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Dex Education: Practicing Safe Dex

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whoami

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- Reversed the Android Market/Google Play
- Always enjoyed reversing "exotic" platforms, writing tools to automate the mundane tasks
- Junkie for reversing mobile malware, creating write ups, teaching others all this fun stuff!
- the "different" tim at work, so I go by "diff"

Agenda

- Dex Education: Let's talk about Dex and what it's all about
- How are attackers hiding/breaking things currently?
- Hiding from, and breaking the tools - Anti-Analysis
- Breaking the toolbox - Anti-emulator/Anti-VM
- PoC Tool and Lessons learned!

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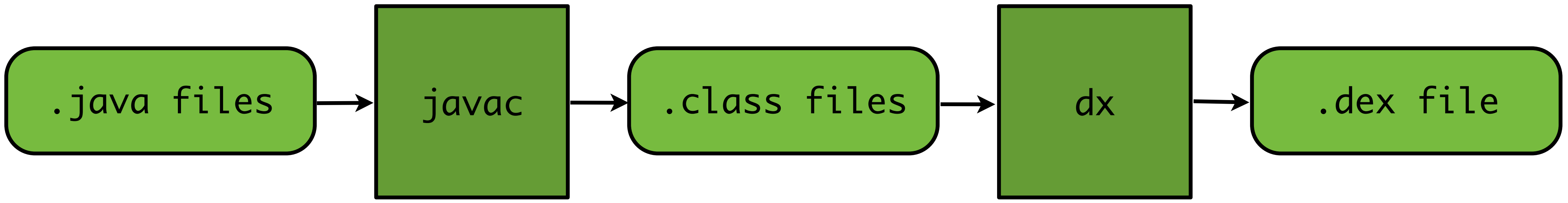
Dex Education

What is this?

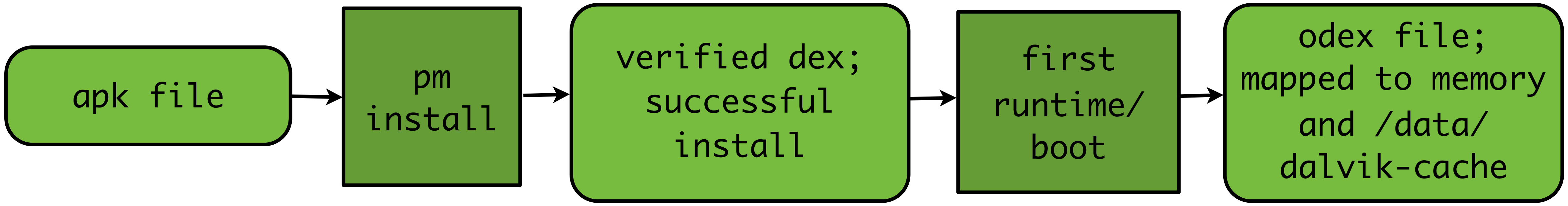
- DEX stands for **D**alivk **EX**ecutable
- Bundled class files which run inside the Dalvik VM
- Packaged inside of the APK file (essentially a jar/zip)



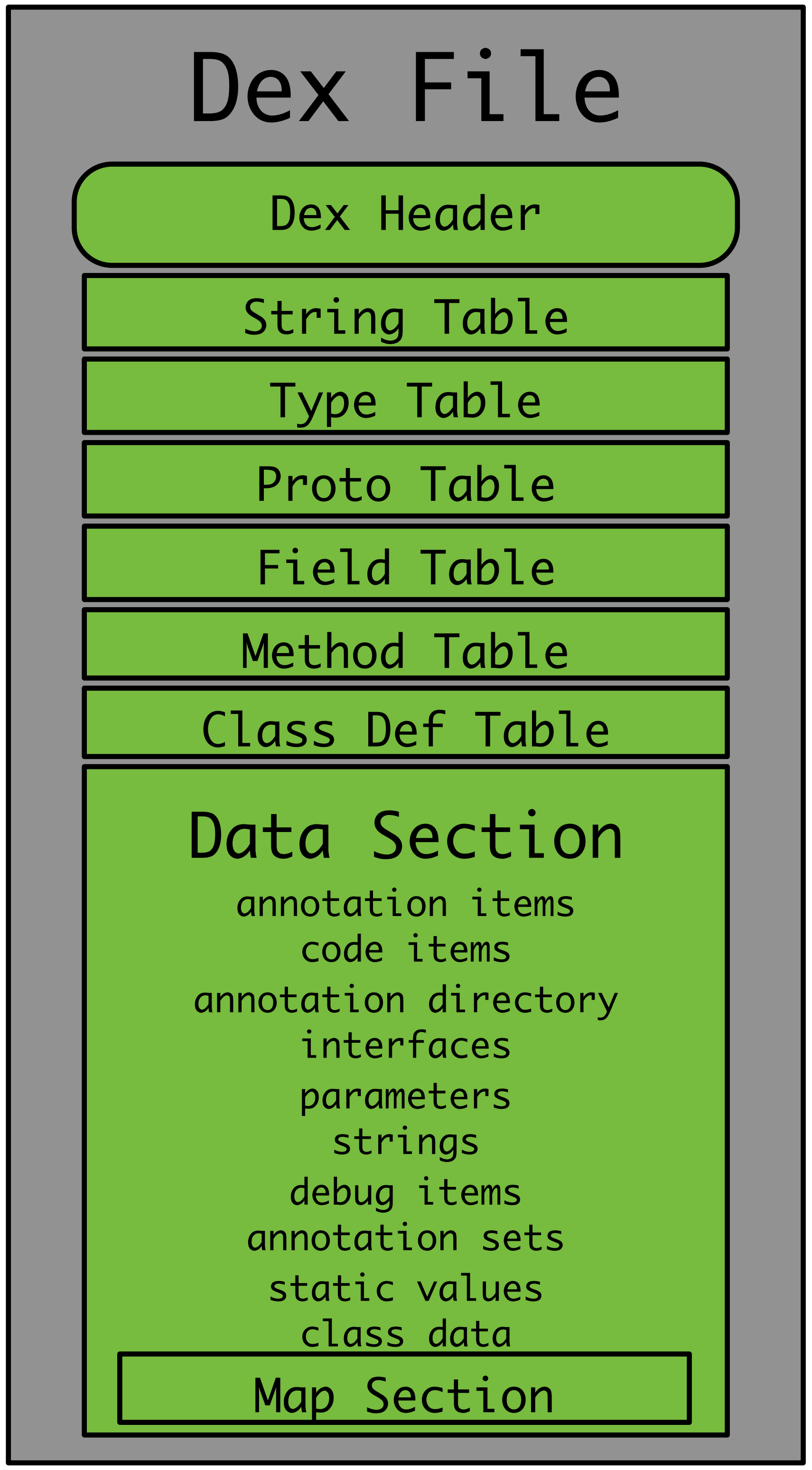
Dex Education

What is this? continued

- Upon install, checked dex file extracted and verified for integrity
- Upon first runtime/boot dex optimized, converted to "odex" (optimized dex)
- odex dropped to /data/dalvik-cache and loaded into memory on execution


apk file
pm install
verified dex; successful install
first runtime/ boot
odex file; mapped to memory and /data/ dalvik-cache

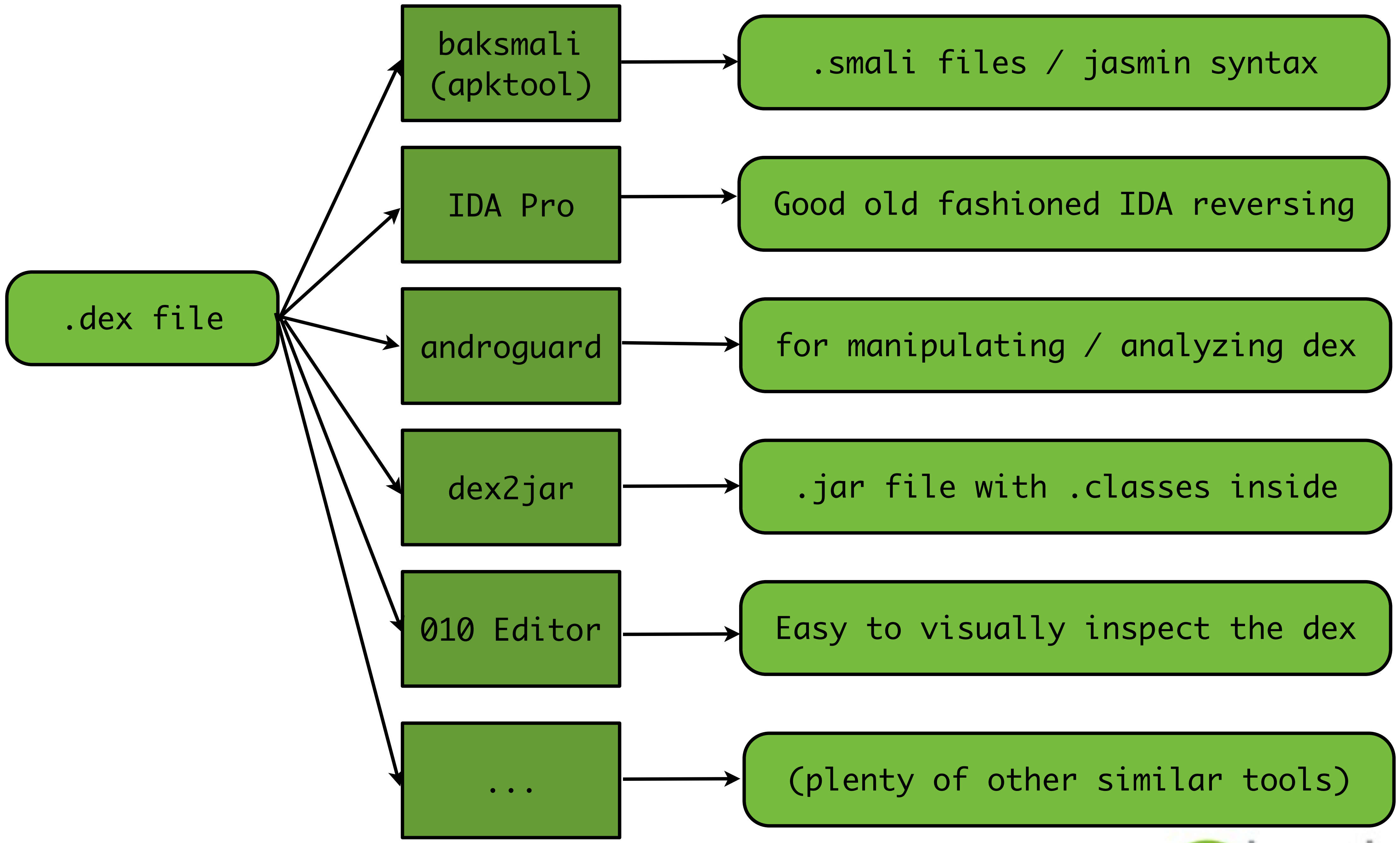
Dex Education: Dex File Format



- Header contains offsets/sizes to all sections
- Tables contain struct data, references to each other and offsets into data
- Data contains the meat of the file

Dex Education

How can we examine dex files?



.dex file
baksmali (apktool)
.smali files / jasmin syntax
IDA Pro
Good old fashioned IDA reversing
androguard
for manipulating / analyzing dex
dex2jar
.jar file with .classes inside
010 Editor
Easy to visually inspect the dex
...
(plenty of other similar tools)

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How are attackers hiding currently?

Simple methods employed

- Some use simple reflection to call “sensitive” function
- Keep dex file “clean” and load data from assets
- Find valid dex nuances which break some tools

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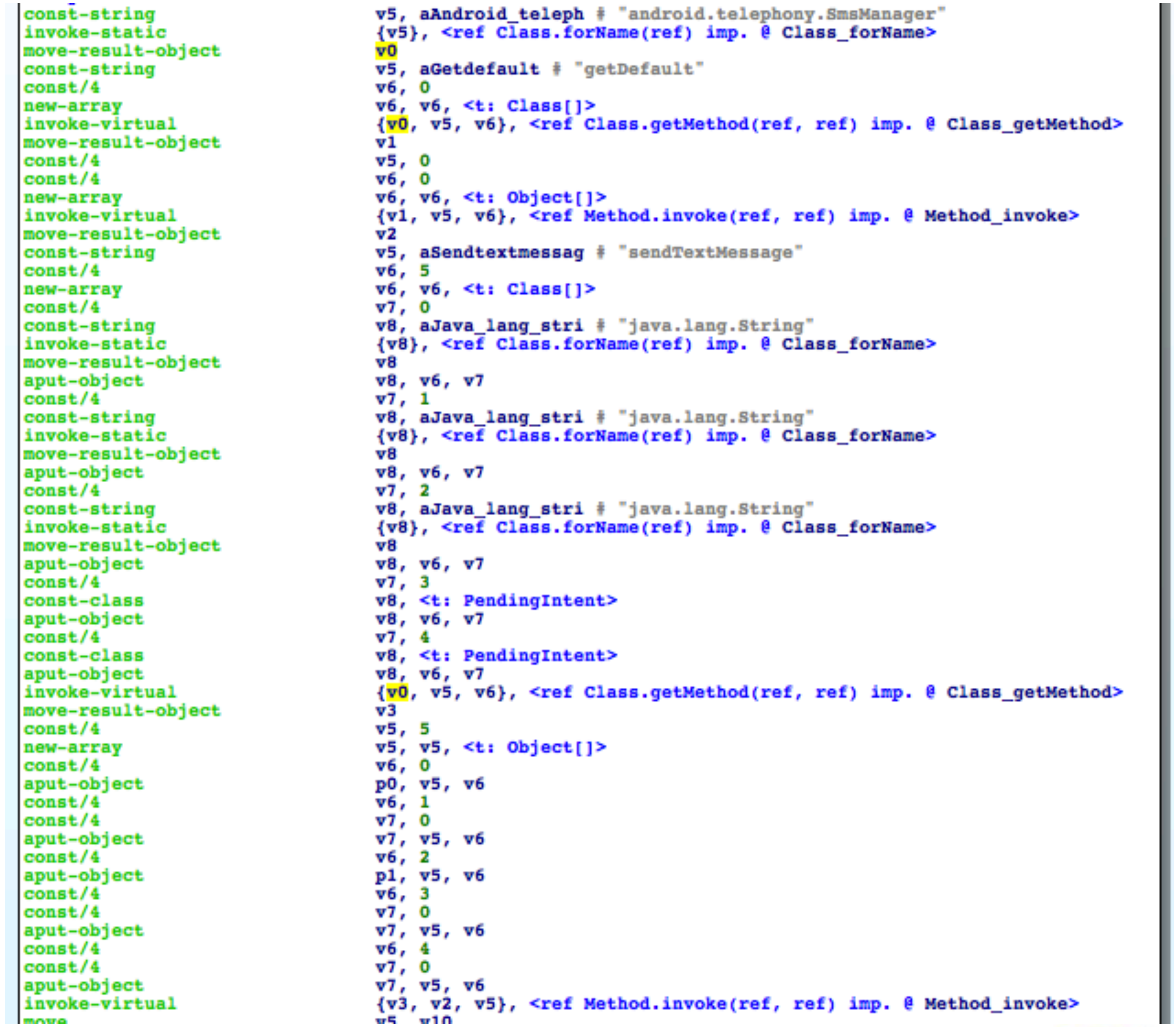
Reflection to hide calls



```
const-string              v5, aAndroid_teleph # "android.telephony.SmsManager"
invoke-static             {v5}, <ref Class.forName(ref) imp. @ Class_forName>
move-result-object        v0
const-string              v5, aGetdefault # "getDefault"
const/4                   v6, 0
new-array                 v6, v6, <t: Class[]>
invoke-virtual            {v0, v5, v6}, <ref Class.getMethod(ref, ref) imp. @ Class_getMethod>
move-result-object        v1
const/4                   v5, 0
const/4                   v6, 0
new-array                 v6, v6, <t: Object[]>
invoke-virtual            {v1, v5, v6}, <ref Method.invoke(ref, ref) imp. @ Method_invoke>
move-result-object        v2
const-string              v5, aSendtextmessag # "sendTextMessage"
const/4                   v6, 5
new-array                 v6, v6, <t: Class[]>
const/4                   v7, 0
const-string              v8, aJava_lang_stri # "java.lang.String"
invoke-static             {v8}, <ref Class.forName(ref) imp. @ Class_forName>
move-result-object        v8
aput-object               v8, v6, v7
const/4                   v7, 1
const-string              v8, aJava_lang_stri # "java.lang.String"
invoke-static             {v8}, <ref Class.forName(ref) imp. @ Class_forName>
move-result-object        v8
aput-object               v8, v6, v7
const/4                   v7, 2
const-string              v8, aJava_lang_stri # "java.lang.String"
invoke-static             {v8}, <ref Class.forName(ref) imp. @ Class_forName>
move-result-object        v8
aput-object               v8, v6, v7
const/4                   v7, 3
const-class               v8, <t: PendingIntent>
aput-object               v8, v6, v7
const/4                   v7, 4
const-class               v8, <t: PendingIntent>
aput-object               v8, v6, v7
invoke-virtual            {v0, v5, v6}, <ref Class.getMethod(ref, ref) imp. @ Class_getMethod>
move-result-object        v3
const/4                   v5, 5
new-array                 v5, v5, <t: Object[]>
const/4                   v6, 0
aput-object               p0, v5, v6
const/4                   v6, 1
const/4                   v7, 0
aput-object               v7, v5, v6
const/4                   v6, 2
aput-object               p1, v5, v6
const/4                   v6, 3
const/4                   v7, 0
aput-object               v7, v5, v6
const/4                   v6, 4
const/4                   v7, 0
aput-object               v7, v5, v6
invoke-virtual            {v3, v2, v5}, <ref Method.invoke(ref, ref) imp. @ Method_invoke>
move                      v5, v10
```

Reflection to hide calls

- This allows attackers to "hide" sensitive calls
- Easy to detect, just look for reflection
- If obfuscation is added; automation becomes harder
- Easier to detect via dynamic analysis

Hiding in Resources

```
champagne:gamex/assets tstrazzere$ ls -l logos.png
-rw-r--r--@ 1 tstrazzere  staff    42K Mar 29 16:33 logos.png
champagne:gamex/assets tstrazzere$ file logos.png
logos.png: data
champagne:gamex/assets tstrazzere$ hexdump -C logos.png | head
00000000  42 59 11 16 18 12 12 1a  12 12 5e 91 6f 52 a4 12  |BY........^.oR..|
00000010  55 4c 58 49 12 12 58 49  12 12 1d 12 15 12 73 61  |ULXI..XI......sa|
00000020  61 77 66 61 3d 7b 71 7d  7c 3c 62 7c 75 ec d8 12  |awfa={q}|<b|u...|
00000030  12 12 12 12 50 4b 03 04  0a 00 00 08 00 00 af 84  |....PK..........|
00000040  7c 40 93 03 c4 66 bc 00  00 00 bc 00 00 00 0f 00  ||@...f..........|
00000050  07 00 61 73 73 65 74 73  2f 69 63 6f 6e 2e 70 6e  |..assets/icon.pn|
00000060  67 fe ca 00 00 00 00 00  39 35 25 24 31 38 32 38  |g.......95%$1828|
00000070  24 33 39 34 25 3e 32 38  34 3f 39 34 39 36 38 39  |$394%>284?949689|
00000080  3c 3b 29 31 39 29 25 3d  3d 39 3d 31 29 3d 38 29  |<;)19)%==9=1)=8)|
00000090  25 3d 31 3c 30 25 34 3c  3b 34 25 3c 38 31 29 25  |%=1<0%4<;4%<81)%|
```

Hiding in Resources

```
champagne:gamex/assets tstrazzere$ unzip -l logos.png
Archive:  logos.png
warning [logos.png]:  52 extra bytes at beginning
  or within zipfile
  (attempting to process anyway)
  Length     Date   Time    Name
 --------    ----   ----    ----
      188  03-28-12 16:37   assets/icon.png
      311  03-29-12 16:25   assets/logo.png
     5666  03-27-12 22:15   res/drawable/ic_launcher.png
     2704  03-29-12 16:26   AndroidManifest.xml
      792  03-29-12 16:26   resources.arsc
    27408  03-29-12 16:26   classes.dex
      472  03-29-12 16:26   META-INF/MANIFEST.MF
      525  03-29-12 16:26   META-INF/CERT.SF
     1077  03-29-12 16:26   META-INF/CERT.RSA
 --------                   -------
    39143                   9 files
```

```
champagne:games/assets tstrazzere$ unzip -l logos.png.xored
Archive:  logos.png.xored
  Length     Date   Time    Name
 --------    ----   ----    ----
    23370  03-29-12 16:26   assets/icon.png
      188  03-28-12 16:37   assets/logo.png
     7359  03-27-12 22:24   res/drawable/ic_launcher.png
     3344  03-29-12 16:26   AndroidManifest.xml
      792  03-29-12 16:26   resources.arsc
    14932  03-29-12 16:26   classes.dex
      472  03-29-12 16:26   META-INF/MANIFEST.MF
      525  03-29-12 16:26   META-INF/CERT.SF
     1077  03-29-12 16:26   META-INF/CERT.RSA
 --------                   -------
    52059                   9 files
```

- Decompressing w/o decryption results in different APK file

Hiding in Resources

- Was this meant to happen? Possibly
- Embed into valid image file?
- Could have done a "better" job making it stealth -- i.e. unzip w/o decrypt is a harmless game
- Still an interesting and maybe most advanced attempt at "hiding" bad code!

Hiding in Resources Part Deux

```
champagne:assets tstrazzere$ file mylogo.jpg
mylogo.jpg: JPEG image data, JFIF standard 1.01

champagne:assets tstrazzere$ hexdump -C mylogo.jpg | grep "ELF\|JFIF" -B 2 -A 2
00000000  ff d8 ff e0 00 10 4a 46  49 46 00 01 01 01 00 60  |......JFIF.....`|
00000010  00 60 00 00 ff e1 00 5a  45 78 69 66 00 00 4d 4d  |.`.....ZExif..MM|
00000020  00 2a 00 00 00 08 00 05  03 01 00 05 00 00 00 01  |.*..............|
--
000051b0  7a 63 c9 52 3b f3 4c 79  38 ab 46 6c 89 9f 34 c6  |zc.R;.Ly8.Fl..4.|
000051c0  6a 91 9f 34 c6 63 54 88  63 68 a2 8a a2 42 8a 28  |j..4.cT.ch...B.(|
000051d0  a0 0f ff d9 7f 45 4c 46  01 01 01 00 00 00 00 00  |.....ELF........|
000051e0  00 00 00 00 02 00 28 00  01 00 00 00 f0 8e 00 00  |......(.........|
000051f0  34 00 00 00 50 9d 00 00  02 00 00 04 34 00 20 00  |4...P.......4. .|
--
00008440  8c 9a 8b 8f 8d 90 8f 00  8d cf d1 9d 90 8b d1 96  |................|
00008450  9b 00 00 00 8d cf d1 9d  90 8b d1 9c 97 00 00 00  |................|
00008460  7f 45 4c 46 01 01 01 00  00 00 00 00 00 00 00 00  |.ELF............|
00008470  02 00 28 00 01 00 00 00  70 9f 00 00 34 00 00 00  |..(.....p...4...|
00008480  dc 65 00 00 02 00 00 04  34 00 20 00 07 00 28 00  |.e......4. ...(.|
```

Simple Studio

- Valid, viewable jpg with malicious ELF payloads

Hiding in Resources Part Deux

- Requires a looking at all resource files more in-depth
- Looks like a JPG, Smells like a JPG
- Could have done a "better" job making it stealth -- i.e. unzip w/o decrypt is a harmless game
- Still an interesting and maybe most advanced attempt at "hiding" bad code!

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Simple Tool Breakage

```
champagne:linklocked tstrazzere$ baksmali protected.apk -o wontwork
UNEXPECTED TOP-LEVEL EXCEPTION:
org.jf.dexlib.Util.ExceptionWithContext: This dex file has a link section, which is not supported
        at org.jf.dexlib.Util.ExceptionWithContext.withContext(ExceptionWithContext.java:54)
        at org.jf.dexlib.Item.addExceptionContext(Item.java:176)
        at org.jf.dexlib.Item.readFrom(Item.java:78)
        at org.jf.dexlib.DexFile.<init>(DexFile.java:390)
        at org.jf.baksmali.main.main(main.java:254)
Caused by: java.lang.RuntimeException: This dex file has a link section, which is not supported
        at org.jf.dexlib.HeaderItem.readItem(HeaderItem.java:84)
        at org.jf.dexlib.Item.readFrom(Item.java:76)
        ... 2 more
header_item
```

- Seen being used by developers to thwart pirates, and pirates to thwart developers
- Seen used by Lohan+ (AntiLVL) / jcase / other devs

Simple Tool Breakage

- simple breakage == simple fix
- link size/offset inside the dex header was being set
- "data used in statically linked files" according to docs, no further details, appears to not be used currently
- Most tools just ignored this section

Hiding from, and breaking the tools

Adventures in Anti-Analysis

Step 1: Put on an evil hat and pretend to be evil
Step 2: Target most popular tools*
Step 3: Break the tools
Step 4: ???
Step 5: Report breakages/patches if possible
Step 6: ???
Step 7: Sell breakages... Wait - crap :\
Step 8: ~~$$$~~

*No data to back this up - just personal pref :)

Adventures in Anti-Analysis

- Targeting:

  Baksmali - used almost universally (apktool/antilvl as well)
  dex2jar - seems almost every uses (and relies heavily on this... barf)
  IDA Pro - most companies have this around
  androguard - seems to be popular, I don't personally use it :)
  others ???

Adventures in Anti-Analysis: Kickin` It Old School

- APK is just an zip/jar, why not just use some old school jar hacks?
- Remember looking at old jars where files might be larger than 255+ characters?
- Required editing the jar file itself since contained files had no character limitation
- Damn those filesystem limitations!

Adventures in Anti-Analysis: Kickin` It Old School

- How can we port this to the dex file for breakage?
- Need the class to be 255+ chars

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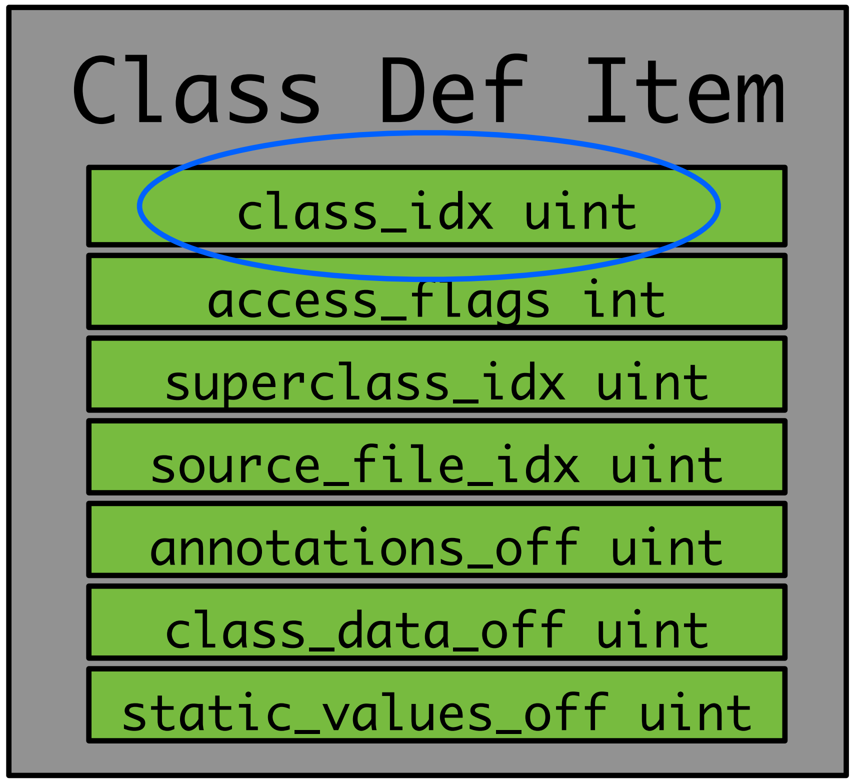

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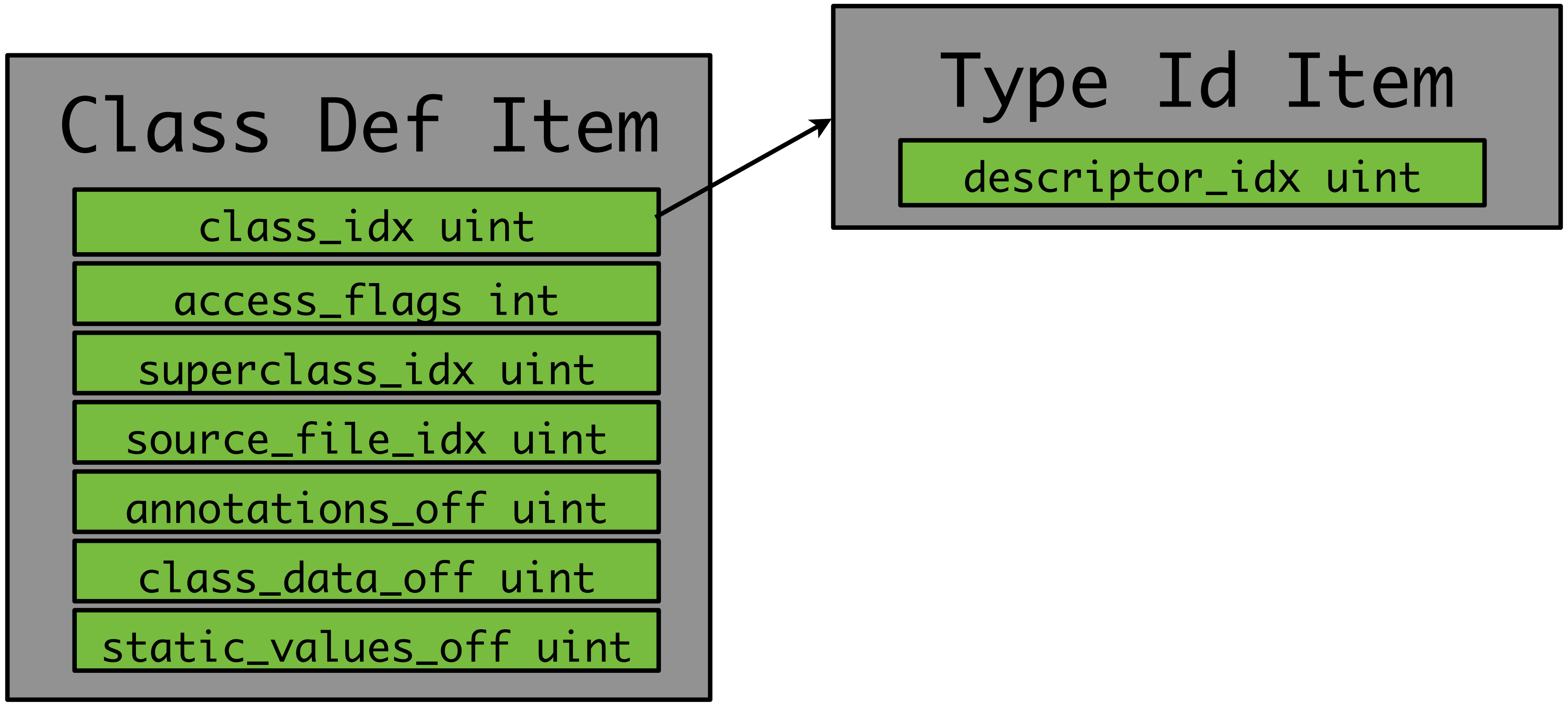

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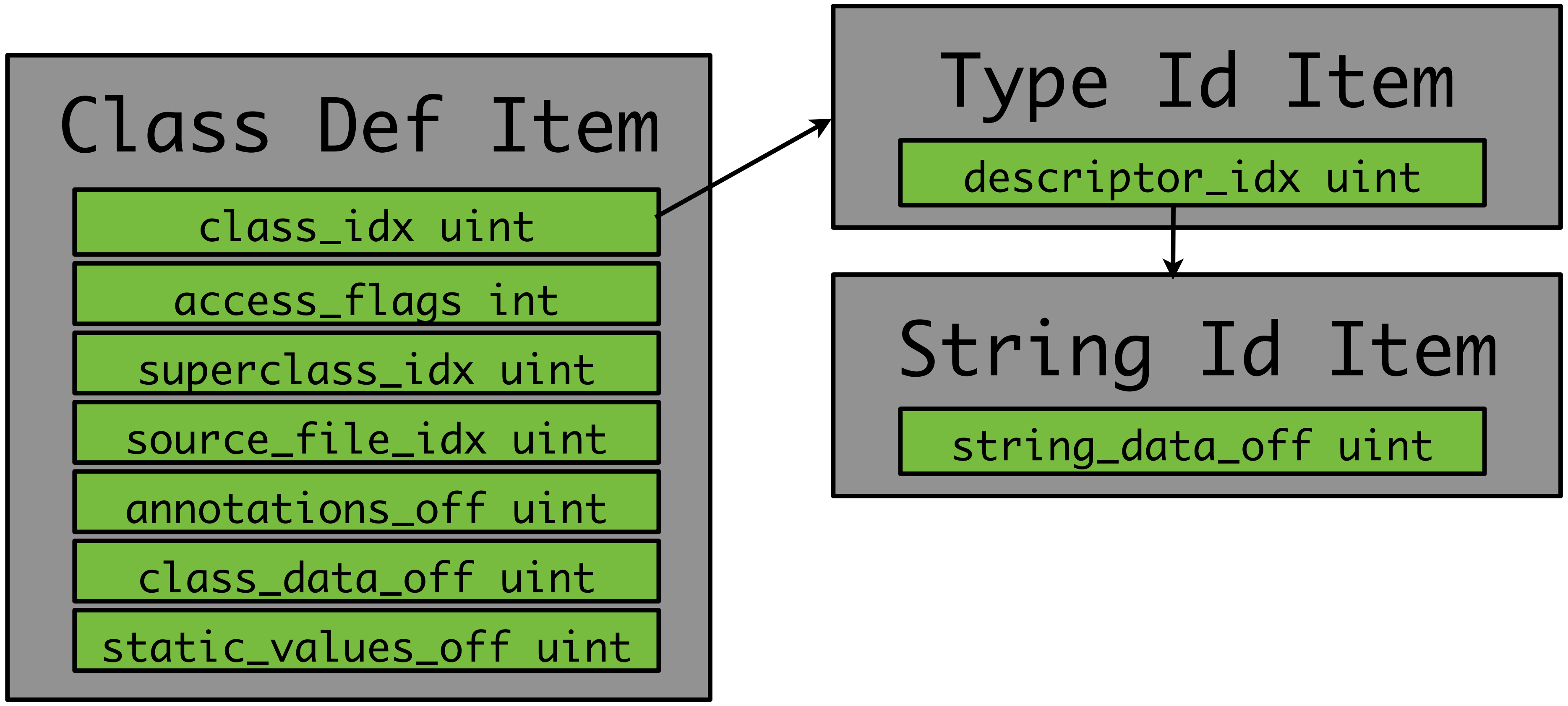

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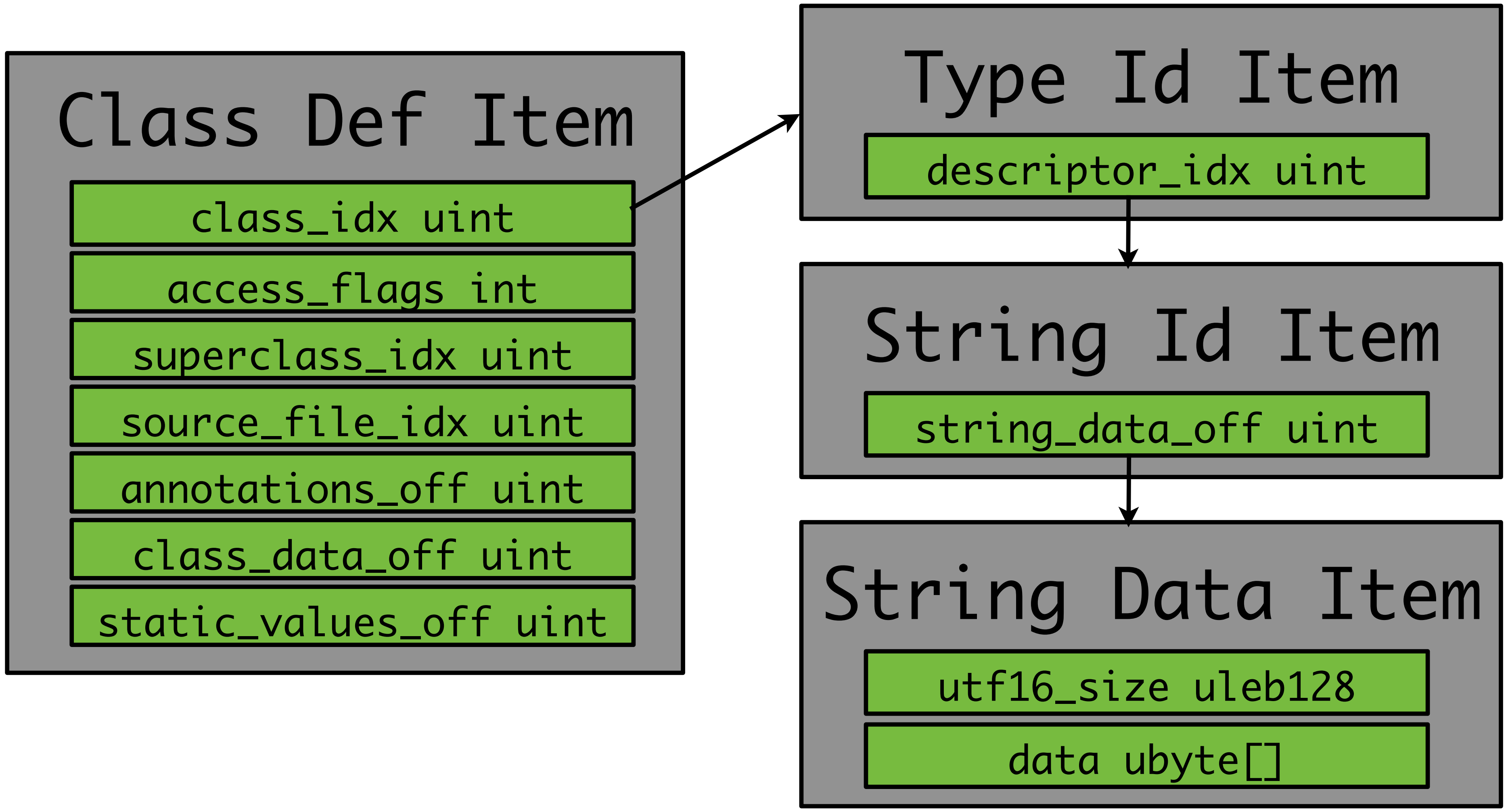

Adventures in Anti-Analysis: Kickin` It Old School

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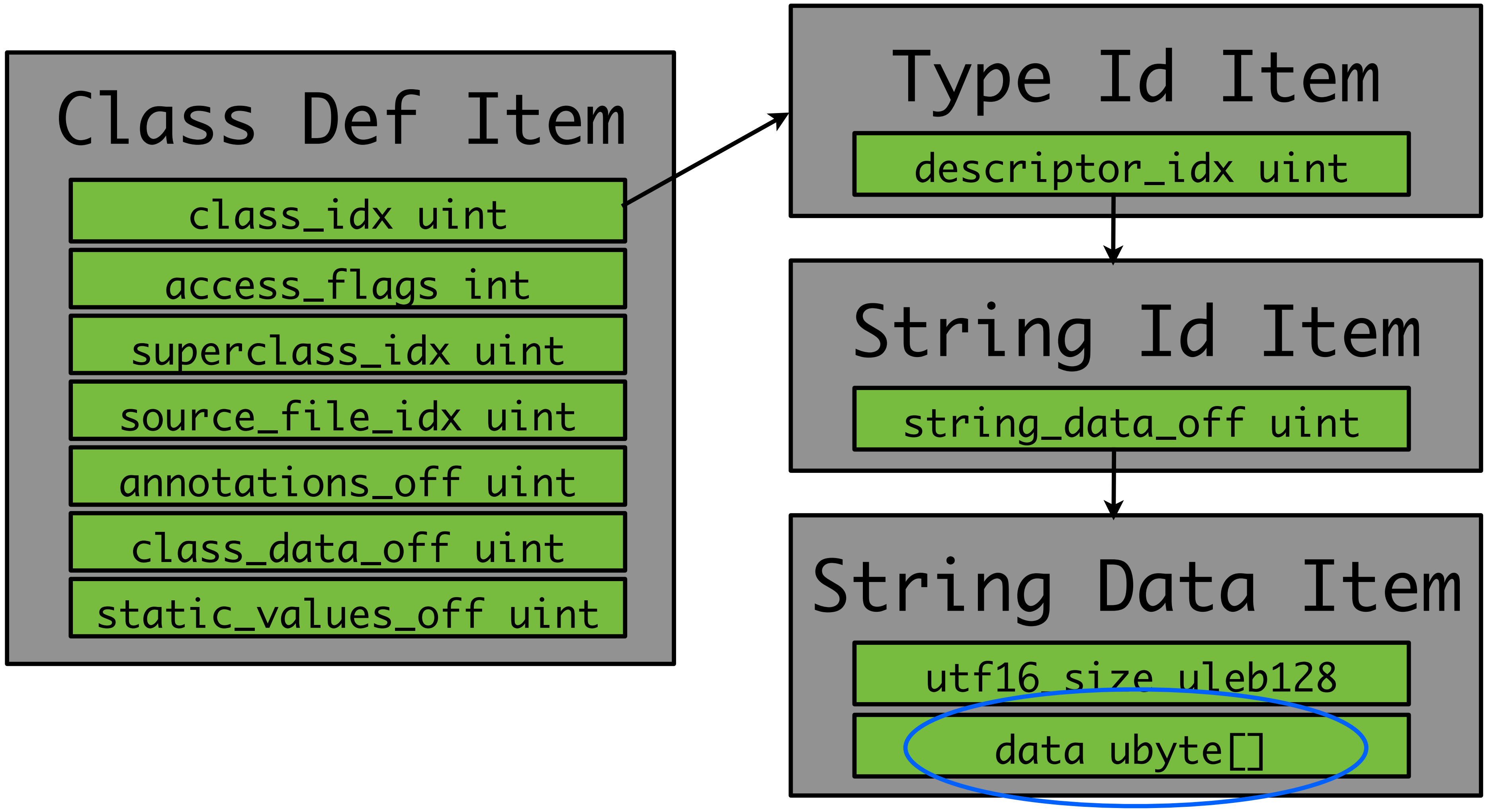

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Adventures in Anti-Analysis: Kickin` It Old School

- Change the class name in the string data to a valid, but large class name
- Minor gotcha -- string table must *always* be in alphanumeric order!
- Just append data to the end of an early processed class (avoids having to reassemble tables)
- Wave our magic wand and see if this works...

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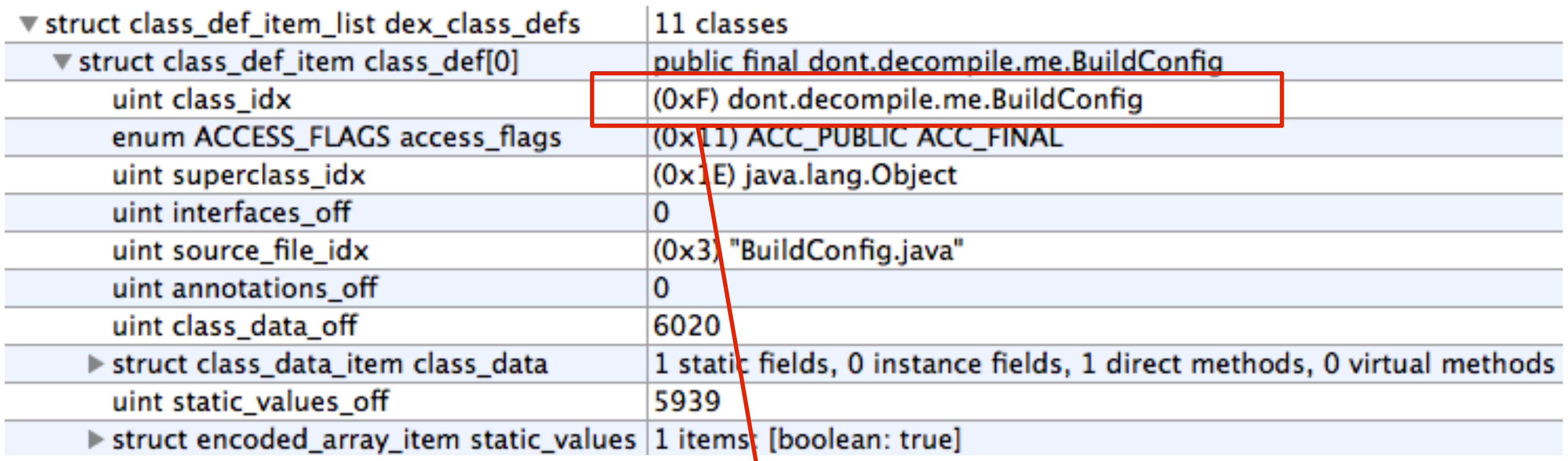
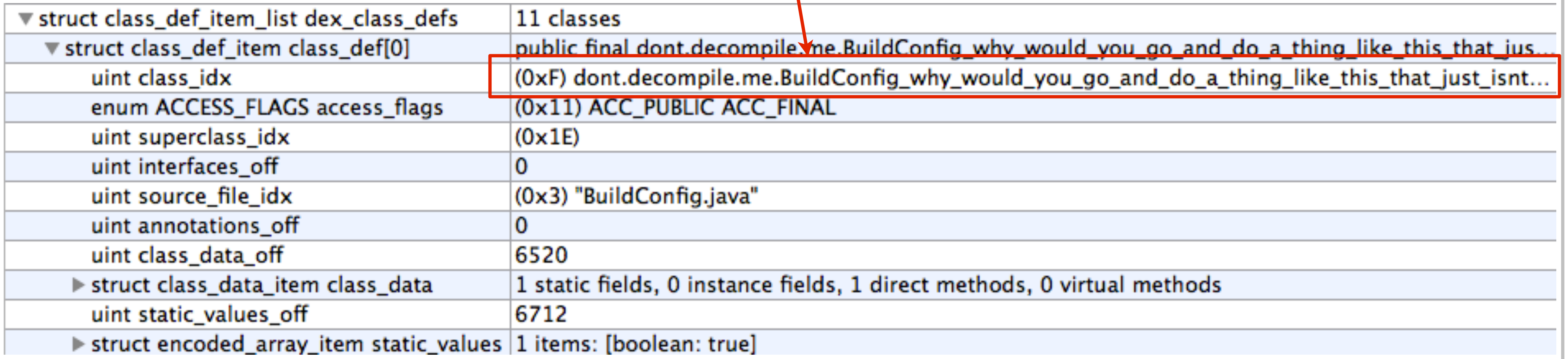
Adventures in Anti-Analysis: Kickin` It Old School



▼ struct class_def_item_list dex_class_defs	11 classes
▼ struct class_def_item class_def[0]	public final dont.decompile.me.BuildConfig
uint class_idx	(0xF) dont.decompile.me.BuildConfig
enum ACCESS_FLAGS access_flags	(0x11) ACC_PUBLIC ACC_FINAL
uint superclass_idx	(0x1E) java.lang.Object
uint interfaces_off	0
uint source_file_idx	(0x3) "BuildConfig.java"
uint annotations_off	0
uint class_data_off	6020
▶ struct class_data_item class_data	1 static fields, 0 instance fields, 1 direct methods, 0 virtual methods
uint static_values_off	5939
▶ struct encoded_array_item static_values	1 items: [boolean: true]



▼ struct class_def_item_list dex_class_defs	11 classes
▼ struct class_def_item class_def[0]	public final dont.decompile.me.BuildConfig_why_would_you_go_and_do_a_thing_like_this_that_jus...
uint class_idx	(0xF) dont.decompile.me.BuildConfig_why_would_you_go_and_do_a_thing_like_this_that_just_isnt...
enum ACCESS_FLAGS access_flags	(0x11) ACC_PUBLIC ACC_FINAL
uint superclass_idx	(0x1E)
uint interfaces_off	0
uint source_file_idx	(0x3) "BuildConfig.java"
uint annotations_off	0
uint class_data_off	6520
▶ struct class_data_item class_data	1 static fields, 0 instance fields, 1 direct methods, 0 virtual methods
uint static_values_off	6712
▶ struct encoded_array_item static_values	1 items: [boolean: true]

Adventures in Anti-Analysis: Kickin` It Old School

- Does it install? Yes!(after some work of course...)

```
champagne:long-class-name tstrazzere$ adb install longclassnamedex.apk
1627 KB/s (9917 bytes in 0.005s)
        pkg: /data/local/tmp/longclassnamedex.apk
Success
```

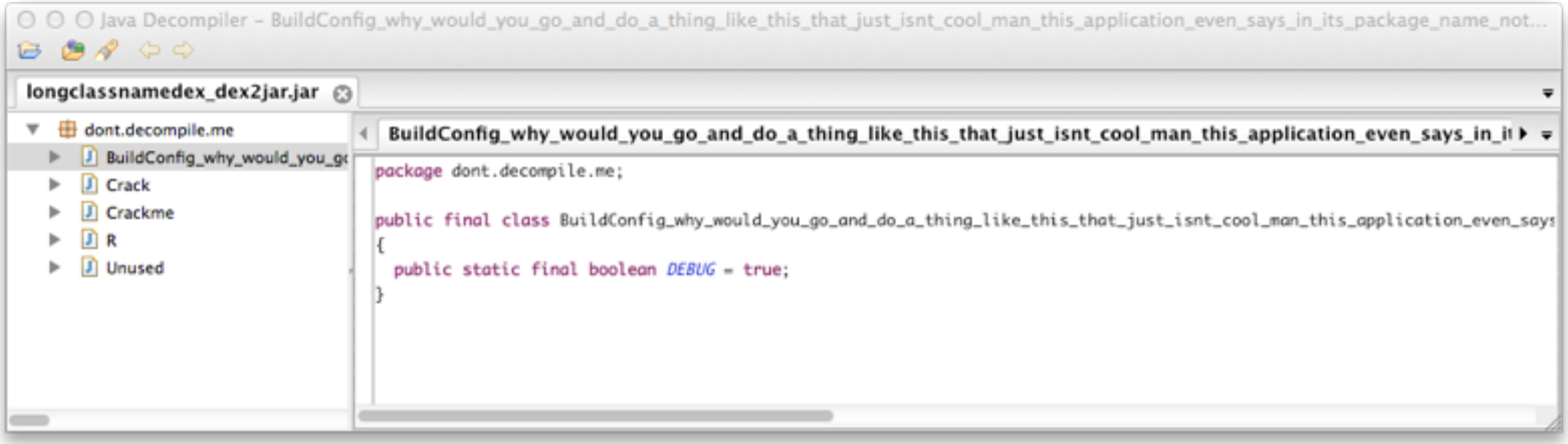
- Does it break any tools? Sort of...

```
champagne:long-class-name tstrazzere$ baksmali longclassnamedex.apk -o wontwork


Error occured while disassembling class
Ldont.decompile.me.BuildConfig_why_would_you_go_and_do_a_thing_like_this_that_just_isnt_cool_man_this
_application_even_says_in_its_package_name_not_to_decompile_it_have_you_no_manners_______someday_
someone_might_decompile_you_then_youll_understand_the_feelings_this_poor_little_dex_file_is_feeling_
right_at_this_moment; - skipping class
java.io.IOException: File name too long
        at java.io.UnixFileSystem.createFileExclusively(Native Method)
        at java.io.File.createNewFile(File.java:883)
        at org.jf.baksmali.baksmali.disassembleDexFile(baksmali.java:195)
        at org.jf.baksmali.main.main(main.java:293)
```

Adventures in Anti-Analysis: Kickin` It Old School

- Results;
  IDA works
  Dex2jar works (depending on tool/use afterwards)
  Androguard works
  Baksmali works (sort of -- except for that class)



Java Decompiler – BuildConfig_why_would_you_go_and_do_a_thing_like_this_that_just_isnt_cool_man_this_application_even_says_in_its_package_name_not...
longclassnamedex_dex2jar.jar
dont.decompile.me
BuildConfig_why_would_you_go
Crack
Crackme
R
Unused
BuildConfig_why_would_you_go_and_do_a_thing_like_this_that_just_isnt_cool_man_this_application_even_says_in_it

```
package dont.decompile.me;

public final class BuildConfig_why_would_you_go_and_do_a_thing_like_this_that_just_isnt_cool_man_this_application_even_says
{
  public static final boolean DEBUG = true;
}
```

- We want something to break more!

Adventures in Anti-Analysis: Kickin` It Old School

- Easy to detect and work around
- Class name > 255 chars? alert! (maybe)
- Someone might be trying to mess with analysis systems
- Someone *might* just not understand that they have a horrible class name...

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Adventures in Anti-Analysis: Kickin` It Old School

- Lots of interesting things you can do with this style of hack
- Targeting a mac user/case-sensitive filesystem? Ii == iI (Fixed in baksmali a little bit back)
- Throwing some nasty ASCII characters in there: ÀÀÁÀÀ - they're a pain to work with on the command line :(

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- What about throwing some bad opcodes at these guys? Sort of like other malware on the PC that would cause tools to die

- Plan of attack:
  Inject "dead code" into the dex file which will never be executed, therefore the devices won't care!

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Adventures in Anti-Analysis: Kickin` It Old School

- Goal to inject:

```
1201        // Load 0 into v1
3801 0300   // A conditional jump which should always succeed, jumps over
            // next bytes
FFFF        // Bad opcodes
```

Into a class we want to protect

```
champagne:long-class-name tstrazzere$ adb install bad-opcodes-1.apk
1627 KB/s (9917 bytes in 0.005s)
        pkg: /data/local/tmp/bad-opcodes-1.apk
Success
```

- Now lets rub our hands together and cackle like an evil genius!

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Adventures in Anti-Analysis: Kickin` It Old School

```
W/dalvikvm( 2567): VFY: invalid instruction (0xffff)
W/dalvikvm( 2567): VFY:  rejected Ldont/decompile/me/Crackme;.access$0 (Ldont/decompile/me/Crackme;)Landroid/widget/
EditText;
W/dalvikvm( 2567): Verifier rejected class Ldont/decompile/me/Crackme;
W/dalvikvm( 2567): Class init failed in newInstance call (Ldont/decompile/me/Crackme;)
D/AndroidRuntime( 2567): Shutting down VM
W/dalvikvm( 2567): threadid=1: thread exiting with uncaught exception (group=0x40d08300)
E/AndroidRuntime( 2567): FATAL EXCEPTION: main
E/AndroidRuntime( 2567): java.lang.VerifyError: dont/decompile/me/Crackme
E/AndroidRuntime( 2567):  at java.lang.Class.newInstanceImpl(Native Method)
E/AndroidRuntime( 2567):  at java.lang.Class.newInstance(Class.java:1319)
E/AndroidRuntime( 2567):  at android.app.Instrumentation.newActivity(Instrumentation.java:1053)
E/AndroidRuntime( 2567):  at android.app.ActivityThread.performLaunchActivity(ActivityThread.java:1974)
E/AndroidRuntime( 2567):  at android.app.ActivityThread.handleLaunchActivity(ActivityThread.java:2084)
E/AndroidRuntime( 2567):  at android.app.ActivityThread.access$600(ActivityThread.java:130)
E/AndroidRuntime( 2567):  at android.app.ActivityThread$H.handleMessage(ActivityThread.java:1195)
E/AndroidRuntime( 2567):  at android.os.Handler.dispatchMessage(Handler.java:99)
E/AndroidRuntime( 2567):  at android.os.Looper.loop(Looper.java:137)
E/AndroidRuntime( 2567):  at android.app.ActivityThread.main(ActivityThread.java:4745)
E/AndroidRuntime( 2567):  at java.lang.reflect.Method.invokeNative(Native Method)
E/AndroidRuntime( 2567):  at java.lang.reflect.Method.invoke(Method.java:511)
E/AndroidRuntime( 2567):  at com.android.internal.os.ZygoteInit$MethodAndArgsCaller.run(ZygoteInit.java:786)
E/AndroidRuntime( 2567):  at com.android.internal.os.ZygoteInit.main(ZygoteInit.java:553)
E/AndroidRuntime( 2567):  at dalvik.system.NativeStart.main(Native Method)
W/ActivityManager(  306):   Force finishing activity dont.decompile.me/.Crackme
```

fail :(

Adventures in Anti-Analysis: Kickin` It Old School

- What happened? Why the failure?
- Dalvik verifier facepalmed us while executing all relevant code paths, it didn't actually skip over the dead code as originally expected :(
- So... if we can avoid the verifier, then we should be able to avoid this!
- Back to the drawing board

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Adventures in Anti-Analysis: Kickin` It Old School

- New goal, to inject:

```
1201        // Load 0 into v1
3801 0300   // A conditional jump which should always succeed, jumps over
            // next bytes
FFFF        // Bad opcodes
```

Into a class we ~~want to protect~~ don't care about

```
champagne:long-class-name tstrazzere$ adb install bad-opcodes-2.apk
1627 KB/s (9917 bytes in 0.005s)
	pkg: /data/local/tmp/bad-opcodes-2.apk
Success
```

- This time... this time we will get it right!

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Adventures in Anti-Analysis: Kickin` It Old School

```
I/ActivityManager(  306): START {act=android.intent.action.MAIN cat=[android.intent.category.LAUNCHER] 
flg=0x10200000 cmp=dont.decompile.me/.Crackme u=0} from pid 538
I/ActivityManager(  306): Start proc dont.decompile.me for activity dont.decompile.me/.Crackme: pid=3464 
uid=10073 gids={1015, 1028}
I/dalvikvm( 3464): Turning on JNI app bug workarounds for target SDK version 3...
I/don't decompile me( 3464): please?
V/PhoneStatusBar(  390): setLightsOn(true)
I/ActivityManager(  306): Displayed dont.decompile.me/.Crackme: +242ms (total +7m18s529ms)
```

- Awesome, what tools can we break now?

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Adventures in Anti-Analysis: Kickin` It Old School

```
champagne:bad-opcodes tstrazzere$ baksmali bad-opcodes-2.apk -o wontwork


UNEXPECTED TOP-LEVEL EXCEPTION:
org.jf.dexlib.Util.ExceptionWithContext: Unknown opcode: ff
        at org.jf.dexlib.Util.ExceptionWithContext.withContext(ExceptionWithContext.java:54)
        at org.jf.dexlib.Code.InstructionIterator.IterateInstructions(InstructionIterator.java:92)
        at org.jf.dexlib.CodeItem.readItem(CodeItem.java:154)
        at org.jf.dexlib.Item.readFrom(Item.java:76)
        at org.jf.dexlib.OffsettedSection.readItems(OffsettedSection.java:48)
        at org.jf.dexlib.Section.readFrom(Section.java:143)
        at org.jf.dexlib.DexFile.<init>(DexFile.java:431)
        at org.jf.baksmali.main.main(main.java:265)
Caused by: java.lang.RuntimeException: Unknown opcode: ff
        at org.jf.dexlib.Code.InstructionIterator.IterateInstructions(InstructionIterator.java:56)
        ... 6 more
Error occured at code address 12
code_item @0x1804
```

- Baksmali - check!
  (fixed in revision 2f81aec886d2 7/28)

Adventures in Anti-Analysis: Kickin` It Old School

```
champagne:bad-opcodes tstrazzere$ dex2jar bad-opcodes-2.apk
dex2jar version: translator-0.0.9.8
dex2jar bad-opcodes-2.apk -> bad-opcodes-2_dex2jar.jar
com.googlecode.dex2jar.DexException: while accept method:[Ldont/decompile/me/Unused;.<init>()V]
	at com.googlecode.dex2jar.reader.DexFileReader.acceptMethod(DexFileReader.java:705)
	at com.googlecode.dex2jar.reader.DexFileReader.acceptClass(DexFileReader.java:446)
	at com.googlecode.dex2jar.reader.DexFileReader.accept(DexFileReader.java:333)
	at com.googlecode.dex2jar.v3.Dex2jar.doTranslate(Dex2jar.java:82)
	at com.googlecode.dex2jar.v3.Dex2jar.to(Dex2jar.java:191)
	at com.googlecode.dex2jar.v3.Dex2jar.to(Dex2jar.java:182)
	at com.googlecode.dex2jar.v3.Main.doData(Main.java:43)
	at com.googlecode.dex2jar.v3.Main.doData(Main.java:35)
	at com.googlecode.dex2jar.v3.Main.doFile(Main.java:63)
	at com.googlecode.dex2jar.v3.Main.main(Main.java:85)
Caused by: com.googlecode.dex2jar.DexException: while accept code in method:[Ldont/decompile/me/Unused;.<init>()V]
	at com.googlecode.dex2jar.reader.DexFileReader.acceptMethod(DexFileReader.java:695)
	... 9 more
Caused by: java.lang.RuntimeException: opcode format for 65535 not found!
	at com.googlecode.dex2jar.reader.OpcodeFormat.get(OpcodeFormat.java:362)
	at com.googlecode.dex2jar.reader.DexCodeReader.findLabels(DexCodeReader.java:85)
	at com.googlecode.dex2jar.reader.DexCodeReader.accept(DexCodeReader.java:287)
	at com.googlecode.dex2jar.reader.DexFileReader.acceptMethod(DexFileReader.java:692)
	... 9 more
Done.
```

- Dex2jar - check!

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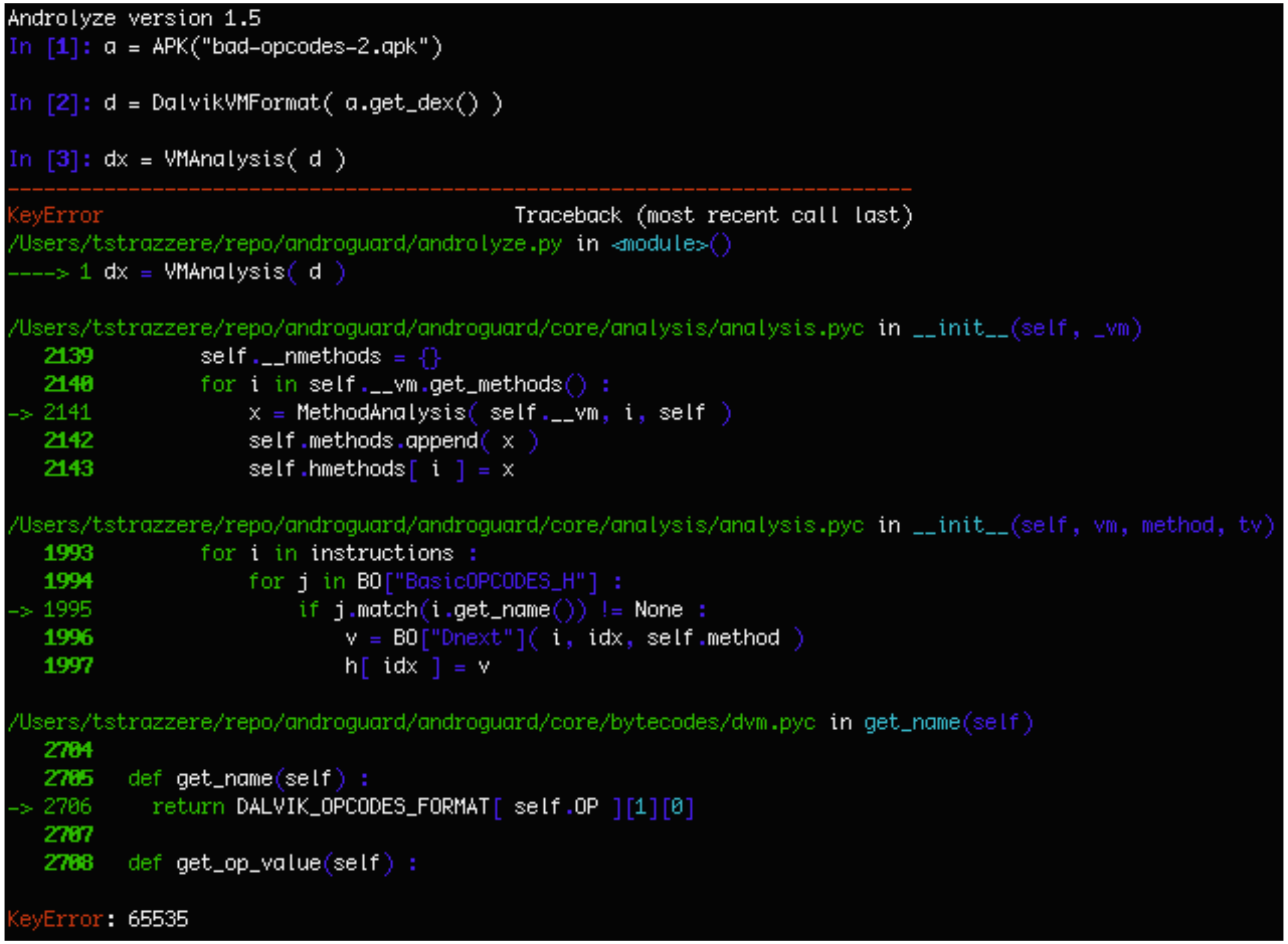
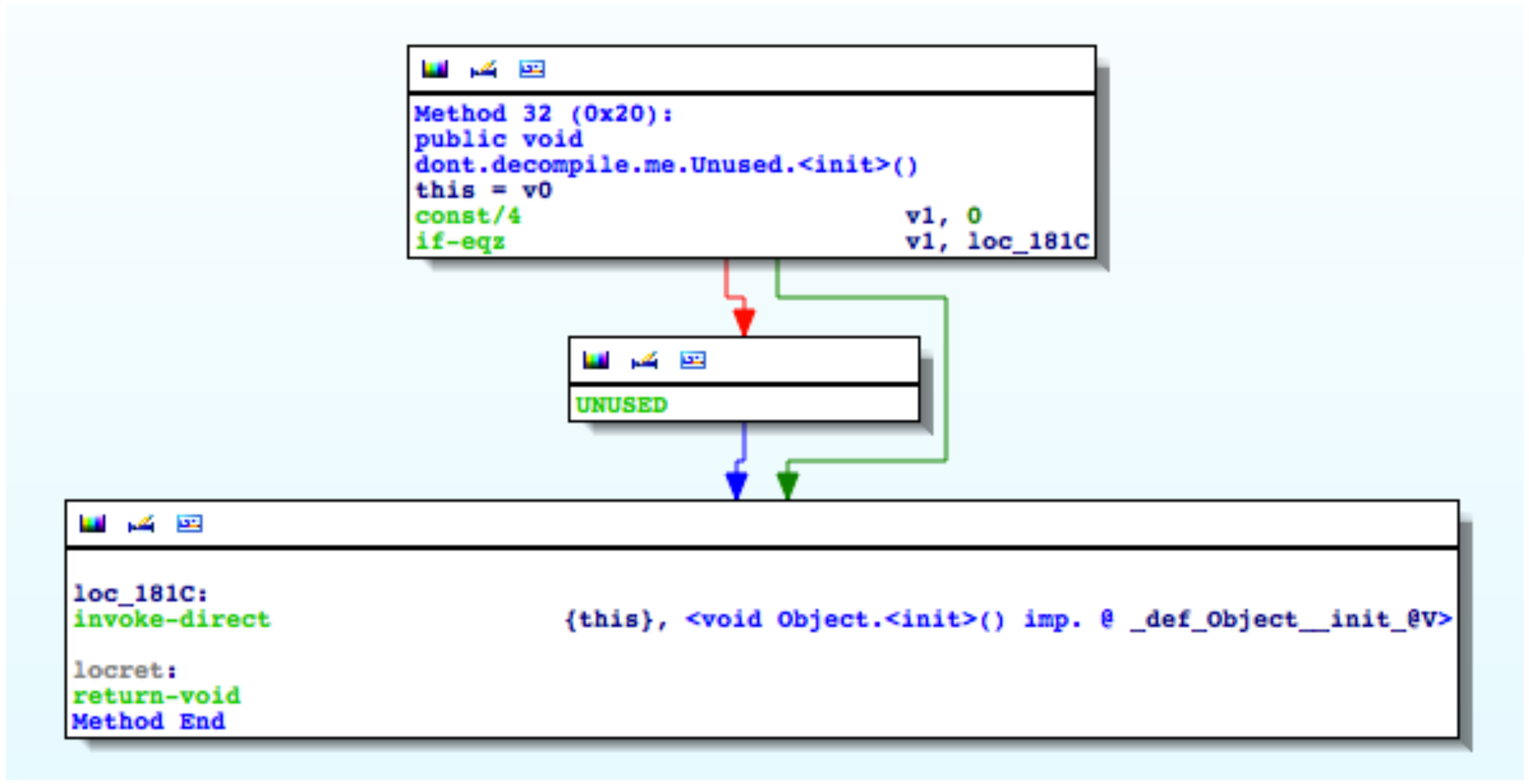
Adventures in Anti-Analysis: Kickin` It Old School



```
Androlyze version 1.5
In [1]: a = APK("bad-opcodes-2.apk")

In [2]: d = DalvikVMFormat( a.get_dex() )

In [3]: dx = VMAnalysis( d )
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
/Users/tstrazzere/repo/androguard/androlyze.py in <module>()
----> 1 dx = VMAnalysis( d )

/Users/tstrazzere/repo/androguard/androguard/core/analysis/analysis.pyc in __init__(self, _vm)
   2139         self.__nmethods = {}
   2140         for i in self.__vm.get_methods() :
-> 2141             x = MethodAnalysis( self.__vm, i, self )
   2142             self.methods.append( x )
   2143             self.hmethods[ i ] = x

/Users/tstrazzere/repo/androguard/androguard/core/analysis/analysis.pyc in __init__(self, vm, method, tv)
   1993         for i in instructions :
   1994             for j in BO["BasicOPCODES_H"] :
-> 1995                 if j.match(i.get_name()) != None :
   1996                     v = BO["Dnext"]( i, idx, self.method )
   1997                     h[ idx ] = v

/Users/tstrazzere/repo/androguard/androguard/core/bytecodes/dvm.pyc in get_name(self)
   2704
   2705     def get_name(self) :
-> 2706       return DALVIK_OPCODES_FORMAT[ self.OP ][1][0]
   2707
   2708     def get_op_value(self) :

KeyError: 65535
```

- Androguard - check! (fix commited already/soon)

Adventures in Anti-Analysis: Kickin` It Old School



```
Method 32 (0x20):
public void
dont.decompile.me.Unused.<init>()
this = v0
const/4                                  v1, 0
if-eqz                                   v1, loc_181C
```

```
UNUSED
```

```
loc_181C:
invoke-direct                    {this}, <void Object.<init>() imp. @ _def_Object__init_@V>

locret:
return-void
Method End
```

- IDA Pro - doh!

Adventures in Anti-Analysis: Kickin` It Old School

```
champagne:bad-opcodes tstrazzere$ ded-0.7.1 -d $PWD -j ~/Downloads/jasminclasses-2.4.0.jar bad-opcodes-2.apk
Processing class #0: Ldont/decompile/me/BuildConfig;
Processing class #1: Ldont/decompile/me/Crack;
Processing class #2: Ldont/decompile/me/Crackme$1;
Processing class #3: Ldont/decompile/me/Crackme;
Processing class #4: Ldont/decompile/me/R$attr;
Processing class #5: Ldont/decompile/me/R$drawable;
Processing class #6: Ldont/decompile/me/R$id;
Processing class #7: Ldont/decompile/me/R$layout;
Processing class #8: Ldont/decompile/me/R$string;
Processing class #9: Ldont/decompile/me/R;
GLITCH: zero-width instruction at idx=0x0003
Processing class #10: Ldont/decompile/me/Unused;
```

- Ded - check! With a bonus of hogging a core until you kill the process!

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Adventures in Anti-Analysis: Kickin` It Old School

- Round up? Only IDA Pro worked out of what I tested
- Why? Resilience to unexpected op codes
- Easy fix, baksmali has it done, androguard already had it done - but 0xFF was missed! ;)
- A good "edge case" to think of when developing these types of tools

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Adventures in Anti-Analysis: Kickin` It Old School

- Good thing to look for with automated analysis
- Used illegal opcodes? alert!
- Could be your tool chain is out of date, need to update to support more opcodes
- Could be someone trying to break your tool chain -- probably something worth looking at for that reason alone!

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Adventures in Anti-Analysis: Pushing the Bounds

- So illegal opcodes work(ed)
- What about legal opcodes, to bad objects?

```
1201       // Load 0 into v1
3801 0300  // A conditional jump which should always succeed, jumps over
           // next bytes
1a00 FF00  // Load const-string at index 255 (doesn't exist)
```

- We still want to avoid the verifier, but this is more "valid" than bad opcodes

Adventures in Anti-Analysis: Pushing the Bounds

```
champagne:bad-offsets tstrazzere$ baksmali bad-string-offsets.apk -o wontwork
UNEXPECTED TOP-LEVEL EXCEPTION:
org.jf.dexlib.Util.ExceptionWithContext: Index: 255, Size: 141
        at org.jf.dexlib.Util.ExceptionWithContext.withContext(ExceptionWithContext.java:54)
        at org.jf.dexlib.IndexedSection.getItemByIndex(IndexedSection.java:77)
        at org.jf.dexlib.Code.InstructionWithReference.lookupReferencedItem(InstructionWithReference.java:88)
        at org.jf.dexlib.Code.InstructionWithReference.<init>(InstructionWithReference.java:57)
        at org.jf.dexlib.Code.Format.Instruction21c.<init>(Instruction21c.java:63)
        at org.jf.dexlib.Code.Format.Instruction21c.<init>(Instruction21c.java:40)
        at org.jf.dexlib.Code.Format.Instruction21c$Factory.makeInstruction(Instruction21c.java:112)
        at org.jf.dexlib.Code.InstructionIterator.IterateInstructions(InstructionIterator.java:84)
        at org.jf.dexlib.CodeItem.readItem(CodeItem.java:154)
        at org.jf.dexlib.Item.readFrom(Item.java:76)
        at org.jf.dexlib.OffsettedSection.readItems(OffsettedSection.java:48)
        at org.jf.dexlib.Section.readFrom(Section.java:143)
        at org.jf.dexlib.DexFile.<init>(DexFile.java:431)
        at org.jf.baksmali.main.main(main.java:265)
Caused by: java.lang.IndexOutOfBoundsException: Index: 255, Size: 141
        at java.util.ArrayList.RangeCheck(ArrayList.java:547)
        at java.util.ArrayList.get(ArrayList.java:322)
        at org.jf.dexlib.IndexedSection.getItemByIndex(IndexedSection.java:75)
        ... 12 more
Error occured while retrieving the string_id_item item at index 255
Error occured at code address 12
code_item @0x1804
```

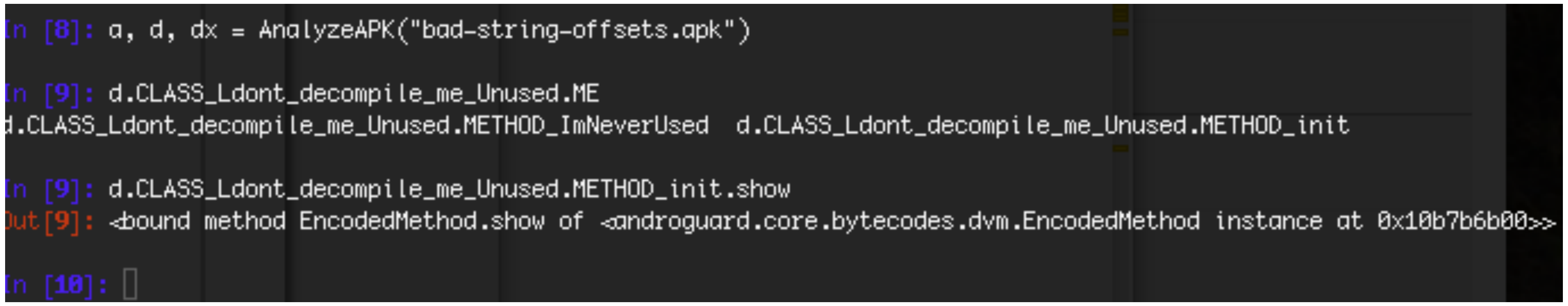
- Baksmali - check!

Adventures in Anti-Analysis: Pushing the Bounds

```
champagne:bad-offsets tstrazzere$ ./dex2jar.sh bad-string-offsets.apk
dex2jar version: translator-0.0.9.8
dex2jar bad-string-offsets.apk -> bad-string-offsets_dex2jar.jar
com.googlecode.dex2jar.DexException: while accept method:[Ldont/decompile/me/Unused;.<init>()V]
	at com.googlecode.dex2jar.reader.DexFileReader.acceptMethod(DexFileReader.java:705)
	at com.googlecode.dex2jar.reader.DexFileReader.acceptClass(DexFileReader.java:446)
	at com.googlecode.dex2jar.reader.DexFileReader.accept(DexFileReader.java:333)
	at com.googlecode.dex2jar.v3.Dex2jar.doTranslate(Dex2jar.java:82)
	at com.googlecode.dex2jar.v3.Dex2jar.to(Dex2jar.java:191)
	at com.googlecode.dex2jar.v3.Dex2jar.to(Dex2jar.java:182)
	at com.googlecode.dex2jar.v3.Main.doData(Main.java:43)
	at com.googlecode.dex2jar.v3.Main.doData(Main.java:35)
	at com.googlecode.dex2jar.v3.Main.doFile(Main.java:63)
	at com.googlecode.dex2jar.v3.Main.main(Main.java:85)
Caused by: com.googlecode.dex2jar.DexException: while accept code in method:[Ldont/decompile/me/Unused;.<init>()V]
	at com.googlecode.dex2jar.reader.DexFileReader.acceptMethod(DexFileReader.java:695)
	... 9 more
Caused by: java.lang.IllegalArgumentException: Id out of bound
	at com.googlecode.dex2jar.reader.DexFileReader.getString(DexFileReader.java:537)
	at com.googlecode.dex2jar.reader.DexOpcodeAdapter.x1c(DexOpcodeAdapter.java:129)
	at com.googlecode.dex2jar.reader.DexCodeReader.acceptInsn(DexCodeReader.java:386)
	at com.googlecode.dex2jar.reader.DexCodeReader.accept(DexCodeReader.java:292)
	at com.googlecode.dex2jar.reader.DexFileReader.acceptMethod(DexFileReader.java:692)
	... 9 more
Done.
```

- Dex2jar - check! (fails only on that file)

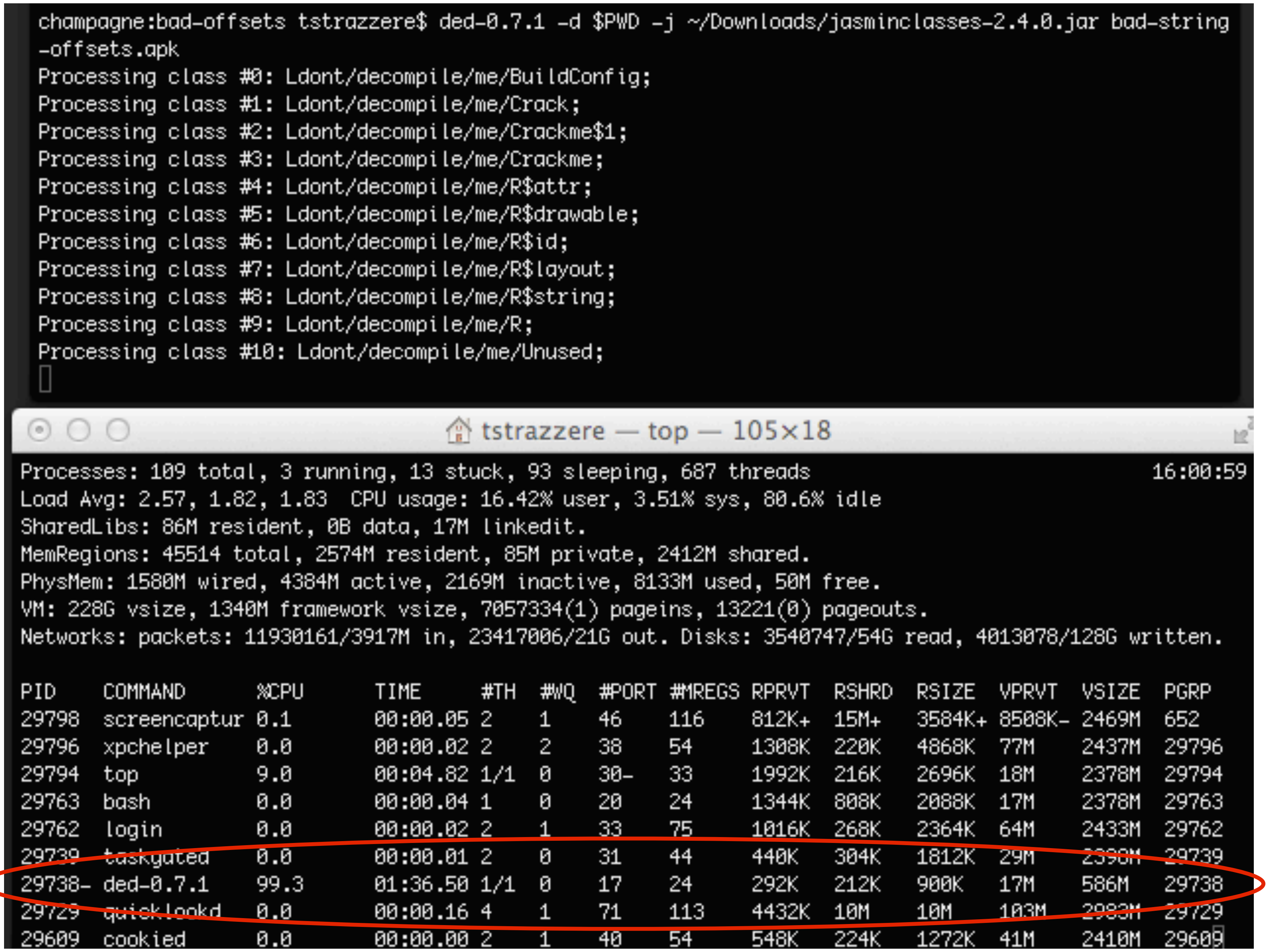
Adventures in Anti-Analysis: Pushing the Bounds



```
In [8]: a, d, dx = AnalyzeAPK("bad-string-offsets.apk")

In [9]: d.CLASS_Ldont_decompile_me_Unused.ME
d.CLASS_Ldont_decompile_me_Unused.METHOD_ImNeverUsed  d.CLASS_Ldont_decompile_me_Unused.METHOD_init

In [9]: d.CLASS_Ldont_decompile_me_Unused.METHOD_init.show
Out[9]: <bound method EncodedMethod.show of <androguard.core.bytecodes.dvm.EncodedMethod instance at 0x10b7b6b00>>

In [10]: 
```

- Androguard - check, sort of - only on the function which is using it

Adventures in Anti-Analysis: Pushing the Bounds



```
champagne:bad-offsets tstrazzere$ ded-0.7.1 -d $PWD -j ~/Downloads/jasminclasses-2.4.0.jar bad-string
-offsets.apk
Processing class #0: Ldont/decompile/me/BuildConfig;
Processing class #1: Ldont/decompile/me/Crack;
Processing class #2: Ldont/decompile/me/Crackme$1;
Processing class #3: Ldont/decompile/me/Crackme;
Processing class #4: Ldont/decompile/me/R$attr;
Processing class #5: Ldont/decompile/me/R$drawable;
Processing class #6: Ldont/decompile/me/R$id;
Processing class #7: Ldont/decompile/me/R$layout;
Processing class #8: Ldont/decompile/me/R$string;
Processing class #9: Ldont/decompile/me/R;
Processing class #10: Ldont/decompile/me/Unused;
```

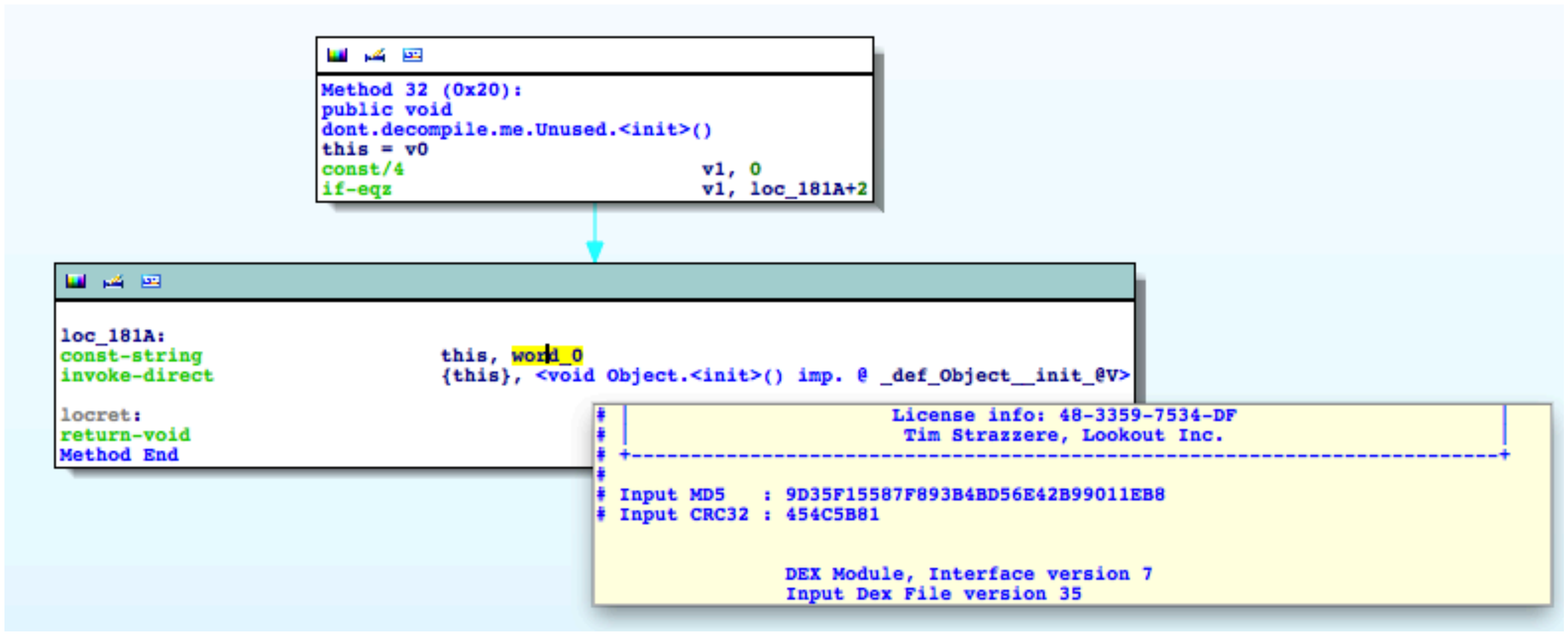
tstrazzere — top — 105×18

```
Processes: 109 total, 3 running, 13 stuck, 93 sleeping, 687 threads                               16:00:59
Load Avg: 2.57, 1.82, 1.83  CPU usage: 16.42% user, 3.51% sys, 80.6% idle
SharedLibs: 86M resident, 0B data, 17M linkedit.
MemRegions: 45514 total, 2574M resident, 85M private, 2412M shared.
PhysMem: 1580M wired, 4384M active, 2169M inactive, 8133M used, 50M free.
VM: 228G vsize, 1340M framework vsize, 7057334(1) pageins, 13221(0) pageouts.
Networks: packets: 11930161/3917M in, 23417006/21G out. Disks: 3540747/54G read, 4013078/128G written.

PID    COMMAND      %CPU      TIME     #TH   #WQ  #PORT #MREGS RPRVT  RSHRD  RSIZE  VPRVT  VSIZE  PGRP
29798  screencaptur 0.1       00:00.05 2     1    46    116    812K+  15M+   3584K+ 8508K- 2469M  652
29796  xpchelper    0.0       00:00.02 2     2    38    54     1308K  220K   4868K  77M    2437M  29796
29794  top          9.0       00:04.82 1/1   0    30-   33     1992K  216K   2696K  18M    2378M  29794
29763  bash         0.0       00:00.04 1     0    20    24     1344K  808K   2088K  17M    2378M  29763
29762  login        0.0       00:00.02 2     1    33    75     1016K  268K   2364K  64M    2433M  29762
29739  taskgated    0.0       00:00.01 2     0    31    44     440K   304K   1812K  29M    2390M  29739
29738- ded-0.7.1    99.3      01:36.50 1/1   0    17    24     292K   212K   900K   17M    586M   29738
29729  quicklookd   0.0       00:00.16 4     1    71    113    4432K  10M    10M    103M   2983M  29729
29609  cookied      0.0       00:00.00 2     1    40    54     548K   224K   1272K  41M    2410M  29609
```

- Ded - check!

Thursday, July 26, 12

Adventures in Anti-Analysis: Pushing the Bounds



```
Method 32 (0x20):
public void
dont.decompile.me.Unused.<init>()
this = v0
const/4                                v1, 0
if-eqz                                 v1, loc_181A+2
```

```
loc_181A:
const-string                    this, word_0
invoke-direct                   {this}, <void Object.<init>() imp. @ _def_Object__init_@V>

locret:
return-void
Method End
```

```
# |                   License info: 48-3359-7534-DF                        |
# |                    Tim Strazzere, Lookout Inc.                         |
# +------------------------------------------------------------------------+
#
# Input MD5    : 9D35F15587F893B4BD56E42B99011EB8
# Input CRC32 : 454C5B81


               DEX Module, Interface version 7
               Input Dex File version 35
```

- IDA Pro - sort of worked?
  Pointing at the header for what string to load

Adventures in Anti-Analysis: Pushing the Bounds

- Not hard to fix - don’t blindly follow an index that doesn’t exist
- loading index > table size ? alert!
- No real (good) reason someone to do this legitimately - if seen, clearly should look at that file!
- This attack is applicable for essentially all index references to the tables (use against type, etc as well)

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Adventures in Anti-Analysis: Fighting the Decompilers

- What about dex2jar?
- Seems popular, so many people talking about using it to leverage other java tools / JD-Gui / JAD
- As a clarification - dex2jar does *not* give you the exact source back, it's a java representation of Dalvik optimized code
- This can result in "odd" java code when attempting to view with JAD/JD-Gui

Adventures in Anti-Analysis: Fighting the Decompilers

- JAD / JD-Gui works (roughly) by looking for known Java patterns
- dx (Dalivk compiler) does not use the same patterns that Java might have been using
- What does this result in?

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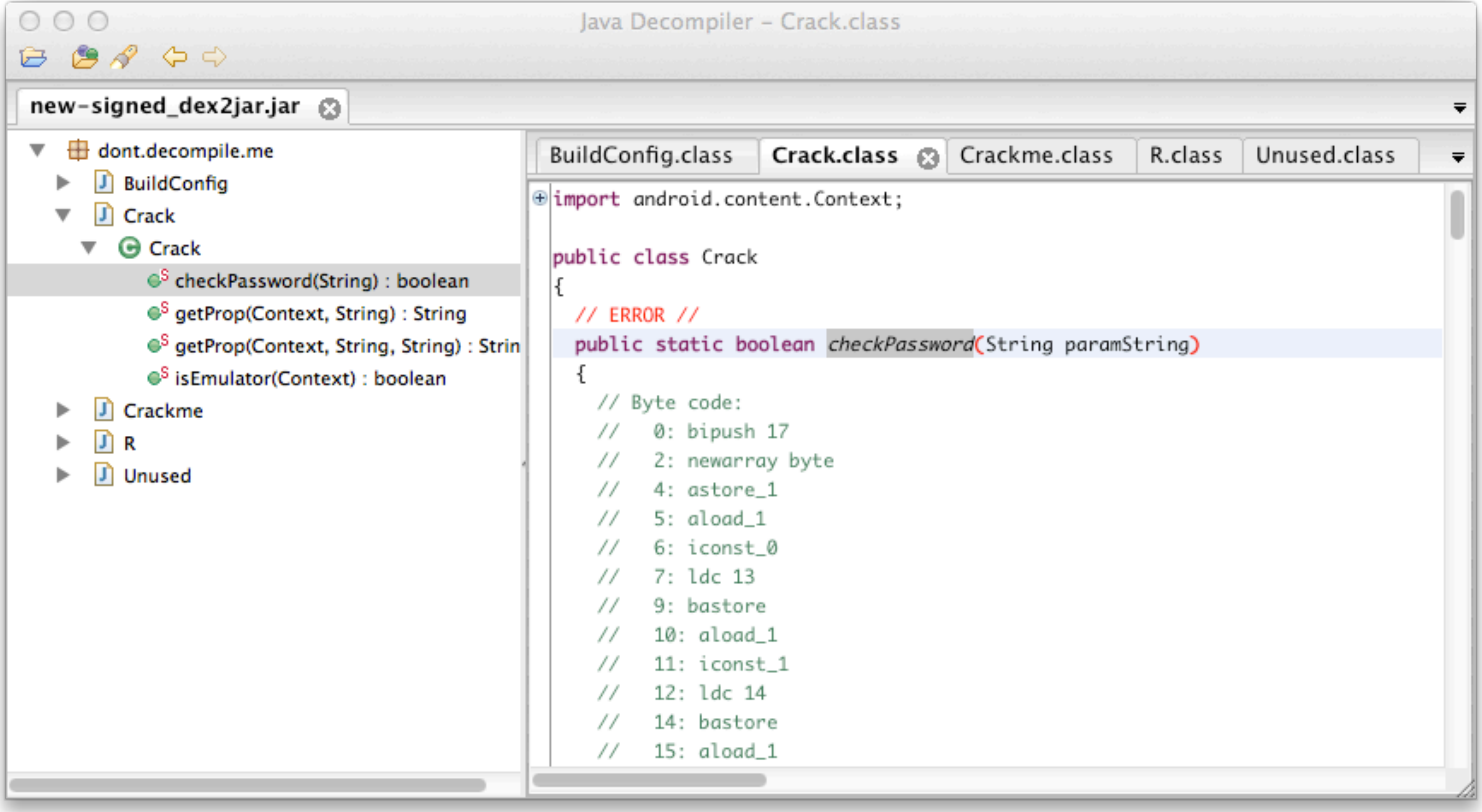
Adventures in Anti-Analysis: Fighting the Decompilers

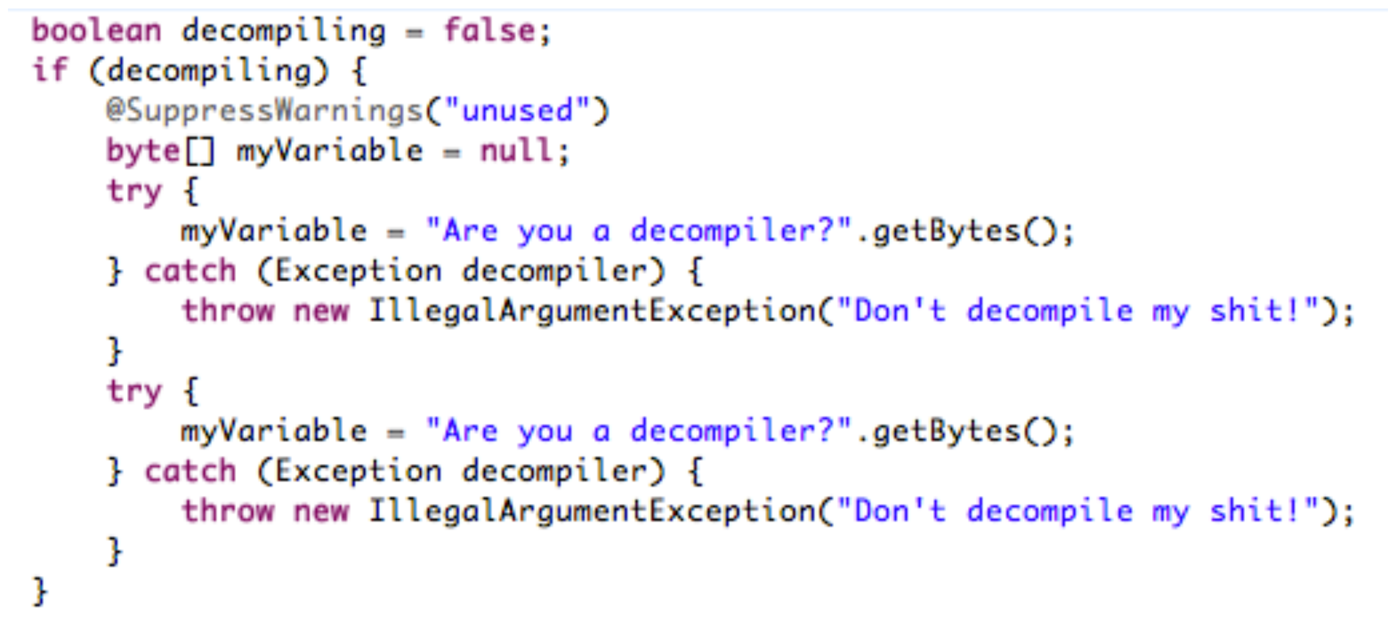

Java Decompiler – Crack.class
new-signed_dex2jar.jar
dont.decompile.me
BuildConfig
Crack
Crack
checkPassword(String) : boolean
getProp(Context, String) : String
getProp(Context, String, String) : Strin
isEmulator(Context) : boolean
Crackme
R
Unused
BuildConfig.class
Crack.class
Crackme.class
R.class
Unused.class

```
import android.content.Context;

public class Crack
{
  // ERROR //
  public static boolean checkPassword(String paramString)
  {
    // Byte code:
    //   0: bipush 17
    //   2: newarray byte
    //   4: astore_1
    //   5: aload_1
    //   6: iconst_0
    //   7: ldc 13
    //   9: bastore
    //   10: aload_1
    //   11: iconst_1
    //   12: ldc 14
    //   14: bastore
    //   15: aload_1
```

Adventures in Anti-Analysis: Fighting the Decompilers

- Confusion via exceptions!



```
boolean decompiling = false;
if (decompiling) {
    @SuppressWarnings("unused")
    byte[] myVariable = null;
    try {
        myVariable = "Are you a decompiler?".getBytes();
    } catch (Exception decompiler) {
        throw new IllegalArgumentException("Don't decompile my shit!");
    }
    try {
        myVariable = "Are you a decompiler?".getBytes();
    } catch (Exception decompiler) {
        throw new IllegalArgumentException("Don't decompile my shit!");
    }
}
```

- Causes JD-Gui to explode on any method - JAD decompiles it fine though

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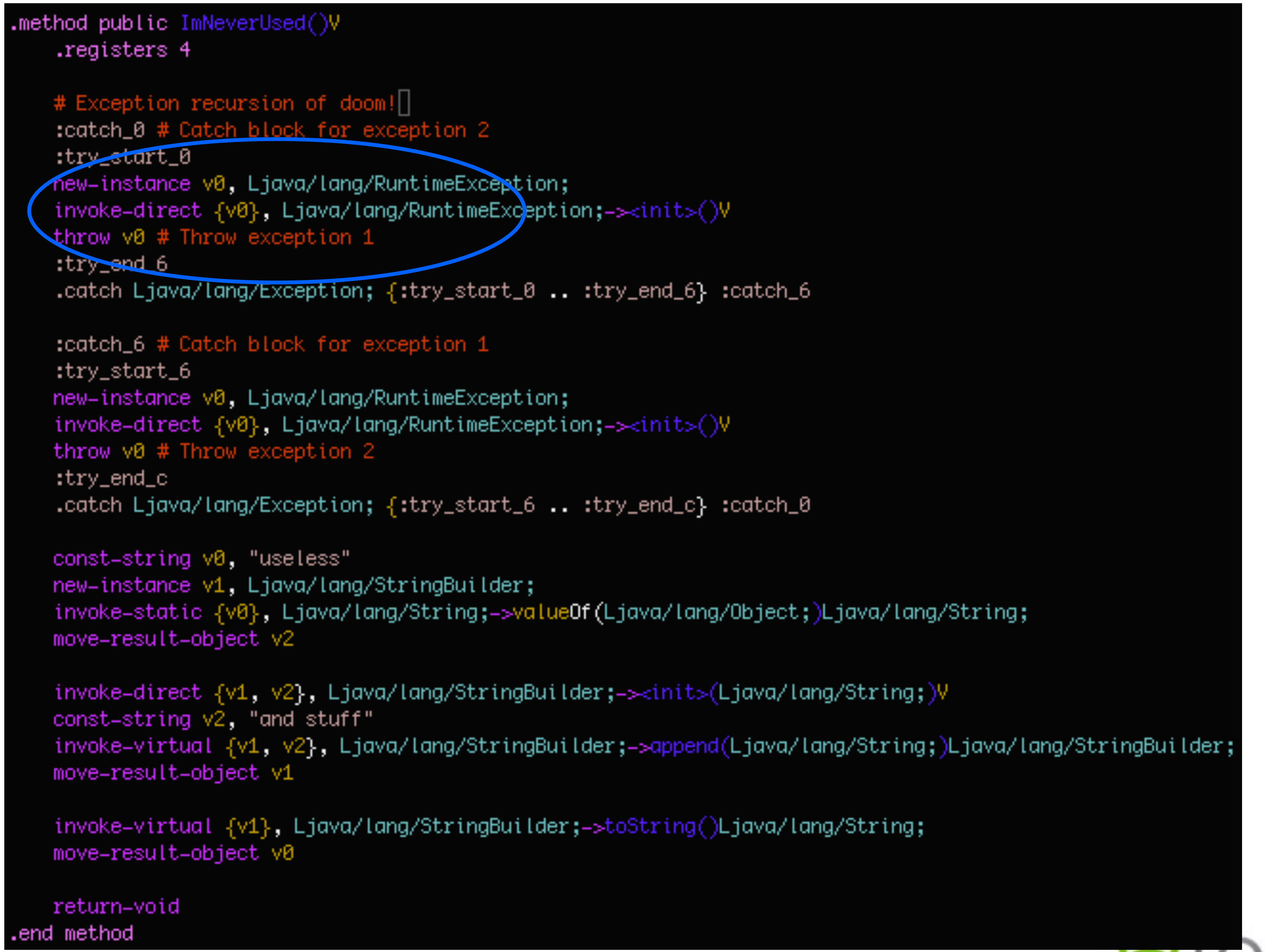
Adventures in Anti-Analysis: Fighting the Decompilers

- More exceptional fun! (example lifted from JF)



```
.method public ImNeverUsed()V
    .registers 4

    # Exception recursion of doom!
    :catch_0 # Catch block for exception 2
    :try_start_0
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 1
    :try_end_6
    .catch Ljava/lang/Exception; {:try_start_0 .. :try_end_6} :catch_6

    :catch_6 # Catch block for exception 1
    :try_start_6
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 2
    :try_end_c
    .catch Ljava/lang/Exception; {:try_start_6 .. :try_end_c} :catch_0

    const-string v0, "useless"
    new-instance v1, Ljava/lang/StringBuilder;
    invoke-static {v0}, Ljava/lang/String;->valueOf(Ljava/lang/Object;)Ljava/lang/String;
    move-result-object v2

    invoke-direct {v1, v2}, Ljava/lang/StringBuilder;-><init>(Ljava/lang/String;)V
    const-string v2, "and stuff"
    invoke-virtual {v1, v2}, Ljava/lang/StringBuilder;->append(Ljava/lang/String;)Ljava/lang/StringBuilder;
    move-result-object v1

    invoke-virtual {v1}, Ljava/lang/StringBuilder;->toString()Ljava/lang/String;
    move-result-object v0

    return-void
.end method
```

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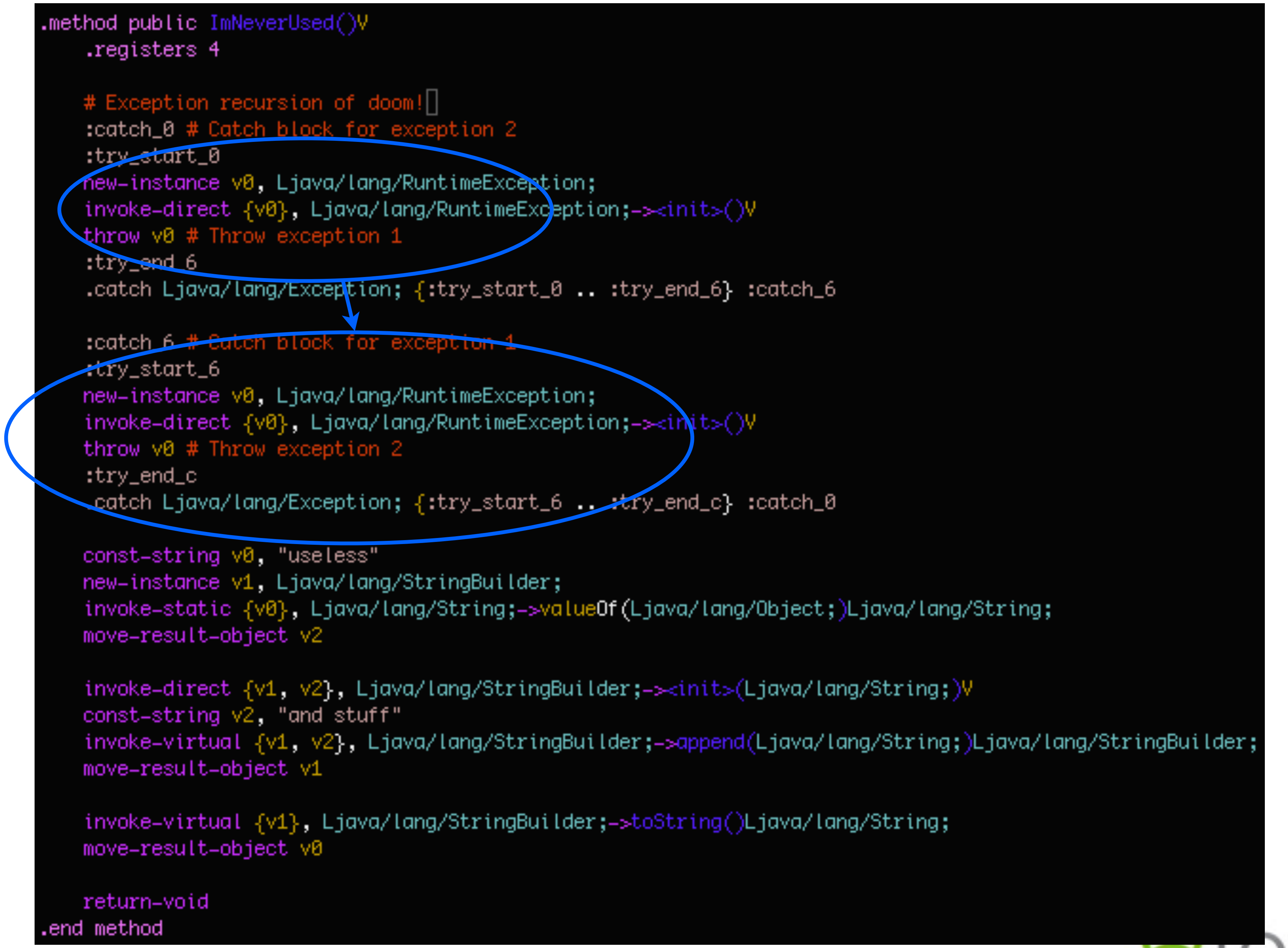
Adventures in Anti-Analysis: Fighting the Decompilers

- More exceptional fun! (example lifted from JF)



```
.method public ImNeverUsed()V
    .registers 4

    # Exception recursion of doom!
    :catch_0 # Catch block for exception 2
    :try_start_0
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 1
    :try_end_6
    .catch Ljava/lang/Exception; {:try_start_0 .. :try_end_6} :catch_6

    :catch_6 # Catch block for exception 1
    :try_start_6
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 2
    :try_end_c
    .catch Ljava/lang/Exception; {:try_start_6 .. :try_end_c} :catch_0

    const-string v0, "useless"
    new-instance v1, Ljava/lang/StringBuilder;
    invoke-static {v0}, Ljava/lang/String;->valueOf(Ljava/lang/Object;)Ljava/lang/String;
    move-result-object v2

    invoke-direct {v1, v2}, Ljava/lang/StringBuilder;-><init>(Ljava/lang/String;)V
    const-string v2, "and stuff"
    invoke-virtual {v1, v2}, Ljava/lang/StringBuilder;->append(Ljava/lang/String;)Ljava/lang/StringBuilder;
    move-result-object v1

    invoke-virtual {v1}, Ljava/lang/StringBuilder;->toString()Ljava/lang/String;
    move-result-object v0

    return-void
.end method
```

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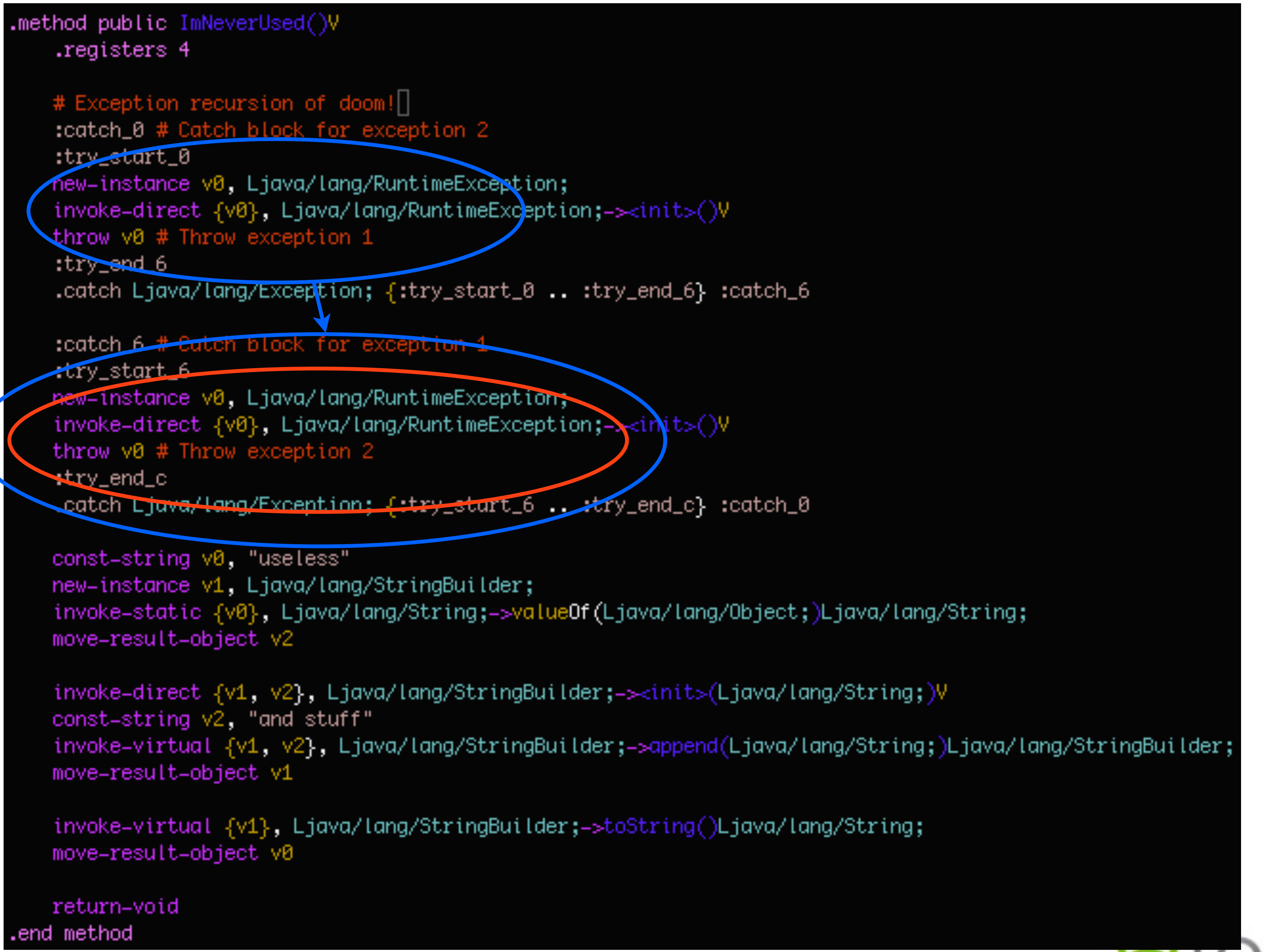
Adventures in Anti-Analysis: Fighting the Decompilers

- More exceptional fun! (example lifted from JF)



```
.method public ImNeverUsed()V
    .registers 4

    # Exception recursion of doom!
    :catch_0 # Catch block for exception 2
    :try_start_0
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 1
    :try_end_6
    .catch Ljava/lang/Exception; {:try_start_0 .. :try_end_6} :catch_6

    :catch_6 # Catch block for exception 1
    :try_start_6
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 2
    :try_end_c
    .catch Ljava/lang/Exception; {:try_start_6 .. :try_end_c} :catch_0

    const-string v0, "useless"
    new-instance v1, Ljava/lang/StringBuilder;
    invoke-static {v0}, Ljava/lang/String;->valueOf(Ljava/lang/Object;)Ljava/lang/String;
    move-result-object v2

    invoke-direct {v1, v2}, Ljava/lang/StringBuilder;-><init>(Ljava/lang/String;)V
    const-string v2, "and stuff"
    invoke-virtual {v1, v2}, Ljava/lang/StringBuilder;->append(Ljava/lang/String;)Ljava/lang/StringBuilder;
    move-result-object v1

    invoke-virtual {v1}, Ljava/lang/StringBuilder;->toString()Ljava/lang/String;
    move-result-object v0

    return-void
.end method
```

Adventures in Anti-Analysis: Fighting the Decompilers

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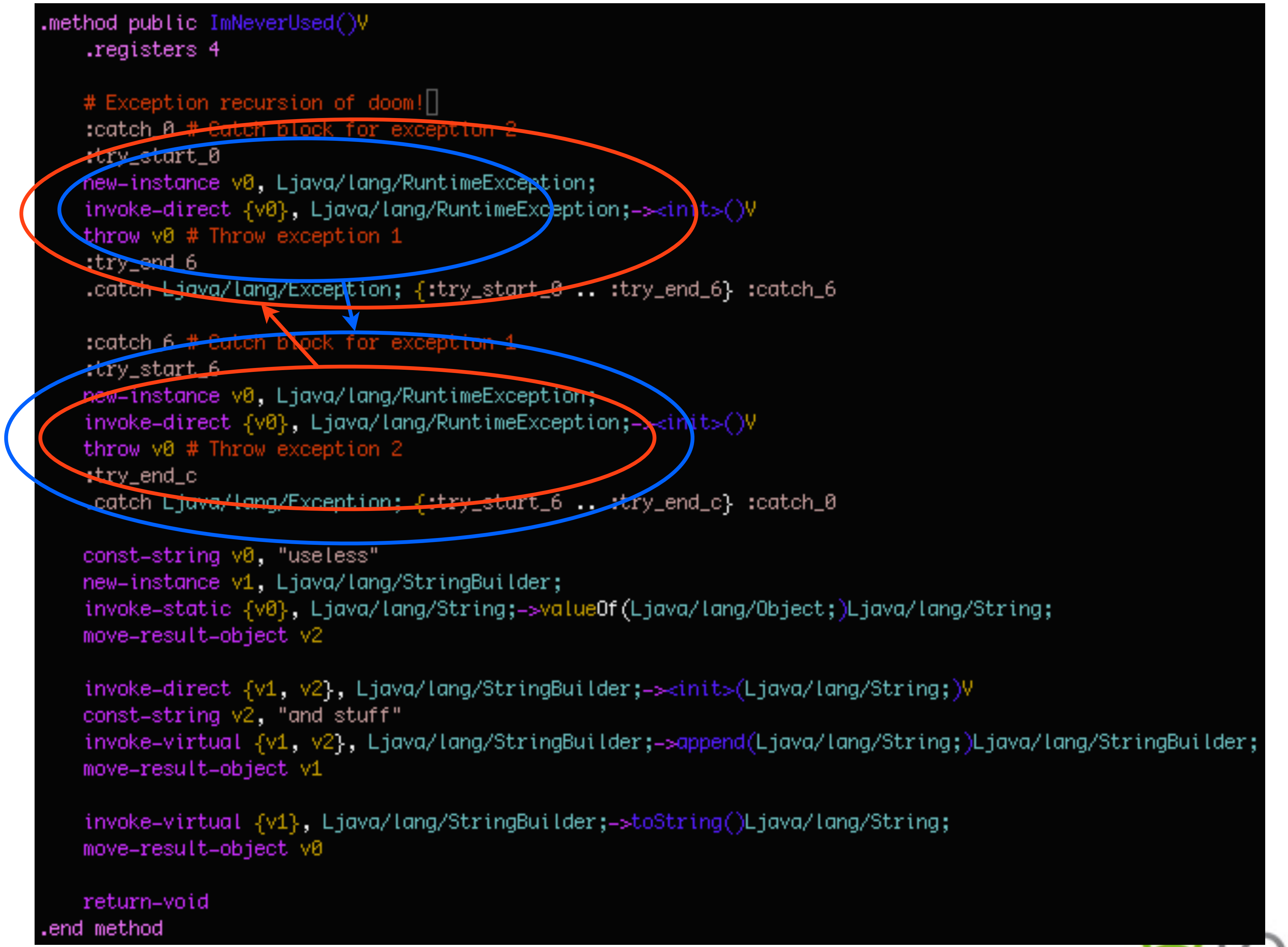

```
.method public ImNeverUsed()V
    .registers 4

    # Exception recursion of doom!
    :catch_0 # Catch block for exception 2
    :try_start_0
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 1
    :try_end_6
    .catch Ljava/lang/Exception; {:try_start_0 .. :try_end_6} :catch_6

    :catch_6 # Catch block for exception 1
    :try_start_6
    new-instance v0, Ljava/lang/RuntimeException;
    invoke-direct {v0}, Ljava/lang/RuntimeException;-><init>()V
    throw v0 # Throw exception 2
    :try_end_c
    .catch Ljava/lang/Exception; {:try_start_6 .. :try_end_c} :catch_0

    const-string v0, "useless"
    new-instance v1, Ljava/lang/StringBuilder;
    invoke-static {v0}, Ljava/lang/String;->valueOf(Ljava/lang/Object;)Ljava/lang/String;
    move-result-object v2

    invoke-direct {v1, v2}, Ljava/lang/StringBuilder;-><init>(Ljava/lang/String;)V
    const-string v2, "and stuff"
    invoke-virtual {v1, v2}, Ljava/lang/StringBuilder;->append(Ljava/lang/String;)Ljava/lang/StringBuilder;
    move-result-object v1

    invoke-virtual {v1}, Ljava/lang/StringBuilder;->toString()Ljava/lang/String;
    move-result-object v0

    return-void
.end method
```

Adventures in Anti-Analysis: Fighting the Decompilers

- This is clearly not valid code, impossible to write in java
- This *is* valid dalvik code - not something you want to run though
- However if this is gated is "dead code", it's legitimate to have inside a class
- Results of this are fun!

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Adventures in Anti-Analysis: Fighting the Decompilers

```
champagne:recursive-exceptions tstrazzere$ jad Unused.class
Parsing Unused.class... Generating Unused.jad
Couldn't fully decompile method ImNeverUsed
Couldn't resolve all exception handlers in method ImNeverUsed
champagne: recursive-exceptions tstrazzere$ cat Unused.jad
// Decompiled by Jad v1.5.8g. Copyright 2001 Pavel Kouznetsov.
// Jad home page: http://www.kpdus.com/jad.html
// Decompiler options: packimports(3)

package dont.decompile.me;

public class Unused
{

    public Unused()
    {
    }

    public void ImNeverUsed()
    {
        JVM INSTR pop ;
        throw new RuntimeException();
        throw new RuntimeException();
    }
}
```

- JAD, check!

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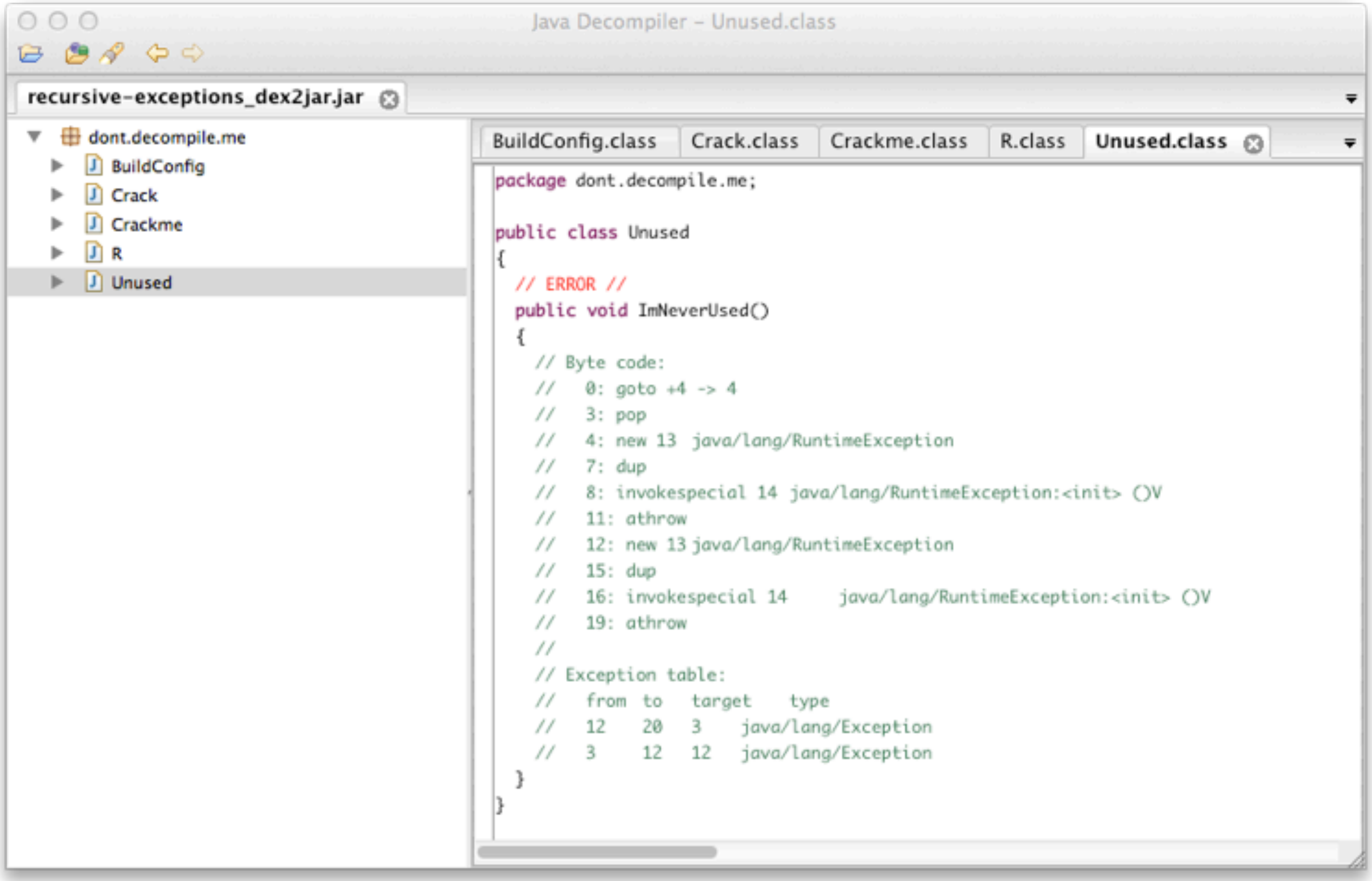
Adventures in Anti-Analysis: Fighting the Decompilers



```
package dont.decompile.me;

public class Unused
{
  // ERROR //
  public void ImNeverUsed()
  {
    // Byte code:
    //   0: goto +4 -> 4
    //   3: pop
    //   4: new 13  java/lang/RuntimeException
    //   7: dup
    //   8: invokespecial 14  java/lang/RuntimeException:<init> ()V
    //   11: athrow
    //   12: new 13 java/lang/RuntimeException
    //   15: dup
    //   16: invokespecial 14     java/lang/RuntimeException:<init> ()V
    //   19: athrow
    //
    // Exception table:
    //   from  to   target    type
    //   12    20   3     java/lang/Exception
    //   3     12   12    java/lang/Exception
  }
}
```

- JD-Gui, check!

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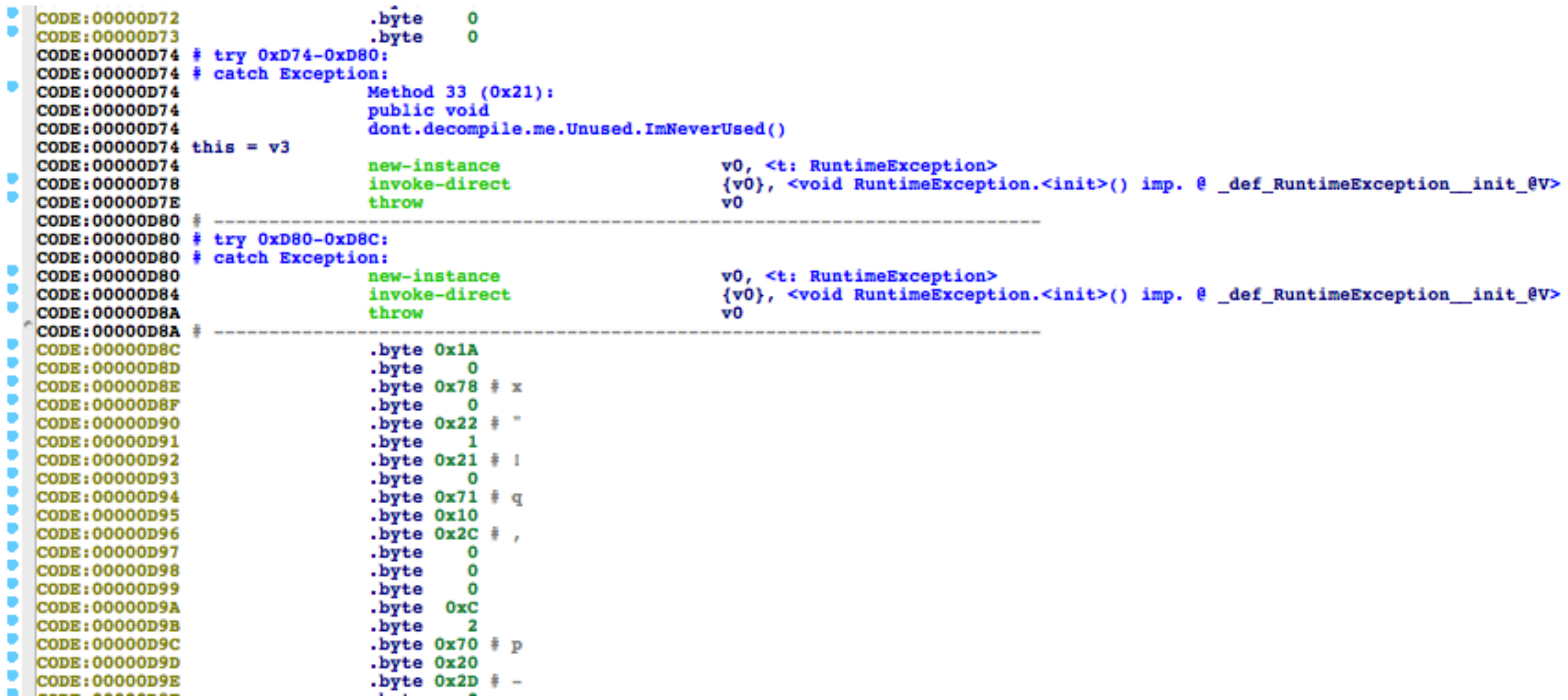
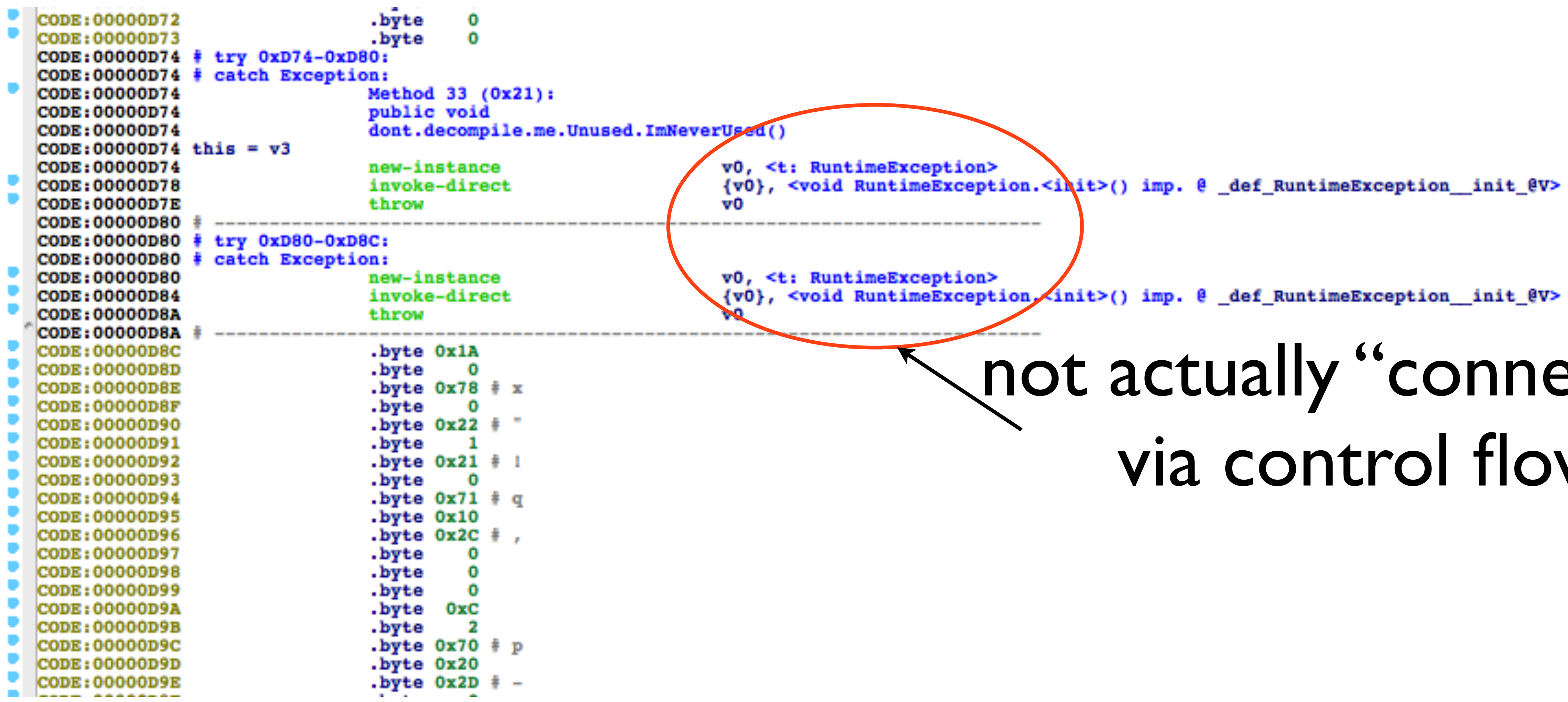
Adventures in Anti-Analysis: Fighting the Decompilers



```
CODE:00000D72                        .byte    0
CODE:00000D73                        .byte    0
CODE:00000D74 # try 0xD74-0xD80:
CODE:00000D74 # catch Exception:
CODE:00000D74                        Method 33 (0x21):
CODE:00000D74                        public void
CODE:00000D74                        dont.decompile.me.Unused.ImNeverUsed()
CODE:00000D74 this = v3
CODE:00000D74                        new-instance                   v0, <t: RuntimeException>
CODE:00000D78                        invoke-direct                  {v0}, <void RuntimeException.<init>() imp. @ _def_RuntimeException__init_@V>
CODE:00000D7E                        throw                          v0
CODE:00000D80 # ---------------------------------------------------------------------------
CODE:00000D80 # try 0xD80-0xD8C:
CODE:00000D80 # catch Exception:
CODE:00000D80                        new-instance                   v0, <t: RuntimeException>
CODE:00000D84                        invoke-direct                  {v0}, <void RuntimeException.<init>() imp. @ _def_RuntimeException__init_@V>
CODE:00000D8A                        throw                          v0
CODE:00000D8A # ---------------------------------------------------------------------------
CODE:00000D8C                        .byte 0x1A
CODE:00000D8D                        .byte    0
CODE:00000D8E                        .byte 0x78 # x
CODE:00000D8F                        .byte    0
CODE:00000D90                        .byte 0x22 # "
CODE:00000D91                        .byte    1
CODE:00000D92                        .byte 0x21 # !
CODE:00000D93                        .byte    0
CODE:00000D94                        .byte 0x71 # q
CODE:00000D95                        .byte 0x10
CODE:00000D96                        .byte 0x2C # ,
CODE:00000D97                        .byte    0
CODE:00000D98                        .byte    0
CODE:00000D99                        .byte    0
CODE:00000D9A                        .byte  0xC
CODE:00000D9B                        .byte    2
CODE:00000D9C                        .byte 0x70 # p
CODE:00000D9D                        .byte 0x20
CODE:00000D9E                        .byte 0x2D # -
```

- IDA Pro - check!

Adventures in Anti-Analysis: Fighting the Decompilers



```
CODE:00000D72                    .byte    0
CODE:00000D73                    .byte    0
CODE:00000D74 # try 0xD74-0xD80:
CODE:00000D74 # catch Exception:
CODE:00000D74                    Method 33 (0x21):
CODE:00000D74                    public void
CODE:00000D74                    dont.decompile.me.Unused.ImNeverUsed()
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CODE:00000D74                    new-instance                v0, <t: RuntimeException>
CODE:00000D78                    invoke-direct               {v0}, <void RuntimeException.<init>() imp. @ _def_RuntimeException__init_@V>
CODE:00000D7E                    throw                       v0
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CODE:00000D80 # try 0xD80-0xD8C:
CODE:00000D80 # catch Exception:
CODE:00000D80                    new-instance                v0, <t: RuntimeException>
CODE:00000D84                    invoke-direct               {v0}, <void RuntimeException.<init>() imp. @ _def_RuntimeException__init_@V>
CODE:00000D8A                    throw                       v0
CODE:00000D8A # ------------------------------------------------------------------------
CODE:00000D8C                    .byte 0x1A
CODE:00000D8D                    .byte    0
CODE:00000D8E                    .byte 0x78 # x
CODE:00000D8F                    .byte    0
CODE:00000D90                    .byte 0x22 # "
CODE:00000D91                    .byte    1
CODE:00000D92                    .byte 0x21 # !
CODE:00000D93                    .byte    0
CODE:00000D94                    .byte 0x71 # q
CODE:00000D95                    .byte 0x10
CODE:00000D96                    .byte 0x2C # ,
CODE:00000D97                    .byte    0
CODE:00000D98                    .byte    0
CODE:00000D99                    .byte    0
CODE:00000D9A                    .byte  0xC
CODE:00000D9B                    .byte    2
CODE:00000D9C                    .byte 0x70 # p
CODE:00000D9D                    .byte 0x20
CODE:00000D9E                    .byte 0x2D # -
```

not actually "connected" via control flow

- Control flow garbage FTW!

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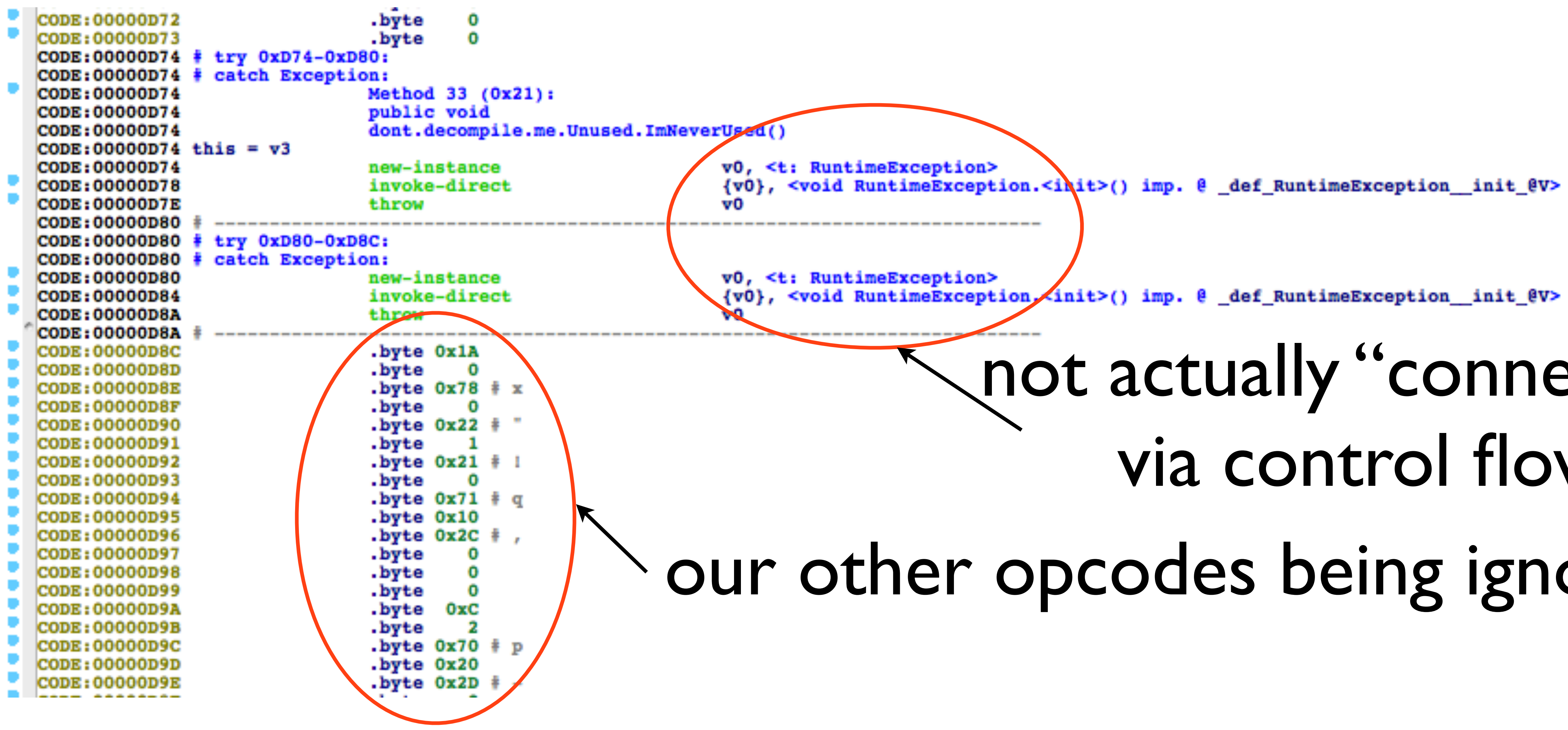
Thursday, July 26, 12

Adventures in Anti-Analysis: Fighting the Decompilers



```
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CODE:00000D74 # try 0xD74-0xD80:
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CODE:00000D80                          new-instance                    v0, <t: RuntimeException>
CODE:00000D84                          invoke-direct                   {v0}, <void RuntimeException.<init>() imp. @ _def_RuntimeException__init_@V>
CODE:00000D8A                          throw                           v0
CODE:00000D8A # ---------------------------------------------------------------------------
CODE:00000D8C                          .byte 0x1A
CODE:00000D8D                          .byte    0
CODE:00000D8E                          .byte 0x78 # x
CODE:00000D8F                          .byte    0
CODE:00000D90                          .byte 0x22 # "
CODE:00000D91                          .byte    1
CODE:00000D92                          .byte 0x21 # !
CODE:00000D93                          .byte    0
CODE:00000D94                          .byte 0x71 # q
CODE:00000D95                          .byte 0x10
CODE:00000D96                          .byte 0x2C # ,
CODE:00000D97                          .byte    0
CODE:00000D98                          .byte    0
CODE:00000D99                          .byte    0
CODE:00000D9A                          .byte  0xC
CODE:00000D9B                          .byte    2
CODE:00000D9C                          .byte 0x70 # p
CODE:00000D9D                          .byte 0x20
CODE:00000D9E                          .byte 0x2D # -
```

not actually "connected" via control flow

our other opcodes being ignored

- Confused as to what's going on after the exceptions

Adventures in Anti-Analysis: Fighting the Decompilers

- Harder to detect automatically (could use pattern matching?)
- Might not matter for automated tools (???)
- Just makes it a pain for people using these tools manually to reverse (could be a big win depending on your goal)

Adventures in Anti-Analysis: Slightly Newer School

- We saw baksmali died on the LinkLocked section
- Anything else a quick win like that?

Adventures in Anti-Analysis: Slightly Newer School

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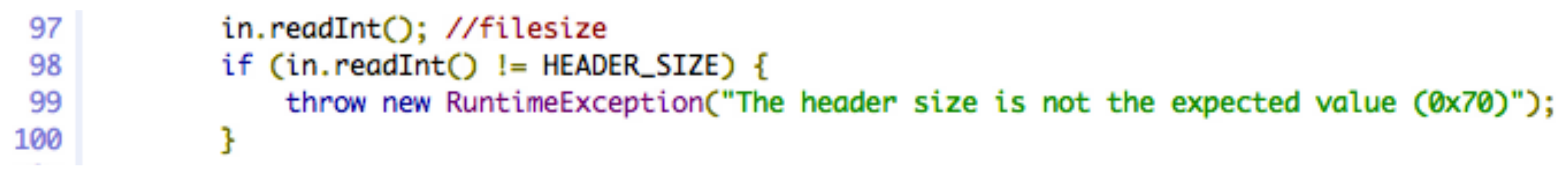

```
        in.readInt(); //filesize
        if (in.readInt() != HEADER_SIZE) {
            throw new RuntimeException("The header size is not the expected value (0x70)");
        }
```

- Header size is open for a quick attack!

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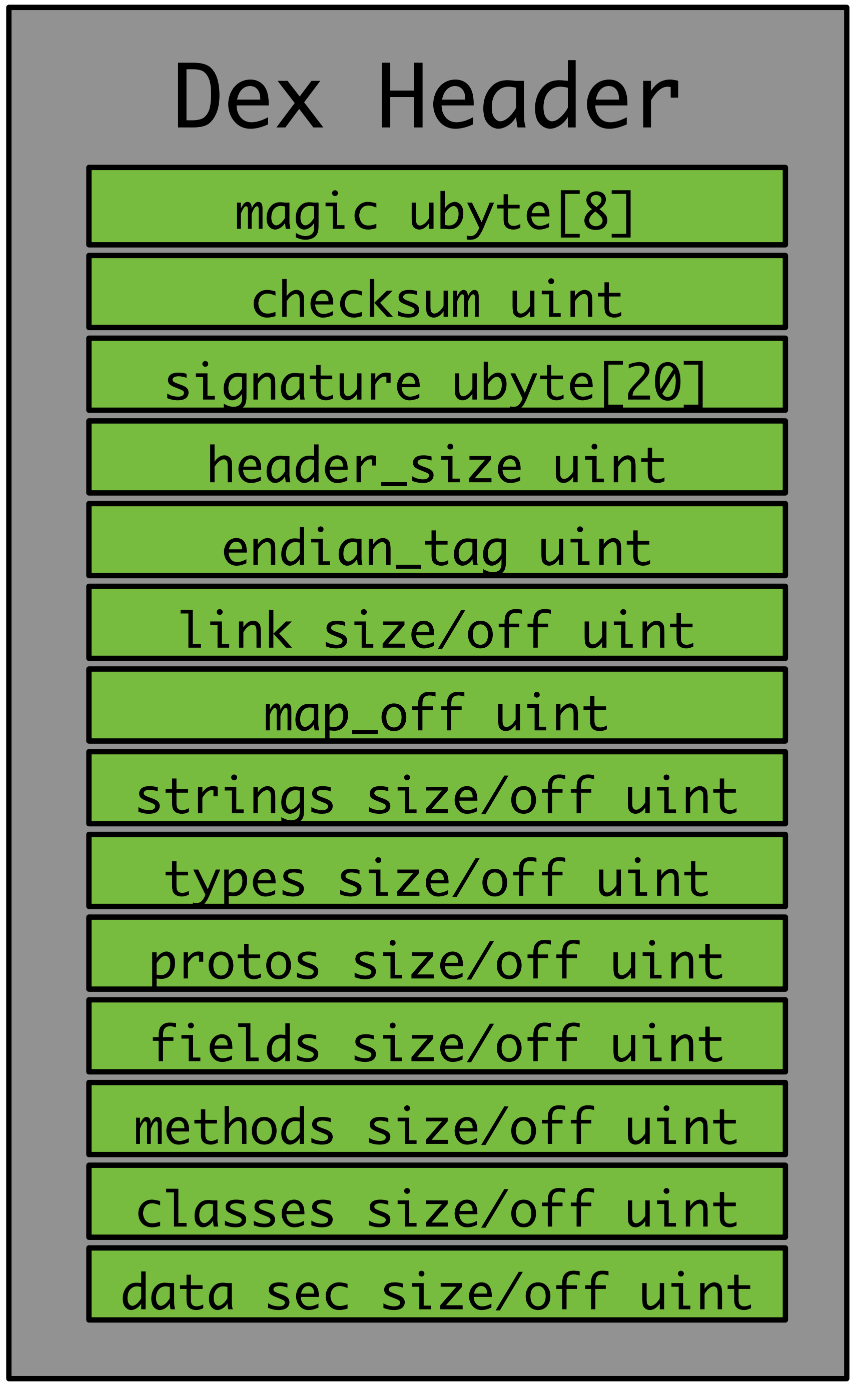
Adventures in Anti-Analysis: Slightly Newer School



- header_size is what we want
- Always currently 0x70 (112)
- Usage is for forward/backward compatibility
- Side effects: causes the verifier to skip over non-null bytes that are "inside" the header

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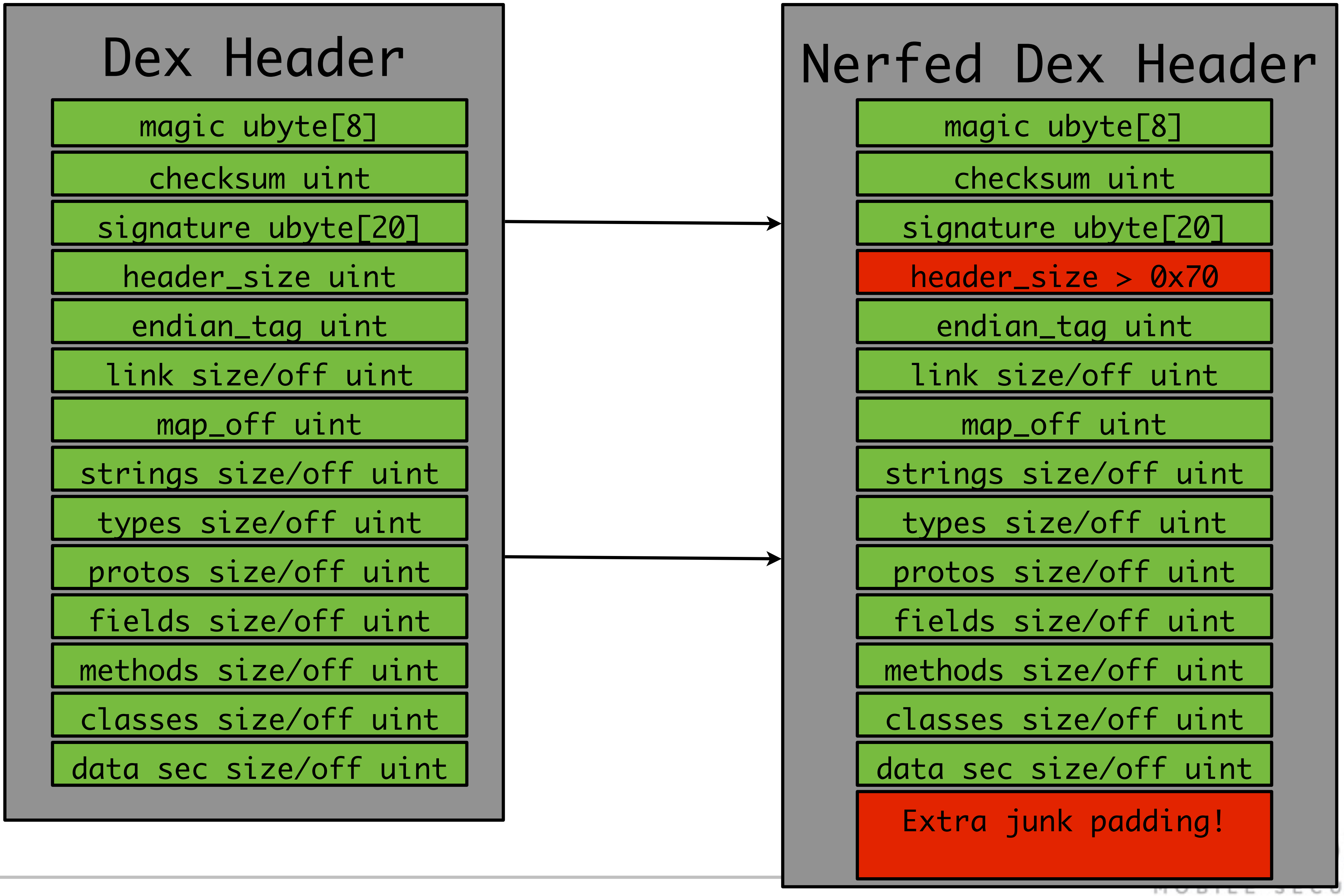
Adventures in Anti-Analysis: Slightly Newer School



Adventures in Anti-Analysis: Slightly Newer School

- Should be easy to implement
- Fix all the offsets in the header and it will be done

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Adventures in Anti-Analysis: Slightly Newer School

- Should be easy to implement
- Fix all the offsets in the header and it will be done

NOPE

Adventures in Anti-Analysis: Slightly Newer School

- ~~Should be easy to implement~~
- Fix all the offsets in the header ~~and it will be done~~
- Fix all the offsets inside every other structure, otherwise all items will be aligned

  i.e. - process every table and item linked in that table :\

  (PoC tool went from 100 lines to 2000+)

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Adventures in Anti-Analysis: Slightly Newer School

- Fast forward to many hours later.... It works! But only against baksmali;

```
champagne:apkfuscator tstrazzere$ hexdump -C such_a_big_ego.dex | head
00000000  64 65 78 0a 30 33 35 00  a5 26 6f 22 c8 85 fc 5c  |dex.035..&o"...\|
00000010  83 be 45 21 d2 5c b9 9f  52 6a 0a 34 dc 55 19 f2  |..E!.\..Rj.4.U..|
00000020  71 19 00 00 78 00 00 00  78 56 34 12 00 00 00 00  |q...x...xV4.....|
00000030  00 00 00 00 18 08 00 00  8d 00 00 00 78 00 00 00  |............x...|
00000040  27 00 00 00 ac 02 00 00  1c 00 00 00 48 03 00 00  |'...........H...|
00000050  14 00 00 00 98 04 00 00  30 00 00 00 38 05 00 00  |........0...8...|
00000060  0b 00 00 00 b8 06 00 00  59 11 00 00 18 08 00 00  |........Y.......|
00000070  00 00 00 00 00 00 00 00  dc 08 00 00 df 08 00 00  |................|

champagne:apkfuscator tstrazzere$ baksmali such_a_big_ego.dex -o wontwork
UNEXPECTED TOP-LEVEL EXCEPTION:
org.jf.dexlib.Util.ExceptionWithContext: The header size is not the expected value (0x70)
        at org.jf.dexlib.Util.ExceptionWithContext.withContext(ExceptionWithContext.java:54)
        at org.jf.dexlib.Item.addExceptionContext(Item.java:176)
        at org.jf.dexlib.Item.readFrom(Item.java:78)
        at org.jf.dexlib.DexFile.<init>(DexFile.java:390)
        at org.jf.baksmali.main.main(main.java:265)
Caused by: java.lang.RuntimeException: The header size is not the expected value (0x70)
        at org.jf.dexlib.HeaderItem.readItem(HeaderItem.java:92)
        at org.jf.dexlib.Item.readFrom(Item.java:76)
        ... 2 more
header_item
```

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Adventures in Anti-Analysis: Slightly Newer School

- Great, but that is an easy fix, so what?
- Well, think of the possibilities this is data loaded into memory / dalvik-cache
- Hide data / resources inside the bloated header
- Hide a DEX file and load at runtime!

A dex inside a dex? Think of all the memes...

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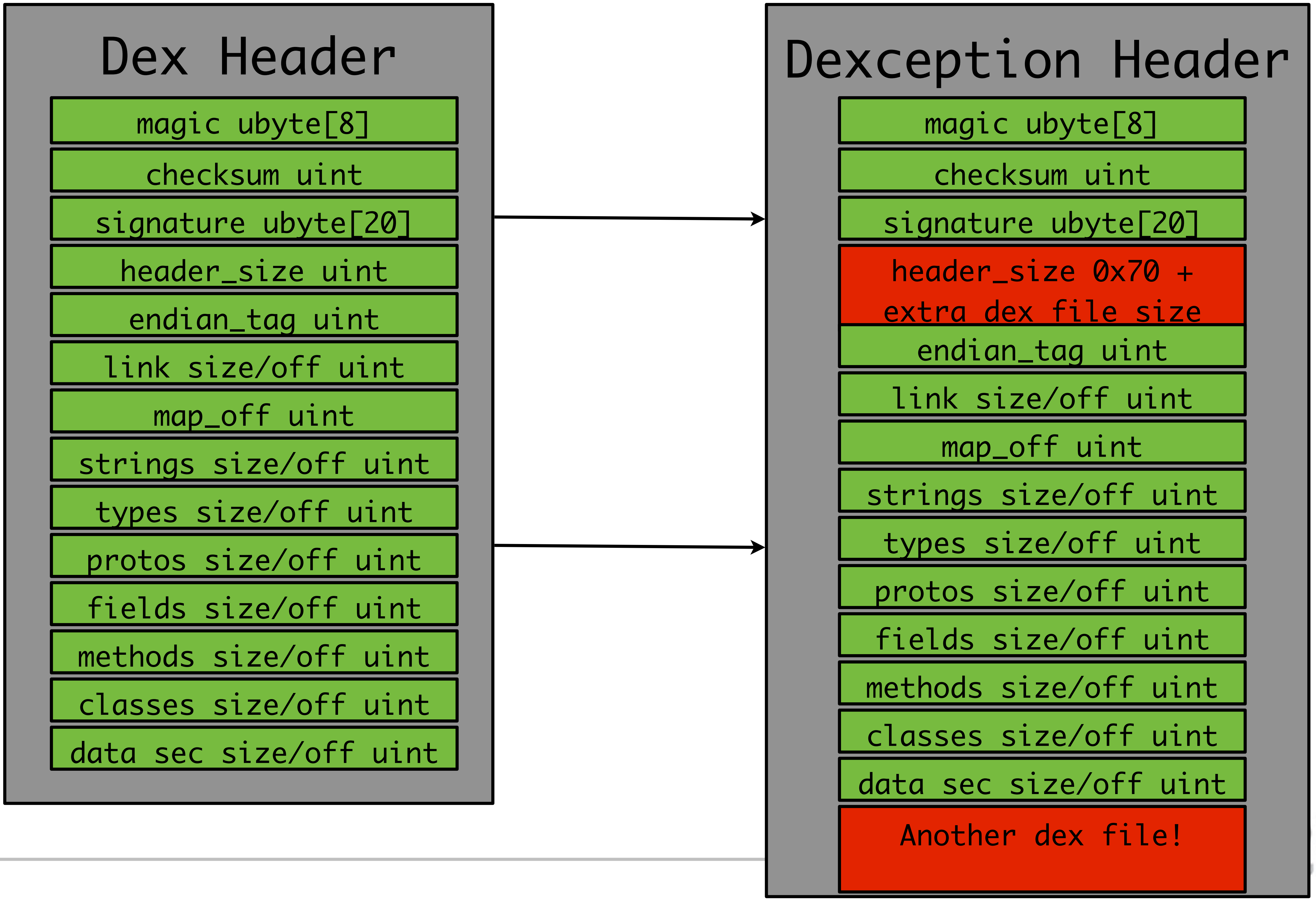
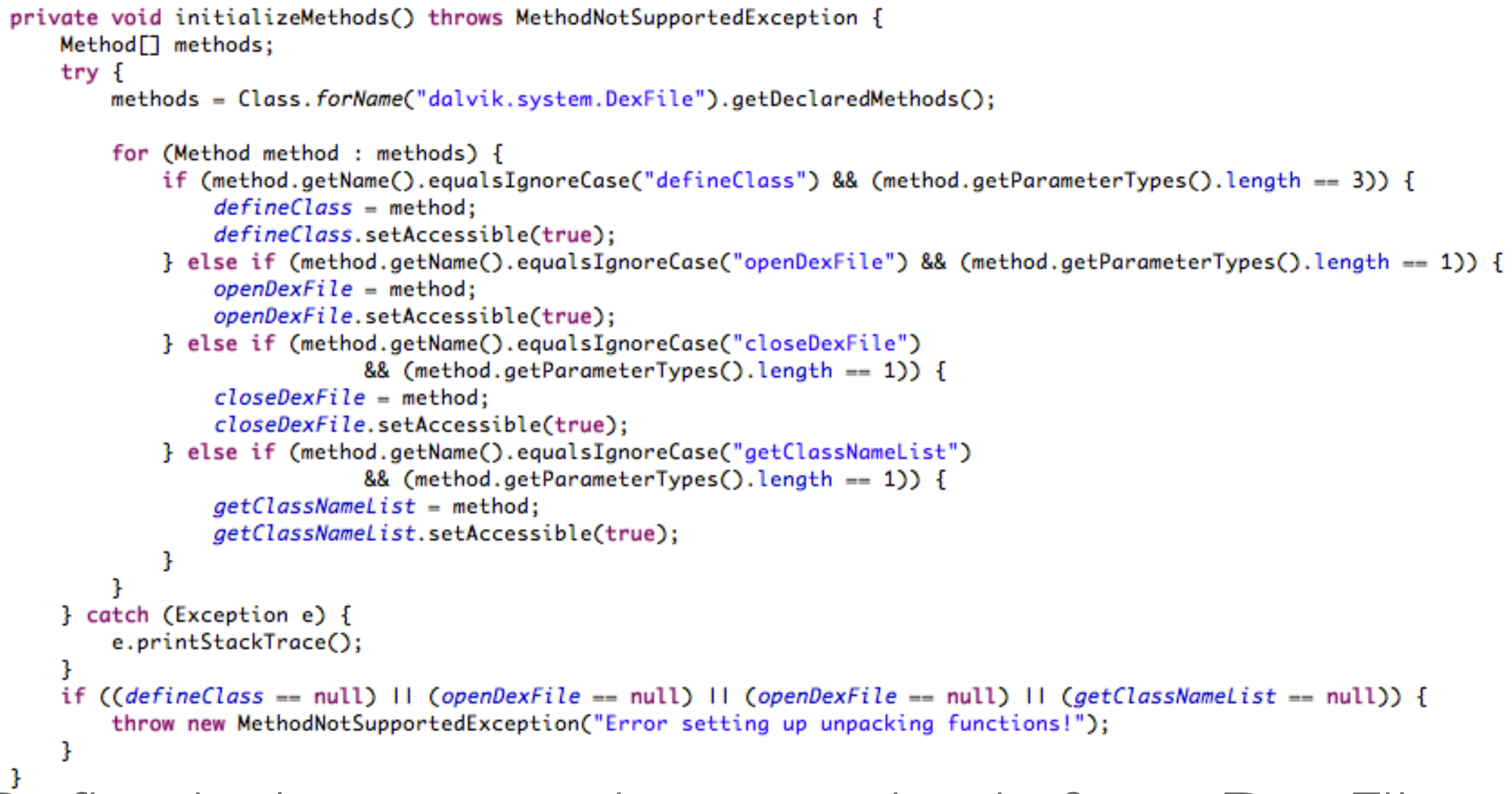
Adventures in Anti-Analysis: Dexception



Adventures in Anti-Analysis: Dexception



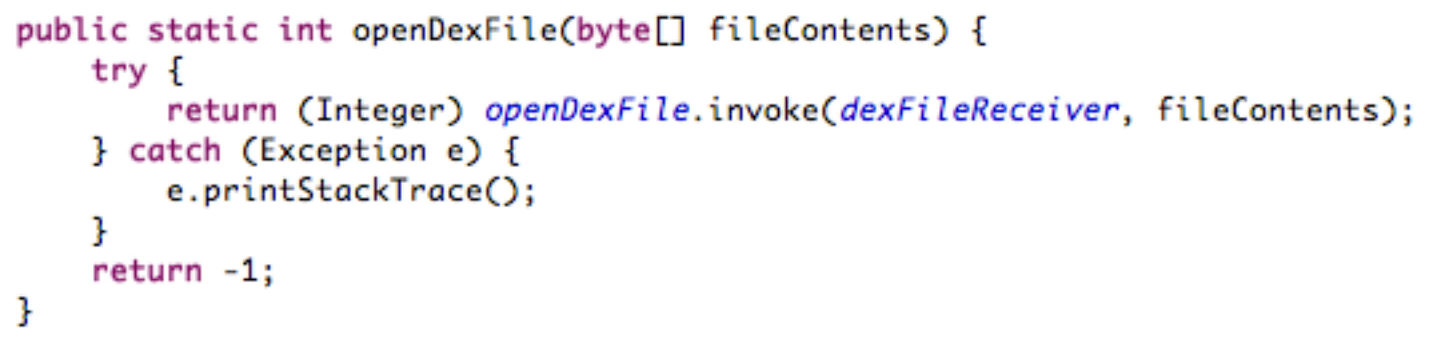
```
private void initializeMethods() throws MethodNotSupportedException {
    Method[] methods;
    try {
        methods = Class.forName("dalvik.system.DexFile").getDeclaredMethods();

        for (Method method : methods) {
            if (method.getName().equalsIgnoreCase("defineClass") && (method.getParameterTypes().length == 3)) {
                defineClass = method;
                defineClass.setAccessible(true);
            } else if (method.getName().equalsIgnoreCase("openDexFile") && (method.getParameterTypes().length == 1)) {
                openDexFile = method;
                openDexFile.setAccessible(true);
            } else if (method.getName().equalsIgnoreCase("closeDexFile")
                                && (method.getParameterTypes().length == 1)) {
                closeDexFile = method;
                closeDexFile.setAccessible(true);
            } else if (method.getName().equalsIgnoreCase("getClassNameList")
                                && (method.getParameterTypes().length == 1)) {
                getClassNameList = method;
                getClassNameList.setAccessible(true);
            }
        }
    } catch (Exception e) {
        e.printStackTrace();
    }
    if ((defineClass == null) || (openDexFile == null) || (openDexFile == null) || (getClassNameList == null)) {
        throw new MethodNotSupportedException("Error setting up unpacking functions!");
    }
}
```

- Reflectively access private methods from DexFile (ICS/JBean only for methods I wanted)

Adventures in Anti-Analysis: Dexception

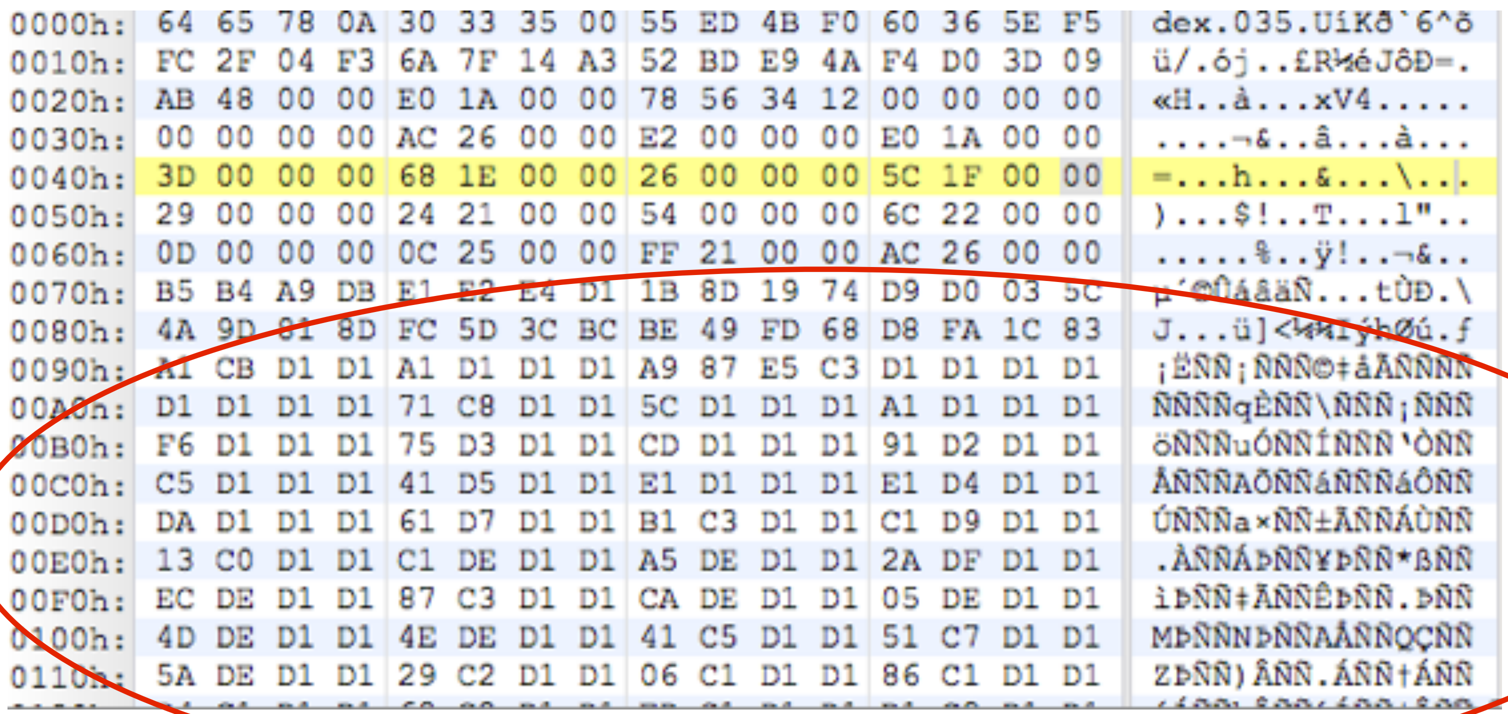
- The best method is actually openDexFile



```java
public static int openDexFile(byte[] fileContents) {
    try {
        return (Integer) openDexFile.invoke(dexFileReceiver, fileContents);
    } catch (Exception e) {
        e.printStackTrace();
    }
    return -1;
}
```

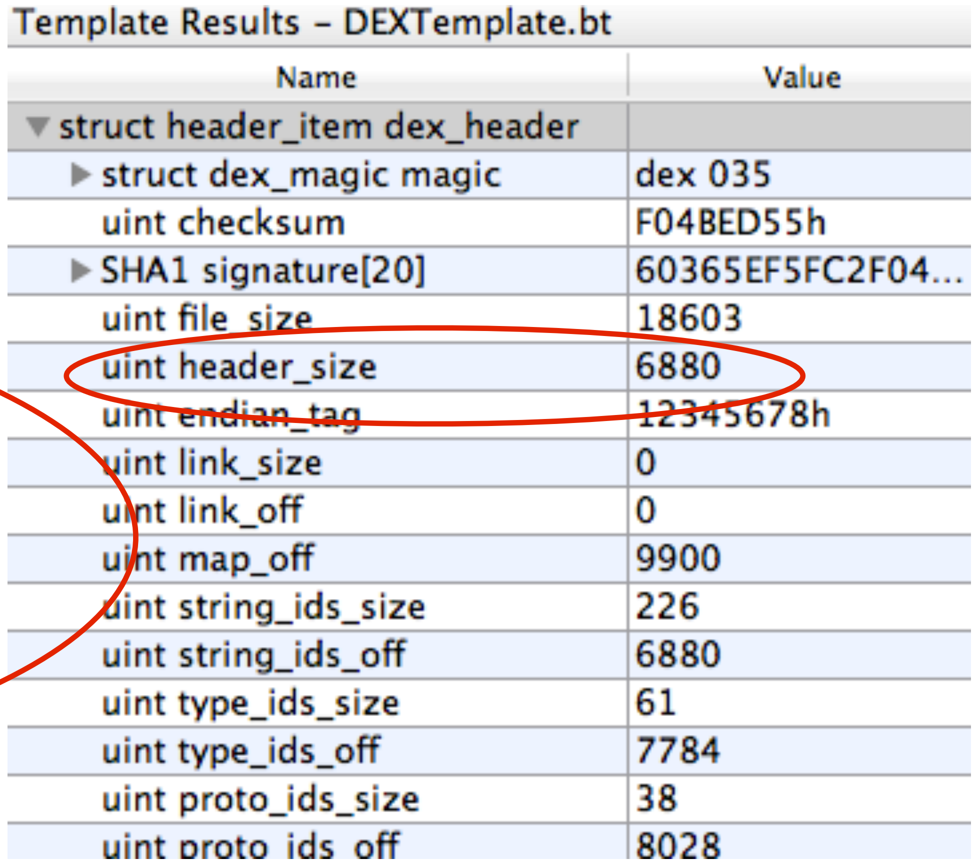
- This allows us to open a dex file from a byte[]
- Read the dex from publicSourceDir / Apps memory / dalvik-cache -- where ever
- Yay! We just created a packer/encryptor!

Adventures in Anti-Analysis: Dexception



```
0000h: 64 65 78 0A 30 33 35 00 55 ED 4B F0 60 36 5E F5  dex.035.UíKð`6^õ
0010h: FC 2F 04 F3 6A 7F 14 A3 52 BD E9 4A F4 D0 3D 09  ü/.ój..£R½éJôÐ=.
0020h: AB 48 00 00 E0 1A 00 00 78 56 34 12 00 00 00 00  «H..à...xV4.....
0030h: 00 00 00 00 AC 26 00 00 E2 00 00 00 E0 1A 00 00  ....¬&..â...à...
0040h: 3D 00 00 00 68 1E 00 00 26 00 00 00 5C 1F 00 00  =...h...&...\...
0050h: 29 00 00 00 24 21 00 00 54 00 00 00 6C 22 00 00  )...$!..T...l"..
0060h: 0D 00 00 00 0C 25 00 00 FF 21 00 00 AC 26 00 00  .....%..ÿ!..¬&..
0070h: B5 B4 A9 DB E1 E2 E4 D1 1B 8D 19 74 D9 D0 03 5C  µ´©ÛáâäÑ...tÙÐ.\
0080h: 4A 9D 81 8D FC 5D 3C BC BE 49 FD 68 D8 FA 1C 83  J...ü]<¼¾IýhØú.ƒ
0090h: A1 CB D1 D1 A1 D1 D1 D1 A9 87 E5 C3 D1 D1 D1 D1  ¡ËÑÑ¡ÑÑÑ©‡åÃÑÑÑÑ
00A0h: D1 D1 D1 D1 71 C8 D1 D1 5C D1 D1 D1 A1 D1 D1 D1  ÑÑÑÑqÈÑÑ\ÑÑÑ¡ÑÑÑ
00B0h: F6 D1 D1 D1 75 D3 D1 D1 CD D1 D1 D1 91 D2 D1 D1  öÑÑÑuÓÑÑÍÑÑÑ'ÒÑÑ
00C0h: C5 D1 D1 D1 41 D5 D1 D1 E1 D1 D1 D1 E1 D4 D1 D1  ÅÑÑÑAÕÑÑáÑÑÑáÔÑÑ
00D0h: DA D1 D1 D1 61 D7 D1 D1 B1 C3 D1 D1 C1 D9 D1 D1  ÚÑÑÑa×ÑÑ±ÃÑÑÁÙÑÑ
00E0h: 13 C0 D1 D1 C1 DE D1 D1 A5 DE D1 D1 2A DF D1 D1  .ÀÑÑÁÞÑÑ¥ÞÑÑ*ßÑÑ
00F0h: EC DE D1 D1 87 C3 D1 D1 CA DE D1 D1 05 DE D1 D1  ìÞÑÑ‡ÃÑÑÊÞÑÑ.ÞÑÑ
0100h: 4D DE D1 D1 4E DE D1 D1 41 C5 D1 D1 51 C7 D1 D1  MÞÑÑNÞÑÑAÅÑÑQÇÑÑ
0110h: 5A DE D1 D1 29 C2 D1 D1 06 C1 D1 D1 86 C1 D1 D1  ZÞÑÑ)ÂÑÑ.ÁÑÑ†ÁÑÑ
```

- header_size = 6880, win!



Template Results – DEXTemplate.bt

Name	Value
▼ struct header_item dex_header	
▶ struct dex_magic magic	dex 035
uint checksum	F04BED55h
▶ SHA1 signature[20]	60365EF5FC2F04...
uint file_size	18603
uint header_size	6880
uint endian_tag	12345678h
uint link_size	0
uint link_off	0
uint map_off	9900
uint string_ids_size	226
uint string_ids_off	6880
uint type_ids_size	61
uint type_ids_off	7784
uint proto_ids_size	38
uint proto_ids_off	8028

- Ok, maybe just a packer since we only XOR'ed everything with 0xd1...

Adventures in Anti-Analysis: Dexception

- This results in a pretty interesting issue
- Automated analysis tools see a valid dex and process it - though the avoid the hidden dex file
- Requires a special tool / hex editor / manual intervention to rip out the embedded dex file
- Many different options available to embedding files making it harder to automate

Adventures in Anti-Analysis: Dexception

- What if it's encrypted? Even a simple XOR could be hard to automate unpacking each time
- Throw an extra layer on top - zip the dex
- Throw in some native code? Load directly from memory?
- Possibilities are pretty much endless

Adventures in Anti-Analysis: Dexception

- The nice part about this "hiding" technique is ease of detection
- header_size > 0x70 ? alert!
- Maybe you just discovered the first Android KeyLime binary! (probably not)
- Someones definitely doing something weird, should definitely take a look at it

Adventures in Anti-Analysis: Endian Reversal Theory

- None of the current tools implement (maybe IDA does?) Reverse Endian support*
- Dalvik verifier/swapper can detect Reverse Endian dex files and swap it to fit the architecture support on the device
- Swap all bytes to Reverse Endian - break tools, still work on the device!
- Didn't actually implement this technique, but theory is sound (famous last words)

Adventures in Anti-Emulator

- Well covered subject (detecting qemu)
- Check out Jono + Charlie’s Summercon presentation on the Bouncer for good details!
- Only seen recommendations are for changing imei/ phone number/androidId
- Anything we can easily look for as an attacker?
- getprop FTW!

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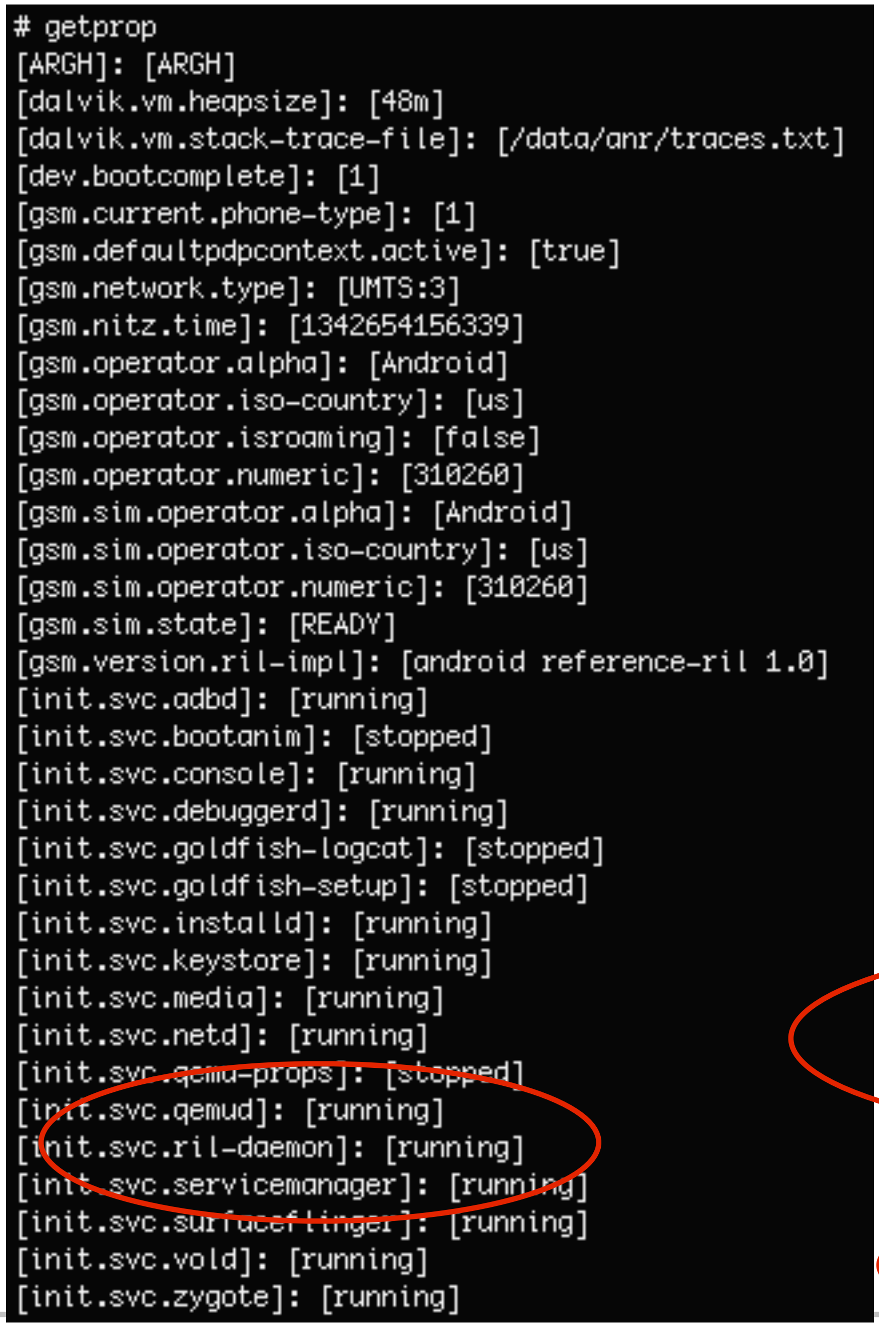
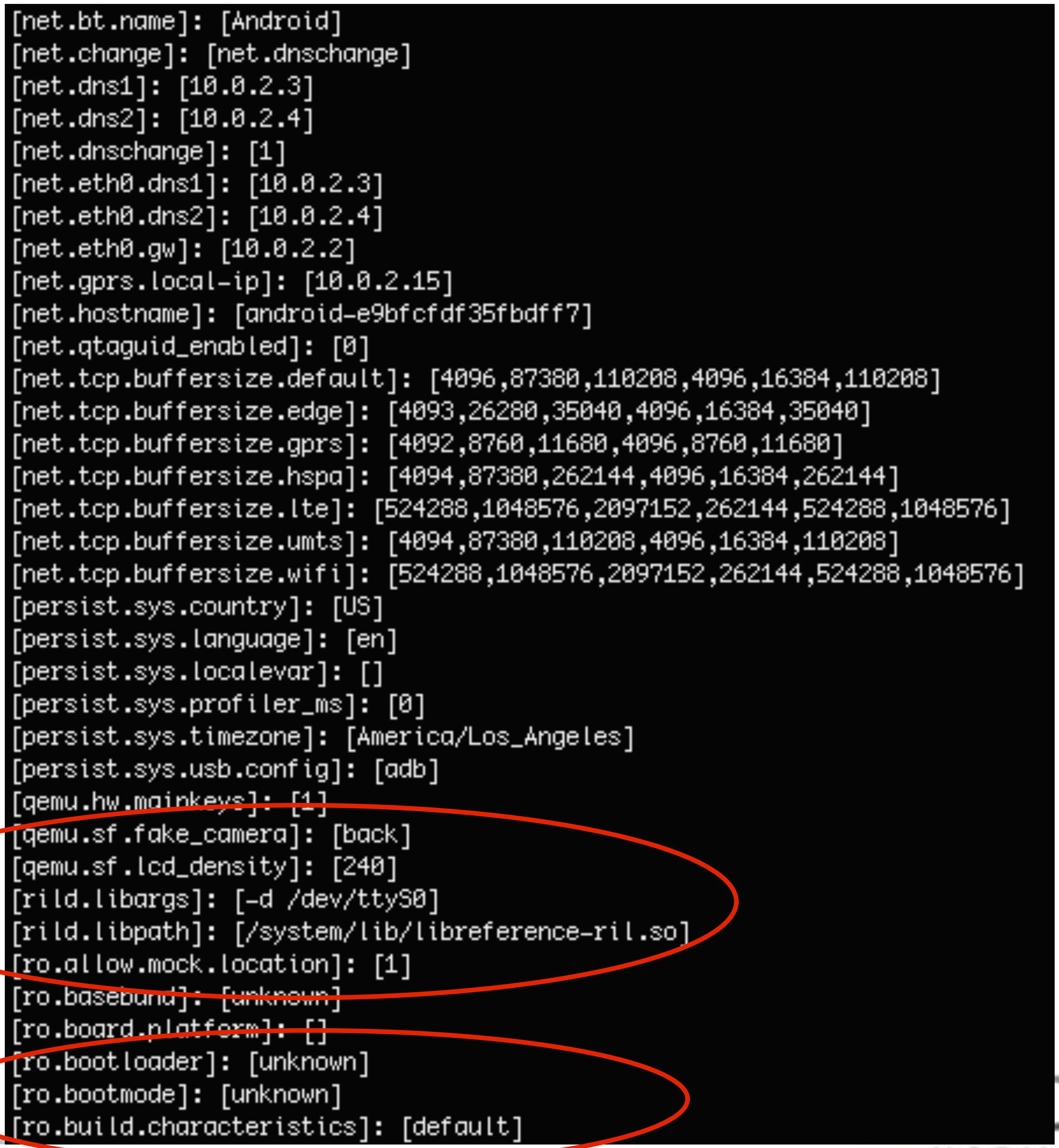
Adventures in Anti-Emulator

- Take your pick -- so many to choose from;



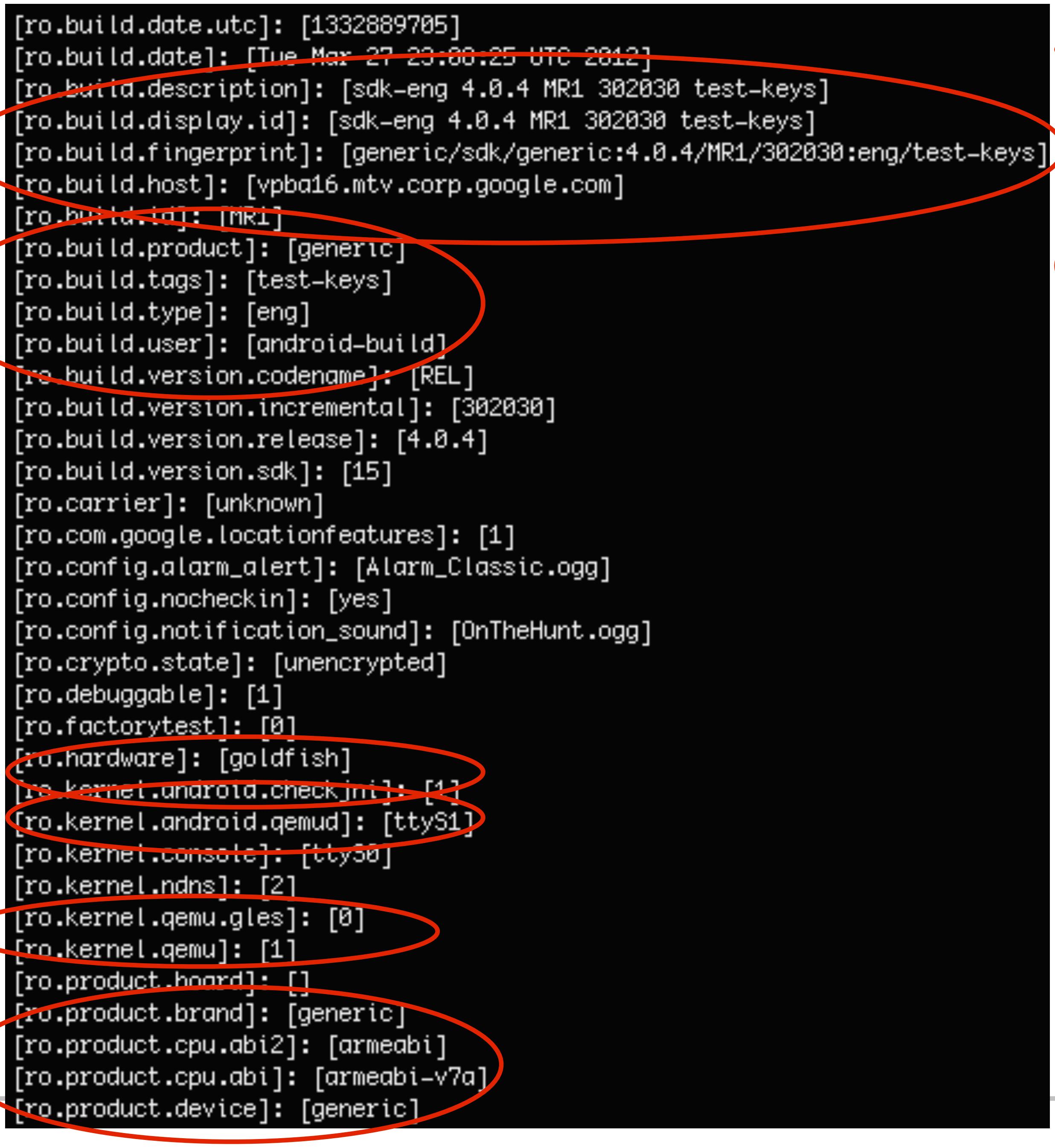
```
# getprop
[ARGH]: [ARGH]
[dalvik.vm.heapsize]: [48m]
[dalvik.vm.stack-trace-file]: [/data/anr/traces.txt]
[dev.bootcomplete]: [1]
[gsm.current.phone-type]: [1]
[gsm.defaultpdpcontext.active]: [true]
[gsm.network.type]: [UMTS:3]
[gsm.nitz.time]: [1342654156339]
[gsm.operator.alpha]: [Android]
[gsm.operator.iso-country]: [us]
[gsm.operator.isroaming]: [false]
[gsm.operator.numeric]: [310260]
[gsm.sim.operator.alpha]: [Android]
[gsm.sim.operator.iso-country]: [us]
[gsm.sim.operator.numeric]: [310260]
[gsm.sim.state]: [READY]
[gsm.version.ril-impl]: [android reference-ril 1.0]
[init.svc.adbd]: [running]
[init.svc.bootanim]: [stopped]
[init.svc.console]: [running]
[init.svc.debuggerd]: [running]
[init.svc.goldfish-logcat]: [stopped]
[init.svc.goldfish-setup]: [stopped]
[init.svc.installd]: [running]
[init.svc.keystore]: [running]
[init.svc.media]: [running]
[init.svc.netd]: [running]
[init.svc.qemu-props]: [stopped]
[init.svc.qemud]: [running]
[init.svc.ril-daemon]: [running]
[init.svc.servicemanager]: [running]
[init.svc.surfaceflinger]: [running]
[init.svc.vold]: [running]
[init.svc.zygote]: [running]
```



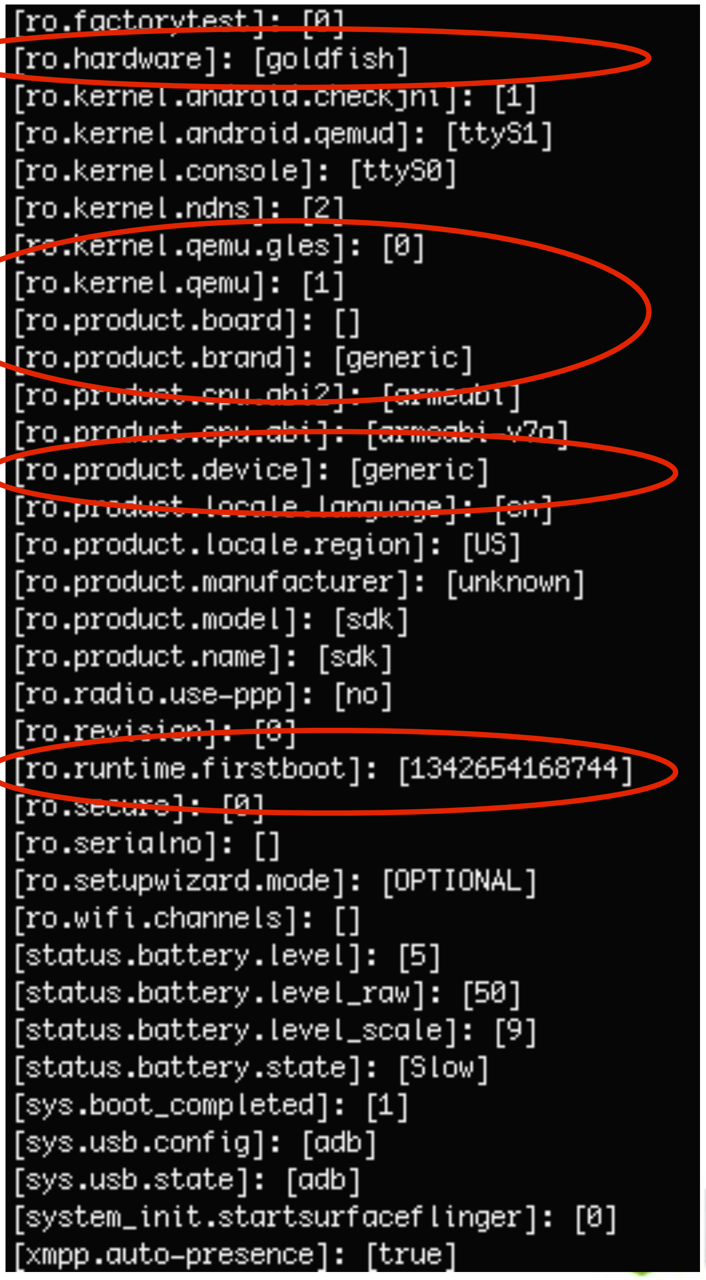
```
[net.bt.name]: [Android]
[net.change]: [net.dnschange]
[net.dns1]: [10.0.2.3]
[net.dns2]: [10.0.2.4]
[net.dnschange]: [1]
[net.eth0.dns1]: [10.0.2.3]
[net.eth0.dns2]: [10.0.2.4]
[net.eth0.gw]: [10.0.2.2]
[net.gprs.local-ip]: [10.0.2.15]
[net.hostname]: [android-e9bfcfdf35fbdff7]
[net.qtaguid_enabled]: [0]
[net.tcp.buffersize.default]: [4096,87380,110208,4096,16384,110208]
[net.tcp.buffersize.edge]: [4093,26280,35040,4096,16384,35040]
[net.tcp.buffersize.gprs]: [4092,8760,11680,4096,8760,11680]
[net.tcp.buffersize.hspa]: [4094,87380,262144,4096,16384,262144]
[net.tcp.buffersize.lte]: [524288,1048576,2097152,262144,524288,1048576]
[net.tcp.buffersize.umts]: [4094,87380,110208,4096,16384,110208]
[net.tcp.buffersize.wifi]: [524288,1048576,2097152,262144,524288,1048576]
[persist.sys.country]: [US]
[persist.sys.language]: [en]
[persist.sys.localevar]: []
[persist.sys.profiler_ms]: [0]
[persist.sys.timezone]: [America/Los_Angeles]
[persist.sys.usb.config]: [adb]
[qemu.hw.mainkeys]: [1]
[qemu.sf.fake_camera]: [back]
[qemu.sf.lcd_density]: [240]
[rild.libargs]: [-d /dev/ttyS0]
[rild.libpath]: [/system/lib/libreference-ril.so]
[ro.allow.mock.location]: [1]
[ro.baseband]: [unknown]
[ro.board.platform]: []
[ro.bootloader]: [unknown]
[ro.bootmode]: [unknown]
[ro.build.characteristics]: [default]
```

Adventures in Anti-Emulator

- And more...



```
[ro.build.date.utc]: [1332889705]
[ro.build.date]: [Tue Mar 27 23:08:25 UTC 2012]
[ro.build.description]: [sdk-eng 4.0.4 MR1 302030 test-keys]
[ro.build.display.id]: [sdk-eng 4.0.4 MR1 302030 test-keys]
[ro.build.fingerprint]: [generic/sdk/generic:4.0.4/MR1/302030:eng/test-keys]
[ro.build.host]: [vpba16.mtv.corp.google.com]
[ro.build.id]: [MR1]
[ro.build.product]: [generic]
[ro.build.tags]: [test-keys]
[ro.build.type]: [eng]
[ro.build.user]: [android-build]
[ro.build.version.codename]: [REL]
[ro.build.version.incremental]: [302030]
[ro.build.version.release]: [4.0.4]
[ro.build.version.sdk]: [15]
[ro.carrier]: [unknown]
[ro.com.google.locationfeatures]: [1]
[ro.config.alarm_alert]: [Alarm_Classic.ogg]
[ro.config.nocheckin]: [yes]
[ro.config.notification_sound]: [OnTheHunt.ogg]
[ro.crypto.state]: [unencrypted]
[ro.debuggable]: [1]
[ro.factorytest]: [0]
[ro.hardware]: [goldfish]
[ro.kernel.android.checkjni]: [1]
[ro.kernel.android.qemud]: [ttyS1]
[ro.kernel.console]: [ttyS0]
[ro.kernel.ndns]: [2]
[ro.kernel.qemu.gles]: [0]
[ro.kernel.qemu]: [1]
[ro.product.board]: []
[ro.product.brand]: [generic]
[ro.product.cpu.abi2]: [armeabi]
[ro.product.cpu.abi]: [armeabi-v7a]
[ro.product.device]: [generic]
```



```
[ro.factorytest]: [0]
[ro.hardware]: [goldfish]
[ro.kernel.android.checkjni]: [1]
[ro.kernel.android.qemud]: [ttyS1]
[ro.kernel.console]: [ttyS0]
[ro.kernel.ndns]: [2]
[ro.kernel.qemu.gles]: [0]
[ro.kernel.qemu]: [1]
[ro.product.board]: []
[ro.product.brand]: [generic]
[ro.product.cpu.abi2]: [armeabi]
[ro.product.cpu.abi]: [armeabi-v7a]
[ro.product.device]: [generic]
[ro.product.locale.language]: [en]
[ro.product.locale.region]: [US]
[ro.product.manufacturer]: [unknown]
[ro.product.model]: [sdk]
[ro.product.name]: [sdk]
[ro.radio.use-ppp]: [no]
[ro.revision]: [0]
[ro.runtime.firstboot]: [1342654168744]
[ro.secure]: [0]
[ro.serialno]: []
[ro.setupwizard.mode]: [OPTIONAL]
[ro.wifi.channels]: []
[status.battery.level]: [5]
[status.battery.level_raw]: [50]
[status.battery.level_scale]: [9]
[status.battery.state]: [Slow]
[sys.boot_completed]: [1]
[sys.usb.config]: [adb]
[sys.usb.state]: [adb]
[system_init.startsurfaceflinger]: [0]
[xmpp.auto-presence]: [true]
```

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Adventures in Anti-Emulator

- Keep in mind, it is easy to do the inverse as well
- Instead of looking if you're in an emulator, see if you're just not a normal looking device
- Look for Google Experience app settings;

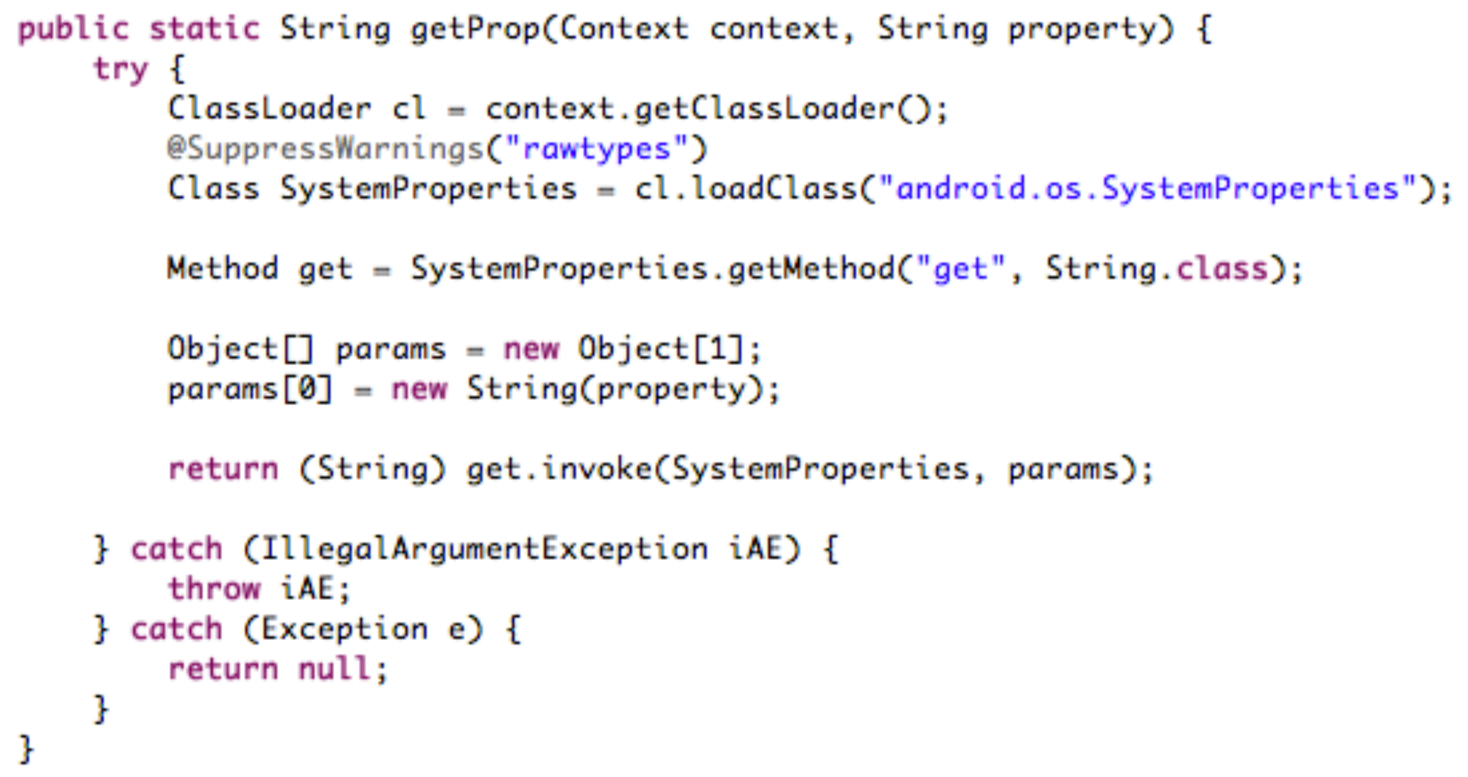
  ro.build.fingerprint
  ro.error.receiver.system.apps
  ro.url.legal.android_privacy
  ro.url.legal

Adventures in Anti-Emulator

- But how to use getprop? There is no public command?!

Adventures in Anti-Emulator

- But how to use getprop? There is no public command?!



```
public static String getProp(Context context, String property) {
    try {
        ClassLoader cl = context.getClassLoader();
        @SuppressWarnings("rawtypes")
        Class SystemProperties = cl.loadClass("android.os.SystemProperties");

        Method get = SystemProperties.getMethod("get", String.class);

        Object[] params = new Object[1];
        params[0] = new String(property);

        return (String) get.invoke(SystemProperties, params);

    } catch (IllegalArgumentException iAE) {
        throw iAE;
    } catch (Exception e) {
        return null;
    }
}
```

- Reflection to the rescue, yet again!

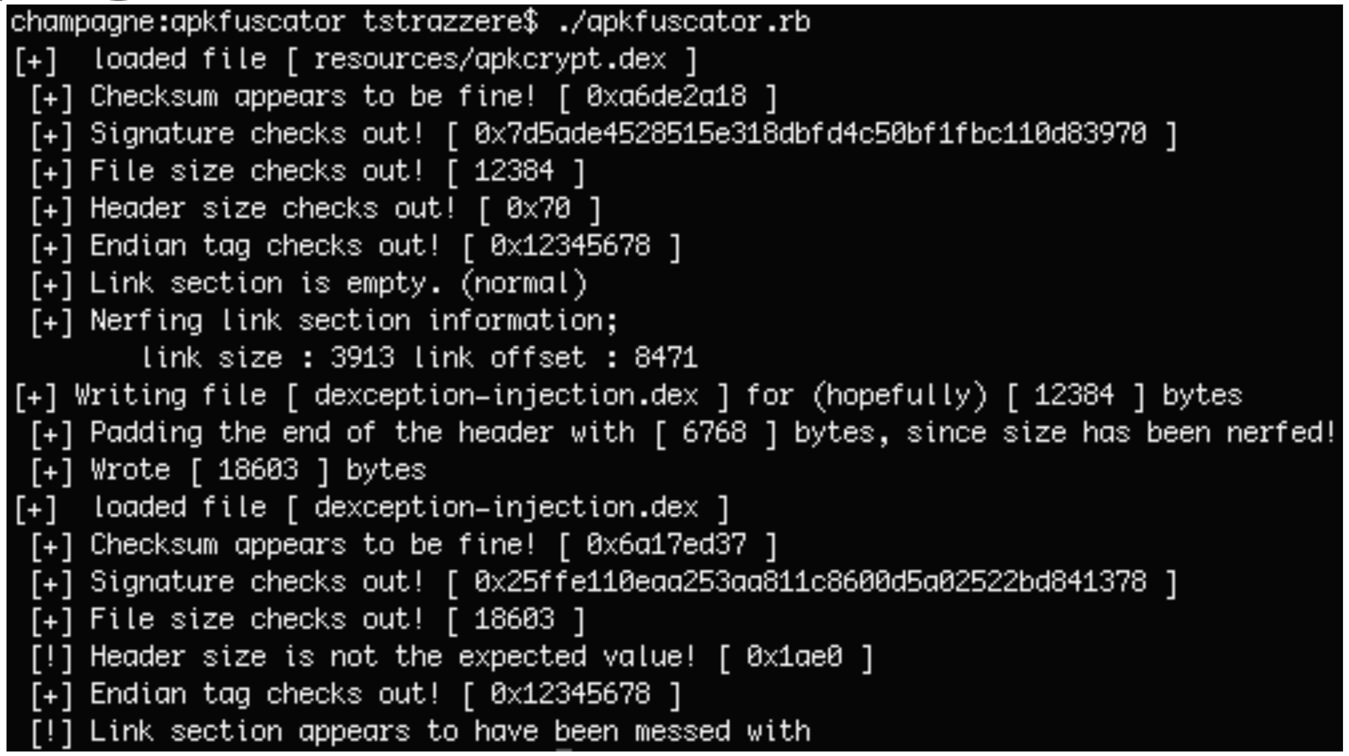
Adventures in Anti-Emulator

- Should be easy to flag statically, but this might not come up in dynamic analysis
- Could build more "believable" emulator images (build.prop)
- Can always flag *every* reflection, but that might cause massive false positives
- Hook the getprop command, maybe with pof's LD_PRELOAD example? (https://github.com/poliva/ldpreloadhook)

PoC and Lessons Learned

Stop Talking I Just Want the Code

- "apkfuscator" - PoC tool used to munge all the dex files / create examples open sourced (GPL) - check my github page soon!



```
champagne:apkfuscator tstrazzere$ ./apkfuscator.rb
[+]  loaded file [ resources/apkcrypt.dex ]
 [+] Checksum appears to be fine! [ 0xa6de2a18 ]
 [+] Signature checks out! [ 0x7d5ade4528515e318dbfd4c50bf1fbc110d83970 ]
 [+] File size checks out! [ 12384 ]
 [+] Header size checks out! [ 0x70 ]
 [+] Endian tag checks out! [ 0x12345678 ]
 [+] Link section is empty. (normal)
 [+] Nerfing link section information;
        link size : 3913 link offset : 8471
[+] Writing file [ dexception-injection.dex ] for (hopefully) [ 12384 ] bytes
 [+] Padding the end of the header with [ 6768 ] bytes, since size has been nerfed!
 [+] Wrote [ 18603 ] bytes
[+]  loaded file [ dexception-injection.dex ]
 [+] Checksum appears to be fine! [ 0x6a17ed37 ]
 [+] Signature checks out! [ 0x25ffe110eaa253aa811c8600d5a02522bd841378 ]
 [+] File size checks out! [ 18603 ]
 [!] Header size is not the expected value! [ 0x1ae0 ]
 [+] Endian tag checks out! [ 0x12345678 ]
 [!] Link section appears to have been messed with
```

- Beware of the code it bites -- quick hack and challenge to do heavy file manipulation in ruby (I know I'm a masochist)

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PoC and Lessons Learned

But What Have We Truly Learned?!
(other than avoid ruby for file manipulation)

- When parsing dex files - expect the unexpected, don't throw an exception if you don't have to, but log that and possibly call attention to it
- Grok`ing the file format can be important, don't rely on all the pre-made tools to do it for you - you're a hacker, know what you're hacking!
- Part of defending is attacking your own weaknesses, stay sharp and keep your tools even sharper

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PoC and Lessons Learned

But What Have We Truly Learned?!
(other than avoid ruby for file manipulation)

- If something explodes - use Jon Larimer's 010 Editor template (I've committed fixes for these methods) - makes analyzing / visualizing dex files so much easier
- Think outside the box - the world is full of people thinking "sms == bad", don't be a lazy analyst/reverser
- Have fun and break stuff - that's why we're reverse engineers

Thanks!

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#droidsec / #smali on freenode

Greets:
fG+, Lohan+, jcase, tmw, jon larimer,
jono, zuk, jduck, syn, JF, pof, thomas cannon,
anthony desnos, snare, crypto girl and many others :)

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http://source.android.com/tech/dalvik/dex-format.html