Code Breakers Journal

October 14, 2005 | http://www.codebreakers-journal.com | Vol. 2, No. 3 2005

After spending a lot of time going through the header files in the IDA SDK as well as looking at the source to other people's plug-ins, I figured there should be an easier way to get started with writing IDA plug-ins. Although the header file commentary is amazingly thorough, I found it a little difficult navigating and finding things when I needed them without a lot of searching and trial-and-error. I thought that I'd write this tutorial to try and help those getting started as well as hopefully provide a quick reference point for people developing plug-ins. I've also dedicated a section to setting up a development environment which should make the development process quicker to get into.

IDA Plug-In Writing in C/C++

Steve Micallef

Steve@Binarypool.com

Legal Information

This article can be found at http://www.CodeBreakers-Journal.com.

Table of Contents

1. Introduction

1.1 Why This Tutorial?

After spending a lot of time going through the header files in the IDA SDK as well as looking at the source to other people's plug-ins, I figured there should be an easier way to get started with writing IDA plug-ins. Although the header file commentary is amazingly thorough, I found it a little difficult navigating and finding things when I needed them without a lot of searching and trial-and-error. I thought that I'd write this tutorial to try and help those getting started as well as hopefully provide a quick reference point for people developing plug-ins. I've also dedicated a section to setting up a development environment which should make the development process quicker to get into.

1.2 What's Covered

This tutorial will get you started with writing IDA plug-ins, beginning with an introduction to the SDK, followed by setting up a development/build environment on various platforms. You'll then gain a good understanding of how various classes and structures are used, followed by usage of some of the more widely used functions exported. Finally, I'll show some examples of using the IDA API for basic things like looping through functions, to hooking into the debugger and manipulating the IDA database (IDB). After reading this, you should be able to apply the knowledge gained to write your own plug-ins and hopefully share them with the community.

1.3 What's Not Covered

I'm focusing on x86 assembly because it's what I have most experience in, although most of the material presented should cover any architecture supported by IDA (which is practically all of them in the Advanced version). Also, if you want a comprehensive reference to *all* IDA functions, I suggest looking through the header files.

This tutorial is focused more on "read only" functionality within the SDK, rather than functions for adding comments, correcting errors, defining data structures, and so on. These sorts of things are a big part of the SDK, but aren't covered here in an attempt to keep this tutorial at a managable size.

I have intentionally left out netnodes from this tutorial, as well as many struct/class members because the IDA SDK is massive, and contains a lot of things for specialised purposes – a tutorial cannot cover everything. If there is something you feel really should be in here, drop me a line and I'll probably include it in the next version if it isn't too specialised.

1.4 Knowledge Required

First and foremost, you must know how to use IDA to the point where you can comfortably navigate disassembled binaries and step through the debugger. You should be equipped with a thorough knowledge of the C/C++ language as well as x86 assembly. C++ knowledge is quite important because the SDK is pretty much all C++. If you don't know C++ but know C, you should at least understand general OOP concepts like classes, objects, methods and inheritance.

1.5 Software Required

To write and run IDA plug-ins, you will need the IDA Pro disassembler 4.8 or 4.9, the IDA SDK (which, as a licensed user of IDA, you get for free from http://www.datarescue.com) and a C/C++ compiler with related tools (Visual Studio, GCC toolset, Borland, etc).

Notes have been added throughout the tutorial where things change in 4.9. Also, as of 4.9, the SDK freezes, and so interfaces to 4.9 functions won't change, and plug-ins written for 4.9 (even in binary form) will work with future versions.

1.6 Alternatives to C/C++

If C is not your thing, take a look at IDAPython, which has all the functionality the C++ API offers in the higher-level language of Python. Check out http://d-dome.net/idapython/ for details. There is a tutorial written on using IDAPython by Ero Carrera at http://dkbza.org/idapython_intro.html, which is obviously more applicable than this text.

There was also an article recently written about using VB6 and C# to write IDA plugins – check it out here: http://www.openrce.org/articles/full_view/13.

1.7 About This Document

If you have any comments, suggestions or if you notice any errors, please contact me, Steve Micallef, at steve@binarypool.com. If you really feel like you've learnt something from this, I'd also appreciate an email, just to make this process worth while :-)

As the SDK continues to grow, this document will be updated gradually over time. You will always be able to obtain the latest copy at http://www.binarypool.com/idapluginwriting/.

1.8 Credits

In no particular order, I'd like to thank the following people for proof reading as well as providing encouragement and feedback for this tutorial.

Ilfak Guilfanov, Pierre Vandevenne, Eric Landuyt, Vitaly Osipov, Scott Madison, Andrew Griffiths, Thorsten Schneider and Pedram Amini.

1.9 Further Reading

At the time of writing, the only other written material on IDA plug-ins is a tutorial on using the universal un-packer plug-in in IDA 4.9, which contains information on how it was written and how it works. It can be found at http://www.datarescue.com/idabase/unpack_pe/unpacking.pdf. If you get stuck while writing a plug-in, you can always ask for help on the Datarescue Bulletin Board (http://www.datarescue.com/cgi-local/ultimatebb.cgi), where even though the SDK is officially unsupported, someone from Datarescue (or one of the many IDA users) is likely to help you out.

Another great resource is http://www.openrce.org/, where you'll find not only some great articles on reverse engineering, but tools, plug-ins and documentation too. There are also a lot of switched-on people on this board, who will most likely be able to help you with almost any IDA or general reverse engineering problem.

2. The IDA SDK

IDA is a fantastic disassembler and more recently comes with a variety of debuggers too. While IDA alone has an amazing amount of functionality, there are always things you'll want to automate or do in some particular way that IDA doesn't support. Thankfully, the guys at Datarescue have released the IDA SDK – a way for you to hook your own desired functionality into IDA.

There are four types of modules you can write for IDA using the IDA SDK, plug-in modules being the subject of this tutorial:

Module Type	Purpose
Processor	Adding support for different processor architectures. Also known as IDP (IDa Processor) modules.
Plug-in	Extending functionality in IDA.
Loader	Adding support for different executable file formats.
Debugger	Adding support for debugging on different platforms and/or interacting with other debuggers / remote debugging.

From here onwards, the term "plug-in" will be used in place of "plug-in module", unless otherwise stated.

The IDA SDK contains all the header and library files you need to write an IDA plug-in. It supports a number of compilers on both Linux and Windows platforms, and also comes with an example plug-in that illustrates a couple of basic features available.

Whether you're a reverse engineer, vulnerability researcher, malware analyst, or a combination of them, the SDK gives you a tremendous amount of power and flexibility. You could essentially write your own debugger/disassembler using it, and that's just scratching the surface. Here's a tiny sample of some very straight-forward things you could do with the SDK:

- Automate the analysis and unpacking of packed binaries.
- Automate the process of finding the use of particular functions (for example, `LoadLibrary()`, `strcpy()`, and whatever else you can think of.)
- Analyse program and/or data flow, looking for things of interest to you.
- Binary diff'ing.
- Write a de-compiler.
- The list goes on..

To see a sample of what some people have written using the IDA SDK, check out the IDA Palace website, at http://home.arcor.de/idapalace/.

2.1 Installation

This is simple. Once you obtain the SDK (which should be in the form of a `.zip` file), unzip it to a location of your choice. My preference is creating an `sdk` directory under the IDA installation and putting everything in there, but it doesn't really matter.

2.2 Directory Layout

Rather than go through every directory and file in the SDK, I'm going to go over the directories relevant to writing plug-ins, and what's in them.

Directory	Contains
`/`	Some makefiles for different environments as well as the `readme.txt` which you should read to get a quick overview of the SDK, in particular anything that might've changed in recent versions.
`include/`	Header files, grouped into areas of functionality. I recommend going through every one of these files and jotting down functions that look applicable to your needs once you have gone through this tutorial.
`libbor.wXX/`	IDA library to link against when compiling with the Borland C compiler
`libgccXX.lnx/`	IDA library to link against when compiling with GCC under Linux
`libgcc.wXX/`	IDA library to link against when compiling with GCC under Windows
`libvc.wXX/`	IDA library to link against when compiling with Visual C++ under Windows
`plugins/`	Sample plug-ins

XX is either 32(bit) or 64(bit), which will depend on the architecture you're running on.

2.3 Header Files

Of the fifty header files in the `include` directory, I found the following to be most relevant when writing plug-ins. If you want information on all the headers, look at `readme.txt` in the SDK root directory, or in the header file itself. This listing is just here to provide a quick reference point when looking for certain functionality – more detail will be revealed in the following sections.

File(s)	Contains
`area.hpp`	`area_t` and `areacb_t` classes, which represent "areas" of code, which will be covered in detail later on
`bytes.hpp`	Functions and definitions for dealing with individual bytes within a disassembled file
`dbg.hpp & idd.hpp`	Debugger classes and functions
`diskio.hpp & fpro.h`	IDA equivalents to `fopen()`, `open()`, etc. as well as some misc. file operations (getting free disk space, current working directory, etc.)
`entry.hpp`	Functions for getting and manipulating executable entry point information
`frame.hpp`	Functions for dealing with the stack, function frames, local variables and labels
`funcs.hpp`	`func_t` class and pretty much everything function related
`ida.hpp`	`idainfo` struct, which holds mostly meta information about the file being disassembled
`kernwin.hpp`	Functions and classes for interacting with the IDA user interface
`lines.hpp`	Functions and definitions that deal with disassembled text, colour coding, etc.
`loader.hpp`	Mostly functions for loading files into and manipulating the IDB
`name.hpp`	Functions and definitions for getting and setting names of bytes

File(s)	Contains
	(variable names, function names, etc.)
`pro.h`	Contains a whole range of misc. definitions and functions
`search.hpp`	Various functions and definitions for searching the disassembled file for text, data, code and more.
`segment.hpp`	`segment_t` class and everything for dealing with binary segments/sections
`strlist.hpp`	`string_info_t` structure and related functions for representing each string in IDA's string list.
`ua.hpp`	`insn_t`, `op_t` and `optype_t` classes representing instructions, operands and operand types respectively as well as functions for working with the IDA analyser
`xref.hpp`	Functions for dealing with cross referencing code and data references

2.4 Using the SDK

Generally speaking, any function within a header file that's prefixed with `ida_export` is available for your use, as well as global variables prefixed with `ida_export_data`. The rule of thumb is to stay away from lower level functions (these are indicated in the header files) and stick to using the higher level interfaces provided. Any defined class, struct and enum is available for your use.

3. Setting Up a Build Environment

Note for Borland users: The only compiler supported by the IDA SDK that isn't covered in this section is Borland's. You should read the `install_cb.txt` and `makeenv_br.mak` in the root of the SDK directory to determine the compiler and linker flags necessary.

Before you start coding away it's best to have a proper environment set up to facilitate the development process. The more popular environments have been covered, so apologies if yours isn't. If you're already set up, feel free to skip to the next section.

3.1 Windows, Using Visual Studio

The version of Visual Studio used for this example is Visual Studio.NET 2003, but almost everything should be applicable to later and even some earlier versions.

Once you have Visual Studio running, close any other solutions and/or projects you might have open; we want a totally clean slate.

1	Go to **`File->New->Project…`** (Ctrl-Shift-N)
2	Expand the **`Visual C++ Projects`** folder, followed by the **`Win32`** sub-folder, and then select the **`Win32 Project`** icon. Name the project whatever you like and click **`OK`**.
3	The Win32 Application Wizard should then appear, click the **`Application Settings`** tab and make sure **`Windows Application`** is selected, and then tick the **`Empty Project`** checkbox. Click **`Finish`**.
4	In the **`Solutions Explorer`** on the right hand side, right click on the **`Source Files`** folder and go to **`Add->Add New Item...`**
5	Select the **`C++ File (.cpp)`** icon and name the file appropriately. Click **`Open`**. Repeat this step for any other files you want to add to the project.
6	Go to **`Project->projectname Properties...`**
7	Change the following settings (some have been put there to reduce the size of the resulting plug-in, as VS seems to bloat the output file massively): **`Configuration Properties->General`**: Change **`Configuration Type`** to `Dynamic Library (.dll)` **`C/C++->General`**: Set **`Detect 64-bit Portability Issue`** checks to `No` **`C/C++->General`**: Set **`Debug Information Format`** to `Disabled` **`C/C++->General`**: Add the SDK include path to the **`Additional Include Directories`** field. e.g. `C:\IDA\SDK\Include` **`C/C++->Preprocessor`**: Add `__NT__;__IDP__` to **`Preprocessor Definitions`** **`C/C++->Code Generation`**: Turn off **`Buffer Security Check`**, and **`Basic Runtime Checks`**, set **`Runtime Library`** to `Single Threaded` **`C/C++->Advanced`**: `Calling Convention` is **`__stdcall`** **`Linker->General`**: Change **`Output File`** from a `.exe` to a `.plw` in the IDA `plugins` directory **`Linker->General`**: Add the path to your `libvc.wXX` to **`Additional Library Directories`**. e.g. `C:\IDA\SDK\libvc.w32` **`Linker->Input`**: Add `ida.lib` to **`Aditional Dependencies`** **`Linker->Debugging`**: `No` to **`Generate Debug Info`** **`Linker->Command Line`**: Add `/EXPORT:PLUGIN` **`Build Events->Post-Build Event`**: Set **`Command-line`** to your `idag.exe` to start IDA after each successful build (Optional) Click **`OK`**

8	Go back to step 6, but before moving on to step 7, change the **Configuration** drop-down from **Active(Debug)** to **Release** and repeat the settings changes in step 7. Click **OK**
9	Move on to section 3.4

3.2 Windows, Using Dev-C++ With GCC and MinGW

You can obtain a copy of Dev-C++, GCC and MinGW as one package from http://www.bloodshed.net/dev/devcpp.html. Installing and setting it up is beyond the scope of this tutorial, so from here on, it'll be assumed that it's all in working order.

As before, start up Dev-C++ and ensure no project or other files are open – we want a clean slate.

1	Go to **File->New Project**, choose **Empty Project**, make sure **C++ Project** is selected and give it any name you wish, click **OK**
2	Choose a directory to save the project file, this can be anywhere you wish.
3	Go to **Project->New File**, this will hold the source code to your plug-in. Repeat this step for any other files you want to add to the project.
4	Go to **Project->Project Options**, click on the **Parameters** tab.
5	Under **C++ compiler**, add: `-DWIN32 -D__NT__ -D__IDP__ -v -mrtd`
6	Under **Linker**, add: `../path/to/your/sdk/libgcc.wXX/ida.a -Wl,--dll -shared` Just a note here - it's usually best to start with `../`, because msys seems to get confused with just `/`, and tries to reference it from the root of the msys directory.
7	Click on the **Directories** tab, and **Include Directories** sub-tab. Add the path to your IDA SDK `include` directory to the list.
8	Click on the **Build Options** tab, set the **output directory** to your IDA `plugins` directory, and Override the **output filename** to be a `.plw` file. Click **OK**.
9	Move on to section 3.4

3.3 Linux, Using GCC

Unlike Windows plug-ins, which end in `.plw`, Linux plug-ins need to end in `.plx`. Also, in this example, there is no GUI IDE, so rather than go through a step-by-step process, I'll just show the `Makefile` you need to use. The below example probably isn't the cleanest `Makefile`, but it should work.

In this example, the IDA installation is in `/usr/local/idaadv`, and the SDK is located under the `sdk` sub-directory. Put the below `Makefile` into the same directory where the source to your plug-in will be. You'll also need to copy the `plugin.script` file from the `sdk/plugins` directory into the directory with your source and `Makefile`.

Set `SRC` below to the source files that make up your plug-in, and `OBJS` to the object files they will be compiled to (same filename, just replace the extension with a `.o`).

```
SRC=file1.cpp file2.cpp
OBJS=file1.o file2.o
CC=g++
LD=g++
CFLAGS=-D__IDP__ -D__PLUGIN__ -c -D__LINUX__ \
```

```
      -I/usr/local/idaadv/sdk/include $(SRC)
LDFLAGS=--shared $(OBJS) -L/usr/local/idaadv -lida \
      --no-undefined -Wl,--version-script=./plugin.script

all:
        $(CC) $(CFLAGS)
        $(LD) $(LDFLAGS) -o myplugin.plx
        cp myplugin.plx /usr/local/idaadv/plugins
```

To compile your plug-in, `make` will do the job and copy it into the IDA `plugins` directory for you.

3.4 A Plug-in Template

The way IDA "hooks in" to your plug-in is via the `PLUGIN` class, and is typically the only thing exported by your plug-in (so that IDA can use it). Also, the only files you need to `#include` that are essential for the most basic plug-in are `ida.hpp`, `idp.hpp` and `loader.hpp`.

The below template should serve as a starter for all your plug-in writing needs. If you paste it into a file in your respective development environment, it should compile, and when run in IDA (**Edit->Plugins->*pluginname***, or the shortcut defined) , it will insert the text "Hello World" into the IDA *Log* window.

```
#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>

int IDAP_init(void)
{
      // Do checks here to ensure your plug-in is being used within
      // an environment it was written for. Return PLUGIN_SKIP if the  //
checks fail, otherwise return PLUGIN_KEEP.
}

void IDAP_term(void)
{
      // Stuff to do when exiting, generally you'd put any sort
      // of clean-up jobs here.
      return;
}

// The plugin can be passed an integer argument from the plugins.cfg
// file. This can be useful when you want the one plug-in to do
// something different depending on the hot-key pressed or menu
// item selected.
void IDAP_run(int arg)
{
      // The "meat" of your plug-in
      msg("Hello world!");
      return;
}

// There isn't much use for these yet, but I set them anyway.
char IDAP_comment[]     = "This is my test plug-in";
char IDAP_help[]        = "My plugin";

// The name of the plug-in displayed in the Edit->Plugins menu. It can //
be overridden in the user's plugins.cfg file.
char IDAP_name[]        = "My plugin";

// The hot-key the user can use to run your plug-in.
```

```
char IDAP_hotkey[]      = "Alt-X";

// The all-important exported PLUGIN object
plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,      // IDA version plug-in is written for
  0,                          // Flags (see below)
  IDAP_init,                  // Initialisation function
  IDAP_term,                  // Clean-up function
  IDAP_run,                   // Main plug-in body
  IDAP_comment,               // Comment – unused
  IDAP_help,                  // As above – unused
  IDAP_name,                  // Plug-in name shown in
                              // Edit->Plugins menu
  IDAP_hotkey                 // Hot key to run the plug-in
};
```

You can usually get away without setting the flags attribute (second from the top) in the `PLUGIN` structure unless it's a debugger module, or you want to do something like hide it from the **`Edit->Plugins`** menu. See `loader.hpp` for more information on the possible flags you can set.

The above template is also available at http://www.binarypool.com/idapluginwriting/template.cpp.

3.5 Configuring and Running Plug-ins

This is the easiest of all – copy the compiled plug-in file (make sure it ends in `.plw` for Windows or `.plx` for Linux) into the IDA `plugins` directory and IDA will load it automatically at start-up.

Make sure your plug-in can load up all of its DLLs and shared libraries at start-up by ensuring your environment is set up correctly (`LD_LIBRARY_PATH` under Linux, for example). You can start IDA with the `-z20` flag, which will enable plug-in debugging. This will usually indicate if there are errors during the loading process.

If you put code into the `IDAP_init()` function, it will get executed when IDA is loading the first file for disassembly, otherwise, if you put code in the `IDAP_run()` function, it will execute when the user presses the hot-key combination or goes through the **`Edit->Plugins`** menu.

The user can override a few of the `PLUGIN` settings in the `plugins.cfg` file (like the name and hot-key), but that's nothing for you to really concern yourself with. The `plugins.cfg` file can also be used to pass arguments to your plug-in at start-up.

4. Fundamentals

There are quite a few different classes, data structures and types within the IDA SDK, some more widely used than others. The aim of this section is to introduce you to them, as they provide great insight into what IDA knows about a disassembled file, and should get you thinking about the possibilities of what can be done with the SDK.

Some of these classes and structures are quite large, with many member variables and methods/functions. In this section, it's mostly the variables that are covered, whereas the methods are covered in *Chapter 5 - Functions*. Some of the below code commentary is taken straight from the SDK, some is my commentary, and some is a combination of the two. `#defines` have, in some cases, been included beneath various members, the same way as it's been done in the SDK. I left these in because it's a good illustration of the valid values a member variable can have.

Important note about the examples: Code from any of the examples in this section should be put into the `IDAP_run()` function from the template in section 3.4, unless otherwise stated.

4.1 Core Types

The following types are used all throughout the SDK and this tutorial, so it's important that you are able to recognise what they represent.

All the below types are unsigned long integers, and unsigned long long integers on 64-bit systems. They are defined in `pro.h`.

Type	Description
`ea_t`	Stands for 'Effective Address', and represents pretty much any address within IDA (memory, file, limits, etc.)
`sel_t`	Segment selectors, as in code, stack and data segment selectors
`uval_t`	Used for representing unsigned values
`asize_t`	Typically used for representing the size of something, usually a chunk of memory

The following are signed long integers, and signed long long integers on 64-bit systems. They are also defined in `pro.h`.

Type	Description
`sval_t`	Used for representing signed values
`adiff_t`	Represents the difference between two addresses

Finally, there are a couple of definitions worth noting; one of these is `BADADDR`, which represents an invalid or non-existent address which you will see used a lot in loops for detecting the end of a readable address range or structure. You will also see `MAXSTR` used in character buffer definitions, which is `1024`.

4.2 Core Structures and Classes

4.2.1 Meta Information

The `idainfo` struct, which is physically stored in the IDA database (IDB), holds what I refer to as 'meta' information about the initial file loaded for disassembly in IDA. It does not change if more files are loaded, however. Here are some of the more interesting parts of it, as defined in `ida.hpp`:

```
struct idainfo
{
  ...
  char          procName[8];  // Name of processor IDA is running on
                              // ("metapc" = x86 for example)
  ushort        filetype;     // The input file type. See the
                              // filetype_t enum – could be f_ELF,
                              // f_PE, etc.
  ea_t          startSP;      // [E]SP register value at the start of
                              // program execution
  ea_t          startIP;      // [E]IP register value at the start of
                              // program execution
  ea_t          beginEA;      // Linear address of program entry point,
                              // usually the same as startIP
  ea_t          minEA;        // First linear address within program
  ea_t          maxEA;        // Last linear address within the
                              // program, excluding maxEA
...
};
```

`inf` is a globally accessible instance of this structure. You will often see checks done against `inf.procName` within the initialisation function of a plug-in, checking that the machine architecture is what the plug-in was written to handle.

For example, if you wrote a plug-in to only handle PE and ELF binary formats for the x86 architecture, you could add the following statement to your plug-in's init function (`IDAP_init` from our plug-in template in section 3.4).

```
// "metapc" represents x86 architecture
if(strncmp(inf.procName, "metapc", 8) != 0
      || inf.filetype != f_ELF && inf.filetype != f_PE))
{
   error("Only PE and ELF binary type compiled for the x86 "
            "platform is supported, sorry.");
   return PLUGIN_SKIP;  // Returning PLUGIN_SKIP means this plug-in
                        // won't be loaded
}
return PLUGIN_KEEP;     // Keep this plug-in loaded
```

4.2.2 Areas

Before going into detail on the “higher level” classes for working with segments, functions and instructions, let's have a look at two key concepts; namely areas and area control blocks.

4.2.2.1 The area_t Structure

An area is represented by the `area_t` struct, as defined in `area.hpp`. Based on commentary in this file, strictly speaking:

"Areas" consists of separate area_t instances. An area is a non-empty contiguous range of addresses (specified by it start and end addresses, end address is excluded) with characteritics. For example, segments are set of areas.

As you can see from the below excerpt from the `area_t` definition, it is defined by a start address (`startEA`) and end address (`endEA`). There are also a couple of functions to see if an area contains an address, if an area is empty, and to return the size of the area. A segment is an area, but functions are too, which means areas can also encompass other areas.

```
struct area_t
{
  ...
  ea_t startEA;
  ea_t endEA;                   // endEA address is excluded from
                                // the area
  bool contains(ea_t ea) const { return startEA <= ea && endEA > ea; }
  bool empty(void) const { return startEA >= endEA; }
  asize_t size(void) const { return endEA - startEA; }
  ...
};
```

Technically speaking, saying that functions and segments are areas, is to say that the `func_t` and `segment_t` classes inherit from the `area_t` struct. This means that all the variables and functions in the `area_t` structure are applicable to `func_t` and `segment_t` (so for example, `segment_t.startEA` and `func_t.contains()` are valid). `func_t` and `segment_t` also extend the `area_t` struct with their own specialized variables and functions. These will be covered later however.

A few other classes that inherit from and extend `area_t` are as follows:

Type (file)	Description
`hidden_area_t (bytes.hpp)`	Hidden areas where code/data is replaced and summarised by a description that can be expanded to view the hidden information
`regvar_t (frame.hpp)`	Register name replacement with user-defined names (register variables)
`memory_info_t (idd.hpp)`	A chunk of memory (when using the debugger)
`segreg_t (srarea.hpp)`	Segment register (CS, SS, etc. on x86) information

4.2.2.2 The areacb_t Class

An area control block is represented by the `areacb_t` class, also defined in `area.hpp`. The commentary for it, shown below, is slightly less descriptive, but doesn't really need to be anyway:

"areacb_t" is a base class used by many parts of IDA

The area control block class is simply a collection of functions that are used to operate on areas. Functions include `get_area_qty()`, `get_next_area()` and so on. You probably won't find yourself using any of these methods directly, as when dealing with functions for example, you're more likely to use `func_t`'s methods, and the same rule applies to other classes that inherit from `area_t`.

There are two global instances of the `areacb_t` class, namely `segs` (defined in `segment.hpp`) and `funcs` (defined in `funcs.hpp`), which represent all segments and functions, respectively, within the

currently disassembled file(s). You can run the following to get the number of segments and functions within the currently disassembled file(s) in IDA:

```
#include <segment.hpp>
#include <funcs.hpp>

msg("Segments: %d, Functions: %d\n",
      segs.get_area_qty(),
      funcs.get_area_qty());
```

4.2.3 Segments and Functions

As mentioned previously, the `segment_t` and `func_t` classes both inherit from and *extend* the `area_t` struct, which means all the `area_t` variables and functions are applicable to these classes and they also bring some of their own functionality into the mix.

4.2.3.1 Segments

The `segment_t` class is defined in `segment.hpp`. Here are the more interesting parts of it.

```
class segment_t : public area_t
{
public:
  uchar perm;           // Segment permissions (0-no information). Will
                        // be one or a combination of the below.
#define SEGPERM_EXEC  1 // Execute
#define SEGPERM_WRITE 2 // Write
#define SEGPERM_READ  4 // Read
  uchar type;   // Type of the segment. This will be one of the below.
#define SEG_NORM        0       // Unknown type, no assumptions
#define SEG_XTRN        1       // Segment with 'extern' definitions,
                                // where no instructions are allowed
#define SEG_CODE        2       // Code segment
#define SEG_DATA        3       // Data segment
#define SEG_NULL        7       // Zero-length segment
#define SEG_BSS         9       // Uninitialized segment
...
};
```

`SEG_XTRN` is a special (i.e. not physically existent) segment type, created by IDA upon disassembly of a file, whereas others represent physical parts of the loaded file. For a typical executable file loaded in IDA for example, the value of `type` for the `.text` segment would be `SEG_CODE` and the value of `perm` would be `SEGPERM_EXEC | SEGPERM_READ`.

To iterate through all the segments within a binary, printing the name and address of each one into IDA's *Log* window, you could do the following:

```
#include <segment.hpp>

// This will only work in IDA 4.8, because get_segm_name() changed
// in 4.9. See the Chapter 5 for more information.

// get_segm_qty() returns the number of total segments
// for file(s) loaded.
for (int s = 0; s < get_segm_qty(); s++)
{
    // getnseg() returns a segment_t struct for the segment
    // number supplied
    segment_t *curSeg = getnseg(s);
    // get_segm_name() returns the name of a segment
```

```
    // msg() prints a message to IDA's Log window
    msg("%s @ %a\n", get_segm_name(curSeg), curSeg->startEA);
}
```

Understanding what the functions above do isn't important at this stage – they'll be explained in more detail under *Chapter 5 - Functions*.

4.2.3.2 Functions

A function is represented by the `func_t` class, which is defined in `funcs.hpp`, but before going into detail on the `func_t` class, it's probably worth shedding some light on function chunks, parents and tails.

Functions are typically contiguous blocks of code within the binary being analysed, and are usually represented as a single chunk. However, there are times when optimizing compilers move code around, and so functions are broken up into multiple chunks with code from other functions separating them. These loose chunks are known as "tails", and the chunks that reference code (by a `JMP` or something similar) within the tails are known as "parents". What makes things a little confusing is that all are still of the `func_t` type, and so you need to check the `flags` member of `func_t` to determine if a `func_t` instance is a tail or parent.

Below is highly stripped-down version of the `func_t` class, along with some slightly edited commentary taken from `funcs.hpp`.

```
class func_t : public area_t
{
public:
...
  ushort flags; // flags indicating the type of function
                // Some of the flags below:
#define FUNC_NORET      0x00000001L     // function doesn't return
#define FUNC_LIB        0x00000004L     // library function
#define FUNC_HIDDEN     0x00000040L     // a hidden function chunk
#define FUNC_THUNK      0x00000080L     // thunk (jump) function
#define FUNC_TAIL       0x00008000L     // This is a function tail.
                                        // Other bits should be clear
                                        // (except FUNC_HIDDEN)
  union  // func_t either represents an entry chunk or a tail chunk
  {
    struct              // attributes of a function entry chunk
    {
      asize_t argsize;  // number of bytes purged from the stack
                        // upon returning
      ushort pntqty;    // number of times the ESP register changes
                        // throughout the function (due to PUSH, etc.)
      int tailqty;      // number of function tails this function owns
      area_t *tails;    // array of tails, sorted by ea
    }
    struct              // attributes of a function tail chunk
    {
      ea_t owner;       // the address of the main function
                        // possessing this tail
  }
...
};
```

Because functions are also areas just like segments, iterating through each function is a process almost identical to dealing with segments. The following example lists all functions and their address within a disassembled file, displaying output in IDA's *Log* window.

```
#include <funcs.hpp>

// get_func_qty() returns the number of functions in file(s)
// loaded.
for (int f = 0; f < get_func_qty(); f++)
{
    // getn_func() returns a func_t struct for the function
    // number supplied
    func_t *curFunc = getn_func(f);
    char funcName[MAXSTR];

    // get_func_name gets the name of a function,
    // stored in funcName
    get_func_name(curFunc->startEA,
                        funcName,
                        sizeof(funcName)-1);
    msg("%s:\t%a\n", funcName, curFunc->startEA);
}
```

4.2.4 Code Representation

Assembly language instructions consist of, in most cases, mnemonics (`PUSH`, `SHR`, `CALL`, etc.) and operands (`EAX`, `[EBP+0xAh]`, `0x0Fh`, etc.) Some operands can take various forms, and some instructions don't even take operands. All of this is represented very cleanly in the IDA SDK.

You have the `insn_t` type to begin with, which represents a whole instruction, for example "`MOV EAX, 0x0A`". `insn_t` is made up of, amongst other member variables, up to 6 `op_t`'s (one for each operand supplied to the instruction), and each operand can be a particular `optype_t` (general register, immediate value, etc.)

Let's look at each component from the bottom-up. They are all defined in `ua.hpp`.

4.2.4.1 Operand Types

`optype_t` represents the *type* of operand that is being supplied to an instruction. Here are the more common operand type values. The descriptions have been taken from the `optype_t` definition in `ua.hpp`.

Operand	Description	Example disassembly (respective operand in bold)
`o_void`	No Operand	`pusha`
`o_reg`	General Register	`dec` **`eax`**
`o_mem`	Direct Memory Reference	`mov eax,` **`ds:1001h`**
`o_phrase`	Memory Ref [Base Reg + Index Reg]	`push dword ptr` **`[eax]`**
`o_displ`	Memory Ref [Base Reg + Index Reg + Displacement]	`push` **`[esp+8]`**
`o_imm`	Immediate Value	`add ebx,` **`10h`**
`o_near`	Immediate Near Address	`call` **`_initterm`**

4.2.4.2 Operands

op_t represents a single operand passed to an instruction. Below is a highly cut-down version of the class.

```
class op_t
{
public:
  char n;          // number/position of the operand (0,1,2)
  optype_t type;   // type of operand (see previous section)
  ushort reg;      // register number (if type is o_reg)
  uval_t value;    // operand value (if type is o_imm)
  ea_t addr;       // virtual address pointed to or used by the
             // operand (if type is o_mem)
...
};
```

So, for example, the operand of [esp+8] will result in type being o_displ, reg being 4 (which is the number for the ESP register) and addr being 8, because you are accessing 8 bytes from the stack pointer, thereby being a memory reference. You can use the following snippet of code for getting the op_t value of the first operand of the instruction your cursor is currently positioned at in IDA:

```
#include <kernwin.hpp>
#include <ua.hpp>

// Disassemble the instruction at the cursor position, store it in
// the globally accessible 'cmd' structure.
ua_ana0(get_screen_ea());
// Display information about the first operand
msg("n = %d type = %d reg = %d value = %a addr = %a\n",
         cmd.Operands[0].n,
         cmd.Operands[0].type,
         cmd.Operands[0].reg,
         cmd.Operands[0].value,
         cmd.Operands[0].addr);
```

4.2.4.3 Mnemonics

The mnemonic (PUSH, MOV, etc.) within the instruction is represented by the itype member of the insn_t class (see the next section). This is, however, an integer, and there is currently no textual representation of the instruction available to the user in any data structure – instead, it is obtained through use of the ua_mnem( ) function, which will be covered in *Chapter 5 - Functions*.

There is an enum, named instruc_t (allins.hpp) that holds all mnemonic identifiers (prefixed with NN_). If you know what instructions you are after or want to test for, you can utilise it rather than work off a text representation. For example, to test if the first instruction in a binary is a PUSH, you could do the following:

```
#include <ua.hpp>
#include <allins.hpp>

// Populate 'cmd' with the code at the entry point of the binary
ua_ana0(inf.startIP);
// Test if that instruction is a PUSH
if (cmd.itype == NN_push)
   msg("First instruction is a PUSH");
else
   msg("First instruction isn't a PUSH");
return;
```

4.2.4.4 Instructions

`insn_t` represents a whole instruction. It contains an `op_t` array, named `Operands`, which represents all operands passed to the instruction. Obviously there are instructions that take no operands (like PUSHA, CDQ, etc.), in which case the `Operands[0]` variable will have an `optype_t` of `o_void` (no operand).

```
class insn_t
{
public:
  ea_t cs;                      // code segment base (in paragraphs)
  ea_t ip;                      // offset within the segment
  ea_t ea;                      // instruction start addresses
  ushort itype;                 // mnemonic identifier
  ushort size;                  // instruction size in bytes
#define UA_MAXOP        6
  op_t Operands[UA_MAXOP];
#define Op1 Operands[0]         // first operand
#define Op2 Operands[1]         // second operand
#define Op3 Operands[2]         // ...
#define Op4 Operands[3]
#define Op5 Operands[4]
#define Op6 Operands[5]
};
```

There is a globally accessible instance of `insn_t` named `cmd`, which gets populated by the `ua_ana0()` and `ua_code()` functions. More on this later, but in the mean time, here's an example to get the instruction at a file's entry point and display its instruction number, address and size in IDA's *Log* window.

```
#include <ua.hpp>

// ua_ana0() populates the cmd structure with a disassembly of the
// address supplied.
ua_ana0(inf.beginEA); // or inf.startIP
msg("instruction number: %d, at %a is %d bytes in size.\n",
            cmd.itype, cmd.ea, cmd.size);
```

4.2.5 Cross Referencing

One of the handy features in IDA is the cross-referencing functionality, which will tell you about all parts of the currently disassembled file that reference another part of that file. For instance, in IDA, you can highlight a function in the disassembly window, press 'x' and all addresses where that function is referenced (e.g. calls made to the function) will appear in a window. The same can be done for data and local variables too.

The SDK provides a simple interface for accessing this information, which is stored internally in a B-tree data structure, accessed via the `xrefblk_t` structure. There are other, more manual, ways to retrieve this sort of information, but they are much slower than the methods outlined below.

One important thing to remember is that even when an instruction naturally flows onto the next, IDA can potentially treat the first as referencing the second, but this can be turned off using flags supplied to some `xrefblk_t` methods, covered in *Chapter 5 - Functions*.

4.2.5.1 The xrefblk_t Structure

Central to cross referencing functionality is the `xrefblk_t` structure, which is defined in `xref.hpp`. This structure first needs to be populated using its `first_from()` or `first_to()` methods (depending on whether you want to find references to or from an address), and subsequently populated using `next_from()` or `next_to()` as you traverse through the references.

The variables within this structure are shown below and commentary is mostly from `xref.hpp`. The methods (`first_from`, `first_to`, `next_from` and `next_to`) have been left out, but will be covered in *Chapter 5 - Functions*.

```
struct xrefblk_t
{
  ea_t from;            // the referencing address
  ea_t to;              // the referenced address
  uchar iscode;         // 1-is code reference; 0-is data reference
  uchar type;           // one of the cref_t or dref_t types (see
                        // section 4.2.5.2 and 4.2.5.3)
...
};
```

As indicated by the `iscode` variable, `xrefblk_t` can contain information about a code reference or a data reference, each of which could be one of a few possible reference types, as indicated by the `type` variable. These code and data reference types are explained in the following two sections.

The below code snippet will give you cross reference information about the address your cursor is currently positioned at:

```
#include <kernwin.hpp>
#include <xref.hpp>

xrefblk_t xb;
// Get the address of the cursor position
ea_t addr = get_screen_ea();
// Loop through all cross references
for (bool res = xb.first_to(addr, XREF_FAR); res; res = xb.next_to()) {
      msg("From: %a, To: %a\n", xb.from, xb.to);
      msg("Type: %d, IsCode: %d\n", xb.type, xb.iscode);
}
```

4.2.5.2 Code

Here is the `cref_t` enum, with some irrelevant items taken out. Depending on the type of reference, the `type` variable in `xrefblk_t` will be one of the below if `iscode` is set to `1`. The commentary for the below is taken from `xref.hpp`.

```
enum cref_t
{
...
  fl_CF = 16,             // Call Far
                          // This xref creates a function at the
                          // referenced location
  fl_CN,                  // Call Near
                          // This xref creates a function at the
                          // referenced location
  fl_JF,                  // Jump Far
  fl_JN,                  // Jump Near
  fl_F,                   // Ordinary flow: used to specify execution
                          // flow to the next instruction.
...
};
```

Below is a code cross reference taken from a sample binary file. In this case, `712D9BFE` is referenced by `712D9BF6`, which is a near jump (`fl_JN`) code reference type.

```
.text:712D9BF6     jz      short loc_712D9BFE
...
.text:712D9BFE loc_712D9BFE:
.text:712D9BFE     lea     ecx, [ebp+var_14]
```

4.2.5.3 Data

If `iscode` in `xrefblk_t` is set to `0`, it is a data cross reference. Here are the possible `type` member values when you're dealing with a data cross reference. The commentary for this enum is also taken from `xref.hpp`.

```
enum dref_t
{
...
  dr_O,                   // Offset
                          // The reference uses 'offset' of data
                          // rather than its value
                          //    OR
                          // The reference appeared because
                          // the "OFFSET" flag of instruction is set.
                          // The meaning of this type is IDP dependent.
  dr_W,                   // Write access
  dr_R,                   // Read access
...
};
```

Keep in mind that when you see the following in a disassembly, you are actually looking at a data cross reference, whereby `712D9BD9` is referencing `712C119C`:

```
.idata:712C119C extrn wsprintfA:dword
...
.text:712D9BD9             call    ds:wsprintfA
```

In this case, the `type` member of `xrefblk_t` would be the typical `dr_R`, because it's simply doing a read of the address represented by `ds:wsprintfA`. Another data cross reference is below, where the `PUSH` instruction at `712EABE2` is referencing a string at `712C255C:`

```
.text:712C255C aVersion:
.text:712C255C             unicode 0, <Version>,0
...
.text:712EABE2             push    offset aVersion
```

The `type` member of `xrefblk_t` would be `dr_O` in this case, because it's accessing the data as an offset.

4.3 Byte Flags

For each byte in a disassembled file, IDA records a corresponding four byte (32-bits) value, stored in the `id1` file. Of these four bytes, each half-byte (four bits or “nibble”) is a flag, which represents an item of information about the byte in the disassembled file. The last byte of the four flag bytes is the actual byte at that address within the disassembled file.

For example, the instruction below takes up a single byte (`0x55`) in the file being disassembled:

```
.text:010060FA             push    ebp
```

The IDA flags for the above address in the file being disassembled are `0x00010755; 0001007` being the flag component and `55` being the byte value at that address in the file. Keep in mind that the

address has no bearing on the flags at all, nor is it possible to derive flags from the address or bytes themselves - you need to use `getFlags()` to get the flags for an address (more on this below).

Obviously, not all instructions are one byte in size; take the below instruction for example, which is three bytes (`0x83 0xEC 0x14`). The instruction is therefore spread across three addresses; `0x010011DE`, `0x010011DF` and `0x010011E0`:

```
.text:010011DE              sub     esp, 14h
.text:010011E1 ...
```

Here are the corresponding flags for each byte in this instruction:

```
010011DE: 41010783
010011DF: 001003EC
010011E0: 00100314
```

Because these three bytes belong to the one instruction, the first byte of the instruction is referred to as the head, and the other two are tail bytes. Once again, notice that the last byte of each flag-set is the corresponding byte of the instruction (`0x83`, `0xEC`, `0x14`).

All flags are defined in `bytes.hpp`, and you can check whether a flag is set by using the flagset returned from `getFlags(ea_t ea)` as the argument to the appropriate flag-checking wrapper function. Here are some common flags along with their wrapper functions which check for their existence. Some functions are covered in *Chapter 5 - Functions*, for others you should look in `bytes.hpp`:

Flag Name	Flag	Indication	Wrapper function
`FF_CODE`	`0x00000600L`	Is the byte code?	`isCode()`
`FF_DATA`	`0x00000400L`	Is the byte data?	`isData()`
`FF_TAIL`	`0x00000200L`	Is this byte a part (non-head) of an instruction data chunk?	`isTail()`
`FF_UNK`	`0x00000000L`	Was IDA unable to classify this byte?	`isUnknown()`
`FF_COMM`	`0x00000800L`	Is the byte commented?	`has_cmt()`
`FF_REF`	`0x00001000L`	Is the byte referenced elsewhere?	`hasRef()`
`FF_NAME`	`0x00004000L`	Is the byte named?	`has_name()`
`FF_FLOW`	`0x00010000L`	Does the previous instruction flow here?	`isFlow()`

Going back to the first “push ebp” example above, if we were to manually check the flags returned from `getFlags(0x010060FA)` against a couple of the above flags, we’d get the following results:

`0x00010755 & 0x00000600 (FF_CODE) = 0x00000600`. We know this is code.
`0x00010755 & 0x00000800 (FF_COMM) = 0x00000000`. We know this isn't commented.

The above example is purely for illustrative purposes - don't do it this way in your plug-in. As mentioned above, you should always use the helper functions to check whether a flag is set or not. The following will return the flags for the given head address your cursor is positioned at in IDA.

```
#include <bytes.hpp>
#include <kernwin.hpp>

msg("%08x\n", getFlags(get_screen_ea()));
```

4.4 The Debugger

One of the most powerful features of the IDA SDK is the ability to interact with the IDA debugger, and unless you've installed your own custom debugger plug-in, it will be one of the debugger plug-ins that came with IDA. The following debugger plug-ins come with IDA by default, and can be found in your IDA `plugins` directory:

Plugin Filename	Description
`win32_user.plw`	Windows local debugger
`win32_stub.plw`	Windows remote debugger
`linux_user.plw`	Linux local debugger
`linux_stub.plw`	Linux remote debugger

These are automatically loaded by IDA and made available at start-up under the *`Debugger->Run`* menu. From here on, the term "debugger" will represent which ever of the above you are using (IDA will choose the most appropriate one for you by default).

As mentioned earlier, it is possible to write debugger modules for IDA, but this isn't to be confused with writing plug-in modules that interact with the debugger. The second type of plug-in is what's described below.

Aside from all the functions provided for interacting with the debugger, which will be explored later in *Chapter 5 - Functions*, there are some key data structures and classes that are essential to understand before moving ahead.

4.4.1 The debugger_t Struct

The `debugger_t` struct, defined in `idd.hpp` and exported as `*dbg`, represents the currently active debugger plug-in, and is available when the debugger is loaded (i.e. at start-up, not just when you run the debugger).

```
struct debugger_t
{
...
  char *name;          // Short debugger name like 'win32' or 'linux'
#define DEBUGGER_ID_X86_IA32_WIN32_USER  0 // Userland win32 processes
#define DEBUGGER_ID_X86_IA32_LINUX_USER  1 // Userland linux processes
  register_info_t *registers;               // Array of registers
  int             registers_size;           // Number of registers
...
}
```

As a plug-in module, it's likely that you'll need to access the `*name` variable, possibly to test what debugger your plug-in is running with. The `*registers` and `registers_size` variables are also useful for obtaining a list of registers available (see the following section).

4.4.2 Registers

A common task while using the debugger is accessing and manipulating register values. In the IDA SDK, a register is described by the `register_info_t` struct, and the value held by a register is represented by the `regval_t` struct. Below is a slightly cut-down `register_info_t` struct, which is defined in `idd.hpp`.

```
struct register_info_t
{
  const char *name;                  // Register full name (EBX, etc.)
  ulong flags;                       // Register special features,
                                    // which can be any combination
                                    // of the below.
#define REGISTER_READONLY 0x0001     // the user can't modify
                                    // the current value of this
                                    // register
#define REGISTER_IP       0x0002     // instruction pointer
#define REGISTER_SP       0x0004     // stack pointer
#define REGISTER_FP       0x0008     // frame pointer
#define REGISTER_ADDRESS  0x0010     // Register can contain an address
...
};
```

The only instance of this structure is accessible as the array member `*registers` of `*dbg` (an instance of `debugger_t`), therefore it is up to the debugger you're using to populate it with the list of registers available on your system.

To obtain the value for any register, it's obviously essential that the debugger be running. The functions for reading and manipulating register values will be covered in more detail in *Chapter 5 - Functions*, but for now, all you need to know is to retrieve the value using the `ival` member of `regval_t`, or use `fval` if you're dealing with floating point numbers.

Below is `regval_t`, which is defined in `idd.hpp`.

```
struct regval_t
{
    ulonglong ival;     // Integer value
    ushort    fval[6];  // Floating point value in the internal
                        // representation (see ieee.h)
};
```

`ival/fval` will correspond directly to what is stored in a register, so if `EBX` contains `0xDEADBEEF`, `ival` (once populated using `get_reg_val()`), will also contain `0xDEADBEEF`.

The following example will loop through all available registers, displaying the value in each. If you run this outside of debug mode, the value will be `0xFFFFFFFF`:

```
#include <dbg.hpp>

// Loop through all registers
for (int i = 0; i < dbg->registers_size; i++) {
    regval_t val;
    // Get the value stored in the register
    get_reg_val((dbg->registers+i)->name, &val);
    msg("%s: %08a\n", (dbg->registers+i)->name, val.ival);
}
```

4.4.3 Breakpoints

A fundamental component of debugging is breakpoints, and IDA represents hardware and software breakpoints differently using the `bpt_t` struct, shown below and defined in `dbg.hpp`. Hardware breakpoints are created using debug-specific registers on the running CPU (`DR0-DR3` on x86), whereas software breakpoints are created by inserting an `INT3` instruction at the desired breakpoint address - although this is handled for you by IDA, it's sometimes helpful to know the difference. On x86, the maximum number of hardware breakpoints you can set is four.

```
struct bpt_t
{
  // read only characteristics:
  ea_t ea;                // starting address of the breakpoint
  asize_t size;           // size of the breakpoint
                          // (undefined if software breakpoint)
  bpttype_t type;         // type of the breakpoint:
// Taken from the bpttype_t const definition in idd.hpp:
// BPT_EXEC  =  0,             // Execute instruction
// BPT_WRITE =  1,             // Write access
// BPT_RDWR  =  3,             // Read/write access
// BPT_SOFT  =  4;             // Software breakpoint
  // modifiable characteristics (use update_bpt() to modify):
  int pass_count;         // how many times does the execution reach
                          // this breakpoint? (-1 if undefined)
  int flags;
#define BPT_BRK   0x01    // does the debugger stop on this breakpoint?
#define BPT_TRACE 0x02    // does the debugger add trace information
                          // when this breakpoint is reached?
  char condition[MAXSTR]; // an IDC expression which will be used as
                          // a breakpoint condition or run when the
                          // breakpoint is hit
};
```

Therefore, if the `type` member of `bpt_t` is set to `0`, `1` or `3`, it is a hardware breakpoint, whereas `4` would indicate a software breakpoint.

There are a lot of functions that create, manipulate and read this struct, but for now, I'll provide a simple example that goes through all defined breakpoints and display whether they are a software or hardware breakpoint in IDA's *Log* window. The functions used will be explained in more detail further on.

```
#include <dbg.hpp>

// get_bpt_qty() gets the number of breakpoints defined
for (int i = 0; i < get_bpt_qty(); i++) {
    bpt_t brkpnt;
    // getn_bpt fills bpt_t struct with breakpoint information based
    // on the breakpoint number supplied.
    getn_bpt(i, &brkpnt);
    // BPT_SOFT is a software breakpoint
    if (brkpnt.type == BPT_SOFT)
        msg("Software breakpoint found at %a\n", brkpnt.ea);
    else
        msg("Hardware breakpoint found at %a\n", brkpnt.ea);
}
```

4.4.4 Tracing

In IDA, there are three types of tracing you can enable; Function tracing, Instruction tracing and Breakpoint (otherwise known as read/write/execute) tracing. When writing plug-ins, an additional form of tracing is available; Step tracing. Step tracing is a low level form of tracing that allows you to build your own tracing mechanism on top of it, utilising event notifications (see section 4.5) to inform your plug-in of each instruction that is executed. This is based on CPU tracing functionality, not breakpoints.

A "trace event" is generated and stored in a buffer when a trace occurs, and what triggers the generation of a trace event depends on the type of tracing you have enabled, however it's worth noting that step tracing will not generate trace events, but event notifications instead. The below table lists all the different trace event types along with the corresponding `tev_type_t` enum value, which is defined in `dbg.hpp`.

Trace Type	Event Type (tev_type_t)	Description
Function call and return	tev_call and tev_ret	A function has been called or returned from
Instruction	tev_insn	An instruction has been executed (this is built on top of step tracing in the IDA kernel)
Breakpoint	tev_bpt	A breakpoint with tracing enabled has been hit. Also known as a Read/Write/Execute trace

All trace events are stored in a circular buffer, so it never fills up, but old trace events will be overwritten if the buffer is too small. Each trace event is represented by the tev_info_t struct, which is defined in dbg.hpp:

```
struct tev_info_t
{
  tev_type_t  type; // Trace event type (one of the above or tev_none)
  thread_id_t tid;  // Thread where the event was recorded
  ea_t        ea;   // Address where the event occurred
};
```

Based on the bpt_t struct described in section 4.4.3, a breakpoint trace is the same as a normal breakpoint but has the BPT_TRACE flag set on the flags member. Optionally, the condition buffer member could have an IDC command to run at each breakpoint.

Trace information is populated during the execution of a process, but can be accessed even once the process has exited and you are returned to static disassembly mode (unless a plug-in you are using explicitly cleared the buffer on exit). You can use the following code to enumerate all trace events (provided you enabled it during exeucution):

```
#include <dbg.hpp>

// Loop through all trace events
for (int i = 0; i < get_tev_qty(); i++) {
    regval_t esp;
    tev_info_t tev;

    // Get the trace event information
    get_tev_info(i, &tev);

    switch (tev.type) {
           case tev_ret:
                msg("Function return at %a\n", tev.ea);
                break;
           case tev_call:
                msg("Function called at %a\n", tev.ea);
                break;
           case tev_insn:
                msg("Instruction executed at %a\n", tev.ea);
                break;
           case tev_bpt:
                msg("Breakpoint with tracing hit at %a\n", tev.ea);
                break;
           default:
                msg("Unknown trace type..\n");
    }
}
```

It's worth noting at this point that it's not possible for a plug-in to add entries to, or even modify the trace event log.

All of the functions used above will be covered in *Chapter 5 - Functions*.

4.4.5 Processes and Threads

IDA maintains information about the processes and threads currently running under the debugger. Process and Thread IDs are represented by the `process_id_t` and `thread_id_t` types, respectively and both are signed integers. All of these types are defined in `idd.hpp`. The only other type, related to processes, is the `process_info_t` type, which is as follows:

```
struct process_info_t
{
  process_id_t pid;    // Process ID
  char name[MAXSTR];   // Process Name (executable file name)
};
```

These are only of use when a binary is being executed under IDA (i.e. you can't use them when in static disassembly mode). The following example illustrates a basic example usage of the `process_info_t` structure.

```
#include <dbg.hpp>

// Get the number of processes available for debugging.
// get_process_qty() also initialises IDA's "process snapshot"
if (get_process_qty() > 0) {
    process_info_t pif;
    get_process_info(0, &pif);
    msg("ID: %d, Name: %s\n", pif.pid, pif.name);
} else {
    msg("No process running!\n");
}
```

The functions that utilise these structures will be discussed under *Chapter 5 - Functions*.

4.5 Event Notifications

Typically, plug-ins are run synchronously, in that they are executed by the user, either via pressing the hot-key or going through the **`Edit->Plugins`** menu. A plug-in can, however, run asynchronously, where it responds to event notifications generated by IDA or the user.

During the course of working in IDA, you'd typically click buttons, conduct searches, and so on. All of these actions are "events", and so what IDA does is generate "event notifications" each time these things take place. If your plug-in is setup to receive these notifications (explained below), it can react in any way you program it to. An application for this sort of thing could be recording macros for instance. A plug-in can also generate events, causing IDA to perform various functions.

4.5.1 Receiving Notification

To receive event notifications from IDA, all a plug-in has to do is register a call-back function using `hook_to_notification_point()`. For generating event notifications, `callui()` is used, which is covered in more detail in *Chapter 5 - Functions*.

When registering a call-back function with `hook_to_notification_point()`, you can specify one of three event types, depending on what notifications you want to receive. These are defined in the `hook_type_t` enum within `loader.hpp`:

Type	Receive Event Notifications From	Enum of All Event Notification Types
HT_IDP	Processor module	idp_notify (not covered here)
HT_UI	IDA user interface	ui_notification_t
HT_DBG	Currently running IDA debugger	dbg_notification_t

Therefore, to receive all event notifications pertaining to the debugger and direct them to your dbg_callback (for example) call-back function, you could put the following inside IDAP_init():

```
hook_to_notification_point(HT_DBG, dbg_callback, NULL);
```

The third argument is typically NULL, unless you want to pass data along to the call-back function when it receives an event (any data structure of your choosing).

The call-back function supplied to hook_to_notification_point() must look something like this:

```
int idaapi mycallback (void *user_data, int notif_code, va_list va)
{
      ...
      return 0;
}
```

When mycallback() is eventually called by IDA to handle an event notification, user_data will point to any data you specified to have passed along to the call-back function (defined in the call to hook_to_notification_point()). notif_code will be the actual event identifier (listed in the following two sections) and va is any data supplied by IDA along with the event, possibly to provide further information.

The call-back function should return 0 if it permits the event notification to be handled by subsequent handlers (the typical scenario), or any other value if it is to be the only/last handler.

Something worth remembering is if you use hook_to_notification_point() in your plug-in, you must also use unhook_from_notification_point(), either once you no longer need to receive notifications, or inside your IDAP_term() function. This will avoid unexpected segmentation faults when exiting IDA. Going by the example above, to unhook the hooked notification point, it would be done like this:

```
unhook_from_notification_point(HT_DBG, dbg_callback, NULL);
```

4.5.2 UI Event Notifications

ui_notification_t is an enum defined in kernwin.hpp, and contains all user interface event notifications that can be generated by IDA or a plug-in. To register for these event notifications, you must use HT_UI as the first argument to hook_to_notification_point().

The following two lists show some of the event notifications that can be received and/or generated by a plug-in. These are only a sub-set of possible event notifications; what's listed are the more general purpose ones.

Although the below can be generated by a plug-in using callui(), most have helper functions, which means you don't need to use callui() and can just call the helper function instead.

Event Notification	Description	Helper Function
ui_jumpto	Moves the cursor to an address	jumpto
ui_screenea	Return the address where the cursor is currently positioned	get_screen_ea

ui_refresh	Refresh all disassembly views	refresh_idaview_anyway
ui_mbox	Display a message box to the user	vwarning, vinfo and more.
ui_msg	Print some text in IDA's Log window	deb, vmsg
ui_askyn	Dislpay a message box with Yes and No as options	askbuttons_cv
ui_askfile	Prompt the user for a filename	askfile_cv
ui_askstr	Prompt the user for a single line string	vaskstr
ui_asktext	Prompt the user for some text	vasktext
ui_form	Display a form (very flexible!)	AskUsingForm_cv
ui_open_url	Open a web browser at a particular URL	open_url
ui_load_plugin	Load a plug-in	load_plugin
ui_run_plugin	Run a plug-in	run_plugin
ui_get_hwnd	Get the HWND (Window Handle) for the IDA window	none
ui_get_curline	Get the colour-coded disassembled line	get_curline
ui_get_cursor	Get the X and Y coordinates of the current cursor position	get_cursor

The following event notifications are received by the plug-in, and would be handled by your call-back function.

Event Notification	Description
ui_saving & ui_saved	IDA is currently saving and has saved the database, respectively
ui_term	IDA has closed the database

For example, the following code will generate a ui_screenea event notification and display the result in an IDA dialog box using an ui_mbox event notification.

```
void IDAP_run(int arg)
{
        ea_t addr;
        va_list va;
        char buf[MAXSTR];

        // Get the current cursor position, store it in addr
        callui(ui_screenea, &addr);
        qsnprintf(buf, sizeof(buf)-1, "Currently at: %a\n", addr);

        // Display an info message box
        callui(ui_mbox, mbox_info, buf, va);

        return;
}
```

In the above case, you would typically use the helper functions, however callui() was used for illustrative purposes.

4.5.3 Debugger Event Notifications

Debugger event notifications are broken up into Low Level, High Level and Function Result event notifications; the difference between them will be made clear in the following sub-sections. All of the event notifications mentioned below belong to the `dbg_notification_t` enum, which is defined in `dbg.hpp`. If you supplied `HT_DBG` to `hook_to_notification_point()`, the below event notifications will be passed to your plug-in while a process is being debugged in IDA.

4.5.3.1 Low Level Events

The following events taken from `dbg_notification_t` are all low level event notifications. Low level event notifications are generated by the debugger.

Event Notification	Description
`dbg_process_start`	Process started
`dbg_process_exit`	Process ended
`dbg_library_load`	Library was loaded
`dbg_library_unload`	Library was unloaded
`dbg_exception`	Exception was raised
`dbg_breakpoint`	A non-user defined breakpoint was hit

The `debug_event_t` struct (`idd.hpp`), which you can use to obtain further information about a debugger event notification, is always supplied in the `va` argument to your call-back function (for low level event notifications only). Here is the whole `debug_event_t` struct.

```
struct debug_event_t
{
  event_id_t   eid;   // Event code (used to decipher 'info' union)
  process_id_t pid;   // Process where the event occurred
  thread_id_t  tid;   // Thread where the event occurred
  ea_t ea;            // Address where the event occurred
  bool handled;       // Is event handled by the debugger?
                      // (from the system's point of view)

  // The comments on the right indicate what eid value is
  // required for the corresponding union member to be set.
  union
  {
    module_info_t modinfo; // PROCESS_START, PROCESS_ATTACH,
                           // LIBRARY_LOAD
    int exit_code;         // PROCESS_EXIT, THREAD_EXIT
    char info[MAXSTR];     // LIBRARY_UNLOAD (unloaded library name)
                           // INFORMATION (will be displayed in the
                           // messages window if not empty)
    e_breakpoint_t bpt;    // BREAKPOINT (non-user defined!)
    e_exception_t exc;     // EXCEPTION
  };
};
```

For example, if your call-back function received the `dbg_library_load` event notification, you could look at `debug_event_t`'s `modinfo` member to see what the file loaded was:

```
...
// Our callback function to handle HT_DBG event notifications
static int idaapi dbg_callback(void *udata, int event_id, va_list va)
{
  // va contains a debug_event_t pointer
  debug_event_t *evt = va_arg(va, debug_event_t *);
```

```
  // If the event is dbg_library_load, we know modinfo will be set
  // and contain the name of the library loaded
  if (event_id == dbg_library_load)
          msg("Loaded library, %s\n", evt->modinfo.name);

  return 0;
}

// Our init function
int IDAP_init(void)
{
    // Register the notification point as our dbg_callback function.
    hook_to_notification_point(HT_DBG, dbg_callback, NULL);
...
```

4.5.3.2 High Level Event Notifications

The following events taken from `dbg_notification_t` are all high level event notifications, which are generated by the IDA kernel.

Event Notification	Description
`dbg_bpt`	User-defined breakpoint was hit
`dbg_trace`	One instruction was executed (needs step tracing enabled)
`dbg_suspend_process`	Process has been suspended
`dbg_request_error`	An error occurred during a request (see section 5.14)

Each of these event notifications has different arguments supplied along with them in the `va` argument to your call-back function. None have `debug_event_t` supplied, like low level event notifications do.

The `dbg_bpt` event notification comes with both the Thread ID (`thread_id_t`) of the affected thread and the address where the breakpoint was hit in `va`. The below example will display a message in IDA's *Log* window when a user-defined breakpoint is hit.

```
...
int idaapi dbg_callback(void *udata, int event_id, va_list va)
{
  // Only for the dbg_bpt event notification
  if (event_id == dbg_bpt)
      // Get the Thread ID
      thread_id_t tid = va_arg(va, thread_id_t);
      // Get the address of where the breakpoint was hit
      ea_t addr = va_arg(va, ea_t);

      msg("Breakpoint hit at: %a, in Thread: %d\n", addr, tid);

      return 0;
}

int IDAP_init(void)
{

    hook_to_notification_point(HT_DBG, dbg_callback, NULL);
...
```

4.5.3.3 Function Result Notifications

In later sections, the concept of Synchronous and Asynchronous debugger functions will be discussed in more detail; until then, all you need to know is that synchronous debugger functions are just like

ordinary functions – you call them, they do something and return. Asynchronous debugger functions however, get called and return without having completed the task, effectively having the request put into a queue and run in the background. When the task is completed, an event notification is generated indicating the completion of the original request.

The following are all function result notifications.

Event Notification	Description
`dbg_attach_process`	Debugger attached to a process (IDA 4.8)
`dbg_detach_process`	Debugger detached from a process (IDA 4.8)
`dbg_process_attach`	Debugger attached to a process (IDA 4.9)
`dbg_process_detach`	Debugger detached from a process (IDA 4.9)
`dbg_step_into`	Debugger stepped into a function
`dbg_step_over`	Debugger stepped over a function
`dbg_run_to`	Debugger has run to user's cursor position
`dbg_step_until_ret`	Debugger has run until return to caller was made

For example, the below code in `IDAP_run()` asks IDA to attach to a process. Once successfully attached, IDA generates the event notification, `dbg_attach_process`, which is handled by the `dbg_callback` call-back function.

```
...
int idaapi dbg_callback(void *udata, int event_id, va_list va)
{
    // Get the process ID of what was attached to.
    process_id_t pid = va_arg(va, process_id_t);
    // Change dbg_attach_process to dbg_process_attach if you're
    // using IDA 4.9
    if (event_id == dbg_attach_process)
       msg("Successfully attached to PID %d\n", pid);

    return 0;
}

void IDAP_run(int arg)
{
    int res;
    // Attach to a process. See Chapter 5 for usage.
    attach_process(NO_PROCESS, res);
    return;
}

int IDAP_init(void) {
    hook_to_notification_point(HT_DBG, dbg_callback, NULL);
...
```

4.6 Strings

The *Strings* window in IDA can be accessed using the SDK, in particular each string within the binary (that is detected when the file is opened) is represented by the `string_info_t` structure, which is defined in `strlist.hpp`. Below is a slightly cut-down version of that structure.

```
struct string_info_t
{
  ea_t ea;          // Address of the string
  int length;       // String length
```

```
  int type;        // String type (0=C, 1=Pascal, 2=Pascal 2 byte
                   // 3=Unicode, etc.)
...
};
```

Keep in mind that the above structure doesn't actually contain the string. To retrieve the string, you need to extract it from the binary file using `get_bytes()` or `get_many_bytes()`. To enumerate through the list of strings available, you could do the following:

```
// Loop through all strings
for (int i = 0; i < get_strlist_qty(); i++) {
      char string[MAXSTR];
      string_info_t si;
      // Get the string item
      get_strlist_item(i, &si);
      if (si.length < sizeof(string)) {
            // Retrieve the string from the binary
            get_many_bytes(si.ea, string, si.length);
            if (si.type == 0) // C string
                  msg("String %d: %s\n", i, string);
            if (si.type == 3) // Unicode
                  msg("String %d: %S\n", i, string);
      }
}
```

The above functions will be covered under *Chapter 5 – Functions*.

5. Functions

This section is broken up into different areas that the exported IDA SDK functions mostly fit into. I'll start from the most simple and more frequently used functions to the more complex and "niche" ones. I'll also provide basic examples with each function and the examples under the *Examples* section should provide more context. Obviously, this isn't a complete reference (refer to the header files in the SDK for that), but more of an overview of the most used and useful functions.

Important note about the examples: All of the functions below can be called from the `IDAP_run()`, `IDAP_init()` or `IDAP_term()` functions, unless otherwise indicated. Any of the examples can be pasted straight into the `IDAP_run()` function from the plug-in template in section 3.4 and should work. The additional header files required for each function and example will be specified where necessary.

5.1 Common Function Replacements

IDA provides many replacement functions for common C library routines. It is recommended that you use the replacements listed below instead of those provided by your C library. As of IDA 4.9, a lot of the C library routines are no longer available - you must use the IDA equivalent.

C Library Functions	IDA Replacements	Defined In
`fopen, fread, fwrite, fseek, fclose`	`qfopen, qfread, qfwrite, qfseek, qfclose`	`fpro.h`
`fputc, fgetc, fputs, fgets`	`qfputc, qfgetc, qfputs, qfgets`	`fpro.h`
`vfprintf, vfscanf, vprintf`	`qfprintf, qfscanf, qvprintf`	`fpro.h`
`strcpy, strncpy, strcat, strncat`	`qstrncpy, qstrncat`	`pro.h`
`sprintf, snprintf, wsprintf`	`qsnprintf`	`pro.h`
`open, close, read, write, seek`	`qopen, qclose, qread, qwrite, qseek`	`pro.h`
`mkdir, isdir, filesize`	`qmkdir, qisdir, qfilesize`	`pro.h`
`exit, atexit`	`qexit, qatexit`	`pro.h`
`malloc, calloc, realloc, strdup, free`	`qalloc, qcalloc, qrealloc, qstrdup, qfree`	`pro.h`

It is strongly recommended that you use the above functions, however if you're porting an old plug-in and for some reason need the C library function, you can compile your plug-in with `-DUSE_DANGEROUS_FUNCTIONS` or `-DUSE_STANDARD_FILE_FUNCTIONS`.

5.2 Messaging

These are the functions you will probably use the most when writing a plug-in; not because they are the most useful, but simply because they provide a means for simple communication with the user and can be a great help when debugging plug-ins.

As you can probably tell from the definitions, all of these functions are inlined and take `printf` style arguments. They are all defined in `kernwin.hpp`.

5.2.1 msg

Definition	**inline int msg(const char *format,...)**
Synopsis	Display a text message in IDA's *Log* window (bottom of the screen during static disassembly, top of the screen during debugging).
Example	`msg("Starting analysis at: %a\n", inf.startIP);`

5.2.2 info

Definition	**inline int info(const char *format,...)**
Synopsis	Display a text message in a pop-up dialog box with an 'info' style icon.
Example	`info("My plug-in v1.202 loaded.");`

5.2.3 warning

Definition	**inline int warning(const char *format,...)**
Synopsis	Display a text message in a pop-up dialog box with an 'warning' style icon.
Example	`warning("Please beware this could crash IDA!\n");`

5.2.4 error

Definition	**inline int error(const char *format,...)**
Synopsis	Display a text message in a pop-up dialog box with an 'error' style icon. Closes IDA (uncleanly) after the user clicks OK.
Example	`error("There was a critical error, exiting IDA.\n");`

5.3 UI Navigation

The functions below are specifically for interacting with the user and the IDA GUI. Some of them use `callui()` to generate an event to IDA. All are defined in `kernwin.hpp`.

5.3.1 get_screen_ea

Definition	**`inline ea_t get_screen_ea(void)`**
Synopsis	Returns the address within the current disassembled file(s) that the user's cursor is positioned at.

Example	`#include <kernwin.hpp>`
	
	`msg("Cursor position is %a\n", get_screen_ea());`

5.3.2 jumpto

Definition	**`inline bool jumpto(ea_t ea, int opnum=-1)`**
Synopsis	Moves the user's cursor to a position within the current disassembled file(s), represented by `ea`. `opnum` is the X coordinate that the cursor will be moved to, or `-1` if it isn't to be changed. Returns true if successful, false if it failed.

Example	`#include <kernwin.hpp>`
	
	`// Jump to the binary entry point + 8 bytes, don't move`
	`// the cursor along the X-axis`
	`jumpto(inf.startIP + 8);`

5.3.3 get_cursor

Definition	**`inline bool get_cursor(int *x, int *y)`**
Synopsis	Fills `*x` and `*y` with the X and Y coordinates of the user's cursor position within the current disassembled file(s).

Example	`#include <kernwin.hpp>`
	
	`int x, y;`
	`// Store the cursor X coordinate in x, and the Y`
	`// coordinate in Y, display the results in the Log window`
	`get_cursor(&x, &y);`
	`msg("X: %d, Y: %d\n", x, y);`

5.3.4 get_curline

Definition	**`inline char * get_curline(void)`**
Synopsis	Return a pointer to the line of text at the user's cursor position. This will return everything on the line – the address, code and comments. It will also be colour-coded, which you would use `tag_remove()` (see section 5.20.1) to clean.

Example	`#include <kernwin.hpp>`
	
	`// Display the current line of text in the Log window`
	`msg("%s\n", get_curline());`

5.3.5 read_selection

Definition	**`inline bool read_selection(ea_t *ea1, ea_t *ea2)`**
Synopsis	Fills `*ea1` and `*ea2` with the start and end addresses, respectively, of the user's selection. Returns true if there was a selection, false if there wasn't.

Example	`#include <kernwin.hpp>`
	
	`ea_t saddr, eaddr;`
	`// Get the address range selected, or return false if`
	`// there was no selection`
	`int selected = read_selection(&saddr, &eaddr);`
	`if (selected) {`
	`  msg("Selected range: %a -> %a\n", saddr, eaddr);`
	`} else {`
	`  msg("No selection.\n");`
	`}`

5.3.6 callui

Definition	**`idaman callui_t ida_export_data (idaapi*callui)(ui_notification_t what,...)`**
Synopsis	The user interface dispatcher function. This enables you to call the events listed in section 4.5.2, and many others within the `ui_notification_t` enum. `callui()` is always passed a `ui_notification_t` type as the first argument (`ui_jumpto`, `ui_banner`, etc.) followed by any arguments required for the respective notification.

Example	`#include <windows.hpp> // For the HWND definition`
	`#include <kernwin.hpp>`
	
	`// For ui_get_hwnd, *vptr of callui_t has the result`
	`// We need to cast the result because vptr is a void`
	`// pointer`
	`HWND hwnd = (HWND)callui(ui_get_hwnd).vptr;`
	
	`// If hwnd is NULL, we're running under the IDA text`
	`// version`
	`if (hwnd == NULL)`
	`  error("Cannot run in the IDA text version!");`

5.3.7 askaddr

Definition	**`inline int`** **`askaddr(ea_t *addr,const char *format,...)`**
Synopsis	Presents a dialog box asking the user to supply an address. `*addr` will be the default value to start with, and then filled with the user supplied address upon clicking `OK`. `*format` is the `printf` style text that goes in the dialog box.

Example	`#include <kernwin.hpp>`
	
	`// Set the default value to the entry point of the file`
	`ea_t addr = inf.startIP;`
	`// As the user for an address.`
	`askaddr(&addr, "Please supply an address to jump to.");`
	`// Move the cursor to that address (see section 5.3.2)`
	`jumpto(addr);`

5.3.8 AskUsingForm_c

Definition	**`inline int`** **`AskUsingForm_c(const char *form,...)`**
Synopsis	Displays a form to the user, and is too flexible to be covered here but is heavily commented in `kernwin.hpp`. It effectively allows you to design your own user form, including buttons, text fields, radio buttons and text as format strings.

Example	`#include <kernwin.hpp>`
	
	`// The text before the first \n is the title, followed`
	`// by the first input field (as indicated by the <>) and`
	`// then a second input field.`
	`// The format of input fields is:`
	`//  <label:field type:maximum chars:field length:help`
	`// identifier>`
	`// The result is stored in result1 and result1`
	`// respectively.`
	`// For more information on input fields, see the`
	`// AskUsingForm_c section of kernwin.hpp`
	
	`char form[] = "My Title\n<Please enter some text "`
	`"here:A:20:30::>\n<And here:A:20:30::>\n";`
	`char result1[MAXSTR] = "";`
	`char result2[MAXSTR] = "";`
	`AskUsingForm_c(form, result1, result2);`
	`msg("User entered text: %s and %s\n", result1, result2);`

5.4 Entry Points

The following functions are for working with entry points (where execution begins) in a binary. They can all be found in `entry.hpp`.

5.4.1 get_entry_qty

Definition	**`idaman size_t`** **`ida_export get_entry_qty(void)`**
Synopsis	Returns the number of entry points in the currently disassembled file(s). This will typically return 1, except for DLLs, which can have many.

Example	`#include <entry.hpp>`
	
	`msg("Number of entry points: %d\n", get_entry_qty());`

5.4.2 get_entry_ordinal

Definition	**`idaman uval_t`** **`ida_export get_entry_ordinal(size_t idx)`**
Synopsis	Returns the ordinal number of the entry point index number supplied as `idx`. You need the ordinal number because `get_entry()` and `get_entry_name()` use it.

Example	`#include <entry.hpp>`
	
	`// Display the ordinal number for all entry points`
	`for (int e = 0; e < get_entry_qty(); e++)`
	`  msg("Ord # for %d is %d\n", e, get_entry_ordinal(e));`

5.4.3 get_entry

Definition	**`idaman ea_t`** **`ida_export get_entry(uval_t ord);`**
Synopsis	Returns the address of an entry point ordinal number, supplied as the `ord` argument. Use `get_entry_ordinal()` to get the ordinal number of an entry point number, as shown in section 5.4.2

Example	`#include <entry.hpp>`
	
	`// Loop through each entry point.`
	`for (int e = 0; e < get_entry_qty(); e++)`
	`  msg("Entry point found at: %a\n",`
	`  get_entry(get_entry_ordinal(e)));`

5.4.4 get_entry_name

Definition	**`idaman char *`** **`ida_export get_entry_name(uval_t ord)`**
Synopsis	Return a pointer to the name of the entry point address (e.g. `start`)

Example	`#include <entry.hpp>`
	
	`// Loop through each entry point`
	`for (int e = 0; e < get_entry_qty(); e++) {`
	`  int ord = get_entry_ordinal(e);`
	`  // Display the entry point address and name`
	`  msg("Entry point %a: %s\n",`
	`  get_entry(ord),`
	`  get_entry_name(ord));`
	`}`

5.5 Areas

The following functions work with areas and area control blocks, as described in section 4.2.2 and 4.2.3 respectively. Unlike all the functions covered so far, they are methods within the `areacb_t` class, and so therefore can only be used on instances of that class. Two instances of `areacb_t` are `funcs` and `segs`, representing all functions and segments within the currently disassembled file(s) in IDA.

Although you should use the segment-specific functions for dealing with segments, and the function-specific functions for dealing with functions, working with areas directly gives you a more abstract way of dealing with functions and segments.

All the below are defined in `area.hpp`.

5.5.1 get_area

Definition	**`area_t *`** **`get_area(ea_t ea)`**
Synopsis	Returns a pointer to the `area_t` structure to which ea belongs.

Example	`#include <kernwin.hpp> // For askaddr() definition`
	`#include <funcs.hpp> // For funcs definition`
	`#include <area.hpp>`
	
	`ea_t addr;`
	
	`// Ask the user for an address (see section 5.3.7)`
	`askaddr(&addr, "Find the function owner of address:");`
	
	`// Get the function that owns that address`
	`// You could use segs.get_area(addr) to get the`
	`// segment that owned to address here too.`
	`area_t *area = funcs.get_area(addr);`
	`msg("Area holding %a starts at %a, ends at %a\n",`
	`  addr,`
	`  area->startEA,`
	`  area->endEA);`

5.5.2 get_area_qty

Definition	**`uint`** **`get_area_qty(void)`**
Synopsis	Get the number of areas within the current area control block.

Example	`#include <funcs.hpp> // For funcs definition`
	`#include <segment.hpp> // For segs definition`
	`#include <area.hpp>`
	
	`msg("%d Functions, and %d Segments",`
	`  funcs.get_area_qty(),`
	`  segs.get_area_qty());`

5.5.3 getn_area

Definition	**area_t * getn_area(unsigned int n)**
Synopsis	Returns a pointer to an `area_t` struct for the area number supplied as `n`.

Example	`#include <funcs.hpp> // For funcs definition`
	`#include <segment.hpp> // For segs definition`
	`#include <area.hpp>`
	
	`// funcs represents all functions, so get the first`
	`// function area (0).`
	`area_t *firstFunc = funcs.getn_area(0);`
	`msg("First func starts: %a, ends: %a\n",`
	`  firstFunc->startEA,`
	`  firstFunc->endEA);`
	
	`// segs represents all segments, so get the first`
	`// segment area (0).`
	`area_t *firstSeg = segs.getn_area(0);`
	`msg("First seg starts: %a, ends: %a\n",`
	`  firstSeg->startEA,`
	`  firstSeg->endEA);`

5.5.4 get_next_area

Definition	**int get_next_area(ea_t ea)**
Synopsis	Returns the number of the area following the area containing address `ea`.

Example	`#include <funcs.hpp> // For funcs definition`
	`#include <area.hpp>`
	
	`// Loop through functions as areas from first to last`
	`int i = 0;`
	`for (area_t *func = funcs.getn_area(0);`
	`  i < funcs.get_area_qty();`
	`  i++)`
	`{`
	`  msg ("Area start: %a, end: %a\n",`
	`  func->startEA,`
	`  func->endEA);`
	`  int funcNo = funcs.get_next_area(func->startEA);`
	`  func = funcs.getn_area(funcNo);`
	`}`

5.5.5 get_prev_area

Definition	**int get_prev_area(ea_t ea)**
Synopsis	Returns the number of the area preceding the area containing address `ea`.

Example	`#include <segment.hpp> // For segs definition`
	`#include <area.hpp>`
	
	`// Loop through segments as areas from last to first`
	`int i = segs.get_area_qty();`
	`for (area_t *seg = segs.getn_area(0); i > 0; i--) {`
	`  msg ("Area start: %a, end: %a\n",`
	`  seg->startEA,`
	`  seg->endEA);`
	`  int segNo = segs.get_next_area(seg->startEA);`
	`  seg = segs.getn_area(segNo);`
	`}`

5.6 Segments

The following functions work with segments (`.text`, `.idata`, etc.) and are defined in `segment.hpp`. A lot of these functions are simply wrappers to `areacb_t` methods for the `segs` variable.

5.6.1 get_segm_qty

Definition	**inline int get_segm_qty(void)**
Synopsis	Returns the number of segments in the currently disassembled file(s). This simply calls `segs.get_area_qty()`.

Example	`#include <segment.hpp>`
	
	`msg("%d segments in disassembled file(s).\n",`
	`  get_segm_qty());`

5.6.2 getnseg

Definition	**inline segment_t * getnseg(int n)**
Synopsis	Returns a pointer to the `segment_t` struct for the segment number, `n`, supplied. This is a wrapper to `segs.getn_area()`.

Example	`#include <segment.hpp>`
	
	`// Get the address of segment 0 (the first segment)`
	`segment_t *firstSeg = getnseg(0);`
	`msg("Address of the first segment is %a\n",`
	`  firstSeg->startEA);`

5.6.3 get_segm_by_name

Definition	**`idaman segment_t *ida_export`** **`get_segm_by_name(const char *name)`**
Synopsis	Returns a pointer to the `segment_t` struct for the segment with name, `*name`. Will return `NULL` if there is no such segment. If there are multiple segments with the same name, the first will be returned.

Example	`#include <segment.hpp>`
	
	`// Get the segment_t structure for the .text segment.`
	`segment_t *textSeg = get_segm_by_name(".text");`
	`msg("Text segment is at %a\n", textSeg->startEA);`

5.6.4 getseg

Definition	**`inline segment_t *`** **`getseg(ea_t ea)`**
Synopsis	Returns the `segment_t` struct for the segment that contains address `ea`. This function is a wrapper to `segs.get_area()`.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <segment.hpp>`
	
	`// Get the address of the user's cursor position`
	`// see section 5.2.1 for get_screen_ea()`
	`ea_t addr = get_screen_ea();`
	
	`// Get the segment that owns that address`
	`area_t *area = segs.get_area(addr);`
	`msg("Segment holding %a starts at %a, ends at %a\n",`
	`  addr,`
	`  area->startEA,`
	`  area->endEA);`

5.6.5 get_segm_name (IDA 4.8)

Definition	**idaman char *ida_export get_segm_name(const segment_t *s)**
Synopsis	Returns the name ("_text", "_idata", etc.) of segment `*s`.

Example	`#include <segment.hpp>`
	
	`// Loop through all segments displaying their names`
	`for (int i = 0; i < get_segm_qty(); i++) {`
	`  segment_t *seg = getnseg(i);`
	`  msg("Segment %d at %a is named %s\n",`
	`  i,`
	`  seg->startEA,`
	`  get_segm_name(seg));`
	`}`

5.6.6 get_segm_name (IDA 4.9)

Definition	**idaman ssize_t ida_export get_segm_name(const segment_t *s, char *buf, size_t bufsize)**
Synopsis	Fills `*buf`, limited by `bufsize` with the name ("_text", "_idata", etc.) of segment `*s`. Returns the size of the segment name, or `-1` if `s` is `NULL`.

Example	`#include <segment.hpp>`
	
	`// Loop through all segments displaying their names`
	`for (int i = 0; i < get_segm_qty(); i++) {`
	`  char segName[MAXSTR];`
	`  segment_t *seg = getnseg(i);`
	`  get_segm_name(seg, segName, sizeof(segName)-1);`
	`  msg("Segment %d at %a is named %s\n",`
	`  i,`
	`  seg->startEA,`
	`  segName);`
	`}`

5.7 Functions

The below set of functions are for working with functions within the currently disassembled file(s) in IDA. As with segments, functions are areas, and so some of the below functions are simply wrappers to `areacb_t` methods, in `funcs`. All are defined in `funcs.hpp`.

5.7.1 get_func_qty

Definition	**idaman size_t ida_export get_func_qty(void)**
Synopsis	Returns the number of functions in the currently disassembled file(s).

Example	`#include <funcs.hpp>`
	
	`msg("%d functions in disassembled file(s).\n",`
	`  get_func_qty());`

5.7.2 get_func

Definition	**idaman func_t *ida_export get_func(ea_t ea)**
Synopsis	Returns a pointer to the `func_t` structure representing the function that "owns" address `ea`. If `ea` is not part of a function, `NULL` is returned. Only function entry chunks are returned (see section 4.2.3.2 for information about chunks and tails).

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <funcs.hpp>`
	
	`// Get the address of the user's cursor`
	`ea_t addr = get_screen_ea();`
	`func_t *func = get_func(addr);`
	`if (func != NULL) {`
	`  msg("Current function starts at %a\n", func->startEA);`
	`} else {`
	`  msg("Not inside a function!\n");`
	`}`

5.7.3 getn_func

Definition	**idaman func_t *ida_export getn_func(size_t n)**
Synopsis	Returns a pointer to the `func_t` representing the function number supplied as `n`. Will return `NULL` if `n` is a non-existent function number. It will also only return function entry chunks.

Example	`#include <funcs.hpp>`
	
	`// Loop through all functions`
	`for (int i = 0; i < get_func_qty(); i++) {`
	`  func_t *curFunc = getn_func(i);`
	`  msg("Function at: %a\n", curFunc->startEA);`
	`}`

5.7.4 get_func_name

Definition	**idaman char *ida_export get_func_name(ea_t ea, char *buf, size_t bufsize)**
Synopsis	Gets the name of the function owning address ea, and stores it in *buf, limited by the length of bufsize. It returns the *buf pointer or NULL if the function has no name.

Example	#include <kernwin.hpp> // For get_screen_ea() definition
	#include <funcs.hpp>
	
	// Get the address of the user's cursor
	ea_t addr = get_screen_ea();
	func_t *func = get_func(addr);
	if (func != NULL) {
	  // Buffer where the function name will be stored
	  char funcName[MAXSTR];
	  if (get_func_name(func->startEA, funcName, MAXSTR)
	  != NULL) {
	  msg("Current function %a, named %s\n",
	  func->startEA,
	  funcName);
	  }
	}

5.7.5 get_next_func

Definition	**idaman func_t * ida_export get_next_func(ea_t ea)**
Synopsis	Returns a pointer to the func_t structure representing the function following the one owning ea. Returns NULL if there is no following function.

Example	#include <kernwin.hpp> // For get_screen_ea() definition
	#include <funcs.hpp>
	
	ea_t addr = get_screen_ea();
	// Get the function after the one containing the
	// address where the user's cursor is positioned
	func_t *nextFunc = get_next_func(addr);
	
	if (nextFunc != NULL)
	  msg("Next function starts at %a\n",
	  nextFunc->startEA);

5.7.6 get_prev_func

Definition	**idaman func_t * ida_export get_prev_func(ea_t ea)**

Synopsis	Returns a pointer to the `func_t` structure representing the function before the one owning `ea`. Returns `NULL` if there is no previous function.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <funcs.hpp>`
	
	`ea_t addr = get_screen_ea();`
	`// Get the function before the one containing the`
	`// address where the user's cursor is positioned`
	`func_t *prevFunc = get_prev_func(addr);`
	
	`if (prevFunc != NULL)`
	`  msg("Previous function starts at %a\n",`
	`  prevFunc->startEA);`

5.7.7 get_func_comment

Definition	**`inline char *`** **`get_func_comment(func_t *fn, bool repeatable)`**
Synopsis	Return any commentary added by the user or IDA for the function indicated by `*fn`. If `repeatable` is true, repeatable comments are included. `NULL` is returned if there are no comments.

Example	`#include <funcs.hpp>`
	
	`// Loop through all functions, displaying their comments`
	`// including repeatable comments.`
	`for (int i = 0; i < get_func_qty(); i++) {`
	`  func_t *curFunc = getn_func(i);`
	`  msg("%a: %s\n",`
	`  curFunc->startEA,`
	`  get_func_comment(curFunc, false));`
	`}`

5.8 Instructions

The functions below work with instructions within the currently disassembled file(s) in IDA. All are defined in `ua.hpp`, except for `generate_disasm_line()`, which is defined in `lines.hpp`.

5.8.1 generate_disasm_line

Definition	**`idaman bool ida_export`** **`generate_disasm_line(ea_t ea, char *buf, size_t bufsize,`** **`int flags=0)`**
Synopsis	Fills `*buf`, limited by `bufsize`, with the disassembly at address `ea`. This text is colour coded, so you need to use `tag_remove()` (see section 5.20.1) to get printable text.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <lines.hpp>`
	
	`ea_t ea = get_screen_ea();`
	`// Buffer that will hold the disassembly text`
	`char buf[MAXSTR];`
	
	`// Store the disassembled text in buf`
	`generate_disasm_line(ea, buf, sizeof(buf)-1);`
	
	`// This will appear as colour-tagged text (which will`
	`// be mostly unreadable in IDA's Log window)`
	`msg("Current line: %s\n", buf);`

5.8.2 ua_ana0

Definition	**`idaman int`** **`ida_export ua_ana0(ea_t ea)`**
Synopsis	Disassemble ea. Returns the length of the instruction in bytes and fills the global cmd structure with information about the instruction. If ea doesn't contain an instruction, 0 is returned. This is a read-only function and doesn't modify the IDA database.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <ua.hpp>`
	
	`ea_t ea = get_screen_ea();`
	
	`if (ua_ana0(ea) > 0)`
	`  msg("Instruction size: %d bytes\n", cmd.size);`
	`else`
	`  msg("Not at an instruction.\n");`

5.8.3 ua_code

Definition	**`idaman int`** **`ida_export ua_code(ea_t ea)`**
Synopsis	Disassemble ea. Returns the length of the instruction in bytes, fills the global cmd structure with information about the instruction and updates the IDA database with the results. If ea doesn't contain an instruction, 0 is returned.

Example	`#include <kernwin.hpp> // For read_selection() definition`
	`#include <ua.hpp>`
	
	`ea_t saddr, eaddr;`
	`ea_t addr;`
	
	`// Get the user selection`
	`int selected = read_selection(&saddr, &eaddr);`
	`if (selected) {`
	`  // Re-analyse the selected address range`
	`  for (addr = saddr; addr <= eaddr; addr++) {`
	`  ua_code(addr);`
	`  }`
	`} else {`
	`  msg("No selection.\n");`
	`}`

5.8.4 ua_outop

Definition	**`idaman bool ida_export`** **`ua_outop(ea_t ea, char *buf, size_t bufsize, int n)`**
Synopsis	Fills `*buf`, limited by `bufsize`, with the text representation of operand number n to the instruction at `ea` and updates the IDA database with the instruction if it isn't already defined. Returns false if operand n doesn't exist. The text returned in `*buf` is colour coded, so you need to use `tag_remove()` (see section 5.20.1) to get printable text.

Example	`#include <ua.hpp>`
	
	`// Get the entry point address`
	`ea_t addr = inf.startIP;`
	
	`// Fill cmd with information about the instruction`
	`// at the entry point`
	`ua_ana0(addr);`
	
	`// Loop through each operand (until one of o_void type`
	`// is reached), displaying the operand text.`
	`for (int i = 0; cmd.Operands[i].type != o_void; i++) {`
	`  char op[MAXSTR];`
	`  ua_outop(addr, op, sizeof(op)-1, i);`
	`  msg("Operand %d: %s\n", i, op);`
	`}`

5.8.5 ua_mnem

Definition	**`idaman const char *ida_export`** **`ua_mnem(ea_t ea, char *buf, size_t bufsize)`**
Synopsis	Fills `*buf`, limited by `bufsize`, with the mnemonic used in the instruction at `ea` and updates the IDA database with the instruction if it isn't already defined. Returns the `*buf` pointer or `NULL` if there is no instruction at `ea`.

Example

```
#include <segment.hpp> // For segment functions
#include <ua.hpp>

// Loop through each executable segment, displaying
// the mnemonic used in each instruction
for (int s = 0; s < get_segm_qty(); s++) {
    segment_t *seg = getnseg(s);
    if (seg->type == SEG_CODE) {
        int bytes = 0;

        // a should always be the address of an
        // instruction, which is why bytes is dynamic
        // depending on the result of ua_mnem()
        for (ea_t a = seg->startEA;
                a < seg->endEA; a += bytes) {
            char mnem[MAXSTR];
            const char *res;

            // Get the mnemonic at a, store it in mnem
            res = ua_mnem(a, mnem, sizeof(mnem)-1);

            // If this was an instruction, display
            // the mnemonic, set the bytes counter
            // to cmd.size, so that the next address
            // processed by ua_mnem() is the next
            // instruction.
            if (res != NULL) {
                msg("Mnemonic at %a: %s\n", a, mnem);
                bytes = cmd.size;
            } else {
                msg ("No code\n");
                // If there was no code at this address,
                // increment the byte counter by 1 so that
                // ua_mnem() works off the next address.
                bytes = 1;
            }
        }
    }
}
```

5.9 Cross Referencing

The following four functions are a part of the `xrefblk_t` structure, defined in `xref.hpp`. They are used to populate and enumerate cross references to or from an address. All functions take flags as an argument, which can be one of the following, as taken from `xref.hpp`:

```
#define XREF_ALL        0x00      // return all references
#define XREF_FAR        0x01      // don't return ordinary flow xrefs
#define XREF_DATA       0x02      // return data references only
```

An ordinary flow is when execution normally passes from one instruction to another without the use of a `CALL` or `JMP` (or equivalent) instruction. If you are only interested in code cross references (ignoring ordinary flows), then you would use `XREF_ALL` and check if the `isCode` member of `xrefblk_t` is true in each case. Use `XREF_DATA` if you are only interested in data references.

5.9.1 first_from

Definition	**bool first_from(ea_t from, int flags)**
Synopsis	Populates the `xrefblk_t` structure with the first cross reference from the `from` address. `flags` dictates what cross references you are interested in. Returns false if there are no references from `from`.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <xref.hpp>`
	
	`ea_t addr = get_screen_ea();`
	`xrefblk_t xb;`
	`if (xb.first_from(addr, XREF_ALL)) {`
	`  // xb is now populated`
	`  msg("First reference FROM %a is %a\n", xb.from,`
	`  xb.to);`
	`}`

5.9.2 first_to

Definition	**bool first_to(ea_t to,int flags)**
Synopsis	Populates the `xrefblk_t` structure with the first cross reference to the `to` address. `flags` dictates what cross references you are interested in. Returns false if there are no references to `to`

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <xref.hpp>`
	
	`ea_t addr = get_screen_ea();`
	`xrefblk_t xb;`
	`if (xb.first_to(addr, XREF_ALL)) {`
	`  // xb is now populated`
	`  msg("First reference TO %a is %a\n", xb.to,`
	`  xb.from);`
	`}`

5.9.3 next_from

Definition	**bool next_from(void)**
Synopsis	Populates the `xrefblk_t` structure with the next cross references from the `from` address. Returns false if there are no more cross references.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <lines.hpp>  // For tag_remove() and`
	`                       // generate_disasm_line()`
	`#include <xref.hpp>`
	
	`xrefblk_t xb;`
	`ea_t addr = get_screen_ea();`
	
	`// Replicate IDA 'x' keyword functionality`
	`for (bool res = xb.first_to(addr, XREF_FAR); res;`
	`                  res = xb.next_to()) {`
	`    char buf[MAXSTR];`
	`    char clean_buf[MAXSTR];`
	
	`    // Get the disassembly text for the referencing addr`
	`    generate_disasm_line(xb.from, buf, sizeof(buf)-1);`
	
	`    // Clean out any format or colour codes`
	`    tag_remove(buf, clean_buf, sizeof(clean_buf)-1);`
	`    msg("%a: %s\n", xb.from, clean_buf);`
	`}`

5.9.4 next_to

Definition	**`bool`** **`next_to(void)`**
Synopsis	Populates the `xrefblk_t` structure with the next cross references to the `to` address. Returns false if there are no more cross references.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <xref.hpp>`
	
	`xrefblk_t xb;`
	`ea_t addr = get_screen_ea();`
	
	`// Get the first cross reference to addr`
	`if (xb.first_to(addr, XREF_FAR)) {`
	`    if (xb.next_to())`
	`        msg("There are multiple references to %a\n",`
	`                    addr);`
	`    else`
	`        msg("The only reference to %a is at %a\n",`
	`                    addr, xb.from);`
	`}`

5.10 Names

The following functions deal with function (`sub_*`), location (`loc_*`) and variable (`arg_*`, `var_*`) names, set by IDA or the user. All are defined in `name.hpp`. Register names are not recognised by these functions.

5.10.1 get_name

Definition	**idaman char *ida_export get_name(ea_t from, ea_t ea, char *buf, size_t bufsize)**
Synopsis	Fill *buf, limited by bufsize, with the uncoloured name for ea. The *buf pointer is returned if ea has a name, or NULL if it doesn't. If you are after a name that is local to a function, from should be within the same function, or it won't be seen. If you are not after a local name, from should just be BADADDR.

Example	`#include <name.hpp>`
	
	`char name[MAXSTR];`
	
	`// Get the name of the entry point, should be start`
	`// in most cases.`
	`char *res = get_name(BADADDR,`
	`inf.startIP, // Entry point`
	`name,`
	`sizeof(name)-1);`
	
	`if (res != NULL)`
	`msg("Name: %s\n", name);`
	`else`
	`msg("No name for %a\n", inf.startIP);`

5.10.2 get_name_ea

Definition	**idaman ea_t ida_export get_name_ea(ea_t from, const char *name)**
Synopsis	Return the address of where the name supplied in *name is defined. If you are after a name that is local to a function, from should be within the same function, or it won't be seen. If you are not after a local name, from should just be BADADDR.

Example	`#include <kernwin.hpp> // For askstr and get_screen_ea`
	`#include <name.hpp>`
	
	`// Get the cursor address`
	`ea_t addr = get_screen_ea();`
	
	`// Ask the user for a string (see kernwin.hpp), which`
	`// will be the name we search for.`
	`char *name = askstr(HIST_IDENT,  // History identifier`
	`"start",     // Default value`
	`"Please enter a name"); // Prompt`
	
	`// Display the address that the name represents. You will`
	`// get FFFFFFFF for stack variables and nonexistent`
	`// names.`
	`msg("Address: %a\n", get_name_ea(addr, name));`

5.10.3 get_name_value

Definition	**idaman int ida_export get_name_value(ea_t from, const char *name, uval_t *value)**

Synopsis	Returns the value into `*value`, represented by the name `*name`, relative to the address from. `*value` will contain either a stack offset or linear address.
	
	If you are after a name that is local to a function, `from` should be within the same function, or it won't be seen. If you are not after a local name, `from` should just be BADADDR. The return value is one of the following, representing the type of name it is. Taken from name.hpp:
	
	`#define NT_NONE 0 // name doesn't exist or has no value`
	`#define NT_BYTE 1 // name is byte name (regular name)`
	`#define NT_LOCAL 2 // name is local label`
	`#define NT_STKVAR 3 // name is stack variable name`
	`#define NT_ENUM 4 // name is symbolic constant`
	`#define NT_ABS 5 // name is absolute symbol`
	`// (SEG_ABSSYM)`
	`#define NT_SEG 6 // name is segment or segment register`
	`// name`
	`#define NT_STROFF 7 // name is structure member`
	`#define NT_BMASK 8 // name is a bit group mask name`

Example	`#include <kernwin.hpp> // For get_screen_ea() and askstr()`
	`#include <name.hpp>`
	
	`uval_t value;`
	`ea_t addr = get_screen_ea();`
	
	`// Ask the user for a name`
	`char *name = askstr(HIST_IDENT, "start",`
	`"Please enter a name");`
	
	`// Get the value of that name, relative to addr`
	`int type = get_name_value(addr, name, &value);`
	
	`// The type will correspond to one of the NT_ values`
	`// defined in name.hpp.`
	`// Value will be FFFFFFF4 for the first local variable`
	`// or 8 for the first argument to a function. It could`
	`// also be the linear address of the strcpy() definition`
	`// for example.`
	`msg("Type: %d, Value: %a\n", type, value);`

5.11 Searching

The following functions are used for doing simple searching within the disassembled file(s) in IDA, and are defined in `search.hpp`. There are also other search functions for specific search types (errors, etc.) which can also be found in `search.hpp`. The search functions take flags, which dictate how the search is conducted, what is searched for, etc. These flags are, as taken from `search.hpp`:

```
#define SEARCH_UP       0x000 // only one of SEARCH_UP or
                              // SEARCH_DOWN can be specified
#define SEARCH_DOWN     0x001
#define SEARCH_NEXT     0x002 // Search for the next occurrence
#define SEARCH_CASE     0x004 // Make the search case-sensitive
#define SEARCH_REGEX    0x008 // Use the regular expression parser
```

```
#define SEARCH_NOBRK    0x010 // don't test ctrl-break
#define SEARCH_NOSHOW   0x020 // don't display the search progress
#define SEARCH_UNICODE  0x040 // treat strings as unicode
#define SEARCH_IDENT    0x080 // search for an identifier
                              // it means that the characters before
                              // and after the pattern can not be
                              // is_visible_char()
#define SEARCH_BRK      0x100 // return BADADDR if break is
                              // pressed during find_imm()
```

Typically, you'd just use `SEARCH_DOWN` to conduct a case-insensitive search, towards the bottom of the file(s).

5.11.1 find_text (IDA 4.9 only)

Definition	**`idaman ea_t ida_export find_text(ea_t startEA, int y, int x, const char *ustr, int sflag);`**
Synopsis	Searches the currently disassembled file(s), starting at `startEA` and x-coordinate `x`, y-coordinate `y` (both can be `0`), for the text `*ustr`. `sflag` can be any of the previously mentioned flags.

Example	`#include <kernwin.hpp> // For askstr() definition`
	`#include <search.hpp>`
	
	`char *s = askstr(0, "", "String to search for", NULL);`
	
	`// Find the first occurrence of the string`
	`ea_t foundAt = find_text(inf.minEA, 0, 0, s, SEARCH_DOWN);`
	`while (foundAt != BADADDR) {`
	`  msg("%s was found at %a\n", s, foundAt);`
	`}`

5.11.2 find_binary

Definition	**`idaman ea_t ida_export find_binary(ea_t startea, ea_t endea, const char *ubinstr, int radix, int sflag)`**
Synopsis	Searches between `startea` and `endea` for the string in `*ubinstr`. `radix` is the numeric base (if you're searching for numbers), which can be `8` (octal), `10` (decimal) or `16` (hex). `sflag` can be any of the previously mentioned flags. Note that this function doesn't search the disassembled text that you see in IDA, but the binary itself. The content of `*ubinstr` will differ depending on the type of search you are conducting. For strings, the string itself must be wrapped in quotes (`"`), for single characters, they must be wrapped in single quotes (`'`). A question-mark (`?`) can be used to indicate a single wildcard byte.

Example	`#include <kernwin.hpp> // for askstr() and jumpto()`
	`#include <search.hpp>`
	
	`// Ask the user for a search string`
	`char *name = askstr(HIST_SRCH, "",`
	`"Please enter a string");`
	`char searchstring[MAXSTR];`
	
	`// Encapsulate the search string in quotes`
	`qsnprintf(searchstring, sizeof(searchstring)-1,`
	`"\"%s\"", name);`
	
	`ea_t res = find_binary(inf.minEA, // Top of the file`
	`inf.maxEA, // Bottom of the file`
	`searchstring,`
	`0, // radix not applicable`
	`SEARCH_DOWN);`
	
	`if (res != NULL) {`
	`msg("Match found at %a\n", res);`
	`// Move the cursor to the address`
	`jumpto(res);`
	`} else {`
	`msg("No match found.\n");`
	`}`

5.12 IDB

The following functions are for working with IDA database (IDB) files, and can be found in `loader.hpp`. Although there is no actual definition of the `linput_t` class, you need to call the `open_linput()` (`diskio.hpp`) function to create an instance of the class, which some functions use as an argument. You can also use `make_linput()` to convert a `FILE` pointer to a `linput_t` instance; see `loader.hpp` for more information.

5.12.1 open_linput

Definition	**`idaman linput_t *ida_export`** **`open_linput(const char *file, bool remote)`**
Synopsis	Create an instance of the `linput_t` class for file path `*file`. If the file is remote, set the `remote` argument to true. Returns `NULL` if it failed to open the file.

Example	`#include <kernwin.hpp> // For askfile_cv definition`
	`#include <diskio.hpp>`
	
	`// Prompt the user for a file`
	`char *file = askfile_cv(0, "", "File to open", NULL);`
	
	`// Open the file`
	`linput_t *myfile = open_linput(file, false);`
	
	`if (myfile == NULL)`
	`msg("Failed to open or corrupt file.\n");`
	`else`
	`// Return the size of the opened file.`
	`msg("File size: %d\n", qlsize(myfile));`

5.12.2 close_linput

Definition	**idaman void ida_export close_linput(linput_t *li)**
Synopsis	Close the file represented by the `linput_t` instance, `*li`, created by `open_linput()`.

Example	`#include <loader.hpp>`
	
	`linput_t *myfile = open_linput("C:\\temp\\myfile.exe", false);`
	`close_linput(myfile);`

5.12.3 load_loader_module

Definition	**idaman int ida_export load_loader_module(linput_t *li, const char *lname, const char *fname, bool is_remote)**
Synopsis	Load a file into the current IDB, either as a `linput_t` instance, `*li`, or file path in `*fname`, using the loader module `*lname`. If `*li` is `NULL`, `*fname` must be supplied and vise versa. Returns 1 on success, 0 on failure.

Example	`#include <kernwin.hpp> // For askfile_cv()`
	`#include <loader.hpp>`
	
	`// Prompt the user for a file to open.`
	`char *file = askfile_cv(0, "", "DLL file..", NULL);`
	
	`// Load it into the IDB using the PE loader module`
	`int res = load_loader_module(NULL, "pe", file, false)`
	
	`if (res < 1)`
	`  msg("Failed to load %s as a PE file.\n", file);`

5.12.4 load_binary_file

Definition	**idaman bool ida_export load_binary_file(const char *filename, linput_t *li, ushort _neflags, long fileoff, ea_t basepara, ea_t binoff, ulong nbytes);**
Synopsis	Load a binary file `*li`, named `*filename` starting at offset, `fileoff`. `_nflags` is any of the `NEF_` flags defined in `loader.hpp`. `nbytes` specifies the number of bytes to load from the file, or `0` for the whole file. `basepara` is the paragraph where this new binary will be loaded, and `binoff` is the offset within that segment. You can safely set `basepara` to the adress

	you want the file loaded at, and set binoff to `0`. Returns false if the load failed. This is not the function you would use for loading a DLL or executable file (a PE file for instance) into the IDB. For that, you would use use `load_loader_module()` above.

Example	`#include <kernwin.hpp> // For askfile_cv()`
	`#include <diskio.hpp> // For open_linput()`
	`#include <loader.hpp>`
	
	`// Ask the user for a filename`
	`char *file = askfile_cv(0, "", "DLL file..", NULL);`
	
	`// Create a linput_t instance for that file`
	`linput_t *li = open_linput(file, false);`
	
	`// Load the file at the end of the currently loaded`
	`// file (inf.maxEA).`
	`bool status = load_binary_file(file,`
	`li,`
	`NEF_SEGS,`
	`0,`
	`inf.maxEA,`
	`0,`
	`0);`
	
	`if (status)`
	`msg("Successfully loaded %s at %a\n", file,`
	`inf.maxEA);`
	`else`
	`msg("Failed to load file.\n");`

5.12.5 gen_file

Definition	**`idaman int ida_export gen_file(ofile_type_t otype, FILE *fp, ea_t ea1, ea_t ea2, int flags)`**

Synopsis	Generate an output file, `*fp`, based on the currently open IDB file. `ea1` and `ea2` are the start and end addresses respectively, however these are ignored for some output types. `otype` must be one of the following, taken from `loader.hpp`:
	
	`OFILE_MAP = 0, // MAP file`
	`OFILE_EXE = 1, // Executable file`
	`OFILE_IDC = 2, // IDC file`
	`OFILE_LST = 3, // Disassembly listing`
	`OFILE_ASM = 4, // Assembly`
	`OFILE_DIF = 5; // Difference`
	
	`flags` can be any combination of the following, also taken from `loader.hpp`:
	
	`#define GENFLG_MAPSEG 0x0001 // map: generate map`
	`// of segments`

	`#define GENFLG_MAPNAME 0x0002 // map: include dummy names`
	`#define GENFLG_MAPDMNG 0x0004 // map: demangle names`
	`#define GENFLG_MAPLOC  0x0008 // map: include local names`
	`#define GENFLG_IDCTYPE 0x0008 // idc: gen only`
	`                                // information about types`
	`#define GENFLG_ASMTYPE 0x0010 // asm&lst: gen`
	`                                // information about`
	`                                // types too`
	`#define GENFLG_GENHTML 0x0020 // asm&lst: generate html`
	`                                // (ui_genfile_callback`
	`                                // will be used)`
	`#define GENFLG_ASMINC  0x0040 // asm&lst: gen information`
	`                                // only about types`
	
	The function will return `-1` if there was an error, or the number of lines generated if it was a success. For `OFILE_EXE` files, it returns `0` for failure, `1` for success.

Example	`#include <loader.hpp>`
	
	`// Open the output file`
	`FILE *fp = qfopen("C:\\output.idc", "w");`
	`// Generate an IDC output file`
	`gen_file(OFILE_IDC, fp, inf.minEA, inf.maxEA, 0);`
	`// Close the output file`
	`qfclose(fp);`

5.12.6 save_database

Definition	**`idaman void ida_export`** **`save_database(const char *outfile, bool delete_unpacked)`**
Synopsis	Save the database to the file path, `*output`. If `delete_unpacked` is false, temporary unpacked files are not deleted. As this function doesn't return anything, there is no way to determine if the save was successful, except for testing whether the file exists after the function call is made.

Example	`#include <loader.hpp>`
	
	`msg("Saving database...");`
	`char *outfile = "c:\\myidb.idb";`
	`save_database(outfile, false);`
	
	`// There was an error if the filesize is <= 0`
	`if (qfilesize(outfile) <= 0)`
	`    msg("failed.\n");`
	`else`
	`    msg("ok\n");`

5.13 Flags

The functions below are for checking whether particular flags (see section 4.3) are set for a byte within the currently disassembled file(s). They are all defined in `bytes.hpp`.

5.13.1 getFlags

Definition	**idaman flags_t ida_export getFlags(ea_t ea)**
Synopsis	Returns the flags set for address ea. You will need to run this to obtain the flags for an address to then use with functions like `isHead()`, `isCode()`, etc.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <bytes.hpp>`
	
	`msg("Flags for %a are %08x\n",`
	`  get_screen_ea(),`
	`  getFlags(get_screen_ea()));`

5.13.2 isEnabled

Definition	**idaman bool ida_export isEnabled(ea_t ea)**
Synopsis	Does the address, ea, exist within the currently disassembled file(s)?

Example	`#include <kernwin.hpp> // For askaddr() definition`
	`#include <bytes.hpp>`
	
	`ea_t addr;`
	`askaddr(&addr, "Address to look for:");`
	
	`if (isEnabled(addr))`
	`  msg("%a found within the currently opened file(s).",`
	`  addr);`
	`else`
	`  msg("%a was not found.\n");`

5.13.3 isHead

Definition	**inline bool idaapi isHead(flags_t F)**
Synopsis	Does the flagset, F, denote the start of code or data?

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <bytes.hpp>`
	
	`ea_t addr = get_screen_ea();`
	
	`// Cycle through 20 bytes from the cursor position`
	`// printing a message if the byte is a head byte.`
	`for (int i = 0; i < 20; i++) {`
	`  flags_t flags = getFlags(addr);`
	`  if (isHead(flags))`
	`  msg("%a is a head (flags = %08x).\n",`
	`  addr, flags);`
	`  addr++;`
	`}`

5.13.4 isCode

Definition	**`inline bool idaapi`** **`isCode(flags_t F)`**
Synopsis	Does the flagset, `F`, denote the start of an instruction? This is the same as `isHead()`, but only returns true for code, not data. Therefore, if used on a code byte that is not a head byte, it will return false.

Example	`#include <segment.hpp> // For segment functions`
	`#include <bytes.hpp>`
	
	`for (int i = 0; i < get_segm_qty(); i++) {`
	`  segment_t *seg = getnseg(i);`
	`  if (seg->type == SEG_CODE) {`
	`  // Look for any bytes in the code segment that`
	`  // aren't code.`
	`  for (ea_t a = seg->startEA; a < seg->endEA; a++) {`
	`  flags_t flags = getFlags(a);`
	`  if (isHead(flags) && !isCode(flags))`
	`  msg("Non-code at %a in segment: %s.\n",`
	`  a,`
	`  get_segm_name(seg));`
	`  }`
	`  }`
	`}`

5.13.5 isData

Definition	**`inline bool idaapi`** **`isData(flags_t F)`**

Synopsis	Does the flagset, F, denote the start of some data? This is the same as `isHead()`, but only returns true for data, not code. Therefore, if used on a data byte that is not a head byte, it will return false.

Example	`#include <segment.hpp> // For segment functions`
	`#include <bytes.hpp>`
	
	`for (int i = 0; i < get_segm_qty(); i++) {`
	`  segment_t *seg = getnseg(i);`
	`  if (seg->type == SEG_DATA) {`
	`  // Look for any bytes in the data segment that`
	`  // aren't data (possibly code).`
	`  for (ea_t a = seg->startEA; a < seg->endEA; a++) {`
	`  flags_t flags = getFlags(a);`
	`  if (isHead(flags) && !isData(flags))`
	`  msg("Non-data at %a in segment: %s.\n",`
	`  a,`
	`  get_segm_name(seg));`
	`  }`
	`  }`
	`}`

5.13.6 isUnknown

Definition	**`inline bool idaapi`** **`isUnknown(flags_t F)`**
Synopsis	Does the flagset, F, denote a byte that hasn't been successfully analysed by IDA?

Example	`#include <segment.hpp> // For segment functions`
	`#include <bytes.hpp>`
	
	`// Loop through every segment`
	`for (int i = 0; i < get_segm_qty(); i++) {`
	`  segment_t *seg = getnseg(i);`
	`  // Look for any unexplored bytes in this segment`
	`  for (ea_t a = seg->startEA; a < seg->endEA; a++) {`
	`  flags_t flags = getFlags(a);`
	`  if (isUnknown(flags))`
	`  msg("Unknown bytes at %a in segment: %s.\n",`
	`  a,`
	`  get_segm_name(seg));`
	`  }`
	`}`

5.14 Data

When working with a disassembled file, it can often be very useful to bypass the disassembler and work directly with the bytes in the binary file itself. IDA provides the functionality to do this with the

below functions (plus some more). All of the below are defined in `bytes.hpp`. These functions work with bytes, however there are also functions to work with words, longs and qwords (`get_word()`, `patch_word()` and so on), which are also to be found in `bytes.hpp`. Aside from using these functions to read data from the binary file itself, they can also be used to read process memory while a process is executing under the debugger. More on this under the Debugger functions section.

5.14.1 get_byte

Definition	**idaman uchar ida_export get_byte(ea_t ea)**
Synopsis	Returns the byte at address `ea` within the disassembled file(s) currently open in IDA. Returns `BADADDR` if ea doesn't exist. Also available for working with larger chunks is `get_word()`, `get_long()` and `get_qword()`. Use `get_many_bytes()` for working with multiple byte chunks.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <bytes.hpp>`
	
	`// Display the byte value for the current cursor`
	`// position. The values returned should correspond`
	`// to those in your IDA Hex view.`
	`msg("%x\n", get_byte(get_screen_ea()));`

5.14.2 get_many_bytes

Definition	**idaman bool ida_export get_many_bytes(ea_t ea, void *buf, ssize_t size)**
Synopsis	Fetch `size` bytes starting at `ea`, and store them into `*buf`.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <bytes.hpp>`
	
	`char string[MAXSTR];`
	`flags_t flags = getFlags(get_screen_ea());`
	
	`// Only get a string if we're at actual data.`
	`if (isData(flags)) {`
	`  // Get a string from the binary`
	`  get_many_bytes(get_screen_ea(),`
	`  string,`
	`  sizeof(string)-2);`
	`  // NULL terminate the string, if not already`
	`  // terminated in the binary (so strlen doesn't barf)`
	`  string[MAXSTR-1] = '\0';`
	`  msg("String length: %d\n", strlen(string));`
	`}`

5.14.3 patch_byte

Definition	**idaman void ida_export patch_byte(ea_t ea, ulong x)**
Synopsis	Replace the byte at `ea` with `x`. The original byte is saved to the IDA database, and can be retrieved using `get_original_byte()` (see `bytes.hpp`). To not save the original byte, use `put_byte(ea_t ea, ulong x)` instead. Also available for working with larger chunks is `put_word()`, `put_long()` and `put_qword()`. Use `put_many_bytes()` for working with multiple byte chunks.

Example	`#include <kernwin.hpp> // For get_screen_ea()`
	`#include <bytes.hpp>`
	
	`// Get the flags for the byte at the cursor position.`
	`flags_t flags = getFlags(get_screen_ea());`
	
	`// Replace the instruction at the cursor position with`
	`// a NOP instruction (0x90).`
	`// Unless used carefully, your executable will probably`
	`// not work correctly after this :-)`
	`if (isCode(flags))`
	`  patch_byte(get_screen_ea(), 0x90);`

5.14.4 patch_many_bytes

Definition	**idaman void ida_export patch_many_bytes(ea_t ea, const void *buf, size_t size)**
Synopsis	Replace `size` bytes at `ea` with the contents of `*buf`.

Example	`#include <kernwin.hpp> // For get_screen_ea() et al`
	`#include <bytes.hpp>`
	
	`// Prompt the user for an address, then a string`
	`ea_t addr = get_screen_ea();`
	`askaddr(&addr, "Address to put string:");`
	`char *string = askstr(0, "", "Please enter a string");`
	
	`// Write the user supplied string to the address`
	`// the user specified.`
	`patch_many_bytes(addr, string, strlen(string));`

5.15 I/O

As mentioned in section 5.1, a lot of standard C library functions for I/O have IDA SDK equivalents, and it's recommended you use them instead of their standard C counterparts. These are all defined in `diskio.hpp`.

5.15.1 fopenWT

Definition	**`idaman FILE *ida_export`** **`fopenWT(const char *file)`**
Synopsis	Open the text file, `*file`, in write mode, return a `FILE` pointer or `NULL` if opening the file failed. To open the file in read mode, use `fopenRT()`, and for binary files, replace the `R` with `W`. For read/write, use `fopenM()`.

Example	`#include <diskio.hpp>`
	
	`FILE *fp = fopenWT("c:\\temp\\txtfile.txt");`
	`if (fp == NULL)`
	`  warning("Failed to open output file.");`

5.15.2 openR

Definition	**`idaman FILE *ida_export`** **`openR(const char *file)`**
Synopsis	Open the binary file, `*file`, in read-only mode, return a `FILE` pointer or exit (display an error and close IDA) if it fails. To open a text file in read-only mode, exiting on failure, use `openRT()`, for read-write use `openM()`.

Example	`#include <diskio.hpp>`
	
	`FILE *fp = openR("c:\\temp\\binfile.exe");`

5.15.3 ecreate

Definition	**`idaman FILE *ida_export`** **`ecreate(const char *file)`**
Synopsis	Create the binary file, `*file`, returning a `FILE` pointer of the file for write only. Displays an error and exits if it is unable to create the file. To create a text file, use `ecreateT()`.

Example	`#include <diskio.hpp>`
	
	`FILE *fp = ecreate("c:\\temp\\newbinfile.exe");`

5.15.4 eclose

Definition	**`idaman void ida_export`** **`eclose(FILE *fp)`**
Synopsis	Closes the file represented by `FILE` pointer `*fp`. Displays an error and exits if it is unable to close the file.

Example	`#include <diskio.hpp>`
	
	`// Open the file first.`
	`FILE *fp = openR("c:\\temp\\binfile.exe");`
	
	`// Close it`
	`eclose(fp);`

5.15.5 eread

Definition	**`idaman void ida_export`** **`eread(FILE *fp, void *buf, ssize_t size)`**
Synopsis	Read `size` bytes from file represented by `FILE` pointer `*fp`, into buffer `*buf`. If the read is unsuccessful, an error is displayed followed by exiting IDA.

Example	`#include <diskio.hpp>`
	
	`char buf[MAXSTR];`
	
	`// Open the text file`
	`FILE *fp = openRT("c:\\temp\\txtfile.txt");`
	
	`// Read MAXSTR bytes from the start of the file.`
	`eread(fp, buf, MAXSTR-1);`
	
	`eclose(fp);`

5.15.6 ewrite

Definition	**idaman void ida_export ewrite(FILE *fp, const void *buf, ssize_t size)**
Synopsis	Write `size` bytes of `*buf` to the file represented by `FILE` pointer `*fp`. If the write operation fails, an error is displayed followed by exiting IDA.

Example	`#include <kernwin.hpp> // For read_selection()`
	`#include <bytes.hpp>  // For get_many_bytes()`
	`#include <diskio.hpp>`
	
	`char buf[MAXSTR];`
	`ea_t saddr, eaddr;`
	
	`// Create the binary dump file`
	`FILE *fp = ecreate("c:\\bindump");`
	
	`// Get the address range selected, or return false if`
	`// there was no selection`
	`if (read_selection(&saddr, &eaddr)) {`
	`  int size = eaddr - saddr;`
	`  // Dump the selected address range to a binary file`
	`  get_many_bytes(saddr, buf, size);`
	`  ewrite(fp, buf, size);`
	`}`
	`eclose(fp);`

5.16 Debugging

Unlike most of the functions covered so far, the next three sections are for working with a binary during execution. This section in particular is for high level operations (like process and thread control) on a binary/process. Debugging and tracing is covered in the following two sections. All functions below are defined in `dbg.hpp` with the exception of `invalidate_dbg_contents()` and `invalidate_dbg_config()`, which are defined in `bytes.hpp`. To get the most out of the examples, you should run them (i.e. invoke your plug-in) whilst a binary is being debugged in IDA.

You will probably notice that all of these functions aren't prefixed with `ida_export`. They don't need to be because they are all inlined wrappers to `callui()`, and use event notifications to carry out their respective functionality.

5.16.0 A Note on Requests

Unlike most functions in the SDK, most debugger functions (and some tracing functions too) come in two forms; their normal asynchronous form, for example `run_to()`, and a synchronous, or *request* form, like `request_run_to()`. Both forms of the function will take the same arguments, but it's the way they carry out the respective operation that makes the difference.

The synchronous form of the function (`request_`) will enter the function into a queue, and eventually be executed by IDA when you call `run_requests()`. The other, asynchronous form, will run straight away, just like a normal function.

The synchronous form of a function can be very handy when you want to queue a bunch of things to be run by IDA in one hit. 5.17.5 is a good example of this, where deleting a bunch of breakpoints using `del_bpt()` would fail unless done synchronously, as the ID number of the breakpoints would be re-organised by the time you went to fetch the next one using `getn_bpt()`. Something important worth

noting is that you *must* use the synchronous form of a function when you are in an debugger event notification handler (see section 4.5, specifically 4.5.3).

All functions in sections 5.16, 5.17 and 5.18 that are also available as requests will have a * following the function name.

5.16.1 run_requests

Definition	**`bool idaapi run_requests(void)`**
Synopsis	Runs any requests (synchronous functions) that have been queued.

Example	`#include <dbg.hpp>`
	
	`// Run to the entry point of the binary`
	`request_run_to(inf.startIP);`
	`// Enable function tracing`
	`request_enable_func_trace();`
	
	`// Run the above requests`
	`run_requests();`

5.16.2 get_process_state

Definition	**`int idaapi get_process_state(void)`**
Synopsis	Returns the state of the process currently being debugged. If the process is suspended, `-1` is returned, `1` if the process is running or `0` if there is no process running under the debugger.

Example	`#include <dbg.hpp>`
	
	`switch (get_process_state()) {`
	`  case 0:`
	`  msg("No process running.\n");`
	`  break;`
	`  case -1:`
	`  msg("Process is suspended.\n");`
	`  break;`
	`  case 1:`
	`  msg("Process is running.\n");`
	`  break;`
	`  default:`
	`  msg("Unknown status.\n");`
	`}`

5.16.3 get_process_qty

Definition	**int idaapi get_process_qty(void)**
Synopsis	Returns the number of running processes matching the image of the executable currently open in IDA. This function also needs to be called to initialise the process snapshot, which is used by IDA for populating data structures utilised by other process-related functions.

Example	`#include <dbg.hpp>`
	
	`msg("There are %d processes running.\n",`
	`  get_process_qty());`

5.16.4 get_process_info

Definition	**process_id_t idaapi get_process_info(int n, process_info_t *process_info);**
Synopsis	Populate `*process_info` with information about process number n (this is *not* the PID). The process ID of the process number n is returned. If `*process_info` is `NULL`, only the PID of the process is returned.

Example	`#include <dbg.hpp>`
	
	`// Only get the info if a process is actually running..`
	`if (get_process_qty() > 0) {`
	`  process_info_t pif;`
	`  // Populate pif`
	`  get_process_info(0, &pif);`
	`  msg("ID: %d, Name: %s\n", pif.pid, pif.name);`
	`} else {`
	`  msg("No process running!\n");`
	`}`

*5.16.5 start_process **

Definition	**int idaapi start_process(const char *path = NULL, const char *args = NULL, const char *sdir = NULL);**
Synopsis	Start debugging the process `*path`, with the arguments `*args`, in the directory `*sdir`. If any of the arguments are `NULL`, they are taken from the process options specified under *Debugger->Process Options…*. This is essentially the same as pressing F9 in IDA.

Example	`#include <kernwin.hpp> // For askstr()`
	`#include <dbg.hpp>`
	
	`// Ask the user for arguments to supply.`
	`char *args = askstr(HIST_IDENT, "", "Arguments");`
	
	`// Run the process with those arguments`
	`start_process(NULL, args, NULL);`

*5.16.6 continue_process **

Definition	**`bool idaapi continue_process(void)`**
Synopsis	Continue the execution of a process. Returns false if continuing the process fails. This is equivalent to pressing F9 in IDA when a process is in the suspended state (breakpoint-hit or suspended).

Example	`#include <dbg.hpp>`
	
	`// Continue running the process when the user`
	`// involkes this plug-in.`
	`if (continue_process())`
	`  msg("Continuing process..\n");`
	`else`
	`  msg("Failed to continue process execution.\n");`

*5.16.7 suspend_process **

Definition	**`bool idaapi suspend_process(void)`**
Synopsis	Suspend the process currently being debugged. Returns false if suspending the process failed. This is the same as pressing the 'Pause Process' button in IDA.

Example	`#include <dbg.hpp>`
	
	`// Suspend the process being debugged.`
	`if (suspend_process())`
	`  msg("Suspended process.\n");`
	`else`
	`  msg("Failed to suspend process.\n");`

*5.16.8 attach_process **

Definition	**`int idaapi attach_process(process_id_t pid=NO_PROCESS, int event_id=-1)`**

Synopsis	Attach to the process with PID `pid`. The process being attached to must be the same executable image as the one currently being disassembled in IDA. If the `pid` argument is `NO_PROCESS`, the user is prompted with a list of potential processes to attach to. The possible return codes are as follows, which is taken from `dbg.hpp`:
	
	`//  -2 - impossible to find a compatible process`
	`//  -1 - impossible to attach to the given process`
	`//  (process died, privilege`
	`//  needed, not supported by the debugger`
	`//  plugin, ...)`
	`//  0 - the user cancelled the attaching to the`
	`//  process`
	`//  1 - the debugger properly attached to the`
	`//  process`

Example	`#include <dbg.hpp>`
	
	`// Present the user with a list of processes to`
	`// attach to. If there is no executable running that`
	`// matches what's open in IDA, no dialog box will`
	`// be presented.`
	`int err;`
	`if ((err = attach_process(NO_PROCESS)) == 1)`
	`  msg("Successfully attached to process.\n");`
	`else`
	`  msg("Unable to attach, error: %d\n", err);`

*5.16.9 detach_process **

Definition	**`bool idaapi`** **`detach_process(void)`**
Synopsis	Detach from the process currently being debugged. This can be a process that was attached to or run through IDA. Returns false if it was unable to detach. Detaching from a process is only supported on Windows XP SP2 and Windows 2003.

Example	`#include <dbg.hpp>`
	
	`// Detach from the debugged process.`
	`if (detach_process())`
	`  msg("Successfully detached from process.\n");`
	`else`
	`  msg("Failed to detach.\n");`

*5.16.10 exit_process **

Definition	**bool idaapi exit_process(void)**
Synopsis	Terminate the process currently being debugged. Returns false if it was unable to terminate the process.

Example	`#include <dbg.hpp>`
	
	`// Terminate the debugged process.`
	`if (exit_process())`
	`  msg("Successfully terminated the process.\n");`
	`else`
	`  msg("Failed to terminate the proces.\n");`

5.16.11 get_thread_qty

Definition	**int idaapi get_thread_qty(void)**
Synopsis	Returns the number of threads that exist in the debugged process.

Example	`#include <dbg.hpp>`
	
	`// Only display if there is a process being debugged.`
	`if (get_process_qty() > 0)`
	`  msg("Threads running: %d\n", get_thread_qty());`

5.16.12 get_reg_val

Definition	**bool idaapi get_reg_val(const char *regname, regval_t *regval)**
Synopsis	Get the value stored in register `*regname` and store it in `*regval`. Returns false if it was unable to retrieve the value from the register. The register name is case insenstive.

Example	`#include <dbg.hpp>`
	
	`// Process needs to be suspended for this to work.`
	
	`regval_t eax;`
	`regval_t eax_upper;`
	`char *regname = "eax";`
	`char *regname_upper = "EAX";`
	
	`// Prooving that the register name is case insenstive`
	`if (get_reg_val(regname, &eax))`
	`  msg("eax = %08a\n", eax.ival);`
	
	`if (get_reg_val(regname_upper, &eax_upper))`
	`  msg("EAX = %08a\n", eax_upper.ival);`

*5.16.13 set_reg_val **

Definition	**`bool idaapi`** **`set_reg_val(const char *regname, const regval_t *regval)`**
Synopsis	Set the register `*regname` to value `*regval in the current thread`. If the write fails, false is returned. Like `get_reg_val()`, `*regname` is case insensitive. Unlike other asynchronous functions, this is safe to call from a debug event notification handler.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <dbg.hpp>`
	
	`// Suspend the currently executing process.`
	`suspend_process();`
	
	`// Continue execution from the user's cursor position.`
	`ea_t addr = get_screen_ea();`
	`char *regname = "EIP";`
	
	`if (set_reg_val(regname, addr)) {`
	`  msg("Continuing execution from %a\n", addr);`
	`  continue_process();`
	`}`

5.16.14 invalidate_dbgmem_contents

Definition	**`idaman void ida_export`** **`invalidate_dbgmem_contents(ea_t ea, asize_t size)`**

Synopsis	Invalidate `size` bytes of memory, starting at `ea`. If you want to invalidate the whole of a processes memory, set `ea` to `BADADDR` and `size` to 0. Invalidating memory contents is essentially flushing the IDA kernel's memory cache for a process, which ensures you are accessing the latest memory contents from a processes memory. You should call this function after a process is suspended, or if you suspect the memory contents have changed.

Example	`#include <dbg.hpp>`
	`#include <bytes.hpp>`
	
	`// Process must be suspended for this to work`
	
	`// Get the address stored in the ESP register`
	`regval_t esp;`
	`get_reg_val("ESP", &esp);`
	
	`// Get the value at the address stored in the ESP reg.`
	`uchar before = get_byte(esp.ival);`
	
	`// Invalidate memory contents`
	`invalidate_dbgmem_contents(BADADDR, 0);`
	
	`// Re-fetch contents of the address stored in ESP`
	`uchar after = get_byte(esp.ival);`
	
	`msg("%08a: Before: %a, After: %a\n",`
	`esp.ival, before, after);`

5.16.15 invalidate_dbgmem_config

Definition	**`idaman void ida_export invalidate_dbgmem_config(void)`**
Synopsis	Like `invalidate_dbgmem_contents()`, you use this function to ensure IDA is looking at the latest memory *configuration*. You need to run this function if the debugged process has allocated or deallocated memory since it was last suspended. This function also flushes the IDA memory cache, however is much slower than `invalidate_dbgmem_contents()`.

Example	`#include <dbg.hpp>`
	`#include <bytes.hpp>`
	
	`regval_t esp;`
	
	`// Get ESP before invalidate config`
	`get_reg_val("ESP", &esp);`
	`uchar before = get_byte(esp.ival);`
	
	`// Invalidate memory config`
	`invalidate_dbgmem_config();`
	
	`// After invalidate`
	`uchar after = get_byte(esp.ival);`
	`msg("%08a Before: %a, After: %a\n",`
	`esp.ival, before, after);`

*5.16.16 run_to **

Definition	**`bool idaapi`** **`run_to(ea_t ea)`**
Synopsis	Run the process until execution gets to address ea. If there is no process running, the currently disassembled file is executed. Returns false if it was unable to execute the process.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <dbg.hpp>`
	
	`// Replicate F4 functionality`
	`if (!run_to(get_screen_ea()))`
	`msg("Failed to run to %a\n", get_screen_ea());`

*5.16.17 step_into **

Definition	**`bool idaapi`** **`step_into(void)`**
Synopsis	Run one instruction within the current thread of the debugged process. This is the same as F7 in IDA. Returns false if it was unable to step into the instruction.

Example	`#include <dbg.hpp>`
	
	`// Go to the entry point (queued)`
	`request_run_to(inf.startIP);`
	
	`// Run 20 instructions (queued)`
	`for (int i = 0; i < 20; i ++)`
	`    request_step_into();`
	
	`// Run through the queue`
	`run_requests();`

*5.16.18 step_over **

Definition	**`bool idaapi`** **`step_over(void)`**
Synopsis	Run one instruction within the current thread of the debugged process, but don't step into functions, treat them as one instruction. This is the same as F8 in IDA. Returns false if it was unable to step over the instruction.

Example	`#include <dbg.hpp>`
	
	`// This can only run when the process is suspended`
	
	`// Step over 5 instructions. This needs to be done as`
	`// a request, otherwise only one step will execute.`
	`for (int i = 0; i < 5; i ++)`
	`    request_step_over();`
	`run_requests();`

*5.16.19 step_until_ret **

Definition	**`bool idaapi`** **`step_until_ret(void)`**
Synopsis	Execute each instruction in the current thread of the debugged process until the current function returns. This is the same as CTRL-F7 in IDA.

Example	`#include <dbg.hpp>`
	
	`// Get the address of where the function named`
	`// 'myfunc' is.`
	`ea_t addr = get_name_ea(BADADDR, "myfunc");`
	
	`if (addr != BADADDR) {`
	`    // Run until execution hits myfunc (queued)`
	`    request_run_to(addr);`
	`    // Step into the function (queued)`
	`    request_step_into();`

```
    // Continue executing until myfunc returns (queued)
    request_step_until_ret();

    // Run through the queue
    run_requests();
}
```

5.17 Breakpoints

An essential part of debugging is having the ability to set and manipulate breakpoints, which can be set on any address within a process memory space and be hardware or software breakpoints. The following set of functions work with breakpoints, and are defined in `dbg.hpp`.

5.17.1 get_bpt_qty

Definition	**`int idaapi`** **`get_bpt_qty(void)`**
Synopsis	Return the current number of breakpoints that exist (regardless of whether they are enabled or not).

Example	`#include <dbg.hpp>`
	
	`msg("There are currently %d breakpoints set.\n",`
	`  get_bpt_qty());`

5.17.2 getn_bpt

Definition	**`bool idaapi`** **`getn_bpt(int n, bpt_t *bpt)`**
Synopsis	Fill `*bpt` with information about breakpoint number `n`. Returns false if there is no such breakpoint number.

Example	`#include <dbg.hpp>`
	
	`// Go through all breakpoints, displaying the address`
	`// of where they are set.`
	`for (int i = 0; i < get_bpt_qty(); i++) {`
	`  bpt_t bpt;`
	`  if (getn_bpt(i, &bpt))`
	`  msg("Breakpoint found at %a\n", bpt.ea);`
	`}`

5.17.3 get_bpt

Definition	**`bool idaapi`** **`get_bpt(ea_t ea, bpt_t *bpt)`**
Synopsis	Fill `*bpt` with information about the breakpoint set at `ea`. If no breakpoint is set at `ea`, false is returned. If `*bpt` is `NULL`, this function simply returns true or false depending if a breakpoint is set at `ea`.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <dbg.hpp>`
	
	`if (get_bpt(get_screen_ea(), NULL))`
	`  msg("Breakpoint is set at %a.\n", get_screen_ea());`
	`else`
	`  msg("No breakpoint set at %a.\n", get_screen_ea());`

*5.17.4 add_bpt **

Definition	**`bool idaapi`** **`add_bpt(ea_t ea, asize_t size = 0, bpttype_t type = BPT_SOFT)`**
Synopsis	Add a breakpoint at `ea` of type `type` and size `size`. Returns false if it was unable to set the breakpoint. Refer to section 4.4.2 for an explanation of different breakpoint types. `size` is irrelevant when setting software breakpoints.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <dbg.hpp>`
	
	`// Add a software breakpoint at the cursor position`
	`if (add_bpt(get_screen_ea(), 0, BPT_SOFT))`
	`  msg("Successfully set software breakpoint at %a\n",`
	`  get_screen_ea());`

*5.17.5 del_bpt **

Definition	**bool idaapi del_bpt(ea_t ea)**
Synopsis	Delete the breakpoint defined at ea. If there is no breakpoint defined there, returns false.

Example	`#include <dbg.hpp>`
	
	`// Go through all breakpoints, deleting each one.`
	`for (int i = 0; i < get_bpt_qty(); i++) {`
	`  bpt_t bpt;`
	`  if (getn_bpt(i, &bpt)) {`
	`  // Because we are performing many delete`
	`  // operations, queue the request, otherwise the`
	`  // getn_bpt call will fail when the id`
	`  // numbers change after the delete operation.`
	`  if (request_del_bpt(bpt.ea))`
	`  msg("Queued deleting breakpoint at %a\n",`
	`  bpt.ea);`
	`  }`
	`}`
	
	`// Run through request queue`
	`run_requests();`
	
	`// Make sure there are no breakpoints left over`
	`if (get_bpt_qty() > 0)`
	`  msg("Failed to delete all breakpoints.\n");`

5.17.6 update_bpt

Definition	**bool idaapi update_bpt(const bpt_t *bpt)**
Synopsis	Update modifiable elements of the breakpoint represented by `*bpt`. Returns false if the modification was unsuccessful.

Example	`#include <dbg.hpp>`
	
	`// Loop through all breakpoints`
	`for (int i = 0; i < get_bpt_qty(); i++) {`
	`  bpt_t bpt;`
	`  if (getn_bpt(i, &bpt)) {`
	
	`  // Change the breakpoint to not pause`
	`  // execution when it's hit`
	`  bpt.flags ^= BPT_BRK;`
	
	`  // Change the breakpoint to a trace breakpoint`

```
        bpt.flags |= BPT_TRACE;

        // Run a little IDC every time it's hit
        qstrncpy(bpt.condition,
                 "Message(\"Trace hit!\")",
                 sizeof(bpt.condition));

        // Update the breakpoint
        if (!update_bpt(&bpt))
            msg("Failed to update breakpoint at %a\n",
                        bpt.ea);
    }
}
```

*5.17.7 enable_bpt **

Definition	**bool idaapi enable_bpt(ea_t ea, bool enable = true)**
Synopsis	Enable or disable the breakpoint set at `ea`. If no breakpoint is defined at `ea`, or there was an error enabling/disabling the breakpoint, false is returned. If `enable` is set to false, the breakpoint is disabled.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <dbg.hpp>`
	
	`bpt_t bpt;`
	
	`// If a breakpoint exists at the user's cursor, disable`
	`// it.`
	`if (get_bpt(get_screen_ea(), &bpt)) {`
	`  if (enable_bpt(get_screen_ea(), false))`
	`  msg("Disabled breakpoint.\n");`
	`}`

5.18 Tracing

The functions available for tracing mostly revolve around checking whether a certain type of tracing is enabled, enabling or disabling a type of tracing and retrieving trace events. All the below are defined in `dbg.hpp`.

5.18.1 set_trace_size

Definition	**bool idaapi set_trace_size(int size)**
Synopsis	Set the tracing buffer size to `size`. Returns false if there was an error allocating `size`. Setting `size` to `0` sets an unlimited buffer size (dangerous). If you set `size` to a value lower than the current number of trace events, `size` events are deleted.

Example	`#include <dbg.hpp>`
	
	`// 1000 trace events allowed`
	`if (set_trace_size(1000))`
	`    msg("Successfully set the trace buffer to 1000\n");`

*5.18.2 clear_trace **

Definition	**`void idaapi`** **`clear_trace(void)`**
Synopsis	Clear the trace buffer.

Example	`#include <dbg.hpp>`
	
	`// Start our plug-in with a clean slate`
	`clear_trace();`

5.18.3 is_step_trace_enabled

Definition	**`bool idaapi`** **`is_step_trace_enabled(void)`**
Synopsis	Returns true if step tracing is currently enabled.

Example	`#include <dbg.hpp>`
	
	`if (is_step_trace_enabled())`
	`    msg("Step tracing is enabled.\n");`

*5.18.4 enable_step_trace **

Definition	**`bool idaapi`** **`enable_step_trace(int enable = true)`**
Synopsis	Enable step tracing. If `enable` is set to false, step tracing is disabled.

Example	`#include <dbg.hpp>`
	
	`// Toggle step tracing`
	`if (is_step_trace_enabled())`
	`    enable_step_trace(false);`
	`else`
	`    enable_step_trace();`

5.18.5 is_insn_trace_enabled

Definition	**`bool idaapi`** **`is_insn_trace_enabled(void)`**
Synopsis	Returns true if instruction tracing is enabled.

Example	`#include <dbg.hpp>`
	
	`if (is_insn_trace_enabled())`
	`    msg("Instruction tracing is enabled.\n");`

*5.18.6 enable_insn_trace **

Definition	**`bool idaapi`** **`enable_insn_trace(int enable = true)`**
Synopsis	Enable instruction tracing. If `enable` is set to false, instruction tracing is disabled.

Example	`#include <dbg.hpp>`
	
	`// Toggle instruction tracing`
	`if (is_insn_trace_enabled())`
	`    enable_insn_trace(false);`
	`else`
	`    enable_insn_trace();`

5.18.7 is_func_trace_enabled

Definition	**`bool idaapi`** **`is_func_trace_enabled(void)`**
Synopsis	Returns true if function tracing is enabled.

Example	`#include <dbg.hpp>`
	
	`if (is_func_trace_enabled())`
	`    msg("Function tracing is enabled.\n");`

*5.18.8 enable_func_trace **

Definition	**`bool idaapi`** **`enable_func_trace(int enable = true)`**
Synopsis	Enable function tracing. If `enable` is set to false, function tracing is disabled.

Example	`#include <dbg.hpp>`
	
	`// Toggle function tracing`
	`if (is_func_trace_enabled())`
	`    enable_func_trace(false);`
	`else`
	`    enable_func_trace();`

5.18.9 get_tev_qty

Definition	**`int idaapi`** **`get_tev_qty(void)`**
Synopsis	Returns the number of trace events in the trace buffer.

Example	`#include <dbg.hpp>`
	
	`msg("There are %d trace events in the trace buffer.\n",`
	`            get_tev_qty());`

5.18.10 get_tev_info

Definition	**`bool idaapi`** **`get_tev_info(int n, tev_info_t *tev_info)`**
Synopsis	Fills `*tev_info` about the trace buffer entry number `n`. Returns false if there is no such trace event number `n`.

Example	`#include <dbg.hpp>`
	
	`// Loop through all trace events`
	`for (int i = 0; i < get_tev_qty(); i++) {`
	`  tev_info_t tev;`
	`  // Get the trace event information`
	`  get_tev_info(i, &tev);`
	
	`  // Display the address the event took place`
	`  msg("Trace event occurred at %a\n", tev.ea);`
	`}`

5.18.11 get_insn_tev_reg_val

Definition	**`bool idaapi get_insn_tev_reg_val(int n, const char *regname, regval_t *regval)`**
Synopsis	Store the value of register `*regname` into `*regval` when instruction trace event number n happened, *before* execution of the instruction. Returns false if the event wasn't an instruction trace event. See `get_insn_tev_reg_result()` for obtaining registers after execution.

Example	`#include <dbg.hpp>`
	
	`// Loop through all trace events`
	`for (int i = 0; i < get_tev_qty(); i++) {`
	`  regval_t esp;`
	`  tev_info_t tev;`
	
	`  // Get the trace event information`
	`  get_tev_info(i, &tev);`
	
	`  // If it's an instruction trace event...`
	`  if (tev.type == tev_insn) {`
	`  // Get ESP, store into &esp`
	`  if (get_insn_tev_reg_val(i, "ESP", &esp))`
	`  // Display the value of ESP`
	`  msg("TEV #%d before exec: %a\n", i, esp.ival);`
	`  else`
	`  msg("No ESP change for TEV #%d\n", i);`
	`  }`
	`}`

5.18.12 get_insn_tev_reg_result

Definition	**`bool idaapi get_insn_tev_reg_result(int n, const char *regname, regval_t *regval)`**

Synopsis	Store the value of register `*regname` into `*regval` when instruction trace event number n happened, *after* execution of the instruction. Returns false if the register wasn't modified or n doesn't represent an instruction trace event. See `get_insn_tev_reg_val()` for obtaining registers before execution.

Example	`#include <dbg.hpp>`
	
	`// Loop through all trace events`
	`for (int i = 0; i < get_tev_qty(); i++) {`
	`  regval_t esp;`
	`  tev_info_t tev;`
	
	`  // Get the trace event information`
	`  get_tev_info(i, &tev);`
	
	`  // If it's an instruction trace event...`
	`  if (tev.type == tev_insn) {`
	`  // Get ESP, store into &esp`
	`  if (get_insn_tev_reg_result(i, "ESP", &esp))`
	`  // Display the value of ESP`
	`  msg("TEV #%d after exec: %a\n", i, esp.ival);`
	`  else`
	`  msg("No ESP change for TEV #%d\n", i);`
	`  }`
	`}`

5.18.13 get_call_tev_callee

Definition	**`ea_t idaapi`** **`get_call_tev_callee(int n)`**
Synopsis	Returns the address of the function called for function trace event number n. Returns BADADDR if there is no such function trace event number n. The type of the function trace event must be `tev_call`.

Example	`#include <dbg.hpp>`
	
	`// Loop through all trace events`
	`for (int i = 0; i < get_tev_qty(); i++) {`
	`  regval_t esp;`
	`  tev_info_t tev;`
	
	`  // Get the trace event information`
	`  get_tev_info(i, &tev);`
	
	`  // If it's an function call trace event...`
	`  if (tev.type == tev_call) {`
	`  ea_t addr;`
	`  // Get ESP, store into &esp`
	`  if ((addr = get_call_tev_callee(i)) != BADADDR)`
	`  msg("Function at %a was called\n", addr);`
	`  }`
	`}`

5.18.14 get_ret_tev_return

Definition	**ea_t idaapi get_ret_tev_return(int n)**
Synopsis	Returns the address of the calling function for function trace event number n. Returns BADADDR if there is no such function trace event number n. The type of the function trace event must be `tev_ret`.

Example	`#include <dbg.hpp>`
	
	`// Loop through all trace events`
	`for (int i = 0; i < get_tev_qty(); i++) {`
	`  tev_info_t tev;`
	
	`  // Get the trace event information`
	`  get_tev_info(i, &tev);`
	
	`  // If it's an function return trace event...`
	`  if (tev.type == tev_ret) {`
	`  ea_t addr;`
	`  if ((addr = get_ret_tev_return(i)) != BADADDR)`
	`  msg("Function returned to %a\n", addr);`
	`  }`
	`}`

5.18.15 get_bpt_tev_ea

Definition	**ea_t idaapi get_bpt_tev_ea(int n)**
Synopsis	Returns the address of the read/write/execution trace number n. Returns false if the trace event wasn't that of a read/write/execution trace.

Example	`#include <dbg.hpp>`
	
	`// Loop through all trace events`
	`for (int i = 0; i < get_tev_qty(); i++) {`
	`  tev_info_t tev;`
	
	`  // Get the trace event information`
	`  get_tev_info(i, &tev);`
	
	`  // If it's an breakpoint trace event...`
	`  if (tev.type == tev_bpt) {`
	`  ea_t addr;`
	`  if ((addr = get_bpt_tev_ea(i)) != BADADDR)`
	`  msg("Breakpoint trace hit at %a\n", addr);`
	`  }`
	`}`

5.19 Strings

The following functions are used for reading the list of strings in IDA's *Strings* window, which is derived from strings found in the currently disassembled file(s). The below functions are defined in `strlist.hpp`.

5.19.1 refresh_strlist

Definition	**idaman void ida_export refresh_strlist(ea_t ea1, ea_t ea2)**
Synopsis	Refresh the list of strings in IDA's *Strings* window. Search between `ea1` and `ea2` in the currently disassembled file(s) for these strings.

Example	`#include <strlist.hpp>`
	
	`// Refresh the string list.`
	`refresh_strlist();`

5.19.2 get_strlist_qty

Definition	**idaman size_t ida_export get_strlist_qty(void)**
Synopsis	Returns the number of strings found in the currently disassembled file(s).

Example	`#include <strlist.hpp>`
	
	`msg("%d strings were found in the currently open file(s)",`
	`  get_strlist_qty());`

5.19.3 get_strlist_item

Definition	**idaman bool ida_export get_strlist_item(int n, string_info_t *si)**
Synopsis	Fills `*si` with information about string number `n`. Returns false if there is no such string number `n`.

Example	`#include <strlist.hpp>`
	
	`int largest = 0;`
	
	`// Loop through all strings, finding the largest one.`
	`for (int i = 0; i < get_strlist_qty(); i++) {`
	`  string_info_t si;`
	`  get_strlist_item(i, &si);`
	`  if (si.length > largest)`
	`  largest = si.length;`

	}
	
	msg("Largest string is %d characters long.\n", largest);

5.20 Miscellaneous

These are functions that don't really fit into any particular category. The headers they are defined in are mentioned in each case.

5.20.1 tag_remove

Definition	**idaman int ida_export tag_remove(const char *instr, char *buf, int bufsize)**
Synopsis	Remove any colour tags from `*instr`, and store the result in `*buf`, limited by `bufsize`. Supplying the same pointer for `*instr` and `*buf` is also supported, in which case `bufsize` is `0`. This function is defined in `lines.hpp`.

Example	`#include <ua.hpp>   // For ua_ functions`
	`#include <lines.hpp>`
	
	`// Get the entry point address`
	`ea_t addr = inf.startIP;`
	
	`// Fill cmd with information about the instruction`
	`// at the entry point`
	`ua_ana0(addr);`
	
	`// Loop through each operand (until one of o_void type`
	`// is reached), displaying the operand text.`
	`for (int i = 0; cmd.Operands[i].type != o_void; i++) {`
	`    char op[MAXSTR];`
	`    ua_outop(addr, op, sizeof(op)-1, i);`
	
	`    // Strip the colour tags off`
	`    tag_remove(op, op, 0);`
	`    msg("Operand %d: %s\n", i, op);`
	`}`

5.20.2 open_url

Definition	**inline void open_url(const char *url)**
Synopsis	Opens `*url` in the system default web browser. This function is defined in `kernwin.hpp`.

Example	`#include <kernwin.hpp>`
	
	`open_url("http://www.binarypool.com/idapluginwriting/");`

5.20.3 call_system

Definition	**`idaman int ida_export call_system(const char *command)`**
Synopsis	Runs the command, `*command`, from a system shell. This function is defined in `diskio.hpp`.

Example	`#include <diskio.hpp>`
	
	`// Run notepad`
	`call_system("notepad.exe");`

5.20.4 idadir

Definition	**`idaman const char *ida_export idadir(const char *subdir)`**

Synopsis	Returns the IDA path if `*subdir` is `NULL`. If `*subdir` is not `NULL`, the IDA sub-directory path is returned. These are the possible sub-directories, as taken from `diskio.hpp`:
	
	`#define CFG_SUBDIR "cfg"`
	`#define IDC_SUBDIR "idc"`
	`#define IDS_SUBDIR "ids"`
	`#define IDP_SUBDIR "procs"`
	`#define LDR_SUBDIR "loaders"`
	`#define SIG_SUBDIR "sig"`
	`#define TIL_SUBDIR "til"`
	
	This function is defined in `diskio.hpp`.

Example	`#include <diskio.hpp>`
	
	`msg("IDA directory is %s\n", idadir(NULL));`

5.20.5 getdspace

Definition	**`idaman ulonglong ida_export getdspace(const char *path)`**
Synopsis	Returns the amount of disk space available on the disk hosting `*path`. This function can be found in `diskio.hpp`.

Example	`#include <diskio.hpp>`
	
	`// Get the disk space on the disk with IDA installed on`
	`// it.`
	`if (getdspace(idadir(NULL)) < 100*1024*1024)`
	`  msg("You need at least 100 MB free to run this.");`

5.20.6 str2ea

Definition	**`idaman bool  ida_export`** **`str2ea(const char *p, ea_t *ea, ea_t screenEA)`**
Synopsis	Convert the string `*p` to an address stored in `*ea` if it exists within the currently disassembled file(s), return true on success. This function is defined in `kernwin.hpp`.

Example	`#include <kernwin.hpp>`
	
	`// Just some random address`
	`char *addr_s = "010100F0";`
	`ea_t addr;`
	
	`// If 010100F0 is in the binary, print the address`
	`if (str2ea(addr_s, &addr, 0))`
	`  msg("Address: %a\n", addr);`

5.20.7 ea2str

Definition	**`idaman char *ida_export`** **`ea2str(ea_t ea, char *buf, int bufsize)`**
Synopsis	Convert the address, `ea`, to string, stored in `*buf`, limited by `bufsize`. The format of the string produced is `segmentname:address`, so for example, supplying the `0100102A` address from the `.text` segment would produce `.text:0100102A`. This function is defined in `kernwin.hpp`.

Example	`#include <kernwin.hpp>`
	
	`ea_t addr = get_screen_ea();`
	`char addr_s[MAXSTR];`
	
	`// Convert addr into addr_s`
	`ea2str(addr, addr_s, sizeof(addr_s)-1);`
	`msg("Address: %s\n", addr_s);`

5.20.8 get_nice_colored_name

Definition	**idaman ssize_t ida_export get_nice_colored_name(ea_t ea, char *buf, size_t bufsize, int flags=0);**
Synopsis	Get the formatted name of `ea`, store it in `*buf` limited by `bufsize`. If flags is set to `GNCN_NOCOLOR`, no colour codes will be included in the name. If `ea` doesn't have a name, its address will be returned in a "human readable" form, like `start+56` or `.text:01002010` for example. This function is defined in `name.hpp`.

Example	`#include <kernwin.hpp> // For get_screen_ea() definition`
	`#include <name.hpp>`
	
	`char buf[MAXSTR];`
	
	`// Get the nicely formatted name/address of the`
	`// current cursor position. No colour codes will`
	`// be included.`
	`get_nice_colored_name(get_screen_ea(),`
	`buf,`
	`sizeof(buf)-1,`
	`GNCN_NOCOLOR);`
	
	`msg("Name at cursor position: %s\n", buf);`

6 Examples

The below examples have been included to provide a bit of context to the use of the structures and functions covered in this tutorial. All are extensively commented and will compile as-is, i.e. not requiring any modification or inclusion of headers, etc. like previous examples did.

The code for each of the below is also available at http://www.binarypool.com/idapluginwriting/.

6.1 Looking for Calls to sprintf, strcpy, and sscanf

The below example will find “low hanging fruit” when auditing a binary. It does this by finding calls to usually misused functions like `sprintf`, `strcpy` and `sscanf` (feel free to add more of your choosing). It first finds the address of the extern definitions of these functions, then uses IDA’s cross referencing functionality to find all the addresses within the binary that reference those extern definitions.

```
//
// unsafefunc.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>
#include <lines.hpp>
#include <name.hpp>

int IDAP_init(void)
{
  if(inf.filetype != f_ELF && inf.filetype != f_PE)    {
    error("Executable format must be PE or ELF, sorry.");
    return PLUGIN_SKIP;
  }

  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  return;
}

void IDAP_run(int arg)
{
  // The functions we're interested in.
  char *funcs[] = { "sprintf", "strcpy", "sscanf", 0 };

  // Loop through all segments
  for (int i = 0; i < get_segm_qty(); i++) {
    segment_t *seg = getnseg(i);

    // We are only interested in the pseudo segment created by
    // IDA, which is of type SEG_XTRN. This segment holds all
    // function 'extern' definitions.
    if (seg->type == SEG_XTRN) {

      // Loop through each of the functions we're interested in.
      for (int i = 0; funcs[i] != 0; i++) {
        // Get the address of the function by its name
        ea_t loc = get_name_ea(seg->startEA, funcs[i]);
```

```
        // If the function was found, loop through it's
        // referrers.
        if (loc != BADADDR) {
          msg("Finding callers to %s (%a)\n", funcs[i], loc);
          xrefblk_t xb;
          // Loop through all the TO xrefs to our function.
          for (bool ok = xb.first_to(loc, XREF_DATA);
                  ok;
                  ok = xb.next_to()) {
            // Get the instruction (as text) at that address.
            char instr[MAXSTR];
            char instr_clean[MAXSTR];
            generate_disasm_line(xb.from, instr, sizeof(instr)-1);
            // Remove the colour coding and format characters
            tag_remove(instr, instr_clean, sizeof(instr_clean)-1);
            msg("Caller to %s: %a [%s]\n",
                  funcs[i],
                  xb.from,
                  instr_clean);
          }
        }
      }
    }
  }

  return;

}

char IDAP_comment[] = "Insecure Function Finder";
char IDAP_help[] = "Searches for all instances"
      " of strcpy(), sprintf() and sscanf().\n";


char IDAP_name[] = "Insecure Function Finder";
char IDAP_hotkey[] = "Alt-I";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```

6.2 Listing Functions Containing MOVS et al.

When looking for the use of vulnerable functions like `strcpy` for example, you might need to look deeper than simple uses of the function and identify functions that use instructions in the movs family (movsb, movsd, etc.). This plug-in will go through all the functions, then each of their instructions looking for anything that uses a movs-like mnemonic.

```
//
// movsfinder.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>
#include <allins.hpp>

int IDAP_init(void)
{
  // Only support x86 architecture
  if(strncmp(inf.procName, "metapc", 8) != 0)    {
    error("Only x86 binary type supported, sorry.");
    return PLUGIN_SKIP;
  }

  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  return;
}

void IDAP_run(int arg)
{
  // Instructions we're interested in. NN_movs covers movsd,
  // movsw, etc.
  int movinstrs[] = { NN_movsx, NN_movsd, NN_movs, 0 };

  // Loop through all segments
  for (int s = 0; s < get_segm_qty(); s++) {
    segment_t *seg = getnseg(s);

    // We are only interested in segments containing code.
    if (seg->type == SEG_CODE) {

      // Loop through each function
      for (int x = 0; x < get_func_qty(); x++) {
        func_t *f = getn_func(x);
        char funcName[MAXSTR];

        // Get the function name
        get_func_name(f->startEA, funcName, sizeof(funcName)-1);

        // Loop through the instructions in each function
        for (ea_t addr = f->startEA; addr < f->endEA; addr++) {

          // Get the flags for this address
          flags_t flags = getFlags(addr);

          // Only look at the address if it's a head byte, i.e.
```

```
          // the start of an instruction and is code.
          if (isHead(flags) && isCode(flags)) {
            char mnem[MAXSTR];

            // Fill the cmd structure with the disassembly of
            // the current address and get the mnemonic text.
            ua_mnem(addr, mnem, sizeof(mnem)-1);

            // Check the mnemonic of the address against all
            // mnemonics we're interested in.
            for (int i = 0; movinstrs[i] != 0; i++) {
              if (cmd.itype == movinstrs[i])
                msg("%s: found %s at %a!\n", funcName, mnem, addr);
            }
          }
        }
      }
    }
  }

  return;
}

char IDAP_comment[] = "MOVSx Instruction Finder";
char IDAP_help[] =
        "Searches for all MOVS-like instructions.\n"
        "\n"
        "This will display a list of all functions along with\n"
        "the movs instruction used within.";


char IDAP_name[] = "MOVSx Instruction Finder";
char IDAP_hotkey[] = "Alt-M";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```

6.3 Auto-loading DLLs Into the IDA Database

Most binaries will spread their functionality across multiple files (DLLs), loading them at runtime using `LoadLibrary`. In these cases, it can be useful to have IDA auto-load these DLLs into the one IDB. This plug-in will search through the strings in a binary looking for anything containing `.dll`. For strings that do, it is assumed they are DLLs intended to be loaded by the binary and will prompt the user for the full path of that DLL and load it into the IDB.

```
//
// loadlib.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>
#include <strlist.hpp>

// Maximum number of library files to load into the IDB
#define MAXLIBS 5

int IDAP_init(void)
{
  if (inf.filetype != f_PE) {
    error("Only PE executable file format supported.\n");
    return PLUGIN_SKIP;
  }

  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  return;
}

void IDAP_run(int arg)
{
  char loadLibs[MAXLIBS][MAXSTR];
  int libno = 0, i;

  // Loop through all strings to find any string that contains
  // .dll. This will eventuall be our list of DLLs to load.
  for (i = 0; i < get_strlist_qty(); i++) {
    char string[MAXSTR];
    string_info_t si;

    // Get the string item
    get_strlist_item(i, &si);

    if (si.length < sizeof(string)) {

      // Retrieve the string from the binary
      get_many_bytes(si.ea, string, si.length);

      // We're only interested in C strings.
      if (si.type == 0) {

        // .. and if the string contains .dll
        if (stristr(string, ".dll") && libno < MAXLIBS) {
```

```
          // Add the string to the list of DLLs to load later on.
          strncpy(loadLibs[libno++], string, MAXSTR-1);
        }
      }
    }
  }

  // Now go through the list of libraries found and load them.
  msg("Loading the first %d libraries found...\n", MAXLIBS);

  for (i = 0; i < MAXLIBS; i++) {
    msg("Lib: %s\n", loadLibs[i]);

    // Ask the user for the full path to the DLL (the executable will
    // only have the file name).
    char *file = askfile_cv(0, loadLibs[i], "File path...\n", NULL);

    // Load the DLL using the pe loader module.
    if (load_loader_module(NULL, "pe", file, 0)) {
      msg("Successfully loaded %s\n", loadLibs[i]);
    } else {
      msg("Failed to load %s\n", loadLibs[i]);
    }
  }
}

char IDAP_comment[] = "DLL Auto-Loader";
char IDAP_help[] = "Loads the first 5 DLLs"
                   " mentioned in a binary file\n";

char IDAP_name[] = "DLL Auto-Loader";
char IDAP_hotkey[] = "Alt-D";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```

6.4 Bulk Breakpoint Setter & Saver

This single plug-in gives you the ability to save the currently set breakpoints to a file, as well as load a list of addresses from a file and set breakpoints on them. To keep the plug-in simple, it expects the format of the input file to be sane, otherwise it will fail. You will also need to modify your `plugins.cfg` file to be able to use the one plug-in for both functions (setting and saving), as shown below.

```
//
// bulkbpt.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>
#include <diskio.hpp>
#include <dbg.hpp>

// Maximum number of breakpoints that can be set
#define  MAX_BPT     100

// Insert the following two lines into your plugins.cfg file
// Replace pluginname with the filename of your plugin minus
// the extension
//
//    Write_Breakpoints    pluginname     Alt-D   0
//    Read_Breakpoints     pluginname     Alt-E   1
//

void read_breakpoints() {
  char c, ea[9];
  int x = 0, b = 0;
  ea_t ea_list[MAX_BPT];

  // Ask the user for the file containing the breakpoints
  char *file = askfile_cv(0, "", "Breakpoint list file...", NULL);

  // Open the file in read-only mode
  FILE *fp = fopenRT(file);
  if (fp == NULL) {
    warning("Unable to open breakpoint list file, %s\n", file);
    return;
  }

  // Grab 8-byte chunks from the file
  while ((c = qfgetc(fp)) != EOF && b < MAX_BPT) {
    if (isalnum(c)) {
      ea[x++] = c;
      if (x == 8) {
        // NULL terminate the string
        ea[x] = 0;
        x = 0;

        // Convert the 8 character string to an address
        str2ea(ea, &ea_list[b], 0);
        msg("Adding breakpoint at %a\n", ea_list[b]);
        // Add the breakpoint as a software breakpoint
        add_bpt(ea_list[b], 0, BPT_SOFT);
        b++;
      }
```

```
    }
  }

  // Close the file handle
  qfclose(fp);
}

void write_breakpoints() {
  char c, ea[9];
  int x = 0, b = 0;
  ea_t ea_list[MAX_BPT];

  // Ask the user for the file to save the breakpoints to
  char *file = askstr(0, "", "Breakpoint list file...", NULL);

  // Open the file in write-only mode
  FILE *fp = ecreateT(file);

  for (int i = 0; i < get_bpt_qty(); i++) {
    bpt_t bpt;
    char buf[MAXSTR];

    getn_bpt(i, &bpt);

    qsnprintf(buf, sizeof(buf)-1, "%08a\n", bpt.ea);
    ewrite(fp, buf, strlen(buf));
  }

  // Close the file handle
  eclose(fp);
}

void IDAP_run(int arg)
{
  // Depending on the argument supplied,
  // read the breakpoint list from a file and
  // apply it, or write the current breakpoints
  // to a file.
  switch (arg) {
    case 0:
      write_breakpoints();
      break;
    case 1:
    default:
      read_breakpoints();
      break;
  }
}

int IDAP_init(void)
{
  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  return;
}

// These are irrelevant because they will be overridden by
// plugins.cfg.
char IDAP_comment[] = "Bulk Breakpoint Setter and Recorder";
```

```
char IDAP_help[] =
        "Sets breakpoints at a list of addresses in a text file"
        " or saves the current breakpoints to file.\n"
        "The read list must have one address per line.\n";


char IDAP_name[] = "Bulk Breakpoint Setter and Recorder";
char IDAP_hotkey[] = "Alt-B";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```

6.5 Selective Tracing (Method 1)

This plug-in gives you the ability to turn on instruction tracing only for a specific address range. It does this by running to the start address, turning on instruction tracing, running to the end address, and then turning instruction tracing off. Method 2 demonstrates a more flexible approach, utilising step tracing.

```
//
// snaptrace.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>
#include <dbg.hpp>

int IDAP_init(void)
{
  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  return;
}

void IDAP_run(int arg)
{
  // Set the default start address to the user cursur position
  ea_t eaddr, saddr = get_screen_ea();

  // Allow the user to specify a start address
  askaddr(&saddr, "Address to start tracing at");

  // Set the end address to the end of the current function
  func_t *func = get_func(saddr);
  eaddr = func->endEA;

  // Allow the user to specify an end address
  askaddr(&eaddr, "Address to end tracing at");

  // Queue the following

  // Run to the start address
  request_run_to(saddr);
  // Then enable tracing
  request_enable_insn_trace();
  // Run to the end address, tracing all stops in between
  request_run_to(eaddr);
  // Turn off tracing once we've hit the end address
  request_disable_insn_trace();
  // Stop the process once we have what we want
  request_exit_process();

  // Run the above queued requests
  run_requests();

}

// These are actually pointless because we'll be overriding them
```

```
// in plugins.cfg
char IDAP_comment[] = "Snap Tracer";
char IDAP_help[] = "Allow tracing only between user "
                   "specified addresses\n";


char IDAP_name[] = "Snap Tracer";
char IDAP_hotkey[] = "Alt-T";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```

6.6 Selective Tracing (Method 2)

Utilising step tracing, this plug-in sets up a debug event notification handler to handle a trace event (one instruction executed). Within this handler, it checks whether `EIP` is within the user-defined range, and if is, displays `ESP`. Obviously there are much more interesting things you can do with this sort of functionality like alerting based on the contents of registers and/or memory.

```
//
// snaptrace2.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>
#include <dbg.hpp>

ea_t start_ea = 0;
ea_t end_ea = 0;

// Handler for HT_DBG events
int idaapi trace_handler(void *udata, int dbg_event_id, va_list va)
{
  regval_t esp, eip;

  // Get ESP register value
  get_reg_val("esp", &esp);
  // Get EIP register value
  get_reg_val("eip", &eip);

  // We'll also receive debug events unrelated to tracing,
  // make sure those are filtered out
  if (dbg_event_id == dbg_trace) {
    // Make sure EIP is between the user-specified range
    if (eip.ival > start_ea && eip.ival < end_ea)
      msg("ESP = %a\n", esp.ival);
  }

  return 0;
}

int IDAP_init(void)
{
  // Receive debug event notifications
  hook_to_notification_point(HT_DBG, trace_handler, NULL);
  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  // Unhook from the notification point on exit
  unhook_from_notification_point(HT_DBG, trace_handler, NULL);
  return;
}

void IDAP_run(int arg)
{
  // Ask the user for a start and end address
  askaddr(&start_ea, "Start Address:");
  askaddr(&end_ea, "End Address:");
```

```
  // Queue the following

  // Run to the binary entry point
  request_run_to(inf.startIP);
  // Enable step tracing
  request_enable_step_trace();

  // Run queued requests
  run_requests();

}

// These are actually pointless because we'll be overriding them
// in plugins.cfg
char IDAP_comment[] = "Snap Tracer 2";
char IDAP_help[] = "Allow tracing only between user "
                   "specified addresses\n";


char IDAP_name[] = "Snap Tracer 2";
char IDAP_hotkey[] = "Alt-I";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```

6.7 Binary Copy & Paste

Seeing there isn't any binary copy-and-paste functionality in IDA, this plug-in will take care of both copy and paste operations allowing you to take a chunk of binary from one place and overwrite another with it. You need to modify your plugins.cfg file as this is a multi-function plug-in, needing one invocation for copy and another for paste. Obviously it only supports copying and pasting within IDA, however it could probably be extended to go beyond that.

```
//
// copypaste.cpp
//

#include <ida.hpp>
#include <idp.hpp>
#include <loader.hpp>

#define  MAX_COPYPASTE  1024

// This will hold our copied buffer for pasting
char data[MAX_COPYPASTE];

// Bytes copied into the above buffer
ssize_t filled = 0;

// Insert the following two lines into your plugins.cfg file
// Replace pluginname with the filename of your plugin minus
// the extension.
//
//  Copy_Buffer    pluginname    Alt-C  0
//  Paste_Buffer    pluginname    Alt-V  1
//

int IDAP_init(void)
{
  return PLUGIN_KEEP;
}

void IDAP_term(void)
{
  return;
}

void copy_buffer() {
  ea_t saddr, eaddr;
  ssize_t size;

  // Get the boundaries of the user selection
  if (read_selection(&saddr, &eaddr)) {
    // Work out the size, make sure it doesn't exceed the buffer
    // we have allocated.
    size = eaddr - saddr;
    if (size > MAX_COPYPASTE) {
      warning("You can only copy a max of %d bytes\n", MAX_COPYPASTE);
      return;
    }

    // Get the bytes from the file, store it in our buffer
    if (get_many_bytes(saddr, data, size)) {
      filled = size;
```

```
      msg("Successfully copied %d bytes from %a into memory.\n",
                  size,
                  saddr);
    } else {
      filled = 0;
    }
  } else {
    warning("No bytes selected!\n");
    return;
  }
}

void paste_buffer() {

  // Get the cursor position. This is where we will paste to
  ea_t curpos = get_screen_ea();

  // Make sure the buffer has been filled with a Copy operation first.
  if (filled) {
    // Patch the binary (paste)
    patch_many_bytes(curpos, data, filled);
    msg("Patched %d bytes at %a.\n", filled, curpos);
  } else {
    warning("No data to paste!\n");
    return;
  }
}

void IDAP_run(int arg) {

  // Based on the argument supplied in plugins.cfg,
  // we can use the one plug-in for both the copy
  // and paste operations.
  switch(arg) {
    case 0:
      copy_buffer();
      break;
    case 1:
      paste_buffer();
      break;
    default:
      warning("Invalid usage!\n");
      return;
  }
}

// These are actually pointless because we'll be overriding them
// in plugins.cfg
char IDAP_comment[] = "Binary Copy and Paster";
char IDAP_help[] = "Allows the user to copy and paste binary\n";

char IDAP_name[] = "Binary Copy and Paster";
char IDAP_hotkey[] = "Alt-I";

plugin_t PLUGIN =
{
  IDP_INTERFACE_VERSION,
  0,
  IDAP_init,
  IDAP_term,
  IDAP_run,
  IDAP_comment,
```

```
  IDAP_help,
  IDAP_name,
  IDAP_hotkey
};
```
