



Private Internet Browsing Forensics

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Introduction

Private-browsing modes in Web browsers have become a mainstay in recent years. Private browsing modes such as Google Chrome's incognito mode allow users to access web content without fear of leaving behind a history of visited pages. As private browsing has become more and more commonplace, and it's becoming increasingly harder to find a browser that does not include this feature. An individual's web history is a very important piece of evidence, meaning forensic investigators and law enforcement need to be familiar with the way these programs function in order to acquire said data.

The goal of this project is to identify and analyze residual data after a user performs a private browsing session. Information collected from this experiment is intended to provide Champlain College, as well as other digital investigation organizations, with potential methods and techniques for acquiring data from a private browsing session. Our information will also determine if there are any factors that will disrupt the integrity of a private browsing session.

Background:

In 2013, The European Association for Signal and Image Processing (EURASIP) Journal on Information Security performed research on both private browsing and portable web browsing (running a browser off a removable source such as a flash drive) with emphasis on portable browsing ([Link](#)). Another study published in 2013 by the Institute of Electrical and Electronics Engineers (IEEE) included analysis on both portable and private browsing sessions across multiple browsers, and found incriminating evidence in all iterations of testing ([Link](#)). A more focused, multi-part blog post by Magnet Forensics showed similar testing parameters and pointed out that private browsing features have many holes that will allow almost any forensically sound investigation to progress almost unhindered under the right circumstances ([Link](#)). These reports were extremely useful and still relevant; however, we would like to see another perspective done with the latest versions of both the browsers and the computer forensic software to ensure that any information regarding private browsing is current and up to date in the year 2015.

Purpose and Scope:

Private browsing has the ability to hide potentially incriminating evidence, meaning it is important for a digital investigator to be able to analyze this data. Web browsing artifacts left behind can include anything from browser history to bank account data.

The browsers utilized in this analysis have their own definitions of private browsing, each varying slightly. [Google Chrome's Privacy Policy](#) states that while in Incognito Mode, Chrome will not save browsing information such as cookies, searches, or history after the browser has been closed. This information is still visible to several sources such as the user's ISP, the destinations themselves, and anyone with administrative privileges over the network. [Internet Explorer's InPrivate browser](#) details that information is encrypted and stored in temporary memory so web browsing works as intended, but not stored past the browsing session. Searches, visits, form data, and login information are not recorded. [Firefox's Private Browsing window](#) offers

the same: no saved history, searches, forms, passwords, cookies, or cache data, with the added benefit of automatic Do Not Track support. [Safari 9's Private Browsing](#) for El Capitan claims to not track history, Autofill data, searches, cookie changes, and also prevents incognito windows from communicating with each other. Safari's policy says nothing about deleting cache, but it was found to be deleted regardless.

Research Questions:

1. Does private browsing delete all incriminating evidence after being closed out?
2. How much useful data can be discovered from artifacts left after a private browsing session?
3. Are there any programs, extensions, etc. that compromise the integrity of a private browsing session?

Terminology:

Adblock Pro – A browser extension that disables advertisement-related scripts from running on the webpage.

Browser Artifacts – Any data generated by user interaction that can be collected and examined. Any user data retrieved from the browser is considered an artifact, including cookies, caches, geolocation, search history, etc.

Browser Cache – In computing, a **cache** is a component that stores data, to allow future requests for the data to be processed faster. Data stored in a cache could be the results of a computation, or data that has been duplicated and is stored elsewhere.

Browser Cookies – A **Cookie** is a small data file placed on a personal computer by a website's server, often without the user's knowledge or permission. This allows the web site to remember that user the next time the user visits the site. The stored information about a user is useful in e-commerce marketing, but is also useful as evidence in litigation. The cookies on a person's computer can tell you what websites that person has visited.

DOM file - Document Object Model or DOM is a convention used by older web browsers to dynamically act with HTML, XHTML, and XML documents. It was created to standardize formatting for browser-scripting languages.

Dumpit.exe – An easy-to-use memory acquisition tool created by MoonSols that uses a simple batch script to duplicate the current physical memory and save it as a .raw file

E01 File – .E01 is the file extension that EnCase uses when imaging a device.

FTK Imager version 3.1.0.1514 – This imager is a free extension of FTK 4.1. This is a powerful imaging program that can be used to create forensic images of a drive, which can then be opened in most forensic software for examination. There are other functions that allow this program to take images of specific files in a storage device as well as floppy disks, CDs, DVDs, and zip disks.

Forensic Toolkit or FTK – A forensic tool made by AccessData. FTK allows users to acquire, process, and verify evidence. FTK supports many image formats. The current is Version 5.6. Version 4.1 may also be used in our lab.

Image – In digital forensics, an **image** often refers to a copy of a hard drive, or disk image, that is compressed into a series of files. Physical images include all information (zeroes and ones) on the hard drive whether the space is being used or not, and ends up being close to the same size as the actual hard drive itself. As opposed to a physical image, a logical image only acquires the parts of the hard drive that have active data and dismisses the rest of the drive. Compared to a physical image, the size can be extremely small or the same size as the drive depending on the amount of data stored.

Internet Evidence Finder or IEF is forensic software created by Magnet Forensics that is capable of recovering internet artifacts in areas such as: cloud artifacts, instant messenger chat logs, media, mobile backup files, P2P file sharing, social networking site content, webmail applications, web related activity, and web page recovery.

Memory Dump – A collection of volatile data dumped into a single file for analysis.

New Technology File System or NTFS - a file system that was developed by Microsoft. It is the default file system for the Windows operating system. NTFS supports metadata, improved performance, reliability, disk space utilization, and supports more extensions compared to formats such as FAT and HPFS.

Private Browsing – A browser mode where user activity that is normally stored in the browser such as cookies, web history, and download history is not recorded. Other elements of web browsing, like search history and passwords are not saved when the user closes the Private Browsing window. While In-private Browsing does provide some privacy, it is still possible to see what sites have been visited by capturing network traffic.

RAM or Random Access Memory - An integrated circuit into which data can be read or written by a microprocessor or other device. The memory is volatile and will be lost if the system is disconnected from its power source..

Residual Data – Data that is not active on a computer system, including (1) data found on media free space; (2) data found in file slack space; and (3) data within files that has functionally been deleted in that it is not visible using the application with which the file was created, without the use of un-delete or special data recovery techniques.

Virtual Machine – A **virtual machine** is a software-based computer that executes and runs programs like a physical machine. A virtual machine supports the execution of a complete operating system. VMs usually emulate an existing architecture and are built with the purpose of either providing a platform to run programs where the real hardware is not available for use, or of having multiple instances of virtual machines. This leads to more efficient use of computing resources, both in terms of energy consumption and cost effectiveness (known as hardware virtualization, the key to a cloud computing environment).

Methodology and Methods

The first part of the project's research phase was identifying the most widely used Internet browsers that offered private/incognito browsing functionality. We studied the separate privacy policies of each company that administered the respective browsers and ascertained the exact language used to describe privacy and what

steps were actually being taken by the browser while using these features. Next, we read previously published reports put out by universities and digital forensic institutions to gain familiarity with the behaviors of each browser, such as the locations of common browsing artifacts. A data generation script was written that encompassed a full session of realistic browsing, complete with social media presence, search engine queries, streaming and downloading pictures and videos, collecting cookies, and saving login/form data. The same procedure was done in both public and private browsing to compare similar artifacts during the analysis phase. The final step of the data generation was a memory dump using DumpIT to keep a record of the machine's RAM for later examination. Upon completion of data generation, the virtual hard drives were imaged in the .E01 format using FTK imager. Once imaged, browsing session files were located and analyzed, as well as files found within the RAM.

Equipment/Software Used

Item	Identifier	Size/Specification
LCDI Workstations	Research-XX	Intel Core i7-3770K CPU @ 3.50GHz 32 GB RAM Windows 7 Enterprise SP1 64-bit
VMware® Workstation 12 Pro version 12.0.0 build-2985596 (x4)	Names based on browser to be used in data generation testing - e.g "Google Chrome"	- Memory: 4 GB - Processors: 2 - Hard drive: 25 GB - Windows 7 Enterprise Edition/ OS X El Capitan
Google Chrome	Browser	v. 46.0.2490.80
Internet Explorer	Browser	v. 11.0.9600.18057
Mozilla Firefox	Browser	v. 42.0
Safari for OSX	Browser	v. 9.0.1
AdBlock Plus	Extension	v. 1.9.3
MoonSols DumpIT	Application	v. 1.3.2.20110401

Table 1: Equipment

Data Collection

Data generation was carried out with four VMWare virtual machines, three running Windows 7 SP1 and one running OS X El Capitan. A total of 8 data gen sessions were run across the machines; one machine per browser and two tests, public and private, per machine. Each virtual machine was host for a specific browser slated for testing: Google Chrome, Internet Explorer, Mozilla Firefox, and Safari.

In the data generation process, we sought to gather as many common Internet artifacts as possible. Therefore, a split was made between which links to search through the taskbar and which to type in exactly, to make sure we could look for both typed URL history and search history. Some pages were bookmarked, although it had already been established that they persist through private browsing sessions to find their location within the file system. Also, we ensured that enough pictures and videos were explored, both by downloading them or viewing them passively (like on imgur.com, for example, when the tester is instructed to scroll through the front page and load a moderate amount of images on-screen, but not actually interact with them). Social media was also a focus, with visits made to Twitter and Facebook and several interactions like liking pages and retweeting added to the process. Further, several different types of correspondence were utilized through email and direct messaging in an attempt to gather forensic evidence of these interactions. Other hotspots like Google Maps and Amazon were used in testing to see if any records of these operations are recorded and recoverable. Finally, the browsing sessions were ended by crashing the browser with an outside utility to find out if a crash had any effect on the outcome of a private browsing session.

Due to the nature of our data generation and our chosen methods, there were discrepancies in our first set of testing. A sign-in to a designated Gmail account was necessary as part of our script, however it was initially overlooked to stop the account information from syncing between sessions, so public history data bled into the private browsing tests. By default, any user account is signed out when a private browsing window is launched, so the best practice in terms of privacy when utilizing these browser functions is to not sign into any personal accounts so that no artifacts sync into a browsing session. The new data, which is presented in this report, was nullified of this issue. Also, since the research conducted prior to this project showed that RAM data held a large number of Internet artifacts, both public and private, a memory dump was added to the new set of each test with the use of MoonSols DumpIT v. 1.3.2.20110401.

Analysis

After each data generation, a post-data generation snapshot was taken the virtual machine. After, the snapshot was downloaded to the local machine used for analysis (the VMs were located on a remote server) and reverted to the pre-data generation snapshot for the second test, if applicable. Meanwhile, the downloaded .vmdk was converted to an .E01 image through FTK Imager v. 3.1.0.1514, and then added as evidence to a case in Forensic Toolkit v5.5 for analysis. After consideration of the Internet artifacts indexed when FTK processed the image, a manual analysis of the NTFS was conducted on the areas that were documented to hold the artifacts normally. Finally, the images were added to Internet Evidence Finder for a final detailed course of perusal.

Does private browsing delete all artifacts after being closed out?

Private browsing does what it advertises: When a session is closed out, no history is saved, no searches are recorded, and cookies are deleted, but *this is only at the browser level*. No information is being sent to the databases that personalizes advertisements and provides suggestions based on search history when browsing (provided that the user remains logged out of accounts with potential synchronization settings, like Google) and no artifacts are being written to the browser directories within the file system of the local machine. This is the limit of the amount power the browser has over the artifacts left behind from Internet activity, and it can be considered fairly adequate for the purposes of the average user.

How much useful data can be discovered from artifacts left after a private browsing session?

A surprising amount of data has the potential to get left behind after a private browsing session, but the amount in any given case is relatively up to circumstance. Generally speaking, searching for artifacts in the browser itself and its directory within the file system will be fruitless. From a forensic standpoint, the most useful resources when searching for private browsing artifacts are those that reference information in the RAM of the machine. In our case, the memory dump we performed directly after the data generation sessions recorded a staggering amount of artifacts from the browsing activities. We were able to find virtually everything we were looking for within the .raw file left by DumpIT, and overshadowed by this was the extremely useful pagefile.sys, which stores data from the RAM that is being used the least and can therefore be transferred out of it.

Are there any programs, browser extensions, etc., that compromise the integrity of a private browsing session?

Many factors such as browser extensions can absolutely compromise the integrity of a private browsing session. If a user signs into a Google account while using Google Chrome in Incognito mode, by default the

system will import history, cache, cookies, and bookmarks from Google's online database. Similarly, services like Mozilla Sync will also sync similar artifacts when signed in on Mozilla Firefox. These syncing services generally offer customization as to what is being synced over between sessions, but sync everything if left at default settings. It should be noted that these accounts are signed out when a private browsing window is launched. In order to maintain the integrity of a clean browsing history, users should refrain from signing into personal accounts with potential synchronization settings while utilizing a private browser.

Similarly to this, browser extensions such as Addthis also compromise browser privacy. Addthis is an extension that saves bookmarks. The information being shared between connected Addthis clients (presumably on different browsers/machines) will "leak" data that would otherwise be hidden in a private browsing session. The artifacts left behind after using Addthis should not be surprising given the context of the extension. However, it should be noted that private browsers universally advertise that they save bookmarks after browsing sessions meaning that, again, best practices would dictate not to make bookmarks when attempting to keep browsing activity a secret.

Results

Our preliminary research suggested that most artifacts for Google Chrome would be found in the directory Users/<USER>/AppData/Local/Google/Chrome/User Data/Default. Indeed, this directory contained many important databases with information relevant to browsing data, as detailed in Figure 1. In Internet Explorer, the browser directories are slightly more difficult to navigate, but the web cache holds a similar amount of information; many artifacts were found within it, using the filepath <USER>/AppData\Local\Microsoft\Windows\WebCache\. These directories were found and searched using FTK, however the .raw files were inaccessible during this analysis because they were image files within the VM, meaning that not only could they not be imported into FTK for it to analyze, but they also couldn't be exported to the local machine because they were too large for FTK to export. When the images were analyzed in IEF, we were able to retrieve virtually all of the artifacts needed to gather information on the private browsing sessions, and we soon realized that this was because the memory dumps were executed immediately after data generation. After reviewing these findings we concluded that the RAM dump had a variable margin of the amount of data it held, very dependent on how long after the browsing session it was executed and how many other browsing sessions were initiated between the one that was analyzed and the memory dump.

As far as the artifacts themselves go relative to the data generation script, not all were able to be found. This had a lot to do with where information is stored based on the service: for example, history and web searches were easy to find because those are stored within the browser directory, but things like Facebook interactions and Gmail correspondence are recorded online so not much information relevant to these browsing activities could be found within the file system of a hard drive.

Chrome Artifacts

Artifact Name	Chrome Public	Chrome Private
History	Users/<USER>/AppData/Local/Google/Chrome/User Data/Default/History	<i>Not Found</i>
Cookies	Users/<USER>/AppData/Local/Google/Chrome/User Data/Default/Cookies	<i>Not Found</i>
Bookmarks	Users\<USER>\AppData\Local\Google\Chrome\User Data\Default\Bookmarks	Users\<USER>\AppData\Local\Google\Chrome\User Data\Default\Bookmarks
Saved Logins	Users/<USER>/AppData/Local/Google/Chrome/User Data/Default/Web Data/tables/ie7_logins	<i>Not Found</i>
Autofill	Users/<USER>/AppData/Local/Google/Chrome/User Data/Default/Web Data/tables/autofill	<i>Not Found</i>
Downloads	Users/<USER>/Downloads	Users/<USER>/Downloads

Searches	Users/<USER>/AppData/Local/Google/Chrome/ /User Data/Default/	<i>Not Found</i>
Web Cache	Users/<USER>/AppData/Local/Google/Chrome/Use r Data/Default/Cache	<i>Not Found</i>

Table 2: Chrome Artifacts

Internet Explorer Artifacts

Artifact Name	IE11 Public	IE11 Private
History	\Users<USER>\NTUSER.DAT	\Users<USER>\AppData\Local\Microsoft\Interne tExplorer\Recovery\Active
Cookies	Users/<USER>/AppData/Roaming/Microsoft/ Windows/Cookies	<i>Not Found</i>
Bookmarks	Users/<USER>/Favorites	Users/<USER>/Favorites
Saved Logins	HKEY_CURRENT_USER\Software\Microsoft\ Internet Explorer\IntelliForms\Storage2	<i>Not Found</i>
Autofill	HKEY_CURRENT_USER\Software\Microsoft\ Internet Explorer\IntelliForms\Storage1	<i>Not Found</i>
Downloads	Users/<USER>/Downloads	Users/<USER>/Downloads
Searches	Users<USER>\AppData\Local\Microsoft\Inter net Explorer\Recovery\Active\	<i>Not Found</i>
Web Cache	Users<USER>\AppData\Local\Microsoft\Wind ows\WebCache\	<i>Not Found</i>

Table 3: Internet Explorer Artifacts

Firefox Artifacts

Artifact Name	Firefox Public	Firefox Private
History	Users<USER>\AppData\Roaming\Mozilla\ Firefox\Profiles\mgzpcnhg.default\places.sq lite	<i>Not Found</i>
Cookies	Users<USER>\AppData\Roaming\Mozilla\ Firefox\Profiles\mgzpcnhg.default\cookies. sqlite	<i>Not Found</i>
Bookmarks	Users<USER>\AppData\Roaming\Mozilla\ Firefox\Profiles\mgzpcnhg.default\places.sq lite	\Users\PrivFireFox\AppData\Roaming\Mozill a\Firefox\Profiles\lif4n89h.default\places.sqlit e

Saved Logins	Users\<USER>\AppData\Roaming\Mozilla\Firefox\Profiles\mgzpcnhg.default/key3.db AND Users\<USER>\AppData\Roaming\Mozilla\Firefox\Profiles\mgzpcnhg.default/logins.json	<i>Not Found</i>
Autofill	Users\<USER>\AppData\Roaming\Mozilla\Firefox\Profiles\mgzpcnhg.default/formhistory.sqlite	<i>Not Found</i>
Downloads	Users\<USER>\Downloads	Users\<USER>\Downloads
DOM Storage	Users\<USER>\AppData\Roaming\Mozilla\Firefox\Profiles\mgzpcnhg.default\webappsstore.sqlite	<i>Not Found</i>
Searches	Users\<USER>\AppData\Roaming\Mozilla\Firefox\Profiles\mgzpcnhg.default\places.sqlite	<i>Not Found</i>
Web Cache	Users\<USER>\AppData\Local\Mozilla\Firefox\Profiles\mgzpcnhg.default\cache2\entries	<i>Not Found</i>

Table 4: Firefox Artifacts

Safari Artifacts

Artifact Name	Safari Public	Safari Private
History	<User>/Library/Safari/History.plist	<i>Not Found</i>
Cookies	<User>/Library/Cookies/Cookies.binarycookies	<i>Not Found</i>
Bookmarks	<USER>/Library/Safari/Bookmarks.plist	<USER>/Library/Safari/Bookmarks.plist
Saved Logins	<USER>/Library/Cookies/Cookies.binarycookies	<i>Not Found</i>
Autofill	<USER>/Library/Preferences/com.apple.Safari.plist	<i>Not Found</i>
Downloads	(By Default) <USER>/Downloads	(By Default) <USER>/Downloads
DOM Storage	N/A	N/A
Searches	<USER>/Library/Safari/HistoryIndex.sk	<i>Not Found</i>

Web Cache	<USER>/Library/Caches/com.apple.Safari/Cache.db	<i>Not Found</i>
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Table 5: Safari Artifacts

Conclusion

We can conclude that private browsing features are a balancing act of positives and negatives. When utilized to its full potential (due largely in part to the vigilance of the user), a browsing session may leave little to no traces in the browser directory of the machine that hosted it. This being said, any discrepancy during the session can potentially allow information to be left discoverable by an investigator, but also holds the risk of corrupting the data left behind with artifacts from public sessions before it. Depending on the scope of the case, it may either be beneficial to an investigator to have outside artifacts or it could compromise the integrity of the findings. Further, almost any artifact (public or private) has the potential to be extracted from RAM, as long as it is recovered and imaged in a timely manner before the machine has time to fill its RAM with a substantial amount of new information. Last-ditch efforts to recover information that was moved out of RAM would revolve around the pagefile.sys of the drive in an attempt to recover the artifacts as data moved to the RAM's virtualized reserve memory.

Further Work

A solid amount of research has gone into the analysis of incognito browsing. The studies referenced during our planning at the beginning of the project were larger in scope and had much more extensive technical methods and presentation. Many of these studies did experimentation on portable browsing; that is, browsers that can be stored on and executed from a portable storage device like a USB stick drive. We consider this to be an integral part of the private browsing question, and working in similar testing for portable browsers would be a great way to progress our findings up to this point. The erratic nature of RAM recovery may be worth investigating further, as we previously stated, the memory dump containing a large amount of our private artifacts was taken immediately after the data generation browsing session. Time-sensitive experimentation that explores RAM data after an additional browsing session, or multiple tests on multiple future sessions increased incrementally, may be an effective way to test a realistic degree of expected reliability from RAM data when looking at a computer's browsing data.

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Appendix

Appendix 1: Chrome Public Data Generation

Time	User Action	Machine Action	Comments
11/9/2015 3:02 PM	Load pre-datagen snapshot and power on VM		From the Workstation interface, find 'Manage Snapshots' in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking "OK".
3:03	Sign into OS	Validation warning given on login.	Credentials provided on password sheet, however password is listed under 'hint' on failed login attempt.
3:04	Launch browser		Click on the desktop shortcut to initialize the browser.
3:05	Navigate to google.com		Type google.com into the address bar to access.
3:05	Sign into Gmail account	Elected not to auto sign-in.	Click on "Sign In" on the top right corner. Credentials utilized are provided in the password sheet.
3:05	Navigate to imgur.com		Type 'imgur' into the search bar and click on the result for http://www.imgur.com
3:06	Peruse imgur		Scroll down imgur's front page. Let more images load at the bottom of the screen at least 3 times.
3:08	Download an image	Saved a picture of a cat on top of someone's head. Named 'cathat.jpg' accordingly.	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select "Save Image As..." Detail the filename and appearance of the image.
3:09	Bookmark imgur		Click on the star on the right side of the address bar.
3:09	Navigate to Facebook		Type 'www.facebook.com' into the address bar to navigate.
3:10	Log in to Facebook		Credentials used can be found on Secret Server.
3:11	Like a page	Liked "8AM Crew".	Click on the "Like Pages" button which is towards the bottom of the menu on the left side of the screen. Like the first page that comes up on the "Top Suggestions" page that follows Document the name of the page

3:11	Message a friend	Word was “Herron”	Click the “Chat” tab at the bottom right of the screen Click on the designated friend Send the friend a ‘code word’; something distinct and unique. Document the code word.
3:13	Upload an image	Cathat.jpg was uploaded.	From the homepage, make a status update. Click “Add Photos/Video” and attached saved image from imgur. Name the test being carried out during this upload.
3:14	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
3:15	Get directions to Saskatchewan		Click on the blue Directions arrow to the right of the Search bar In the starting point field, type “My Location” In the destination field, type “Saskatchewan”
3:15	Navigate to Youtube.com		Type ‘youtube.com’ into the address bar to navigate.
3:16	Watch the ‘Corgi Flop’		Type ‘corgi flop’ into YouTube search bar and click on ‘Corgi Flop’ by geddesd21; watch the video.
3:17	Download Corgi Flop		Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
3:17	Navigate to Twitter and sign in		Type twitter.com into the address bar to navigate. The account credentials used were identical to the Facebook account.
3:19	Retweet something		Click on the first link under the ‘Trends’ tab on the left side of the screen. Retweet the first tweet; screencap it.
3:19	DM a follower	Word was Golf	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their ‘followers’ list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique ‘code word’ and document who the DM was sent to and what the word was.
3:20	Bookmark Twitter		See ‘Bookmark imgur’ above

3:21	Navigate to /r/duck		Type 'reddit.com/r/duck' into the address bar and click on the first result to navigate.
3:21	Download a .gif of a duck		Find an entry on /r/duck called 'ducks on ice' Click on it to navigate. Click the download button on the bottom right corner of the image. Save as 'ducks.gif'.
3:21	Navigate to Wikipedia		Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site. Click 'English' to access https://en.wikipedia.org/
3:22	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
3:22	Bookmark page		Click on the star to the right of the address bar to favorite.
3:23	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
3:24	Sign into Amazon		Sign into Amazon by clicking 'login' in the top right corner. Login using credentials in the password sheet.
3:25	Find a "BEAVER THING" T-Shirt		At the search bar atop the homepage, type in 'Champlain college' and click on the suggestion 'Champlain College – All Departments' Click on the first result; BEAVER "THING" BLACK T SHIRT by STUFF WITH ATTITUDE Right-click on the t-shirt's thumbnail, click on 'Save image as...' Save to downloads directory as 'shirt.jpg'
3:25	Find a Red Sox baseball cap		Type 'red sox hat' in the search bar Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand Click 'Add to Cart'
3:25	Navigate to gmail		Type 'gmail.com' into the address bar to navigate.
3:26	Send an email	Sent cathat.jpg and ducks.gif.	Click 'Compose' Send an email to a designated address Name the subject in accordance to the test being run. (e.g Chrome Public)

			Attach at least two files retrieved during the session – document which ones.
3:27	Navigate to American Express		Search ‘American Express’ in the address bar and click on the result for www.americanexpress.com to navigate
3:28	Attempt to login		On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
3:31	Crash the browser		Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.
3:32	Run DumpIt	Destination: Desktop/<USER>-P C-20151109020320 1.raw	On the desktop, click the DumpIt icon. When prompted to run, input ‘y’ and allow it to execute the dump.
3:34	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
3:39	Power down VM		Click Start>Shut down from within the VM

Table 6: Chrome Public

Appendix 2: Chrome Private Data Generation

Time	User Action	Machine Action	Comments
11/13/2015 3:20 PM	Load pre-datagen snapshot and power on VM		From the Workstation interface, find ‘Manage Snapshots’ in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking “OK”.
3:20	Sign into OS		Credentials provided on password sheet, however password is listed under ‘hint’ on failed login attempt.
3:20	Launch browser		Click on the desktop shortcut to initialize the browser.
3:21	Launch Incognito window		
3:21	Navigate to google.com		Type google.com into the address bar to access.
3:21	Sign into Gmail account	Elected not to auto sign-in.	Click on “Sign In” on the top right corner. Credentials utilized are provided in the password sheet.
3:21	Navigate to imgur.com		Type ‘imgur’ into the search bar and click on the result for http://www.imgur.com

3:22	Peruse imgur		Scroll down imgur’s front page. Let more images load at the bottom of the screen at least 3 times.
3:22	Download an image	Saved a picture of a little boy clutching some sand. Named “sand.png” appropriately.	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select “Save Image As...” Detail the filename and appearance of the image.
3:24	Bookmark imgur		Click on the star on the right side of the address bar.
3:24	Navigate to Facebook		Type ‘www.facebook.com’ into the address bar to navigate.
3:24	Log in to Facebook		Credentials used can be found on Secret Server.
3:25	Like a page	Liked “Benjamin Jon Burr Music”	Click on the “Like Pages” button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the “Top Suggestions” page that follows Document the name of the page
3:26	Message a friend	Word was “Kepler”	Click the “Chat” tab at the bottom right of the screen Click on Joseph Mitchell Send Joe a ‘code word’; something distinct and unique. Document the code word.
3:26	Upload an image	Sand.png uploaded.	From the homepage, make a status update. Click “Add Photos/Video” and attached saved image from imgur. Name the test being carried out during this upload.
3:27	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
3:27	Get directions to Saskatchewan		Click on the blue Directions arrow to the right of the Search bar In the starting point field, type “My Location” In the destination field, type “Saskatchewan”
3:27	Navigate to Youtube.com		Type ‘youtube.com’ into the address bar to navigate.
3:28	Watch the ‘Corgi Flop’		Type ‘corgi flop’ into YouTube search bar and click on ‘Corgi Flop’ by geddesd21; watch the video.

3:29	Download Corgi Flop		Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
3:30	Navigate to Twitter and sign in		Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
3:32	Retweet something		Click on the first link under the 'Trends' tab on the left side of the screen. Retweet the first tweet; screencap it.
3:32	DM a follower	Word was Juliet	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their 'followers' list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique 'code word' and document who the DM was sent to and what the word was.
3:32	Bookmark Twitter		See 'Bookmark imgur' above
3:33	Navigate to /r/duck		Type 'reddit.com/r/duck' into the address bar and click on the first result to navigate.
3:33	Download a .gif of a duck		Find an entry on /r/duck called 'ducks on ice' Click on it to navigate. Click the download button on the bottom right corner of the image. Save as 'ducks.gif'.
3:33	Navigate to Wikipedia		Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site. Click 'English' to access https://en.wikipedia.org/
3:33	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
3:33	Bookmark page		Click on the star to the right of the address bar to favorite.
3:34	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
3:34	Sign into Amazon		Sign into Amazon by clicking 'login' in the top right corner. Login using credentials in the password sheet.

3:35	Find a “BEAVER THING” T-Shirt		<p>At the search bar atop the homepage, type in ‘Champlain college’ and click on the suggestion ‘Champlain College – All Departments’</p> <p>Click on the first result; BEAVER “THING” BLACK T SHIRT by STUFF WITH ATTITUDE</p> <p>Right-click on the t-shirt’s thumbnail, click on ‘Save image as...’</p> <p>Save to downloads directory as ‘shirt.jpg’</p>
3:36	Find a Red Sox baseball cap		<p>Type ‘red sox hat’ in the search bar</p> <p>Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand</p> <p>Click ‘Add to Cart’</p>
3:37	Navigate to gmail		Type ‘gmail.com’ into the address bar to navigate.
3:37	Send an email	Sent cathat.jpg and ducks.gif.	<p>Click ‘Compose’</p> <p>Send an email to a designated address</p> <p>Name the subject in accordance to the test being run. (e.g Chrome Public)</p> <p>Attach at least two files retrieved during the session – document which ones.</p>
3:37	Navigate to American Express		<p>Search ‘American Express’ in the address bar and click on the result for www.americanexpress.com to navigate</p>
3:38	Attempt to login		On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
3:42	Crash the browser		<p>Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.</p>
3:44	Run DumpIt	Destination: C:/Users/<USER>/Desktop/	On the desktop, click the DumpIt icon. When prompted to run, input ‘y’ and allow it to execute the dump.
3:47	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
3:52	Power down VM	Update applied.	Click Start>Shut down from within the VM

Table 7: Chrome Private

Appendix 3: Internet Explorer Public Data Generation

Time	User Action	Machine Action	Comments
11/9/2015 4:15 PM	Load pre-datagen snapshot and power on VM		From the Workstation interface, find 'Manage Snapshots' in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking "OK".
4:17	Sign into OS	Validation warning given on login.	Credentials provided on password sheet, however password is listed under 'hint' on failed login attempt.
4:17	Launch browser		Click on the desktop shortcut to initialize the browser.
4:17	Navigate to google.com		Type google.com into the address bar to access.
4:19	Sign into Gmail account	Elected not to auto sign-in.	Click on "Sign In" on the top right corner. Credentials utilized are provided in the password sheet.
4:20	Navigate to imgur.com		Type 'imgur' into the search bar and click on the result for http://www.imgur.com
4:22	Peruse imgur		Scroll down imgur's front page. Let more images load at the bottom of the screen at least 3 times.
4:24	Download an image	Saved the title picture of a presentation on private browsing. Called 'private browsing.png'.	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select "Save Image As..." Detail the filename and appearance of the image.
4:24	Bookmark imgur		Click on the star on the right side of the address bar.
4:24	Navigate to Facebook		Type 'www.facebook.com' into the address bar to navigate.
4:25	Log in to Facebook		Credentials used can be found on Secret Server.
4:26	Like a page	Liked "The Open Door Project"	Click on the "Like Pages" button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the "Top Suggestions" page that follows Document the name of the page
4:27	Message a friend	Word was "Diesel"	Click the "Chat" tab at the bottom right of the screen Click on Joseph Mitchell

			Send Joe a 'code word'; something distinct and unique. Document the code word.
4:25	Upload an image	Lighthouse.jpg (Sample picture) uploaded. Done out of order unintentionally.	From the homepage, make a status update. Click "Add Photos/Video" and attached saved image from imgur. Name the test being carried out during this upload.
4:27	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
4:27	Get directions to Saskatchewan		Click on the blue Directions arrow to the right of the Search bar In the starting point field, type "My Location" In the destination field, type "Saskatchewan"
4:28	Navigate to Youtube.com		Type 'youtube.com' into the address bar to navigate.
4:28	Watch the 'Corgi Flop'		Type 'corgi flop' into YouTube search bar and click on 'Corgi Flop' by geddesd21; watch the video.
4:30	Download Corgi Flop		Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
4:30	Navigate to Twitter and sign in		Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
4:32	Retweet something		Click on the first link under the 'Trends' tab on the left side of the screen. Retweet the first tweet; screencap it.
4:34	DM a follower	Word was Hotel	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their 'followers' list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique 'code word' and document who the DM was sent to and what the word was.
4:34	Bookmark Twitter		See 'Bookmark imgur' above
4:34	Navigate to /r/duck		Type 'reddit.com/r/duck' into the address bar and click on the first result to navigate.
4:35	Download a .gif of a duck		Find an entry on /r/duck called 'ducks on ice' Click on it to navigate.

			Click the download button on the bottom right corner of the image. Save as 'ducks.gif'.
4:35	Navigate to Wikipedia		Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site. Click 'English' to access https://en.wikipedia.org/
4:36	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
4:36	Bookmark page		Click on the star to the right of the address bar to favorite.
4:36	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
4:37	Sign into Amazon		Sign into Amazon by clicking 'login' in the top right corner. Login using credentials in the password sheet.
4:37	Find a "BEAVER THING" T-Shirt		At the search bar atop the homepage, type in 'Champlain college' and click on the suggestion 'Champlain College – All Departments' Click on the first result; BEAVER "THING" BLACK T SHIRT by STUFF WITH ATTITUDE Right-click on the t-shirt's thumbnail, click on 'Save image as...' Save to downloads directory as 'shirt.jpg'
4:38	Find a Red Sox baseball cap		Type 'red sox hat' in the search bar Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand Click 'Add to Cart'
4:38	Navigate to gmail		Type 'gmail.com' into the address bar to navigate.
4:39	Send an email	Sent shirt.jpg and Corgi Flop.mp4	Click 'Compose' Send an email to a designated address Name the subject in accordance to the test being run. (e.g Chrome Public) Attach at least two files retrieved during the session – document which ones.
4:40	Navigate to American Express		Search 'American Express' in the address bar and click on the result for www.americanexpress.com to navigate

4:40	Attempt to login	Login 'credentials' were identical to gmail	On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
4:43	Crash the browser		Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.
5:07	Run DumpIt	Destination: C:/Users/<USER>/Desktop/ Memory compression required for RAM dump	On the desktop, click the DumpIt icon. When prompted to run, input 'y' and allow it to execute the dump.
5:19	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
5:19	Power down VM		Click Start>Shut down from within the VM

Table 8: IE Public

Appendix 4: Internet Explorer Private Data Generation

Time	User Action	Machine Action	Comments
11/13/2015 2:42PM	Load pre-datagen snapshot and power on VM		From the Workstation interface, find 'Manage Snapshots' in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking "OK".
2:43	Sign into OS	Validation warning given on login. (VM issue.)	Credentials provided on password sheet, however password is listed under 'hint' on failed login attempt.
2:43	Launch browser		Click on the desktop shortcut to initialize the browser.
2:43	Launch InPrivate browsing session		Click the gearhead on the top-right of the task bar, navigate to Safety > InPrivate Browsing
2:44	Navigate to google.com		Type google.com into the address bar to access.
2:44	Sign into Gmail account	Elected not to auto sign-in.	Click on "Sign In" on the top right corner. Credentials utilized are provided in the password sheet.
2:45	Navigate to imgur.com		Type 'imgur' into the search bar and click on the result for http://www.imgur.com

2:45	Peruse imgur		Scroll down imgur’s front page. Let more images load at the bottom of the screen at least 3 times.
2:45	Download an image	Saved a picture of Shia Lebeouf watching Transformers. Named “shia lebeouf.jpg”	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select “Save Image As...” Detail the filename and appearance of the image.
2:46	Bookmark imgur		Click on the star on the right side of the address bar.
2:47	Navigate to Facebook		Type ‘www.facebook.com’ into the address bar to navigate.
2:47	Log in to Facebook		Credentials used can be found on Secret Server.
2:14	Like a page	Liked “Olivetree Photography”	Click on the “Like Pages” button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the “Top Suggestions” page that follows Document the name of the page
2:15	Message a friend	Word was “Lovelace”	Click the “Chat” tab at the bottom right of the screen Click on Joseph Mitchell Send Joe a ‘code word’; something distinct and unique. Document the code word.
2:15	Upload an image	Uploaded Shia Lebeouf.jpg	From the homepage, make a status update. Click “Add Photos/Video” and attached saved image from imgur. Name the test being carried out during this upload.
2:48	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
2:50	Get directions to Saskatchewan		Click on the blue Directions arrow to the right of the Search bar In the starting point field, type “My Location” In the destination field, type “Saskatchewan”
2:50	Navigate to Youtube.com		Type ‘youtube.com’ into the address bar to navigate.
2:51	Watch the ‘Corgi Flop’		Type ‘corgi flop’ into YouTube search bar and click on ‘Corgi Flop’ by geddesd21; watch the video.

2:52	Download Corgi Flop		Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
2:52	Navigate to Twitter and sign in		Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
2:23	Retweet something		Click on the first link under the 'Trends' tab on the left side of the screen. Retweet the first tweet; screencap it.
2:23	DM a follower	Word was India	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their 'followers' list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique 'code word' and document who the DM was sent to and what the word was.
2:53	Bookmark Twitter		See 'Bookmark imgur' above
2:53	Navigate to /r/duck		Type 'reddit.com/r/duck' into the address bar and click on the first result to navigate.
2:54	Download a .gif of a duck		Find an entry on /r/duck called 'ducks on ice' Click on it to navigate. Click the download button on the bottom right corner of the image. Save as 'ducks.gif'.
2:54	Navigate to Wikipedia		Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site. Click 'English' to access https://en.wikipedia.org/
2:55	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
2:55	Bookmark page		Click on the star to the right of the address bar to favorite.
2:55	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
2:56	Sign into Amazon		Sign into Amazon by clicking 'login' in the top right corner. Login using credentials in the password sheet.

2:56	Find a “BEAVER THING” T-Shirt		<p>At the search bar atop the homepage, type in ‘Champlain college’ and click on the suggestion ‘Champlain College – All Departments’</p> <p>Click on the first result; BEAVER “THING” BLACK T SHIRT by STUFF WITH ATTITUDE</p> <p>Right-click on the t-shirt’s thumbnail, click on ‘Save image as...’</p> <p>Save to downloads directory as ‘shirt.jpg’</p>
2:56	Find a Red Sox baseball cap		<p>Type ‘red sox hat’ in the search bar</p> <p>Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand</p> <p>Click ‘Add to Cart’</p>
2:57	Navigate to gmail		Type ‘gmail.com’ into the address bar to navigate.
2:58	Send an email	Sent shia lebeouf.jpg and ducks.gif	<p>Click ‘Compose’</p> <p>Send an email to a designated address</p> <p>Name the subject in accordance to the test being run. (e.g Chrome Public)</p> <p>Attach at least two files retrieved during the session – document which ones.</p>
2:59	Navigate to American Express		Search ‘American Express’ in the address bar and click on the result for www.americanexpress.com to navigate
2:59	Attempt to login	Login ‘credentials’ were identical to gmail	On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
3:11	Crash the browser		Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.
3:12	Run DumpIt	<p>Destination: C:/Users/<USER>/Desktop/</p> <p>Memory compression required for RAM dump</p>	On the desktop, click the DumpIt icon. When prompted to run, input ‘y’ and allow it to execute the dump.
3:16	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen

			snapshot. Record the browser and type of test that was run, public or private.
3:16	Power down VM		Click Start>Shut down from within the VM
	Download VM		Right-click on the VM name from the VMWare library, go to 'Manage', and select Download. Save to designated VM folder.

Table 9: IE Private

Appendix 5: Firefox Public Data Generation

Time	User Action	Machine Action	Comments
11/11/2015 Times are VM recorded 11/9/2015 1:13	Load pre-datagen snapshot and power on VM		From the Workstation interface, find 'Manage Snapshots' in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking "OK".
n/a	Sign into OS		Credentials provided on password sheet, however password is listed under 'hint' on failed login attempt.
1:13	Launch browser		Click on the desktop shortcut to initialize the browser.
1:14	Navigate to google.com		Type google.com into the address bar to access.
1:15	Sign into Gmail account		Click on "Sign In" on the top right corner. Credentials utilized are provided in the password sheet.
1:16	Navigate to imgur.com		Type 'imgur' into the search bar and click on the result for http://www.imgur.com
1:16	Peruse imgur		Scroll down imgur's front page. Let more images load at the bottom of the screen at least 3 times.
1:17	Download an image	Saved a picture of Abe Simpson as cup.jpeg In VM pictures directory on user folder	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select "Save Image As..." Detail the filename and appearance of the image.
1:17	Bookmark imgur		Click on the star on the right side of the address bar.
1:17	Navigate to Facebook		Type 'www.facebook.com' into the address bar to navigate.
1:18	Log in to Facebook	Opted to not stay signed in	Credentials used can be found on Secret Server.

1:19	Like a page	Liked "iFishVT"	Click on the "Like Pages" button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the "Top Suggestions" page that follows Document the name of the page
1:20	Message a friend	Word was "birds"	Click the "Chat" tab at the bottom right of the screen Click on Joseph Mitchell Send Joe a 'code word'; something distinct and unique. Document the code word.
1:21	Upload an image	cup.jpg was uploaded.	From the homepage, make a status update. Click "Add Photos/Video" and attached saved image from imgur. Name the test being carried out during this upload.
1:21	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
1:22	Get directions to Saskatchewan	Would not locate my location, input Burlington VT	Click on the blue Directions arrow to the right of the Search bar In the starting point field, type "My Location" In the destination field, type "Saskatchewan"
1:23	Navigate to Youtube.com		Type 'youtube.com' into the address bar to navigate.
1:23	Watch the 'Corgi Flop'		Type 'corgi flop' into YouTube search bar and click on 'Corgi Flop' by geddesd21; watch the video.
1:24	Download Corgi Flop	Corgi_Flop.mp4 (720p) Downloads directory	Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
1:25 (12:00)	Navigate to Twitter and sign in	Twitter page is mostly broken, text and some links appear but signing in is not an option (fixed)	Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
n/a (12:01)	Retweet something	Broken site (retweeted Peanuts Movie Veterans Day post)	Click on the first link under the 'Trends' tab on the left side of the screen. Retweet the first tweet; screencap it.
(12:03)	DM a follower	Code is 'peanuts'	To send a direct message, navigate to the user profile by clicking on the profile picture of

			<p>the account signed in. Navigate through their 'followers' list and choose one. To send a DM, click on the small chat bubble icon.</p> <p>Send them a unique 'code word' and document who the DM was sent to and what the word was.</p>
1:27	Bookmark Twitter		See 'Bookmark imgur' above
10:39	Navigate to /r/duck	Site was broken, determined it was due to system clock being off, going back to twitter	Type 'reddit.com/r/duck' into the address bar and click on the first result to navigate.
12:05	Download a .gif of a duck	iQtizMG – Imgur.gif	<p>Find an entry on /r/duck called 'ducks on ice' Click on it to navigate.</p> <p>Click the download button on the bottom right corner of the image.</p> <p>Save as 'ducks.gif'.</p>
12:06	Navigate to Wikipedia		<p>Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site.</p> <p>Click 'English' to access https://en.wikipedia.org/</p>
12:06	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
12:06	Bookmark page		Click on the star to the right of the address bar to favorite.
12:07	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
12:08	Sign into Amazon		<p>Sign into Amazon by clicking 'login' in the top right corner.</p> <p>Login using credentials in the password sheet.</p>
12:08	Find a "BEAVER THING" T-Shirt		<p>At the search bar atop the homepage, type in 'Champlain college' and click on the suggestion 'Champlain College – All Departments'</p> <p>Click on the first result; BEAVER "THING" BLACK T SHIRT by STUFF WITH ATTITUDE</p> <p>Right-click on the t-shirt's thumbnail, click on 'Save image as...'</p> <p>Save to downloads directory as 'shirt.jpg'</p>

12:09	Find a Red Sox baseball cap		Type 'red sox hat' in the search bar Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand Click 'Add to Cart'
12:10	Navigate to gmail	Signing in required verification. Provided cell phone number to receive activation code	Type 'gmail.com' into the address bar to navigate.
12:11	Send an email	Sent cup.jpg and iQtizMG - Imgur.gif.	Click 'Compose' Send an email to a designated address Name the subject in accordance to the test being run. (e.g Chrome Public) Attach at least two files retrieved during the session – document which ones.
12:13	Navigate to American Express		Search 'American Express' in the address bar and click on the result for www.americanexpress.com to navigate
10:54	Attempt to login	User: pumpkinseeds Pass: peanuts	On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
12:15	Crash the browser	Ran page, browser did not crash. Closed out	Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.
10:56	Run DumpIt	Destination: C:/Users/<USER>/Desktop/	On the desktop, click the DumpIt icon. When prompted to run, input 'y' and allow it to execute the dump.
11:05	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
11:05	Power down VM		Click Start>Shut down from within the VM

Table 10: Firefox Public

Appendix 6: Firefox Private Data Generation

Time	User Action	Machine Action	Comments
11/11/2015 10:10	Load pre-datagen snapshot and power on VM		From the Workstation interface, find 'Manage Snapshots' in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking "OK".

10:11	Sign into OS		Credentials provided on password sheet, however password is listed under 'hint' on failed login attempt.
10:12	Launch browser		Click on the desktop shortcut to initialize the browser.
n/a	Navigate to google.com		Type google.com into the address bar to access.
n/a	Sign into Gmail account		Click on "Sign In" on the top right corner. Credentials utilized are provided in the password sheet.
10:12	Navigate to imgur.com	Accidentally performed Public search of Imgur. Opened Private here at (10:12)	Type 'imgur' into the search bar and click on the result for http://www.imgur.com
10:15	Peruse imgur	Would not load subsequent pages until 10:17 after what I can only assume to be java script errors	Scroll down imgur's front page. Let more images load at the bottom of the screen at least 3 times.
10:19	Download an image	Saved a picture of Ninja Turtles as ninjaturtles.jpeg In VM pictures directory on user folder	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select "Save Image As..." Detail the filename and appearance of the image.
10:20	Bookmark imgur		Click on the star on the right side of the address bar.
10:20	Navigate to Facebook		Type 'www.facebook.com' into the address bar to navigate.
10:23	Log in to Facebook	Opted to not stay signed in	Credentials used can be found on Secret Server.
10:24	Like a page	Liked "Streets Finest"	Click on the "Like Pages" button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the "Top Suggestions" page that follows Document the name of the page
10:25	Message a friend	Word was "stagnant"	Click the "Chat" tab at the bottom right of the screen Click on Joseph Mitchell Send Joe a 'code word'; something distinct and unique. Document the code word.

10:26	Upload an image	ninjaturtles.jpg was uploaded.	From the homepage, make a status update. Click “Add Photos/Video” and attached saved image from imgur. Name the test being carried out during this upload.
10:26	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
10:29	Get directions to Saskatchewan	Would not locate my location, input Burlington VT	Click on the blue Directions arrow to the right of the Search bar In the starting point field, type “My Location” In the destination field, type “Saskatchewan”
10:31	Navigate to Youtube.com		Type ‘youtube.com’ into the address bar to navigate.
10:31	Watch the ‘Corgi Flop’		Type ‘corgi flop’ into YouTube search bar and click on ‘Corgi Flop’ by geddesd21; watch the video.
10:32	Download Corgi Flop	Corgi_Flop.mp4 (720p)	Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
10:34	Navigate to Twitter and sign in	Don’t remember me	Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
10:35	Retweet something	GMC @This is GMC	Click on the first link under the ‘Trends’ tab on the left side of the screen. Retweet the first tweet; screenshot it.
10:37	DM a follower	Word was Toast DANIELLE Victoria	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their ‘followers’ list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique ‘code word’ and document who the DM was sent to and what the word was.
10:38	Bookmark Twitter		See ‘Bookmark imgur’ above
10:39	Navigate to /r/duck		Type ‘reddit.com/r/duck’ into the address bar and click on the first result to navigate.
10:40	Download a .gif of a duck	iQtizMG – Imgur.gif	Find an entry on /r/duck called ‘ducks on ice’ Click on it to navigate. Click the download button on the bottom right corner of the image.

			Save as 'ducks.gif'.
10:41	Navigate to Wikipedia		Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site. Click 'English' to access https://en.wikipedia.org/
10:41	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
10:42	Bookmark page		Click on the star to the right of the address bar to favorite.
10:42	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
10:43	Sign into Amazon		Sign into Amazon by clicking 'login' in the top right corner. Login using credentials in the password sheet.
10:43	Find a "BEAVER THING" T-Shirt		At the search bar atop the homepage, type in 'Champlain college' and click on the suggestion 'Champlain College – All Departments' Click on the first result; BEAVER "THING" BLACK T SHIRT by STUFF WITH ATTITUDE Right-click on the t-shirt's thumbnail, click on 'Save image as...' Save to downloads directory as 'shirt.jpg'
10:44	Find a Red Sox baseball cap		Type 'red sox hat' in the search bar Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand Click 'Add to Cart'
10:44-10:49	Navigate to gmail	Signing in required verification. Provided cell phone number to receive activation code	Type 'gmail.com' into the address bar to navigate.
10:50	Send an email	Sent ninjaturtles.jpg and iQtizMG - Imgur.gif.	Click 'Compose' Send an email to a designated address Name the subject in accordance to the test being run. (e.g Chrome Public) Attach at least two files retrieved during the session – document which ones.

10:52	Navigate to American Express		Search ‘American Express’ in the address bar and click on the result for www.americanexpress.com to navigate
10:54	Attempt to login	Login: shrimply Pass: pibbles	On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
10:54	Crash the browser	Ran page, browser did not crash. Closed out	Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.
10:56	Run DumpIt	Destination: C:/Users/<USER>/Desktop/	On the desktop, click the DumpIt icon. When prompted to run, input ‘y’ and allow it to execute the dump.
11:05	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
11:05	Power down VM		Click Start>Shut down from within the VM

Table 11: Firefox Private

Appendix 7: Safari Public Data Generation

Time	User Action	Machine Action	Comments
11/18/2015 Times are VM recorded	Load pre-datagen snapshot and power on VM		From the Workstation interface, find ‘Manage Snapshots’ in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking “OK”.
n/a	Sign into OS		Credentials provided on password sheet, however password is listed under ‘hint’ on failed login attempt.
11:10	Launch browser in private mode		Click on the desktop shortcut to initialize the browser.
11:12	Navigate to google.com		Type google.com into the address bar to access.
n/a	Sign into Gmail account		Click on “Sign In” on the top right corner. Credentials utilized are provided in the password sheet.
11:13	Navigate to imgur.com		Type ‘imgur’ into the search bar and click on the result for http://www.imgur.com
11:14	Peruse imgur		Scroll down imgur’s front page. Let more images load at the bottom of the screen at least 3 times.

11:14	Download an image	Saved a picture of Abe Simpson as cup.jpeg In VM pictures directory on user folder	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select "Save Image As..." Detail the filename and appearance of the image.
11:16	Bookmark imgur		Click on the star on the right side of the address bar.
11:17	Navigate to Facebook		Type 'www.facebook.com' into the address bar to navigate.
11:18	Log in to Facebook	Opted to not stay signed in	Credentials used can be found on Secret Server.
11:19	Like a page	Liked "VT Gas"	Click on the "Like Pages" button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the "Top Suggestions" page that follows Document the name of the page
11:21	Message a friend	Word was "luck"	Click the "Chat" tab at the bottom right of the screen Click on Joseph Mitchell Send Joe a 'code word'; something distinct and unique. Document the code word.
11:22	Upload an image	cup.jpg was uploaded.	From the homepage, make a status update. Click "Add Photos/Video" and attached saved image from imgur. Name the test being carried out during this upload.
11:23	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
11:24	Get directions to Saskatchewan	Would not locate my location, input Burlington VT	Click on the blue Directions arrow to the right of the Search bar In the starting point field, type "My Location" In the destination field, type "Saskatchewan"
11:25	Navigate to Youtube.com		Type 'youtube.com' into the address bar to navigate.
11:25	Watch the 'Corgi Flop'		Type 'corgi flop' into YouTube search bar and click on 'Corgi Flop' by geddesd21; watch the video.
11:28	Download Corgi Flop	Corgi_Flop.mp4 (720p) Downloads directory	Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/

			Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
11:30	Navigate to Twitter and sign in		Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
11:32	Retweet something		Click on the first link under the ‘Trends’ tab on the left side of the screen. Retweet the first tweet; screenshot it.
11:32	DM a follower	Code is ‘Orange’	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their ‘followers’ list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique ‘code word’ and document who the DM was sent to and what the word was.
11:33	Bookmark Twitter		See ‘Bookmark imgur’ above
11:35	Navigate to /r/duck		Type ‘reddit.com/r/duck’ into the address bar and click on the first result to navigate.
11:36	Download a .gif of a duck	iQtizMG – Imgur.gif	Find an entry on /r/duck called ‘ducks on ice’ Click on it to navigate. Click the download button on the bottom right corner of the image. Save as ‘ducks.gif’.
11:38	Navigate to Wikipedia		Type ‘wikipedia’ into the omnibox/search bar and click on the first result to access the site. Click ‘English’ to access https://en.wikipedia.org/
11:38	Search ‘Duck Hunt’; peruse article		Type ‘duck hunt’ into the search bar on the top right of the page. Scroll from top to bottom of the page.
11:40	Bookmark page		Click on the star to the right of the address bar to favorite.
12:41	Navigate to Amazon		Type “amazon.com” into the address bar to be redirected to the site.
12:43	Sign into Amazon		Sign into Amazon by clicking ‘login’ in the top right corner. Login using credentials in the password sheet.
12:43	Find a “BEAVER THING” T-Shirt		At the search bar atop the homepage, type in ‘Champlain college’ and click on the

			<p>suggestion ‘Champlain College – All Departments’</p> <p>Click on the first result; BEAVER “THING” BLACK T SHIRT by STUFF WITH ATTITUDE</p> <p>Right-click on the t-shirt’s thumbnail, click on ‘Save image as...’</p> <p>Save to downloads directory as ‘shirt.jpg’</p>
12:45	Find a Red Sox baseball cap		<p>Type ‘red sox hat’ in the search bar</p> <p>Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand</p> <p>Click ‘Add to Cart’</p>
12:46	Navigate to gmail		Type ‘gmail.com’ into the address bar to navigate.
12:48	Send an email	Sent cup.jpg and iQtizMG - Imgur.gif.	<p>Click ‘Compose’</p> <p>Send an email to a designated address</p> <p>Name the subject in accordance to the test being run. (e.g Chrome Public)</p> <p>Attach at least two files retrieved during the session – document which ones.</p>
12:50	Navigate to American Express		<p>Search ‘American Express’ in the address bar and click on the result for www.americanexpress.com to navigate</p>
12:50	Attempt to login	User: dubby Pass: grubs	On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
12:55	Crash the browser	Ran page, browser did not crash. Closed out	<p>Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.</p>
1:01	Run DumpIt	Destination: C:/Users/<USER>/Desktop/	On the desktop, click the DumpIt icon. When prompted to run, input ‘y’ and allow it to execute the dump.
1:05	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
	Power down VM		Click Start>Shut down from within the VM
	Download VM		Right-click on the VM name from the VMWare library, go to ‘Manage’, and select Download. Save to designated VM folder.

Table 12: Safari Public

Appendix 8: Safari Private Data Generation

Time	User Action	Machine Action	Comments
11/18/2015 Times are VM recorded	Load pre-datagen snapshot and power on VM		From the Workstation interface, find 'Manage Snapshots' in the center-left side of the top taskbar and choose to load the prepared snapshot. The VM will power on automatically upon clicking "OK".
n/a	Sign into OS		Credentials provided on password sheet, however password is listed under 'hint' on failed login attempt.
8:39	Launch browser in private mode		Click on the desktop shortcut to initialize the browser.
8:43	Navigate to google.com		Type google.com into the address bar to access.
n/a	Sign into Gmail account		Click on "Sign In" on the top right corner. Credentials utilized are provided in the password sheet.
1:16	Navigate to imgur.com		Type 'imgur' into the search bar and click on the result for http://www.imgur.com
1:16	Peruse imgur		Scroll down imgur's front page. Let more images load at the bottom of the screen at least 3 times.
1:17	Download an image	Saved a picture of Abe Simpson as cup.jpeg In VM pictures directory on user folder	Find a picture on the imgur front page. Click on the image to navigate to its page; then right-click on it and select "Save Image As..." Detail the filename and appearance of the image.
1:17	Bookmark imgur		Click on the star on the right side of the address bar.
1:17	Navigate to Facebook		Type 'www.facebook.com' into the address bar to navigate.
1:18	Log in to Facebook	Opted to not stay signed in	Credentials used can be found on Secret Server.
1:19	Like a page	Liked "iFishVT"	Click on the "Like Pages" button which is towards the bottom of the menu on the left side of the screen Like the first page that comes up on the "Top Suggestions" page that follows Document the name of the page
1:20	Message a friend	Word was "birds"	Click the "Chat" tab at the bottom right of the screen Click on Joseph Mitchell

			Send Joe a 'code word'; something distinct and unique. Document the code word.
1:21	Upload an image	cup.jpg was uploaded.	From the homepage, make a status update. Click "Add Photos/Video" and attached saved image from imgur. Name the test being carried out during this upload.
1:21	Navigate to Google Maps		Type http://www.google.com/maps/ into address bar
1:22	Get directions to Saskatchewan	Would not locate my location, input Burlington VT	Click on the blue Directions arrow to the right of the Search bar In the starting point field, type "My Location" In the destination field, type "Saskatchewan"
1:23	Navigate to Youtube.com		Type 'youtube.com' into the address bar to navigate.
1:23	Watch the 'Corgi Flop'		Type 'corgi flop' into YouTube search bar and click on 'Corgi Flop' by geddesd21; watch the video.
1:24	Download Corgi Flop	Corgi_Flop.mp4 (720p) Downloads directory	Navigate to: http://en.savefrom.net/1-how-to-download-youtube-video/ Paste the link from Corgi Flop to the URL above. Download as corgi.mp4
1:25 (12:00)	Navigate to Twitter and sign in	Twitter page is mostly broken, text and some links appear but signing in is not an option (fixed)	Type twitter.com into the address bar to navigate. The account credentials are identical to the Facebook account.
n/a (12:01)	Retweet something	Broken site (retweeted Peanuts Movie Veterans Day post)	Click on the first link under the 'Trends' tab on the left side of the screen. Retweet the first tweet; screencap it.
(12:03)	DM a follower	Code is 'peanuts'	To send a direct message, navigate to the user profile by clicking on the profile picture of the account signed in. Navigate through their 'followers' list and choose one. To send a DM, click on the small chat bubble icon. Send them a unique 'code word' and document who the DM was sent to and what the word was.
1:27	Bookmark Twitter		See 'Bookmark imgur' above

10:39	Navigate to /r/duck	Site was broken, determined it was due to system clock being off, going back to twitter	Type 'reddit.com/r/duck' into the address bar and click on the first result to navigate.
12:05	Download a .gif of a duck	iQtizMG – Imgur.gif	Find an entry on /r/duck called 'ducks on ice' Click on it to navigate. Click the download button on the bottom right corner of the image. Save as 'ducks.gif'.
12:06	Navigate to Wikipedia		Type 'wikipedia' into the omnibox/search bar and click on the first result to access the site. Click 'English' to access https://en.wikipedia.org/
12:06	Search 'Duck Hunt'; peruse article		Type 'duck hunt' into the search bar on the top right of the page. Scroll from top to bottom of the page.
12:06	Bookmark page		Click on the star to the right of the address bar to favorite.
12:07	Navigate to Amazon		Type "amazon.com" into the address bar to be redirected to the site.
12:08	Sign into Amazon		Sign into Amazon by clicking 'login' in the top right corner. Login using credentials in the password sheet.
12:08	Find a "BEAVER THING" T-Shirt		At the search bar atop the homepage, type in 'Champlain college' and click on the suggestion 'Champlain College – All Departments' Click on the first result; BEAVER "THING" BLACK T SHIRT by STUFF WITH ATTITUDE Right-click on the t-shirt's thumbnail, click on 'Save image as...' Save to downloads directory as 'shirt.jpg'
12:09	Find a Red Sox baseball cap		Type 'red sox hat' in the search bar Click on first result; MLB '47 Clean Up Adjustable Hat, One Size Fits All by '47 Brand Click 'Add to Cart'
12:10	Navigate to gmail	Signing in required verification. Provided cell phone number to receive activation code	Type 'gmail.com' into the address bar to navigate.

12:11	Send an email	Sent cup.jpg and iQtizMG - Imgur.gif.	Click 'Compose' Send an email to a designated address Name the subject in accordance to the test being run. (e.g Chrome Public) Attach at least two files retrieved during the session – document which ones.
12:13	Navigate to American Express		Search 'American Express' in the address bar and click on the result for www.americanexpress.com to navigate
10:54	Attempt to login	User: pumpkinseeds Pass: peanuts	On the top-left login dropdown, type in phony account info and try to log in. You will be rejected.
12:15	Crash the browser	Ran page, browser did not crash. Closed out	Type http://www.newdream.net/crash/js2.html into the address bar and allow it to run until the browser crashes.
10:56	Run DumpIt	Destination: C:/Users/<USER>/Desktop/	On the desktop, click the DumpIt icon. When prompted to run, input 'y' and allow it to execute the dump.
11:05	Take snapshot		On the VMWare header, find the Add Snapshot button and create a post-data gen snapshot. Record the browser and type of test that was run, public or private.
11:05	Power down VM		Click Start>Shut down from within the VM
	Download VM		Right-click on the VM name from the VMWare library, go to 'Manage', and select Download. Save to designated VM folder.

Table 13: Safari Private