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Web-browsing history

Computer Forensics

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Agenda

- The elements of web-browsing history and intentionality
- HTTP – Hypertext Transfer Protocol
  - → Cookies
- Internet Explorer
  - → File locations
  - → The index.dat file format
  - → Example
- Date/Time formats
- Firefox
  - → File locations
  - → Cookies, history, cache
- Webmail reconstruction example

The elements of web-browsing history

- History
  - → The list of URLs visited (at which time, …)
  - → Provides general information on time and location of activity
    - » URL's may also contain information: GET requests
      - – Example: Google searches
- Cookies
  - → Which websites were visited when + additional information
  - → May allow determining whether the user was logged in
  - → Can survive much longer than the history
    - » Depends on the expiry date of the Cookie and the configuration
- Cache
  - → The content of the pages visited
    - » Incomplete: E.g. ad's will rarely be cached
    - » See e.g. HTML headers to prevent caching
  - → Provides the full content of what was seen, e.g. Webmail

Web-browsing history: Intentionality

- Did the user visit the webpage intentionally?
  - → In general: If it's in the cache/history/cookie file: Yes
  - → See also: Bookmarks!
- BUT:
  - → What about pop-ups?
    - » E.g.: Pornography advertisements!
  - → Password protected pages?
    - » But images/JavaScript can easily supply passwords as well when opening a file!
- Investigation of other files, trying it out, content inspection … needed to verify, whether a page that was visited was actually intended to be visited
  - → Usually this should not be a problem:
    - » Logging in to the mail
    - » Visiting a website after entering log-ins
    - » Downloading files

Web browsing procedure

1. User enters the URL
2. Browser determines the IP address for the host part
3. Browser connect to the IP address (+port if specified)
4. Sends request
   - → With additional information, e.g. what compression is allowed
   - → May contain cookie(s)
5. Retrieves response
   - → Headers and actual content
     - » Header may contain cookie
   - → Saved to memory (and perhaps the disk in the cache file)
     - » Depends on headers, settings, …
6. Connection is closed
   - → Note: HTTP 1.1 may keep the connection open for further requests (incl. pipelining). This e.g. is especially useful for images from the same site!

The HTTP protocol

- Basis of HTTP is a reliable stream protocol (usually TCP)
- The HTTP state diagram is very simple
    - » With some exceptions, e.g. authorization
  - → There is only a single request
  - → There is only a single response
- HTTP request methods:
  - → GET: Retrieve some content
    - » Should never change the state on the server!
      - – Especially important if caching takes place somewhere
    - » Parameters (optional) are encoded in the URL
  - → POST: Send data for processing and retrieve result
    - » To be used for requests changing the server state!
    - » Parameters are sent in the request body
  - → HEAD, PUT, DELETE, TRACE, OPTIONS, CONNECT
    - » Of less importance

The HTTP protocol

- The response always includes a status code
  - → 1xx Informational
  - → 2xx Success
  - → 3xx Redirection (request should be sent again differently)
  - → 4xx Client side error (e.g. incorrect request, not existing)
  - → 5xx Server side error (should not be retried)
- Caching of HTTP: Commonly performed through proxies
  - → Must either be validated with the source
  - → Or it is "fresh enough" according to client, server, and cache
  - → Note: Browsers often ignore this
    - » E.g. IE can be configured to never check for a newer version even if the cached page is already expired!
    - » This has no influence on what proxies do!

The HTTP protocol

- Local (=browser) caches
  - → If a page is expired, it is not necessarily deleted from the local cache → It might remain there for much longer
  - → Can store even pages marked as "no-cache" and "no-store"
    - » "no-cache": Should not be cached for future requests
      - – But might still be written to disk (e.g. Mozilla)
    - » "no-store": Should only be held in memory
      - – Users are still allowed to use "Save As"!
  - → This cache can be very large and contain very old files
    - » Very important for computer forensics!
    - » Manual deletion or cleaner programs are simple and effective
      - – But must be used every time after surfing
      - – Attention: Many such programs just delete the files, only the more serious ones overwrite them securely!
      - – Also, fragments of files might remain in unused areas, so all free sectors and slack spaces would have to be cleaned every time!
      - – See also swap file/partition

The HTTP protocol example:

http://elearning.fim.uni-linz.ac.at/cms/elearn_ebiz.phtml

```
GET /cms/elearn_ebiz.phtml HTTP/1.1
Host: elearning.fim.uni-linz.ac.at
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.8.1.7) Gecko/20070914 Firefox/2.0.0.7
Accept: text/xml,application/xml,application/xhtml+xml,text/html;q=0.9,text/plain;q=0.8,image/png,*/*;q=0.5
Accept-Language: en-us,en;q=0.7,de-at;q=0.3
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
Keep-Alive: 300
Connection: keep-alive

HTTP/1.1 200 OK
Date: Mon, 08 Oct 2007 13:36:22 GMT
Server: Apache/1.3.34 (Debian)
Set-Cookie: hashID=22d68c8b5698827d57f071f43d818456; path=/
Expires: Thu, 19 Nov 1981 08:52:00 GMT  ← Page, not Cookie!
Cache-Control: no-store, no-cache, must-revalidate, post-check=0, pre-check=0
Pragma: no-cache
Keep-Alive: timeout=15, max=100
Connection: Keep-Alive
Transfer-Encoding: chunked
Content-Type: text/html; charset=iso-8859-1
```

Cookies

- What is a "cookie"?
  - → Small (max. 4 kB) text file with information
    - » Originates form the server
    - » Stored locally
    - » Transmitted back to server on "matching" requests
  - → Content (with exemplary data):
    - » Name: "session-id"
    - » Value: "303-1195544-4348244"
    - » Domain: ".amazon.de"
    - » Website path: "/"

      } Sent to all requests ("/") of subdomains of ".amazon.de"
    - » Expiry date and time: 15.10.2007, 00:02:22

      None → Till browser is closed ("session cookie")
    - » Secure(https): * Will be sent also on non-HTTPS connections
- The data may have any meaning
  - → Very rarely this is some "plain-text data"
  - → Some part of it might be the IP address or the user name
  - → But usually it is just a (more or less!) random unique number

Internet Explorer: Interesting files/locations

- Where can we find information on what users did with IE?
  - » Att.: Locations change slightly with OS version/language!
  - → <User profile>\Local Settings\Temporary Internet Files\Content.IE5
    - » Cache (webpages, images, applets, flash-files, …)
  - → <User profile>\Local Settings\History
    - » Where the user had been (URLs);
    - » Subdirectories for various time spans
  - → <User profile>\Cookies
    - » Cookies
- Note: Data is deleted from these locations independently!
  - → What is (was) present in one, is not necessarily available any more in the other locations
    - » We must search all three locations and assemble the results

Internet Explorer: Cookie file structure

- Each cookie file contains all cookies for a single domain
  - → The information is stored line-by-line; 9 lines = 1 cookie
- Example:

  __utma Name
  36557369.378120483.1187701792.1189418701.1190710388.4 Value
  hotel.at/ Domain
  1088 Flags
  $\left.\begin{array}{l}\text{2350186496}\\\text{32111674}\end{array}\right\}$ Expiration time (UTC; LoVal","HiVal)
  $\left.\begin{array}{l}\text{2116717664}\\\text{29884241}\end{array}\right\}$ Creation time (UTC; format as above)
  * Secure (here: False)
  __utmb
  …
- Note: Additional information on the cookies is in the index.dat file in the same directory!
  - → Number of hits, suspected as advertisement

Internet Explorer: index.dat structure (1)

- This structure is the same for cookies, cache, and history
- Overall structure:
      - » Remember: File has bytes in reverse order (little endian)!
  - → Header: Magic number (text), file size, hash table offset, subdirectory names (cache only)
      - » Subdirectory names are referred to by index (0 = first)
  - → Hash table: Length of table, pointer to next hash table, 8-byte hash entries
      - » Entries: 4 bytes flags, 4 bytes record offset
  - → Activity records: Type, length, data (dependent on type)
      - » Type can be REDR, URL, or LEAK
          - – URL: Website visit
          - – REDR: Redirection to another URL
          - – LEAK: Purpose unknown (Possibly: Cache entry deleted, but file couldn't be deleted)
      - » Each record is a multiple of 128 bytes long

Source: http://odessa.sourceforge.net/

Internet Explorer: index.dat structure (2)

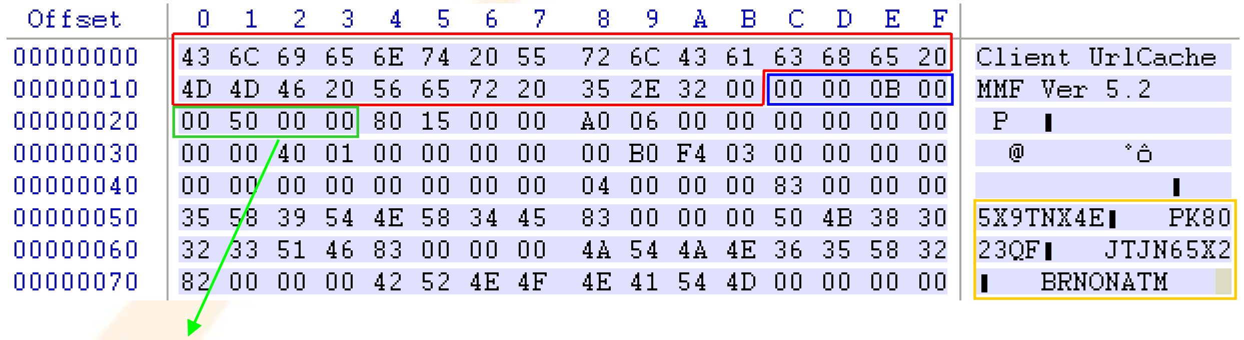
- URL records
  - Last modified time: When the information was modified on the web server
    - » Filetime format; All zero if unknown
  - Last access time: When the URL was visited
    - » Filetime format!
  - URL offset
    - » URL itself is Null-terminated; no Unicode – ASCII only!
  - Filename offset
    - » The name in the cache directory
  - Cache directory index
    - » In which cache directory the file is stored (index; 0 = first dir)
  - HTTP header offset
    - » The response headers only; not always present
  - Hit count: How often visited

Internet Explorer: index.dat structure (3)

- REDR records
  - → Flags: Exact meaning unknown
  - → URL offset
    - » Null-terminated
- LEAK records
  - → Structure similar to URL record
  - → Purpose unknown
- Not all records are necessarily present in the hash table
  - → When deleted, sometimes a record remains and only the hash entry is removed
    - » "Delete history" → Mark as deleted in hashtable
  - → As all records are block-sized (see before), "undelete" is possible without too many problems!
      - – A kind of file system within a file ☺ !
    - » Especially as each record starts with the type, and destroyed records are filled with well-known values (0x0BADF00D)

Internet Explorer: index.dat example

- Screenshot of header:



```
Offset     0  1  2  3  4  5  6  7   8  9  A  B  C  D  E  F
00000000  43 6C 69 65 6E 74 20 55  72 6C 43 61 63 68 65 20  Client UrlCache 
00000010  4D 4D 46 20 56 65 72 20  35 2E 32 00 00 00 0B 00  MMF Ver 5.2
00000020  00 50 00 00 80 15 00 00  A0 06 00 00 00 00 00 00   P  ▌
00000030  00 00 40 01 00 00 00 00  00 B0 F4 03 00 00 00 00    @       °ô
00000040  00 00 00 00 00 00 00 00  04 00 00 00 83 00 00 00              ▌
00000050  35 58 39 54 4E 58 34 45  83 00 00 00 50 4B 38 30  5X9TNX4E▌   PK80
00000060  32 33 51 46 83 00 00 00  4A 54 4A 4E 36 35 58 32  23QF▌   JTJN65X2
00000070  82 00 00 00 42 52 4E 4F  4E 41 54 4D 00 00 00 00  ▌   BRNONATM
```

🟥 Magic "number"

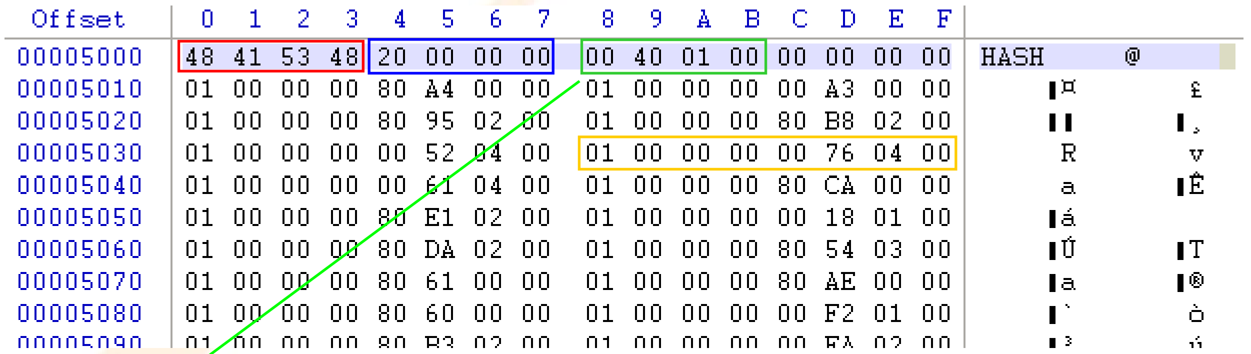
🟦 File size (0x000B0000 = 704 kB)

🟩 Hash table offset (0x00005000)

🟨 Cache directory names

Internet Explorer: index.dat example

- Screenshot of (start of) hash table :



```
Offset     0  1  2  3  4  5  6  7   8  9  A  B  C  D  E  F
00005000  48 41 53 48 20 00 00 00  00 40 01 00 00 00 00 00  HASH     @
00005010  01 00 00 00 80 A4 00 00  01 00 00 00 00 A3 00 00      ▌¤       £
00005020  01 00 00 00 80 95 02 00  01 00 00 00 80 B8 02 00      ▌▌      ▌¸
00005030  01 00 00 00 00 52 04 00  01 00 00 00 00 76 04 00       R        v
00005040  01 00 00 00 00 61 04 00  01 00 00 00 80 CA 00 00       a       ▌Ê
00005050  01 00 00 00 80 E1 02 00  01 00 00 00 00 18 01 00      ▌á
00005060  01 00 00 00 80 DA 02 00  01 00 00 00 80 54 03 00      ▌Ú      ▌T
00005070  01 00 00 00 80 61 00 00  01 00 00 00 80 AE 00 00      ▌a      ▌®
00005080  01 00 00 00 80 60 00 00  01 00 00 00 00 F2 01 00      ▌`       ò
00005090  01 00 00 00 80 B3 02 00  01 00 00 00 00 FA 02 00      ▌³       ú
```

🟥 Magic "number"

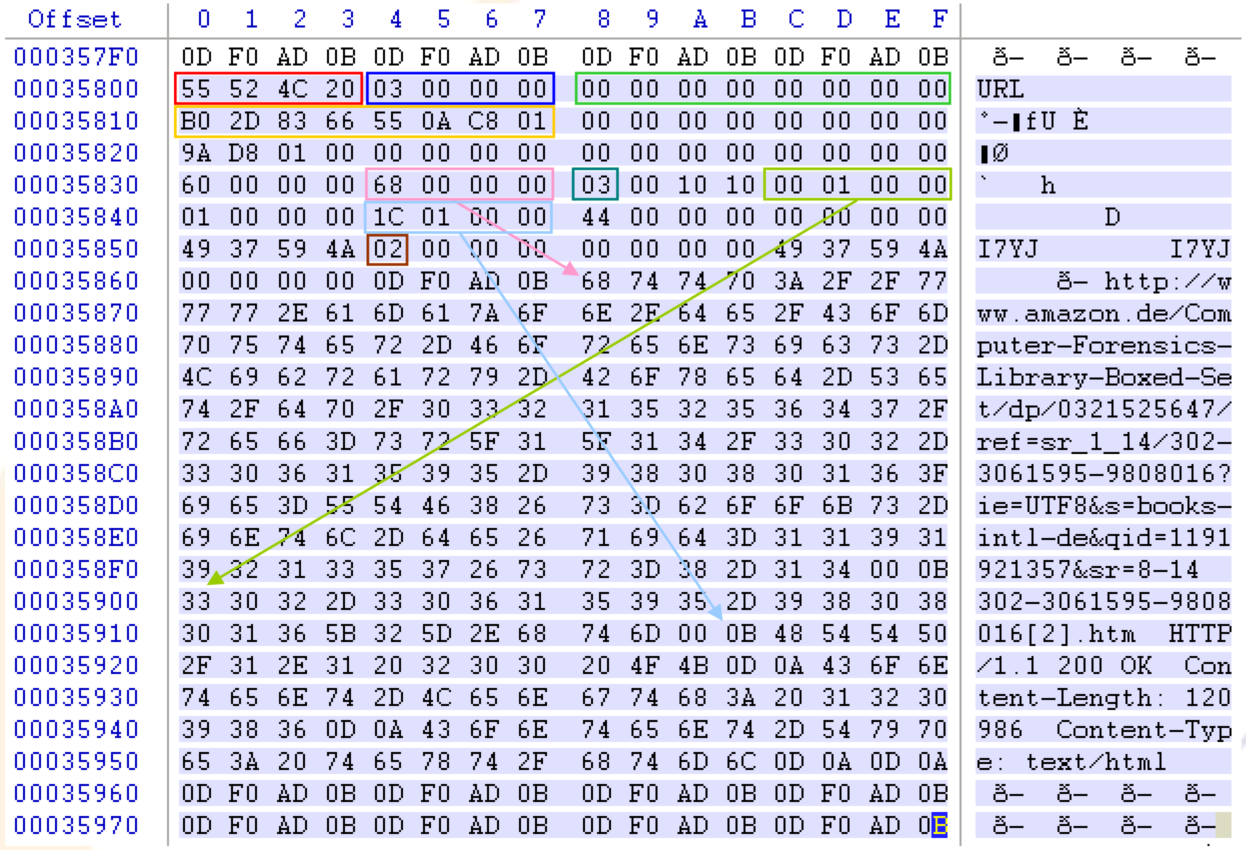
🟦 Table length (0x0000020 → 32*128 Byte = 4096 Bytes long)

🟩 Next hash table offset (0x00014000; absolute from start of file!)

🟨 Cache entries (example)

Internet Explorer: index.dat example

- Screenshot of detail record:



```
Offset     0  1  2  3  4  5  6  7   8  9  A  B  C  D  E  F
000357F0  0D F0 AD 0B 0D F0 AD 0B  0D F0 AD 0B 0D F0 AD 0B   ð–  ð–  ð–  ð–
00035800  55 52 4C 20 03 00 00 00  00 00 00 00 00 00 00 00  URL
00035810  B0 2D 83 66 55 0A C8 01  00 00 00 00 00 00 00 00  °–▌fU È
00035820  9A D8 01 00 00 00 00 00  00 00 00 00 00 00 00 00  ▌Ø
00035830  60 00 00 00 68 00 00 00  03 00 10 10 00 01 00 00  `   h
00035840  01 00 00 00 1C 01 00 00  44 00 00 00 00 00 00 00          D
00035850  49 37 59 4A 02 00 00 00  00 00 00 00 49 37 59 4A  I7YJ        I7YJ
00035860  00 00 00 00 0D F0 AD 0B  68 74 74 70 3A 2F 2F 77      ð– http://w
00035870  77 77 2E 61 6D 61 7A 6F  6E 2E 64 65 2F 43 6F 6D  ww.amazon.de/Com
00035880  70 75 74 65 72 2D 46 6F  72 65 6E 73 69 63 73 2D  puter-Forensics-
00035890  4C 69 62 72 61 72 79 2D  42 6F 78 65 64 2D 53 65  Library-Boxed-Se
000358A0  74 2F 64 70 2F 30 33 32  31 35 32 35 36 34 37 2F  t/dp/0321525647/
000358B0  72 65 66 3D 73 72 5F 31  5F 31 34 2F 33 30 32 2D  ref=sr_1_14/302-
000358C0  33 30 36 31 35 39 35 2D  39 38 30 38 30 31 36 3F  3061595-9808016?
000358D0  69 65 3D 55 54 46 38 26  73 3D 62 6F 6F 6B 73 2D  ie=UTF8&s=books-
000358E0  69 6E 74 6C 2D 64 65 26  71 69 64 3D 31 31 39 31  intl-de&qid=1191
000358F0  39 32 31 33 35 37 26 73  72 3D 38 2D 31 34 00 0B  921357&sr=8-14
00035900  33 30 32 2D 33 30 36 31  35 39 35 2D 39 38 30 38  302-3061595-9808
00035910  30 31 36 5B 32 5D 2E 68  74 6D 00 0B 48 54 54 50  016[2].htm  HTTP
00035920  2F 31 2E 31 20 32 30 30  20 4F 4B 0D 0A 43 6F 6E  /1.1 200 OK  Con
00035930  74 65 6E 74 2D 4C 65 6E  67 74 68 3A 20 31 32 30  tent-Length: 120
00035940  39 38 36 0D 0A 43 6F 6E  74 65 6E 74 2D 54 79 70  986  Content-Typ
00035950  65 3A 20 74 65 78 74 2F  68 74 6D 6C 0D 0A 0D 0A  e: text/html
00035960  0D F0 AD 0B 0D F0 AD 0B  0D F0 AD 0B 0D F0 AD 0B   ð–  ð–  ð–  ð–
00035970  0D F0 AD 0B 0D F0 AD 0B  0D F0 AD 0B 0D F0 AD 0B   ð–  ð–  ð–  ð–
```

- 🟥 Type
- 🟦 Record length
- 🟩 Last modified time
- 🟨 Last access time
- 🟪 URL offset
- 🟩 Filename offset
- 🟩 Cache directory index
  - 3 → BRNONATM
  - Missing; non-cacheable!
- 🟦 HTTP header offset
- 🟫 Hit count

Internet Explorer: index.dat example

- Output from Pasco:
  - → Type: URL
  - → URL: http://www.amazon.de/Computer-Forensics-Library-Boxed-Set/dp/0321525647/ref=sr_1_14/302-3061595-9808016?ie=UTF8&s=books-intl-de&qid=1191921357&sr=8-14
  - → Modified time: <Not present in file>
  - → Last accessed time: 10/09/2007 11:18:48 9.10.2007, 9:18:48 UTC
  - → Filename: 302-3061595-9808016[2].htm
  - → Directory: BRNONATM
  - → HTTP headers:
    HTTP/1.1 200 OK
    Content-Length: 120986
    Content-Type: text/html
- Other data:
  - → Record length: 3 (=3*128 = 384 bytes = 0x180)
    - » From 0x035800 to 0x35980

Sidetrack: Date/time formats

- Filetime: Number of ticks since 1.1.1601
  - → UTC; 100 ns resolution
  - → Usually stored as 8 hexadecimal numbers
- Unix time: Number of ticks since 1.1.1970
  - → UTC, 1 s resolution
  - → May appear as hexadecimal or decimal value (take care!)
    - » Hex: 9940F039
    - » Dec: 971815414
- Attention:
  - → Big endian or little endian?
  - → UTC or a different time zone? Which?
    - » Windows NT stores everything as GMT (according to its own time zone as configured)
  - → Difference of system time to actual time?

Nice tool: http://www.digital-detective.co.uk/freetools/decode.asp

Sidetrack: Date/time formats Examples

- index.dat example: Filetime – Little endian
  - → B02D8366550AC801 = Tue, 09 October 2007 09:18:48 UTC
    - » Actually: Di, 09 Oktober 2007 11:18:48 +0200
- Cookie example (expiration time; Windows Cookie time):
  - → 2350186496,32111674 = 25.9.2007 08:53:07 UTC
- Firefox cookie (Unix numeric timestamp):
  - → 1192658552 = 17.10.2007 22:02:32 UTC

Sidetrack: Date/time formats Time zone and delta

- Time zone issues:
  - → Identify time zone from installation
    - » Alternative: Geographical area of usage of the system
- Delta: Identify delta between computer time and UTC
  - → Attention: This might not necessarily be the same delta as when the timestamp was created!
    - » Manual corrections, time drift (important for longer timespans)

Sidetrack: Date/time formats Daylight Saving Time (DST)

- Attention: Summer time ("daylight saving time", "DST")!
  - → Sometimes its UTC+1, but at the other dates it's UTC+2 !
    - » Austria: 29.3.2009-25.10.2009 → UTC+2; Rest of year: UTC+1
    - » Note: Dates of start/end changed over the years
      - – Was the corresponding patch applied to the computer? When?
      - – Windows: Registry stores start/end date, …
    - » Usually defined by certain weekends, not dates!
      - – Last Sunday in March to last Sunday in October
  - → Does the system account for this?
    - » Timestamp stored as UTC or local time?
      - – NTFS: UTC; but FAT: Local time

Internet Explorer: Cache information

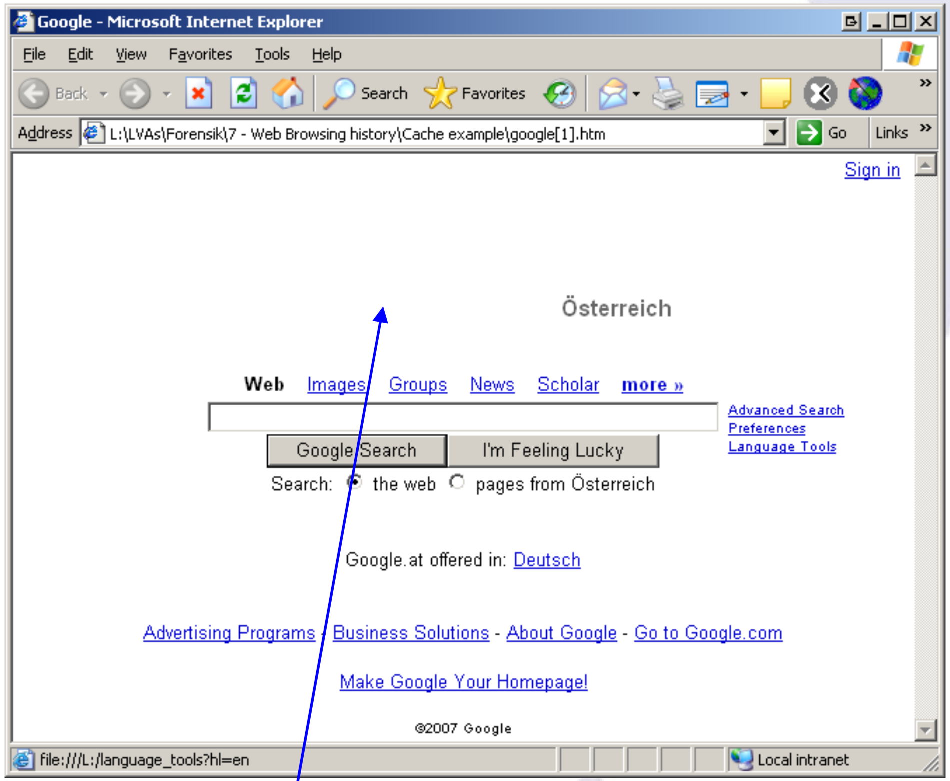
- Information is stored in the file "index.dat"
  - → File format see before!
  - → Again: Content is not necessarily the same as in other files
- Additionally: Several subdirectories for the actual files
  - → Note: These receive "random" filenames to avoid collisions
    - » Typically with "[1]", "[2"], … added at the end
    - » The files itself are NOT modified; URL's are kept the same!
      - – Recreating pages: Must "load" the URLs from the cache too
      - – "Transparent proxy" is needed
- The URL also contains GET parameters
  - → These might also be interesting!

    http://www.hotel.de/Booking.aspx?h_rooms=1&h_fbrs=1&h_step=3&h_departure=9/1/2007&h_arrival=8/26/2007&h_rmod=0&h_sbl=/Search.aspx?hs_arrival=8/26/2007&hs_destination=Lübeck&hs_circum=0&hs_landisoa3=DEU&hs_locationnr=37547&hs=2&hs_departure=9/1/2007&hs_ltype=1&hs_validate=2&hs_llat=53,86626&lng=EN&hs_llong=10,67468&lng=EN&h_persons=1&h_validate=1&h_hmid=50727&h_persons_total=1

    Booking a hotel for one person in Lübeck (Germany) from 26.8.2007 till 1.9.2007

Internet Explorer: Cache directory example

- Directory 5X9TNX4E:
  - → nav_logo3[1].png
- Directory BRNONATM:
  - → google[1].htm
  - → logo_plain[1].png
  - → google[1]
    LEAK record: Some binary data


Google - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Go Links

Address L:\LVAs\Forensik\7 - Web Browsing history\Cache example\google[1].htm

Sign in

Österreich

Web Images Groups News Scholar more »

Advanced Search
Preferences
Language Tools

Google Search | I'm Feeling Lucky

Search: ◉ the web ○ pages from Österreich

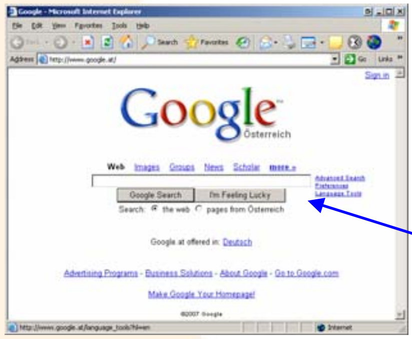
Google.at offered in: Deutsch

Advertising Programs - Business Solutions - About Google - Go to Google.com

Make Google Your Homepage!

©2007 Google

file:///L:/language_tools?hl=en Local intranet


Google - Microsoft Internet Explorer

Address http://www.google.at/

Sign in

Google Österreich

Web Images Groups News Scholar more »

Advanced Search
Preferences
Language Tools

Google Search | I'm Feeling Lucky

Search: ◉ the web ○ pages from Österreich

Google.at offered in: Deutsch

Advertising Programs - Business Solutions - About Google - Go to Google.com

Make Google Your Homepage!

©2007 Google

http://www.google.at/language_tools?hl=en Internet

Webpage

Directly opened as a file in the cache directory

Note: Images are missing!

Firefox: Interesting files/locations

- Where can we find data on what users did with Firefox?
    - » Profile ID is a random string generated once
  - → <User profile>\Local Settings\Application Data\Mozilla\Firefox\Profiles\<Profile ID>\ Cache
    - » Cache (webpages, images, applets, flash-files, …)
  - → <User profile>\Application Data\Mozilla\Firefox\Profiles\<Profile ID>\ history.dat
    - » **Extremely** strange file format ("Mork")
    - » There does exist an exporter ("Dork")
  - → <User profile>\Application Data\Mozilla\Firefox\Profiles\<Profile ID>\ cookies.txt
    - » Cookies; Tab-delimited text file
- Easy cache access: URL "about:cache"
  - → Also extensions available for directly viewing cached files
    - » Should only be used on write-protected disks/images!
  - → Firefox has two caches: In-memory and on disk

Firefox: Cookie file

- Simple text file with tab-delimiters: Single line per cookie
- Format:
  - → Domain: ".amazon.de"
  - → Domain access: "TRUE"
    - » Probably a security setting
  - → Path: "/"
  - → Secure : "FALSE" (= Sent over any type of connection)
  - → Timestamp: 1192658552 (=17.10.2007 22:02:32 UTC)
      - – Local time: Do, 18 Oktober 2007 00:02:32 +0200 (Sommerzeit!)
    - » Format: Unix numeric value
  - → Name: "session-id"
  - → Value: " 302-0868837-0800841"
- Example:
  - → .amazon.de	TRUE	/	FALSE	1192658552 session-id	302-0868837-0800841

Firefox: History file

- Stored in a "strange" format, a kind of database
  - → Replaced in version 3 with a real DB (SQLite)!
    - » Examination quite simple: SQL queries!
- V2: Very difficult to parse, except through Firefox
  - → But there is an exporter, generating a tab-delimited file
- Example:
  - → C7D0D 3 2007-10-08 14:44:44 2007-10-08 14:47:07 http://www.amazon.de/ref=rd_www_amazon_at/?site-redirect=at
  - → ID of the visit: C7D0D
  - → Visit count: 3
  - → First visit date: 2007-10-08 14:44:44
  - → Last visit date: 2007-10-08 14:47:07
  - → URL: http://www.amazon.de/......
  - → Take care of timezone of dates!

http://www.forensicswiki.org/wiki/Mozilla_Firefox_3_History_File_Format

Firefox: Cache

- The cache consists of 4 files plus the data files
  - → 1 cache map: Hash table for entries ("_CACHE_MAP_")
    - » Header plus 8192 records of cached elements
      - – Record: Hash number, eviction rank, data / metadata location
    - » Data may be saved within cache block file (below) or separately
  - → 3 cache block files ("_CACHE_00?_")
    - » Bitmap header and some cache content and/or metadata
    - » Varying block sizes: cache 1 = 256, 2 = 512, 3 = 1024 Bytes
      - – Maximum block count per data: 3 (→ up to 3072 Bytes)
  - → Data files: If the content doesn't fit into the cache blocks
    - » Filename = <Hash number><type><generation number>
      - – Type: d = cache, m = metadata (rare!)
      - – Generation number: Lowest byte of location
    - » No filename extension! → Filename doesn't tell file type!
      - – If known → Rename → Original file

IE-Example: Reconstructing a Webmail message

- Cookies:
  - → www.gmx.net/de/
    - » Visits 1
    - » moveinBrowser
      new%20MoveinData%28%29%2Eunpickle%28%7B%22viewed%22%3A%201%2C%20%22closed%22%3A%20false%2C%20%22latest%22%3A%20new%20Date%281192174225718%29%7D%29
      - – Decoded: new MoveinData().unpickle({"viewed": 1, "closed": false, "latest": new Date(1192174225718)})
      - – Decoded date (Unix): Fr, 12 October 2007 07:30:25 UTC
  - → gmx.net/
    - » GUD
      bMDEpJi1JPF9xN0JINkUyQkExJSIhJxweJBkeGyAvLjcsLDQpKzJCSzElliEnHB8dGRwcIC83Ny8tNC0uMktBMSMtSzksIh0gGw==
      - – Mime encoded, but is just a binary value
      - – Probably a unique ID for session handling
  - → logout.gmx.net/
    - » POPUPCHECK 1192260804812 ← Sa, 13 Oktober 2007 07:33:24 UTC

IE-Example: Reconstructing a Webmail message

- History (pasco; adjusts for local time zone!): = 12.10.2007 7:30-7:33 UTC!
  - → Modified/access time: 10/12/2007 09:30 until 09:33
    - » Local time of event: Western European DST (=+2)
      - – But done according to the time zone set at the moment of the analysis; physically stored as UTC time!
- URLs (selection):
  - → sonntag@http://www.gmx.net/de
    - » User visited GMX homepage
  - → sonntag@http://service.gmx.net/de/cgi/login
    - » User logged in to GMX
  - → sonntag@http://service.gmx.net/de/cgi/g.fcgi/mail/index?CUSTOMERNO=10333901&t=de1690301692.1192174366.c35ea10d&FOLDER=inbox
    - » User visited his inbox
  - → sonntag@http://service.gmx.net/de/cgi/derefer?TYPE=2&DEST=http%3A%2F%2Fwww.gmxattachments.net%2Fde%2Fcgi%2Fg.fcgi%2Fmail%2Fprint%2Fattachment%3Fmid%3Dbabgehj.1192174412.25124.s9vnnjbfon.74%26uid%3DKxs5Dm8bQEVsw%252FqY9HVpw45KNTg2NcIR%26frame%3Ddownload
    - » User opened an attachment
  - → sonntag@http://www.gmxattachments.net/de/cgi/g.fcgi/mail/print/attachment:/filename/Lebenslauf.doc?mid=babgehj.1192174412.25124.s9vnnjbfon.74&uid=Kxs5Dm8bQEVsw%2FqY9HVpw45KNTg2NcIR&frame=attachment
    - » User downloaded an attachment called "Lebenslauf.doc"

IE-Example: Reconstructing a Webmail message

- Cache:
  - → 282 entries
    - » Images (GIF, JPG)
    - » Stylesheets (CSS)
    - » JavaScript (JS)
    - » HTML files (HTML)
      - – Only static files, login screen, etc.!
- What is missing are the actual E-Mails
  - → These are not cached on disk
    - » In previous versions they might have been cached
      - – Probably depending on server, not version of Internet Explorer!
  - → So webmail is not necessarily recoverable, but perhaps in some instances
- Note: The cache only contains, what is sent to the computer
  - → Locally drafted E-Mail is "form input" which is **never** cached!

Other information: Careful interpretation necessary!

- Typed URLS: Visited sites
- Form history and stored passwords
  - → For identifying visited sites and accessing them
  - → Often encrypted, but decryption programs exist
- Search history: What was the person looking for?
- Blocked sites: If the popup-host of a site was blocked, the site itself was probably visited!
  - → Manually unblocked sites obviously interesting!
- Certificate store: To identify secured sites visited often
  - → Might include client certificates, which act as a kind of key
- Download history: What file(names) were downloaded
  - → And where they were stored locally (name; for searching)
- Installed add-ons (browser controls)
- Language preferences and all other configuration options

Privacy mode: IE 8 "InPrivate Browsing"

- Allows Browsing without leaving traces (but see below!)
- Additional feature: Prevent Sites from sending data to other sites (InPrivate Filtering)
  - → IE traces third party content; if it appears on more than 10 (can be modified from 3 to 30) sites visited, it is blocked in InPrivate Browsing mode
    - » Must be activated manually each time (works per-session)!
    - » Can also be activated in non-private browsing mode
  - → Complete blocking (no third-party content) can be set manually; exceptions can be configured as well
- InPrivate Browsing does not store:
  - → New cookies (existing can still be read!), history entries, form data, passwords, typed URLs, search queries, visited links
  - → Toolbars and extensions are disabled
- Will keep: Bookmarks, downloaded files, Flash cookies

Privacy mode: IE 8 "InPrivate Browsing"

- InPrivate Browsing still stores files in the cache on the disk, but deletes them when closing the window
  - → This means, traces **WILL** remain on the disk!
  - → Which can be found through careful investigation
- Reconstructing the history:
  - → Not available directly (not stored!)
    - » Article unclear about this; some parts might remain
  - → But possible through the cache, which contains the last access time of every stored element!

Privacy mode: Firefox 3

- Firefox does not store
  - → History entries (incl. intelligent address bar), search queries, download history, form data, cookies, cache, typed URLs, passwords, visited links
- Will keep: Bookmarks, downloaded files, Flash cookies
- Same features as IE8
  - → Except third party elements
    - » Cookies can be filtered
    - » Images too, but not through the UI!
      - – about:config → permissions.default.image=3 (no third party images)
    - » Scripts etc.: NoScript or other extensions
- Extensions remain active!
  - → Configuration (e.g. third party images) is the same

Conclusions

- What a user did with a web browser can usually be reconstructed quite good
  - → Especially Internet Explorer: Deleting the index.dat files is almost impossible
    - » Dedicated "cleaner" programs are needed
    - » Information may be stored multiple times
- Reconstructing the content of web-based E-Mail is difficult
  - → That, which, … can be done
  - → But content is typically not cached and therefore unavailable
- A variety of programs exist to investigate these files
  - → Few of them are free
  - → File formats are often not at all/badly documented
- Timestamps are very important, but many formats occur
  - → Identifying delta and timezone are paramount!

Questions?

Thank you for your attention!

Links

- Anderson, Keith: Firefox history exporter: https://bugzilla.mozilla.org/show_bug.cgi?id=241438
  (Entry at 2006-03-17 09:10:47 PDT)