1 Literature review 2 - Digital forensic related datasets

1.1 Purpose of the literature review

Identify and summarize publicly available datasets that relates to digital forensic and consider their applicability for this thesis experiments. Table 1 shows examples of relevant datasets:

Catagory	Abbreviation	Example dataset
Forensics images	IMG	The Real Data Corpus (RDC)
Files	FILE	RAISE (RAw ImageS datasEt)
RAM contents	RAM	Memory Buddies Traces(MBT)
Network	NET	Common crawl
Malware	MAL	Kharon dataset
Email	EM	The Webb Spam Corpus 2011
SMS	SMS	The NUS SMS Corpus
Password	PASS	Yahoo Password Frequency
Phishing	PHI	Phishing Websites Data
Spam	SPAM	TREC 2011
Authorship	AUTH	Personae
Financial data/ fraud	FIN	CMS dataset
Forgery corpus	FORG	MICC-F2000
Collection of different datasets	COLL	CAIDA data

Table 1: Example of datasets

Decisions was made to limit the scope of the data collection, by excluding biometric datasets such as images of fingerprints, hand signature, gait, voice recognition and iris. But the review will include authorship attribution corpus.

1.2 Protocol/methodology

1. Search digital libraries and scan scientific articles for names, direct links or sources related to the datasets above and use this information on google search engine to identify individual datasets or repositories of datasets.

2. Document search phrases that resulted in identifying new datasets.

3. Repeat step 1 and 2 with other resources like github, keegle and figshare to locate more datsets.

1.3 Search phrases and justification

Documents was excluded from consideration if their title had little relation to information security, and if the document format was not easily searchable. An

example of the latter case is pdf documents scanned by a scanner machine, where full text search of the text content is not applicable. Without the assistance of search, the process of finding the datasets would be too time consuming.

In table 1.3 is a summary of the collection phase of the literature review. Entries included in this table all lead to finding new datasets. An entry has an ID number, search phrase + search options, database name (search resource) and the number of hits for the search phrase. Entries with ID 1-5 is essentially full text search (matching based on meta data and text content). Fulltext search lead to more false positives, then only meta search. But was used in cases where the number of hits was manageable. An example for when fulltext was deemed unmanageable can be seen in entry 6, where meta search was used instead. The phrase 'forensic dataset' was used to find different types of relevant datasets, but this phrase alone is not good enough. This is because relevant papers may use publicly available datasets, but does not contain the term 'forensic'. Therefore more specific search terms from list in subsection 1.1 was also used. In entry 9 the NOT operator was used to discard biometric datasets. Entry 10 in table 1.3 returned hits that both included the phrase 'IDS dataset' and the term 'Network' in the meta data, and excluded hits that contained some already known network datasets. The term IDS was used to reduce the number of non-network related articles. This term may exclude some relevant hits, but its usage is justified as the other search phrases also covered some network related datasets. In entry 16 the first 10 results was used on Google to look find datasets on Github. This was done as it was tricky to identify relevant repositories using Githubs internal search. In entry 18 figshare did not provide the number of hits. Therefore Not Available (N/A) is in the #Hits column for this entry.

ID	Search phrase (comma (,) separates search options)	DB	#Hits
1	forensic corpora, exact phrase match	a	22
2	forensic corpus', advanced search, both words must match (be present) in any field	b	9
3	forensic corpora', advanced search, both words must match (be present) in any field	b	3
4	forensic dataset', advanced search, both words must match (be present) in any field	b	61
5	forensic corpus, full text search	c	112
6	forensic dataset, in metadata only	d	94
7	malware dataset, in metadata only	d	174
8	((password dataset) NOT biometrics), in metadata only	d	19
9	Spam dataset, in metadata only	d	173
10	(((((((((((IDS dataset) AND Network) NOT DARPA) NOT KDD) NOT KDD99cup) NOT DARPA98) NOT DARPA99) NOT DARPA-98) NOT DARPA-99) NOT NSL-KDD), in metadata only	d	118
11	fraud dataset, in metadata only	d	104
12	Forensic dataset, in All Sources(Computer Science), no books	e	1100
13	fraud	f	10
14	spam	f	3
15	email	f	18
16	dataset github	g	576000
17	spam	h	107
18	network	h	N/A

[a] https://link.springer.com/
[b] http://dl.acm.org/
[c] http://search.arxiv.org
[d] http://ieeexplore.ieee.org/
[e] http://www.sciencedirect.com
[f] https://www.kaggle.com
[g] https://www.google.no/
[h] https://figshare.com/

Table 2: Search summary

1.4 Search summary - datasets:

During the collection phase of the literature review, two related reviews was identified. The first review was from 2014 and identified 7 datasets[1]. The second review is as recent as 2017 and compiled a list online of 79 digital forensic related datasets [2],[3]. This review expands on the two reviews and its findings where largely independent from the two previous works.

Table 3 is a summary of the identified datasets in this review. An entry in this table is explained in the list below:

- Column Item = Numbered Item.
- Column C = Contribution, where S=dataset was obtained by the aid of supervisors, I=Thesis author found the same dataset independently from

the two reviews [1, 2], R=The reviews[1, 2] identified datasets that was not obtained by this review, N=This review identified datasets not present in [1, 2].

- Column Acc = Access, where P=public and R=By request

- Column DT = Data type, where S = Synthetic, R=Real and H=Hybrid
  Column CAT= Catagory, where the catagories abbriviations is shown in table 1

- Column Size= Size is either given in S=samples, GigaBytes (comrpressed/uncompressed) or Not avaliable (N/A)

- Column Description= A description that will include the name of the dataset, where it can be downloaded from, include original paper if available and additional details about the dataset.

Table 3: Datasets

I	C	Acc	DT	Cat	Size	Description
1	I	P	R	AUTH	19320 S	A authorship corpus of 681288 Blog entries and 19320 problems[4],[5] Obtain dataset here
2	I	P	S	AUTH	20 S	A capture the flag (CTF) authorship corpus[6],[7]. The corpus have been used in the multi-classification problem of classifying the origin of the exploit attempts to one of 20 CTF teams. The data is available in JSON format and includes source and destination of attack, timing information and histogram of payload. Obtain dataset here
3	I	R	R	AUTH	609 S	Polish Corpus of Suicide Notes (PCSN) are real suicide letter written by both young and old polish men and women from the period of 1999-2009[8],[9]. Obtain dataset here
4	I	P	R	AUTH	12 S	The Brennan-Greenstadt corpus contains two documents from each of the 12 participating authors[10], [11]. In the first text the authors attempted to obfuscate the characteristics of their writing. And in the second text the authors tried to imitate the writing style of a different writer. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
5	I	R	R	AUTH	145 S	The paper claims that the size of the German corpus Personae makes it possible to classify the author of the text as well as the author personality[12],[13]. Personae consist of 145 bachelor student essays with lengths around 1400 words. The students, took a personality test. This test made classification of their personality possible. But it is difficult to infer from the sources [12],[13] whether the personality test is part of the dataset or not. Obtain dataset here
6	I	P	R	AUTH	12338 S	This corpus is a subset of the Enron dataset and can be used for authorship attribution and verification. 24% of the samples is from non-Enron authors while the rest is from the Enron set[14],[15]. Names and email addresses was omitted from the dataset. Obtain dataset here
7	I	P	R	AUTH	N/A	The dataset contains training and test data for several authorship attribution scenarios based on works of fiction. Each scenario has a different amount of authors, number of documents, and minimum word length[16],[15]. Obtain dataset here
8	I	P	R	AUTH	110 S	Authorship classification on English, Spanish and Greek texts. Most of the documents are in the word length range 1001-1500 words[17],[15]. Obtain dataset here
9	I	P	R	AUTH	4959 S	Authorship attribution corpus with documents written in English, Dutch, Spanish, and Greek[18], [15]. University students created the Dutch and English documents. And the Spanish and Greek documents was obtained from newspapers. Obtain dataset here
10	I	P	R	AUTH	3701 S	Authorship attribution corpus with documents written in English, Dutch, Spanish, and Greek. The authors of the Dutch documents was Students at a university in Belgium[19],[15]. English documents was taken from theatre plays. Spanish and Greek documents was obtained from opinion articles. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
11	I	P	R	AUTH	1000 S	Reddit Cross-Topic AV Corpus consist of 1000 reddit users and their comments from 2010-2016 on 1388 different subjects [20], [21]. Obtain dataset here
*	I	P	N/A	AUTH	750000 S	A dataset of 750000 UNIX commands[22], [23]. The commands are either from one of 50 legitimate users or a user imitating one of the 50. Each legitimate user has 5000 commands that is theirs and a random proportion of 10000 commands that is attribute to them or a masquerading person. Obtain dataset here
*	I	P	P,R	COLL	N/A	This website have compiled a list of available PCAP files online[24]. The list contain PCAP files that have been used in competitions, conferences, and PCAP files that contain malware or exploits. Obtain dataset here
*	I	P	N/A	COLL	≈ 1100 S	This website host a collection of PCAP files and malware samples[25]. Obtain dataset here
*	I	P	S,R	COLL	60507109 S_1 / 3465 S_2	A large publicly available searchable database that contains 60507109 packets and 3465 pcaps[26]. Obtain datasets here
*	I	P	S,R	COLL	N/A	PCAPsDB is a repository of different PCAP files, some of which are Malware[27]. Obtain dataset here
*	I	P	R	COLL	71 S	CAIDA Data: A collection that contains a mixture of publicly availably and by request network datasets[28]. These network dataset focuses on Autonomous System (AS) topology, denial of service attacks, worms, anonymized passive network traffic monitoring and darknet traffic. Obtain dataset here
12	I	P	R	EM	5000000 S	The Global Intelligence files (GIfiles) are a collection of 5 million leaked emails from Stratfor, that gives insight into how the intelligence community operates[29], [30]. Obtain dataset here
*	I	P	R	EM	60 MB S	≈ 7000 PDF pages of [US president candidate] Hillary Clinton emails was released as a result of a freedom of information claim[31]. The dataset contains both email content and metadata. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
*	I	P	R	EM	2500 S	419 fraud emails: Content and metadata from 2500 fraud emails[32]. Obtain dataset here
13	I	P	R	FILE	350GB N/A	RAISE (RAw ImageS datasEt): 8156 Unprocessed and high resolution images. The images are taken by the following cameras: Nikon D40, Nikon D90 and Nikon D7000[33], [34]. The original paper states that this dataset can be useful to test image forgery algorithms[33]. Obtain dataset here
14	I	R	R	FILE	10 billion S	SherLock is a Android Smartphone dataset that contains running application/process information, sensory data and OS data captured with normal user privileges[35], [36]. The dataset also have labels that can be assign to describe ongoing malicious activity on the phone. Obtain dataset here
15	I	R	R	FILE	5546565 S	AndroZoo dataset includes over 5 million android applications (APKs)[37],[38]. The APKs was obtained by crawling multiple APKs distributors such as google play, AppChina, torrents etc. Efforts was made to avoid downloading duplicate files from the same vendor. But creators of the dataset gives no guarantees that the same file was not downloaded from multiple vendors. Each sample contains a zipped apk file, with its byte code, meta data, signed certificate and miscellaneous files. Obtain dataset here
*	I	P	R	FIN	68MB / 284807 S	A numerical dataset of 284807 bank transactions[39], [40]. Of all the transactions only 492 of them are fraudulent. In the feature vector there are 28 principal components, the elapsed time between transactions, the transactions amount, and the fraud/not fraud class label. Obtain dataset here
*	I	P	R	FIN	> 100000 S	UCSD-FICO-09 is a electronic commerce fraud dataset with anonymized features [41], [42]. The numerical dataset has both labelled (training) and unlabelled(testing) samples. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
*	I	P	R	FIN	≈ 6 GB	CMS dataset: Real financial statements in .csv format from Centers for Medicare & Medicaid Services [US], in the year 2013-2016[43], [44]. Obtain dataset here
16	I	P	R	FORG	220/2000 S	MICC-F220 and MICC-F2000 are datasets that contains untouched images and images where parts of the image is modified by scaling, rotating and scaling[45], [46]. The datasets have been used to benchmark a copy-move forgery algorithm. Obtain dataset here
17	I	P	R	IMG	14 S	A collection of forensic images made/hosted by Brian Carrier[47]. The 14 forensic images can be divided up into the following categories: NTFS file systems, FAT file system, ISO9660 file system and a memory image. Brian created scenarios to test string search, partitions with multiple file systems, file carving etc. Obtain dataset here
18	I	R	R	IMG	70TB Compressed	The Real Data Corpus (RDC) is data collected of digital devices from the secondary market[48]. The dataset contains hard drives images, flash memory images and CDROMS. According Obtain dataset here
19	I	P	S	IMG	16 S	Computer Forensic Reference Data Sets (CFReDS) can be used for forensic tool testing[49]. CFReDS includes forensic images and simulated data for memory forensics, file carving, string search and file recovery. Obtain dataset here
20	I	R	R	MAL	29385674 S	VirusShare.com is a virus sharing website with currently 29385674 malware samples [50]. Obtain dataset here
21	I	P	R	MAL	≈ 500GB	A dataset for classifying known malware and their associated malware family[51]. There are in total 500GB worth of malware samples, that belongs into one of 9 families of malware. Obtain dataset here
22	I	R	R	MAL	5560 S	The Drebin Dataset have 5560 malicious android applications that can be categorized into one of 179 malware families[52], [53]. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
23	I	P	S	MAL	399 S	DroidWare is a malware dataset for the android platform. The dataset is made up of 278 benign and 121 malicious samples[54],[55]. Each sample has a 152 feature vector of Android application permissions. Obtain dataset here
24	I	P	S	MAL	4S	Synthetic dataset with 4 botnet samples. The botnet actions in each sample differs from injection, reconnaissance, command and control (C&C) communication channels and botnet prorogation[56],[57]. Obtain dataset here
25	I	P	R	MAL	7 S	Kharon dataset contains malware documentation, that has been used to benchmark GroddDroid capability to trigger malicious code[58], [59]. The documentation was obtained though Static and dynamic analysis on a set of malware samples. The documentation includes the location of the malicious code blocks, the trigger conditions, and how the malware acts when triggered. Obtain dataset here
*	I	P	R	MAL	18204 S	The Mudflow dataset was used to train a "benign or malign" binary classifier, on the information flow from benign Android applications obtained from the Google store[60], [61]. Instead of focusing on what resources the applications request access to, the classifier determines if the usage of these resources are to be deemed normal. The dataset contains 2866 benign and 15338 malicious apps. Obtain dataset and scripts here
*	I	P	R	MAL	N/A	ISOT is a dataset that is built up of benign and malicious network traffic, from multiple sources[62], [63], [64]. The malicious samples is off the Storm and Waledac botnets. Obtain dataset here
*	I	R	H	MAL	50000 S	ECML/PKDD-2007: A dataset made up of 40 000 normal queries, 9000 exploits with descriptions on the target environment and 1000 exploits without target information [65]. The dataset is in XML format and contain attacks from 7 different categories. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
*	I	P	R	MAL	610000 S	The motivation behind the creation of the HTTP-CSIC-2010 dataset, was a shortage of malware datasets that exploits real web applications[66]. HTTP-CSIC-2010 contains malign and benign labelled request against a Spanish electronic commerce web application. The samples with malicious consequence target the confidentiality and integrity of the web application resources. Obtain dataset here
*	I	P	N/A	MAL	1000 S	A list of 1000 Malware PCAP files. The blog also contain other malware samples as well[67], [68]. Obtain dataset here
*	I	P	R	MAL	24389 S	The Malrec Dataset: A dataset of the system calls and arguments made by malicious software[69]. Obtain dataset her
*	I	P	R	MAL	334 S	Malware Capture Facility Project: A repository of Botnet and benign network traffic[70]. Obtain dataset here
*	I	R	H	MAL	N/A	ISCX Botnet: Is a derivative dataset from multiple sources[71], [72]. The dataset contains normal traffic and malicious traffic from 16 different families of botnets. Obtain dataset here
*	I	R	R	MAL	1929 S	ISCX Android Botnet: This dataset is built up of AnserverBot, Bmaster, DroidDream, Geinimi, MisoSMS, NickySpy, Not Compatible, PJapps, Pletor, RootSmart, Sandroid, TigerBot, Wroba and Zitmo botnets in the form of Android application package (APK) files[73], [74]. Obtain dataset here
26	I	P	S	NET	38/50 S	DARPA 1998 and 1999 is datasets of simulated network traffic used to assess the detection capabilities of intrusion detection systems[75],[76]. DARPA 1998 contains 38 categories of UNIX based attacks. DARPA 1999 increases the number of categories to 50 and added Windows NT based exploits as well. Obtain dataset here
27	I	P	S	NET	2 S	DARPA 2000 has simulated data from two distributed denial of service attacks[77]. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
28	I	P	R	NET	N/A	The MAWILab database contains labels, that categorize network anomalies. It can be used to assist in evaluating the performance of intrusion detection systems (IDS)[78],[79]. Obtain dataset here
29	I	P	S	NET	743M	KDD Cup 1999 Data: A synthetic dataset that is made up off network traffic samples[80]. These samples is labelled benign or malign[81]. Malign samples are attempting to attack availability, to perform privilege escalation, to imitating a local user and to perform reconnaissance. The dataset is produced based on the DARPA98 dataset. Obtain dataset here
30	I	P	H	NET	2540044 S	UNSW-NB15: The samples are labelled malign or benign. Each sample has 49 features that includes variables such as time to live (TTL), IP information, sequence number, time between TCP SYN and TCP ACK etc[82], [83]. The malicious samples aims to identify vulnerabilities by perform active reconnaissance and by using fuzzed inputs. The malware samples also attempts to install backdoors, target the availability of services, opening a shell to run arbitrary code and to compromise new hosts. There are in total 2 540 044 samples spread across 4 .csv files, a smaller subset of this dataset is used to create a training and a test set. Obtain dataset here
*	I	P	R	NET	5 S	A collection of Cyber Defense Exercises (CDX) from the National Security Agency (NSA)[84]. In the CDX 2009 collection there are logs of DNS, web server, and IDS. Obtain datasets here
*	I	P	N/A	NET	N/A	The ADFA Intrusion Detection Datasets: According to the author in [85] the ADFA dataset has higher complexity, more attack options, frequency of attacks/normal traffic is more evenly distributed, and more extensive in scope then the KDD 98/99 evaluation datasets[86]. Given the reasons above the author concludes that the ADFA is the better dataset to assess the performance of Host based IDS (HIDS). Obtain datasets here

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I	C	Acc	DT	Cat	Size	Description
*	I	P	R	NET	19683 MB	A numerical dataset that tracks network activity from Honeypots and sensors that is in the management control of Kyoto University[87],[88]. The network activity has been tracked from the end of 2006 to December 2015. The dataset includes 24 features, 14 of them is based on the KDD Cup 99 feature vector and the last 10 features was added to better describe what happens on the network. The latter 10 features are described below: • Binary valued features that cover the observation of IDS alerts, Malicious connections and exploits of the network traffic. • Abnormal session feature state if the network traffic is benign or is a known/unknown attack. • Sanitized IP address, ports and session information was also captured. Obtain dataset here
*	I	P	R	NET	N/A	crawdad is a compiled list of publicly available datasets of wireless protocols[89]. Obtain dataset here
*	I	P	N/A	NET	N/A	ICS-pcap: A repository of ICS/SCADA pcaps gathered from multiple sources[90]. Obtain dataset here
*	I	R	R	NET	≈ 2000000 S	Common Crawl: A dataset of web content and metadata from 2000000 crawled webpages[91]. Obtain dataset here
*	I	R	S	NET	N/A	NSL-KDD dataset: Is a subset of KDD99[81], [92] . Preproccsing that was performed on NSL-KDD: • Deduplication of training and testing set samples in NSL-KDD • The count of samples that is hard to classify in the NSL-kDD set, is inversely proportional to the percentage of hard samples in KDD. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
*	I	R	R	NET	22GB	ISCX Tor-nonTor: Contains both normal and Tor traffic[93],[94]. The real Tor traffic was generated from network, email and filesharing protocols. And audio, and video streams from popular applications. The samples/traffic is assign a class label for what application or protocol they belong to. Obtain dataset here
*	I	R	R	NET	28GB	ISCX VPN-nonVPN dataset: Similar to the ISCX Tor-nonTor dataset[95], [96]. It has non-VPN traffic and labelled VPN traffic from multiple applications and protocols. Obtain dataset here
*	I	R	H	NET	229712,8 MB	ISCX IDS: This dataset includes real traffic for IPv4, IPv6, UDP, TCP, ARP, DNS, ICMP, HTTP, SMTP, SSH, IMAP, POP3, and FTP generated by using agents that simulate users interacting with these protocols[97], [98]. Obtain dataset here
31	I	P	R	PASS	N/A	Yahoo Password Frequency Corpus: A sanitized password frequency corpus that protect the privacy of the user accounts[99], [100] . The scheme also protects up to two duplicate accounts, that has similar passwords. The sanitization is performed to prevent adversaries to gain knowledge of individual users. Obtain dataset here
*	I	P	N/A	PASS	2000000 S / 20 MB	Password dataset with 2000000 samples[101]. Obtain dataset here
*	I	P	R	RAM	N/A	Memory Buddies Traces(MBT): This dataset is built up of the memory contents from computers and servers. The dataset contains metadata of the underlying platform, metadata of live processes, and the hash values of the 4KB memory pages[102], [103], [104]. Obtain dataset here
32	I	P	R	SMS	87300 S	The NUS SMS Corpus includes 55835 English and 31465 Chinese SMS messages[105], [106]. To avoid bias or promote message diversity in the sampling process, the individual SMS messages was captured without considering any particular topic. The SMS messages can be download in JSON, XML and SQL format. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
33	I	P	R	SPAM	≈ 350000 S/ 1GB compressed	The Webb Spam Corpus 2011: A custom crawler was built to collect spam web pages[107], [108]. The resulting collection was preprocessed to remove instances of legitimate websites and websites that could not get resolved. The dataset contains both the spam and the HTTP sessions for the spam servers. Obtain dataset here
*	I	P	R	SPAM	1353 S	The samples from DIT SMS spam corpus is a collection of reported SMS spam, by UK mobile users. The corpus is stored in a XML format. Unique entries in the collection was assured by performing case insensitive depublication[109],[110]. Obtain dataset here
*	I	R	N/A	SPAM	3 C	Spam corpora from TREC. This server host 3 spam corpus from 2005-2007[111]. Obtain dataset here
*	I	P	R	SPAM	4601 S	A spam dataset created by Hewlett-Packard Labs[112]. The feature vector contains: - frequencies of words and characters, - the average length, max length and total count of "uninterrupted sequences of capital letters" - class label Obtain dataset here
*	I	P	R	SPAM	105896555 S	WEBSPAM-UK2007: A labeled spam dataset of 105896555 entries[113]. Obtain dataset here
*	I	P	R	SPAM	221579 S	microblogPCU Data Set: A labeled spam dataset[114]. Example features: - Microblog poster gender, username, user id - Number of followers - Number of reposts Obtain dataset here
*	I	R	R	SPAM	16000000 S	TREC 2011 microblog dataset contains 16 million normal and spam twitter posts[115]. Obtain dataset here

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I	C	Acc	DT	Cat	Size	Description
*	I	P	R	SPAM	273 MB/ 5780 S	Image Spam Dataset: contains images that is originated from a normal (HAM) email message or a spam message (SPAM)[116], [117]. This dataset can be used as a training and testing set in a SPAM or HAM classification problem. Obtain dataset here
*	I	P	R	PHI	N/A	phishtank is a open community where the users can add, search and validate instances of network phsising [118]. Search repository here
*	I	P	R	PHI	N/A	millersmiles is a repository of phising samples and allows users to add to the collection or search though the repository[119]. Search repository here
*	I	P	R	PHI	2456 S	Phishing Websites Data: A collection of 2456 phishing websites[120], [121]. Example features in this dataset: • Long URL, Tiny url or abnormal url. • Special symbols in URL: '@', '//', and '_' • The count of dots in URL • Domain registration date • Protocol information and ports Obtain dataset here
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I	C	Acc	DT	Cat	Size	Description

Table 3: Datasets

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