



Fill in the Blank: Context-aware Automated Text Input Generation for Mobile GUI Testing

完形填空：上下文驱动的移动应用程序文本输入自动生成

Zhe Liu, Chunyang Chen, Junjie Wang, Xing Che, Yuekai Huang, Jun Hu, Qing Wang
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联系人：刘哲, 王俊杰, 王青

联系方式：{liuzhe2020, junjie, wq}@iscas.ac.cn

Background

Mobile Application

- become an indispensable part
- Rich GUIs & interactive operations
- Text input is a common operation
- The input content needs to meet semantic requirements

Automated GUI Testing

- 80% apps have >1 page requiring text inputs
- No appropriate text input

Motivation

- Requires a specific value for different types of the inputs
- Some text inputs within the same UI page may correlate with each other

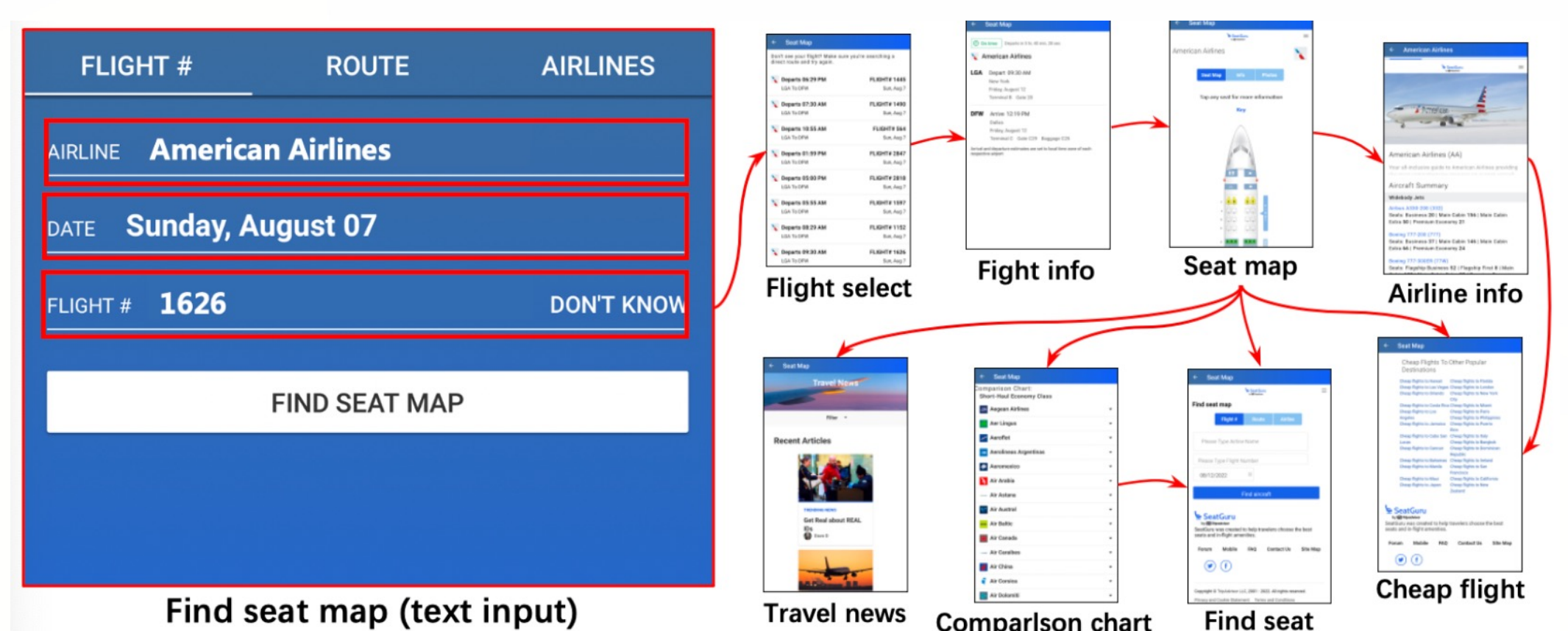
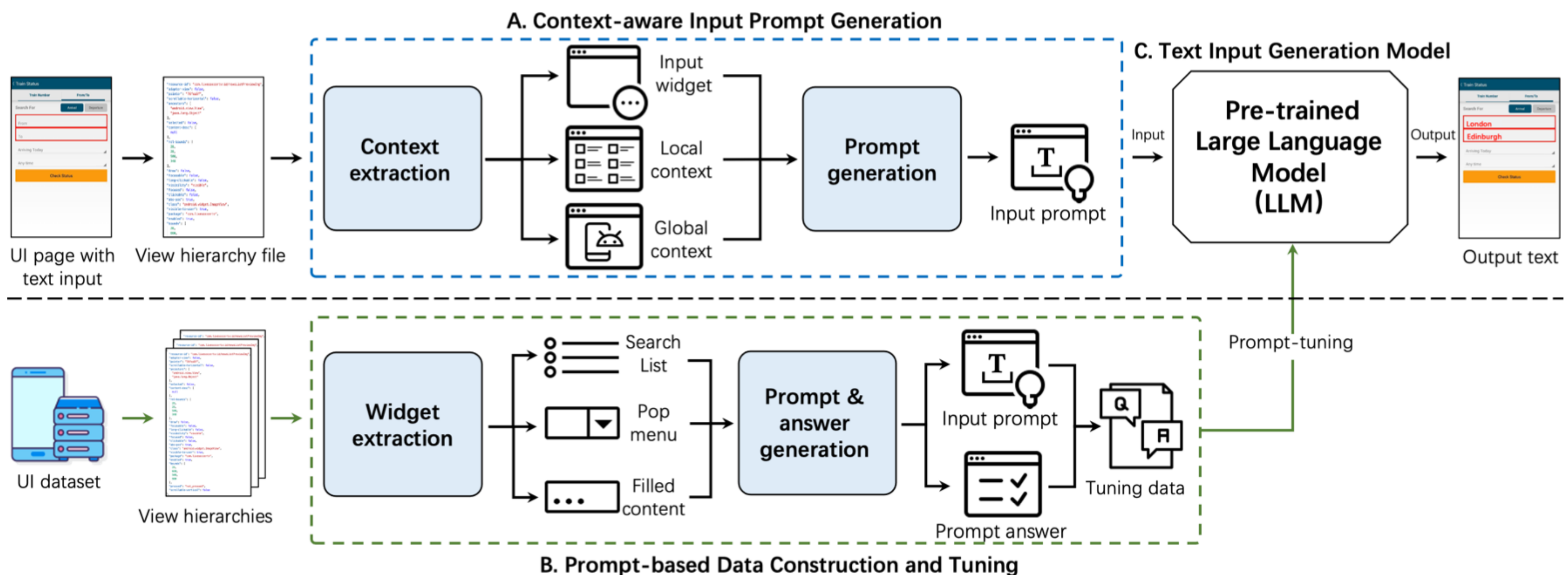


Fig. 1: Example of text input in Android app.

Approach

We find that the text input widget generation task is like the “fill in blank” in our daily life. Inspired by this, we propose a context-aware automated text input generation approach *QTypist* to enhance mobile GUI testing. It can generate the valid inputs like an excellent typist.



Context-aware Prompt Generation

- Context Extraction
 - Input widget, local context, global context
- Prompt Generation
 - Linguistic patterns of prompt
 - 14 linguistic patterns respectively related to input widget, local context and global context

Prompt-based Data Construction

- Extraction from search list
- Extraction from popup menu
- Extraction from filled content



Evaluation

Effectiveness Evaluation

- 0.87 pass rate, 93% higher than baseline
- Can also generate some text with actual meaning

Usefulness Evaluation

- We integrated the *QTypist* into 3 automated GUI testing tools
- Significant activity boost by added to GUI testing tools

<p>a Blood pressure record</p> <p>Date: _____ Time: _____</p> <p>Systolic pressure: _____ Diastolic pressure: _____</p> <p>Pulse: _____ Weight: _____</p>	<p>Random-based: "Hello Word", "Hello", "3", "3", "3", "3" ✗</p> <p>Rule-based: "2022", "2022", "1", "1211", "1", "11" ✗</p> <p>Mobolic: "FDS", "AL", "186", "200", "186", "200" ✗</p> <p>TextExerciser: "1/1/2022", "8:00", "90", "70", "19", "23" ✓</p> <p>RNNInput: "1/1/2016", "9:00", "1", "1", "60", "1" ✓</p> <p>QTypist (-T): "2022", "2022", "130", "80", "90", "60" ✗</p> <p>QTypist: "08/08/2022", "11:29", "112", "76", "78", "66" ✓</p>
<p>b Fill in blank True or false</p> <p>1. German physicist Wilhelm Roentgen is working in his laboratory in Würzburg when he accidentally discovers the _____.</p> <p>2. Coulomb's inverse-square law, is an experimental law of physics that quantifies the amount of force between _____.</p>	<p>Random-based: "Hello Word", "Hello" ✗</p> <p>Rule-based: "America", "home" ✗</p> <p>Mobolic: "German", "Coilomb" ✗</p> <p>TextExerciser: "UI", "UI" ✗</p> <p>RNNInput: "X-ray", "New York" ✗</p> <p>QTypist (-T): "X-ray while working ...", "stationary" ✗</p> <p>QTypist: "X-ray", "stationary" ✓</p>
<p>c Enter code</p> <p>Please input your JAVA code</p> <pre> public class Demo { public static void main(String[] args) { System.out.println("Hello world"); } } </pre>	<p>Other baselines: "Hello Word"/"code"/"123456" ✗</p> <p>QTypist: <code>public static Pattern { public static void main(String[] args) { int rows = 5; for (int i = rows; i >= 1; --i) { for (int j = 1; j <= i; ++j) { ... } } } }</code> ✓</p>