ArchiDroid

Ex pede Herculem: Augmenting Activity Transition Graph for Apps via GCN

一叶知秋：通过图卷积神经网络自动化增强App的活动转移图

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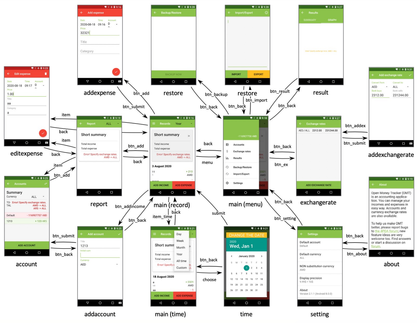
ArchiDroid Link: *https://github.com/20200829/Archidroid*

Background

- **Mobile Application**
  - *Companies design rich functions*
  - *more and more complex*
  - *Model the mobile app is highly needed*
  - *Activity name conveys its functionality*
  - *Transition is inferred from activity name*
- **Automated GUI Testing**
  - *Explore App with random actions*
  - *Low test coverage*

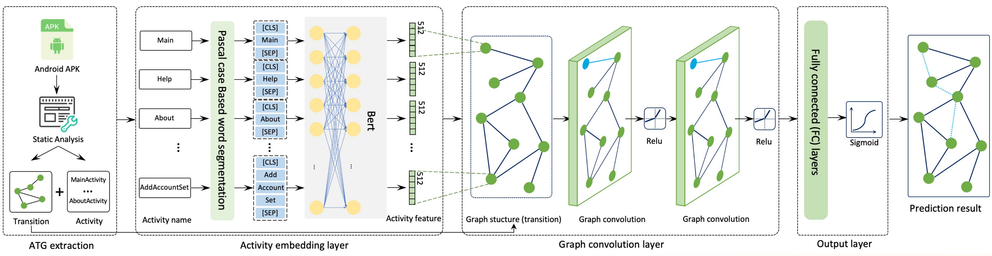
Motivation

- *Missing activities or incorrect transitions from static analysis*
- *Low activity coverage for dynamic analysis*



Approach

ArchiDroid *will automatically predict the transition between activities of the app and augment its Activity Transition Graph (ATG). We first extract a seed ATG by static analysis. Then, we adopt the prediction model to discover missing transitions. The output layer predicts the transition between activities and builds ATG of the app automatically.*



- **Seed ATG extraction**
  - *Static analysis to extract seed ATG*
  - *Analysis intent() method*
- **Activity Embedding layer**
  - *Aim at encode the name semantic of each activity into the embedding vector of activities*
  - *Pascal case based word tokenize*
  - *Bidirectional Encoder Representation from Transformers*
- **Graph Convolution Layer**
  - *Predict the transitions between activities*
  - *Capture information about immediate neighbors*
  - *Two layers of graph convolution*
- **Three-phase Model Training**
  - *Fine-tune the pre-trained model*
  - *Pre-train the GCN*
  - *Fine-tune the pre-trained GCN*

Evaluation

- **Effectiveness Evaluation**
  - *Precision 0.86, Recall 0.94, 24% higher than baseline*
  - *The app has a similar business logic to other apps*
- **Usefulness Evaluation**
  - *Exploration time through the ATG extracted by ArchiDroid*
  - *43% more than activity coverage of DroidBot without ArchiDroid*
  - *The accuracy of ArchiDroid in predicting transition is 0.85*

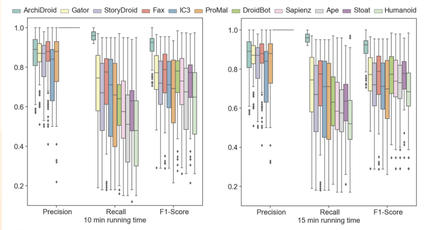


Fig. 4: Comparison with static and dynamic analysis tools.

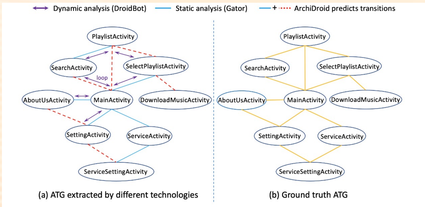


Fig. 3: Example of ArchiDroid's transition prediction result compares with static and dynamic analysis.