DeepApp: Predicting Personalized Smartpohone APP usage via context-aware multi-task learning

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- Multi-task Learning: 具有多个不同的loss，如同时执行视频点赞/转发/停留时长等多个具有类似特征，可泛化的任务。
  1. 方便，节省开销：大量同源任务本身是可泛化的，可以通过共享参数、共享模型进行任务学习。
  2. 利用泛化能力缓解单任务数据稀疏的问题。

- Hard-Parameter Sharing: 底层参数共享，Dense层参数各自根据Loss学习。
- Soft-Parameter Sharing: 底层参数**部分**共享或者相互约束。

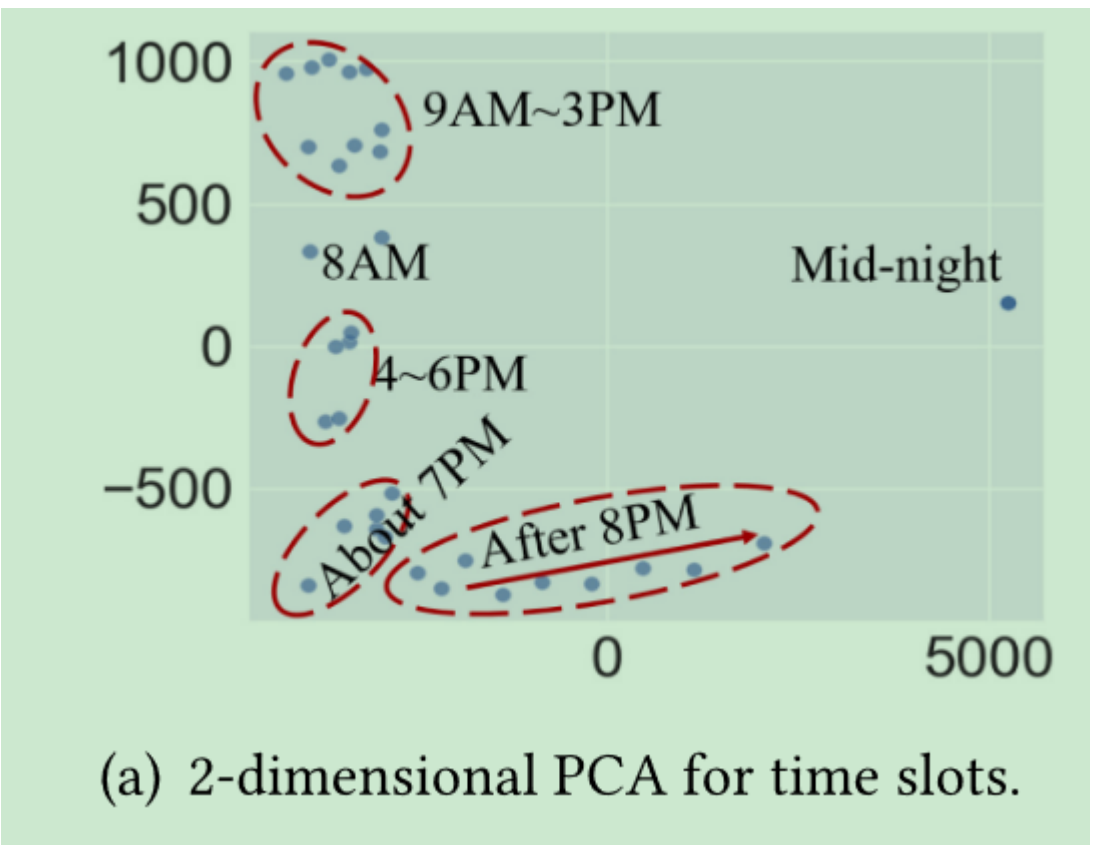
▼ Paper Content:

For Next App Prediction:

- Task1: 预测User ID
- Task2: 预测Location Unit ID
- Task3: 预测Next App usage

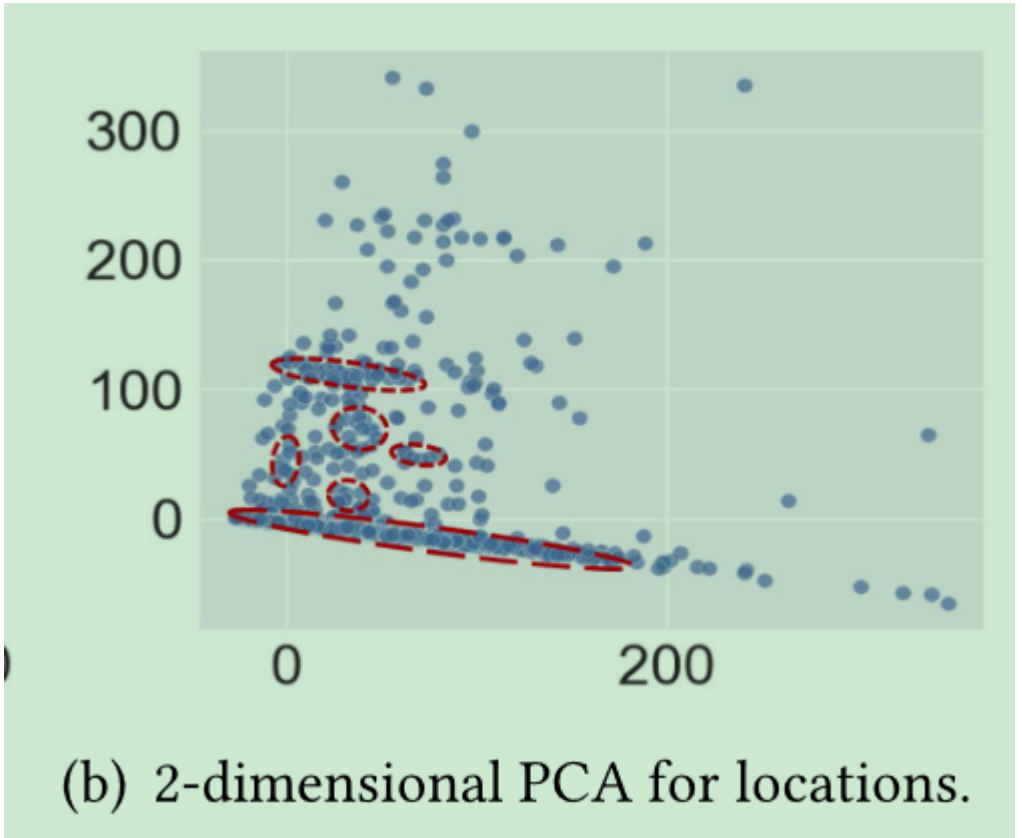
▼ **App Usage Pattern:** Not only spatio-temporal related but also highly personalized:

From app usage amount perspective, **the Temporal pattern**:



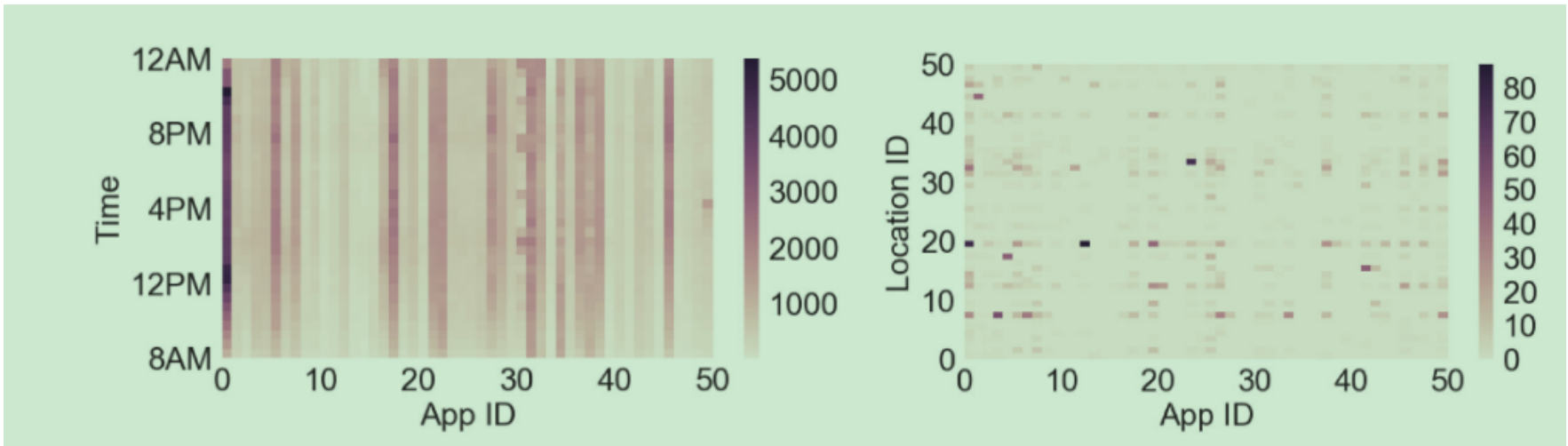
(a) 2-dimensional PCA for time slots.

Location Pattern:



(b) 2-dimensional PCA for locations.

Randomly select 50 apps, heatmap with usage:



(d) Time-App usage matrix for weekdays. (e) Location-App usage matrix.

▼ **Chanllenge**:

- Train a model for every person → data scarce
- Train for all people, fail to uncover user preference.

▼ **App Prediction Problem**

Given app usage sequence, predict app will be used next time.

▼ **Model**

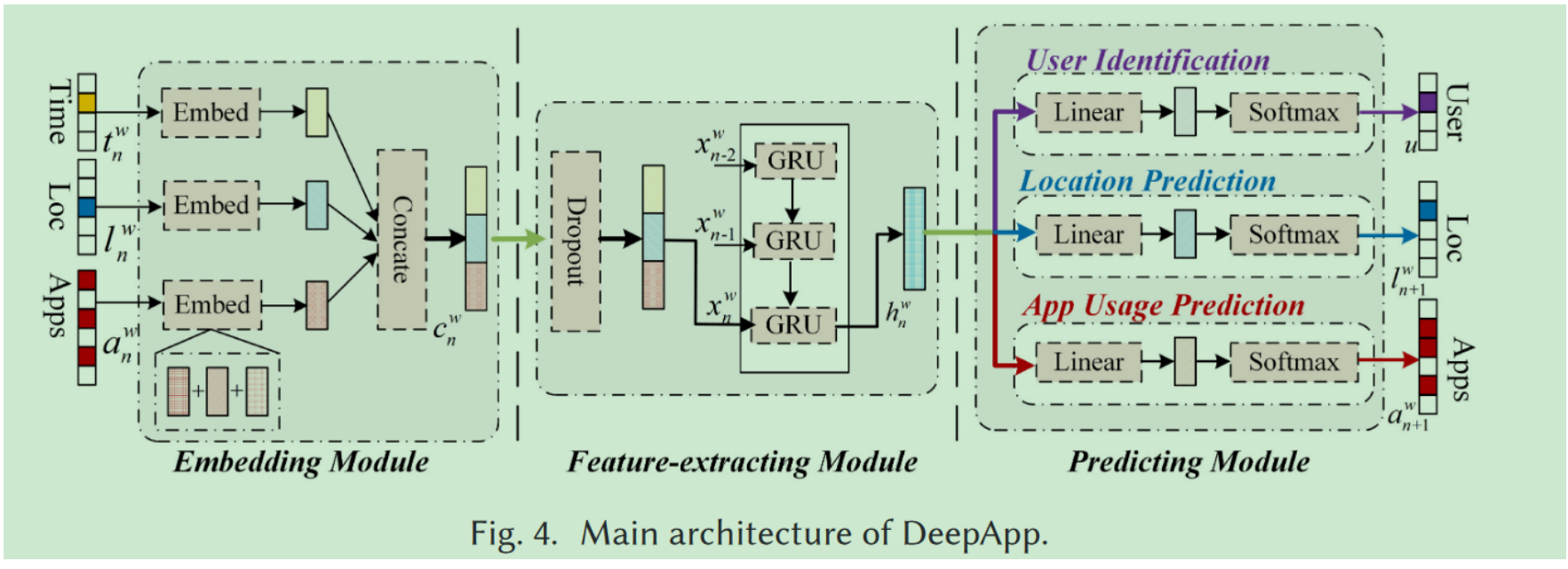


Fig. 4. Main architecture of DeepApp.

▼ **Embedding Module:**

对App Sequence: Doc2Vec

对Time: nn.embedding

对Loc: nn.Embedding

然后concat起来

- ▼ **Feature Extraction Module**

  Drop Out然后GRU

- ▼ **Prediction Module**

  multi-task learning

- ▼ **Loss**

  $Loss = J_a + \lambda_1 J_{user} + \lambda_2 J_{Location}$

▼ **Comparison and Ablation Study**

- MRU(most recently used)
- MFU(most frequently used)
- Bayes(条件概率)
- AppUsage2Vec(将Loc,user,time等放在输入端，单任务学习)

Abaltion_Study:

- Abaltion:Individual,Unified(no user), Backward(user as input end), no location, location as input but not task...