

Code Generation for Fun & Profit

(Swift Edition)

Ragunath Jawahar

A mobile app developer walks
into the bar...

A mobile app developer walks
into the ~~bar~~ office...



Tracking Code (Swift)

```
let properties = [
    "Gender": "Female",
    "Logged in": false,
    "Source": "Twitter"
]

Mixpanel.mainInstance()
    .track(event: "Signup", properties: properties)
```

Tracking Code (Swift)

```
let properties = [  
    "Gender": "Female",  
    "Logged in": false,  
    "Source": "Twitter"  
]
```

```
Mixpanel.mainInstance()  
    .track(event: "Signup", properties: properties)
```

Tracking Code (Swift)

```
let properties = [
    "Gender": "Female",
    "Logged in": false,
    "Source": "Twitter"
]

Mixpanel.mainInstance()
    .track(event: "Signup", properties: properties)
```

Tracking Code (Java)

```
MixpanelAPI mixpanel = MixpanelAPI.getInstance(this, token);
try {
    JSONObject payload = new JSONObject();
    payload.put("Gender", "Female");
    payload.put("Logged in", false);
    payload.put("Source", "Twitter");
    mixpanel.track("Signup", payload);
} catch (JSONException exception) {
    Log.e("Frodo", "JsonException", exception);
}
```

Tracking Code (Java)

```
MixpanelAPI mixpanel = MixpanelAPI.getInstance(this, token);
try {
    JSONObject payload = new JSONObject();
    payload.put("Gender", "Female");
    payload.put("Logged in", false);
    payload.put("Source", "Twitter");
    mixpanel.track("Signup", payload);
} catch (JSONException exception) {
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Tracking Code (Java)

```
MixpanelAPI mixpanel = MixpanelAPI.getInstance(this, token);
try {
    JSONObject payload = new JSONObject();
    payload.put("Gender", "Female");
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    mixpanel.track("Signup", payload);
} catch (JSONException exception) {
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Tracking Code (Java)

```
MixpanelAPI mixpanel = MixpanelAPI.getInstance(this, token);
try {
    JSONObject payload = new JSONObject();
    payload.put("Gender", "Female");
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    payload.put("Source", "Twitter");
    mixpanel.track("Signup", payload);
} catch (JSONException exception) {
    Log.e("Frodo", "JsonException", exception);
}
```

GREMLINS





	A	B	L	M
1	Screen Identifier	Workflow	Trigger Name	Data
2	Digital Cash In : Bank List	Digital Cash In	Selected Bank Cancelled Net Banking	<Bank Name>
35	Digital Cash Out : Enter Amount	Digital Cash Out	Opened "Help" Entered Amount Cancelled Entering Amount	<Amount>
36	Digital Cash Out : Enter New Account Details	Digital Cash Out	Searched IFSC Code Confirmed Withdrawal Cancelled Entering New Bank A/C Details	<IFSC Code>
37	Digital Cash Out : Response	Digital Cash Out	Accepted Response	<Response>
41	Digital Cash Out : Select Existing Account Details	Digital Cash Out	Selected New Bank A/C Option Confirmed Withdrawal Cancelled Adding New Bank Account	
42	dKYC : Select PoA	dKYC	Opened "Help" Selected PoA	<PoA>
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				

...and only 300 more rows

	A	B	L	M
1	Screen Identifier	Workflow	Trigger Name	Data
2	Digital Cash In : Bank List	Digital Cash In	Selected Bank Cancelled Net Banking	<Bank Name>
35	Digital Cash Out : Enter Amount	Digital Cash Out	Opened "Help" Entered Amount Cancelled Entering Amount	<Amount>
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37	Digital Cash Out : Response	Digital Cash Out	Accepted Response	<Response>
41	Digital Cash Out : Select Existing Account Details	Digital Cash Out	Selected New Bank A/C Option Confirmed Withdrawal Cancelled Adding New Bank Account	
42	dKYC : Select PoA	dKYC	Opened "Help" Selected PoA	<PoA>
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				

MAY THE “BRUTE”
FORCE BE WITH YOU



Problems

- Slow
- Boring
- Inaccurate
- Error Prone
- Hard to Test
- Difficult to Change
- Multiple Platforms
- Multiple Apps

Requirements

- Accuracy
- Accommodate Changes
- Don't Leak Cognitive Resources
- Testability
- Support Multiple Apps and Platforms

	A	B	L	M
1	Screen Identifier	Workflow	Trigger Name	Data
35	Digital Cash In : Bank List	Digital Cash In	Selected Bank Cancelled Net Banking	<Bank Name>
36				
37				
38	Digital Cash Out : Enter Amount	Digital Cash Out	Opened "Help" Entered Amount Cancelled Entering Amount	<Amount>
39				
40				
41				
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44				
45				
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47				
48	Digital Cash Out : Select Existing Account Details	Digital Cash Out	Selected New Bank A/C Option Confirmed Withdrawal Cancelled Adding New Bank Account	
49				
50				
51				
52	dKYC : Select PoA	dKYC	Opened "Help" Selected PoA	<PoA>
53				

WORKFLOW – SCREEN – EVENT

	A	B	L	M
1	Screen Identifier	Workflow	Trigger Name	Data
35	Digital Cash In : Bank List	Digital Cash In	Selected Bank Cancelled Net Banking	<Bank Name>
36				
37				
38	Digital Cash Out : Enter Amount	Digital Cash Out	Opened "Help" Entered Amount Cancelled Entering Amount	<Amount>
39				
40				
41				
42	Digital Cash Out : Enter New Account Details	Digital Cash Out	Searched IFSC Code Confirmed Withdrawal Cancelled Entering New Bank A/C Details	<IFSC Code>
43				
44				
45				
46	Digital Cash Out : Response	Digital Cash Out	Accepted Response	<Response>
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49				
50				
51				
52	dKYC : Select PoA	dKYC	Opened "Help" Selected PoA	<PoA>
53				

workflow().screen().event()

	A	B	L	M
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35	Digital Cash Out : Enter Amount	Digital Cash Out	Opened "Help" Entered Amount Cancelled Entering Amount	<Amount>
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48				
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51				
52				
53				

SOLVING MYSTERY



Java Poet – Method

```
MethodSpec mainMethod = MethodSpec.methodBuilder("main")
    .addModifiers(Modifier.PUBLIC, Modifier.STATIC)
    .addParameter(String[].class, "args")
    .addStatement(
        "$T.out.println($S)",
        System.class,
        "Hello, World!")
    ).build();
```

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        "$T.out.println($S)",
        System.class,
        "Hello, World!")
    ).build();
```

Java Poet – Class

```
TypeSpec greeterClass = TypeSpec.classBuilder("Greeter")
    .addModifiers(Modifier.PUBLIC)
    .addMethod(mainMethod)
    .build();
```

Java Poet – Class

```
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Java Poet – Class

```
TypeSpec greeterClass = TypeSpec.classBuilder("Greeter")
    .addModifiers(Modifier.PUBLIC)
    .addMethod(mainMethod)
    .build();
```

Java Poet – Compilation Unit

```
JavaFile greeterFile = JavaFile.builder("in.kitecash",
    greeterClass).build();

greeterFile.writeTo(System.out);
```

Java Poet – Compilation Unit

```
JavaFile greeterFile = JavaFile.builder("in.kitecash",
    greeterClass).build();

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Java Poet – Compilation Unit

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Java Poet – Compilation Unit

```
JavaFile greeterFile = JavaFile.builder("in.kitecash",
    greeterClass).build();

greeterFile.writeTo(System.out);
```

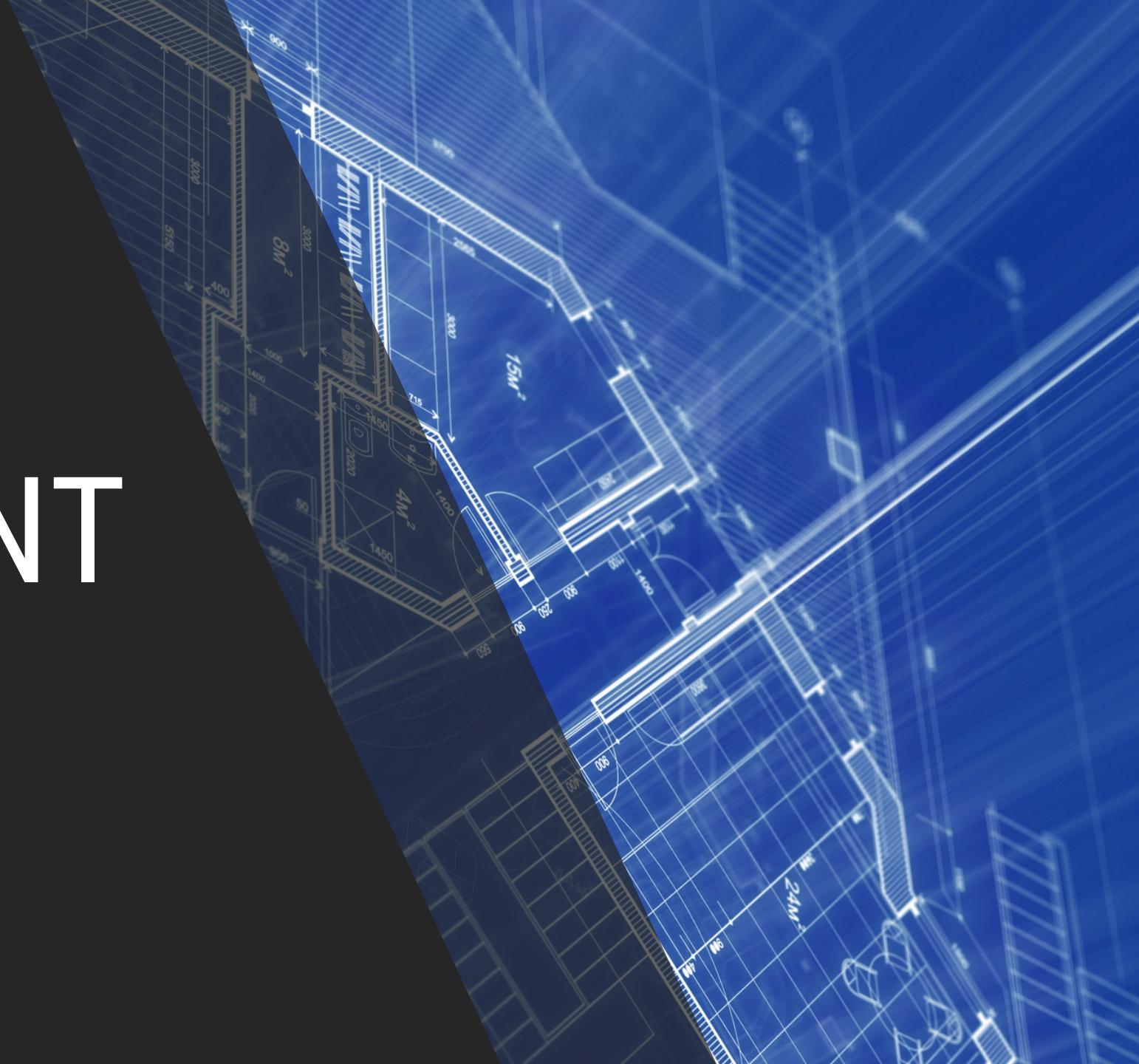
Java Poet – Generated Class

```
package in.kitecash;

import java.lang.String;
import java.lang.System;

public class Greeter {
    public static void main(String[] args) {
        System.out.println("Hello, World!");
    }
}
```

BLUEPRINT



Objective

`workflow().screen().event()`

ITERATE ON PAPER



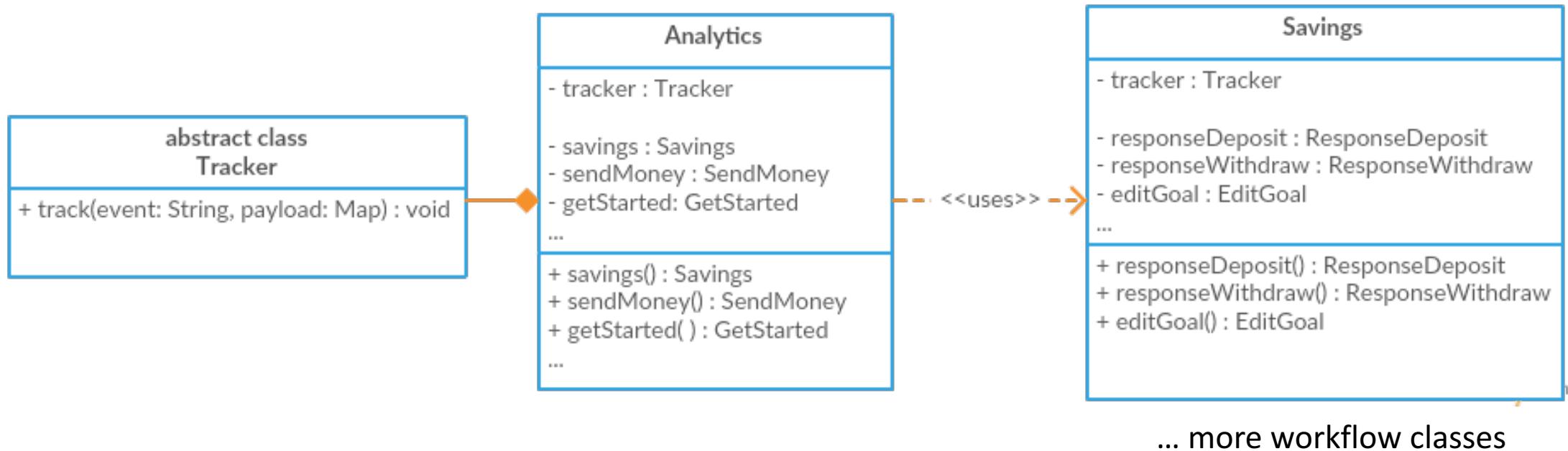
Components

- CSV Parser
- Source Code Generator

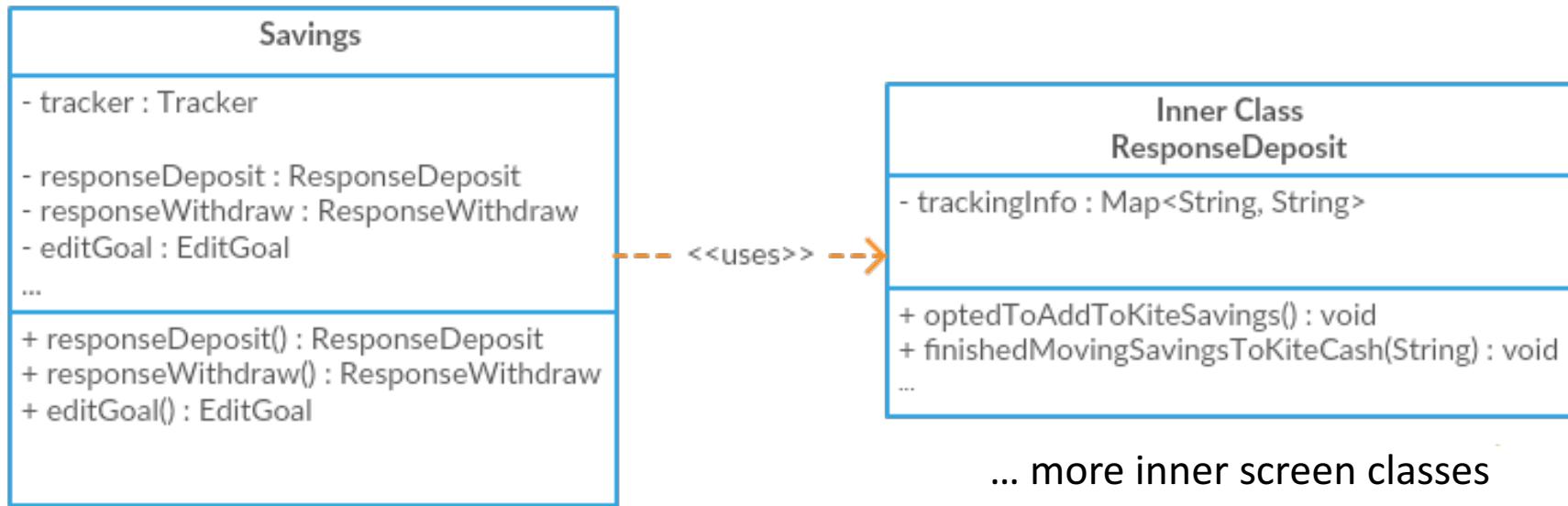
High-Level Design

- Generated abstract **Tracker** class
- Generated **Analytics** class
- Generated **Workflow** classes
- Generated **Screen** inner classes

Class Diagram



Class Diagram



Tracker

```
public abstract class Tracker {  
  
    public abstract void track(String event,  
                               Map<String, String> payload);  
}
```

Tracker

```
public abstract class Tracker {  
  
    public abstract void track(String event,  
                               Map<String, String> payload);  
}
```

Tracker

```
public abstract class Tracker {  
  
    public abstract void track(String event,  
                            Map<String, String> payload);  
}
```

Tracker

```
public abstract class Tracker {  
    public abstract void track(String event,  
                               Map<String, String> payload);  
}
```

Analytics

- Instantiated by supplying a Tracker implementation
- Entry-point to event tracking

`workflow().screen().event()`

- Generated as top-level classes
- Encapsulates screen inner classes

`workflow().screen().event()`

- Workflow inner classes
- Encapsulates event tracking methods

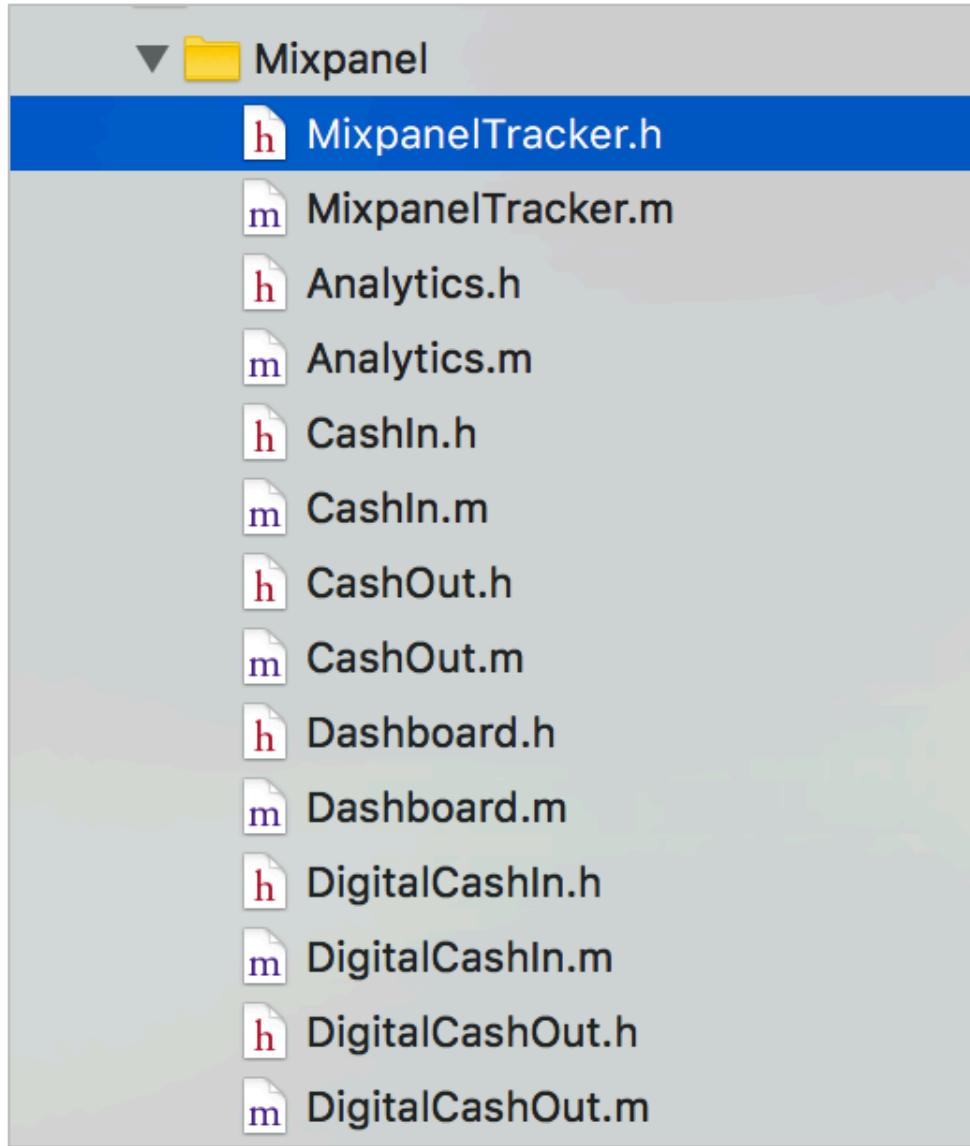
`workflow().screen().event()`

- Event tracking methods
- Resides inside screen classes
- May accept parameters for collecting additional data

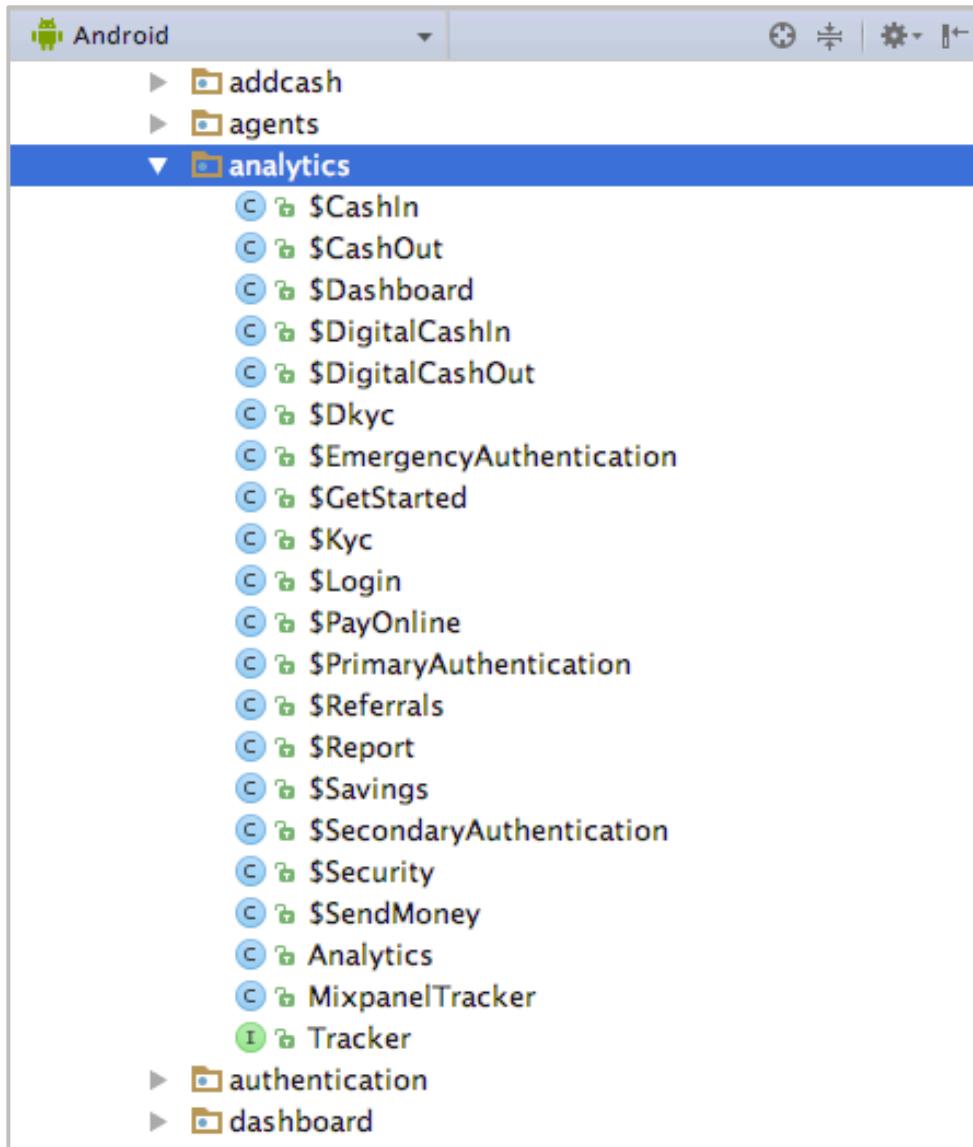
ACCURACY



**WRITE
CODE TO
GENERATE
CODE**



WRITE
CODE TO
GENERATE
CODE



CHANGES



CSV Removals – Red Markers

```
@IBAction func sendMoneyButtonTap(_ sender: AnyObject) {
    AppDelegate.analytics.dashboard().landing().sendMoney()
    loadViewControllerWithIdentifier("KISendMoneyController")
}

@IBAction func addKiteCashButtonTap(_ sender: UIButton) {
    AppDelegate.analytics.dashboard().landing().initiatedCashInProcess()
    openAddKiteCashOptions()
}

@IBAction func cashOutButtonTap(_ sender: UIButton) {
    AppDelegate.analytics.dashboard().landing().initiatedCashOutProcess()
    openCashOutOptions()
}
```

! Value of type 'Dashboard_Landing' has no member 'sendMoney'

CSV Removals – Red Markers

```
        default:
            setTitle("Upgrade To Level 2");
            break;
    }
}

@OnClick(R.id.kyc_upgrade_now)
void onUpgradeNowClick() {
    Kite.analytics().kyc().landing().initiateKycUpgrade();

    setupForwardAnimationOnFlipper(true);
    transitionToStep2Options();
}

@OnClick(R.id.kyc_upgrade_what_is_level2)
void onWhatIsLevel2Click() {
    Kite.analytics().kyc().landing().openedKycHelp();

    HelpQuestionActivity.start(this, "A60");
}

@OnClick(R.id.kyc_upgrade_report_a_problem)
void onReportAProblemClick() {
    Kite.analytics().kyc().landing().initiatedKycProblemReporting();
```

CSV Additions – Gray Methods

```
@interface Dashboard_Landing : NSObject

#pragma mark Public

- (void)initiatedCashInProcess OBJC_METHOD_FAMILY_NONE;
- (void)initiatedCashOutProcess OBJC_METHOD_FAMILY_NONE;
- (void)initiatedP2pProcess OBJC_METHOD_FAMILY_NONE;
- (void)initiatedVcCreationProcess OBJC_METHOD_FAMILY_NONE;

#pragma mark Package-Private

- (instancetype)initWithDashboard:(Dashboard *)outer$;

@end
```

CSV Additions – Gray Methods

```
public void closedKycUpgrade() {
    trigger("Closed KYC Upgrade", trackingInfo);
}

/**
 * Click "Upgrade Now"
 */
public void initiateKycUpgrade() {
    trigger("Initiate KYC Upgrade", trackingInfo);
}

/**
 * Click "What is Level 2?"
 */
public void openedKycHelp() {
    trigger("Opened KYC Help", trackingInfo);
}

/**
 * Click "Report a problem"
 */
public void initiatedKycProblemReporting() {
    trigger("Initiated KYC Problem Reporting", trackingInfo);
}
```

PRODUCTIVITY



Auto-Completion

```
@IBAction func sendMoneyButtonTap(_ sender: AnyObject) {
    AppDelegate.analytics.dashboard().landing().initiatedP2pProcess()
    loadViewControllerWithIdentifier("KISendMoneyController")
}

@IBAction func addKiteCashButtonTap(_ sender: UIButton) {
    AppDelegate.analytics.dashboard().|
    openAddKiteC V String debugDescription
} V String description
M Void initiatedCashInProcess()
M Void initiatedCashOutProcess()
M Void initiatedP2pProcess()
M Void initiatedVcCreationProcess()
M Void __javaClone(original: Any!)
M String _IQDescription()

String debugDescription
String description
Void initiatedCashInProcess()
Void initiatedCashOutProcess()
Void initiatedP2pProcess()
Void initiatedVcCreationProcess()
Void __javaClone(original: Any!)
String _IQDescription()
```

A textual representation of this instance, suitable for debugging.

Auto-Completion

```
@OnClick(R.id.kyc_upgrade_express_kyc)
void onExpressKycClicked() {
    Kite.analytics().kyc().options().selectedAkyc();

    FindAgentActivity.startWithTooltip(this, FindAgentActivity.AgentPurpose.KYC, KiteTooltip.HOW_TO_EXPRESS_UPGRADE);
}

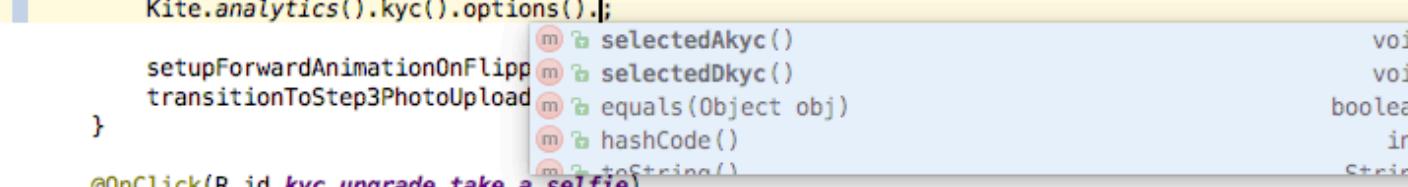
@OnClick(R.id.kyc_upgrade_standard_kyc)
void onStandardKycClicked() {
    Kite.analytics().kyc().options().selectedDkyc();
    setupForwardAnimationOnFlip();
    transitionToStep3PhotoUpload();
}

@OnClick(R.id.kyc_upgrade_take_a_selfie)
void onTakeSelfieClicked() {
    Kite.analytics().dkyc().uploadPhoto().selectedSelfieOption();

    transitionToStep4PhotoPreview(true);
}

@OnClick(R.id.kyc_upgrade_upload_from_album)
void onUploadFromAlbumClicked() {
    Kite.analytics().dkyc().uploadPhoto().selectedFromAlbum();

    transitionToStep4PhotoPreview(false);
}
```



Checklist

```
@interface Dashboard_Landing : NSObject

#pragma mark Public

- (void)initiatedCashInProcess OBJC_METHOD_FAMILY_NONE;
- (void)initiatedCashOutProcess OBJC_METHOD_FAMILY_NONE;
- (void)initiatedP2pProcess OBJC_METHOD_FAMILY_NONE;
- (void)initiatedVcCreationProcess OBJC_METHOD_FAMILY_NONE;

#pragma mark Package-Private

- (instancetype)initWithDashboard:(Dashboard *)outer$;

@end
```

Checklist

```
@interface Dashboard_Landing : NSObject  
  
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- (void)initiatedCashInProcess OBJC_METHOD_FAMILY_NONE;  
  
- (void)initiatedCashOutProcess OBJC_METHOD_FAMILY_NONE;  
  
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- (void)initiatedVcCreationProcess OBJC_METHOD_FAMILY_NONE;  
  
#pragma mark Package-Private  
  
- (instancetype)initWithDashboard:(Dashboard *)outer$;  
  
@end
```



Checklist

```
@interface Dashboard_Landing : NSObject  
  
#pragma mark Public  
  
- (void)initiatedCashInProcess OBJC_METHOD_FAMILY_NONE;  
- (void)initiatedCashOutProcess OBJC_METHOD_FAMILY_NONE;   
- (void)initiatedP2pProcess OBJC_METHOD_FAMILY_NONE;  
- (void)initiatedVcCreationProcess OBJC_METHOD_FAMILY_NONE;  
  
#pragma mark Package-Private  
  
- (instancetype)initWithDashboard:(Dashboard *)outer$;  
  
@end
```

Checklist

```
@interface Dashboard_Landing : NSObject  
  
#pragma mark Public  
  
- (void)initiatedCashInProcess OBJC_METHOD_FAMILY_NONE; ✓  
- (void)initiatedCashOutProcess OBJC_METHOD_FAMILY_NONE; ✓  
- (void)initiatedP2pProcess OBJC_METHOD_FAMILY_NONE;  
- (void)initiatedVcCreationProcess OBJC_METHOD_FAMILY_NONE; ✓  
  
#pragma mark Package-Private  
  
- (instancetype)initWithDashboard:(Dashboard *)outer$;  
  
@end
```

Checklist

```
public void closedKycUpgrade() {
    trigger("Closed KYC Upgrade", trackingInfo);
}

/**
 * Click "Upgrade Now"
 */
public void initiateKycUpgrade() {
    trigger("Initiate KYC Upgrade", trackingInfo);
}

/**
 * Click "What is Level 2?"
 */
public void openedKycHelp() {
    trigger("Opened KYC Help", trackingInfo);
}

/**
 * Click "Report a problem"
 */
public void initiatedKycProblemReporting() {
    trigger("Initiated KYC Problem Reporting", trackingInfo);
}
}
```

Checklist

```
public void closedKycUpgrade() {
    trigger("Closed KYC Upgrade", trackingInfo);
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Checklist

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}

/**
 * Click "Report a problem"
 */
public void initiatedKycProblemReporting() {
    trigger("Initiated KYC Problem Reporting", trackingInfo);
}
```



TESTING



HOW?

- Schemes (iOS) & Product Flavors (Android)
- Dependency Injection

Trackers

- Log Tracker
- Mixpanel Tracker
- Dialog Tracker
- Verifying Tracker

iOS + Swift



DIFFICULTIES

- Swift
- No Transpilers
- No Code Generation Libraries

J2objc

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Code Issues 64 Pull requests 2 Projects 0 Wiki Pulse Graphs

A Java to iOS Objective-C translation tool and runtime. <http://j2objc.org>

3,494 commits 3 branches 22 releases 33 contributors Apache-2.0

Branch: master New pull request Create new file Upload files Find file Clone or download

Author	Commit Message	Date
tomball	Merge branch 'master' of github.com:google/j2objc	Latest commit 3af6f9b 10 days ago
Annotations	Update RetainedWith javadoc.	10 days ago
Cycle_finder	Fixed CycleFinderTest	10 days ago
Doc	Added flag to report any javadoc warnings found by javac.	4 months ago
examples/Hello	Updated Hello example to use JRE framework, Xcode 8.2.	10 days ago
Guava	Removed j2objc flags specifying what is now default.	a month ago
InjectMessage	Moved non-public warning build info added. Meaning field initializ...	2 years ago

J2ObjC

Java → Objective-C

J2ObjC

Java → Objective-C ⤵ → Swift

J2ObjC

Java → Objective-C → Swift

PEACE



PEACE

The word "PEACE" is written in large, bold, black capital letters. It is partially obscured by a red circular "prohibited" or "no" symbol. The symbol consists of a thick red circle with a diagonal red line from the top-left corner to the bottom-right corner, creating a shape similar to a slash or a 'X'. The word "PEACE" is positioned such that the letters P, E, A, C, and E are visible, though the symbol covers most of the letter bodies.

abstract class(es)

NOT

interface(s)

J2ObjC NUANCES

- Runtime Library
- Adds ~10 MB

CODE GENERATION TIPS

- Doesn't have to be DRY
- Iterate through the design several times
- Add "Auto-Generated" comments and documentation
- Prefer abstract classes over interfaces
- Extract platform-specific code and provide abstraction
- Communicate with Business Intelligence team

ragunathjawahar

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