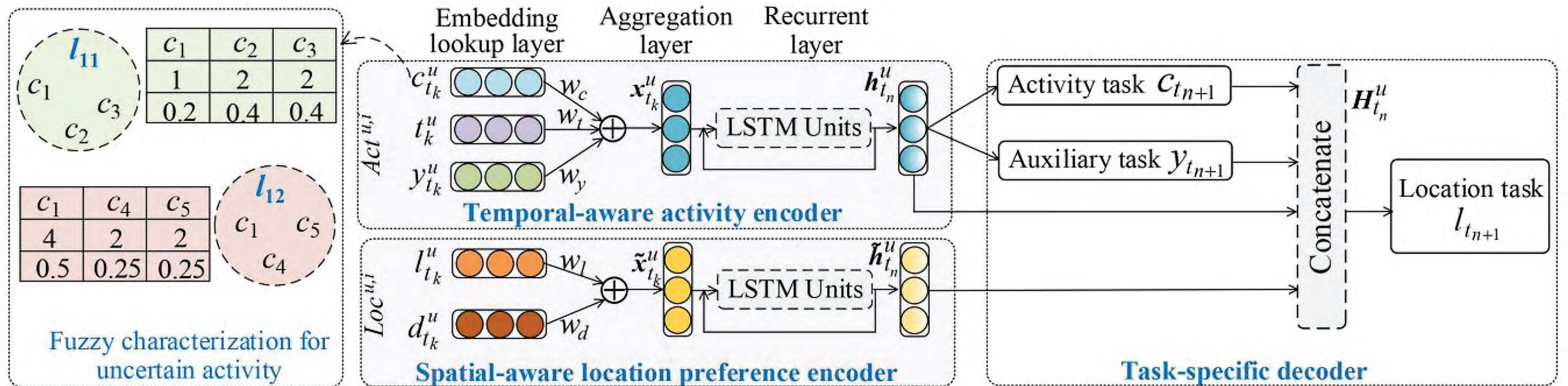


Figure 2: Proposed Model Structure

The model consists of three parts:

- **Temporal aware activity encoder:** use category, type and time sequential information to capture user's intention (activity) information
- **Spatial aware location preference encoder:** use POI and distance sequential information to capture location-related information
- **Task-specific decoder:** use activity information to predict the category of the next POI and then use all information to predict next POI

4. Performance comparison

Activity Prediction Task											
Data	Metrics	MostPop	CateMF	ME	LBPR	ST-RNN	ATST-LSTM	MCARNN	HCT	iMTL	Improve
CLT	Rec@10	0.1321	0.1516	-	0.1829	-	-	0.1935	0.1984*	0.2213	11.5%
	MAP@10	0.0435	0.0482	-	0.0558	-	-	0.0621	0.0614*	0.0709	15.5%
CAL	Rec@10	0.1063	0.1238	-	0.1425	-	-	0.1579	0.1602*	0.1724	7.6%
	MAP@10	0.0417	0.0454	-	0.0618	-	-	0.0751	0.0764*	0.0887	16.1%
PHO	Rec@10	0.1102	0.1214	-	0.1647	-	-	0.1974	0.2010*	0.2311	15.0%
	MAP@10	0.0430	0.0506	-	0.0624	-	-	0.0776	0.0781*	0.0947	21.3%
Location (POI) Prediction Task											
Data	Metrics	MostPop	CateMF	ME	LBPR	ST-RNN	ATST-LSTM	MCARNN	HCT	iMTL	Improve
CLT	Rec@10	0.0305	0.0323	0.0401	0.0446	0.0421	0.0465	0.0458	0.0477*	0.0534	11.9%
	MAP@10	0.0104	0.0124	0.0137	0.0174	0.0162	0.0201	0.0210	0.0204*	0.0238	13.3%
CAL	Rec@10	0.0317	0.0341	0.0416	0.0483	0.0479	0.0522	0.0545	0.0617*	0.0691	12.0%
	MAP@10	0.0119	0.0155	0.0205	0.0226	0.0230	0.0328	0.0364	0.0372*	0.0443	16.4%
PHO	Rec@10	0.0323	0.0352	0.0434	0.0525	0.0506	0.0591	0.0608	0.0662*	0.0769	16.2%
	MAP@10	0.0125	0.0180	0.0207	0.0218	0.0243	0.0260	0.0275	0.0301*	0.0352	16.9%