目录

逆向利器：IDA

- 最新版本：`v1.0`
- 更新时间：`20230714`

简介

介绍逆向领域中功能强大且好用的利器：IDA。先介绍IDA概览；再介绍IDA的快速上手过程；再介绍IDA中通用的基础知识，包括版本选择、界面相关比如布局等、常见命名和含义、自动分析过程、搜索、快捷键；以及介绍IDA各种功能，包括查看代码，比如汇编代码、F5伪代码、函数调用、结构体的类的定义、字符串、函数列表插件等等；再去记录IDA的使用心得；最后整理一些IDA相关的文档和资料，供参考。

源码+浏览+下载

本书的各种源码、在线浏览地址、多种格式文件下载如下：

HonKit源码

- crifan/reverse_tool_ida: 逆向利器：IDA

如何使用此HonKit源码去生成发布为电子书

详见：crifan/honkit_template: demo how to use crifan honkit template and demo

在线浏览

- 逆向利器：IDA book.crifan.org
- 逆向利器：IDA crifan.github.io

离线下载阅读

- 逆向利器：IDA PDF
- 逆向利器：IDA ePub
- 逆向利器：IDA Mobi

版权和用途说明

鸣谢

感谢我的老婆**陈雪**的包容理解和悉心照料，才使得我 `crifan` 有更多精力去专注技术专研和整理归纳出这些电子书和技术教程，特此鸣谢。

其他

作者的其他电子书

本人 `crifan` 还写了其他 `150+` 本电子书教程，感兴趣可移步至：

crifan/crifan_ebook_readme: Crifan的电子书的使用说明

关于作者

关于作者更多介绍，详见：

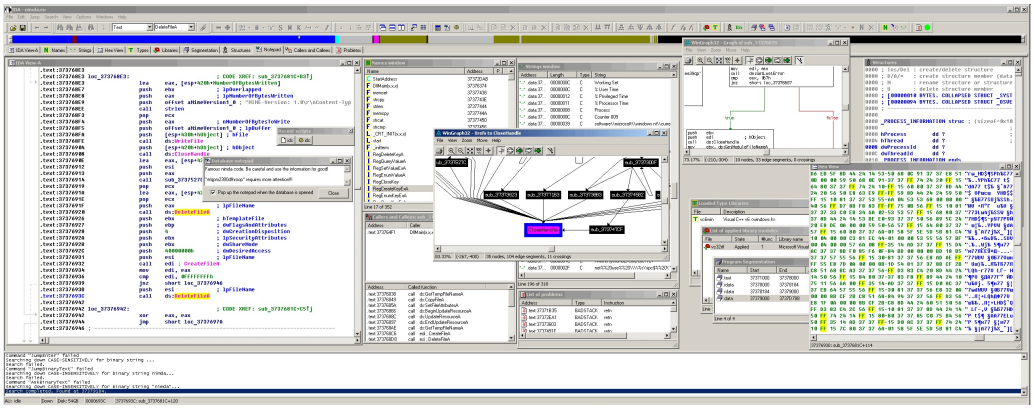
关于CrifanLi李茂 – 在路上

IDA概览

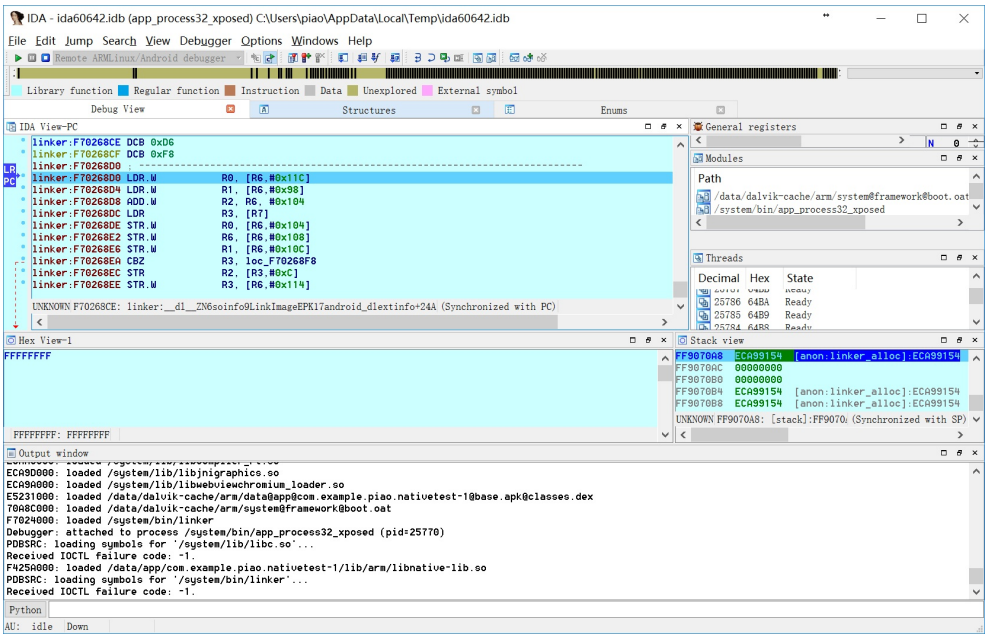
在逆向领域，有款很功能强大且好用的工具=利器是：`IDA`

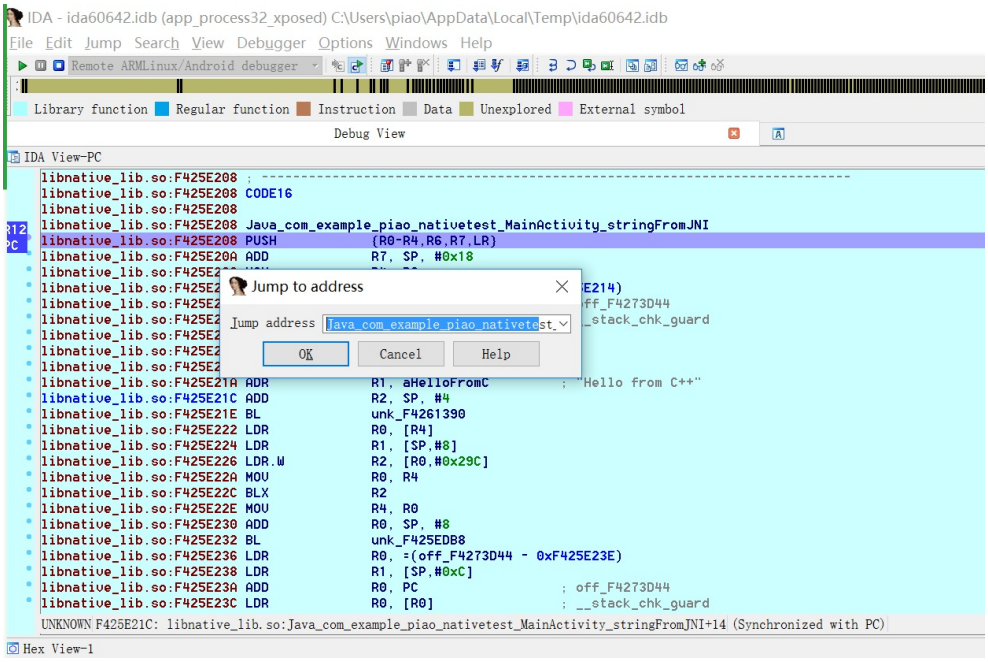
- `IDA`
  - 版本和名称
    - 概述：
      - `IDA` 有多个版本，功能最强、用的最多最广泛是：`IDA Pro`
        - 所以 `IDA Pro` 常简称为：`IDA`
    - 详解
      - 后续章节：版本
  - 概述：逆向工程的利器
    - 图

    - 文字
      - `IDA Pro` – the state-of-the-art binary code analysis solution
      - `IDA Pro` is the flagship product of `Hex-Rays`, the software provider in reverse engineering.
      - Being an interactive and programmable disassembler and debugger, `IDA Pro` provides excellent quality performance on different platforms and is compatible with many processors. `IDA Pro` has become the de-facto standard for the analysis of hostile code, vulnerability research and commercial off-the-shelf validation
  - 常用于
    - iOS逆向
      - 静态分析：逆向二进制，研究代码逻辑
        - 常用功能：函数、F5伪代码、字符串、类的结构体定义等等
      - 动态调试：调试iOS的app
    - Android逆向
      - 支持对Android的静态分析与动态调试
        - 包括：动态调试so文件
  - 特点
    - 支持多平台运行：`Windows`、`Mac`、`Linux`(`CentOS`、`Ubuntu`等)等
    - 支持多种CPU架构：`x86/x64`、`ARM/ARM64`、`MIPS/MIPS64`、`PowerPC/PPC64`、`Motorola 68K/Coldfire`等共**68**种
    - 支持插件，可以扩展各种功能
    - 可编程=支持API接口调用，写脚本，实现各种功能
  - 主页
    - https://hex-rays.com/
      - 关于
        - IDA: About
      - 下载
        - IDA Support: Download Center
          - 注：`IDA Pro`是商业收费软件，请支持和购买正版
      - 官网截图



- 调试安卓dex





IDA快手上手

- iOS逆向
  - 常用：（Mac中）用IDA分析代码
    - 下载和安装IDA
    - 找到要分析的iOS的app的二进制文件
    - 拖动二进制到IDA中
    - 等待分析完毕
    - 利用各种功能，研究代码逻辑
      - 常用功能
        - 字符串
          - 搜索感兴趣的关键字
            - 比如：越狱对应的单词：`jailbreak`、`jail`、`jb`等
        - 函数
          - 搜索已找到的iOS的ObjC的类和函数
            - 然后打开查看代码逻辑
        - 伪代码
          - 当打开函数后，默认是汇编代码，按`F5`即可打开`伪代码`
            - 近似于自己写的源码，人类可读的那种，就可以分析代码，搞懂函数的基本（甚至全部的）逻辑了
        - 结构体：类的定义
          - 结构体定义的来源
            - 有些是自动分析出来的
              - 如果没有错误，无需调整
            - 有些需要自己额外新增类的定义
          - 效果
            - 如果类的结构体定义是正确的话，那么伪代码中，自动会解析出，类的函数和属性的调用，即可大大增加伪代码的可读性
    - 之后的重点
      - IDA的静态分析：`IDA`的`F5伪代码`，查看伪代码的大概逻辑
      - Xcode的动态调试：iOS逆向的`Xcode+`+`MonkeyDev`+`LLDB`的动态调试，通过hook等手段，确认调用了哪些函数，参数值如何等等
      - 互相配合：把Xcode中的实时的汇编代码 和 IDA中伪代码，互相对应起来，便于理解代码逻辑
      - 后续的优化代码逻辑：在逐渐搞懂更多代码逻辑后，继续给IDA中的`伪代码`去优化代码，主要是给参数、变量、函数等改名，以及更进一步的，新增或修改类的结构体定义，使得伪代码中自动解析出正确的类的函数和属性的调用等内容。
  - 偶尔用：用IDA调试二进制

下载

IDA官网有试用版可供下载：

Download center (hex-rays.com)

->

- IDA Free
- IDA Evaluation

IDA通用知识

此处整理IDA中的基础的通用的知识。

- 版本
- 界面
  - 功能布局
  - 显示相关
- 命名和含义
- 自动分析
  - 基本流程
  - 进度
- 搜索
- 快捷键

版本

IDA软件的不同版本

- 常用结论
  - 此处iOS逆向的话，常用的是 `v7.0` 的 `IDA Pro` （中64位的 `id64` ）
- 概述
  - `IDA Teams`： Collaborative reverse-engineering work
    - 团队合作时才需要
  - `IDA Pro`： The state-of-the-art binary code analysis tool
    - 常简称为 `IDA` -> 大家常说的**IDA**，指的是**IDA Pro**
    - 功能最全，最强大，但**价格也最贵**
  - `IDA Home`： Affordable tool for reverse engineering hobbyists
    - 功能相对没 `IDA Pro` 全，但对于个人（应该）基本够用，价格相对也便宜点（所以宣传是Affordable）
  - `IDA Free`： Free binary code analysis tool to evaluate IDA's basic functionalities
    - 免费，但功能有限
  - `IDA Demo`： 仅仅作演示用，了解功能而已
- 详解

-

IDA的历史版本号

- 心得
  - 刚发现，IDA的版本号，是 `Major.Minor.ReleaseDate` 的模式
    - 举例
      - IDA 8.1.221006 October 6, 2022
        - `8.1.221006`
          - `8.1`：主次版本号
          - `221006`：发布日期=October 6, 2022

历史发布的所有版本：

IDA updates and releases

- IDA 8.x
  - IDA 8.1.221006 October 6, 2022
  - IDA 8.0.220829 (SP1) August 29, 2022
  - IDA 8.0.220729 July 29, 2022
- IDA 7.x
  - IDA 7.7.220118 (SP1) January 18, 2022
  - IDA 7.7.211224 December 24, 2021
  - IDA 7.6.210427 (SP1) April 28, 2021
  - IDA 7.6.210322 March 22, 2021
  - IDA 7.5.201028 (SP3) October 28, 2020
  - IDA 7.5.200728 (SP2) July 28, 2020
  - IDA 7.5.200619 (SP1) June 19, 2020
  - IDA 7.5.200519 May 19, 2020
  - IDA 7.4.191112 (SP1) November 12, 2019
  - IDA 7.4.191011 October 11, 2019
  - IDA 7.3.190614 June 14, 2019
  - IDA 7.2.181105 November 5, 2018
  - IDA 7.1.180227 February 27, 2018
  - IDA 7.0.171130 (SP1) November 30, 2017
  - IDA 7.0.190914 September 14, 2017
- IDA 6.x
  - IDA 6.95.160808 August 08, 2016
  - IDA 6.9.151221 December 21, 2015
  - IDA 6.8.150413 April 13, 2015
  - IDA 6.7.141229 December 29, 2014
  - IDA 6.6.140604 June 04, 2014
  - IDA 6.5.131217 December 17, 2013
  - IDA 6.4.130306 March 6, 2013
  - IDA 6.4 January 10, 2013
  - IDA 6.3 May 31, 2012
  - IDA 6.2 October 05, 2011
  - IDA 6.1 April 08, 2011
  - IDA 6.0 October 01, 2010
- IDA 5.x
  - IDA 5.7 June 25, 2010
  - IDA 5.6 December 30, 2009
  - IDA 5.5 June 12, 2009
  - IDA 5.4 January 29, 2009
  - IDA 5.3 July 14, 2008
  - IDA 5.2 November 20, 2007
  - IDA 5.1 February 21, 2007
  - IDA 5.0 March 23, 2006
- IDA 4.x
  - IDA 4.9(SP) January 27, 2006
  - IDA 4.9 September 25, 2005
  - IDA 4.8 March 15, 2005
  - IDA 4.7 August 2004
  - IDA 4.6 October 27, 2003
  - IDA 4.x August 29, 2022
- IDA 3.x
  - IDA 3.x

界面布局

此处整理，IDA中关于界面显示和布局方面的内容。

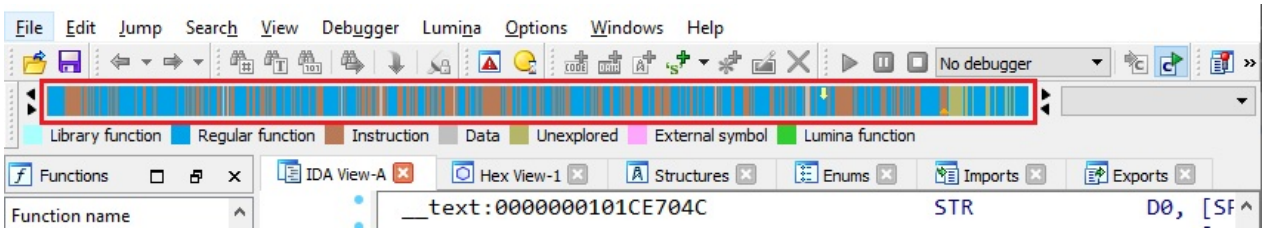
导航条=navigator

关于这个：

`Navigation band` = `navigator` = `navbar` = `导航栏` = `导航条`

有专门的介绍

Igor's tip of the week #49: Navigation band – Hex Rays (hex-rays.com)

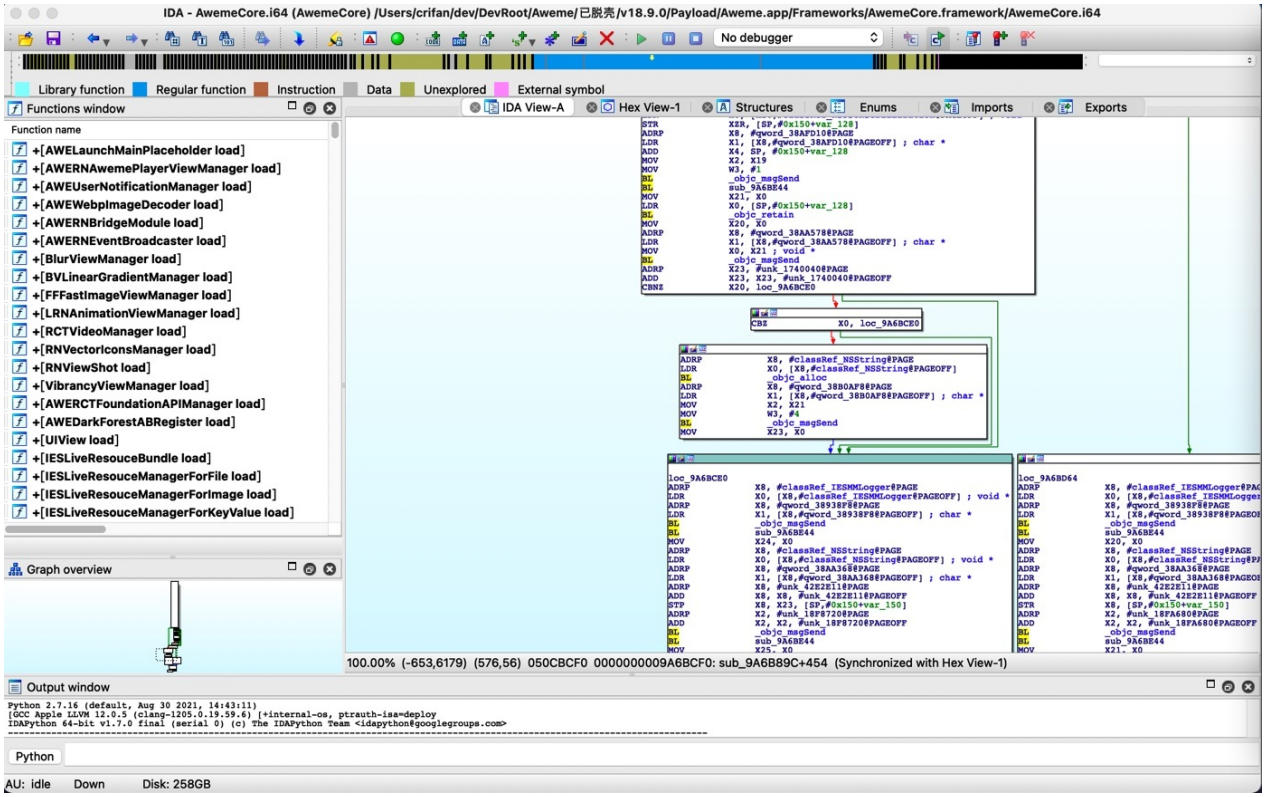


有空可以好好学习看看

切换显示模式

`Text View` 和 `Graph View`

`IDA View-A`：在 `Text View` 和 `Graph View` 模式之间切换

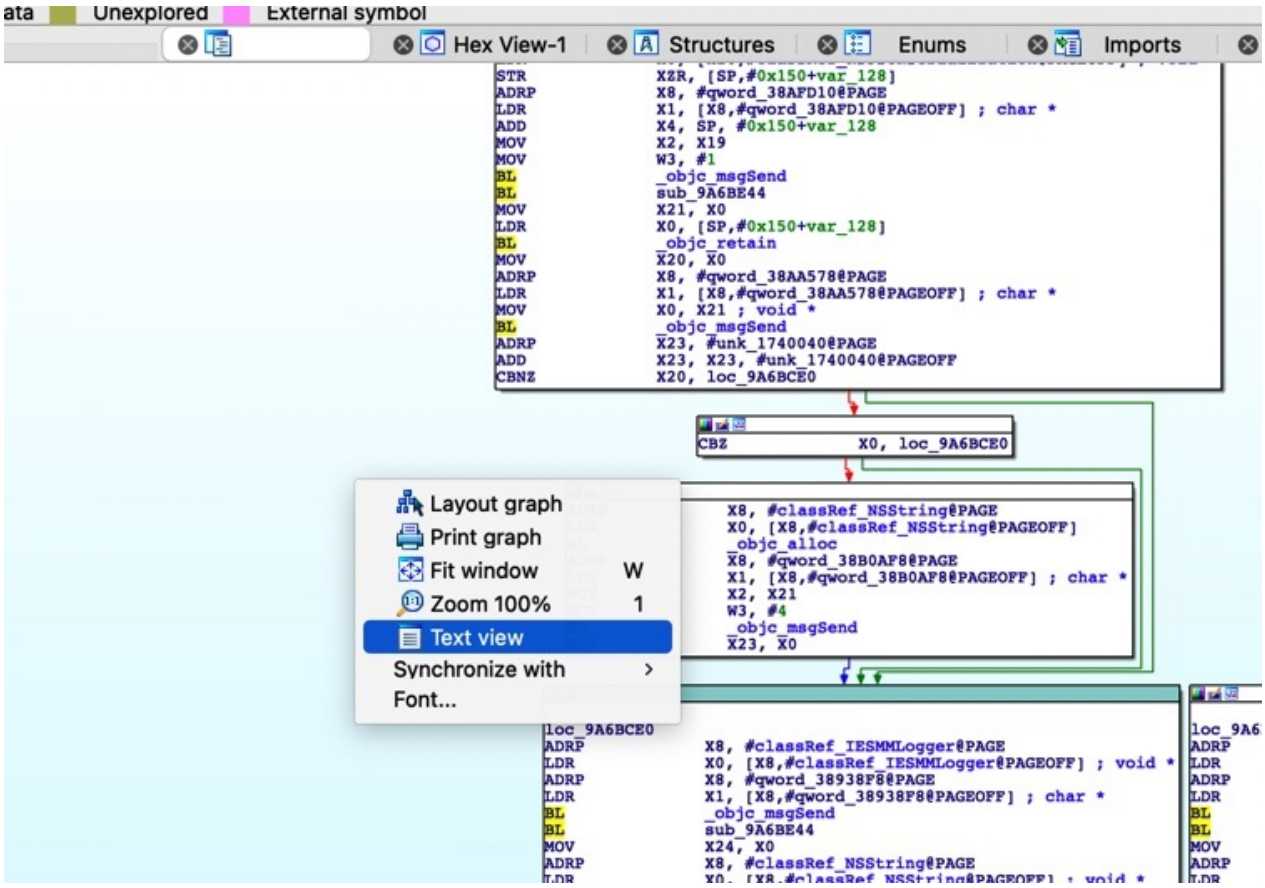


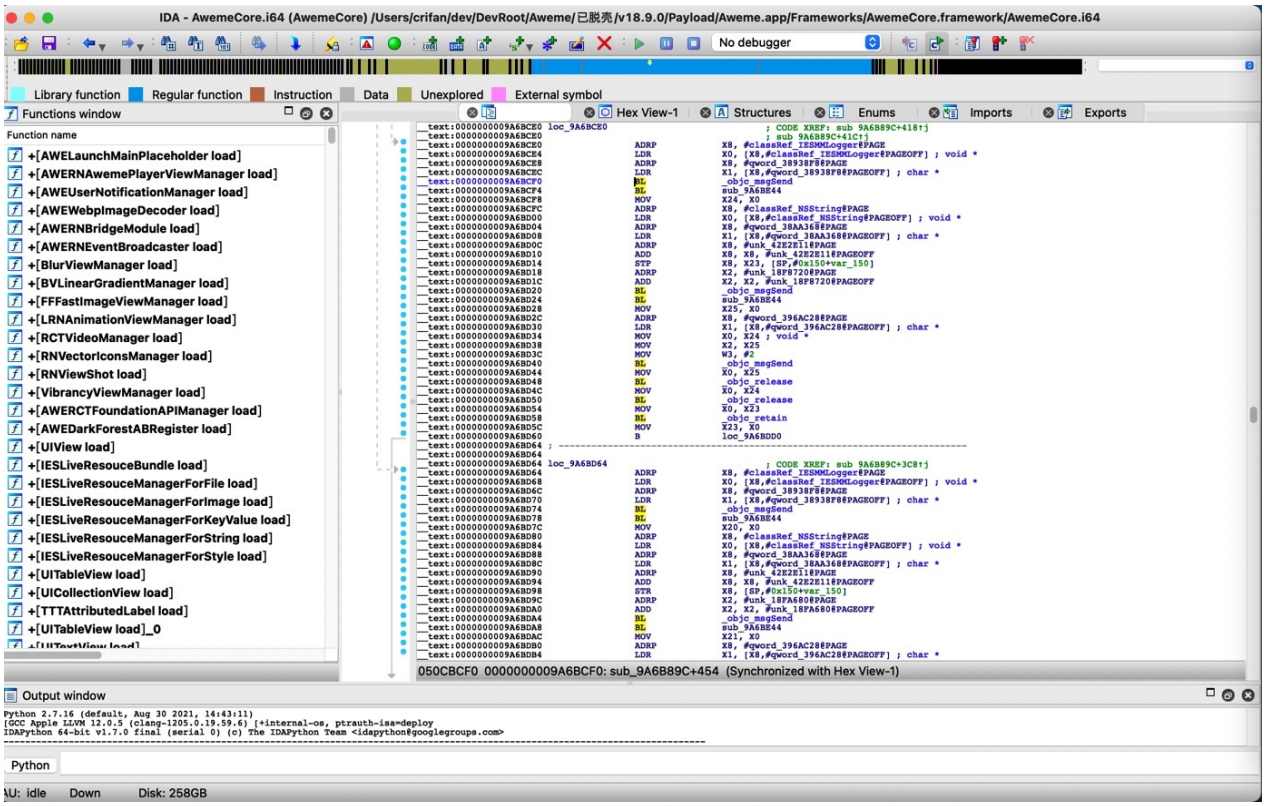
这个叫做：`Graph View` =图形视图

好处：方便看函数调用的逻辑关系

如果想要切换到：`文本模式`， `汇编模式`

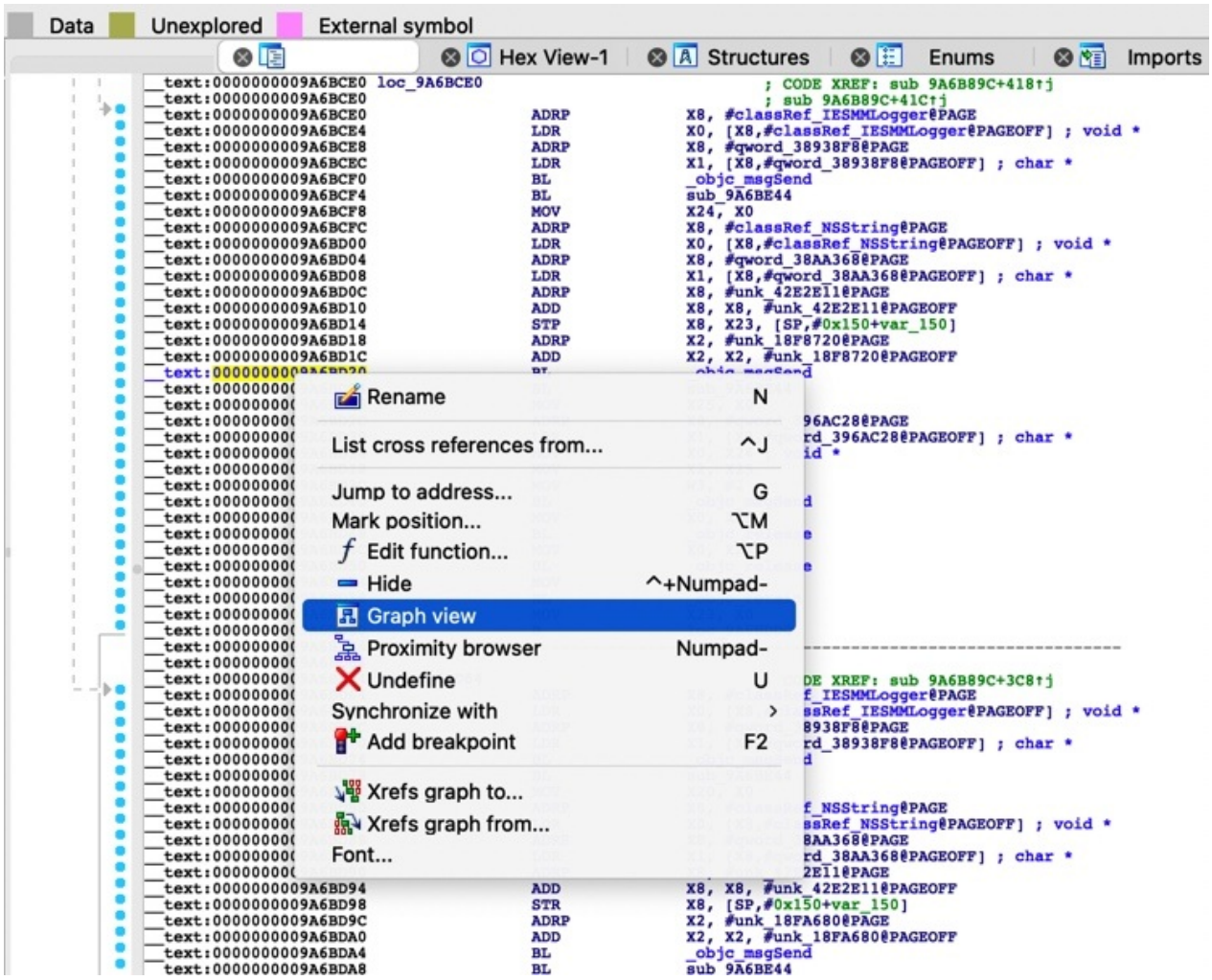
则可以：`右键 -》 Text View`



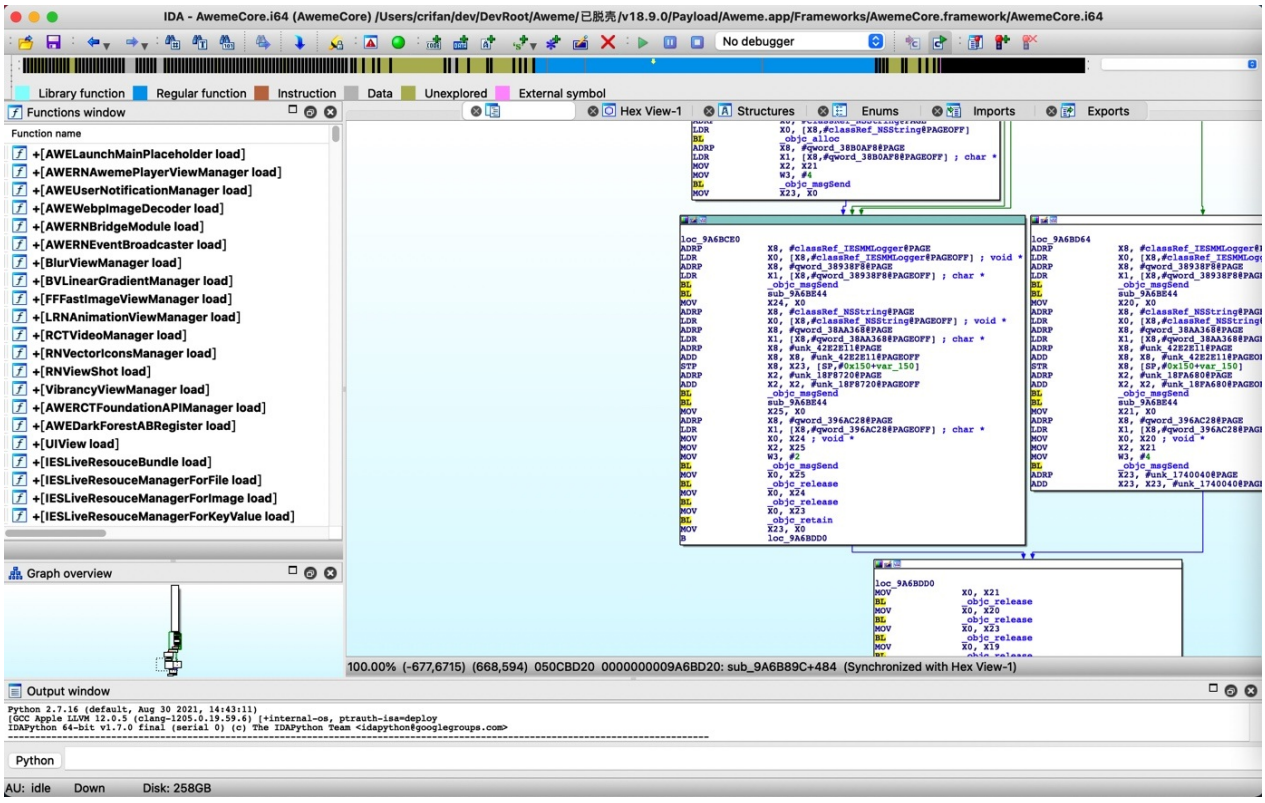


同理，从Text View想要切换到Graph View，也可以：

右键 -》 Graph View

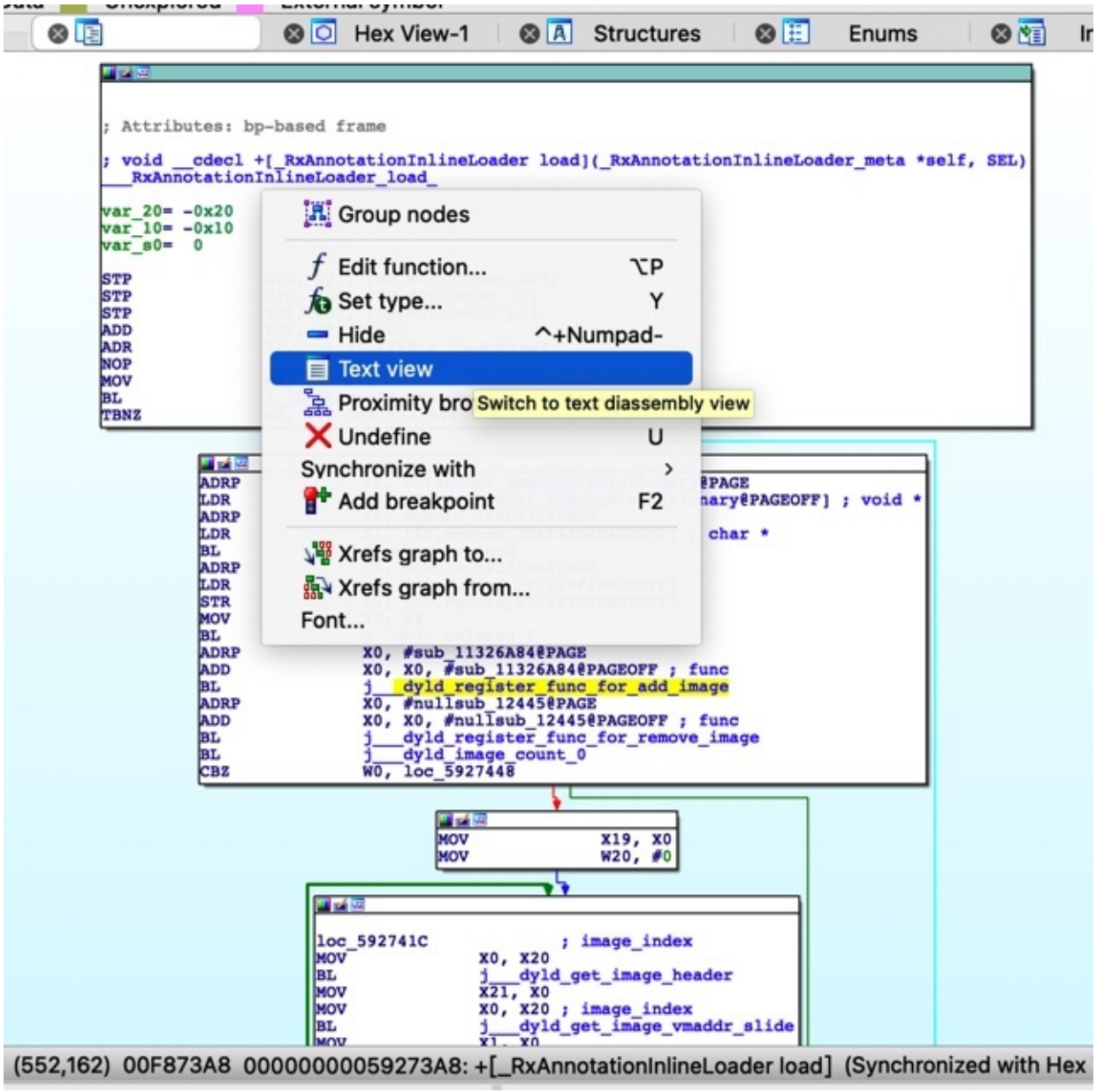


回到了： graph视图

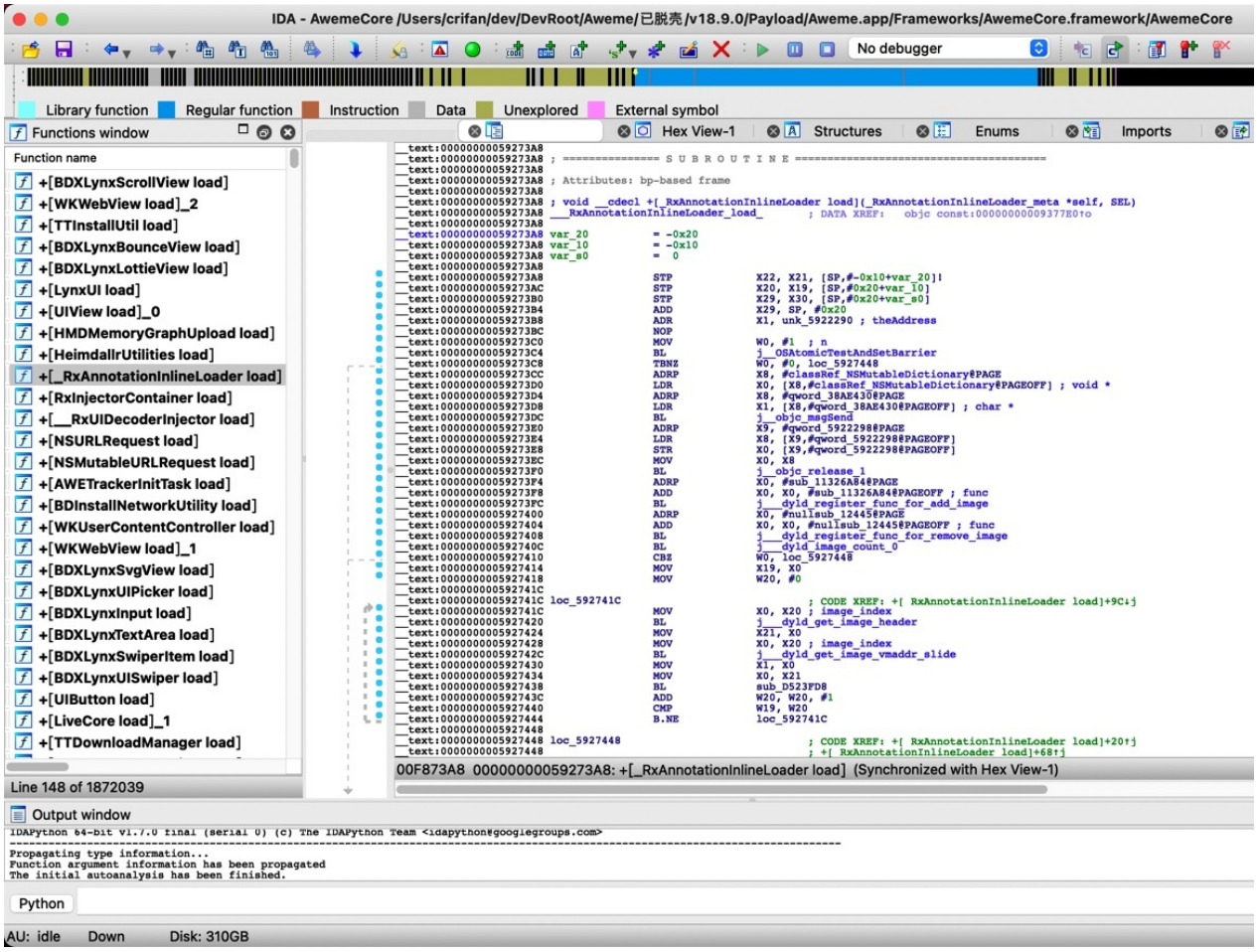


函数调用图 和 `Text View`

从函数调用图 切换到原先汇编指令形式：

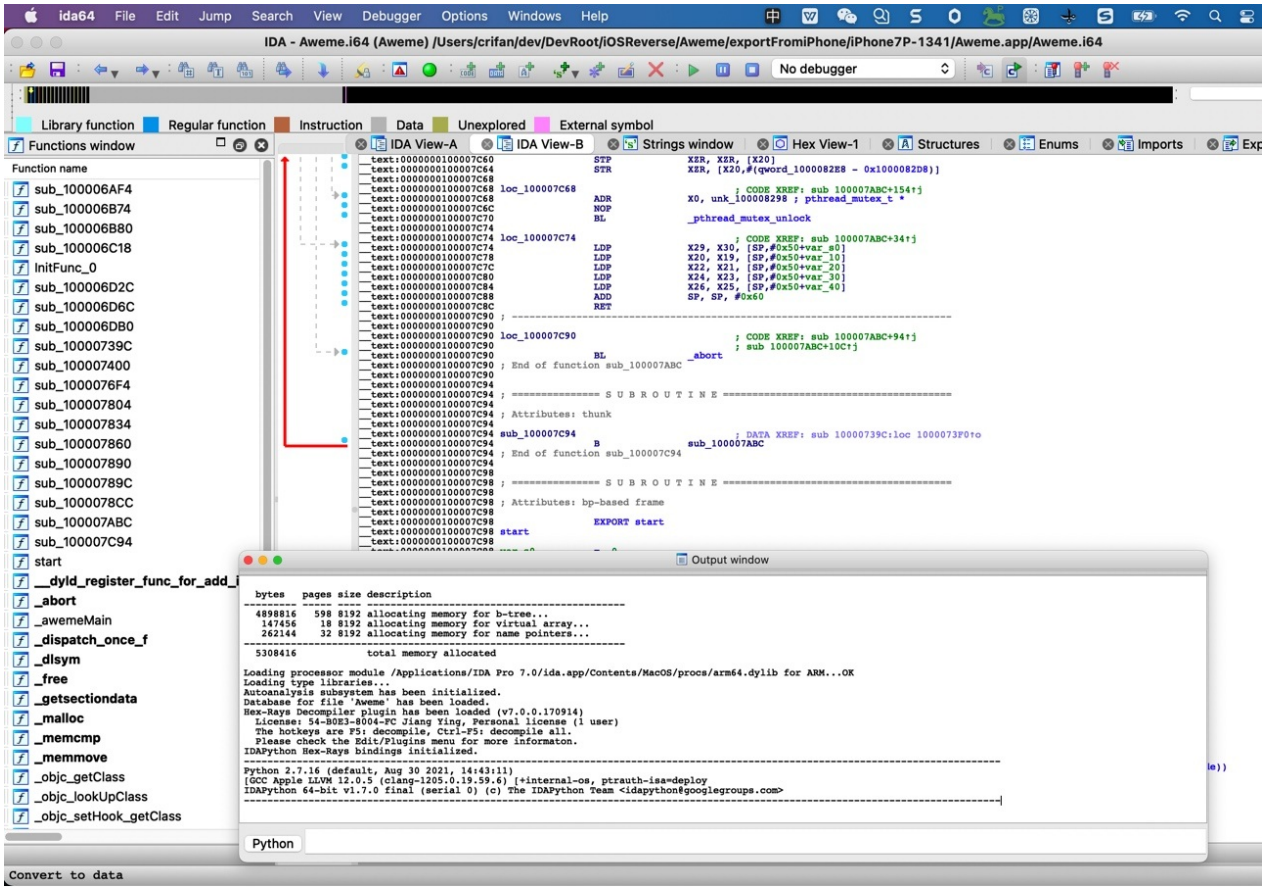


切换到： `IDA View`



如何把浮动窗口 `Output Window` 固定到底部

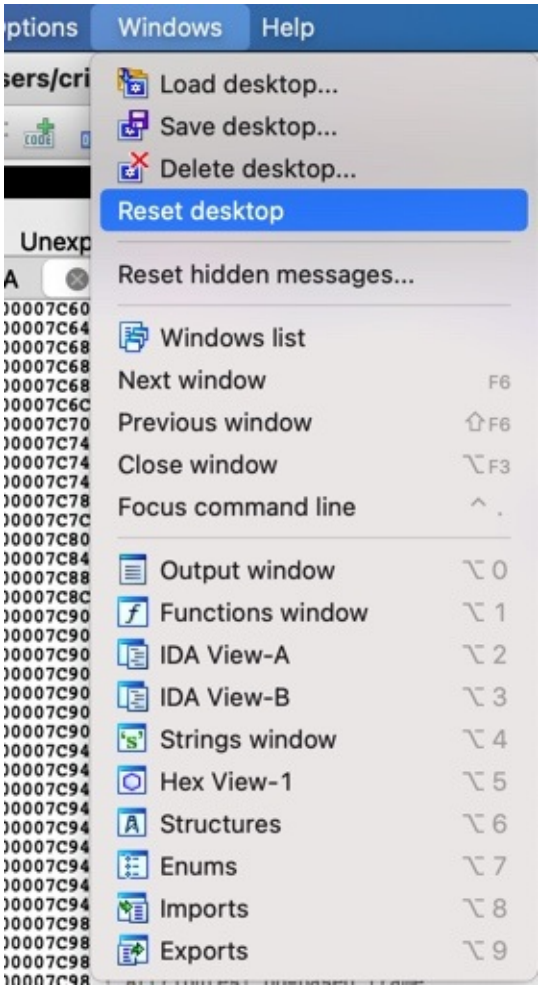
问题：IDA中的 `Output Window` ，不知何故，悬浮在主体窗口上面了：



希望是：能固定到底部或左下角等位置

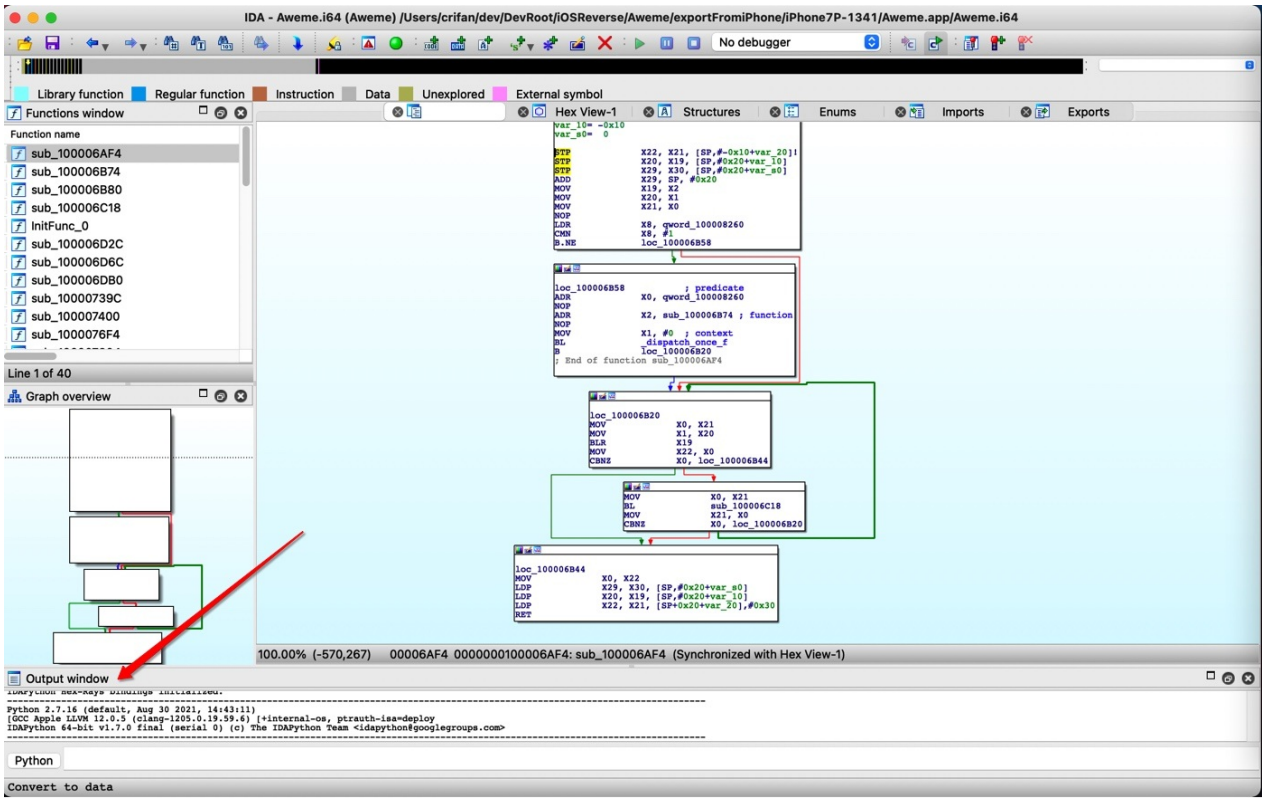
解决办法：

`IDA -> Window -> Reset desktop`



可以恢复IDA桌面原始布局

-》从而使得此处的 `Output Window`，恢复最初的位置=固定在最底部的位置



命名和含义

TODO：

-
- 【已解决】iOS逆向心得：如何从对x8的adrp和ldr计算出对应的qword字符串值

此处整理IDA中，各处看到的，各种名称的命令规则的含义。

背景知识

- `动态链接库` 文件类型=后缀
  - `Windows`： `.dll`
  - `Linux`： `.so`
  - `Mac`： `.dylib`

大的类型

- `F` = `Function`: regular function, which is not a library function.
- `L` = `Library`: library function that can be recognized with different signatures that are part of IDA. If the matching signature is not found, the name is labeled as a regular function.
- `I` = `Imported`: imported name from the shared library. The code from this function/name is not present in the executable and is provided at run time, whereas the library function is embedded into the executable.
- `C` = `Code`: named code that represent program locations that are not part of any function, which can happen if the name is a part of the symbol table, but the executable never calls this function.
- `D` = `Data`: named data locations that are usually global variables.
- `A` = `Ascii`: ASCII string data that represents a string terminated with a null byte in the executable.

命名规则

IDA中，对于未命令的内容，会采用默认从缩写命名。其命名规则是：

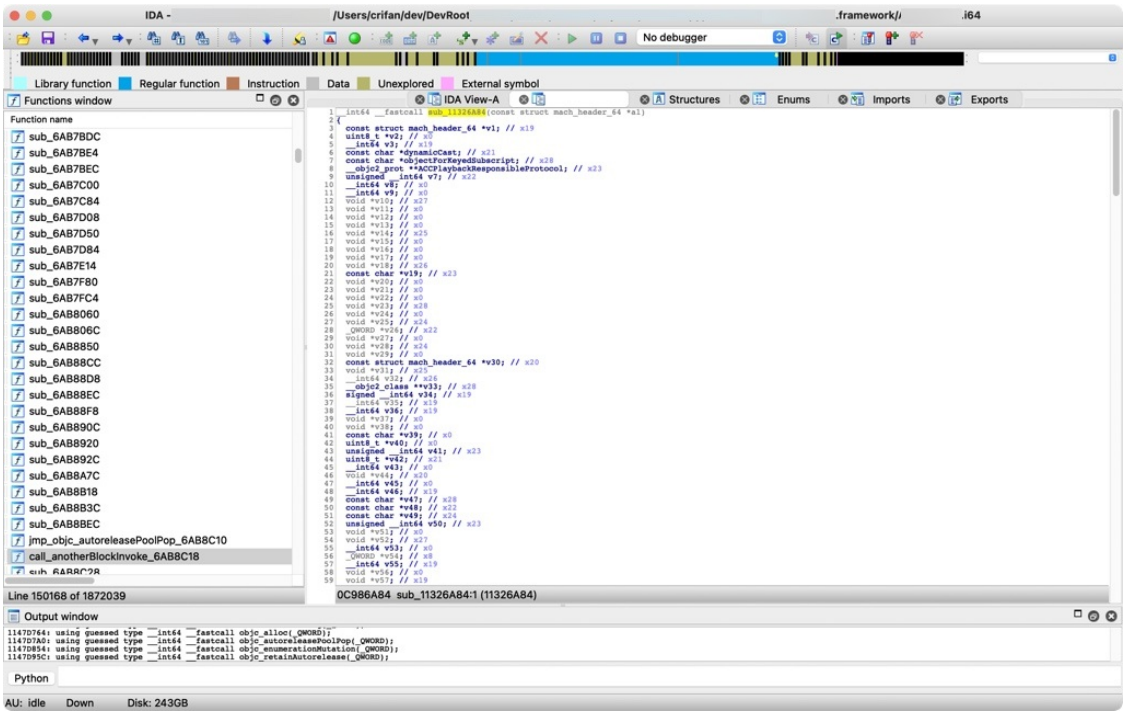
- IDA常见命名
  - `sub` = `subroutine` = `子程序`： 函数
  - `locret`： 返回指令
  - `loc`： 指令
  - `off` = `offset`： 某个偏移量，存放某个数据
  - `seg` = `segment`： 数据，包含段地址值
  - `asc` = `ascii`： 数据，ASCII字符串
  - `byte`： 数据，字节（或字节数组）
  - `word`： 数据，16位数据（或字数组）
  - `dword`： 数据，32位数据（或双字数组）
  - `qword`： 数据，64位数据（或4字数组）
  - `flt`： 浮点数据，32位（或浮点数组）
  - `dbl`： 浮点数，64位（或双精度数组）
  - `tbyte`： 浮点数，80位（或扩展精度浮点数）
  - `stru` = `structure`： 结构体(或结构体数组)
  - `algn` = `align`： 对齐指示
  - `unk` = `unknown`： 未处理字节

    - 字节相关
        - db=1个字节
        - dw=2个字节
        - dd=4个字节

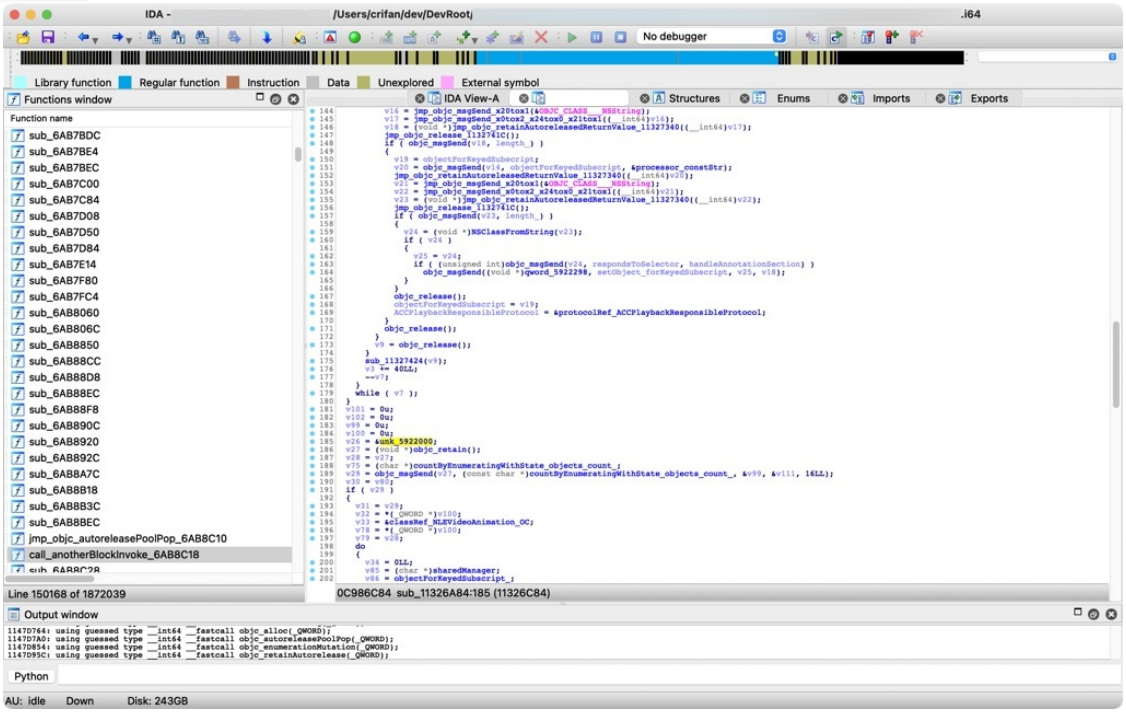
举例

- 各种

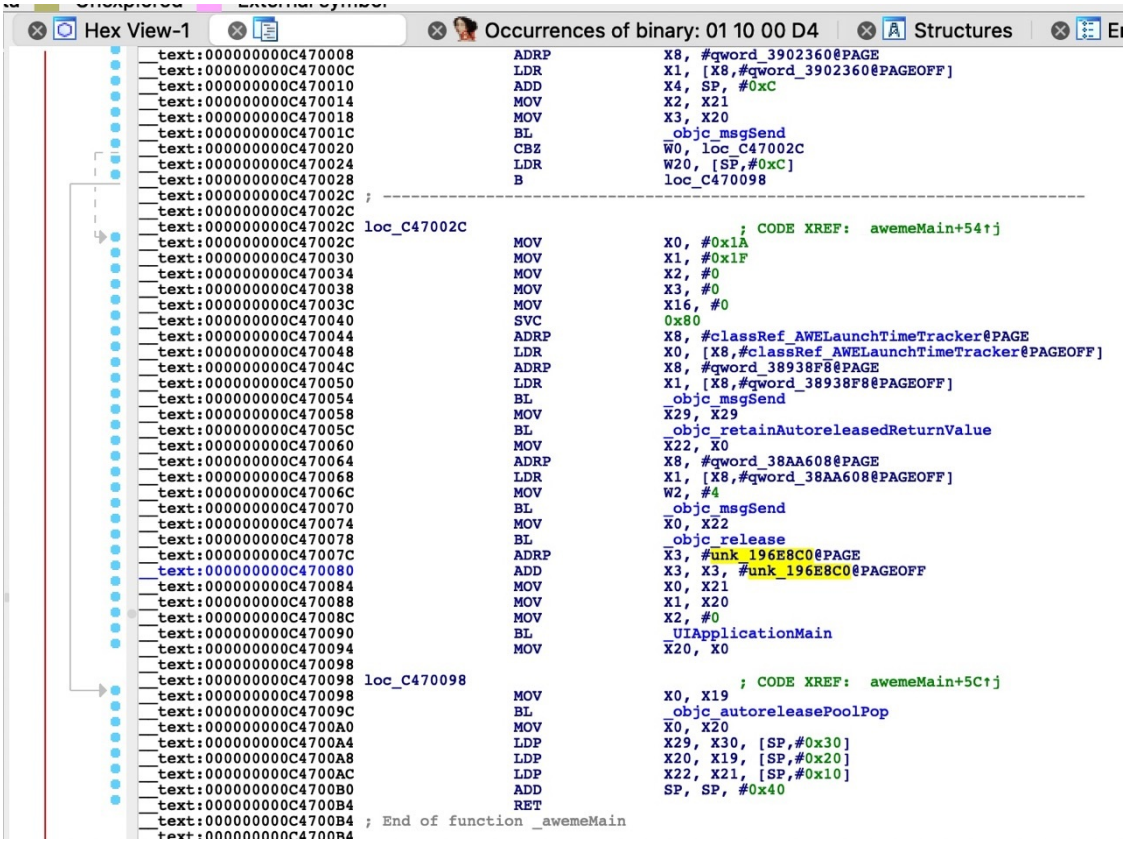
    -
        - `sub_B7CBB90`
        - `loc_B7CBBC4`
        - `locret_B7CBC00`
- `sub`
    - `sub_11326A84`



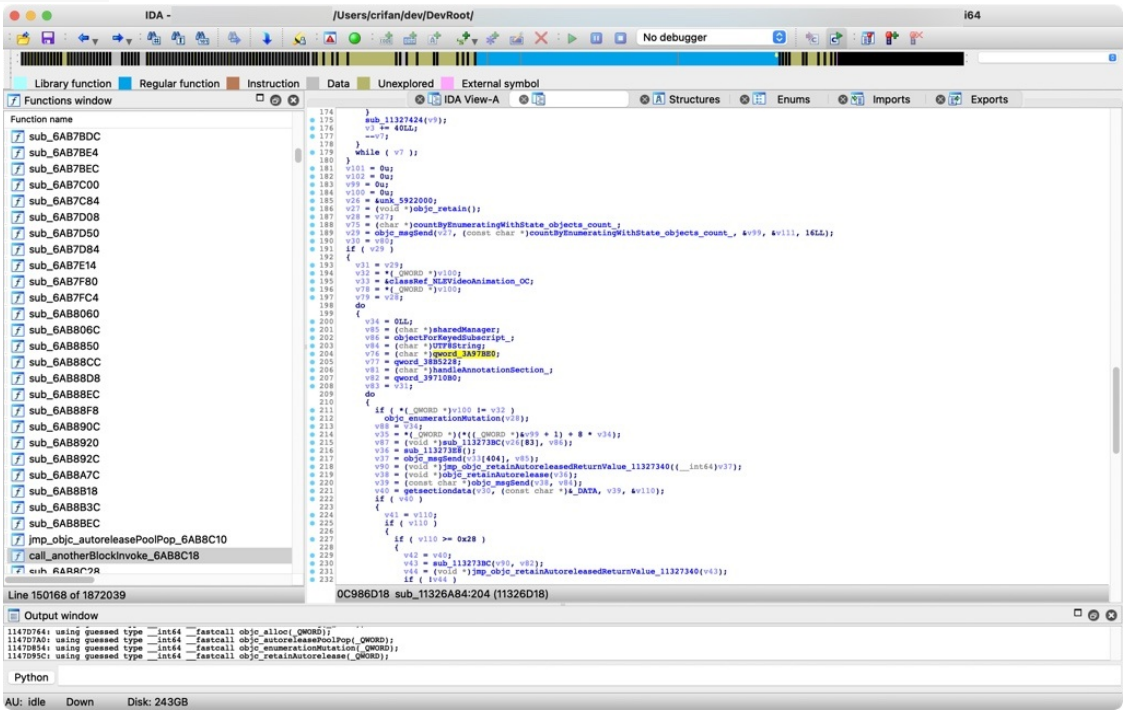
- unk
  - unk_5922000



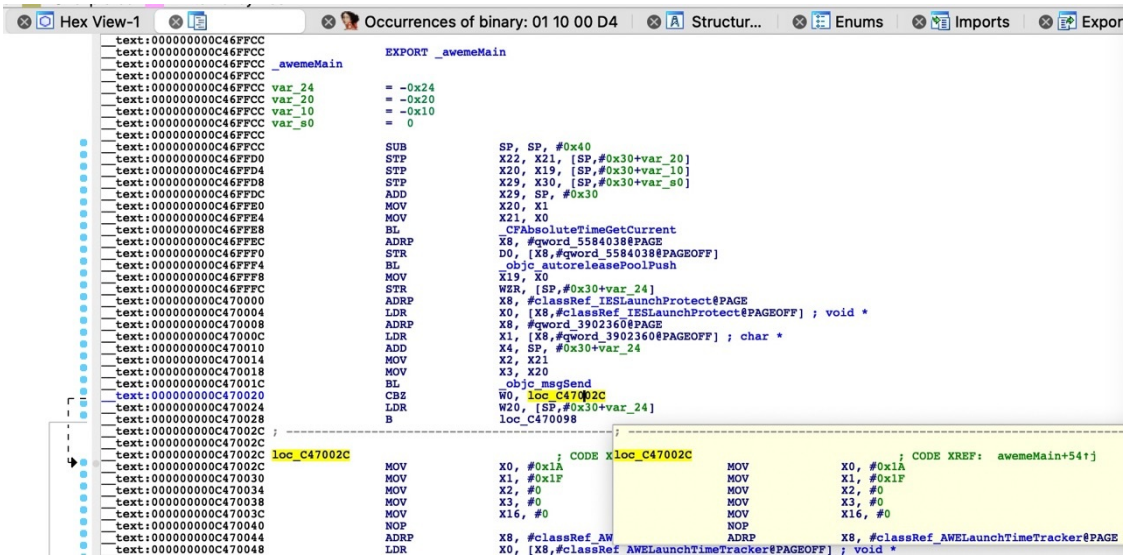
  - unk_196E8C0



- `qword`
  - `qword_3A97BE0`



- `loc`
  - `loc_C47002C`



sub函数

关于sub函数的一些细节说明：

- `sub_xxx`：普通的函数（有代码处理逻辑的）
  - 比如去改名的话，可以改名叫做：
    - sub_BinaryOffset
    - sub_AddressInsideBinary
- `nullsub_xxx`：`空函数`（没有任何代码逻辑的）
  - IDA中关于`空函数`的介绍

```
Rename empty functions as nullsub_...
  This option allows IDA to rename empty functions containing only a "return" instruction as "nullsub_..."
  (... is replaced by a serial number: 0,1,2,3...)
```

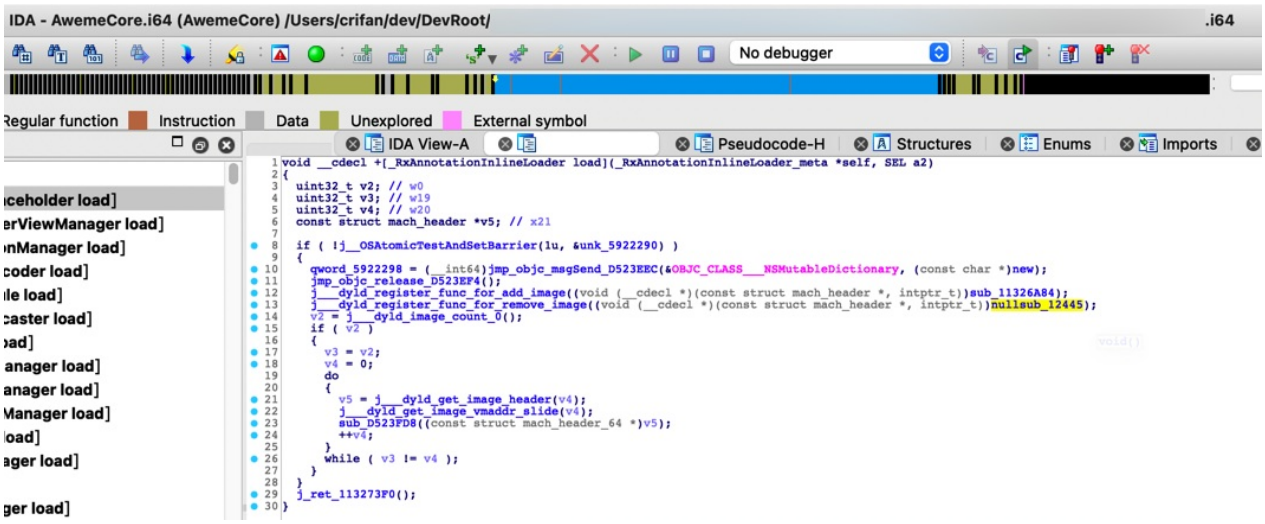
此处给出实例：

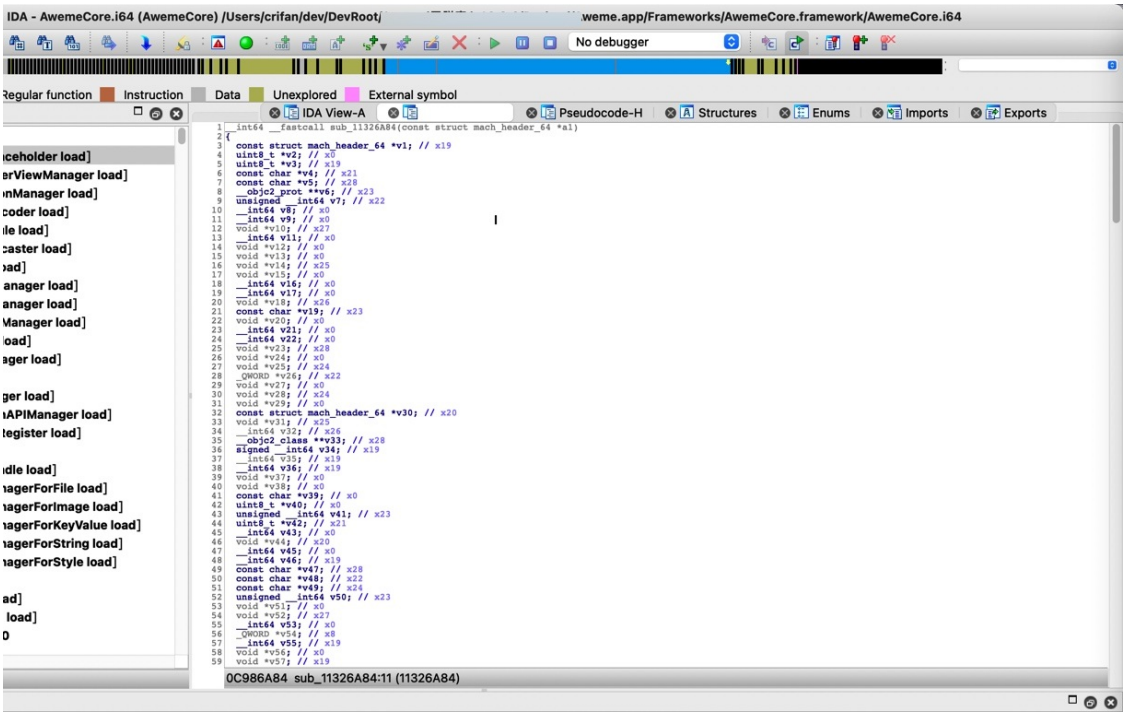
举例：

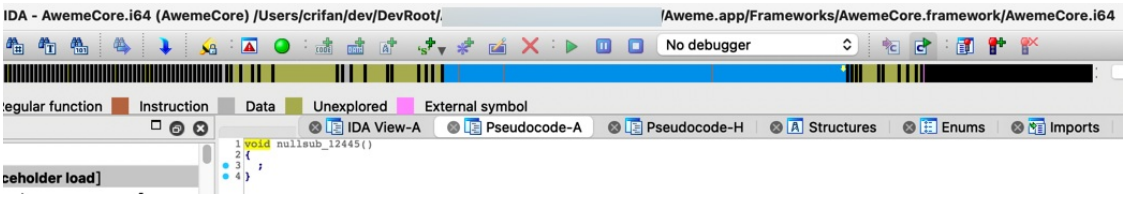
【未解决】研究抖音越狱检测逻辑：_RxAnnotationInlineLoader的load

中的：

```
void __cdecl +[_RxAnnotationInlineLoader load](_RxAnnotationInlineLoader_meta *self, SEL a2)
{
...
    j___dyld_register_func_for_add_image((void (__cdecl *)(const struct mach_header *, intptr_t))sub_11326A84);
    j___dyld_register_func_for_remove_image((void (__cdecl *)(const struct mach_header *, intptr_t))nullsub_12445);
```



- _dyld_register_func_for_add_image传入的函数：sub_11326A84
  - 就是个普通的，内部有代码逻辑的函数：
    - 

- _dyld_register_func_for_remove_image传入的函数：nullsub_12445
  - 从名字看，就知道：是个null的 空的 函数
  - 进入看，果然是空的，啥也没有
    - 

具体含义

qword

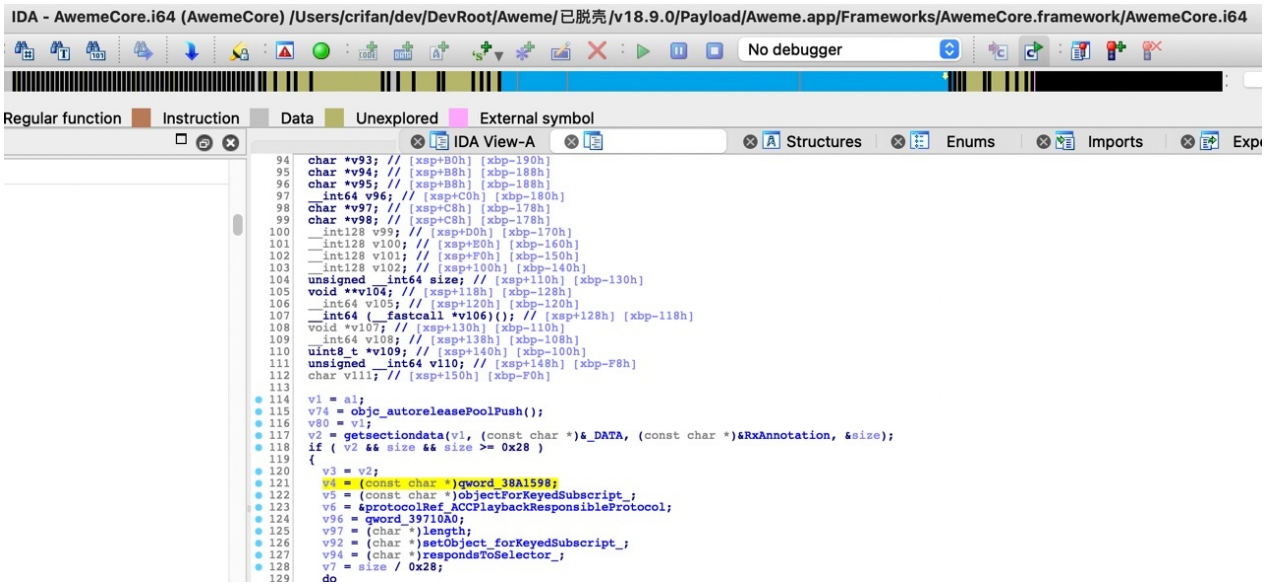
对于qword：

- 常常是：常量字符串

- 偶尔是：其他类型
  - 比如字典的指针等等
- 核心逻辑是：
  - qword_xxx的xxx是二进制内偏移量 + 二进制的ALSR = 实际（字符串的）地址
  - 去查看： 实际（字符串的）地址 = （即可查看到）保存了对应的字符串

此处举例说明：

IDA伪代码：




```
v4 = (const char *)qword_38A1598;
```

计算 `qword_38A1598` 的实际的值是什么

而通过此处的类型强制转换 `(const char *)` 可以看出是个字符串，所以此处就是去看看：到底字符串的值是什么

先查看当前二进制的ALSR基地址：

```
(lldb) image list -o -f | grep AwemeCore
[  0] 0x0000000100a98000 /Users/crifan/Library/Developer/Xcode/DerivedData/Aweme-fswcidjoxbkibsdwekuzlsfcdqls/Build/Products/Debug-iphoneos/Aweme.app/Frameworks/AweMeCore.framework/AweMeCore
```

再继续计算此处的字符串的值：

```
(lldb) p/x 0x0000000100a98000 + 0x38A1598
(long) $7 = 0x0000000104339598
(lldb) x/1gx 0x0000000104339598
0x104339598: 0x000000010185c42e
(lldb) po (char *)0x000000010185c42e
"dynamicCast:"
```

unk

`unk` 本身是IDA伪代码解析后，不知道变量具体的值什么类型，所以无法给出更加精准的变量命令。

此处，通过具体例子来介绍，如何调试和计算真实的值

unk_3F852B3是字符串

比如：

```
__int64 __fastcall sub_11326A84(const struct mach_header_64 *a1)
{
  ...
  v2 = getsectiondata(v1, (const char *)unk_3F852B3, (const char *)unk_47DC9B8, &size);
  if ( v2 && size && size >= 0x28 )
  {
  ...
    v4 = (const char *)qword_38A1598;
```

其中的：`unk_3F852B3`

由名字可知，该变量的地址是：`3F852B3`

IDA中通过地址可以查看到内容=定义是：

```
_D_cstring 0000000003F852B3 unk_3F852B3     % 1                     ; DATA XREF: sub_5B77470 3C↓o
```

是看不出具体类型和具体的值的。

不过，此处动态调试期间，可以根据地址算出来：

`unk_RelativeAddress` -> `ALSR` 基地址 + `RelativeAddress` = 当前内存地址

先去看：ALSR基地址 = 二进制加载的首地址 = 此处是抖音的 `AwemeCore` 加载的首地址 = 如前面已计算出是 `0x0000000100a98000`

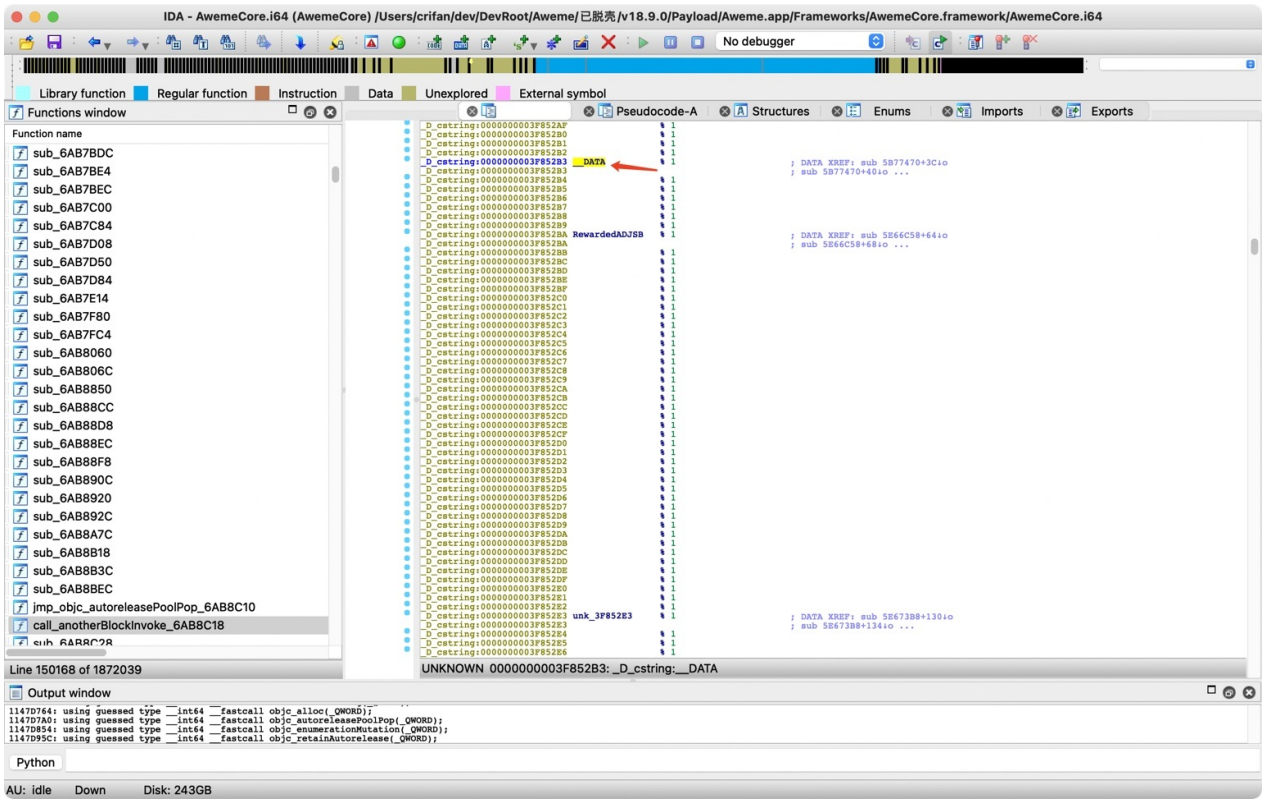
计算过程：

```
(lldb) p/x 0x0000000100a98000 + 0x3F852B3
(long) $0 = 0x0000000104a1d2b3
(lldb) po (char*)0x0000000104a1d2b3
"__DATA"

(lldb) x/1gx 0x0000000104a1d2b3
0x104a1d2b3: 0x5200415441445f5f
(lldb) po (char*)0x5200415441445f5f
""
```

所以才看出此时：

`unk_3F852B3` == "__DATA"

所以再去优化IDA中的代码：把 `unk_3F852B3` 改名为 `__DATA`



以及，IDA伪代码中，也去刷新即可看到新的变量名：

```
v2 = getsectiondata(v1, (const char *)_DATA, (const char *)RxAnnotation, size);
if ( v2 && size && size >= 0x28 )
```

-> 从而使得代码逻辑稍微更加清晰了一点。

-> 类似的，别的 `unk` 的地址，也可以计算出调试时的内存地址，从而查看到是什么值

- `unk_3F852BA`

```
(lldb) p x 0x0000000100a98000 + 0x3F852BA
(long) $3 = 0x0000000104a1d2ba
(lldb) po (char *)0x0000000104a1d2ba
"RewardedADJSB"
```

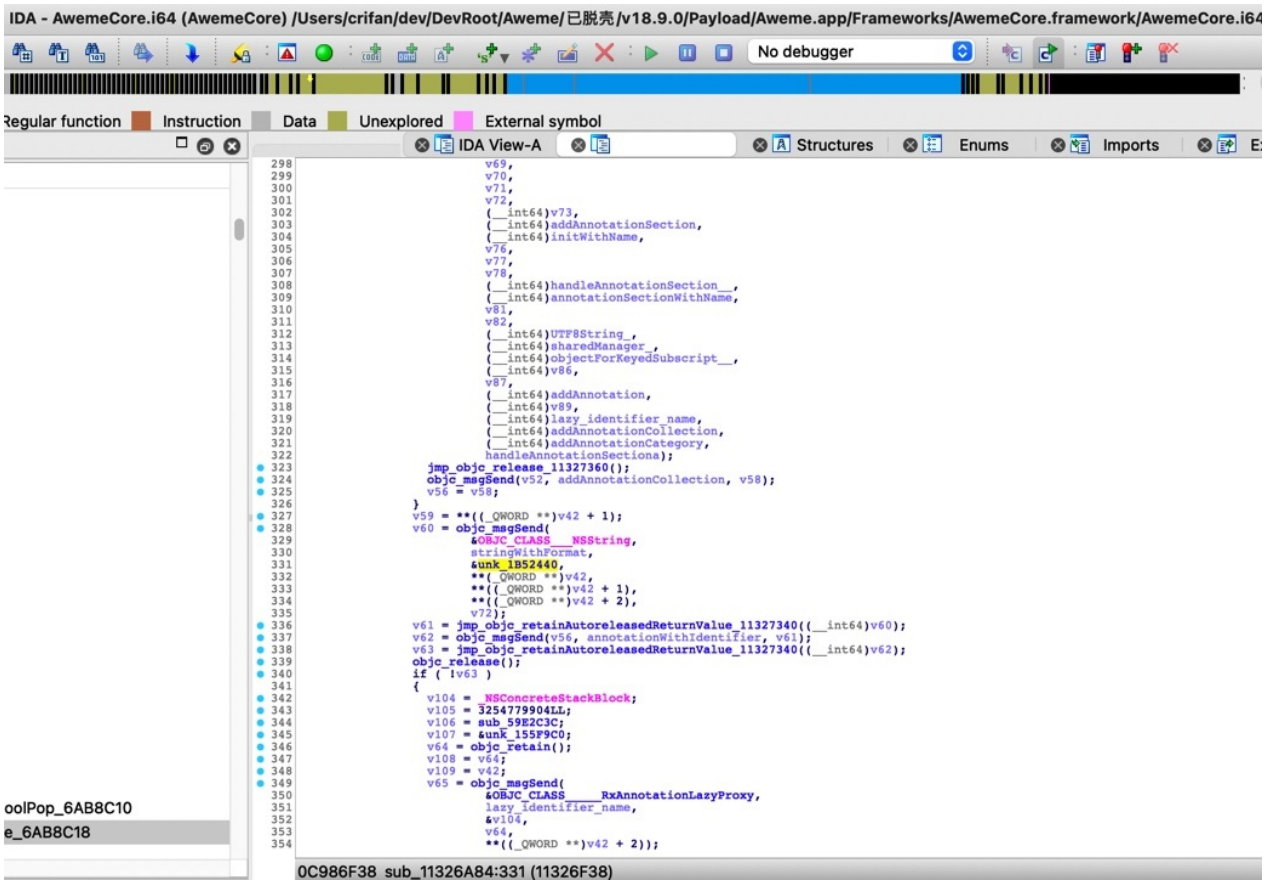
- `unk_47DC9B8`

```
(lldb) p x 0x0000000100a98000 + 0x47DC9B8
(long) $5 = 0x00000001052749b8
(lldb) po (char *)0x00000001052749b8
"RxAnnotation"
```

unk_1B52440是字符串

再给出一个例子，介绍如何计算unk的值：

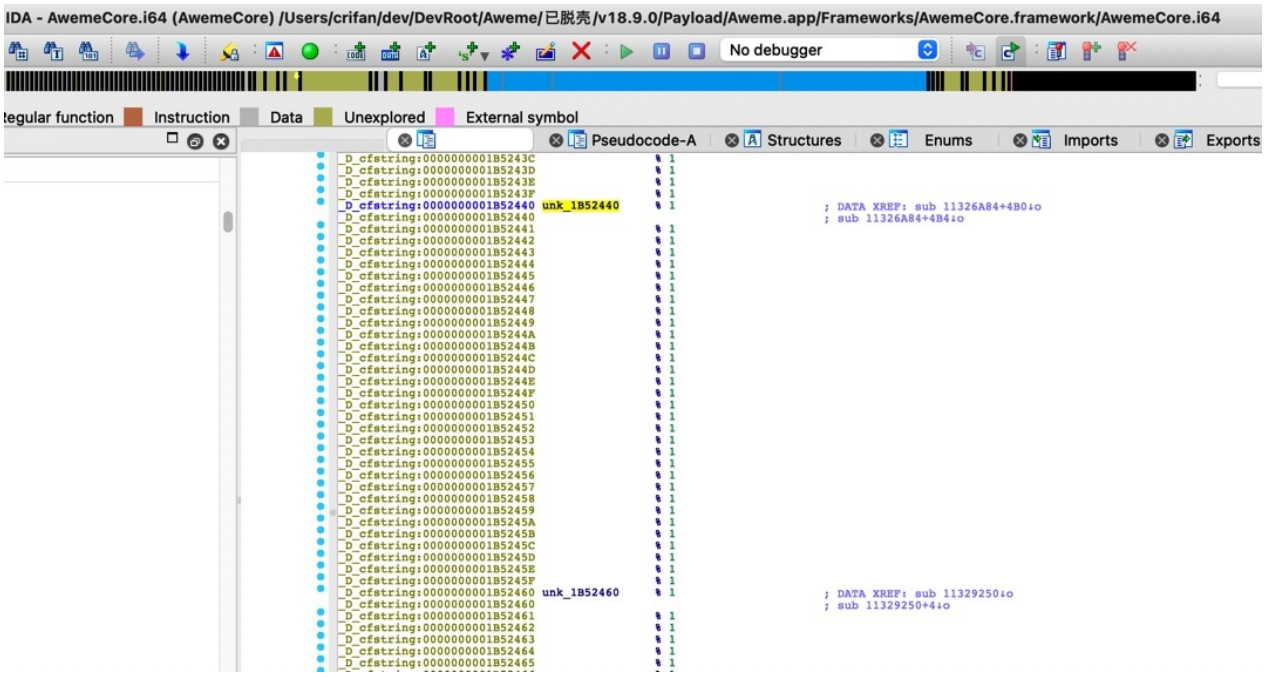
IDA伪代码：




```
v60 = objc_msgSend(
        OBJC_CLASS___NSString,
        stringWithFormat,
        unk_1B52440,
        **(_QWORD **)v42,
        **((_QWORD **)v42 + 1),
        **((_QWORD **)v42 + 2),
        v72);
```

IDA中定义是：

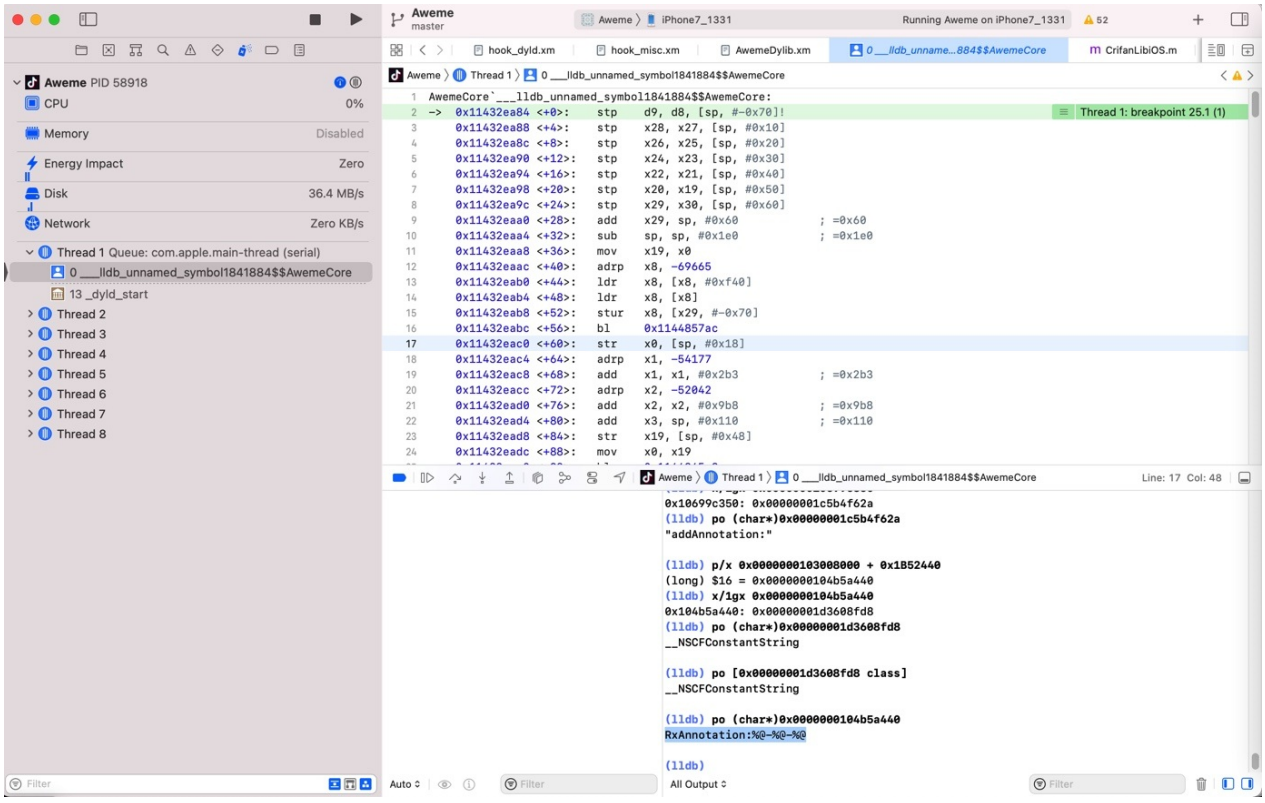
```
_D_cfstring 0000000001B52440 unk_1B52440      % 1                     ; DATA XREF  sub_11326A84 4B0↓o
```



注意到其中的 `_D_cfstring` = `constant string` ？

去计算值：

```
(lldb) p x 0x0000000103008000 + 0x1B52440
(long) $16 = 0x0000000104b5a440

(lldb) po (char *)0x0000000104b5a440
RxAnnotation @ @ @
```



即：

`unk_1B52440` = `constant string` 常量字符串： `RxAnnotation:%@-%@-%@`

然后去优化IDA伪代码，把 `unk_1B52440` 改为更容易读懂的名字，比如 `RxAnnotation_percentAt_percentAt_percentAt` 。

另外类似的例子：

- `unk_1942B60`

IDA伪代码：

```
jmp_objc_msgSend_D523EEC(HMDNetworkReqModelObj, (const char *)setMethod_, unk_1942B60);
```

IDA中定义：

```
_D_cfstring 0000000001942B60 unk_1942B60     % 1                    ; DATA XREF  sub_59FA0FC 14↓o
_D_cfstring 0000000001942B60                                        ; sub_59FA0FC 18↓o ...
```

计算逻辑：

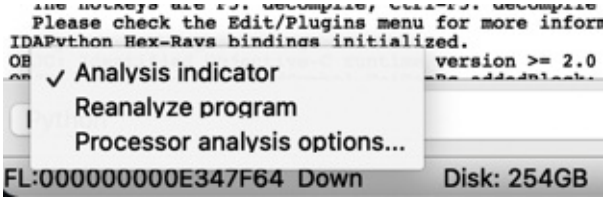
```
(lldb) p x 0x0000000105140000 + 0x1942B60
(long) $22 = 0x0000000106a82b60
(lldb) po (char *)0x0000000106a82b60
POST

(lldb) po [0x0000000106a82b60 class]
__NSCFConstantString
```

-> `unk_1942B60` 是 `__NSCFConstantString` 字符串常量： `"POST"`

自动分析

典型过程：把二进制文件拖动到IDA后，就开始自动分析`了。

IDA中默认已开启左下角的：

- `Analysis indicator` = `自动分析指示器`
  - 图
    - 

  - 作用：可以显示当前自动分析的进度

为何要（自动）分析?

我们用IDA去分析二进制中代码的逻辑。

而二进制本身其实只有 `0` 和 `1` 二进制数据而已。

而想要分析代码，即查看对应二进制对应的 `汇编代码` （以及后续的 `伪代码` ），所包含的函数，所包含的字符串等等信息，则就需要：

对二进制进行充分的分析，最后才能显示出我们要的上述的各种信息。

而对于二进制加载后的分析过程，IDA叫做：

- `自动分析` = `auto analysis`

自动分析的过程和阶段

自动分析会先后有多个阶段，其中阶段的名称是2个字母的缩写，可以在左下角看到

具体阶段和含义是：

- `FL:<address>` execution **FL**ow is being traced
- `PR:<address>` a function (=**PR**ocedure?) is being created
- `TL:<address>` a function **T**ai**L** is being created
- `SP:<address>` the **S**tack **P**ointer is being traced
- `AC:<address>` the **A**ddress is being analyzed
- `LL:<number>` a signature file is being loaded
- `L1:<address>` the first pass (**L**evel **1**) of FLIRT
- `L2:<address>` the second pass (**L**evel **2**) of FLIRT
- `L3:<address>` the third pass (**L**evel **3**) of FLIRT
- `TP:<address>` **TP**pe information is being applied
- `FI:<address>` the **FI**nal pass of autoanalysis
- `WF:<address>` **W**eak execution **F**low is being traced
- `AU: idle` **A**utoanalysis is finished

不同阶段举例

- FL=Flow

- PR=PRocedure

- AC = Address

- FI=Final
- WF=Weak

- WU: idle

自动分析要多长时间

自动分析完毕所需时间，取决于，二进制文件大小，以及其内部逻辑复杂程度

一般来说：

- 很小的二进制文件：耗时很短，马上就结束了
  - 举例
    - 几十KB的抖音Aweme，耗时很短，没几分钟就结束了
- 很大的二进制文件：耗时很久，有的长达数个小时
  - 举例

- 200多MB的抖音AwemeCore，IDA自动解析最终耗时，大约12个小时

搜索

TODO：

- 【整理】IDA使用心得：search搜索查找

IDA中的搜索，可以用于各种地方，包括函数列表，字符串列表，全局搜索，等等。

其中和搜索相关，有些通用的逻辑，此处解释一下。

快捷键

此处整理IDA的快捷键：

IDA_Pro_Shortcuts.pdf (hex-rays.com)

由于：`快捷键` = `Shortcut` = `cheatsheet`

所以此处是：`IDA Pro Cheatsheet`

IDAPro 7.5 – document updated February 09, 2021

File Operations

Parse C header file...	Ctrl+F9
Create ASM file...	Alt+F10
Save	Ctrl+W
Exit with Save	Alt+X or Alt+F4

Navigation

Jump to operand	Enter
Jump in a new window	Alt+Enter
Jump to previous position	Esc
Jump to next position	Ctrl+Enter
Jump to address...	G
Jump by name...	Ctrl+L
Jump to function...	Ctrl+P
Jump to pseudocode	Tab
Jump to segment...	Ctrl+S
Jump to segment register...	Ctrl+G
Jump to problem...	Ctrl+Q
List cross references to...	Ctrl+X
Jump to xref to operand...	X
Jump to entry point...	Ctrl+E
Mark position...	Alt+M
Jump to marked position...	Ctrl+M
Error operand	Ctrl+F

Search

Next code	Alt+C
Next data	Ctrl+D
Next explored	Ctrl+A
Next unexplored	Ctrl+U
Immediate value...	Alt+I
Next immediate value	Ctrl+I
Text...	Alt+T
Next text	Ctrl+T
Sequence of bytes...	Alt+B
Next sequence of bytes	Ctrl+B

Edit (Data Types – etc)

Rename	N
Enter repeatable comment...	;
Enter comment...	:
Begin selection	Alt+L
Code	C
Data	D
Struct var...	Alt+Q
String	A
Array...	Numpad*,*
Undefine	U
Enter anterior lines...	Ins
Enter posterior lines...	Shift+Ins
Offset (data segment)	O
Offset (current segment)	Ctrl+O
Offset by (any segment)...	Alt+R
Offset (user-defined)...	Ctrl+R
Offset (struct)...	T
Number (default)	#
Hexadecimal	Q
Decimal	H
Binary	B
Character	R
Segment	S
Enum member...	M
Stack variable	K
Change sign	_
Bitwise negate	~
String literals...	Alt+A
Setup data types...	Alt+D
Edit segment...	Alt+S
Change segment register value...	Alt+G
Struct var...	Alt+Q
Select union member...	Alt+Y
Undo	Ctrl+Z
Redo	Ctrl+Shift+Z

Open Subviews

Local types	Shift+F1
Functions	Shift+F3
Names	Shift+F4
Signatures	Shift+F5
Segments	Shift+F7
Segment registers	Shift+F8
Structures	Shift+F9
Enumerations	Shift+F10
Type libraries	Shift+F11
Strings	Shift+F12

Functions

Create function...	P
Edit function...	Alt+P
Set function end	E
Stack variables...	Ctrl+K
Change stack pointer...	Alt+K
Rename register...	V
Set type...	Y

Lumina

Pull all metadata	F12
Push all metadata	Ctrl+F12
View all metadata	Alt+F12

Debugger

Add breakpoint	F2
Start process	F9
Terminate process	Ctrl+F2
Step into	F7
Step over	F8
Run until return	Ctrl+F7
Run to cursor	F4
Breakpoint list	Ctrl+Alt+B
Stack trace	Ctrl+Alt+S

Dialog Boxes

Navigate	Tab, Shift+Tab
Toggle	Space
Confirm	Enter, Alt+K, Ctrl+Enter
Cancel	Esc, Alt+F4

Miscellaneous

Calculator...	?
Windows list (next)	Ctrl+Tab
Switch to window #1…9	Alt+1…9
Close window	Alt+F3
Script command...	Shift+F2
Exit	Alt+X

IDA功能详解

此处整理IDA中各种强大且好用的功能。

- 字符串
- 函数列表
- 查看代码
  - 汇编代码
  - 伪代码
    - F5查看伪代码
    - 导出伪代码
  - 函数调用关系
  - 结构体：设置好类的定义，伪代码自动解析出属性调用
- 导入和导出
- 插件
  - keypatch

查看代码

一般主要用IDA来查看和分析代码，代码主要分：

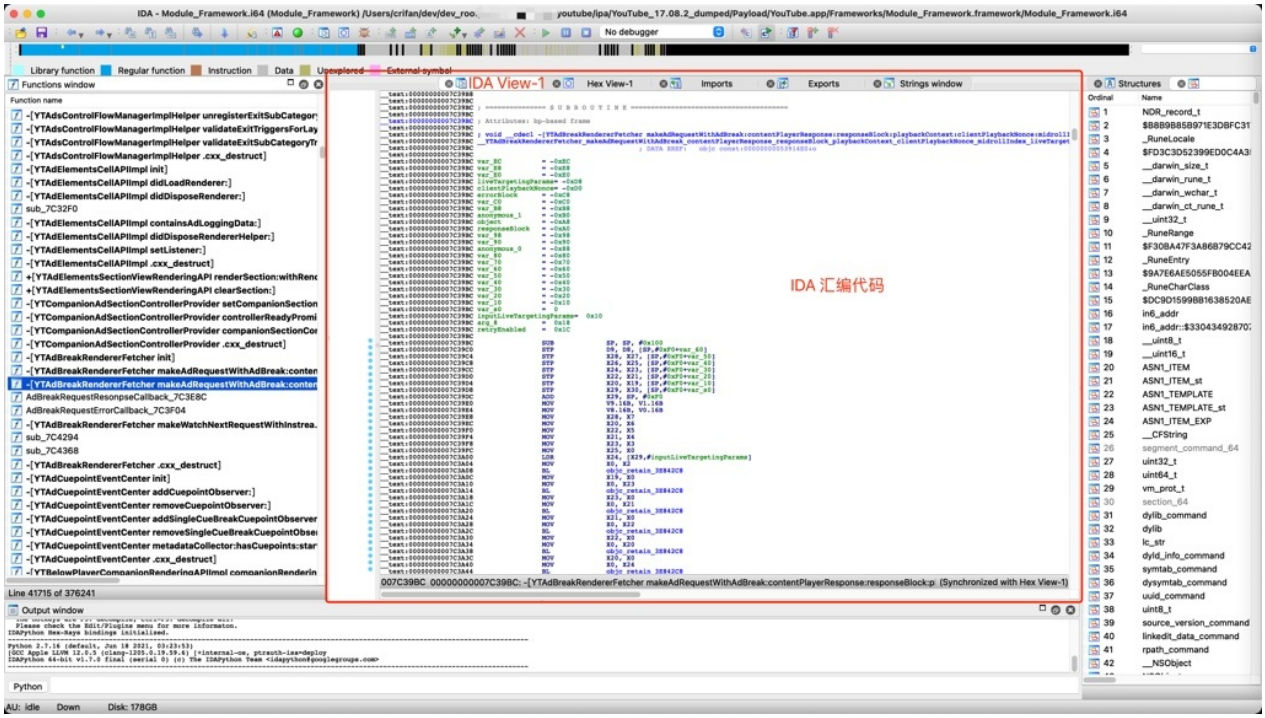
- `汇编代码`：从原始二进制的字节码，反汇编得到的汇编代码
- `伪代码`：从`汇编代码`用`F5`反编译得到的，很接近人类写的代码，人类能读懂代码逻辑的代码

汇编代码

TODO：

- 【已解决】IDA使用心得：IDA汇编代码如何快速找到匹配的Xcode汇编代码
- 【已解决】IDA中查看ARM汇编的伪代码
- 【未解决】IDA中开启宏指令比如ADRP和ADD变成ADRL
- 【整理】IDA使用心得：auto comments
- 【整理】IDA使用心得：OpCode区

IDA中的 `汇编代码` ，是从原始二进制的字节码，反汇编得到的汇编代码



一般来说，在逆向尝试搞懂代码逻辑时，不太需要直接查看汇编代码，因为的确很难直接看懂逻辑。

不过有些情况下，会用到汇编代码：

- iOS逆向
  - 静态分析
    - 有些汇编代码中，IDA已帮忙分析和插入了相关的解释信息，值得研究逻辑时去参考
      - 比如，YouTube逆向期间，IDA已帮忙给相关汇编加上了描述，指明了有些代码是vtable的部分
        - 便于分析和对照，寻找对应虚函数的具体实现
  - 动态调试
    - 想要找到调试期间的，Xcode中汇编代码，对应的代码逻辑
      - 往往就需要找到IDA中对应的伪代码是什么
        - 往往就需要先去找到IDA中汇编代码的位置
          - 再去F5（或Tab键）跳转到对应的伪代码的位置

伪代码

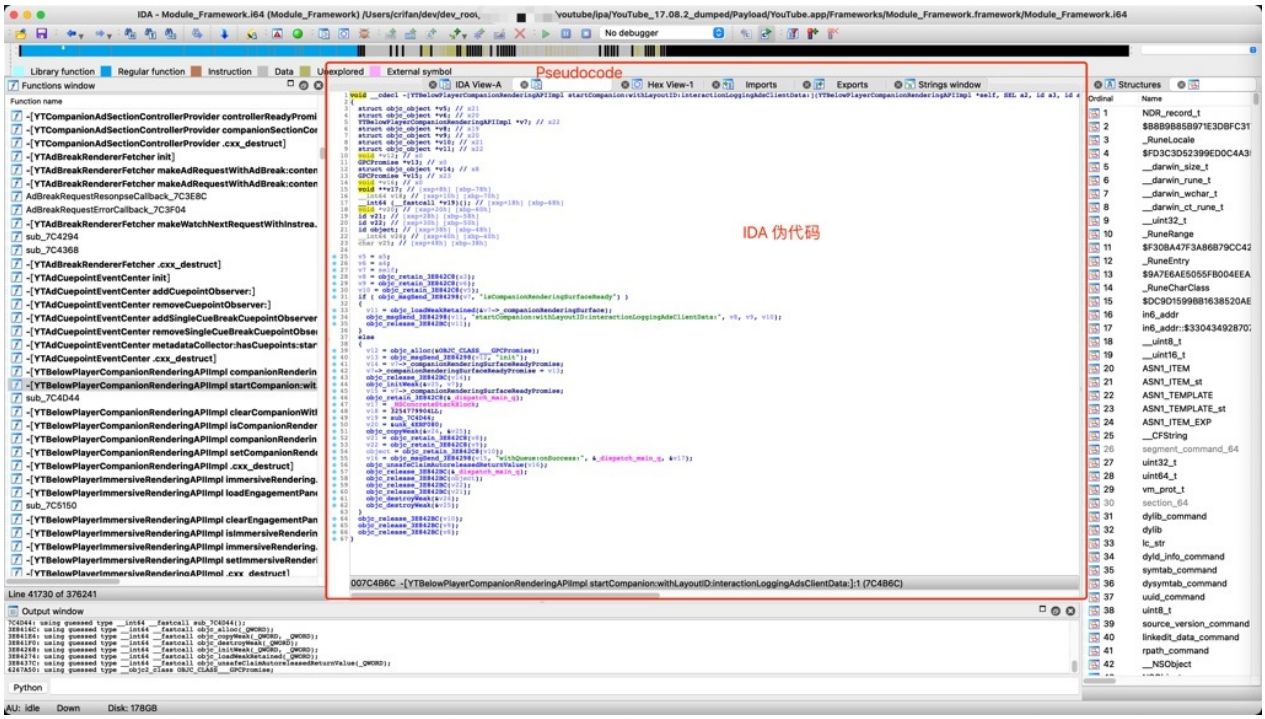
TODO：

- 【未解决】IDA使用心得：伪代码内新增变量
- 【整理】IDA使用心得：刷新当前已打开的伪代码用F5
- 【整理】IDA使用心得：伪代码中的指针+某个数值和0x开头LL结尾的数值不是一个意思
- 【整理】IDA使用心得：给伪代码添加注释
- 【整理】IDA使用心得：伪代码中的可变参数个数的函数去增加或删除参数
- 【整理】iOS逆向心得：IDA使用心得：改变值的显示格式从10进制改为16进制查看Block的flags标志位
- 【整理】iOS逆向心得：IDA Pro使用心得：给函数改名便于快速定位汇编伪代码对应关系
- 【iOS逆向心得】IDA使用心得：伪代码中在修改了别处函数定义后返回导致伪代码中函数调用参数丢失
- 【整理】IDA使用心得：反编译伪代码常见错误
  - Failures and troubleshooting (hex-rays.com)
- 【整理】IDA使用心得：如何理解反汇编后的伪代码的逻辑
- 【记录】IDA使用心得：objc_msgSend跳板函数重命名优化
- 【记录】IDA使用心得：伪代码改名重命名改回默认值
- 【记录】IDA使用心得：给伪代码的变量改名
- 【已解决】IDA使用心得：伪代码中如何找到对应的IDA汇编代码
- 【已解决】IDA中给汇编代码或伪代码改名
- 【整理】IDA使用心得：改名 给变量改类型
- 【整理】IDA使用心得：F5伪代码

代码逆向相关：

- 【已解决】IDA中xsp和xbp是什么意思如何定位地址
- 【整理】IDA使用心得：IDA伪代码和汇编代码 反汇编 逻辑关系 理解

IDA中，支持从 `汇编代码` ，按 `F5` 快捷键去 `反编译` 得到的 `伪代码` -> 很接近人类写的代码，人类能容易读懂代码逻辑的代码



IDA中最强的功能，应该就属这个 `伪代码` 了。

IDA反编译出的 `伪代码` ：

- 质量很高：很接近原程序的代码的逻辑
- 且有很多额外好用的功能支持
  - 比如
    - 重命名：rename
    - 变量更改类型：change type
    - 增加减少参数个数
    - 自动解析出类的属性的引用
    - 等等

伪代码中，右键，支持很多功能：

- Rename
- Set type
- Set number representation
- Edit indented comment
- Edit block comment
- Hide/unhide statements
- Split/unsplit expression
- Force call type
- Set call type
- Add/del variadic arguments
- Del function argument
- Add/delete function return type
- Jump to cross reference
- Jump to cross reference globally
- Generate HTML file
- Mark/unmark as decompiled
- Copy to assembly
- Show/hide casts

而根据当前元素类型，（可能）会显示额外菜单=功能=选项：

- 局部变量
  - Reset pointer type
  - Convert to struct *
  - Create new struct type
  - Map to another variable
  - Unmap variable(s)
  - Force new variable
- 联合体union
  - Select union field
- 括号类：圆括号、中括号、花括号
  - Jump to paired paren
- 文本
  - Copy快捷键：Ctrl+C
- C表达式关键字
  - Collapse/uncollapse item

具体细节详见：

Interactive operation (hex-rays.com)

导出全部伪代码

IDA中，一般来说，伪代码都是针对单个函数的：反编译再查看单个函数的伪代码。

后来发现，想要导出全部伪代码，也是可以的。

详见：

- 【未解决】用插件导出IDA的YouTube的Module_Framework的全部反汇编的源码伪代码
- 【已解决】IDA中用idat64的Batch Mode尝试反编译导出YouTube的Module_Framework全部代码伪代码

标记为已编译 Mark/unmark as decompiled

This command marks the current function as decompiled. It is a convenient way to track decompiled functions. Feel free to use it any way you want. Marking a function as decompiled will change its background color to the value specified by the MARK_BGCOLOR parameter in the configuration file. The background color will be used in the pseudocode window, in the disassembly listing, and in the function list.

拷贝到汇编 Copy to assembly

This command copies the pseudocode text to the disassembly window. It is available from the popup right-click menu. Please note that only "meaningful" lines are copied. Lines containing curly braces, else/do keywords will be omitted. The copied text is represented as anterior comments in the disassembly. Feel free edit them the way you want. The copied text is static and will not change if the pseudocode text changes.

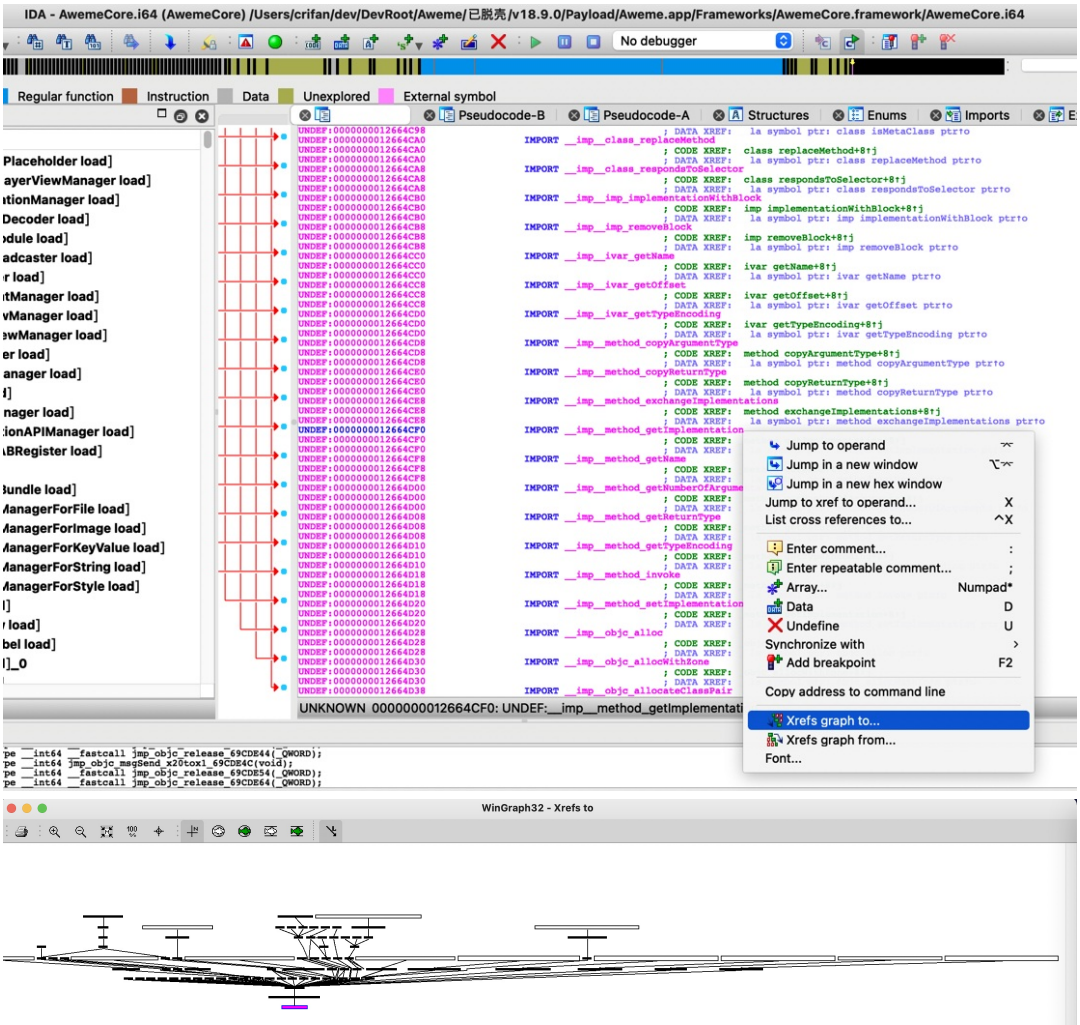
函数调用

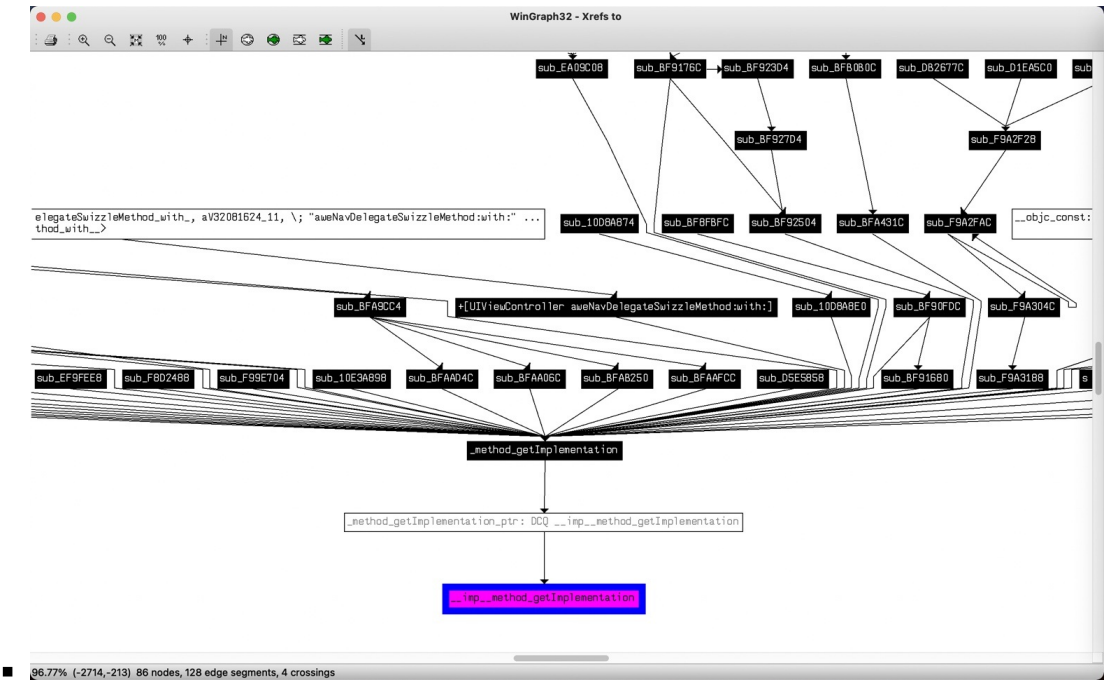
TODO：

- 【整理】iOS逆向心得：IDA中以列表形式列出函数被调用的地方
  - 【整理】iOS逆向心得之IDA使用心得：查看函数被调用的所有的地方即被调用函数的列表
  - 【整理】iOS逆向心得之IDA使用心得：如何快速找到真正的函数的被调用的列表函数名
- 【整理】IDA 使用心得：交叉引用以列表方式显示
- 【已解决】研究抖音Hook检测：调用到method_getImplementation的地方

IDA中代码分析方面，对于函数的调用的关系，也有很好的支持。

iOS逆向期间，往往涉及到，想要搞懂一个函数，被其他哪些地方调用到了等等，和函数调用关系相关的内容。IDA对此支持的都很好。

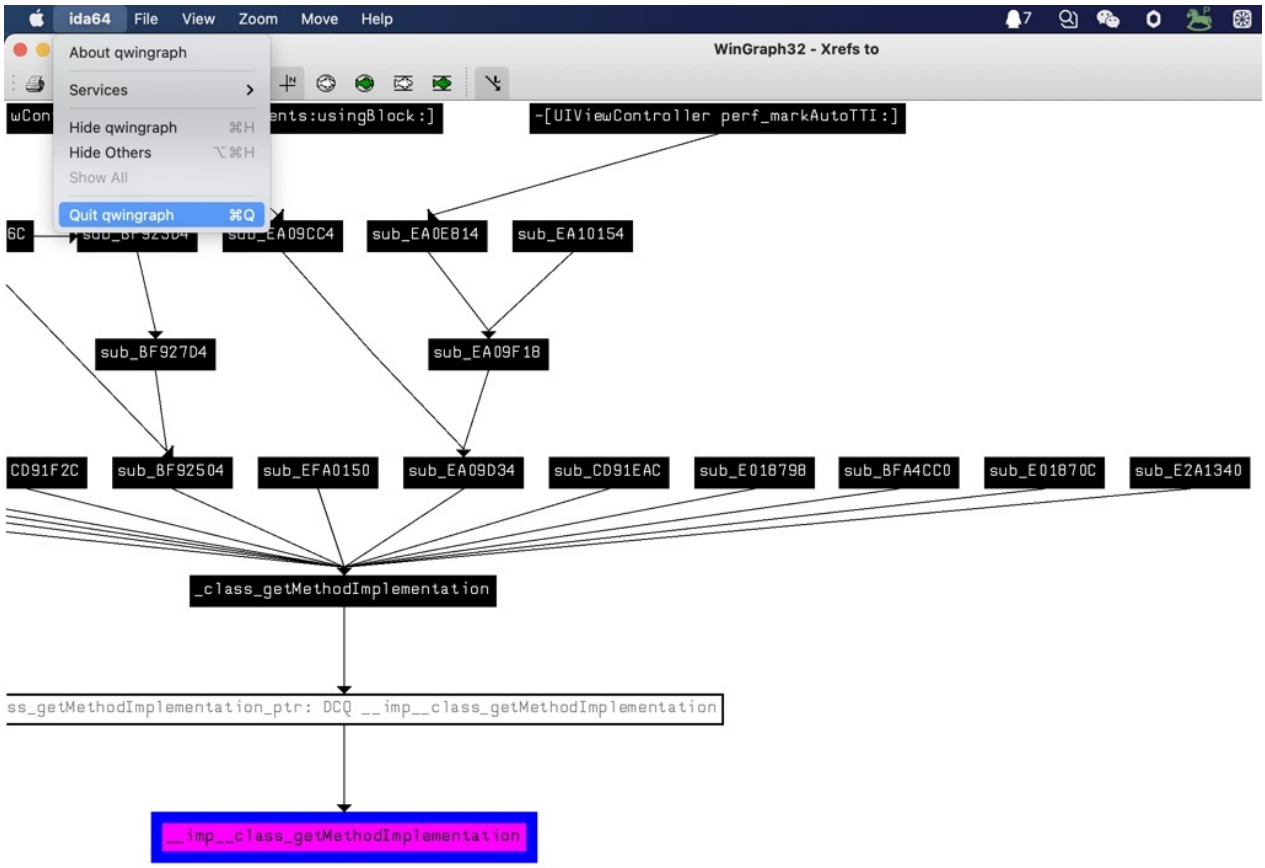
- 函数调用
  - 效果举例
    - Xrefs graph to
    - 



Xrefs to=有哪些地方引用到了此函数

显示界面的底层实现所用的库

IDA中函数调用的graph，通过 `ida64` 的quit，看到的是： `qwingraph`



而 `qwingraph` ，其实是一个插件，底层可视化插件

可以从

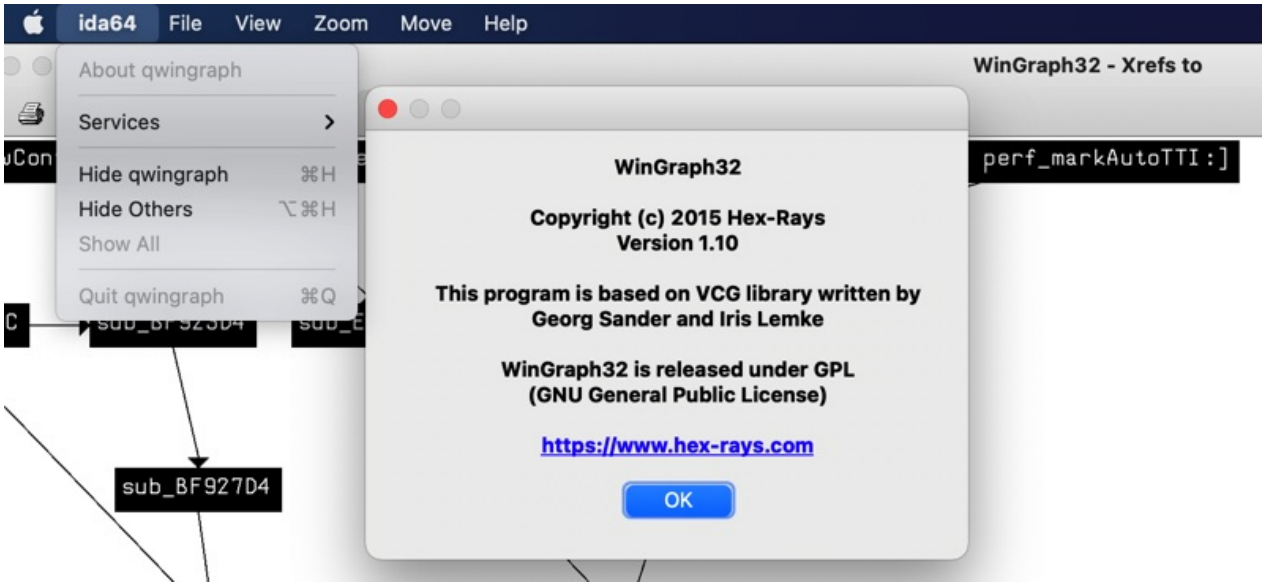
Download center (hex-rays.com)

找到：

- Qwingraph v1.10
  - Source code the Wingraph we use and modified (GPL)
    - https://hex-rays.com/products/ida/support/freefiles/qwingraph_src.zip

而 `WinGraph32` 本身的 `关于` 的信息是：

```
WinGraph32

Copyright (c) 2015 Hex-Rays
Version 1.10

This program is based on VCG library written by Georg Sander and Iris Lemke

WinGraph32 is released under GPL (GNU General Public License)

https://www.hex-rays.com
```



结构体定义

TODO：

- 新增Structure结构体定义 + 且双击后，可以导入到数据库中
  - 【已解决】IDA中如何给Local Types中struct MLServerABRLoader加上嵌入的struct结构体定义
- 【整理】iOS逆向心得：IDA使用心得：修改变量类型Set Ivar Type后IDA可以自动解析结构体的属性和字段
- 【整理】IDA使用心得：类的部分字段无法解析，导致伪代码中类的属性错误，需要手动修复结构体定义
-

IDA中，支持把类的原始定义，通过结构体的形式写出来（甚至自动分析出来对应结构体定义），从而后续的汇编代码和伪代码中，自动解析出类的属性和函数的调用，很是方便。

此处的类的结构体定义，主要涉及到两方面：

- `Structures`
  -
- `Local Types`

-

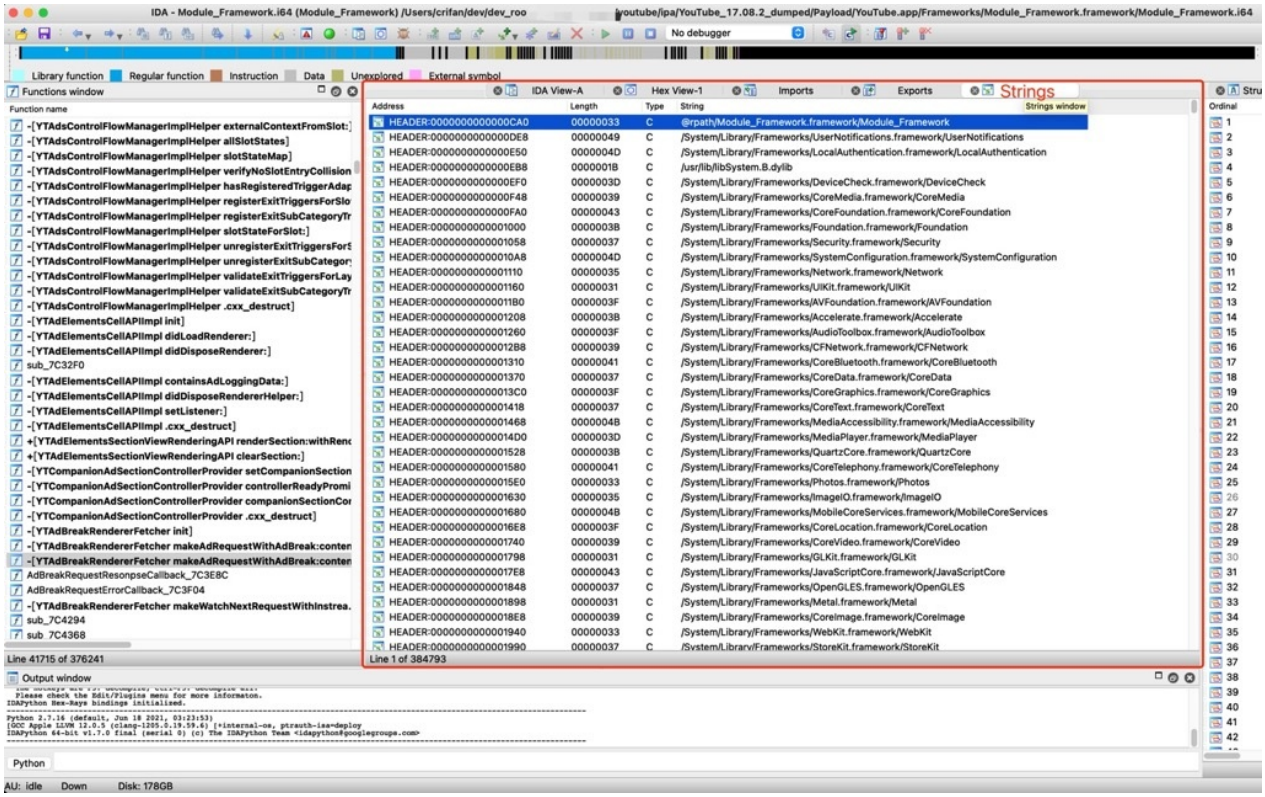
且也支持新增自定义的结构体，更改已有类的结构体的字段定义等，很强大好用的功能。

- 创建结构体

-

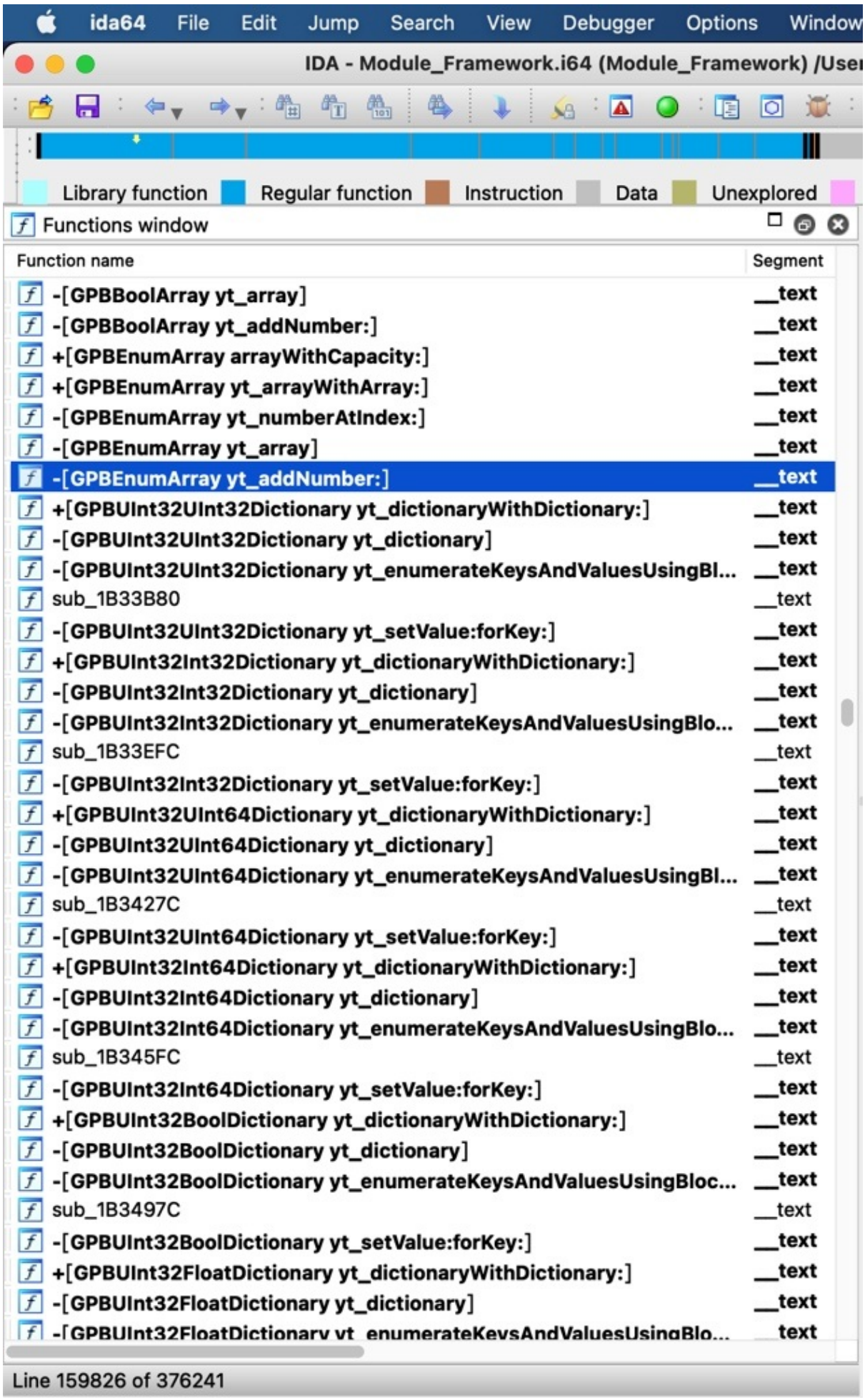
字符串

IDA也能自动分析出，二进制中有哪些字符串，放到一个单独视图 `Strings` ，供分析和研究。



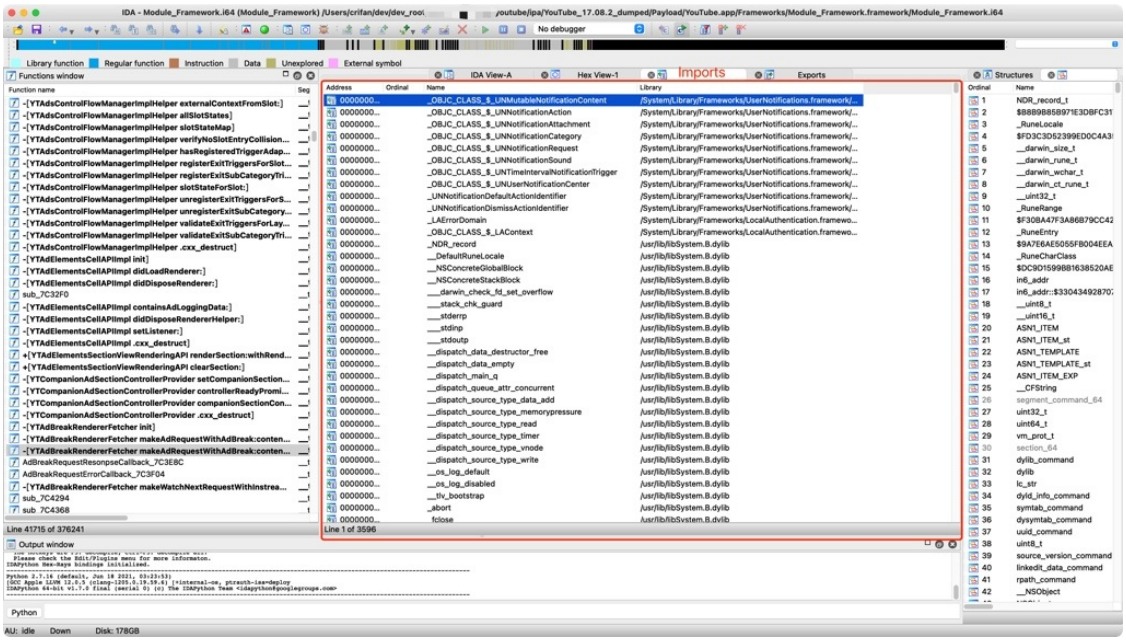
函数列表

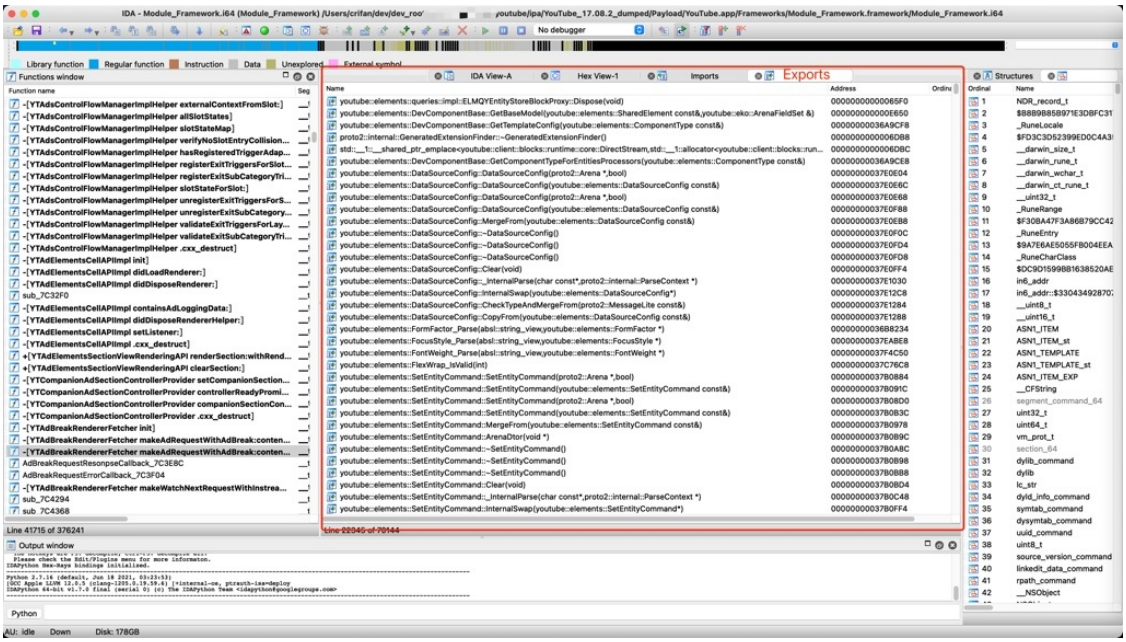
IDA可以分析出，二进制中的所有的函数，并且列出函数的列表，供查找和定位，以及后续代码逻辑的研究。


ida64 File Edit Jump Search View Debugger Options Window
IDA - Module_Framework.i64 (Module_Framework) /User
Library function
Regular function
Instruction
Data
Unexplored
Functions window
Function name
Segment
-[GPBBoolArray yt_array] __text
-[GPBBoolArray yt_addNumber:] __text
+[GPBEnumArray arrayWithCapacity:] __text
+[GPBEnumArray yt_arrayWithArray:] __text
-[GPBEnumArray yt_numberAtIndex:] __text
-[GPBEnumArray yt_array] __text
-[GPBEnumArray yt_addNumber:] __text
+[GPBUInt32UInt32Dictionary yt_dictionaryWithDictionary:] __text
-[GPBUInt32UInt32Dictionary yt_dictionary] __text
-[GPBUInt32UInt32Dictionary yt_enumerateKeysAndValuesUsingBl... __text
sub_1B33B80 __text
-[GPBUInt32UInt32Dictionary yt_setValue:forKey:] __text
+[GPBUInt32Int32Dictionary yt_dictionaryWithDictionary:] __text
-[GPBUInt32Int32Dictionary yt_dictionary] __text
-[GPBUInt32Int32Dictionary yt_enumerateKeysAndValuesUsingBlo... __text
sub_1B33EFC __text
-[GPBUInt32Int32Dictionary yt_setValue:forKey:] __text
+[GPBUInt32UInt64Dictionary yt_dictionaryWithDictionary:] __text
-[GPBUInt32UInt64Dictionary yt_dictionary] __text
-[GPBUInt32UInt64Dictionary yt_enumerateKeysAndValuesUsingBl... __text
sub_1B3427C __text
-[GPBUInt32UInt64Dictionary yt_setValue:forKey:] __text
+[GPBUInt32Int64Dictionary yt_dictionaryWithDictionary:] __text
-[GPBUInt32Int64Dictionary yt_dictionary] __text
-[GPBUInt32Int64Dictionary yt_enumerateKeysAndValuesUsingBlo... __text
sub_1B345FC __text
-[GPBUInt32Int64Dictionary yt_setValue:forKey:] __text
+[GPBUInt32BoolDictionary yt_dictionaryWithDictionary:] __text
-[GPBUInt32BoolDictionary yt_dictionary] __text
-[GPBUInt32BoolDictionary yt_enumerateKeysAndValuesUsingBloc... __text
sub_1B3497C __text
-[GPBUInt32BoolDictionary yt_setValue:forKey:] __text
+[GPBUInt32FloatDictionary yt_dictionaryWithDictionary:] __text
-[GPBUInt32FloatDictionary yt_dictionary] __text
-[GPBUInt32FloatDictionary yt_enumerateKeysAndValuesUsingBlo... __text
Line 159826 of 376241

导入和导出

IDA中还有2个独立的窗口是：

- Import=导入
  - 当前二进制，导入了哪些函数
    - = 引用了外部的，别的库的哪些函数
  - 举例
    - 

- Export=导出
  - 当前二进制，导出了哪些函数
    - 供别处（比如自己程序的另外的二进制中去）使用
  - 举例
    - 

在逆向分析时，可以根据，导出和导出，找到一些相关线索

比如，在iOS逆向的越狱检测和反越狱检测中，就可以去找，当前二进制是否导入了，常用于越狱检测的一些系统函数。

详见：

【整理Book】iOS逆向开发：越狱检测和反越狱检测

插件

IDA还支持插件的机制，可以扩展支持更多更强的各种功能。

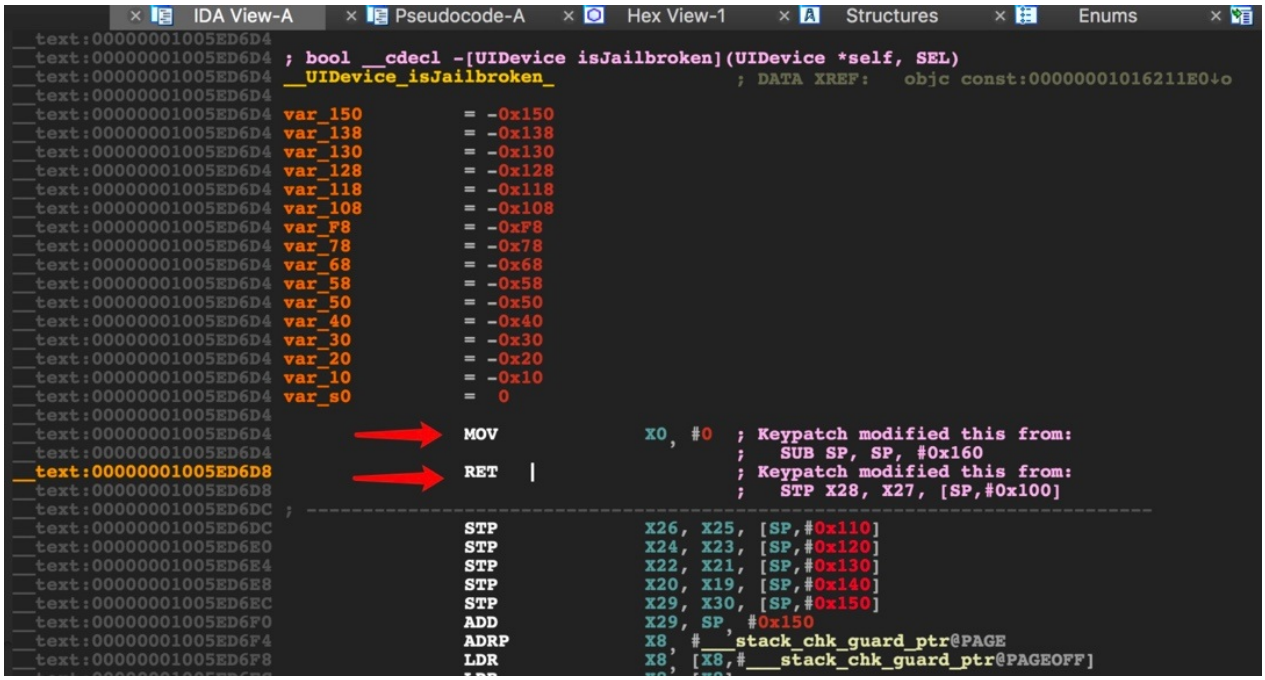
常见的插件有：

- keypatch

有机会参考

iOS重打包绕过签名校验防护 | La0s

> 使用Keypatch插件patch两条汇编 `MOV X0, #0` && `RET`



去试试：

- 用keypatch插件，patch打补丁，插入（汇编）指令

其他插件

Third-party plugins

->

onethawt/idaplugins-list: A list of IDA Plugins

IDA使用心得

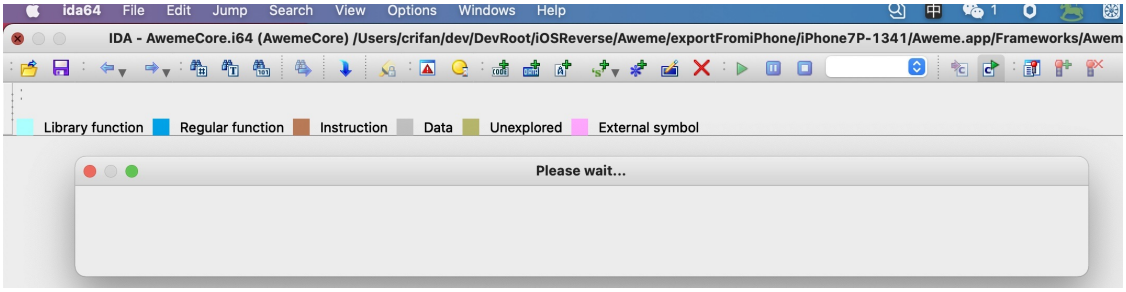
TODO：

- 【记录】IDA Pro使用记录
- 【已解决】IDA中View-A中如何方便的选择并拷贝汇编代码
- 【未解决】IDA反编译的伪代码有错误如何修改改动
- 【未解决】IDA调试iPhone中的iOS的app
-
- 【已解决】自己Mac中恢复IDA开发环境
  - 【已解决】Mac Big Sur中运行ida64.app报错：您没有权限来打开应用程序
  - 【已解决】Mac Big Sur中正常运行IDA Pro中的ida.app
- 函数调用图
  - 【记录】研究YouTube广告视频请求相关函数：sub_3B8318C
- 【无需解决】自己Mac打开ida64的文件提示IDA Pro已过期
- 【iOS逆向心得】IDA使用心得：伪代码中在修改了别处函数定义后返回导致伪代码中函数调用参数丢失
- 【整理】iOS逆向心得：IDA Pro使用心得：给函数改名便于快速定位汇编伪代码对应关系
- 【整理】IDA使用心得：通过给函数Set Item Type去修正函数的参数的个数和类型和返回值类型
- 【整理】iOS逆向心得：IDA使用心得：改变值的显示格式从10进制改为16进制查看Block的flags标志位
- 【整理】iOS逆向心得：IDA使用心得：修改变量类型Set Ivar Type后IDA可以自动解析结构体的属性和字段
-
- 【整理】IDA使用心得：根据selector跳转到函数
-
- Local Types 结构体 类定义
  - 【已解决】IDA中如何给Local Types中struct MLServerABRLoader加上嵌入的struct结构体定义
  - 【已解决】IDA中修改类的结构体定义报错：Failed to save the new type Probably some of its symbols are already used elsewhere
  - 【已解决】IDA中如何指定Local Types中HAMDASHSampleBufferSource的bool属性_pendingSeek后偏移量是0x4
  - 【无法解决】IDA尝试修改Structures中类型的属性的offset偏移量时弹框警告：Oops IDA has almost crashed
  - 【已解决】IDA中类HAMDASHSampleBufferSource的属性解析出错：could not convert typeinfo failed to add null invalid type name
  - 【已解决】IDA中Structures结构体定义中修改自定义类的属性的偏移量
  - 【整理】IDA心得：自定义的类的属性偏移量和自动生成的偏移量不匹配
  - 【整理】IDA使用心得：类的部分字段无法解析，导致伪代码中类的属性错误，需要手动修复结构体定义
  - 【未解决】研究YouTube逻辑：补全MLServerABRLoader的字段属性偏移量对应关系
- 【记录】IDA中新增YouTube的CDStruct的相关结构体字段定义
- 【整理】IDA使用心得：跳转到历史列表的函数位置
- 【整理】IDA使用心得：给伪代码添加注释
- 【整理】IDA使用心得：伪代码中的可变参数个数的函数去增加或删除参数
- 【整理】IDA使用心得：伪代码中的指针+某个数值和0x开头LL结尾的数值不是一个意思
- 【已解决】IDA中伪代码含义：std basic_string char_traits allocator append
- 【整理】IDA使用心得：把类结构Structures的窗口放在右边方便对比查看
- 【整理】IDA使用心得：刷新当前已打开的伪代码用F5
- 【未解决】IDA使用心得：伪代码内新增变量
- 【已解决】IDA使用心得：如何修改设置函数结束位置
- 【整理】IDA使用心得：反编译伪代码有bug导致子函数调用丢失
- 【或许解决】IDA伪代码更改变量名等改动代码后切换回来改动丢失

使用IDA逆向分析和调试期间，有很多心得，整理如下，供参考。

打开和关闭

IDA，对于打开比较大（比如100多MB）的二进制的话：

- 打开：
  - 首次打开：需要的解析时间很长
  - 再次打开：也需要点时间（大概几十秒，根据已解析的数据库大小决定）
- 关闭：保存改动，写入数据库，也会耗时较长
  - 所以在关闭时，要有耐心，等正常完成后自动关闭
    - 

打开

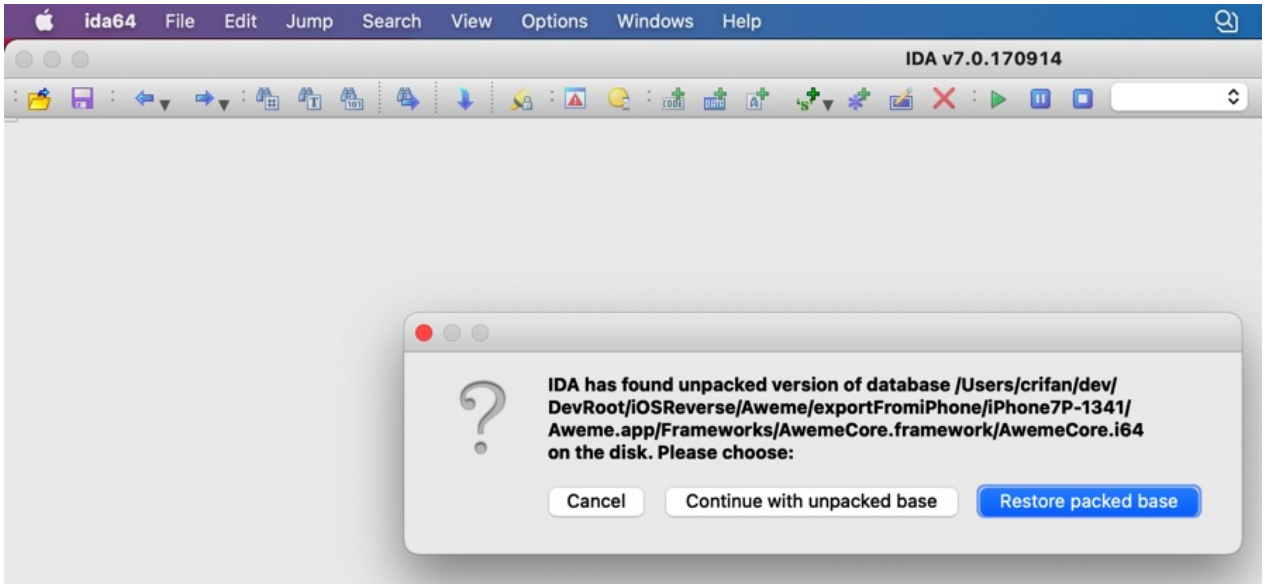
双击 `.i64` 文件，可以调用IDA（中的 `ida64` ）去打开：

即可正常打开。

如果之前没有正常关闭，则会提示：

> IDA has found unpacked version of database on the disk. Please choose:
>
> - Cancel
> - Continue with unpacked base
> - Restore packed base

一般选：`Restore packed base`

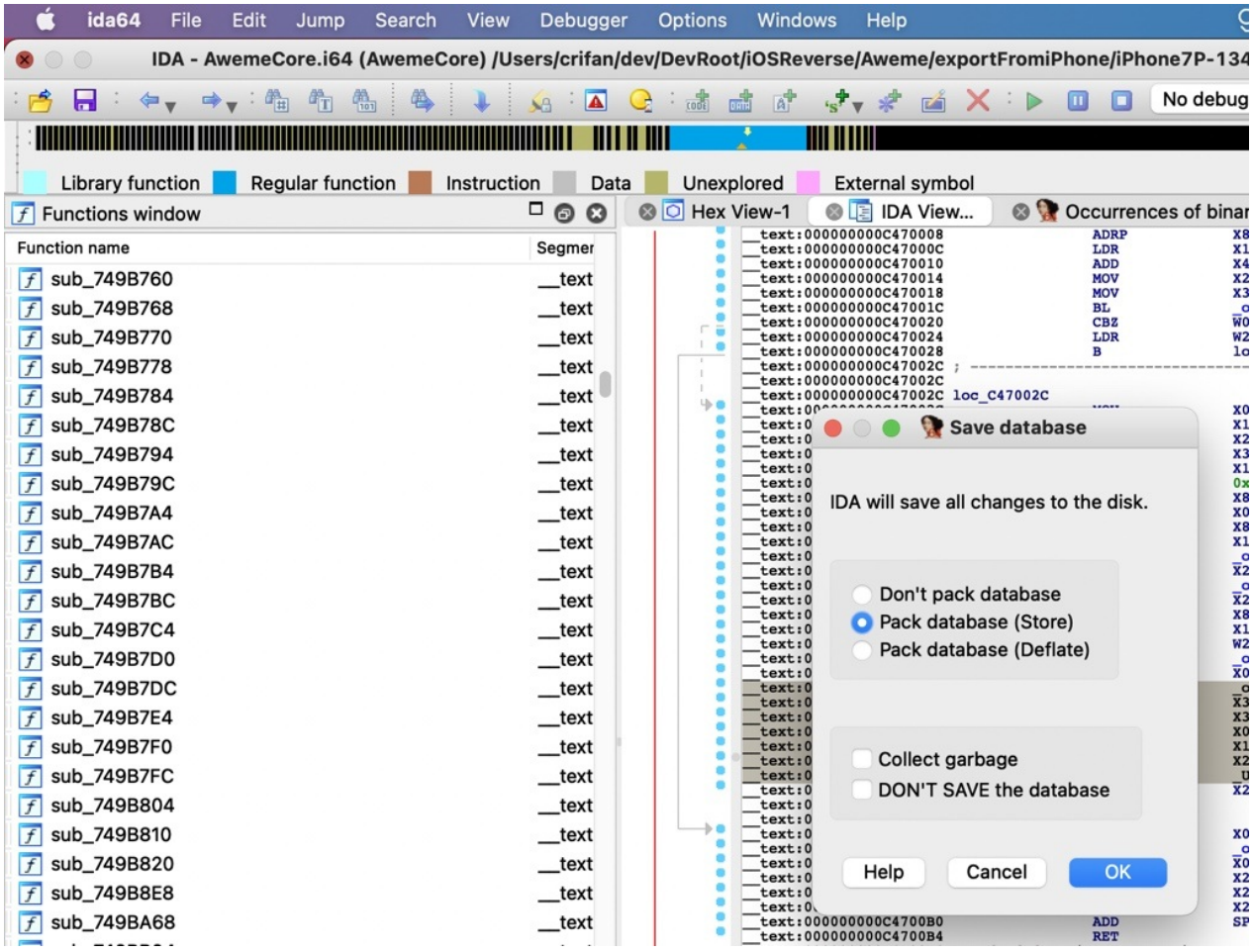


即可。

关闭

去点击关闭时，一般会有提示：

> IDA will save all changes to the disk.
>
> - Don't pack database
> - Pack database (Store)
> - Pack database (Deflate)



一般选默认的：`Pack database (Store)`

然后保存出的是单个文件：`.i64`：

关闭的心得

- 没有特殊情况时，**千万不要轻易在关闭时，强制杀掉进程**
  - 否则可能会导致：之前的数据库被损坏，再次打开后，之前分析的数据丢失了
    - 比如自己的优化改动，比如给函数变量重命名等

比如之前自己就遇到过：

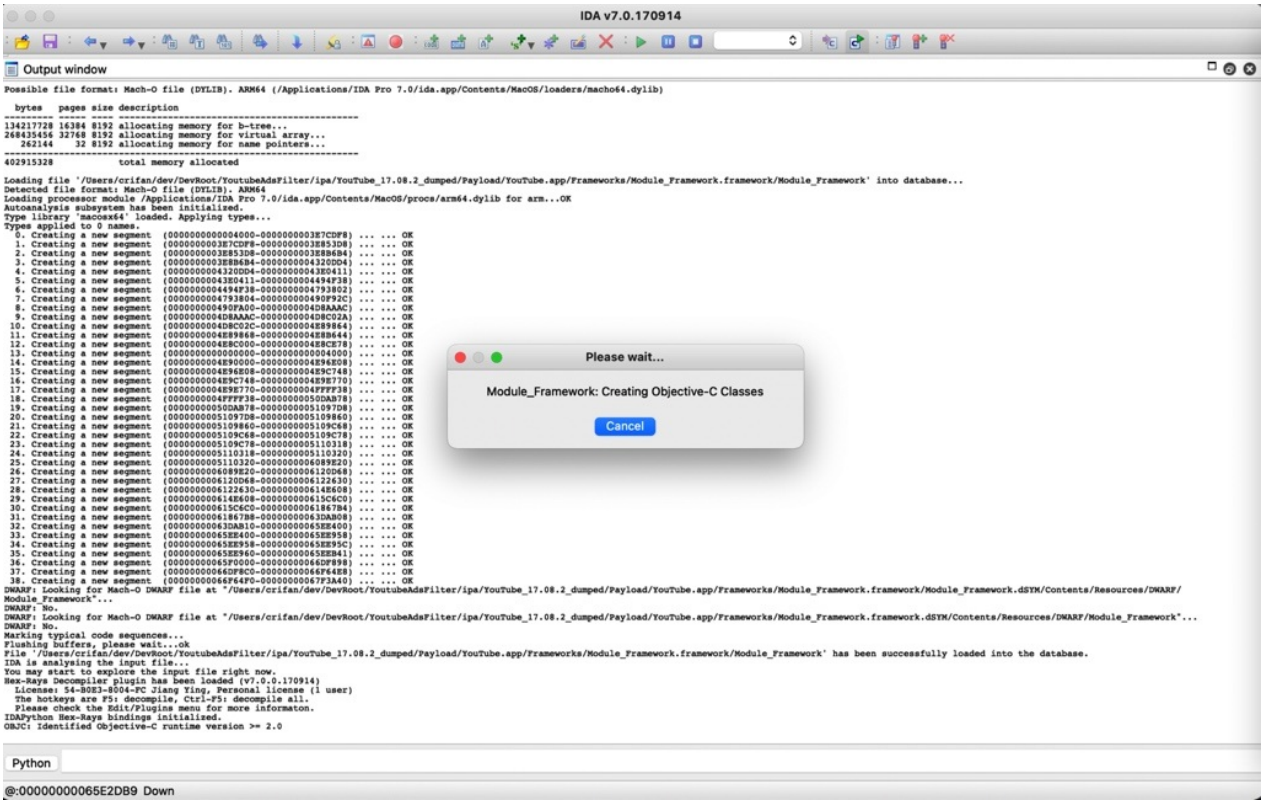
折腾：

【未解决】IDA中用idat64的Batch Mode尝试反编译导出YouTube的Module_Framework全部代码伪代码

期间，对于IDA的text mode的导出过程，觉得是卡死了，强制杀掉了IDA进程

再去打开IDA的GUI mode，即正常通过IDA图标双击打开，结果报错了

只好去，删除残留文件，全新的加载打开



界面布局

- 【整理】IDA使用心得：把类结构Structures的窗口放在右边方便对比查看

代码分析

`*(_DWORD *)`的含义

```
v7 = *(_DWORD *)(v7 + 8);
```

==

```
v7 = *(v7 + 8)
```

==

汇编的：

```
MOV v7, DWORD PTR  v7 + 0x8
```

含义解释：

v7 is assigned with the value located at address v7+8*sizeof(DWORD). For example, if v7 = 0xabcd0123 then v7 + 8*sizeof(DWORD) = 0xabcd0143. Whatever is located at 0xabcd0143 will be assigned to v7.

函数跳转

- Jump跳转
  - 【整理】IDA使用心得：根据selector跳转到函数
  - 【整理】IDA使用心得：跳转到历史列表的函数位置

函数

- 【整理】IDA使用心得：通过给函数Set Item Type去修正函数的参数的个数和类型和返回值类型

类

- 【整理】IDA心得：自定义的类的属性偏移量和自动生成的偏移量不匹配

bug

- 【整理】IDA使用心得：iOS的ObjC伪代码反编译翻译的有错误不够准确

如何处理数组Array

Working with array

https://hex-rays.com/wp-content/uploads/2021/10/igor-tip-of-the-week-S01.pdf

09-Oct-2020

https://hex-rays.com/blog/igor-tip-of-the-week-10-working-with-arrays/

Arrays are used in IDA to represent a sequence of multiple items of the same type: basic types (byte, word, dword etc.) or complex ones (e.g. structures).

Creating an array

To create an array:

1. Create the first item;
2. Choose "Array..." from the context menu , or press * ;
3. Fill in at least the *Array size* field and click OK.

Step 1 is optional; if no data item exists at the current location, a byte array will be created.

Hint: if you select a range before pressing *, *Array size* will be pre-filled with the number of items which fits into the selected range.

Quick menu navigation

Array parameters affect how the array is displayed in the listing and can be set at the time the array is first created or any time later by pressing *.

- Array size: total number of elements in the array;
- Items on a line: how many items (at most) to print on one line. 0 means to print the maximum number which fits into the disassembly line;
- Element print width: how many characters to use for each element. Together with the previous parameter can be used for formatting arrays into nice-looking tables. For example: 8 items per line, print width **-1**:

```
db 1, 2, 3, 4, 5, 6, 7, 8
db 9, 10, 11, 12, 13, 14, 15, 16
db 17, 18, 19, 20, 21, 22, 23, 24
db 25, 255, 255, 255, 255, 255, 255, 26
db 27, 28, 29, 30, 31, 32, 33, 34
db 35, 36, 37, 38, 39, 40, 41, 42
```

print width **0**:

```
db   1,  2,  3,  4,  5,  6,  7,  8
db   9, 10, 11, 12, 13, 14, 15, 16
db  17, 18, 19, 20, 21, 22, 23, 24
db  25,255,255,255,255,255,255, 26
db  27, 28, 29, 30, 31, 32, 33, 34
db  35, 36, 37, 38, 39, 40, 41, 42
```

print width **5**:

```
db     1,    2,    3,    4,    5,    6,    7,    8
db     9,   10,   11,   12,   13,   14,   15,   16
db    17,   18,   19,   20,   21,   22,   23,   24
db    25,  255,  255,  255,  255,  255,  255,   26
db    27,   28,   29,   30,   31,   32,   33,   34
db    35,   36,   37,   38,   39,   40,   41,   42
```

- Use "dup" construct: for assemblers that support it, repeated items with the same value will be collapsed into a dup expression instead of printing each item separately;
  dup off: `db 0FFh, 0FFh, 0FFh, 0FFh, 0FFh, 0FFh`
  dup on: `db 6 dup(0FFh)`
- Signed elements: integer items will be treated as signed numbers;
- Display indexes: for each line, first item's array index will be printed in a comment.
- Create as array: if unchecked, IDA will convert the array into separate items.

ObjC

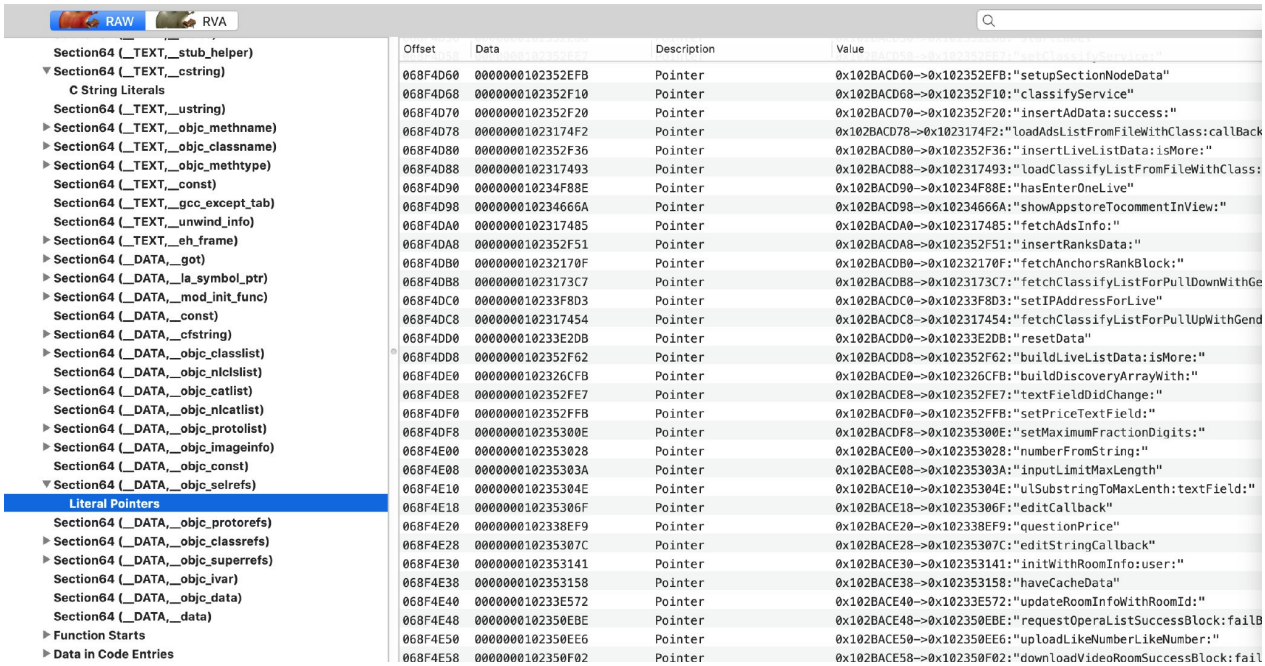
TODO：

- 【已解决】研究抖音设备注册逻辑：___lldb_unnamed_symbol580715$$AwemeCore
- 【已解决】iOS逆向心得：如何从对x8的adrp和ldr计算出对应的qword字符串值

背景知识

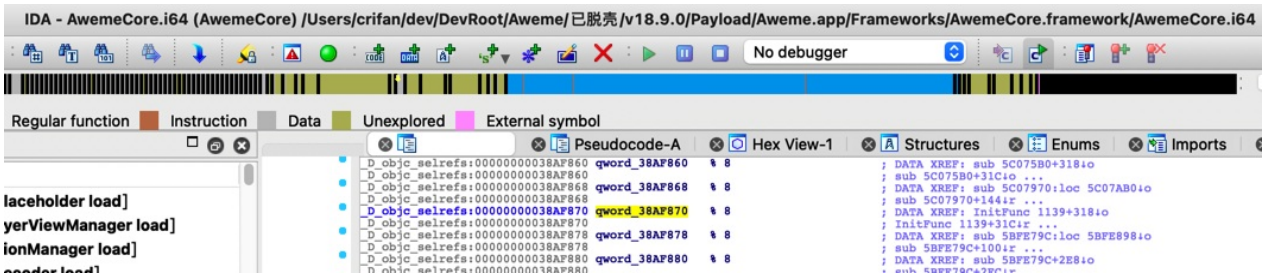
- `SectionName` 和描述
- `__objc_imageinfo` 记录 Objective-C 环境信息等，dyld 用它来判断镜像是否是 objc 镜像
- `__objc_classlist` 记录镜像所定义的类，每个条目都是一个指针，指向到 __objc_data section
- `__objc_data` 存放真正的类数据，和 __objc_classlist 条目呼应
- `__objc_classname` 类名列表
- `__objc_methodname` 方法名列表
- `__objc_methodtype` 方法类型列表
- `__objc_selrefs` selector 列表信息，每个条目是指向到 __objc_methname 的指针，记录 selector 的名字
- `__objc_classrefs` 类引用列表
- `__objc_ivar` 类的成员变量列表
- `__objc_const` 存放类的元数据，包括：method list、variable list、property list、class info

->MachOView可以查看二进制的这些段的信息：



数据定义含义

_D_objc_selrefs




```
_D_objc_selrefs:00000000038AF870 qword_38AF870   % 8
```

中的含义是：

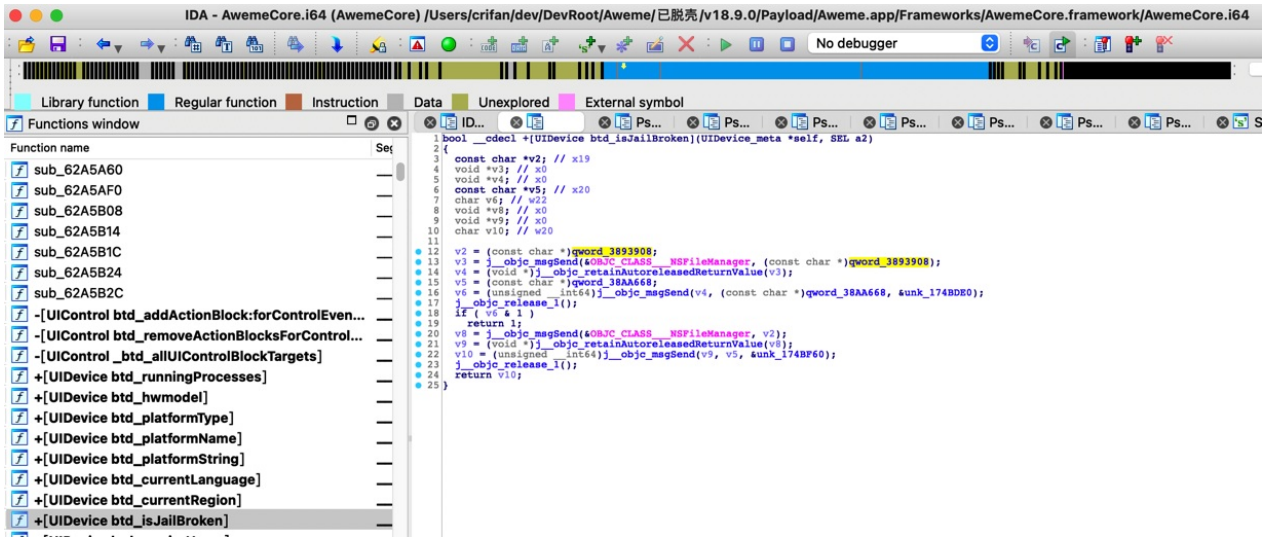
- `_D_objc_selrefs`
  - ObjC的section段 `__objc_selrefs` 中的 `D` = `Data` = `数据`
- `%`
  - align对齐?
- `8`
  - 以 `8` 字节对齐?

调试出const char* qword是字符串并改名优化定义和伪代码

- 背景

IDA分析抖音AwemeCore时，发现：

伪代码：



)

```
bool __cdecl +[UIDevice btd_isJailBroken](UIDevice_meta *self, SEL a2)
{
  const char *v2; // x19
  void *v3; // x0
  void *v4; // x0
  const char *v5; // x20
  char v6; // w22
  void *v8; // x0
  void *v9; // x0
  char v10; // w20

  v2 = (const char *)qword_3893908;
  v3 = j__objc_msgSend(&OBJC_CLASS___NSFileManager, (const char *)qword_3893908);
  v4 = (void *)j__objc_retainAutoreleasedReturnValue(v3);
  v5 = (const char *)qword_38AA668;
```

```
  v8 = (unsigned __int64)j__objc_msgSend(v4, (const char *)qword_38AA668, unk_174BDE0);
  j__objc_release_1();
  if ( v8 & 1 )
    return 1;
  v8 = j__objc_msgSend(OBJC_CLASS___NSFileManager, v2);
  v9 = (void *)j__objc_retainAutoreleasedReturnValue(v8);
  v10 = (unsigned __int64)j__objc_msgSend(v9, v5, unk_174BF60);
  j__objc_release_1();
  return v10;
}
```

希望知道 `qword_3893908` 是什么内容，搞懂后，改名，优化伪代码和定义。

- 过程

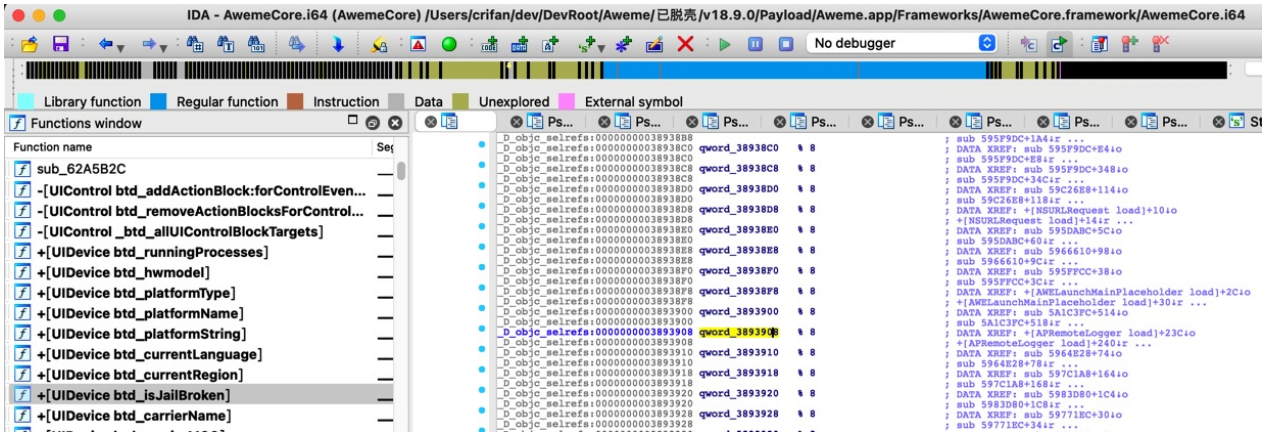
经过调试：

```
(lldb) po (BOOL)[(UIDevice*)0x1dfc62a88 btd_isJailBroken]
2022-03-28 14:55:19.836905+0800 Aweme[39046:2680736] hook_openFile_iOS.xm NSFileManager$fileExistsAtPath$: path /Appl
ications/Cydia.app - isJbPath True - isExists False
2022-03-28 14:55:19.838832+0800 Aweme[39046:2680736] hook_openFile_iOS.xm NSFileManager$fileExistsAtPath$: path /priv
ate/var/lib/apt - isJbPath True - isExists False
```

得知 `qword_3893908` 应该是其中一个越狱路径字符串

但是IDA中却看不出来，只能看出定义是：

```
_D_objc_selrefs:0000000003893908 qword_3893908    % 8                    ; DATA XREF: +[APRemoteLogger load]+23C↓o
_D_objc_selrefs:0000000003893908                                         ; +[APRemoteLogger load]+240↓r ...
```



参考资料地址：

- `dword`
  - 具体的含义，取决于实际情况
    - 指针
    - 指针的指针（地址）
    - 指针的指针的指针
    - 等等
  - 总之就是：
    - `offset dword_XXXX` = `dword_XXXX` 的原始地址 = 其指向一个东西 = 具体是啥东西，取决于实际情况
      - 此处抖音 `AwemeCore` 中，往往是一个字符串
        - 只不过IDA静态分析，看不出具体值
    - qword_xxx
      - 虽然多数情况下是字符串
        - `IDA` 伪代码中常见写法：`(char *)qword_xxx`
      - 但是偶尔也有：非字符串的，比如是某个类，比如
        - `<                0x281d67bf0>{recursion count = 0, name = nil}`

- IDA伪代码写法：`(void *)qword_56AB210`

后续得知，可以通过调试去打印出具体值：

核心逻辑是：

`qword_xxx` 的 `xxx` 是二进制内偏移量 + 二进制的ALSR = 实际（字符串的）地址

去查看：[实际（字符串的）地址] = （即可查看到）保存了对应的字符串

举几个例子：

```
(lldb) image list -o -f | grep AwemeCore
[  0] 0x0000000104acc000 /Users/crifan/Library/Developer/Xcode/DerivedData/Aweme-fswcidjoxbkibsdwekuzlsfcdqls/Build/Products/Debug-iphoneos/Aweme.app/Frameworks/AwemeCore.framework/AwemeCore

qword_3896270

(lldb) p/x 0x0000000104acc000 + 0x3896270
(long) $15 = 0x0000000108362270
(lldb) x/1gx 0x0000000108362270
0x108362270: 0x00000001058596c6
(lldb) po (char*)0x00000001058596c6
"onTheFlyParameter"
=》
qword_3896270 = "onTheFlyParameter"


qword_38B2148
(lldb) p/x 0x0000000104acc000 + 0x38B2148
(long) $17 = 0x000000010837e148
(lldb) x/1gx 0x000000010837e148
0x10837e148: 0x00000001c5619497
(lldb) po (char*)0x00000001c5619497
"dictionaryWithDictionary:"
- qword_38B2148 = "dictionaryWithDictionary:"


qword_3925208
(lldb) p/x 0x0000000104acc000 + 0x3925208
(long) $19 = 0x000000011083f1208
(lldb) x/1gx 0x000000011083f1208
0x1083f1208: 0x0000000010957bb48
(lldb) po (char*)0x0000000010957bb48
"configParams"
- qword_3925208 = "configParams"


qword_38A1D98
(lldb) p/x 0x0000000104acc000 + 0x38A1D98
(long) $21 = 0x0000000010836dd98
(lldb) x/1gx 0x0000000010836dd98
0x10836dd98: 0x0000000105892952
(lldb) po (char*)0x0000000105892952
"ttinstall_stringValueForKey:"
- qword_38A1D98 = "ttinstall_stringValueForKey:"
```

后续还遇到其他类似例子：

- IDA的伪代码中qword没有char*的强制转换如果是_D_objc_selrefs则也表示是字符串

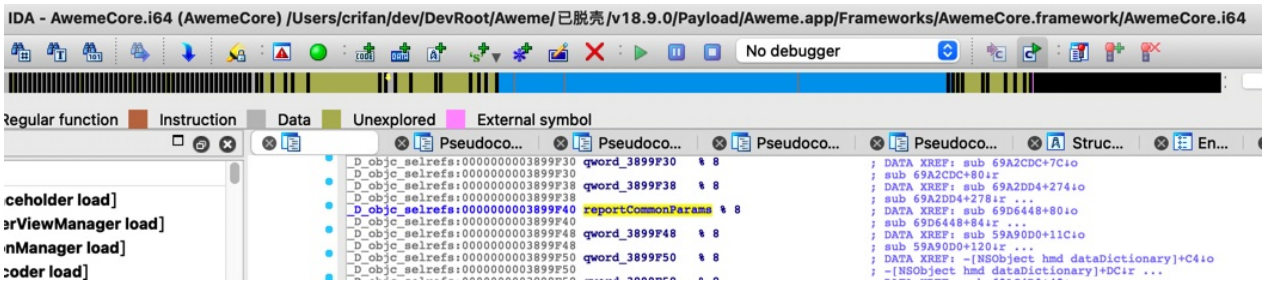
IDA伪代码中：

```
    if ( (unsigned int)jmp_objc_msgSend_D523EEC(v0, respondsToSelector_1, qword_3899F40) )
```

虽然 `qword_3899F40` 前面没有 `const char *` 或 `char *` 的强制转换。

但是，看到定义中（修改值后）是：

```
_D_objc_selrefs:0000000003899F40 reportCommonParams % 8                 ; DATA XREF: sub_69D6448+80↓o
_D_objc_selrefs:0000000003899F40                                        ; sub_69D6448+84↓r ...
```



即是 `objc_selrefs` 的类型，即是 `ObjC` 的函数的自我引用

-》则可以推断出就是：某个类的某个函数名

所以也就是：字符串类型的值

所以此处去计算和转换成 `char *` 是合理的

所以算出来是：

- `qword_3899F40` -> `0x3899F40`

```
(lldb) p/x 0x00000001037b4000 + 0x3899F40
(long) $1 = 0x0000000010704df40
(lldb) x/1gx 0x0000000010704df40
0x10704df40: 0x00000001045537b4
(lldb) po (char*)0x00000001045537b4
"reportCommonParams"
```

然后再去优化伪代码，改为：

```
    if ( (unsigned int)jmp_objc_msgSend_D523EEC(v0, respondsToSelector_1, reportCommonParams) )
```

即可。

附录

下面列出相关参考资料。

文档和资料

此处整理IDA相关的文档、教程、书籍等有价值的参考资料。

IDA官网

IDA的官网：

https://www.hex-rays.com

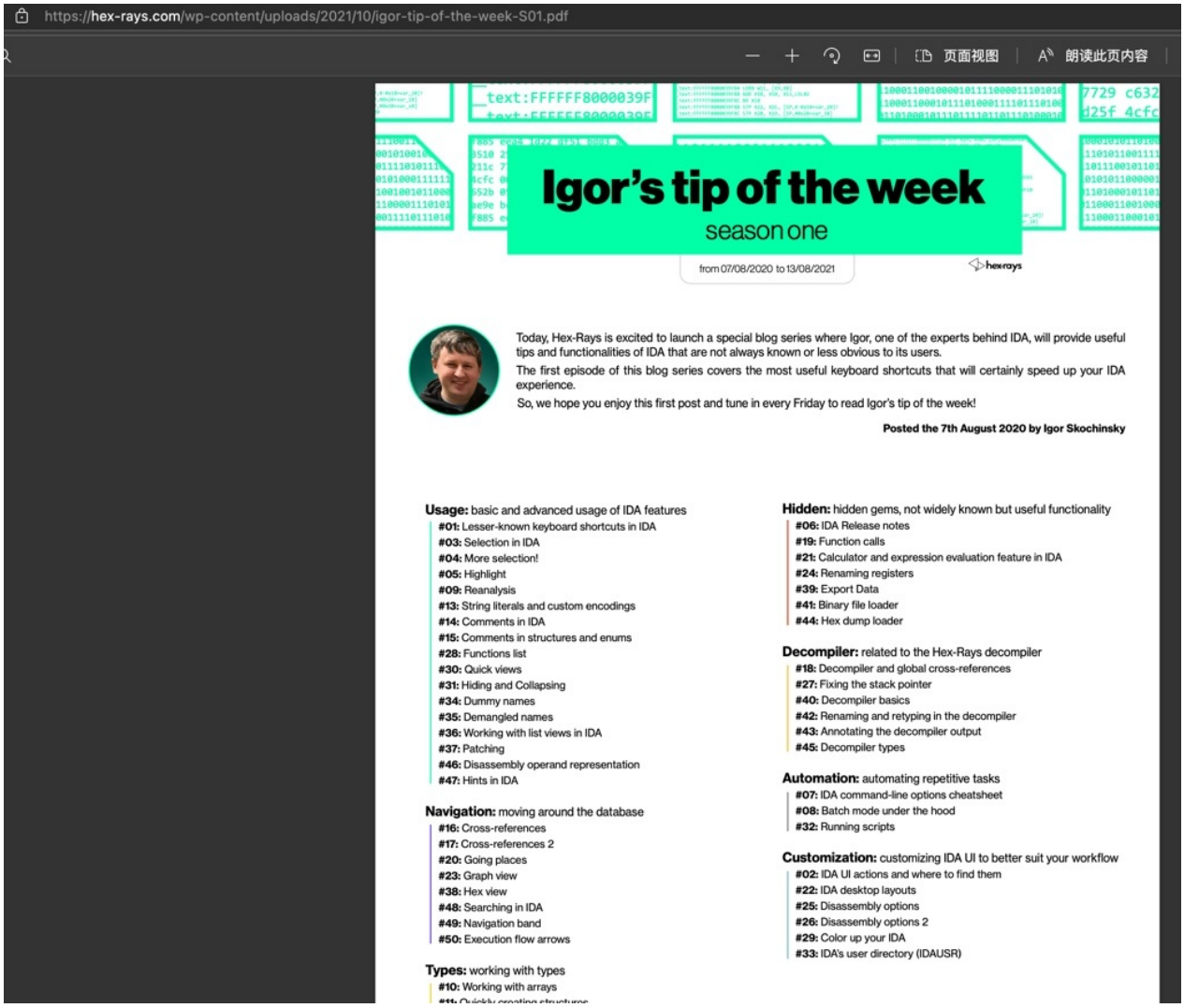
本身就有很多不错的教程和资料。

IDA官网在线文档

- 文档总入口：https://hex-rays.com/documentation/
  - Help总入口：https://hex-rays.com/products/ida/support/idadoc/index.shtml
  - 反编译器：https://hex-rays.com/products/decompiler/manual/index.shtml
    - 其中最常用的一些：
      - 伪代码中右键菜单中的各种功能
        - Interactive operation
      - 常见问题和错误
        - Failures and troubleshooting

IDA的tip of week

tip of week index (hex-rays.com)



有很多有用提示

有空可以看看

IDA官网的下载中心

IDA官网的下载中心：

Download center (hex-rays.com)

有很多相关内容，可供学习和使用：

- SDK and Utilities
  - Some downloads are only available to IDA Pro users and require a password which can be found in the latest download email.
  - IDA SDK 7.7
    - Develop processor modules, loaders and extensions - extended with the source of 30+ modules and 20+ loaders.
    - Please check out the SDK documentation online (or download the zip file for offline use).
  - Flair 7.7
    - Add your own compiler libraries to the FLIRT engine
      - `FLIRT` = `Fast Library Identification and Recognition Technology`
  - IDAClang 7.7
    - A type library generator based on libclang. Use this when parsing complex C++ code that tilib cannot handle.
  - Tilib 7.7

        - Create your own type libraries
    - Loadint 7.7
        - Create your own disassembler comment databases
    - idsutils 7.7
        - Create your own IDS files from DLLs
    - ios_deploy
        - iOS helper utility to manipulate iOS devices
    - PIN tool
        - The source code of our PIN tool. It creates a debugger backend out of Intel's PIN framework
        - See: PIN framework
    - TVision 2015 library
        - For the IDA text interface (source code)
    - Qwingraph v1.10
        - Source code the Wingraph we use and modified (GPL)
- Sample plugins
    - Stealth
        - Stealth against anti-debugging tricks
    - findcrypt
        - Identifies some frequently used block ciphers
    - highlighter
        - Highlights code that has been single stepped through in a debugging session
    - unispector
        - Extracts unicode strings from an IDA database
    - IDA Pro, Python and Qt
    - Migrating PySide code to PyQt5
    - Using custom viewers from IDAPython
    - Augmenting IDA UI with your own actions
    - Plugin contest pages
        - Our plugins contest pages offer many useful plugins!
        - By year: 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
- User contributions
    - Plugins
        - COM Interface Plugin
            - By Dieter Spaar
        - Sobek
            - A simple data-flow analysis plugin by JF Michel
        - PDBPlus
            - By Dean Ashton
        - IDB_2_PAT
            - By J.C Roberts
        - strucrec
            - By Halvar Flake
        - Class Informer plugin
            - To reconstruct C++ classes using the RTTI info
            - By Sirmabus
    - IDC scripts
        - Visual Basic Disassembly IDC script
            - To assist in the disassembly of VB5/VB6 hostile code
            - By Reginald Wong
        - IDC Delphi script
            - Delphi constants and class definitions
            - By Dietrich Teickner
        - h2enum

        - converts C/C++ header files to IDA enums - Nice if you have no TIL files
        - By Leonid Lisovsky
    - IDC PDR script
        - Useful in the analysis of PDR files (port drivers)
        - By Huang Yu
    - Loader script
        - For VC++ and Borland C++
        - By Toshiyuki Tega
    - Microchipss 16F84 PIC script
        - Defines SFR and bit names for Microchip's 16F84 PIC processor but can be used as a template for other processors
        - By an anonymous contributor
    - dumpinfo
        - By JC Roberts
    - Pentica-B script
        - Pentica-B import script for the H8-8300
        - By Tom Hayes
    - H8 script
        - Improves the inital H8 autoanalysis
        - By Tom Hayes
- Processor modules
    - AMD 29K processor module
        - By Arne Wichmann
    - NEC V830 processor module
        - By Ben Byer
    - Samsung SAM8
        - By Andrew de Quincey. Also available is a plugin that generates files compatible with the SAMA assembler.
- Miscellaneous
    - symload
        - By Dainis Jonitis
    - PE utilities
        - A set of extremely useful PE utilities
        - By Atli Mar Gudmundsson
    - H8 utilities
        - A few utilities that could be useful to H8 developers
        - By Tom Hayes

抽空可以好好找找看看，有哪些值得好好利用的东西。

《The IDA Pro Book - The Unofficial Guide to the World's Most Popular Disassembler.pdf》

- 《The IDA Pro Book - The Unofficial Guide to the World's Most Popular Disassembler.pdf》

-
- 评价：
  - 内容详实，值得抽空好好参考和学习
  - 感觉解释的很到位
    - 先介绍背景知识
    - 再介绍反编译
    - 再介绍工具：IDA

-> 已摘录的部分内容：

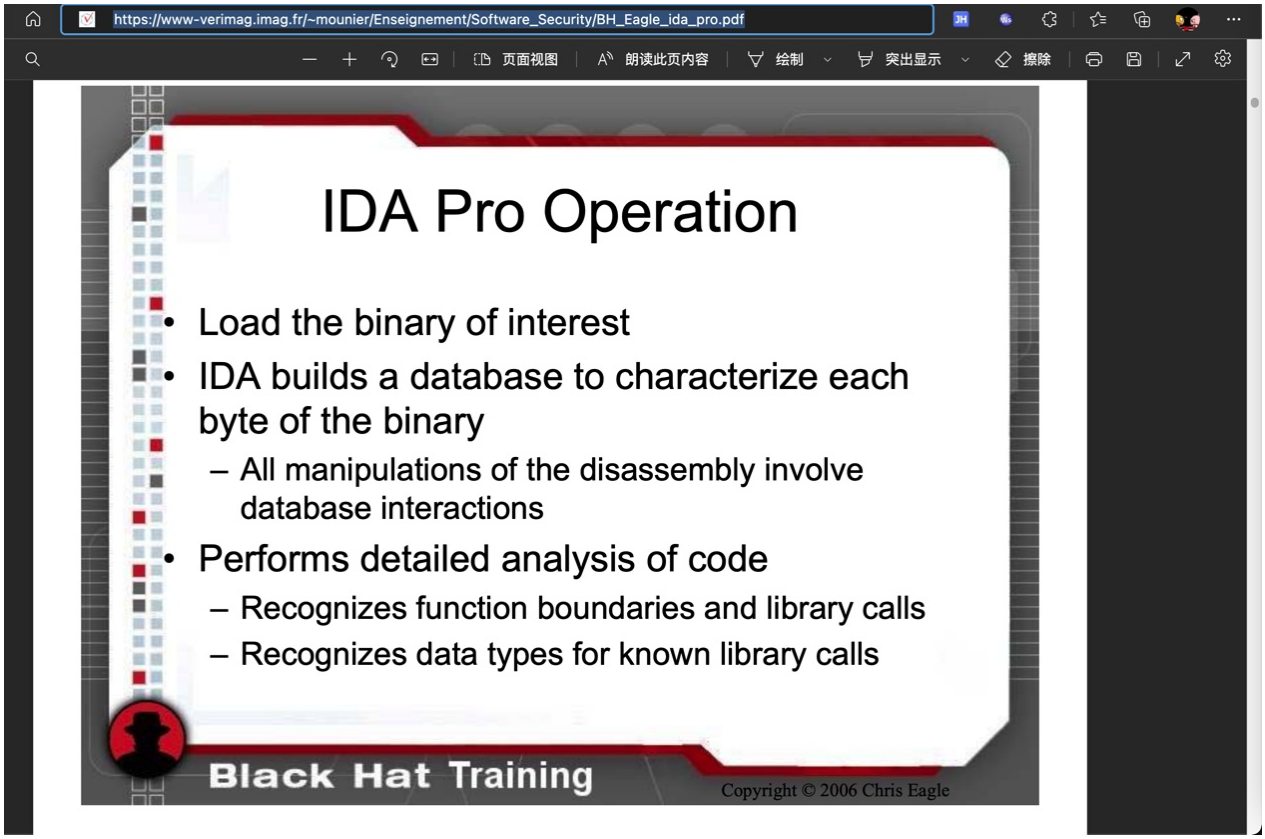
- 编程语言历史
  - First-generation languages
    - These are the lowest form of language, generally consisting of ones and zeros or some shorthand form such as hexadecimal, and readable only by binary ninjas. Things are confusing at this level because it is often difficult to distinguish data from instructions since everything looks pretty much the same. First-generation languages may also be referred to as machine languages, and in some cases byte code, while machine language programs are often referred to as binaries.
  - Second-generation languages
    - Also called assembly languages, second-generation languages are a mere table lookup away from machine language and generally map specific bit patterns, or operation codes (opcodes), to short but memorable character sequences called mnemonics. Occasionally these mnemonics actually help programmers remember the instructions with which they are associated.
    - An assembler is a tool used by programmers to translate their assembly language programs into machine language suitable for execution.
  - Third-generation languages
    - These languages take another step toward the expressive capability of natural languages by introducing keywords and constructs that programmers use as the building blocks for their programs. Third-generation languages are generally platform independent, though programs written using them may be platform dependent as a result of using features unique to a specific operating system. Often-cited examples include FORTRAN, COBOL, C, and Java. Programmers generally use compilers to translate their programs into assembly language or all the way to machine language (or some rough equivalent such as byte code).
  - Fourth-generation languages

        - These exist but aren't relevant to this book and will not be discussed
- 反汇编器、反编译器 的由来
    - In a traditional software development model, compilers, assemblers, and linkers are used by themselves or in combination to create executable programs. In order to work our way backwards (or reverse engineer programs), we use tools to undo the assembly and compilation processes. Not surprisingly, such tools are called disassemblers and decompilers, and they do pretty much what their names imply. A disassembler undoes the assembly process, so we should expect assembly language as the output (and therefore machine language as input). Decompilers aim to produce output in a high-level language when given assembly or even machine language as input.
- 为何恢复源代码source code recovery 不太容易?
    - The compilation process is lossy.
        - At the machine language level there are no variable or function names, and variable type information can be determined only by how the data is used rather than explicit type declarations. When you observe 32 bits of data being transferred, you'll need to do some investigative work to determine whether those 32 bits represent an integer, a 32-bit floating point value, or a 32-bit pointer.
    - Compilation is a many-to-many operation.
        - This means that a source program can be translated to assembly language in many different ways, and machine language can be translated back to source in many different ways. As a result, it is quite common that compiling a file and immediately decompiling it may yield a vastly different source file from the one that was input.
    - Decompilers are very language and library dependent.
        - Processing a binary produced by a Delphi compiler with a decompiler designed to generate C code can yield very strange results. Similarly, feeding a compiled Windows binary through a decompiler that has no knowledge of the Windows programming API may not yield anything useful.
    - A nearly perfect disassembly capability is needed in order to accurately decompile a binary.
        - Any errors or omissions in the disassembly phase will almost certainly propagate through to the decompiled code.
- 反汇编的典型用途
    - The purpose of disassembly tools is often to facilitate understanding of programs when source code is unavailable. Common situations in which disassembly is used include these:
        - Analysis of malware
        - Analysis of closed-source software for vulnerabilities
        - Analysis of closed-source software for interoperability
        - Analysis of compiler-generated code to validate compiler performance/correctness
        - Display of program instructions while debugging

BH_Eagle_ida_pro.pdf

无意间看到的别人整理的IDA的内容:

BH_Eagle_ida_pro.pdf



下载到此处 BH_Eagle_ida_pro.pdf 供下载和学习。

其他待学习和待研究的资料

- IDA software reverse engineering - Code World (codetd.com)
  - IDA的用法，内容很多，值得看看。
- IDA Pro Tips to Add to Your Bag of Tricks – PT SWARM (ptsecurity.com)
  - 这里有很多感觉有用的，值得参考的内容，抽空去研究学习
-

参考资料

- 【整理】iOS逆向心得：IDA中的unk的含义
- 【整理】IDA使用心得：常见名称及含义
- 【整理】IDA使用心得：多种显示模式
- 【已解决】IDA中浮动窗口Output Window如何固定到底部
- 【未解决】研究抖音越狱检测逻辑：_RxAnnotationInlineLoader的load
- 【未解决】IDA中用idat64的Batch Mode尝试反编译导出YouTube的Module_Framework全部代码伪代码
- 【整理】学习IDA教程：The IDA Pro Book
- 【整理】IDA中一些功能和选项设置
- 【整理】IDA中的自动分析Autoanalysis
- 【记录】用IDA分析加了符号表的抖音AwemeCore二进制
- 【未解决】搞懂IDA中_D_objc_selrefs qword_38AF870 % 8的含义
- 【记录】iOS的二进制中的__objc_selrefs的含义
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