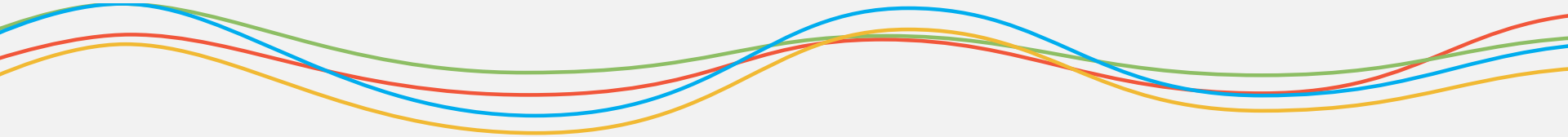
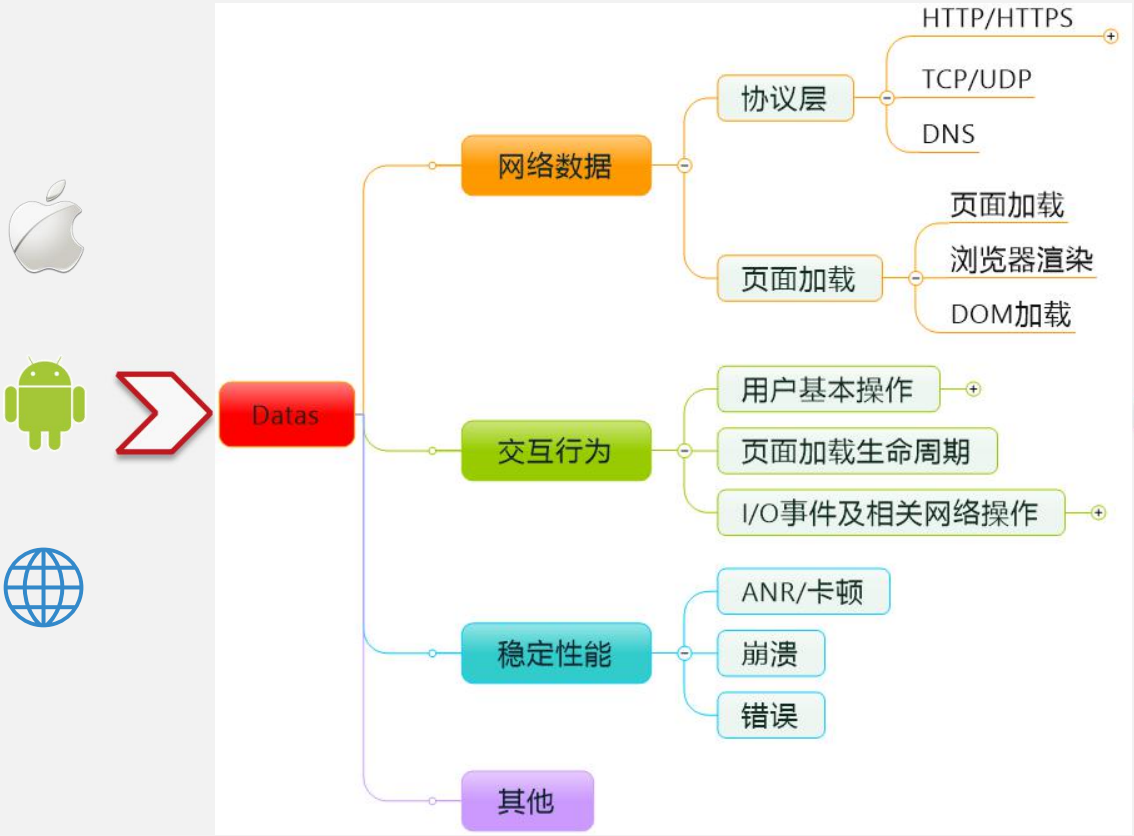
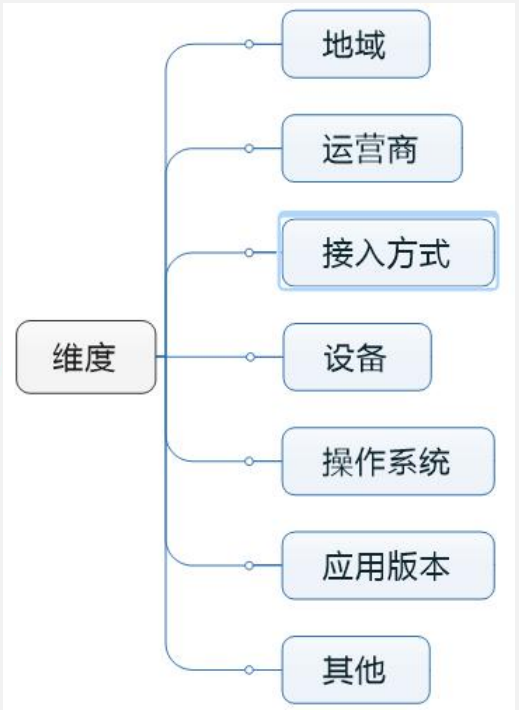
APMCon

移动端APM产品研发技能

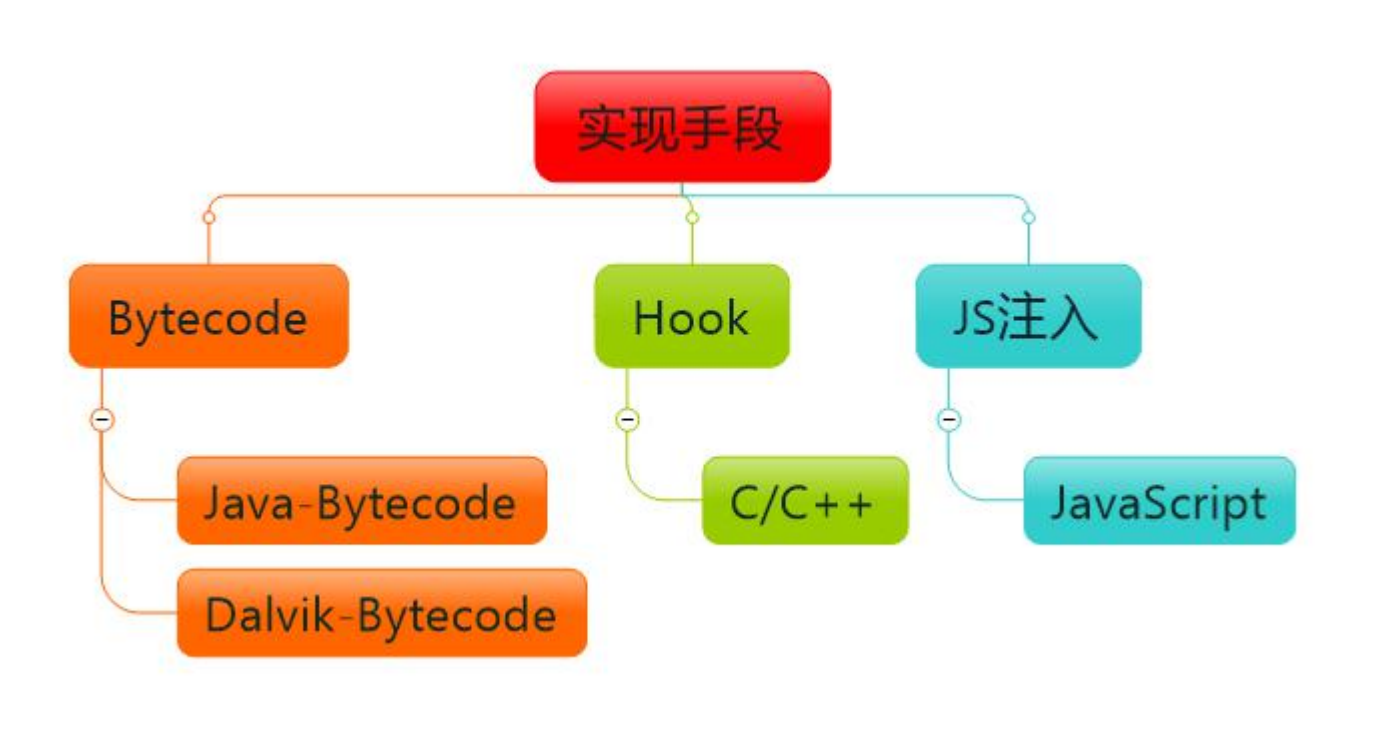
江赛




Datas
网络数据
协议层
HTTP/HTTPS
TCP/UDP
DNS
页面加载
页面加载
浏览器渲染
DOM加载
交互行为
用户基本操作
页面加载生命周期
I/O事件及相关网络操作
稳定性能
ANR/卡顿
崩溃
错误
其他

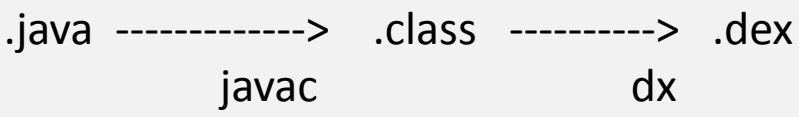

维度
地域
运营商
接入方式
设备
操作系统
应用版本
其他

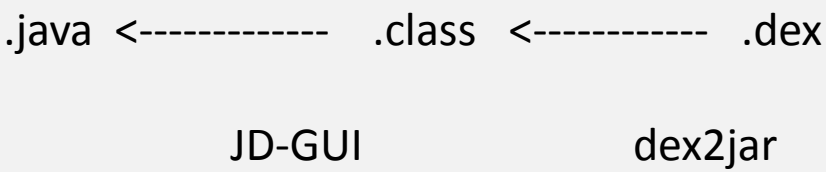
为了减少开发者的工作量，采用了自动埋点技术



一、从Java源代码到Dalvik Bytecode

APM实现-Bytecode





Example Java source: Foo.java

```
class Foo {

        public static void main(String[] args) {
                System.out.println("Hello, world");
        }

        public int method(int i1, int i2) {
                int i3 = i1 * i2;
                return i3 * 2;
        }
}
```

APM实现-Bytecode

```
$ javac Foo.java
$ javap -v Foo

 public int method(int, int);
    flags: ACC_PUBLIC
    Code:
      stack=2, locals=4, args_size=3
         0: iload_1
         1: iload_2
         2: imul
         3: istore_3
         4: iload_3
         5: iconst_2
         6: imul
         7: ireturn
       LineNumberTable:
         line 6: 0
         line 7: 4
```

Stack

Before	**After**
value1	result
value2	…
… …	（imul指令对栈的操作）

APM实现-Bytecode

```
$ dx --dex --output=Foo.dex Foo.class
$ dexdump -d Foo.dex


 Virtual methods   -
   #0              : (in LFoo;)
     name          : 'method'
     type          : '(II)I'
     access        : 0x0001 (PUBLIC)
     code          -
     registers     : 4
     ins           : 3
     outs          : 0
     insns size    : 5 16-bit code units
00018c:                                        |[00018c] Foo.method:(II)I
00019c: 9200 0203                              |0000: mul-int v0, v2, v3
0001a0: da00 0002                              |0002: mul-int/lit8 v0, v0, #int 2 // #02
0001a4: 0f00                                   |0004: return v0
     catches       : (none)
     positions     :
       0x0000 line=6
       0x0002 line=7
     locals        :
       0x0000 - 0x0005 reg=1 this LFoo;
```

9200 0203

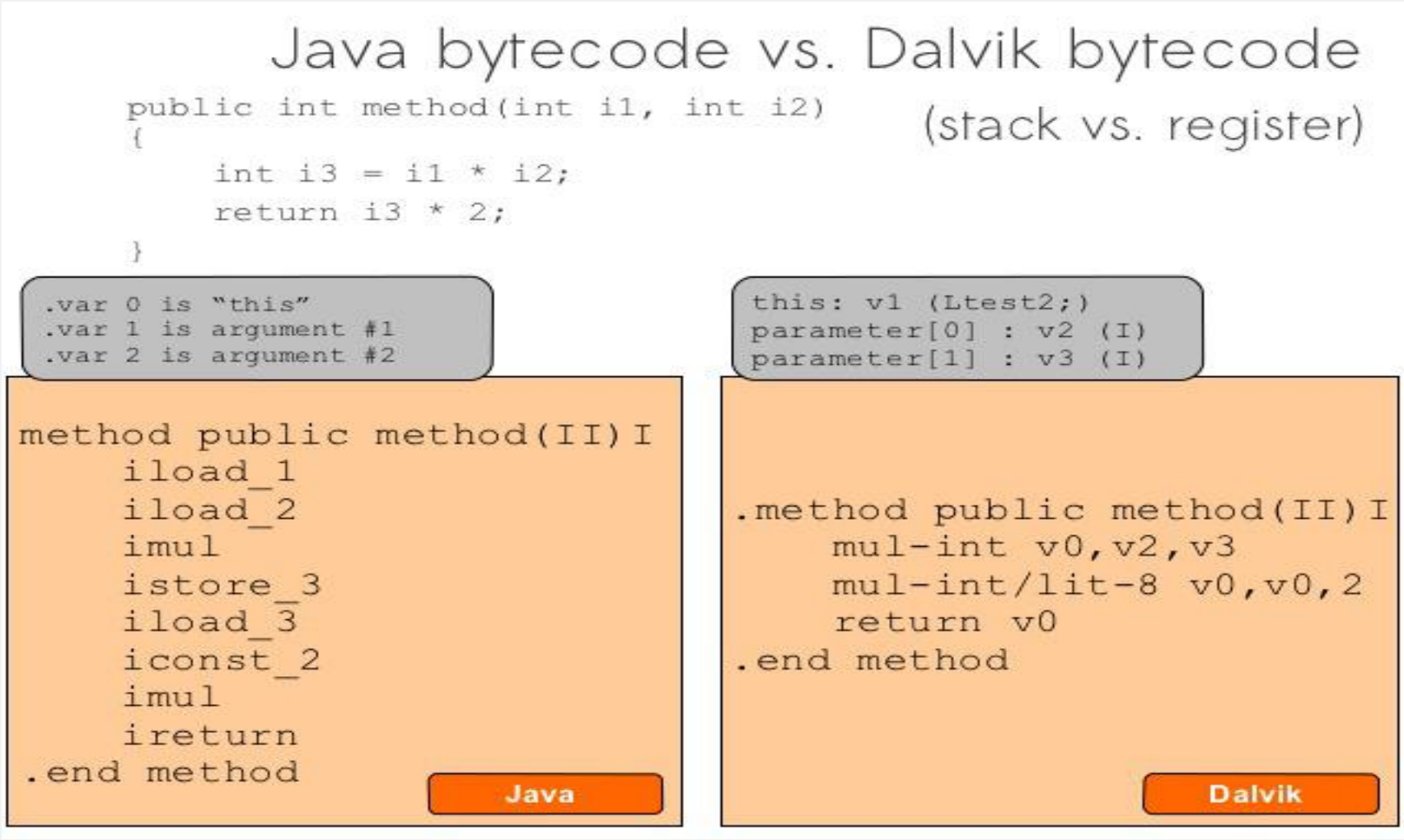
92: mul-int

binop vAA, vBB, vCC

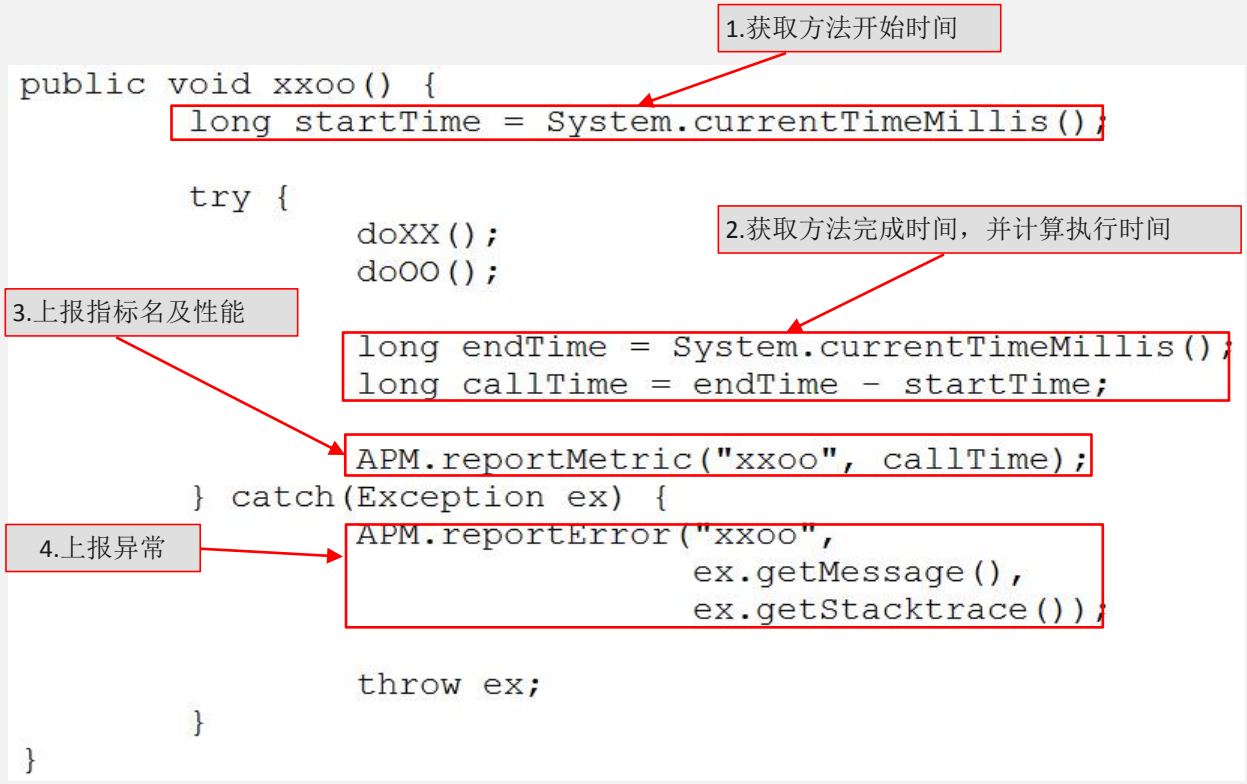
00: v0 (destination register)

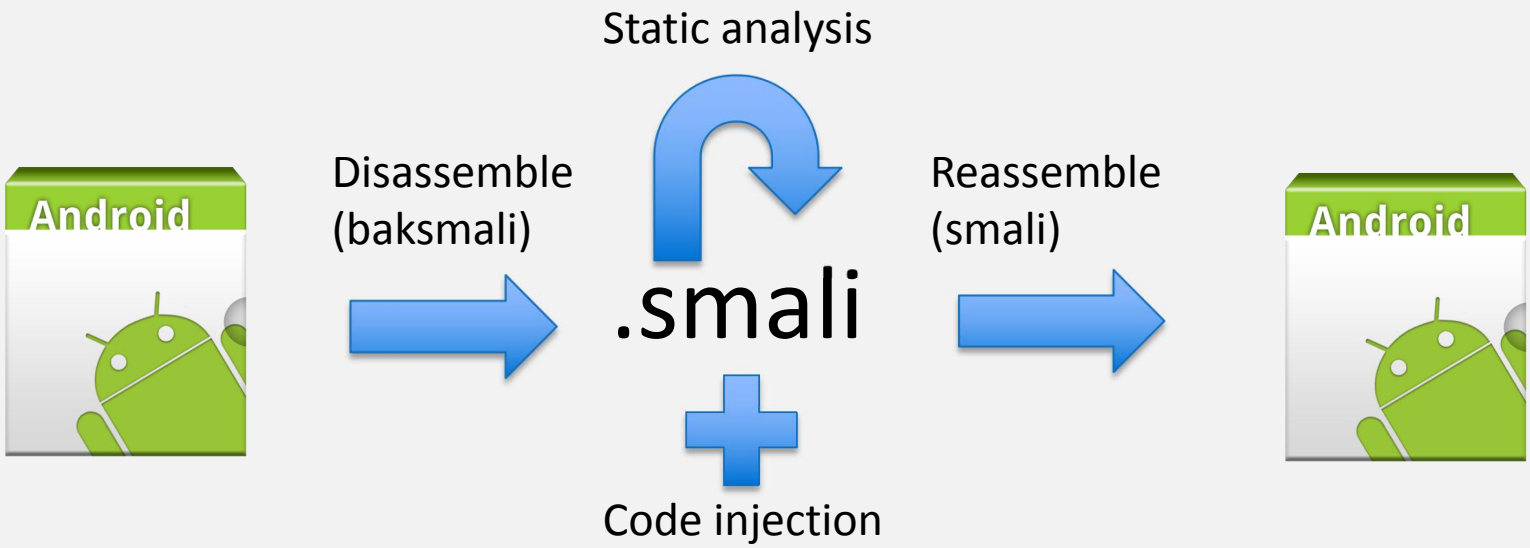
02: v2 (first resource register)

03: v3 (second ...)

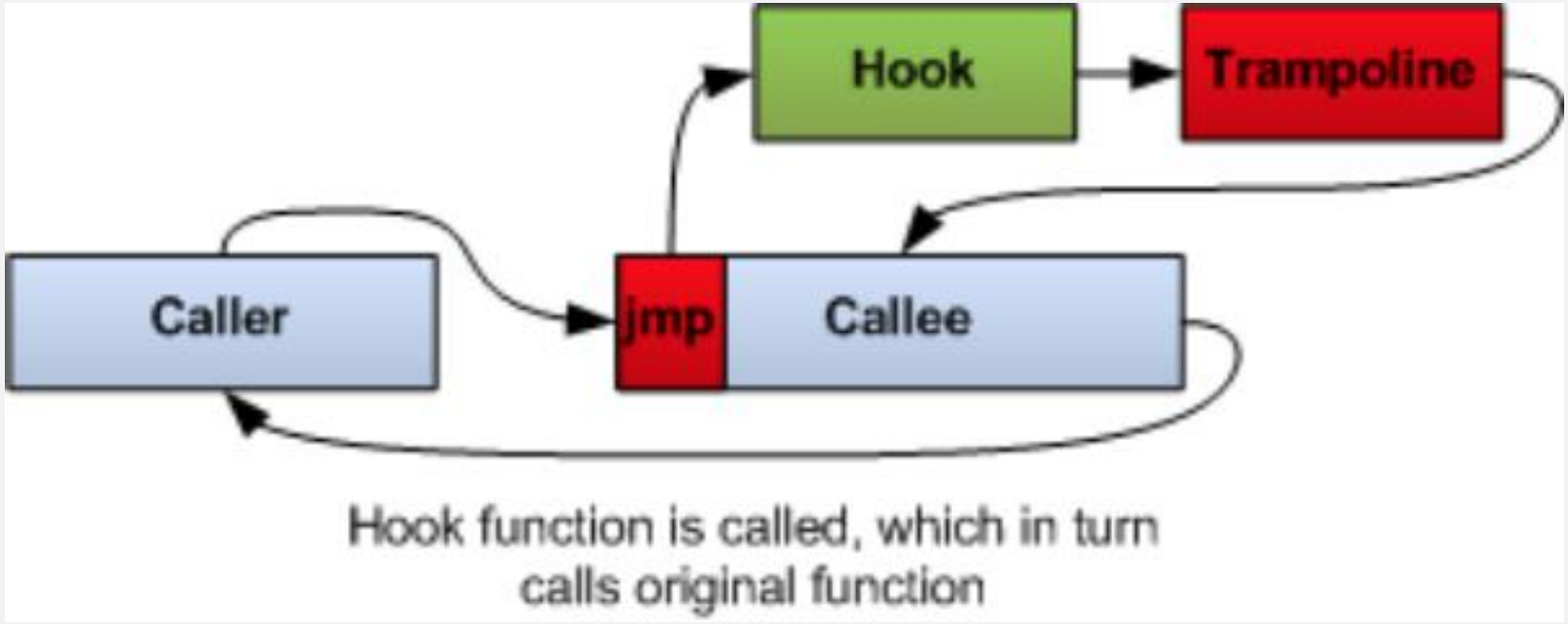

Java bytecode vs. Dalvik bytecode
(stack vs. register)
public int method(int i1, int i2)
{
int i3 = i1 * i2;
return i3 * 2;
}
.var 0 is "this"
.var 1 is argument #1
.var 2 is argument #2
method public method(II)I
iload_1
iload_2
imul
istore_3
iload_3
iconst_2
imul
ireturn
.end method
Java
this: v1 (Ltest2;)
parameter[0] : v2 (I)
parameter[1] : v3 (I)
.method public method(II)I
mul-int v0,v2,v3
mul-int/lit-8 v0,v0,2
return v0
.end method
Dalvik

APM实现-Bytecode




Static analysis
Android
Disassemble
(baksmali)
.smali
Reassemble
(smali)
Android
Code injection

二、native inline hook


Hook
Trampoline
Caller
jmp
Callee
Hook function is called, which in turn
calls original function

ARM Instruction Layout Summary

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Multiply	cond				0	0	0	0	0	0	A	S	Rd				Rn				Rs				1	0	0	1	Rm			
Data Processing	cond				0	0	1	op-code				S	Rn				Rd				#rot				8-bit immediate							
"	cond				0	0	0	op-code				S	Rn				Rd				#shift					Sh		0	Rm			
"	cond				0	0	0	op-code				S	Rn				Rd				Rs			0	Sh		1	Rm			
Store/Load	cond				0	1	0	P	U	B	W	L	Rn				Rd				12-bit immediate											
"	cond				0	1	1	P	U	B	W	L	Rn				Rd				#shift					Sh		0	Rm			
Branch	cond				1	0	1	L	24-bit signed offset																							
SWI	cond				1	1	1	1	24-bit (interpreted) immediate																							

```
if ((instruction & 0xF000000) == 0xA000000) {
        /*is B instruction*/
    address = PC + (SignExtend_30(signed_immed_24) << 2)
      /*get absolutely address*/
}
```

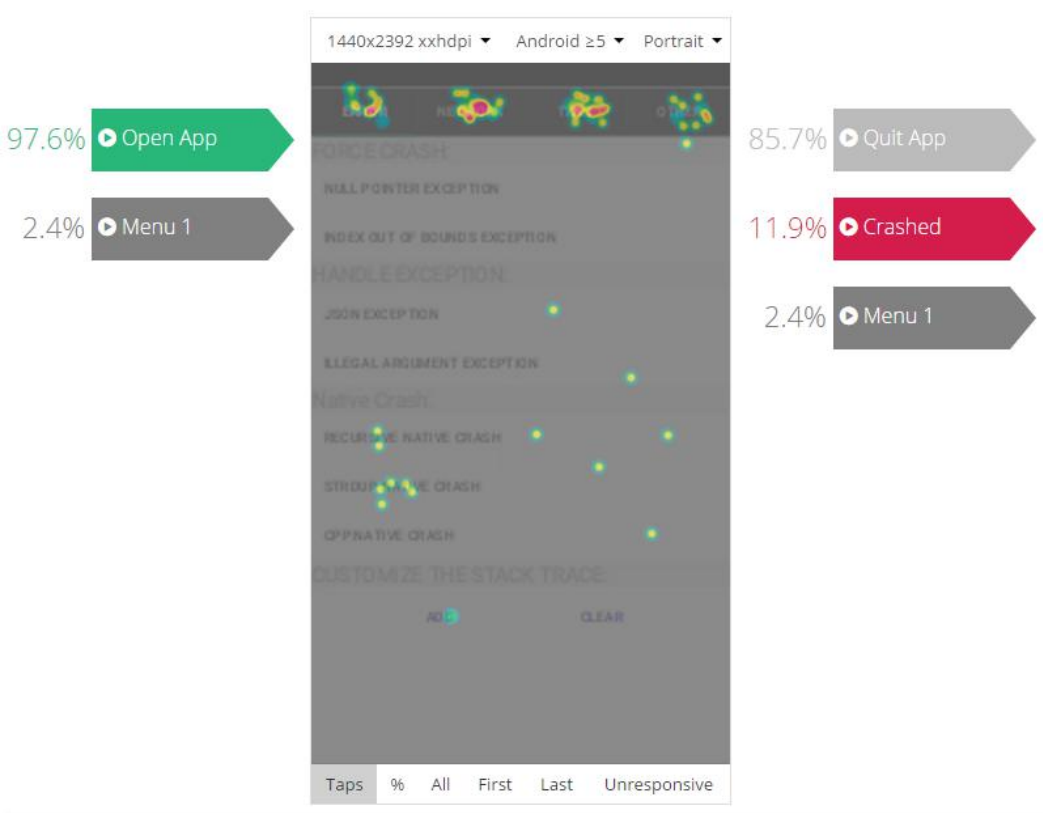
B指令转换为等效指令

```
LDR PC, [PC, #-4]
0x.....    //Absolutely address
```

- When an inline hook is implemented it will overwrite **the first two instructions** in order to redirect code flow;

```
ARM instruction:
LDR PC, [PC, #-4]
addr
```

- Fix instruction which is PC-related;


97.6%
Open App
2.4%
Menu 1
1440x2392 xxhdpi
Android ≥5
Portrait
FORCE CRASH
NULL POINTER EXCEPTION
INDEX OUT OF BOUNDS EXCEPTION
HANDLE EXCEPTION
JSON EXCEPTION
ILLEGAL ARGUMENT EXCEPTION
Native Crash
CUSTOMIZE THE STACK TRACE
CLEAR
Taps
%
All
First
Last
Unresponsive
85.7%
Quit App
11.9%
Crashed
2.4%
Menu 1

THANK YOU