R4ndom's Tutorial #20A: Working With Visual Basic Binaries, Pt. 1

by R4ndom on Sep.02, 2012, under Beginner, Reverse Engineering, Tutorials

Introduction

In this tutorial we will go over working with targets written in Visual Basic. Unfortunately, to become a well-rounded reverse engineer, we must know how to deal with these animals as there are many applications written in VB. Because this is a rather large subject, I will split it into two tutorials.

We will be looking at two crackmes, both included in the download of this tutorial. We will also be using VB Decompiler (the Lite version) which is included in the download.

As always, this tutorial, as well as all support files, can be downloaded on the tutorials page.

Introducing Visual Basic

Visual Basic is an event-driven language. This means that instead of a program running from beginning to end, VB reacts to events that happen in a window. This is similar to Windows programming in that events take place and call methods that are registered to handle those events, but VB differs in that most of the processing and message creation is performed in a DLL file. This file is the Visual Basic 'runtime'.

The process of creating an application is a little different than, say, C++. You generally create a window (or dialog box) by dragging elements from a toolbox onto your window canvas. It is similar to C# .NET in this regard (and Delphi). Once you have your window built, you then create methods that will handle any events that can come from a user interacting with your windows contents; if a user clicks a button, the method you have made that handles the button event is called. If a user types in an edit box, the edit box method is called. Because the only code you are providing is the event code, most of the window's processing is done for you. All of this processing is done in a DLL file called "msvbvm60.dll", though the '60′ may be different if using a different version of the runtime.

Another huge difference between Visual Basic and more traditional languages is a programmer has the option of compiling a VB application natively or in something called P-code. Native is simply assembly language, running natively on a processor, therefore OS and processor specific. P-code, on the other hand, is interpreted, much like Java and .NET, making it runnable on various operating systems. Interpreted means that, after compiling your VB application into P-code, when a user runs your application, something like a virtual machine is run, which interprets the P-code into native code for that specific operating system on-the-fly. When used, the p-code engine is a relatively simple machine that processes a series of "high-level" operation codes ("opcodes"). This engine is also stack-based, so very few arguments or functions are passed through registers.

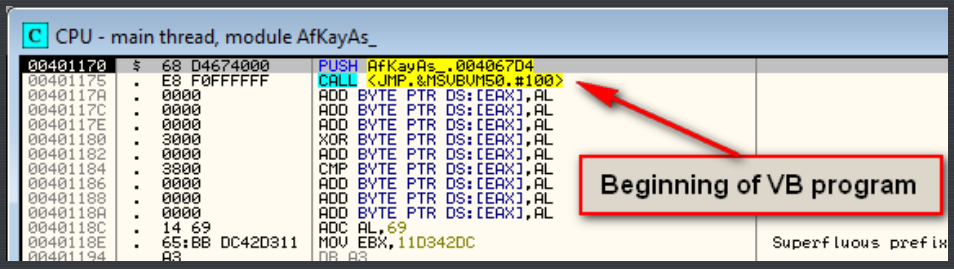
The benefit of this is that if you install the VB runtime on, say, a Mac, then the P-code compiled application will be interpreted and run on a Mac. Switching to a Linux environment simply means running the Linux virtual machine (by installing the runtime), and voila, your app will run in Linux. Of course the downside is you take a speed hit as the code must be converted to native code before running.

Because VB applications can be compiled into P-code, the traditional debugging tools are a lot harder to use. Combine this with the fact that most of the time is spent in a DLL we don't care about, and it can be quite challenging. The good news is that there are a couple tools out there that will help us. We will be going over these shortly.

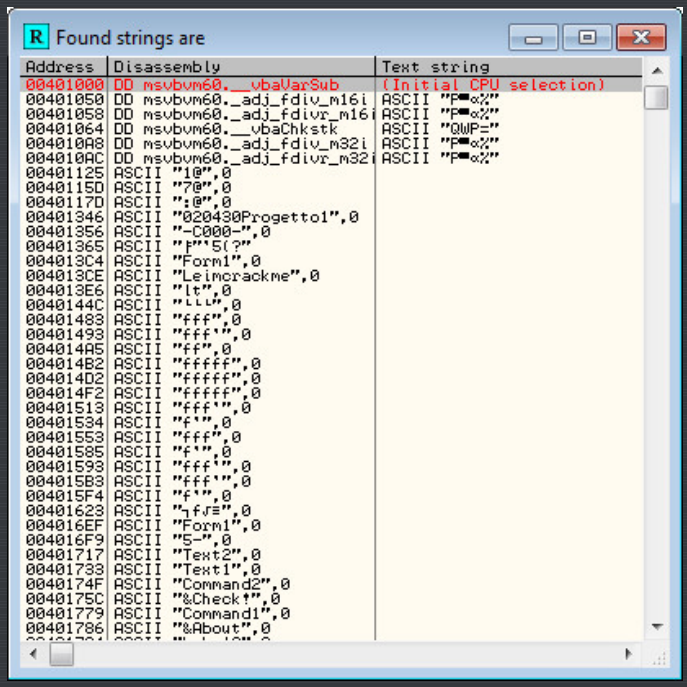
Investigating The Target in Olly

When you first load a Visual Basic program in a debugger such as Olly, you will see a call is immediately

performed into the VB DLL, where it will stay until an event happens. Because of this, VB programs are a little different to reverse engineer. The first thing you will notice is that the call stack is worthless; this is because most of the program's running time is within a DLL file, the VB runtime DLL. We don't care about this DLL, but we do care about the callback methods that handle events.

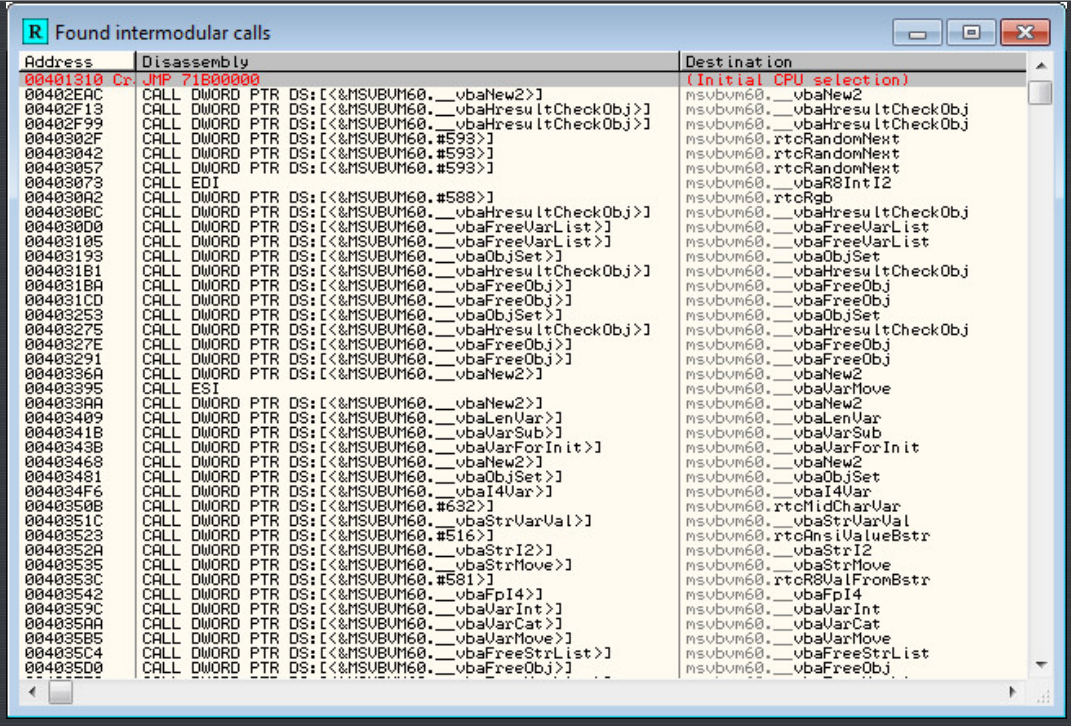


Another difference is in the way strings are handled. Because most of the message boxes, as well as all other window controls, are stored in resource sections, Olly won't display strings like a traditional C or C++ program. Therefore, using strings to find relevant sections of code is usually not an option:



****If you want to see the following data yourself in Olly, load CrackmeVB1.exe.****

Another hindrance to reversing is the fact that the method calls are completely different in a VB executable. Instead of calls to such things as RegisterWindowEx and MessageBoxA, VB uses its own API calls, embedded in the runtime DLL:



Clicking through to one of these methods details the difference between VB and what we are used to:

```
004031FE     90              NOP
004031FF     90              NOP
00403200  >  55              PUSH EBP
00403201  .  8BEC            MOV EBP,ESP
00403203  .  83EC 0C         SUB ESP,0C
00403206  .  68 A6114000     PUSH <JMP.&MSVBVM60.__vbaExceptHandler>          SE handler installation
0040320B  .  64:A1 00000000  MOV EAX,DWORD PTR FS:[0]
00403211  .  50              PUSH EAX                                         kernel32.BaseThreadInitThunk
00403212  .  64:8925 00000000 MOV DWORD PTR FS:[0],ESP
00403219  .  83EC 14         SUB ESP,14
0040321C  .  53              PUSH EBX
0040321D  .  56              PUSH ESI
0040321E  .  57              PUSH EDI
0040321F  .  8965 F4         MOV DWORD PTR SS:[EBP-C],ESP
00403222  .  C745 F8 30114000 MOV DWORD PTR SS:[EBP-8],Crackme_.00401130
00403229  .  8B75 08         MOV ESI,DWORD PTR SS:[EBP+8]
0040322C  .  8BC6            MOV EAX,ESI
0040322E  .  83E0 01         AND EAX,1
00403231  .  8945 FC         MOV DWORD PTR SS:[EBP-4],EAX                     kernel32.BaseThreadInitThunk
00403234  .  83E6 FE         AND ESI,FFFFFFFE
00403237  .  56              PUSH ESI
00403238  .  8975 08         MOV DWORD PTR SS:[EBP+8],ESI
0040323B  .  8B0E            MOV ECX,DWORD PTR DS:[ESI]
0040323D  .  FF51 04         CALL DWORD PTR DS:[ECX+4]
00403240  .  8B16            MOV EDX,DWORD PTR DS:[ESI]
00403242  .  33FF            XOR EDI,EDI
00403244  .  56              PUSH ESI
00403245  .  897D E8         MOV DWORD PTR SS:[EBP-18],EDI
00403248  .  FF92 FC020000   CALL DWORD PTR DS:[EDX+2FC]
0040324E  .  50              PUSH EAX                                         kernel32.BaseThreadInitThunk
0040324F  .  8D45 E8         LEA EAX,DWORD PTR SS:[EBP-18]
00403252  .  50              PUSH EAX                                         kernel32.BaseThreadInitThunk
00403253  .  FF15 4C104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaObjSet>]      msvbvm60.__vbaObjSet
00403259  .  8BF0            MOV ESI,EAX                                      kernel32.BaseThreadInitThunk
0040325B  .  68 FF000000     PUSH 0FF
00403260  .  56              PUSH ESI
00403261  .  8B0E            MOV ECX,DWORD PTR DS:[ESI]
00403263  .  FF51 6C         CALL DWORD PTR DS:[ECX+6C]
00403266  .  3BC7            CMP EAX,EDI
00403268  .  DBE2            FCLEX
0040326A  .v 7D 0F           JGE SHORT Crackme_.0040327B
0040326C  .  6A 6C           PUSH 6C
0040326E  .  68 48274000     PUSH Crackme_.00402748
00403273  .  56              PUSH ESI
00403274  .  50              PUSH EAX                                         kernel32.BaseThreadInitThunk
00403275  .  FF15 34104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaHresultCheckObj>] msvbvm60.__vbaHresultCheckObj
0040327B  >  8D4D E8         LEA ECX,DWORD PTR SS:[EBP-18]
0040327E  .  FF15 EC104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaFreeObj>]     msvbvm60.__vbaFreeObj
00403284  .  897D FC         MOV DWORD PTR SS:[EBP-4],EDI
00403287  .  68 99324000     PUSH Crackme_.00403299
0040328C  .v EB 0A           JMP SHORT Crackme_.00403298
0040328E  .  8D4D E8         LEA ECX,DWORD PTR SS:[EBP-18]
00403291  .  FF15 EC104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaFreeObj>]     msvbvm60.__vbaFreeObj
00403297  .  C3              RETN
00403298  >  C3              RETN                                             RET used as a jump to 00403299
00403299  >  8B45 08         MOV EAX,DWORD PTR SS:[EBP+8]
0040329C  .  50              PUSH EAX                                         kernel32.BaseThreadInitThunk
0040329D  .  8B10            MOV EDX,DWORD PTR DS:[EAX]
0040329F  .  FF52 08         CALL DWORD PTR DS:[EDX+8]
004032A2  .  8B45 FC         MOV EAX,DWORD PTR SS:[EBP-4]
004032A5  .  8B4D EC         MOV ECX,DWORD PTR SS:[EBP-14]
004032A8  .  5F              POP EDI                                          kernel32.751B339A
004032A9  .  5E              POP ESI                                          kernel32.751B339A
004032AA  .  64:890D 00000000 MOV DWORD PTR FS:[0],ECX
```

As you can see, there are no helpful strings, no recognizable API calls.

Before we look at the tools at our disposal, let's see what the basic file structure of a VB executable is. I have loaded CrackmeVB1.exe, which is compiled in P-code. Scrolling to the top of the code in the disassembly view, we see the list of functions in the binary:

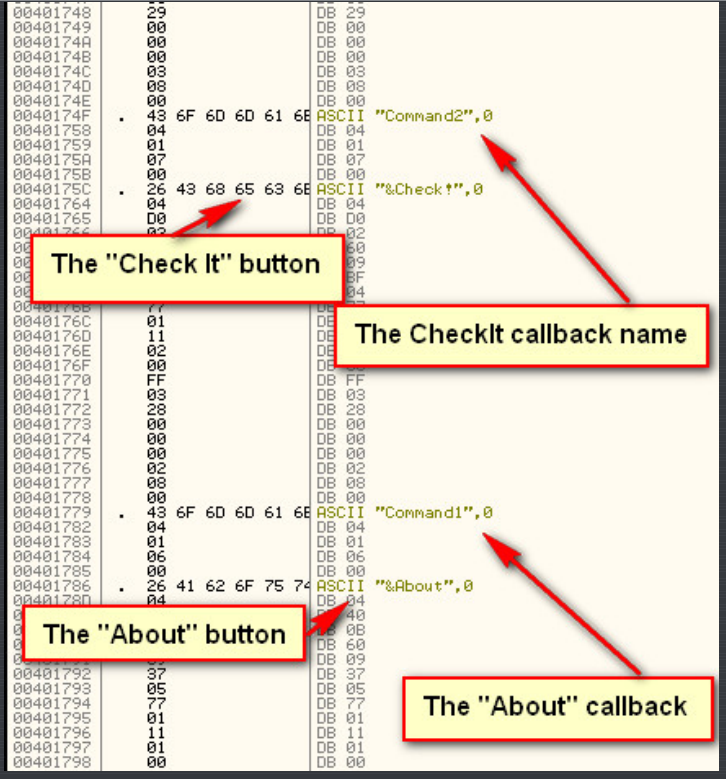
```
00401000  .  EA77A472          DD msvbvm60.__vbaVarSub
00401004  .  0705A272          DD msvbvm60.__vbaStrI2
00401008  .  8693A372          DD msvbvm60._CIcos
0040100C  .  F909A372          DD msvbvm60._adj_fptan
00401010  .  EE6AA472          DD msvbvm60.__vbaVarMove
00401014  .  3168A472          DD msvbvm60.__vbaFreeVar
00401018  .  9B6AA272          DD msvbvm60.__vbaLenBstr
0040101C  .  8DCCA172          DD msvbvm60.rtcRgb
00401020  .  6272A472          DD msvbvm60.__vbaFreeVarList
00401024  .  BA02A372          DD msvbvm60._adj_fdiv_m64
00401028  .  C39FA172          DD msvbvm60.__vbaFreeObjList
0040102C  .  B770A272          DD msvbvm60.rtcAnsiValueBstr
00401030  .  4109A372          DD msvbvm60._adj_fprem1
00401034  .  74A2A172          DD msvbvm60.__vbaHresultCheckObj
00401038  .  AB6AA272          DD msvbvm60.__vbaLenVar
0040103C  .  6E02A372          DD msvbvm60._adj_fdiv_m32
00401040  .  CC93A472          DD msvbvm60.__vbaVarForInit
00401044  .  05CDA172          DD msvbvm60.rtcRandomNext
00401048  .  32D1A172          DD msvbvm60.rtcMsgBox
0040104C  .  F19FA172          DD msvbvm60.__vbaObjSet
00401050  .  0603A372          DD msvbvm60._adj_fdiv_m16i
00401054  .  08A0A172          DD msvbvm60.__vbaObjSetAddref
00401058  .  0604A372          DD msvbvm60._adj_fdivr_m16i
0040105C  .  EE94A372          DD msvbvm60._CIsin
00401060  .  2F70A272          DD msvbvm60.rtcMidCharVar
00401064  .  EA62A372          DD msvbvm60.__vbaChkstk
00401068  .  749BA072          DD msvbvm60.EVENT_SINK_AddRef
0040106C  .  F697A472          DD msvbvm60.__vbaVarTstEq
00401070  .  F609A372          DD msvbvm60._adj_fpatan
00401074  .  879BA072          DD msvbvm60.EVENT_SINK_Release
00401078  .  9395A372          DD msvbvm60._CIsqrt
0040107C  .  859AA072          DD msvbvm60.EVENT_SINK_QueryInterface
00401080  .  6076A472          DD msvbvm60.__vbaVarMul
00401084  .  DF47A272          DD msvbvm60.__vbaExceptHandler
00401088  .  8906A372          DD msvbvm60._adj_fprem
0040108C  .  BA03A372          DD msvbvm60._adj_fdivr_m64
00401090  .  1375A472          DD msvbvm60.__vbaFPException
00401094  .  4819A272          DD msvbvm60.__vbaStrVarVal
00401098  .  7D69A272          DD msvbvm60.__vbaVarCat
0040109C  .  2B94A372          DD msvbvm60._CIlog
004010A0  .  37A2A172          DD msvbvm60.__vbaNew2
```

This is a reference for the runtime for the API calls that will be needed when the program is run.

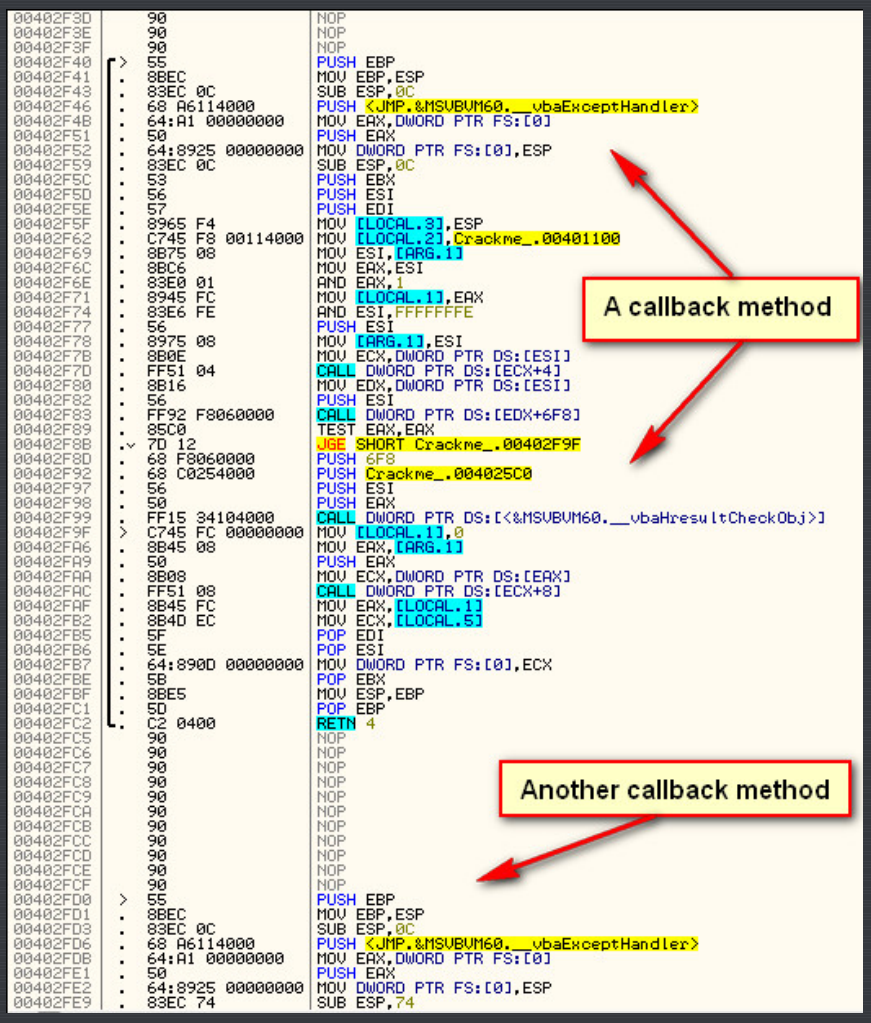
Scrolling down a little we come to the jump table. This is similar to the jump table seen in most windows binaries and is there to help with code relocation:

```
0040119C     DF3C4000          DD Crackme_.00403CDF
004011A0  .- FF25 64104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaChkstk>]          msvbvm60.__vbaChkstk
004011A6  $- FF25 84104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaExceptHandler>]   msvbvm60.__vbaExceptHandler; Struc
004011AC  >- FF25 90104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaFPException>]     msvbvm60.__vbaFPException
004011B2  .- FF25 50104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdiv_m16i>]       msvbvm60._adj_fdiv_m16i
004011B8  .- FF25 3C104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdiv_m32>]        msvbvm60._adj_fdiv_m32
004011BE  .- FF25 A8104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdiv_m32i>]       msvbvm60._adj_fdiv_m32i
004011C4  .- FF25 24104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdiv_m64>]        msvbvm60._adj_fdiv_m64
004011CA  .- FF25 B8104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdiv_r>]          msvbvm60._adj_fdiv_r
004011D0  .- FF25 58104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdivr_m16i>]      msvbvm60._adj_fdivr_m16i
004011D6  .- FF25 B4104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdivr_m32>]       msvbvm60._adj_fdivr_m32
004011DC  .- FF25 AC104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdivr_m32i>]      msvbvm60._adj_fdivr_m32i
004011E2  .- FF25 8C104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fdivr_m64>]       msvbvm60._adj_fdivr_m64
004011E8  .- FF25 70104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fpatan>]          msvbvm60._adj_fpatan
004011EE  .- FF25 88104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fprem>]           msvbvm60._adj_fprem
004011F4  .- FF25 30104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fprem1>]          msvbvm60._adj_fprem1
004011FA  .- FF25 0C104000     JMP DWORD PTR DS:[<&MSVBVM60._adj_fptan>]           msvbvm60._adj_fptan
00401200  .- FF25 D4104000     JMP DWORD PTR DS:[<&MSVBVM60._CIatan>]              msvbvm60._CIatan
00401206  .- FF25 08104000     JMP DWORD PTR DS:[<&MSVBVM60._CIcos>]               msvbvm60._CIcos
0040120C  .- FF25 E8104000     JMP DWORD PTR DS:[<&MSVBVM60._CIexp>]               msvbvm60._CIexp
00401212  .- FF25 9C104000     JMP DWORD PTR DS:[<&MSVBVM60._CIlog>]               msvbvm60._CIlog
00401218  .- FF25 5C104000     JMP DWORD PTR DS:[<&MSVBVM60._CIsin>]               msvbvm60._CIsin
0040121E  .- FF25 78104000     JMP DWORD PTR DS:[<&MSVBVM60._CIsqrt>]              msvbvm60._CIsqrt
00401224  .- FF25 E0104000     JMP DWORD PTR DS:[<&MSVBVM60._CItan>]               msvbvm60._CItan
0040122A  .- FF25 DC104000     JMP DWORD PTR DS:[<&MSVBVM60._allmul>]              msvbvm60._allmul
00401230  .- FF25 EC104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaFreeObj>]         msvbvm60.__vbaFreeObj
00401236  .- FF25 4C104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaObjSet>]          msvbvm60.__vbaObjSet
0040123C  .- FF25 20104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaFreeVarList>]     msvbvm60.__vbaFreeVarList
00401242  .- FF25 D0104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaR8IntI2>]         msvbvm60.__vbaR8IntI2
00401248  .- FF25 1C104000     JMP DWORD PTR DS:[<&MSVBVM60.#588>]                 msvbvm60.rtcRgb
0040124E  .- FF25 44104000     JMP DWORD PTR DS:[<&MSVBVM60.#593>]                 msvbvm60.rtcRandomNext
00401254  .- FF25 34104000     JMP DWORD PTR DS:[<&MSVBVM60.__vbaHresultCheckObj>] msvbvm60.__vbaHresultCheckObj
```

After this, we come to a vast sea of data. This is where the VB binary stores it's resources. Anything from strings, to buttons, to callbacks are stored in here. One thing to note is that Visual Basic uses the actual name of a callback; so if you want “MyButtonCallback” to handle the button event, that string will be used to reference it. Because of this, you will see the various callback names embedded in this resource section:



Scrolling down (much) further, we get to the actual event callbacks. These are the user generated callback methods to handle the various events. As you can see, there is no documentation as to which callback methods each is, though we will change this later with MAP files:



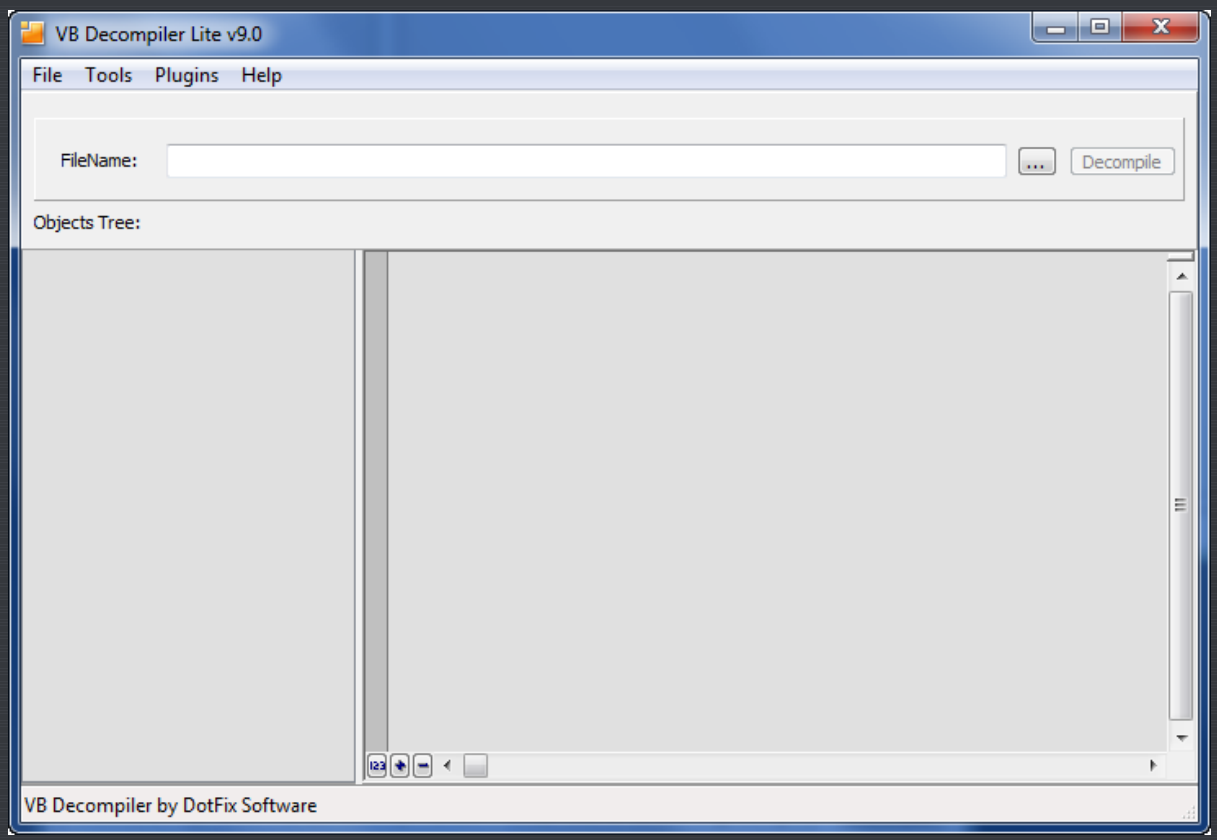
Lastly we come to the Import Address Table, or IAT. We will get *much* more familiar with this in the tutorials on unpacking:

```
00403D12     9E                DB 9E
00403D13     9E                DB 9E
00403D14  .  3C3D0000          DD 00003D3C      Struct 'IMAGE_IMPORT_DESCRIPTOR'
00403D18  .  FFFFFFFF          DD FFFFFFFF
00403D1C  .  FFFFFFFF          DD FFFFFFFF
00403D20  .  343E0000          DD 00003E34
00403D24  .  00100000          DD 00001000      Struct 'IMAGE_IMPORT_DESCRIPTOR'
00403D28  .  00000000          DD 00000000
00403D2C  .  00000000          DD 00000000
00403D30  .  00000000          DD 00000000
00403D34  .  00000000          DD 00000000
00403D38  .  00000000          DD 00000000
00403D3C  .  423E0000          DD 00003E42      Import lookup table for 'MSVBVM60.DLL'
00403D40  .  503E0000          DD 00003E50
00403D44  .  5E3E0000          DD 00003E5E
00403D48  .  683E0000          DD 00003E68
00403D4C  .  763E0000          DD 00003E76
00403D50  .  863E0000          DD 00003E86
00403D54  .  963E0000          DD 00003E96
00403D58  .  4C020080          DD 8000024C
00403D5C  .  A63E0000          DD 00003EA6
00403D60  .  BA3E0000          DD 00003EBA
00403D64  .  CA3E0000          DD 00003ECA
00403D68  .  04020080          DD 80000204
00403D6C  .  DE3E0000          DD 00003EDE
00403D70  .  EC3E0000          DD 00003EEC
00403D74  .  043F0000          DD 00003F04
00403D78  .  123F0000          DD 00003F12
00403D7C  .  223F0000          DD 00003F22
00403D80  .  51020080          DD 80000251
00403D84  .  53020080          DD 80000253
00403D88  .  343F0000          DD 00003F34
00403D8C  .  423F0000          DD 00003F42
00403D90  .  543F0000          DD 00003F54
00403D94  .  683F0000          DD 00003F68
00403D98     7A3E0000          DD 00003E7A
```

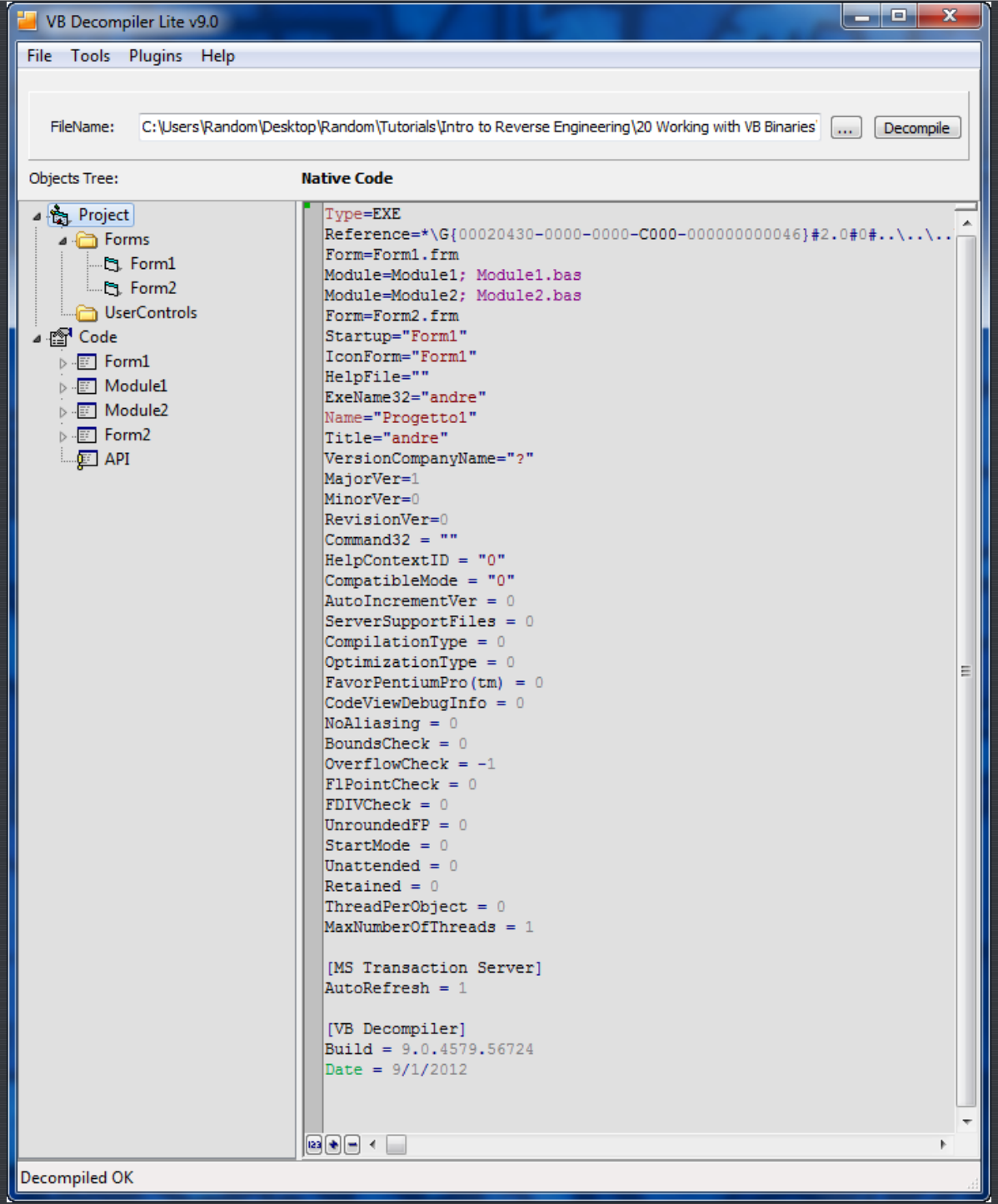
and that's pretty much it. Obviously, this isn't a heck of a lot of information to work with. Fortunately, we have a tool…

VB Decompiler Lite

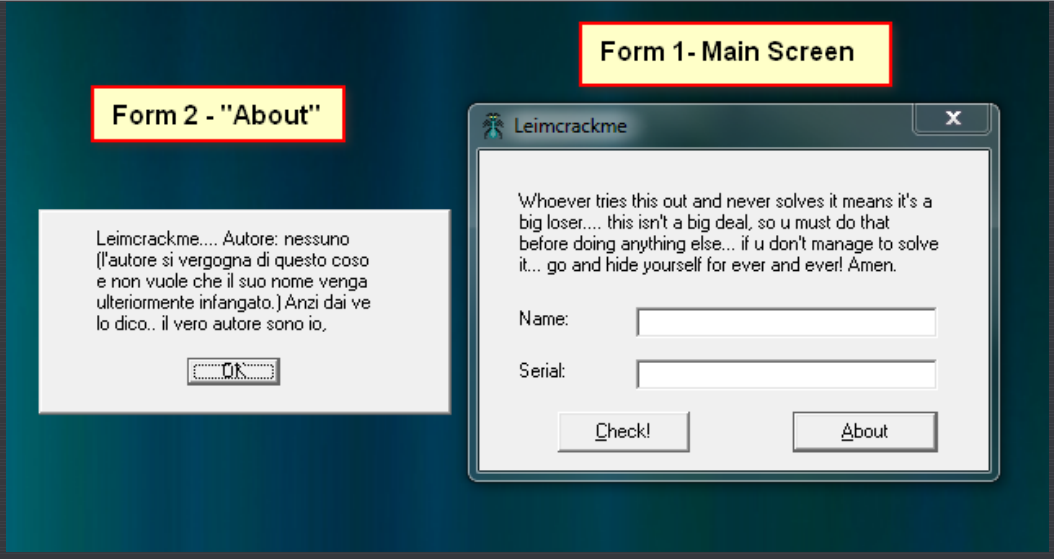
VB Decompiler is available in both a 'Lite' and 'Pro' version, the Lite version being free (and so, the one included with this tutorial). VB Decompiler allows us to decompile Visual Basic code, that has been converted into P-code, back into the original VB source code. Well, almost anyway . It also allows us to view the resources embedded in the executable in a much friendlier format. Running VB Decompiler Lite, we first see the main screen:



Opening our first crackme, "CrackmeVB1.exe" and selecting the 'Decompile' button, we see the main project:

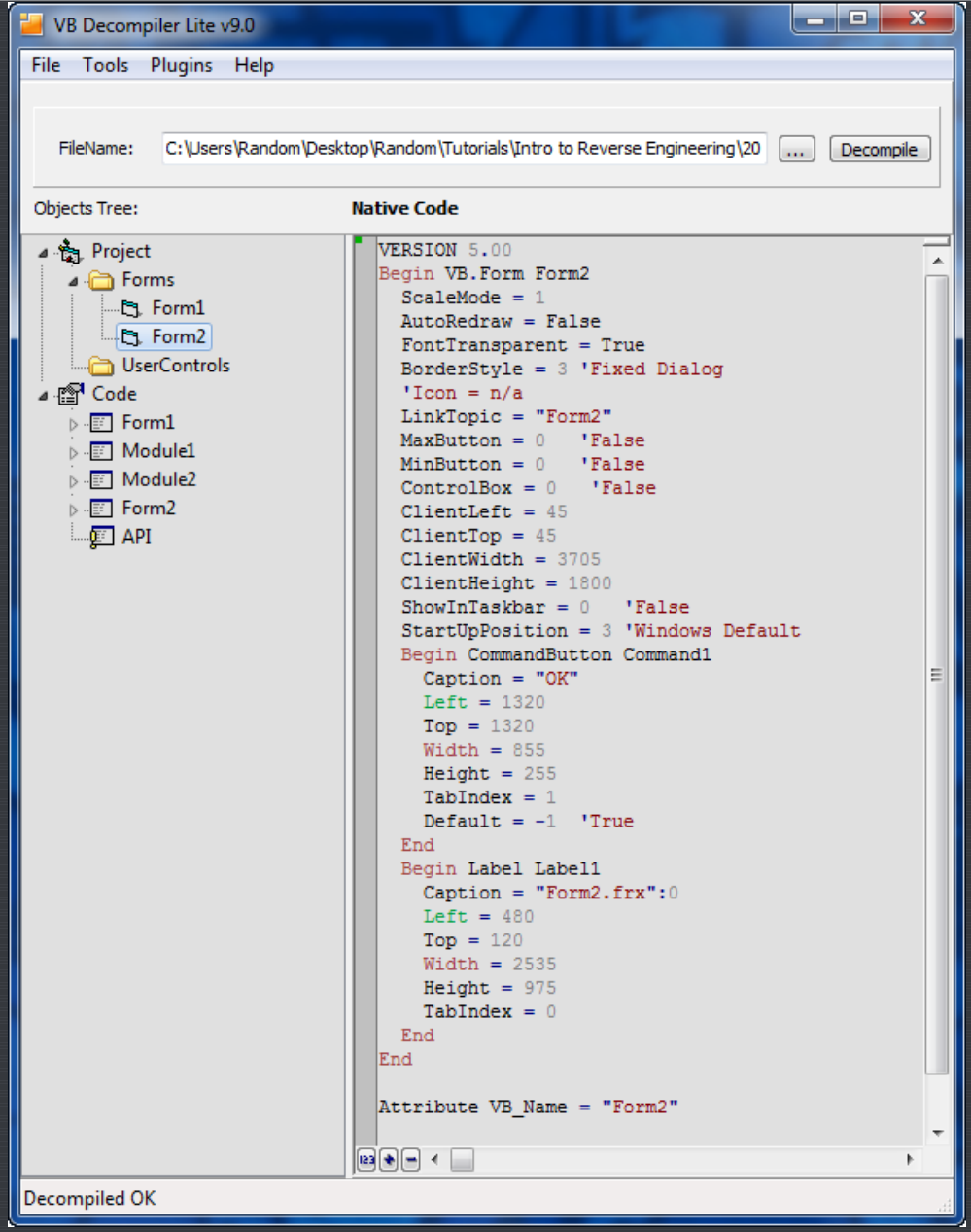


Most of this information is unimportant- mostly just file attributes etc. Notice, though, that in the project tree (under the 'Forms' folder) there are two forms, form1 and Form2. These are the resources associated with each form. Because there are two, we know that this application actually has two forms; One the main window and, in this case, one an about screen. Running that app confirms this:



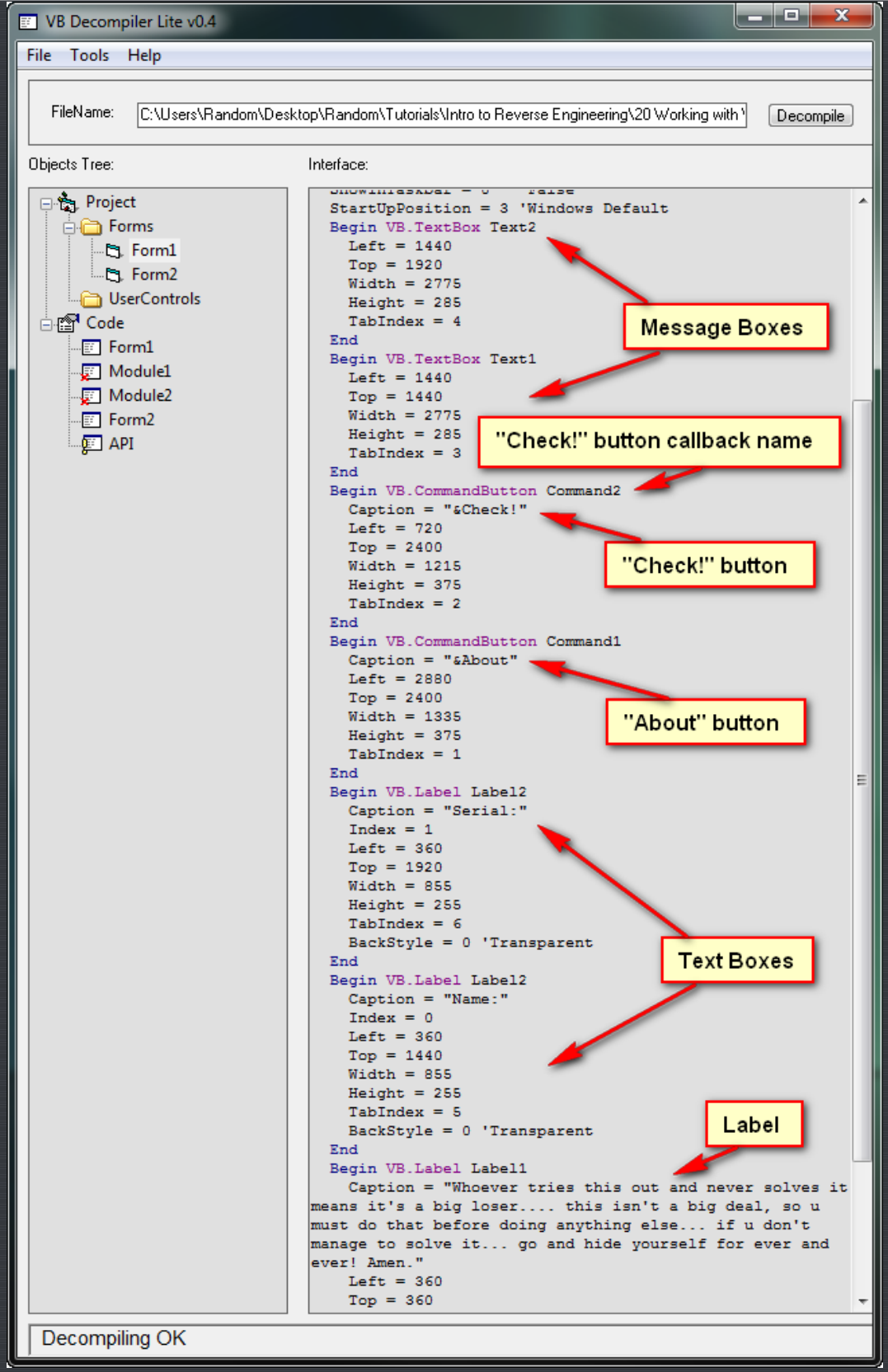
You will also notice two additional things when running this target; The about screen is in a different language, and you cannot click the “OK” button in the about screen. If any of you have followed my tutorials on modifying binaries, you will know that, of course, this is my favorite thing about this crackme 🙂 .

If you double click on “Form2″ in the “Forms” folder (in the project tree of VB Decompiler) we will see the various resources, along with attributes, for Form2:



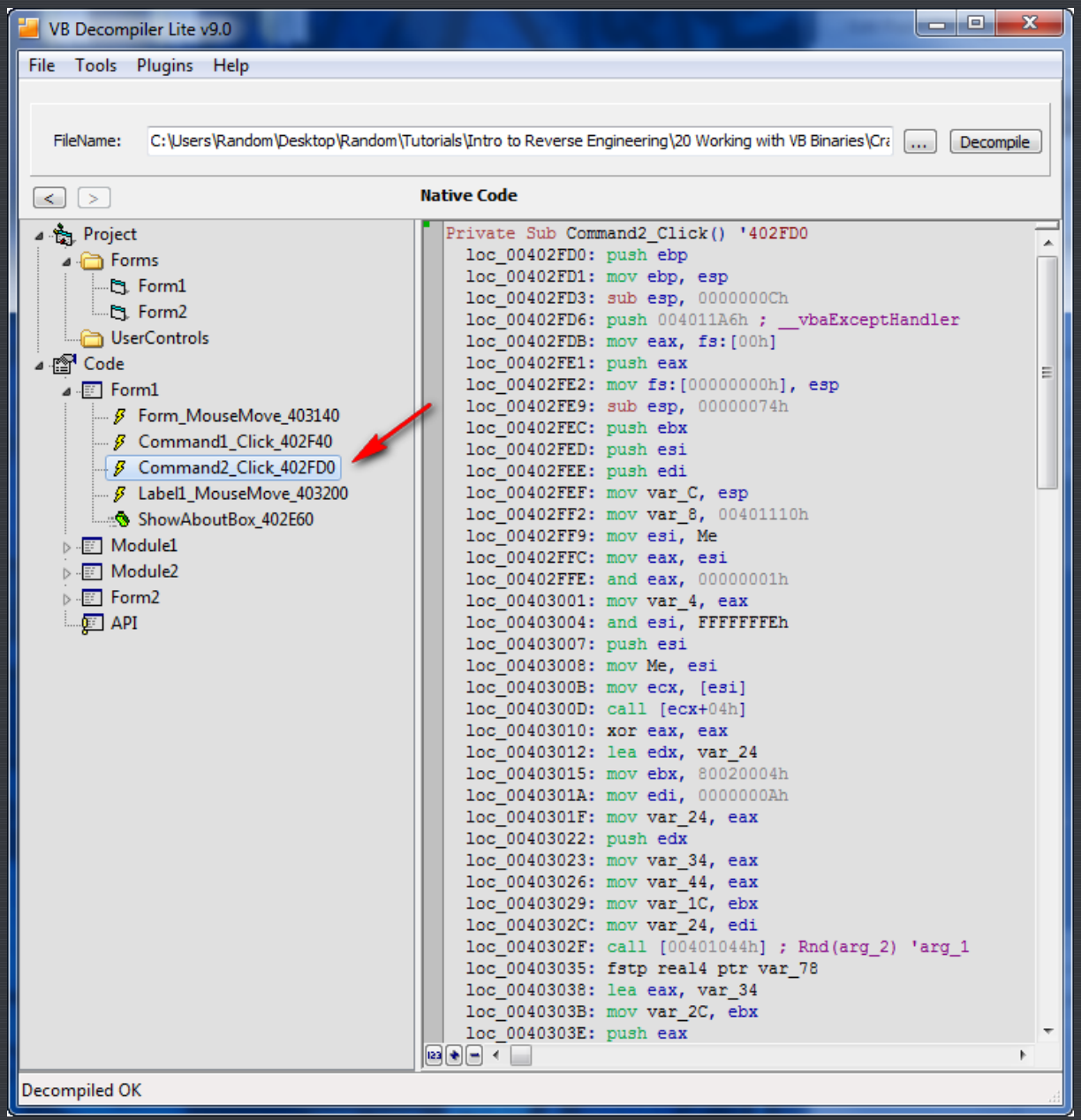
Here we can see that there is one button with the text “OK”, one label with the text in a different language, and one callback method for the “OK” button event called “Command1”.

Double clicking on Form1 brings up the main window's attributes:



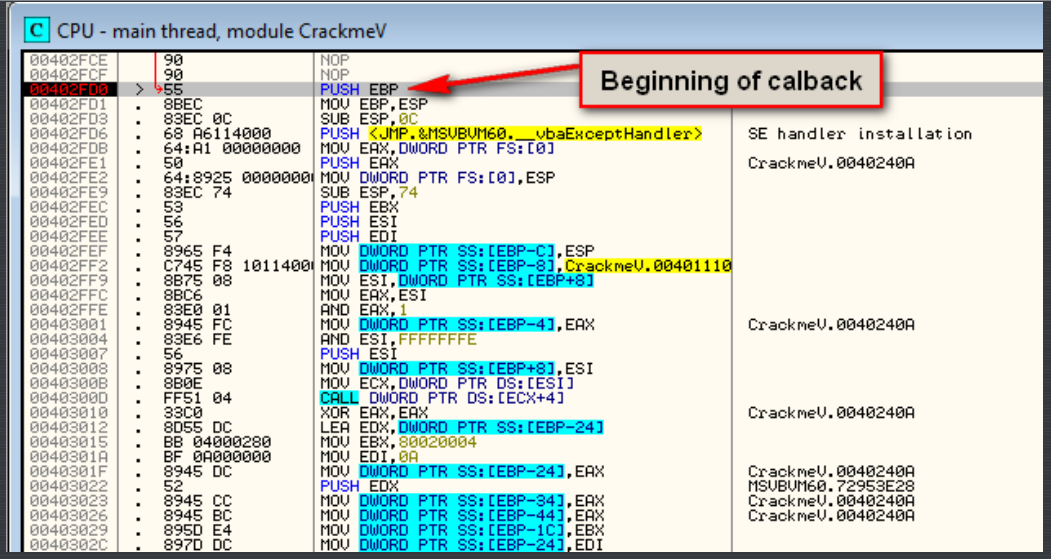
Now we know several important things about this crackme; the important button is called “Check!” and has a callback method with the name of “Command2”, and Form1 is the main form we want to concern ourselves with. If you look down the tree, under the “Code” node, you will see the code that corresponds with the various forms. Opening the ‘Form1’ tree, we see that there are five callbacks, one for the “Checkit” button (Command2_Click_402FD0) and others for other buttons and mouse movements. If you run the target, you will see that the mouse movements callback is to change the color of the text when you hover over it.

What we want is Command2, as that’s our callback:



Double clicking on this shows us the actual assembly code…

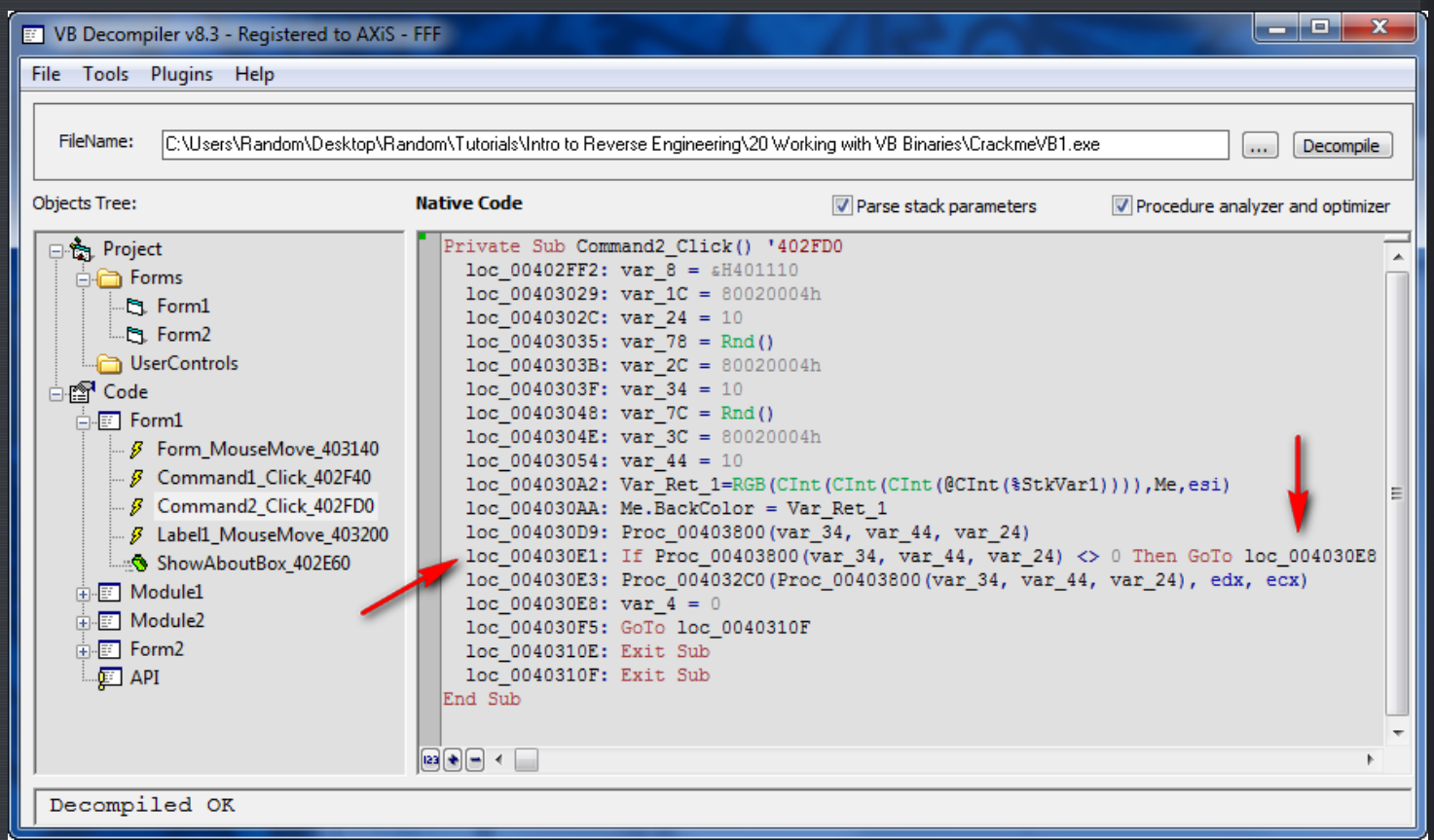
The important thing about this screen is the address of the callback. All we really wanted to use VB Decompiler for (in this case) is to find the address of the callback for the “Checkit” button, which we can see is 402FD0. Going to this address in Olly (with the target loaded) shows us the beginning of the callback function:



If you set a BP here, run the target, and enter a username and serial, you will see that, after clicking the "Checkit" button, Olly pauses at our callback. We have now found our main registration callback code!!!

VB Decompiler Pro

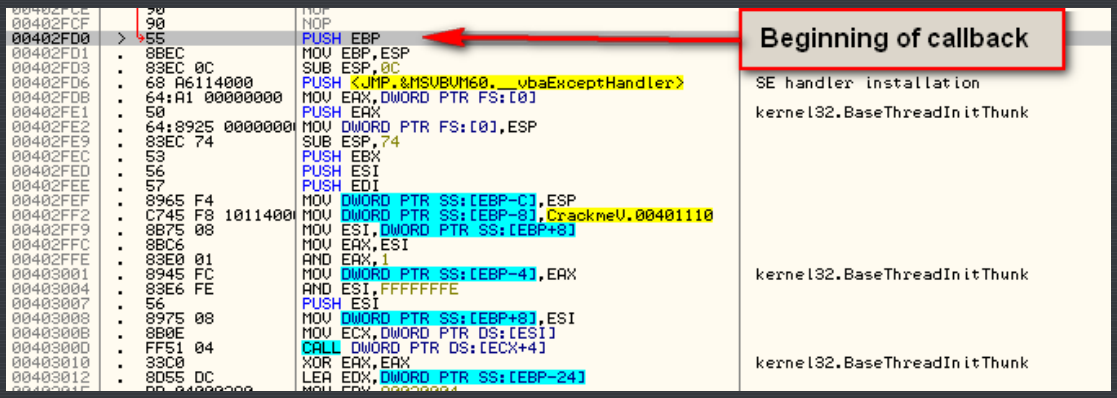
I wanted to show what the actual P-code looks like, and for that we need VB Decompiler Pro. Unfortunately, this application requires that you buy it (... 🙂 ...) to use this function. Looking at the same code in VB Decompiler Pro looks like this:



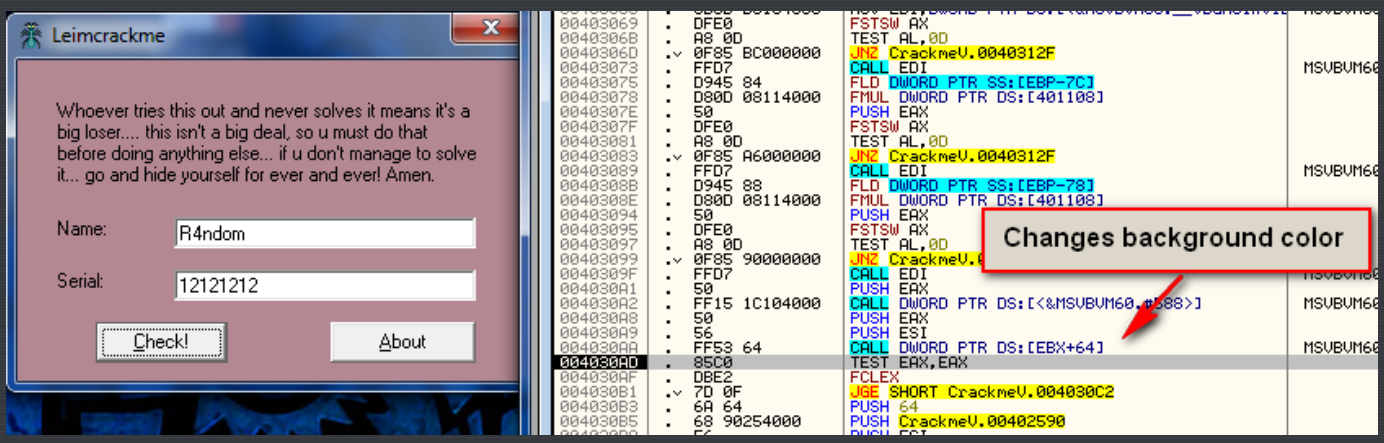
Here, we can see the actual P-code method for the callback. First, several variables are set up. The background is changed at 4030A2, a procedure is called at 4030D9 (and it looks pretty interesting), and then what is probably our magic compare/jump is performed at address 4030E1. We can see that if the results of calling the procedure at 403800 are true, we will then jump to 4030E8. If not, we will fall through and perform the instructions beginning at address 4030E2. Taking a little time, we could actually find the patch this way, though I personally like going back to Olly to do it, as it doesn't hurt my brain so much.

Patching the App

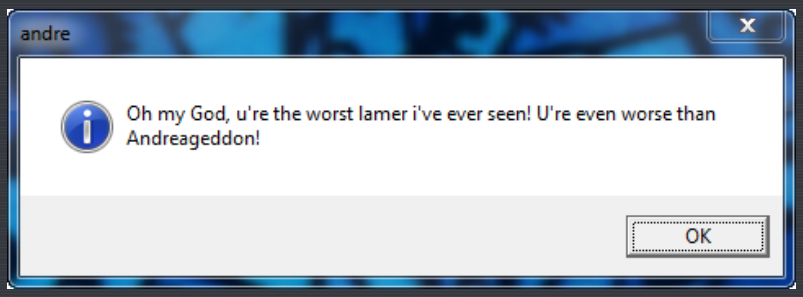
Going to address 402FD0, the beginning of the callback, we can see the actual code:



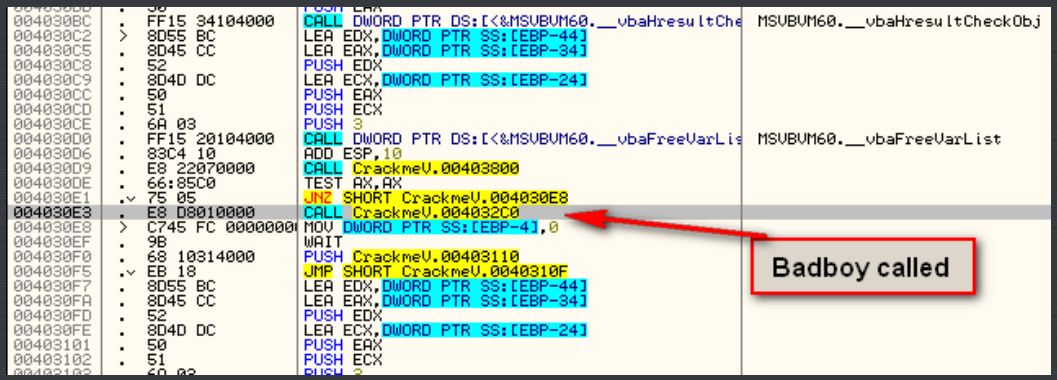
Setting a BP here and restarting the target, then stepping down some, we see at address 4030AA the background of the window changes color, just as we suspected from the P-code:



At address 4030E3, we see the badboy message pop up:

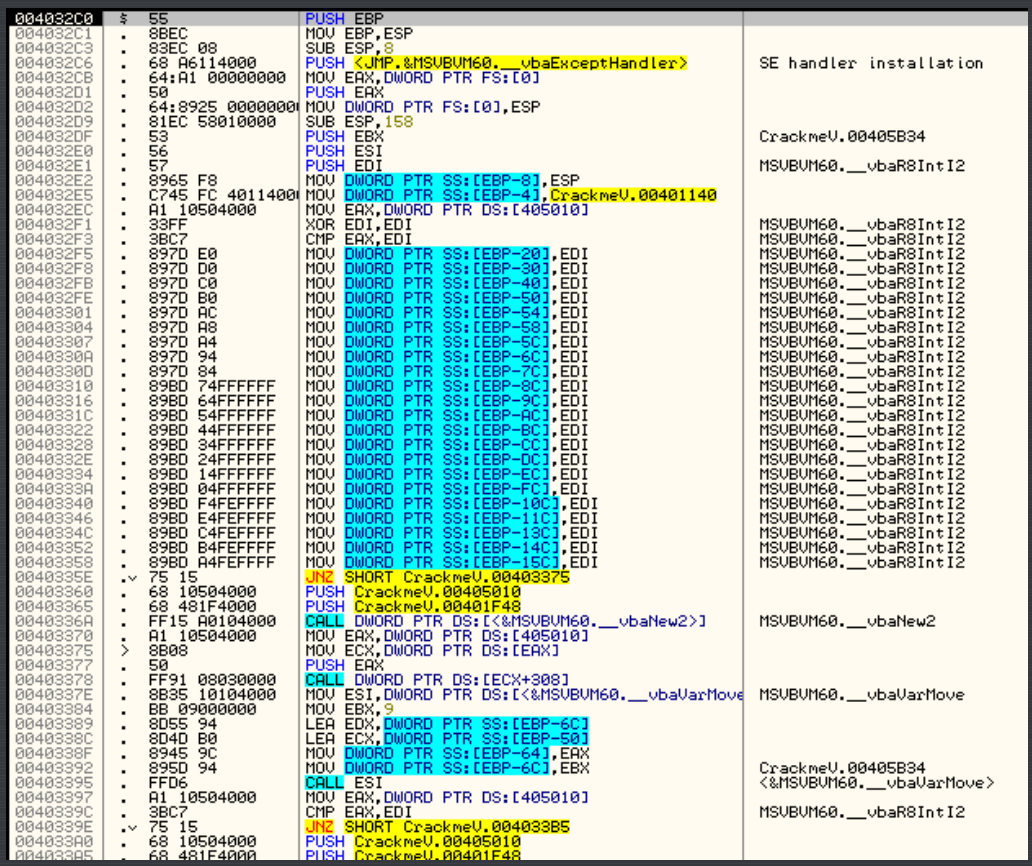


Looking at that area of code, we can see that right before it is a compare/jump combo:

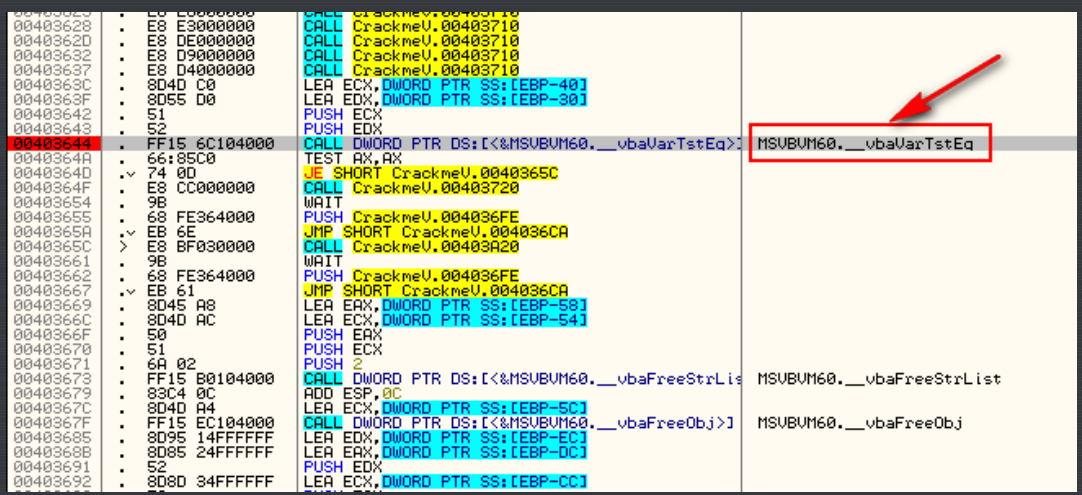


Let's set a BP at address 4030E1, restart the target, and see if that's the check. When Olly pauses,

changing the zero flag forces the jump at address 4030E1. Unfortunately, this doesn't display anything. This means we want to take a closer look at the call to address 4032C0 at address 4030E3. Placing a BP here, restarting the target, and stepping in, we see the main decryption routine:



As we will see shortly, there are some very standard method calls in VB that should be memorized. Scrolling down the code, we see one of these at address 403644:



vbaVarTstEq is like StrCmp in native code- it checks two entities to see if they match. Highlighting the call down three lines at address 40364F and clicking "Enter", Olly follows the call and we see we're on the right track:

```
0040371F    90              NOP
00403720  $ 55              PUSH EBP
00403721  . 8BEC            MOV EBP,ESP
00403723  . 83EC 08         SUB ESP,8
00403726  . 68 A6114000     PUSH <JMP.&MSVBVM60.__vbaExceptHandler>     SE handler installation
0040372B  . 64:A1 00000000  MOV EAX,DWORD PTR FS:[0]
00403731  . 50              PUSH EAX
00403732  . 64:8925 0000000 MOV DWORD PTR FS:[0],ESP
00403739  . 81EC 84000000   SUB ESP,84
0040373F  . 53              PUSH EBX                                    MSVBVM60.__vbaVarAdd
00403740  . 56              PUSH ESI
00403741  . 57              PUSH EDI                                    MSVBVM60.__vbaVarMul
00403742  . 8965 F8         MOV DWORD PTR SS:[EBP-8],ESP
00403745  . C745 FC 5011400 MOV DWORD PTR SS:[EBP-4],CrackmeV.00401150
0040374C  . B9 04000280     MOV ECX,80020004
00403751  . B8 0A000000     MOV EAX,0A
00403756  . 894D B8         MOV DWORD PTR SS:[EBP-48],ECX
00403759  . 894D C8         MOV DWORD PTR SS:[EBP-38],ECX
0040375C  . 894D D8         MOV DWORD PTR SS:[EBP-28],ECX
0040375F  . 8D55 A0         LEA EDX,DWORD PTR SS:[EBP-60]
00403762  . 8D4D E0         LEA ECX,DWORD PTR SS:[EBP-20]
00403765  . C745 E0 0000000 MOV DWORD PTR SS:[EBP-20],0
0040376C  . 8945 B0         MOV DWORD PTR SS:[EBP-50],EAX
0040376F  . 8945 C0         MOV DWORD PTR SS:[EBP-40],EAX
00403772  . 8945 D0         MOV DWORD PTR SS:[EBP-30],EAX
00403775  . C745 A8 D028400 MOV DWORD PTR SS:[EBP-58],CrackmeV.004028D0 UNICODE "You did it. I won't congratulate with you, i
0040377C  . C745 A0 0800000 MOV DWORD PTR SS:[EBP-60],8
00403783  . FF15 C8104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaVarDup>] MSVBVM60.__vbaVarDup
00403789  . 8D45 B0         LEA EAX,DWORD PTR SS:[EBP-50]
0040378C  . 8D4D C0         LEA ECX,DWORD PTR SS:[EBP-40]
0040378F  . 50              PUSH EAX
```

So we know we must make the code execute to address 403644. Looking above this at the various jumps, we find the following JE at address 40344F:

```
00403435  . 50              PUSH EAX
00403436  . 8D55 E0         LEA EDX,DWORD PTR SS:[EBP-20]
00403439  . 51              PUSH ECX
0040343A  . 52              PUSH EDX
0040343B  . FF15 40104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaVarForInit MSVBVM60.__vbaVarForInit
00403441  . 8B3D 80104000   MOV EDI,DWORD PTR DS:[<&MSVBVM60.__vbaVarMul> MSVBVM60.__vbaVarMul
00403447  . 8B1D C4104000   MOV EBX,DWORD PTR DS:[<&MSVBVM60.__vbaVarAdd> MSVBVM60.__vbaVarAdd
0040344D  > 85C0            TEST EAX,EAX
0040344F  .v 0F84 C9010000  JE CrackmeV.0040361E
00403455  . A1 10504000     MOV EAX,DWORD PTR DS:[405010]
0040345A  . 85C0            TEST EAX,EAX
0040345C  .v 75 15          JNZ SHORT CrackmeV.00403473
0040345E  . 68 10504000     PUSH CrackmeV.00405010
00403463  . 68 481F4000     PUSH CrackmeV.00401F48
00403468  . FF15 A0104000   CALL DWORD PTR DS:[<&MSVBVM60.__vbaNew2>] MSVBVM60.__vbaNew2
```

Jumps to goodboy

which jumps to the area of code we want:

```
00403601  . 8D8D A4FEFFFF  LEA ECX,DWORD PTR SS:[EBP-15C]
00403607  . 8D95 B4FEFFFF  LEA EDX,DWORD PTR SS:[EBP-14C]
0040360D  . 8D45 E0        LEA EAX,DWORD PTR SS:[EBP-20]
00403610  . 51             PUSH ECX
00403611  . 52             PUSH EDX
00403612  . 50             PUSH EAX
00403613  . FF15 E4104000  CALL DWORD PTR DS:[<&MSVBVM60.__vbaVarForNext MSVBVM60.__vbaVarForNext
00403619  .^ E9 2FFEFFFF   JMP CrackmeV.0040344D
0040361E  > E8 ED000000    CALL CrackmeV.00403710
00403623  . E8 E8000000    CALL CrackmeV.00403710
00403628  . E8 E3000000    CALL CrackmeV.00403710
0040362D  . E8 DE000000    CALL CrackmeV.00403710
00403632  . E8 D9000000    CALL CrackmeV.00403710
00403637  . E8 D4000000    CALL CrackmeV.00403710
0040363C  . 8D4D C0        LEA ECX,DWORD PTR SS:[EBP-40]
0040363F  . 8D55 D0        LEA EDX,DWORD PTR SS:[EBP-30]
00403642  . 51             PUSH ECX
00403643  . 52             PUSH EDX
00403644  . FF15 6C104000  CALL DWORD PTR DS:[<&MSVBVM60.__vbaVarTstEq>] MSVBVM60.__vbaVarTstEq
0040364A  . 66:85C0        TEST AX,AX
0040364D  .v 74 0D         JE SHORT CrackmeV.0040365C
0040364F  . E8 CC000000    CALL CrackmeV.00403720
00403654  . 9B             WAIT
00403655  . 68 FE364000    PUSH CrackmeV.004036FE
0040365A  .v EB 6E         JMP SHORT CrackmeV.004036CA
0040365C  > E8 BF030000    CALL CrackmeV.00403A20
```

Jumps to here

Test our serial

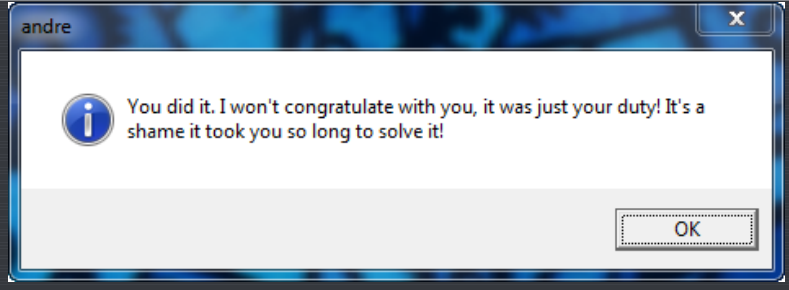
Shows goodboy

So let's place a BP at address 40344F, run the target, and change the zero flag to force the jump:

```
00403611  . 52             PUSH EDX
00403612  . 50             PUSH EAX
00403613  . FF15 E4104000  CALL DWORD PTR DS:[<&MSVBVM60.__vbaVarForNext MSVBVM60.__vbaVarForNext
00403619  .^ E9 2FFEFFFF   JMP CrackmeV.0040344D
0040361E  > E8 ED000000    CALL CrackmeV.00403710
00403623  . E8 E8000000    CALL CrackmeV.00403710
00403628  . E8 E3000000    CALL CrackmeV.00403710
0040362D  . E8 DE000000    CALL CrackmeV.00403710
00403632  . E8 D9000000    CALL CrackmeV.00403710
00403637  . E8 D4000000    CALL CrackmeV.00403710
0040363C  . 8D4D C0        LEA ECX,DWORD PTR SS:[EBP-40]
0040363F  . 8D55 D0        LEA EDX,DWORD PTR SS:[EBP-30]
00403642  . 51             PUSH ECX
00403643  . 52             PUSH EDX
00403644  . FF15 6C104000  CALL DWORD PTR DS:[<&MSVBVM60.__vbaVarTstEq>] MSVBVM60.__vbaVarTstEq
0040364A  . 66:85C0        TEST AX,AX
0040364D  .v 74 0D         JE SHORT CrackmeV.0040365C
0040364F  . E8 CC000000    CALL CrackmeV.00403720
00403654  . 9B             WAIT
00403655  . 68 FE364000    PUSH CrackmeV.004036FE
```

We land here after forcing the jump

Now, stepping down to the JE instruction at 40364D, we obviously want to stop this from jumping over our call to the goodboy. Changing the zero flag when we land here, we see that we have in fact cracked the target:



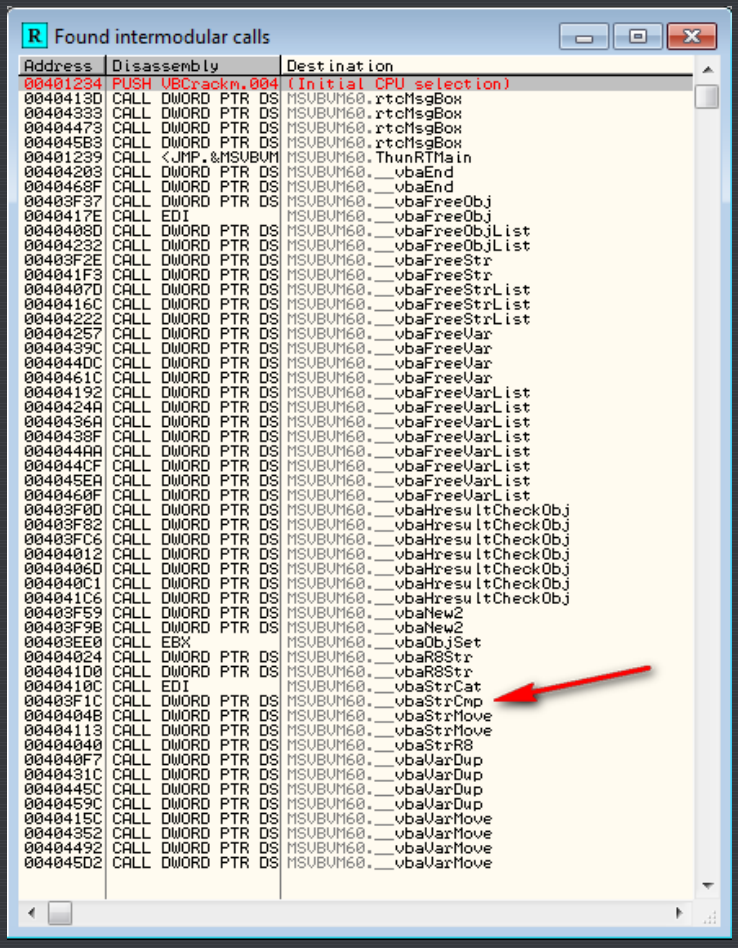
Frequently Called Methods

As stated earlier, there are some methods that are called a lot when looking at protection schemes:

_vbaVarTstEq
_vbaVarTstNe
_vbaVarCmpEq
_vbaStrCmp
_vbaStrComp
_vbaStrCompVar

9 out of 10 times, one of these routines will be used to compare a serial with the correct one. One of these, _vbaVarTstEq, was used in the previous crackme.

Go ahead and load CrackmeVB2.exe into Olly. Performing a search of intermodular calls, we see one of our suspicious calls:



Here we see the call to _vbaStrCmp. Looking up the String.Compare method call in the Visual Basic API, we see that it takes two strings as arguments and returns an int. The return value is either -1, 0 (for equals) and 1, depending on if the first is greater than or less than the second, or zero if they are equal. This is what the call looks like in VB:

```
'Declaration
Public Shared Function Compare ( _
        strA As String, _
        strB As String _
) As Integer
'Usage
Dim strA As String
Dim strB As String
Dim returnValue As Integer

returnValue = String.Compare(strA, strB)
```

Double clicking this call in Olly, we jump to where this call is performed.

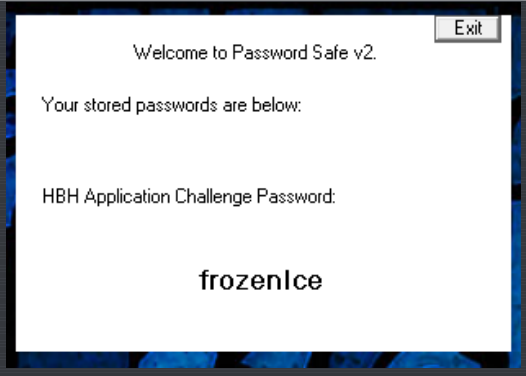
```
00403EF9  .v 7D 18        JGE SHORT VBCrackm.00403F13
00403EFB  .  8B8D 48FFFFFF MOV ECX,DWORD PTR SS:[EBP-B8]
00403F01  .  68 A0000000   PUSH 0A0
00403F06  .  68 F8374000   PUSH VBCrackm.004037F8
00403F0B  .  51            PUSH ECX
00403F0C  .  50            PUSH EAX                                kernel32.BaseThreadInitThunk
00403F0D  .  FF15 28104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaHresultChe MSVBVM60.__vbaHresultCheckObj
00403F13  >  8B55 D8       MOV EDX,DWORD PTR SS:[EBP-28]
00403F16  .  52            PUSH EDX                                VBCrackm.<ModuleEntryPoint>
00403F17  .  68 0C384000   PUSH VBCrackm.0040380C                  UNICODE "g7*2+'&1,3"
00403F1C  .  FF15 4C104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaStrCmp>] MSVBVM60.__vbaStrCmp
00403F22  .  8BF8          MOV EDI,EAX                             kernel32.BaseThreadInitThunk
00403F24  .  8D4D D8       LEA ECX,DWORD PTR SS:[EBP-28]
00403F27  .  F7DF          NEG EDI
00403F29  .  1BFF          SBB EDI,EDI
00403F2B  .  47            INC EDI
00403F2C  .  F7DF          NEG EDI
00403F2E  .  FF15 B0104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaFreeStr>] MSVBVM60.__vbaFreeStr
00403F34  .  8D4D D0       LEA ECX,DWORD PTR SS:[EBP-30]
00403F37  .  FF15 B4104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaFreeObj>] MSVBVM60.__vbaFreeObj
```

Let's set a BP on this line and run the target:

Entering a password (I entered '12121212') and clicking OK, Olly breaks right where we want him to:

```
00403F06  .  68 F8374000   PUSH VBCrackm.004037F8
00403F0B  .  51            PUSH ECX                                ntdll.77866500
00403F0C  .  50            PUSH EAX
00403F0D  .  FF15 28104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaHresultChe MSVBVM60.__vbaHresultCheckO
00403F13  >  8B55 D8       MOV EDX,DWORD PTR SS:[EBP-28]
00403F16  .  52            PUSH EDX
00403F17  .  68 0C384000   PUSH VBCrackm.0040380C                  UNICODE "g7*2+'&1,3"
00403F1C  .  FF15 4C104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaStrCmp>] MSVBVM60.__vbaStrCmp
00403F22  .  8BF8          MOV EDI,EAX
00403F24  .  8D4D D8       LEA ECX,DWORD PTR SS:[EBP-28]
00403F27  .  F7DF          NEG EDI
00403F29  .  1BFF          SBB EDI,EDI
00403F2B  .  47            INC EDI
00403F2C  .  F7DF          NEG EDI
00403F2E  .  FF15 B0104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaFreeStr>] MSVBVM60.__vbaFreeStr
00403F34  .  8D4D D0       LEA ECX,DWORD PTR SS:[EBP-30]
00403F37  .  FF15 B4104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaFreeObj>] MSVBVM60.__vbaFreeObj
00403F3D  .  66:85FF       TEST DI,DI
00403F40  .v 0F84 8B000000 JE VBCrackm.00403FD1
00403F46  .  A1 24504000   MOV EAX,DWORD PTR DS:[405024]
00403F4B  .  85C0          TEST EAX,EAX
00403F4D  .v 75 10         JNZ SHORT VBCrackm.00403F5F
00403F4F  .  68 24504000   PUSH VBCrackm.00405024
00403F54  .  68 A82C4000   PUSH VBCrackm.00402CA8
00403F59  .  FF15 78104000 CALL DWORD PTR DS:[<&MSVBVM60.__vbaNew2>] MSVBVM60.__vbaNew2
00403F5F  >  8B35 24504000 MOV ESI,DWORD PTR DS:[405024]
00403F65  .  6A FF         PUSH -1
00403F67  .  56            PUSH ESI
00403F68  .  8B06          MOV EAX,DWORD PTR DS:[ESI]              VBCrackm.00405A64
00403F6A  .  FF90 BC010000 CALL DWORD PTR DS:[EAX+1BC]
```

Looking down a little bit at address 403f40, we see our wonderful compare/jump instruction. Stepping down to there and changing the zero flag, then running the target, we see that this was our simplest crack yet 😀 :



There is a lot to take in here, but the most important thing is to mess around some on your own and discover how this stuff works on your own. I have included a crackme that we will be going over in the next tutorial (crackmeVB3.exe), so that you may try your hand at it. Following the same steps in this tutorial will solve this crackme as well.

In the next tutorial we will go over Smartcheck and the Point-H method, as well as creating MAP files.

-Till next time

R4ndom