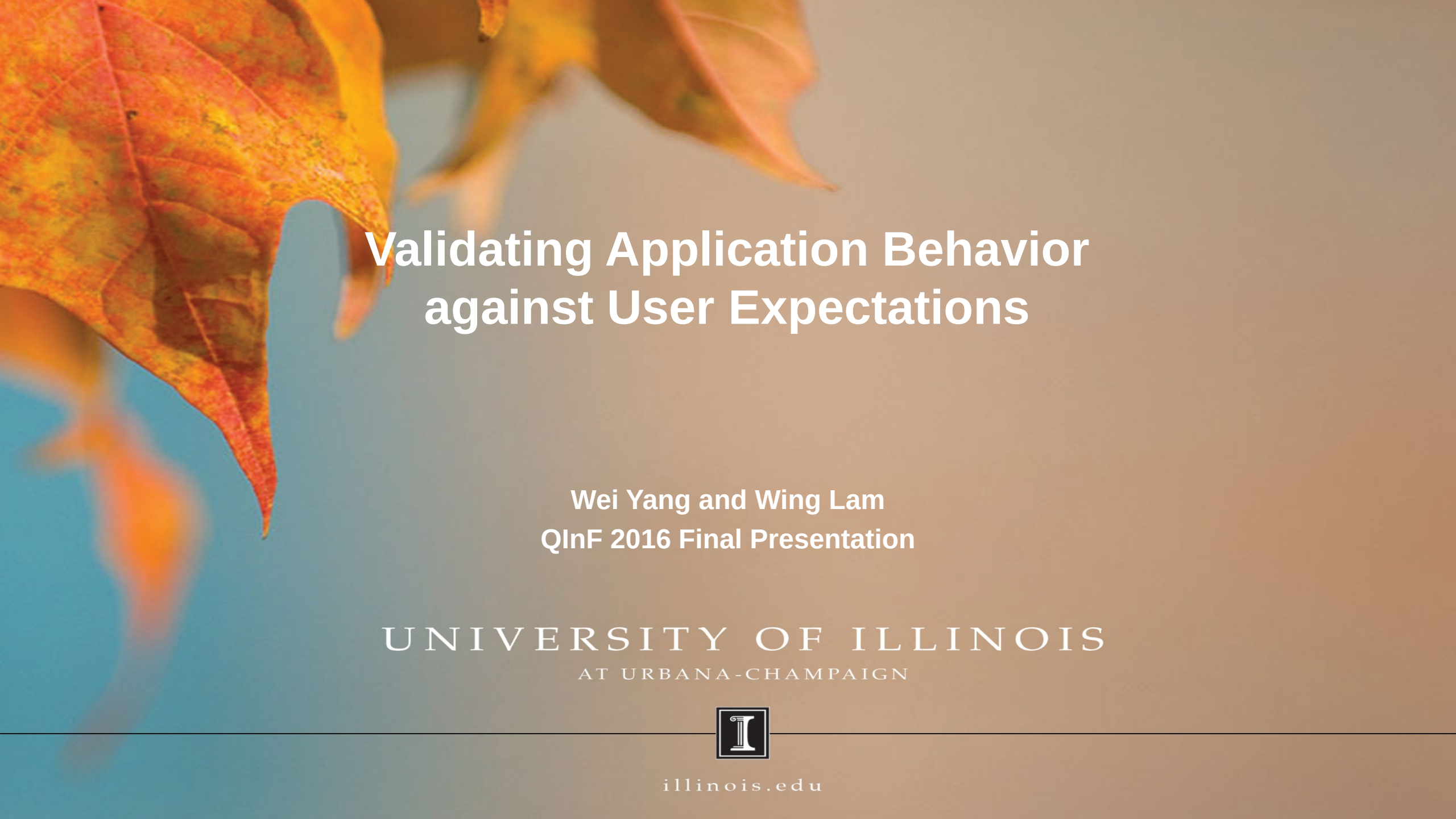


# Validating Application Behavior against User Expectations

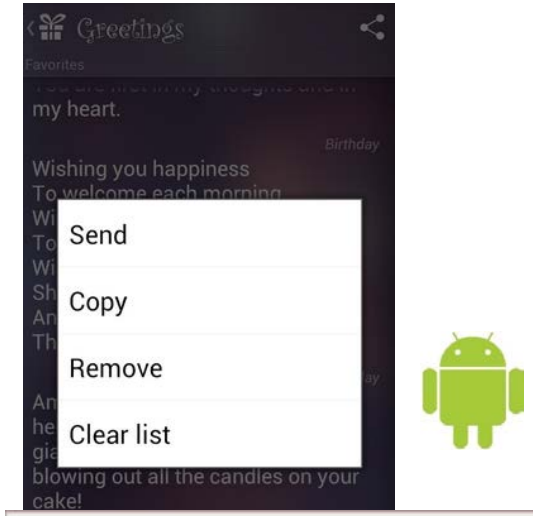
**Wei Yang and Wing Lam**

**QInF 2016 Final Presentation**

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

illinois.edu

# Context Matters: Malware vs Benign Apps




Your messages
Edit your text messages (SMS or MMS), read your text messages (SMS or MMS), receive text messages (SMS), send SMS messages

sendTextMessage (String destinationAddress, String scAddress, String text,
Send a text based SMS.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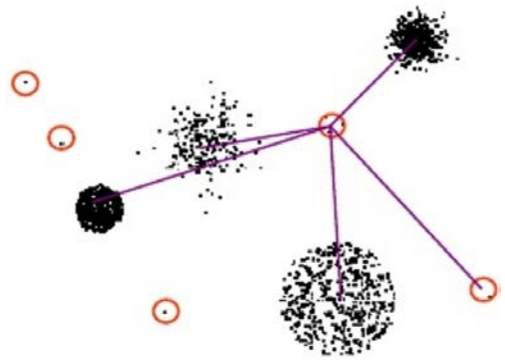
sendTextMessage (String destinationAddress, String scAddress, String text,
Send a text based SMS.

# Related Work

- Signature based
- Learning based

| | Download from IP A | Download from IP B |
|---|---|---|
| Redirected URL | http://[censored]agent.ru/midlet**/d4usk**/ml/mt73/a5_3_1/nOpera%20Mini%206.5/s0/sml/sub0/dommoby-agent.ru/u552/Opera_Mini_6_5.apk | http://[censored]agent.ru/midlet/**d4uATo**/ml/mt73/a5_3_1/nOpera%20Mini%206.5/s0/sml/sub0/dommoby-agent.ru/u552/Opera_Mini_6_5.apk |
| **Difference** | **d4us-k** | **d4uATo** |
| APK MD5 | d92b0e7906eeed4d6d0e747a0404aeb2 | ef05e600240dd1dbf452d300a3f63316 |
| res/raw/config.txt MD5 | 72f17a3fd22d34f98eff234d50a514f5 | 11cceb3c0fa9c08795bac4b648f00c49 |

Limitation:
Existing approaches focuses on limited data sources



# Yin-Yang View on Mobile App Security

**Expectation**
Context

***Check Consistency***

**Security**
Behavior

***Characterize***

Behavioral data: API invocations, network incoming and outgoing traffic, keyboard logs, app execution trace, bug/crash reports, static analysis

**Goal of our system:**

- To comprehensively characterize expectation contexts and security behaviors,
- And check their consistency.

Contextual data: user usage data, user reviews, UI screen (labels, hints, screen, buttons, sequence of screen), app descriptions, privacy policy, pictures/videos, tags (app category)

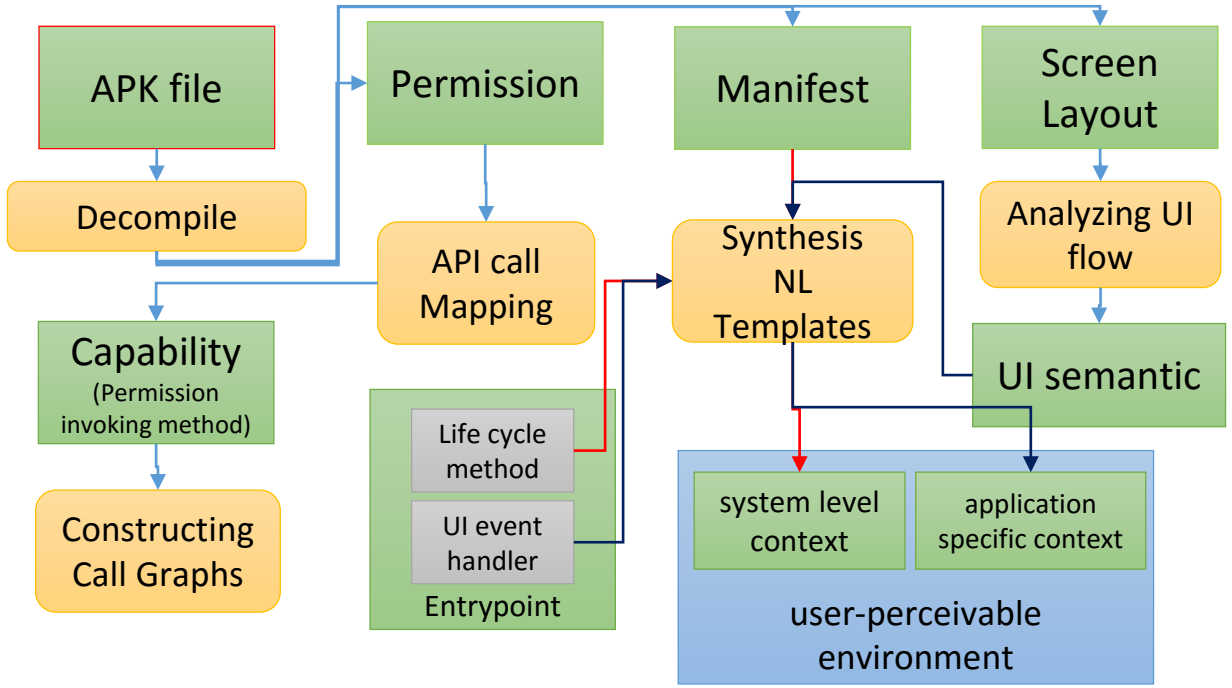
# Traceability-Centric Security Vetting System

- **Key Insights:**
  - Malicious behaviors can be detected as inconsistencies across expectation contexts and security behaviors
  - Leveraging heterogeneous data sources can provide comprehensive characterization

- **Challenges:**
  1. Traceability recovery across expectation context and security behaviors (consistency checking)
  2. Traceability recovery among heterogeneous data sources (characterization)

# Challenge 1: Traceability Recovery for Consistency Checking

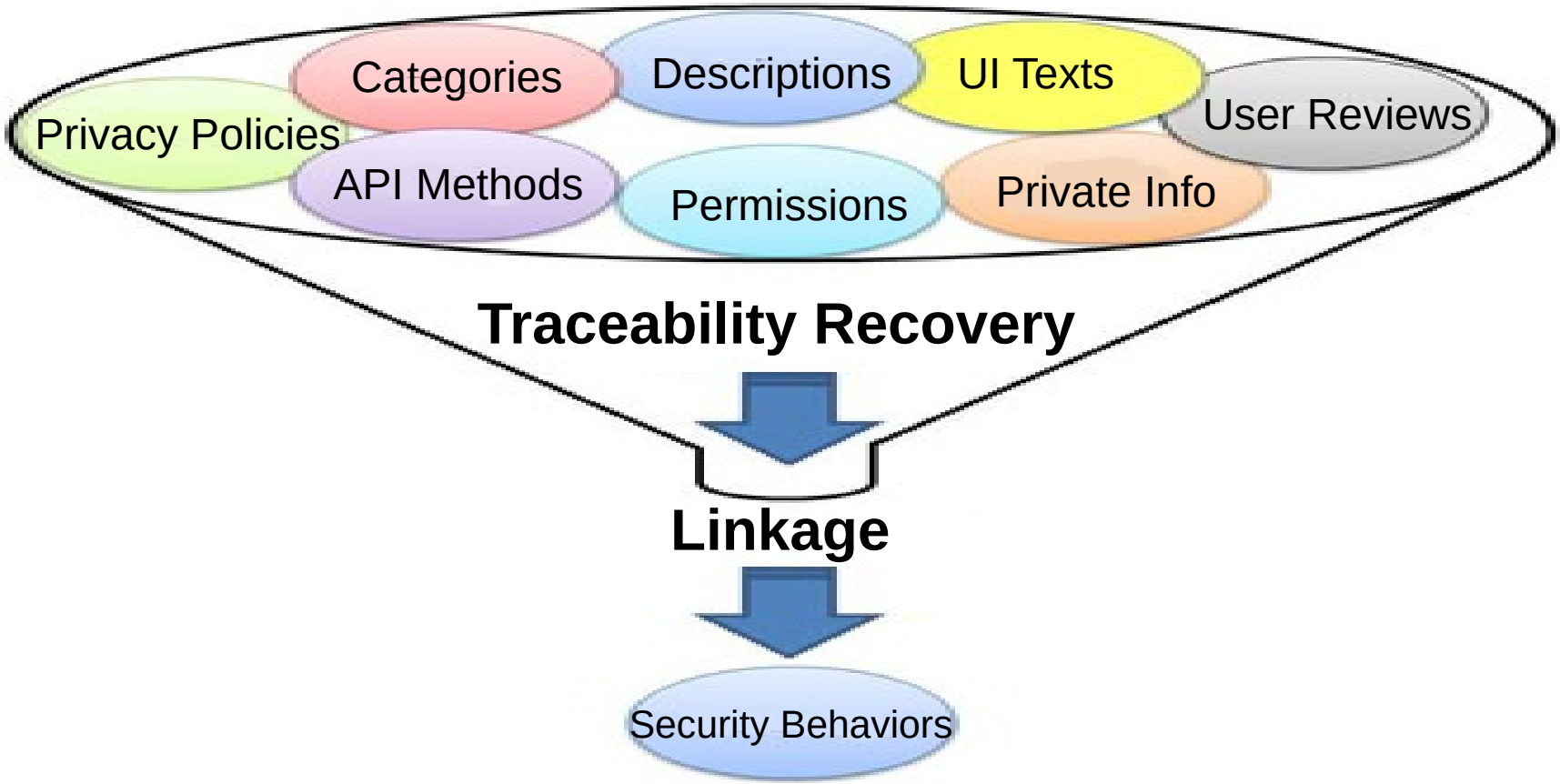
**Goal:** Develop a set of automated analyses to check inconsistencies and warn users about potential risks



# Roadmap (~12 months)

- **Permission Refinement** (~2 months)
  - Refine permission used by detecting which capability is actually leveraged
- **Context Recovery** (~3 months)
  - Combine *context factors* with *activation events* to generate a context tuple
- **Checking Unexpected Behaviors** (~3 months)
  - Report inconsistencies between synthesized descriptions and app descriptions
- **Removing Unwanted Behaviors** (~4 months)
  - Develop a suite of repair strategies to repair the apps at four levels of granularity ("where", "when", "what", and "how")

# Challenge 2: Traceability Recovery for Characterization



# Strength of the Team

**Wei Yang**

- Experienced in Android app security and testing, and natural language processing
- Published in *USENIX Security '13* and in *FASE '13*, *ICSE '15*, *NDSS '16*

**Wing Lam**

- Experienced in empirical studies, software testing, program analysis, and Android development
- Published in *ISSTA '14*

**WHYPER** (Published in Usenix Security)

Uses NLP to analyze app descriptions and permissions
Results attracted Google's strong interest and attention

**Pluto** (Published in NDSS)

Examines in-app information available to libraries at runtime

**AppContext** (Published in ICSE)

Leverage context information to check malicious behaviors

# Conclusion

- **Key Insights:**
  - Malicious behaviors can be detected as inconsistencies across expectation contexts and security behaviors
  - Leveraging heterogeneous data sources can provide comprehensive characterization

- **Proposed Techniques:**
  1. Traceability recovery across expectation context and security behaviors (consistency checking)
  2. Traceability recovery among heterogeneous data sources (characterization)